IWMC - Remote Maintenance – state of the art versus normative limitations

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OVERVIEW

AQUASYS

- Motivation
- Analysis of maintenance schedule acc EN14972-1
- Concept and example for remote maintenance / automation
- Takeaways

MOTIVATION - FIREFIGHTING IS RESPONSIBILITY

AQUASYS

- **High standards already in place, but we think it can be done better**
  - High quality production and used materials (stainless steel components)
  - Comprehensive system expertise and therefore experience in application and operation
  - Long time experience in the fire fighting and hydraulic business
- **Investments**
  - Time and money in research, design, type testing and calculations etc
  - Continuous product development and improvements of existing components
  - Designing new components (relief valves with low hysteresis, cartridge valves,…)
- **Hand over of safe and turnkey systems for operators**
  - Provide sufficent and easy testability on site supported by our own supervisory teams
- **Choose the right partners and distributors**
  - Qualification of staff, quality management system etc
  - Trainings, guidance and supervision from manufacture
  - Ensure suitable organizational structure to serve customers needs (local project management and technical support etc)

MOTIVATION - AUTOMATION

AQUASYS

Reduction of preventive maintenance effort, without impairing high reliability by:

- A higher degree of automation
- Carrying out automated function tests
- Use components with low FIT rates
- Use a reliable pipe work:
  - force fit (cutting ring)
  - form fit (flare, Walform)
- Redundancy R: (more cost intensive)
  2 parallel path improves reliability (2 full ident path increase reliability up to $1-(1-R)^2$)

Demand for efficiency and potential cost savings for manufacturers and operators by:

- More automated system checks and reduced manpower on site for mid-year maintenance
- Due to automation the checks will be done more likely and with secured quality
- Immediately fault analysis and generation of system and component data possible
  (e.g. To predict future failure rates)
- Only one comprehensive test per year by the installer or specialist company necessary

MAINTENANCE SCHEDULE ACC EN 14972-1

AQUASYS

Weekly

Section	Task	Automatable?
9.2.1.2	Check - all water and air **pressure gauge readings** - all **water levels** in water storage tanks - **correct position of all main shut-off valves** (not for remote monitoring) - **alarm of** each **control valve**.	 YES, replace analog gauges with digital sensors YES, with monitoring YES
9.2.1.3	**Pump starting test:** shall be initiated locally and shall be stopped by external means. - Check starting pressure of pumps. Simulation of a pressure drop in main line. - Fuel and oil levels - oil pressures	Basically yes, depends on the definition of „locally“ YES YES YES
9.2.1.4	**Diesel engine restarting test** - Stop the engine after **20 min** and immediately **restart it (manual start test button)** - Check **water level** in the primary circuit of closed circuit cooling systems - Check **oil pressure** (where gauges are fitted), **engine temperatures** and **coolant flow.** - Check oil hoses and a general inspection made for leakage of fuel, coolant or exhaust fumes.	 YES YES: water level, pressures, temperatures, coolant flow NO: Check of hoses

Monthly

Section	Task	Automatable?
9.2.2.1	**Check heating systems** to prevent freezing in the system: The electrolyte level and density of all lead acid cells (including diesel engine starter batteries and those for control panel power supplies) shall be checked.	YES YES, basically possible with monitoring device

MAINTENANCE SCHEDULE ACC EN 14972-1

AQUASYS

Quarterly

Section	Task	Automatable?
9.2.3.2	**Check of water supplies:** Each water supply shall be tested with each control valve set in the system. The pump(s), if fitted, in the supply shall start automatically and the supply pressure shall be not less than the appropriate value. The sequential starting of multiple pumps, and pumps using multiple drivers, shall be undertaken.	YES
9.2.3.3	**Check of electrical supplies**: Any secondary electrical supplies from diesel generators	YES
9.2.3.4	**Check of all Shut-off valves:** All shut-off valves controlling the flow of water to the system shall be operated to ensure that they are in working order, and securely refastened in the correct mode. Including shut-off valves on all water supplies, at the alarm valve(s) and all zone or other subsidiary shut-off valves.	YES
9.2.3.5	**Fire alarm flow** and/or pressure switches: shall be checked for correct function by operating the alarm test connection to simulate flow to a single nozzle and checking that the pump starts automatically, water flows and that the flow alarm functions as designed.	YES
9.2.3.6	**Replacement:** The number and condition of replacement parts held as spare shall be checked and replenished as necessary	NO

