Field Device Diagnostics
1. Challenge in plant operation
Challenge: Balance of maintenance for best reliability at minimum cost.

Measures for maintenance savings

- Predictive, event-driven maintenance concept
- Assignment of maintenance tasks to the right people to do the task
- Remote access to field devices
- Significant field diagnostics information
Effective maintenance

Detailed Diagnostics

Know when to take action

Effective Maintenance

→ 63% result in no action taken and could’ve been avoided!
Diagnostic Categories: FF-890 / NAMUR NE 107

- **Maintenance required – M**
  - Although the device is still able to provide a valid output signal, the device is about to lose some of its functionality or capability due to some external operation conditions.

- **Failure – F**
  - The device provides a non-valid output signal due to some malfunction at the device level.

- **Function Check – C**
  - The device value is temporarily non-valid due to some activities, e.g. maintenance activities on the device (PV frozen)

- **Out of specification – S**
  - The device operates outside of the specified measurement range
  
  - Internal diagnostics in the device indicate a drift in the measurement (internal problems in the device or as consequence of some process influence (cavitation, empty pipe, ...).
System integration of device diagnostics

Operator station

Process configuration, monitoring and operation

GOOD
UNCERTAIN
BAD

Maintenance console

Performance and condition management of fieldbus devices

Field Diagnostics

- Standardized communication of device diagnostics
- Diagnostic messages are clustered into 4 categories
- Role based information management of device diagnostics (operator, maintenance)
2. Benefits and applications
<table>
<thead>
<tr>
<th>Benefit</th>
<th>Advantage</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Engineer</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convenience and efficiency during design</td>
<td>Single design approach for all parameters</td>
<td>Unified implementation of device diagnostics</td>
</tr>
<tr>
<td><strong>Operator</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safe and reliable process operation</td>
<td>Process pending handling of measuring loops</td>
<td>Separate handling of single process induced diagnostic information</td>
</tr>
<tr>
<td></td>
<td>Prevention of overload on field device information</td>
<td>Masking of device diagnostic information</td>
</tr>
<tr>
<td><strong>Service Engineer</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficient management of measuring loops with high up-time for plants</td>
<td>Best preparation for on-site tasks and easy trouble shooting</td>
<td>Distinctive remedy information</td>
</tr>
<tr>
<td></td>
<td>Opportunity for preventive maintenance concepts</td>
<td>Predictive maintenance information available</td>
</tr>
</tbody>
</table>
Example with Liquiline CM42

Copper extraction - flotation cell -

Customer challenges
- Keep people away from dangerous environment
- Reliable information to prevent unnecessary maintenance jobs

Benefits Endress+Hauser offering
- Reduction of preventive maintenance tasks through evaluation of diagnostic information (i.e. reference impedance of the electrode)
- Increased safety through less on-site maintenance effort thanks to process specific configuration of calibration timer and Memosens technology
Example with Promass 83

Copper smelter - oil lead to burner -

Customer challenges

- Ensure, that smelter works stable at the operating point to
  - save costs (i.e. for consumables like fuel)
  - reduce environmental impact

Benefits Endress+Hauser offering

- Safe and cost-conscious operation based on reliable measurement using diagnostic information (i.e. mass flow deviation)
- Opportunity to implement predictive maintenance concept instead of preventive maintenance through evaluation of field device diagnostics
Example with Liquiline CM42

Wet gas scrubbers

Customer challenges

- Prevention of any environmental impact for example through acid steam
- Reduction of operational costs

Benefits Endress+Hauser offering

- Safe and cost-conscious operation based on reliable measurement through evaluation of diagnostic information (for example reference impedance of the electrode) provided by Memosens and forwarded via FOUNDATION fieldbus
3. Implementation
## Endress+Hauser implementation field device diagnostics

### Manufacturer: Implementation

<table>
<thead>
<tr>
<th>Diagnostics</th>
<th>Assignment</th>
<th>Masking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor Highest Severity</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Electronic Highest Severity</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Config. Highest Severity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process Highest Severity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor High Severity</td>
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<tr>
<td>Process High Severity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor Low Severity</td>
<td></td>
<td></td>
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<tr>
<td>Electronic Low Severity</td>
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<tr>
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<td>Process Low Severity</td>
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<tr>
<td>Config. Lowest Severity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process Lowest Severity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process Diagnostic 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process Diagnostic X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process Diagnostic Z</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### User: Configuration

