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New Low-Cost Simple Method to Collect Gas Lift Compressor Data using Scada, with Three Real Life Benefit Cases

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SCADA History

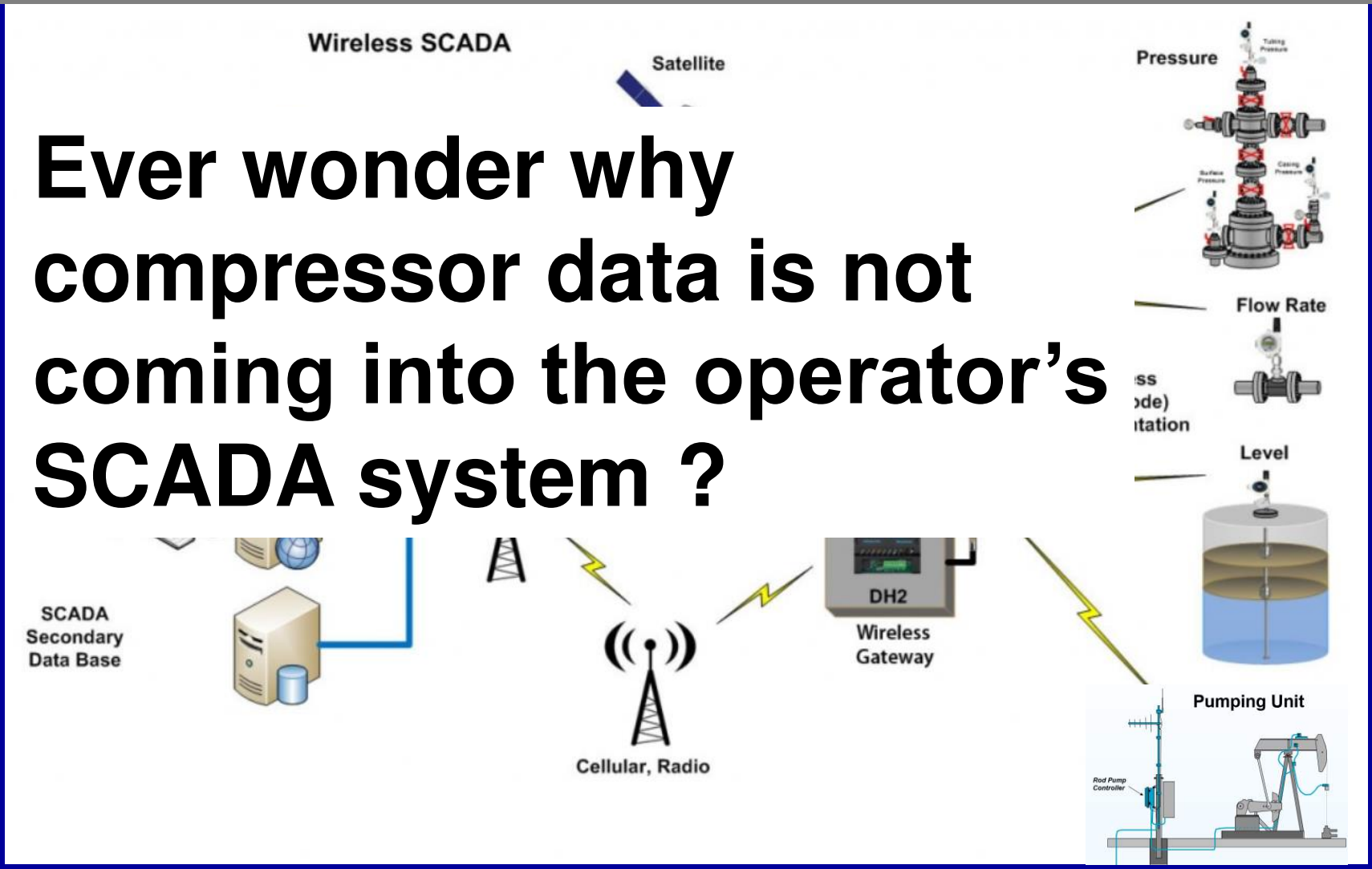
- Traditional SCADA
  - Stand-alone systems owned by operators
  - Field technicians operated and maintained systems
- Transition to Internet SCADA
  - Broadband and satellite communications growth
  - Equipment now in reach of Internet-based comms
  - Allows reliable and low-cost equipment monitoring
  - Third parties provide alternative to owned systems

From 2009 SPE 120760: Modern Internet Technologies Provide More Value Than Traditional SCADA

Benefits of Internet-Based SCADA

- Freedom from legacy SCADA protocols
- Any manufacturer RTU, Flowmeter, RPC, VFD, Plunger Controller, or PLC directly connected
- Equipment selected on virtues of equipment, not on handling communication protocol
- Very Scalable

Modern Operator Internet Scada



Ever wonder why compressor data is not coming into the operator's SCADA system ?