Half-yearly

Section	Task	Automatable?
9.2.4.2	**Operation of dry and deluge valves:** The moving parts of dry and deluge valves shall be exercised and the function checked	YES
9.2.4.3	**Test of fire detection and alarm system** The fire detection and alarm system shall be tested and serviced	YES

MAINTENANCE SCHEDULE ACC EN 14972-1

AQUASYS

Yearly

Section	Task	Automatable?
9.2.5.2	**Review of hazard:** The effect of any changes of structure, occupancy, storage configuration etc, shall be identified and assessed by a competent person in order that the necessary and appropriate modifications to the water mist system can be carried out.	NO
9.2.5.3	**Visual check of water mist nozzles**: Potential impairment of heat sensing and spray pattern	NO
9.2.5.4	**Automatic pump set flow test:** Each water supply pump set in the installation shall be tested at the full load condition and shall give the pressure/flow values stated on the nameplate	YES
9.2.5.5	**Diesel engine failed-to-start test:** The failed-to-start alarm shall function correctly Immediately after this test the engine shall be started using the manual starting system.	YES, depends on the definition of „locally“
9.2.5.6	**Infill valves** on water storage tanks: shall be functionally tested for correct operation.	YES
9.2.5.7	Pump and **system strainers**: Water shall be flowed through pump and system strainers at least annually, and the strainers shall then be inspected and cleaned as necessary.	NO
9.2.5.8	**Pipework** and pipe supports: shall be checked for corrosion and mechanical damage, and remedial action taken as necessary. The pipework shall be checked for electrical earthing connections.	NO
9.2.5.9	Examination of **cylinders and tanks**: shall be examined externally for signs of damage or unauthorized modification, and for damage to system hoses. The contents shall be checked and confirmed that they are within 5 % of correct filling or charge pressure.	NO
9.2.5.10	Remote **alarm transmission**: The electrical transmission and receipt shall be checked.	YES
9.2.5.11	System **integrity**: The system shall be visually inspected for leaks. If a leak is suspected the system shall be tested.	NO

“Minimum once a year, or more frequently (when required), the system shall be maintained in accordance with the DIOM manual.”

MAINTENANCE SCHEDULE ACC EN 14972-1

AQUASYS

3-yearly

Section	Task	Automatable?
9.2.6.2	**Check of storage tanks**: All tanks shall be examined externally for corrosion. They shall be drained, cleaned as necessary and examined internally for corrosion. All tanks shall be repainted and/or have the corrosion protection refurbished, as necessary.	NO
9.2.6.3	**Check of valves:** All water supply shut-off valves, control and check valves shall be examined and replaced or overhauled as necessary.	YES

5-yearly

Section	Task	Automatable?
9.2.7.2	**Check of nozzle heads**: 2 nozzles per section shall be removed from various parts of the system. function; K-factor; operating temperature; thermal response.	NO

10-yearly

Section	Task	Automatable?
9.2.7.2	**Check of pipe system**: Pipework shall be flushed and inspected and all storage tanks shall be cleaned and examined internally and the fabric attended to as necessary.	NO

CONCLUSION OF REQUIREMENTS

AQUASYS

- **Not all of the required maintenance tasks can or should be automated!**
- **BUT: Tasks that shall be performed less than once a year can be automated without necessarily compromising the quality of the system.**
- **It might be necessary to demonstrate equivalence of some planed automated processes compared to the maintenance work carried out by humans on site.**
- **Possible measures:**
  - Monitored ball valves
  - Digital sensor outputs (pressure, flow rates, filling levels etc)
  - Cable monitoring (integrity)
  - Reliable pipe work (connection techniques)
  - Function checks (pipe integrity test, performance tests etc)
  - Redundancies
  - …