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Masking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Info 1</td>
<td>Yes</td>
</tr>
<tr>
<td>Info 5</td>
<td>Yes</td>
</tr>
<tr>
<td>Info 11</td>
<td>Yes</td>
</tr>
<tr>
<td>Info 16</td>
<td>Yes</td>
</tr>
<tr>
<td>Info 31</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Management of field device diagnostics

- Process variables
  - Status process value
  - Category diagnostic

- Alarming
  - List of non masked alarms with category

- Device status
  - Detailed field diagnostics
  - Remedy information

- Device configuration
  - Assignment category
  - Masking for DCS
Configuration of field device diagnostics

- Default mapping of field diagnostic, developed by the supplier
- Easy modification through end-user modifying based on process requirements.
Configuration of field device diagnostics

Example

- In case of sensor corrosion; send „Instrument health status „Failure“
## Product and technology roadmap FF

- FF product portfolio for “FF-912” diagnostic capability will be complete for all relevant devices by end 2014.

<table>
<thead>
<tr>
<th>FF-912 – portfolio update until end of 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2012</strong></td>
</tr>
<tr>
<td>Temperature</td>
</tr>
<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Level</td>
</tr>
<tr>
<td>Flow</td>
</tr>
<tr>
<td>Analysis</td>
</tr>
</tbody>
</table>

- Released
- Scheduled

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*FOUNDATION fieldbus Technology*

*Endress+Hauser*
4. Extended functionality
Foundation fieldbus Technology

Status

- All input and output and some parameter values (e.g. process value) are accompanied by a status.
- The status and the value are evaluated from the following depending block.

- 1 Byte status comprises
  - Quality
  - Substatus
  - Limits

4 Byte Process Value (IEEE 754 floating point)
1 Byte Status

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FOUNDATION fieldbus Technology

**Status**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BAD - The value is not useful.</td>
</tr>
<tr>
<td>2</td>
<td>UNCERTAIN - The quality of the value is less than normal, but the value still be useful.</td>
</tr>
<tr>
<td>3</td>
<td>Good - The value is useful</td>
</tr>
</tbody>
</table>

All Process Data has a Value and a Status
**PV status config (E+H specific)**

- With PV status configuration you have the possibility to influence the PV status information according to your actual plant process.
- This is done directly in the field device.
- Example; in case of corrosion PV status = “bad”
5. System integration
## Quality gate for FOUNDATION fieldbus devices

<table>
<thead>
<tr>
<th>HOST Supplier</th>
<th>Control System</th>
<th>Installation Tool</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerson</td>
<td>Delta V</td>
<td>AMS</td>
<td>Download area Emerson <a href="http://www2.emersonprocess.com/en-US/documentation/deviceinstallkits/Pages/deviceinstallkitsearch.aspx">www2.emersonprocess.com/en-US/documentation/deviceinstallkits/Pages/deviceinstallkitsearch.aspx</a></td>
</tr>
<tr>
<td>ABB</td>
<td>AC800F</td>
<td>Control Builder F</td>
<td></td>
</tr>
<tr>
<td>Rockwell Automation</td>
<td>ControlLogix</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invensys</td>
<td>IA Series</td>
<td>Archestra</td>
<td></td>
</tr>
</tbody>
</table>

Endress+Hauser as HOST independent supplier ensures seamless integration into all major control systems

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Integration environment – System World

http://www.fieldbuslab.endress.com/index.html

Our Competence Center for Device Integration
**Challenge: Device replacement during MRO phase**

- **Requirement for device replacement**
  - **Device on stock**
    - No
    - **Order device**
    - **Same Dev. Rev.**
      - No
      - **Install new DD Modify design**
      - **Same Dev. Rev.**
        - Yes
        - Install new DD Modify design
  - Yes
  - **Replacing device**

**Working packages MRO phase**
- HOST specific trainings
- Technology training
- Maintenance of FF field devices
- Field network maintenance
- Field network audit
6. Conclusion
Conclusion

- **Reduced** maintenance effort implementing corresponding concepts (e.g. predictive, event-driven maintenance) using device diagnostics

- Foundation fieldbus specification enables **end user** to adjust diagnostic messages easily according to **process requirements**

- **Endress+Hauser** provides **complete product portfolio** of field devices with **standardized device diagnostics**

- **HOST independent** approach ensures **seamless integration** in all major DCS

- **Endress+Hauser** offers **unique working packages** for **MRO phase**
Thank You for your attention!