Look again at SPE 120760

- Major rental compressor company contracted for third party Internet based service
  - Remote Monitoring, Control, Alarms and Alerts
  - Reporting and Data Analysis
  - Technician Dispatch and Tracking
  - 1500 Natural Gas Compressors across country
- No E&P operator owned SCADA system utilized
  - Consequently NO SHARING of compressor data with operator (the real customer)
  - Why not?

How to Share Data with Operator

- Third Party Server to Operator Server
  - Concerns about data security at server level
  - No standardization of data tags
  - File sharing not timely
- Better option: Operator also collects data directly from compressors as does third party
  - Compressor controllers support multiple communication ports, most are serial (slow)
  - Compressor controllers don’t have standardized Modbus data locations, requiring tedious setup by operator SCADA personnel

How to Share Data with Operator

- **Best Option: Operator collects compressor data from third party device**
  - **Third party device already sorted compressor data**
  - **Data given standardized tags / Modbus registers**
  - **Operator SCADA team uses standardized Modbus register map to pull data – very easy**
- **Requirements**
  - **Standardized Modbus register map**
  - **Cooperative compressor rental company**

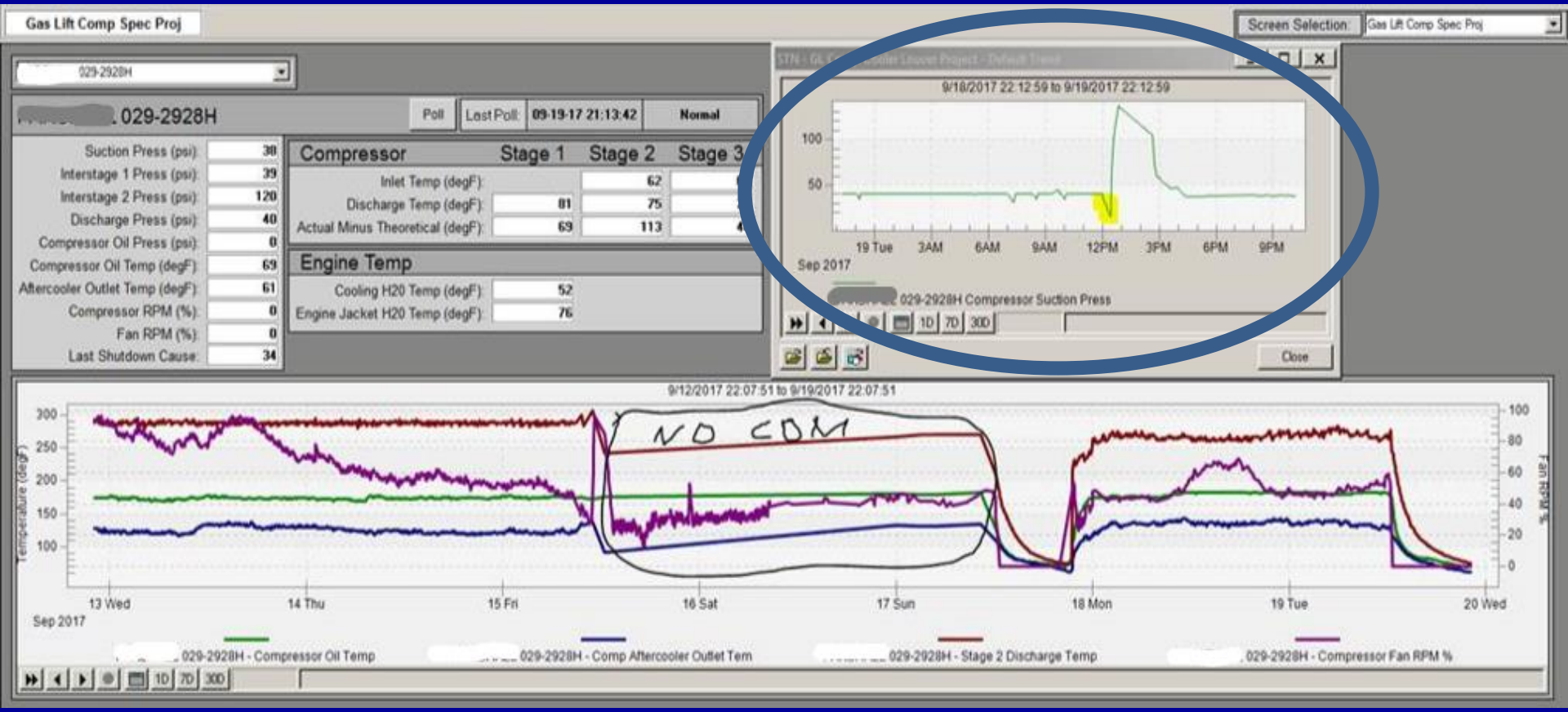
Available Compressor Data

- Analog Compressor Data
  - Suction, interstage, and discharge pressures
  - Inlet temperatures each stage
  - Discharge temperatures each stage
  - Final discharge temperature (out of aftercooler)
  - Compressor frame oil temperature
  - Compressor and engine vibration
- Digital Data
  - Compressor RPM
  - Compressor status / shutdown cause
  - PID values for temp control

Available Engine Data (Examples)

- Analog Engine Data
  - Intake manifold, fuel, coolant, and oil temperatures
  - Throttle Inlet and intake fuel pressures, % throttle
  - Spark voltage of each cylinder
  - Pre- and post-catalyst temperatures
- Digital Engine Data
  - Engine RPM and hours
  - Fuel flow and air flow, air fuel ratio
  - Calculated Horsepower
  - Speed control PID variables
  - Alarm status

Example 1: Operator Using Comp Modbus Data in Cygnet



- Cygnet provided E&P operator graphs for easy evaluation

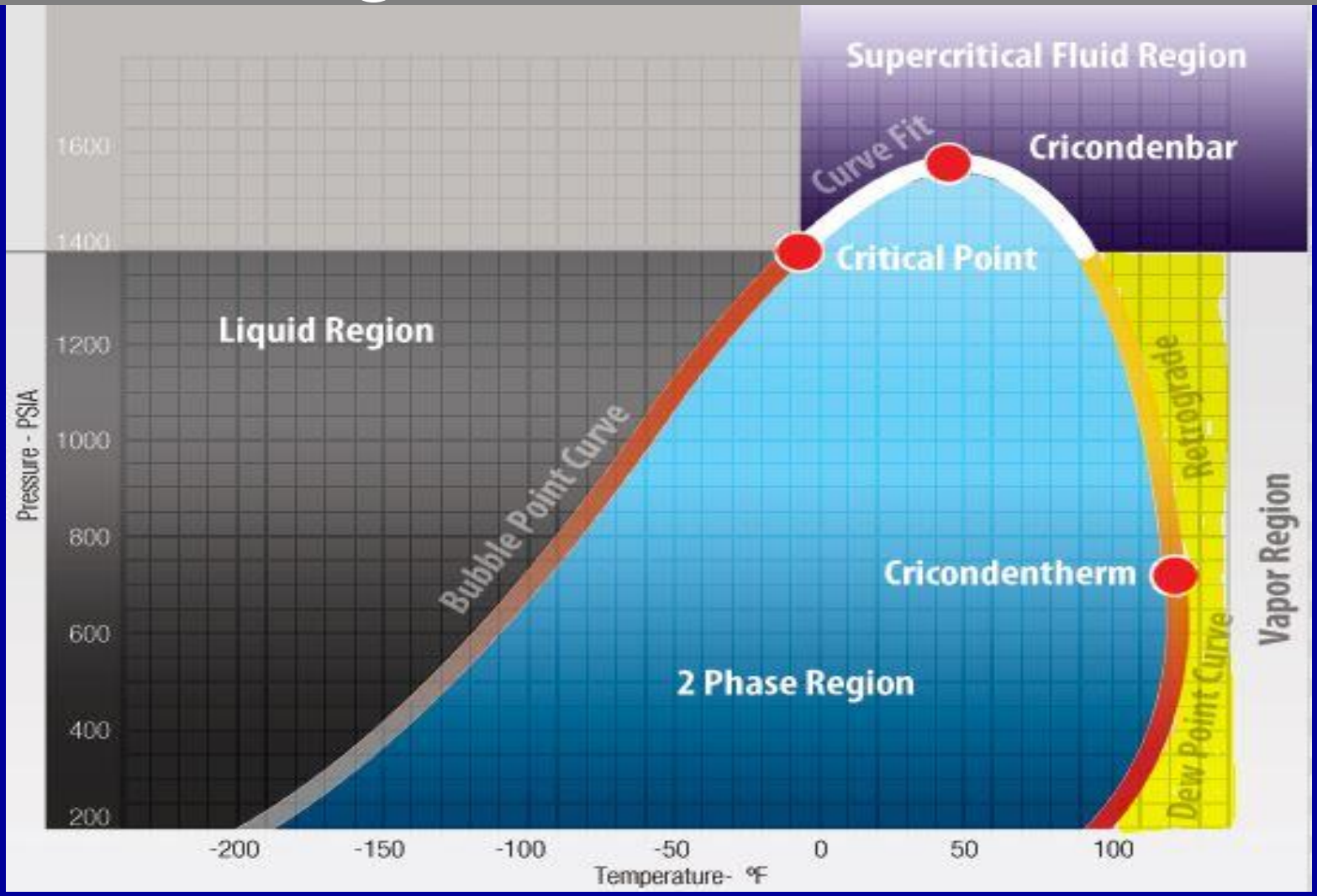
Example 1: Detailed 24 Hour Suction Pressure Data