CONCEPT

AQUASYS

PC ↔ Router ↔ VPN ↔ ☁ ↔ VPN ↔ Router ↔ FAS

Cyber Security: EN 50710, IEC 62443 …

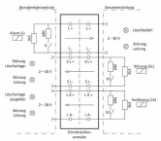
FAS/FDS Supplier

Alarm

Triggered, Fault, Maintenance

HPWMS Supplier

FAS/FFS Interface



CP

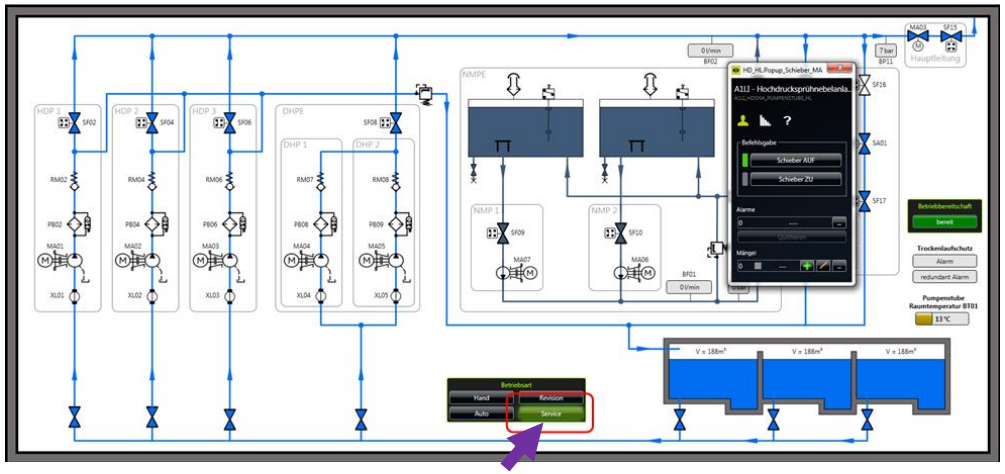
SC

ECP

Maintenance program 1
Maintenance program 2
Maintenance program 3
…

Remote HMI

Field components: e.g. Valves, sensors, flow meters etc



Click for service program

0/1

Q in $\frac{l}{min}$

$4-20\ mA$

p in bar

$4-20\ mA$

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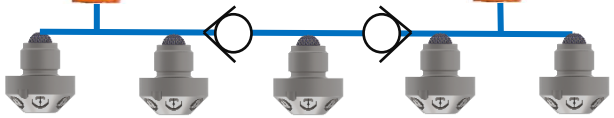
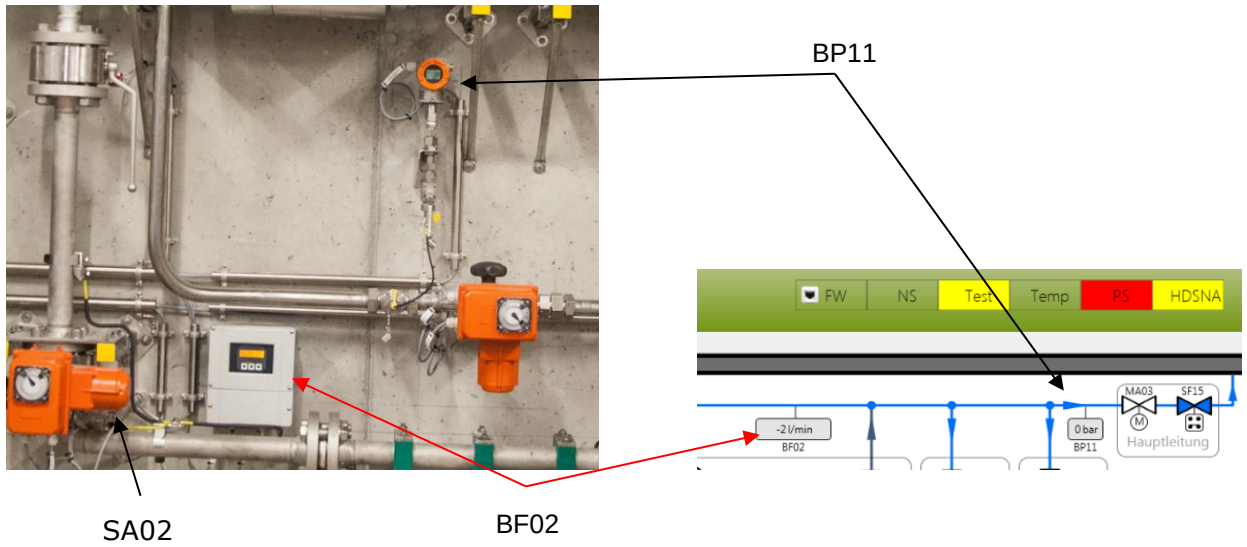


