Data-enabled Fire Sprinkler Systems

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Johnson Controls – Global Fire Suppression Products
NFPA 25 – Establishes Minimum Requirement

NFPA 25 – 2017

Standard for the Inspection, Testing, 
and Maintenance of Water-Based 
Fire Protection Systems
System performance can change rapidly

Inspection reports offer regular snapshot of health and compliance.

Failures happen without warning when no one is watching.
Status Quo is Reactive

Reactive Approach
- Expectation of system failures
- Respond to problems as they come

Outcomes
- Costly repairs
- Disruption & inconvenience
- Negative impact to productivity

Can we do more? Can we do better?
Internet of Things (IoT) Uses by Other Industries

**HOME**
- Smart Temperature Control
- Optimized Energy Use

**INDUSTRIAL**
- Machine-to-Machine Communication
- Quality Control

**AUTOMOTIVE**
- Vehicle Auto-Diagnosis
- Optimized Traffic Flow
- Smart Parking

**AGRICULTURE**
- Offspring Care
- Crop Management
- Soil Analysis

**MILITARY**
- Situational Awareness
- Threat Analysis

**MEDICAL**
- Optimized Patient Care
- Wearable Fitness Devices
- Quality Data Reporting

**ENVIRONMENTAL**
- Forest Fire Detection
- Species Tracking
- Weather Prediction

**RETAIL**
- Theft Protection
- Inventory Control
- Focused Marketing

Moving the fire sprinkler industry toward a smarter future.
Applying IoT to Fire Sprinkler Systems

**System Data Flow**

**Current Sensor Suite**

<table>
<thead>
<tr>
<th>Sensor Suite</th>
<th>Wet</th>
<th>Dry</th>
<th>Pre-Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gateway</strong></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td><strong>Temperature Monitor</strong></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td><strong>DPV Monitor</strong></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>• Air Pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Water Pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Compressor Pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Low Point Monitor</strong></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>(Water presence)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Advanced notice:**
- System trips
- Presence of water
- Freeze ups
- Leaks/corrosion

Goal to prove that data can enable and empower sites to be proactive.
A Closer Look at the Sensor Suite

- Dry/Pre-Action Valve Sensors
- Pressure Sensor
- Temperature Sensor
- Low Point Sensor
A New Way to Look at Fire Sprinkler Systems

System 1

<table>
<thead>
<tr>
<th>Name</th>
<th>Air Temperature</th>
<th>Water Pressure</th>
<th>Air Pressure</th>
<th>Compressor Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA-Riser 1</td>
<td>76.5 °F</td>
<td>125.2 PSI</td>
<td>9.7 PSI</td>
<td>71 PSI</td>
</tr>
</tbody>
</table>

Live Chart

Compressor Pressure | Air Pressure | Water Pressure | Air Temperature

Date Range: Mar 5, 2019 to Apr 5, 2019
A New Way to Look at Fire Sprinkler Systems

<table>
<thead>
<tr>
<th>Name</th>
<th>Battery Status</th>
<th>Air Temperature</th>
<th>Water Pressure</th>
<th>Air Pressure</th>
<th>Compressor Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Pipe riser room</td>
<td>OK</td>
<td>71.8 °F</td>
<td>71.9 PSI</td>
<td>30.2 PSI</td>
<td>31 PSI</td>
</tr>
</tbody>
</table>

Live Chart

- Air Temperature
- Compressor Pressure
- Air Pressure
- Water Pressure
Making Data Useful

- A rules engine analyzes data and applies thresholds to trigger notifications
- Priority level pre-determined by severity of risk to system operation
- Notification method varies from passive to active, depending on the severity
Validating IoT on Fire Sprinkler Systems

Methodology

- Controlled pace of rollout
- 25 connected sites across the US
- Targeting mix of facility profiles
- Build-Measure-Learn approach

Can a data enabled fire sprinkler system …

- Reduce service related downtime?
- Decrease annual repair costs?
- Increase operational efficiency?
- Ensure continuous compliance?
- Lead to a proactive approach to maintenance?
Validated learnings from real world application.
Example 1 – Phantom False Trips

