The Future of Compressed Air Control

Reed Lawless, Compressed Air Systems Specialist

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<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Air Compressor Controls Mandates</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Protect the compressor</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Deliver required pressure / flow</strong></td>
<td></td>
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<tr>
<td><strong>Minimize energy use</strong></td>
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</table>
### Air Compressor Controls Overview and Comparison…

#### What’s Out There Now

<table>
<thead>
<tr>
<th>Features / Capabilities</th>
<th>OEM</th>
<th>PLC Standalone</th>
<th>PLC Piggyback</th>
<th>Purpose Built</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal Compatibility</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Multi-Compressor Control</td>
<td>Sometimes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Hardware</td>
<td>Proprietary</td>
<td>Open</td>
<td>Open</td>
<td>Proprietary</td>
</tr>
<tr>
<td>Software</td>
<td>Proprietary</td>
<td>Proprietary</td>
<td>Proprietary</td>
<td>Proprietary</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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</table>
What’s Working in the Industry

- Machine protection
- Pressure regulation (single-compressor)
- Multi-compressor control (when it’s implemented)
Areas for Improvement

- Multi-compressor control (stranded assets)
- System pressure regulation
- Pressure set backs (during production and non-production)
- Auto start / stop
- Data-driven operation and maintenance
Where Do We Go From Here?

• Increased automation: start/stop, surge testing/tuning, pressure set backs, etc.

• Improved / integrated compressor performance benchmarking

• Performance-based maintenance via reminders and/or performance thresholds

• Demand-side integration and optimization
Automation: Let the Machines Do Their Jobs

Performance Capabilities for the Next Generation of Controls

- Automated valve characterization and tuning
- Automated (semi-automated) surge tuning
- Adaptive schedules and pressure set backs
Benchmarking:

How is Your Compressor / System REALLY Performing?

Making compressed air system data more actionable
- Adding context to monitoring data: how does the performance compare to:
  - Historical performance
  - Industry standards
  - Rated performance
  - Sister sites/plants
- Quantify the benefits / potential savings from improvement
Performance-Based Maintenance and Overhauls

- Utilize existing instrumentation (avg. Bay-controlled centrifugal has 45-50 monitoring points)

- Compressor efficiency/performance:
  - Stage compression ratio (current vs. design)
  - Surge test history

- Automated, performance-based alerting based on design and industry standards for various compressor components
  - Inlet filters
  - Intercoolers and aftercoolers
  - Bearings

<table>
<thead>
<tr>
<th>Surge Test Type</th>
<th>Design</th>
<th>11/25/2011</th>
<th>3/1/2014</th>
<th>7/6/2019</th>
<th>Deviation to Design%</th>
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<tbody>
<tr>
<td></td>
<td>Pressure kW/Amps</td>
<td>Pressure kW/Amps</td>
<td>Pressure kW/Amps</td>
<td>Pressure kW/Amps</td>
<td></td>
</tr>
<tr>
<td>Natural Test</td>
<td>165 105</td>
<td>161 106</td>
<td>155 104</td>
<td>141 101</td>
<td>13.2%</td>
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<tr>
<td>High Pressure Test</td>
<td>120 85</td>
<td>121 87</td>
<td>119 90</td>
<td>120 94</td>
<td>11.1%</td>
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<tr>
<td>Operating Pressure Test</td>
<td>100 70</td>
<td>101 72</td>
<td>103 78</td>
<td>100 78</td>
<td>11.4%</td>
</tr>
<tr>
<td>Low Pressure Test</td>
<td>80 55</td>
<td>81 57</td>
<td>78 58</td>
<td>80 62</td>
<td>12.7%</td>
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</table>
Demand-Side Integration and Optimization

- Divide demand side into distinct pressure zones based on end-use requirements (as appropriate)
- Control zoning valves independently based on production schedules / air requirements

**Savings Potential: 15-30%**

**HP End Use:** 105 psi (45%)

**LP End Use:** 89 psi (55%)
## How Do We Take the Next Steps?

- Keep it simple (UI and automation)
- Show, don’t tell (UI and presentation of data)
- Make best practices the default (auto stop/setback)
- Ensure controls failure ≠ production failure (redundancy and expected failure modes)
Questions and Contact Information

For more information contact:

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