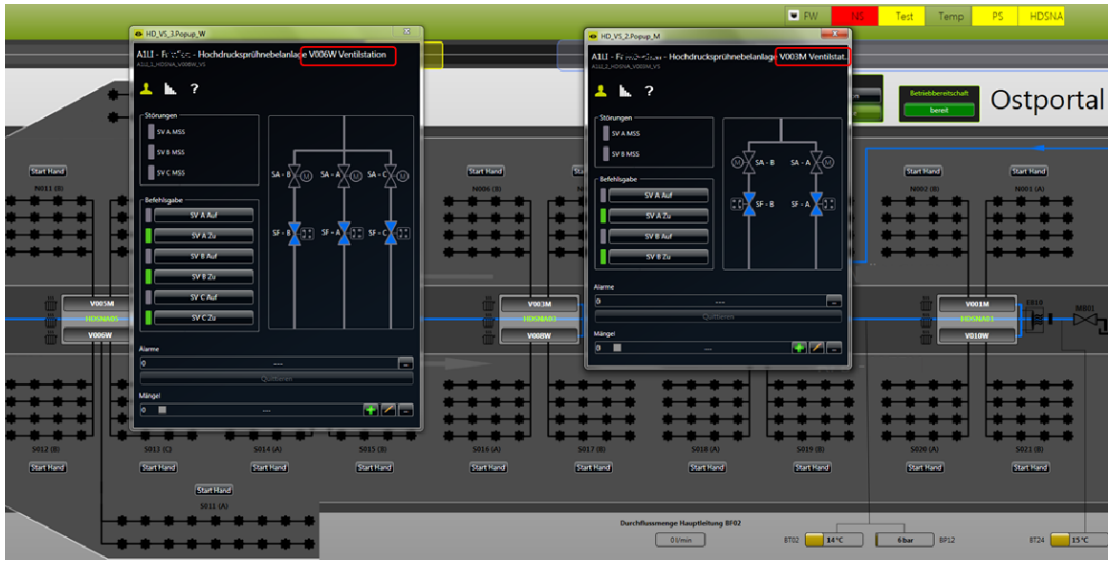
EXAMPLE ON REAL SYSTEM

AQUASYS

Performance Test

- System remains in automatic mode
- The valve in the main line closes while the valve for power measurement opens automatically.
- The selected pump starts and ramps up to the test speed (rpm),
- The flow rate will be measured at the flow sensor BF02 while the pressure will be measured at the pressure transmitter BP11
- Both measuring data will be transferred locally, provided on the HMI and entered in the maintenance log.





TAKEAWAYS

AQUASYS

- A higher degree of automation does not automatically mean lower system reliability
- Higher initial costs can pay off over system life time
- In order to further reduce personnel effort on site, it might be necessary to demonstrate the equivalence of some automated processes compared to the maintenance work carried out by humans on site
- Collecting system data might help to increase efficiency of system by early prediction of failures

AQUASYS

FIREFIGHTING IS RESPONSIBILITY