Big Box Retail

Pain of Sprinkler System Failures:
- Evacuate building
- Lost revenue
- Damaged inventory
- Repairs and replacement
- Fines / issues with AHJ
- Brand reputation / future customers

Problem:
- Multiple false trips causing disruption in store
- Customer convinced it was a faulty dry pipe valve
- Repeated service calls after false trip showed no issues

Applying Data Enabled Solutions:
- Installed Valve Monitoring kit for diagnostics
- Monitored air pressure, water pressure, compressor activity and temperature at the riser
Example 1 – Phantom False Trips

What we observed:

- Water and air pressure swings correlated with times when temperatures also fluctuated
- Pressure relief valve was not installed on original system
Example 1 – Phantom False Trips

Big Box Retail

Outcomes:

• Recommended install of pressure relief valve
• System returned to stable
• Learned value of real-time monitoring and notifications
Example 2 – Symptom of a Bigger Problem

Problem:
• Previous system failures resulting in high repair costs
• Seeking more preventative maintenance approach to shift from dealing with issues to avoiding issues

Applying Data Enabled Solutions:
• Valve Monitoring kit installed at site as part of limited commercial release
• Monitored air pressure, water pressure, compressor activity and temperature at the riser

Board & Care

Pain of Sprinkler System Failures:
• Evacuate patients (health risk & liability)
• Repair / re-sterilize rooms
• Replace damaged equipment
• Fire watch costs
• Brand reputation / future occupancy
Example 2 – Symptom of a Bigger Problem

What we observed:

• Compressor run time growing
• Timing between compressor runs shrinking
• Both indicate potential leak in piping network
• Leakage Rate = 13 psi/hr
Example 2 – Symptom of a Bigger Problem

**Board & Care**

Outcomes:
- Leak at piping joint identified through data trends
- Preventative maintenance moved to high priority

**Benefits of Advanced Notification**

- **Notification Triggered Action**
- **System Failure Avoided**

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Example 3 – Trouble at Home

Problem:
• Sprinkler pipes near exterior wall above apartment balconies freezing and bursting
• Implemented venting solution with inconsistent results

Applying Data Enabled Solutions:
• Installed Temperature kit to monitor temperature along the piping near exterior wall
• Applied thresholds on pipe temperature to allow for advanced notification if trending toward freezing

Residential

Pain of Sprinkler System Failures:
• Evacuate multiple floors
• Relocation costs for tenants and living expenses
• Repairs and replacement
• Brand reputation / future occupancy
Example 3 – Trouble at Home

Residential

Observations:

• Venting heat from apartment unit into area between ceiling and floor only effective if heat in apartment is sufficient
• Temperature above unoccupied units showed highest risk, especially if heat is turned off in demo unit

Outcomes:

• Advanced notifications of freezing risk in demo unit drove immediate action to increase heat
Example 4 – School’s Out

Higher Education

Pain of Sprinkler System Failures:
• Evacuate building
• Relocation costs for students and living expenses
• Repairs and replacement
• Reputation / future students

Problem:
• Freeze and burst at low point caused significant damage to a new building at a university
• Response was to hire a service company to physically come on campus to drain low points weekly

Applying Data Enabled Solutions:
• Installed Low Point kit to monitor temperature and presence of water each low point
• Applied thresholds to both ambient temperature and pipe temperature to allow for advanced notification of freezing risk at each low points
Example 4 – School’s Out

Higher Education

Observations:
• Not all low points accumulate water equally
• Heating at low points varies greatly across buildings
• System data can be valuable to both the site and service provider

Outcomes:
• Real-time dashboard showing water presence and temperature increased efficiency of weekly site visits with targeted draining
• Advanced notifications encourage immediate action
What lies ahead for the fire sprinkler industry?
React Less. Control More.

Anticipated Trends
- System data becoming more valuable
- Data presented in creative & useful ways
- Uncover patterns to drive best practices for system designs
- New insights for air & water pressure
- New diagnostic and preventative solutions
- Optimize system maintenance schedules
- Reduction in costly repairs
- Reduction in disruption & inconvenience
- Long term – real-time data supporting ITM providing “continuous compliance”

Data enabled insights can help the fire industry do MORE and do BETTER.
Thank you.

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