- Four short duration dips in suction pressure
  - Related to horizontal well slugging
  - Severe dip just after noon resulted in shutdown

Example 2: Drilling down into KPI determined from Compressor Data

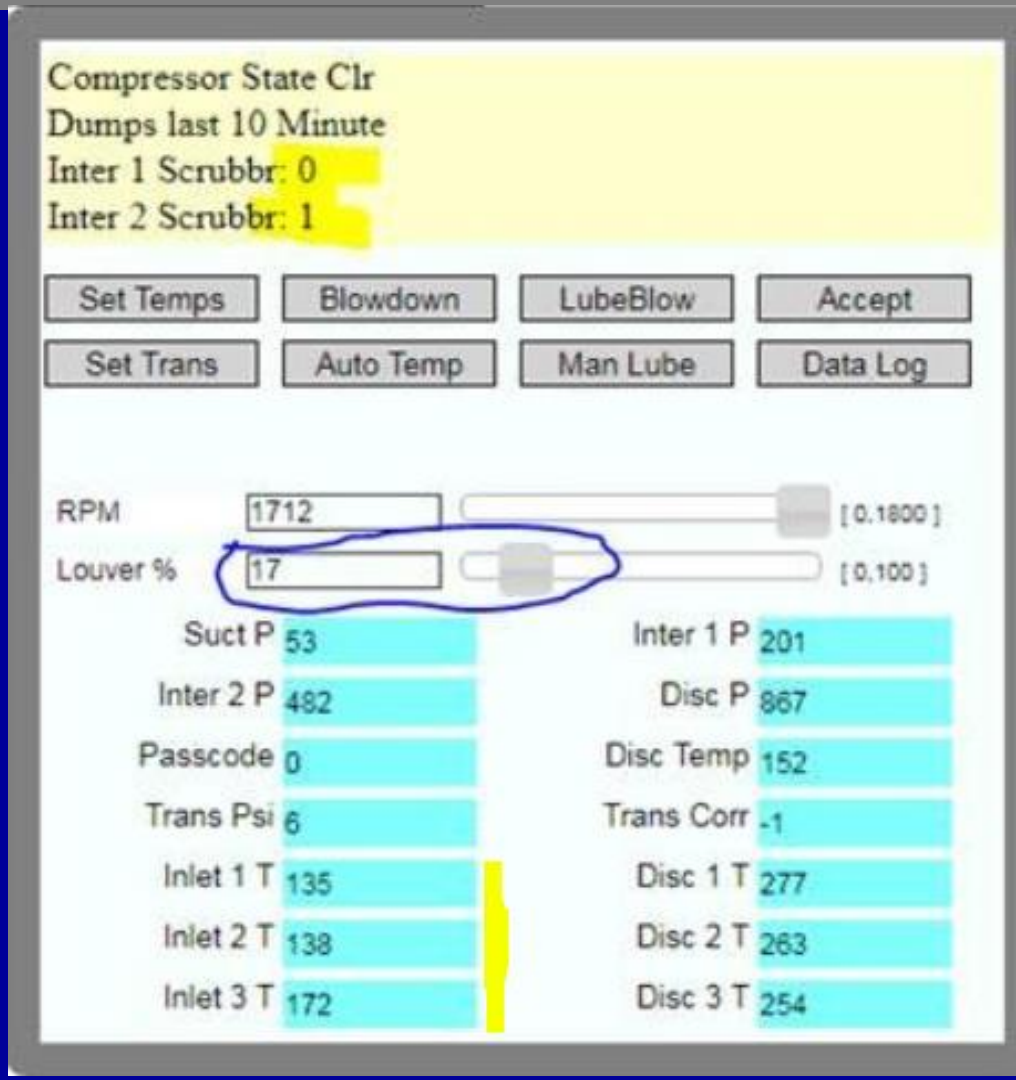
- **KPI: Actual less Theoretical Discharge Temp**
  - **Second stage discharge valves damaged - BLUE**
  - **Repaired before causing shutdown**

Understanding Compression: The Phase Diagram (Slide from 2019 Workshop)



Example 3: Compressor Data used to Perform Precision Gas Cooler Outlet Temp Control

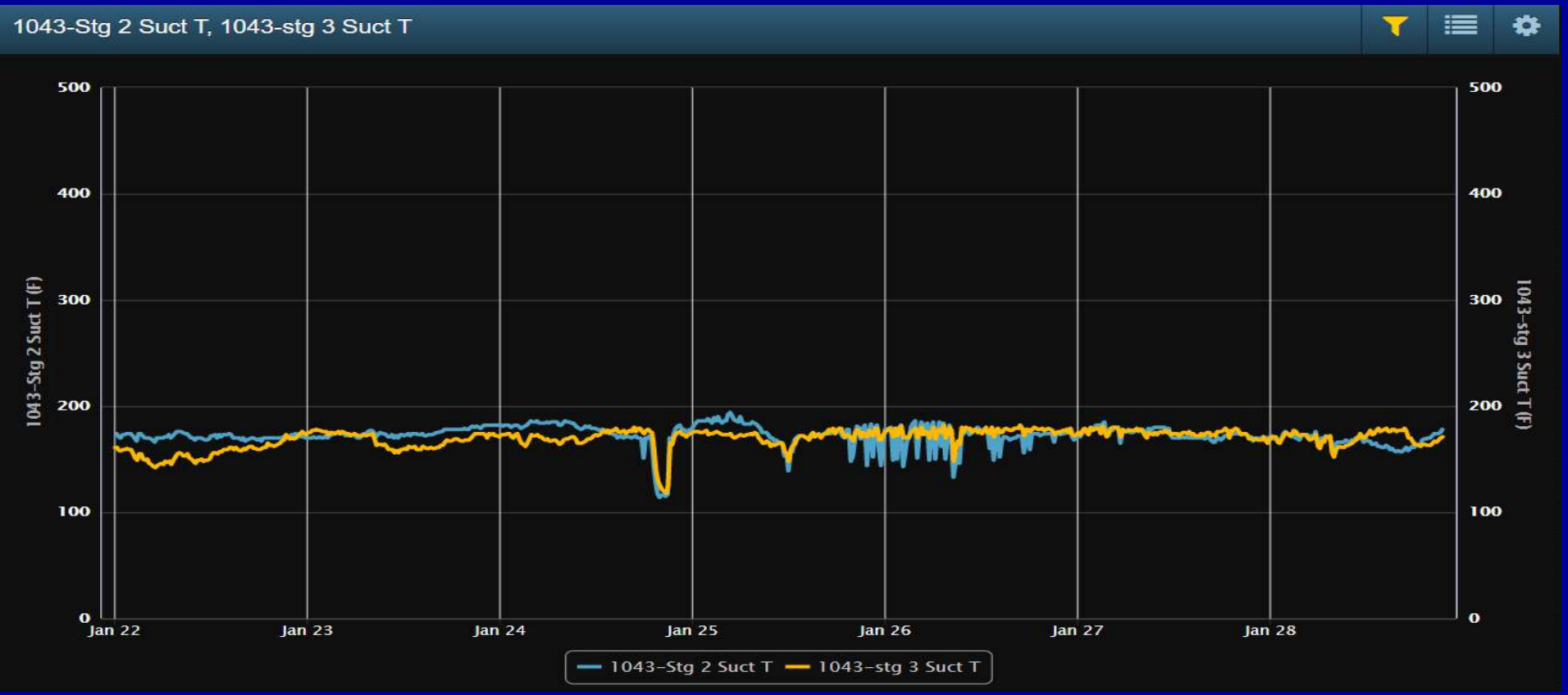
- Encline Phase Transition Control PLC pulls Modbus data from Detechtion device on compressor
- PLC evaluates multiple temps
  - Cooler Outlet Temps
  - Cylinder Discharge Temps
  - Adjusts louver position
- Scrubber dump counts adjust temp setpoints



Local real-time data sharing makes control options a reality

- Detechtion “Hub” provides data to control louver

Detechtion Web based “Dashboard” Confirms Temp Control Operation



- 7 days of Second and third stage inlet temp data
  - Shows how data can be shared at device for control

Conclusions

- Data available locally from IoT compressor devices should be shared onsite with E&P operators
- Data analysis helps understand root cause of compressor downtime (Ex 1)
- Data derived KPI's expose compressor problems before causing a shutdown (Ex 2)
- Data can also be shared with compressor site control systems (Ex 3)

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