IoT Solution for Chiller Condition Monitoring

1. Executive Summary

- 14.3% reduction in Specific Power Consumption (SPC)
- 20.4% increase in cooling capacity with 14.3% lower power usage

Parameter	Before Dec 23	After June 24	Change
Avg. SPC (KW/TR)	0.775	0.665	↓14.3%
Avg. Power (KW)	162.83	139.56	↓14.3%
Cooling Capacity (TR)	180.51	217.28	↑20.4%
Avg. COP	4.0	5.5	↑37.5%

Note:

- Above data points for the period between Dec 23 and June 24
- Chiller capacity: 115TR
- Customer: an Indian conglomerate making industrial tools and gadgets

2. The Challenge

Challenge:

- High energy consumption
- Degraded cooling capacity of the chillers
- Elevated operational costs.
- At one unit, operators were routinely operating both the main and backup chillers simultaneously during production to support the demand.

Key Pain Points:

- Excessive operational costs and energy waste due to suboptimal chiller operation
- Lack of real-time insights into critical chiller health parameters
- No automated system for early detection of inefficiencies or potential failures

Solution:

Deployment of custom Ficus IoT data acquisition devices, seamlessly integrated with existing PLCs, to enable real-time condition monitoring. Data was visualized through the Crowsensor dashboard, providing actionable insights for operators and management.

Outcome:

- Centralized, real-time operational visibility
- Optimized production processes
- Significant energy and cost savings

3. The Solution

IoT-Based Chiller Condition Monitoring

Chiller performance monitoring was achieved by capturing and analyzing key operational parameters, such as:

- Chiller Cooling Capacity
- Specific Power Consumption
- Coefficient of Performance (COP)
- Energy Efficiency Ratio (EER)

These derived metrics were calculated from raw data sourced from:

- PLCs
- Flow meters
- Energy meters

Sample Data Points Acquired

Below table shows some of the parameters out of several data points being acquired.

Parameter	Details
Water Inlet Temperature	Unit: °F
Condenser Inlet Water Temperature	Unit: °F
Refrigerant Level	Unit: %
Inlet Guide Vane	Unit: %
Suction Pressure	Unit: PSI
Cavity Temperature	Unit: °F

Loading Status	Unit: %
Compressor Run Hour	Unit: Hr
Evaporator Approach	Unit: °F
Power	Unit: kW
Compressor Inverter Temperature	Unit: °F

Solution Architecture

Ficus IoT devices interfaced directly with the chiller PLCs and ancillary sensors, transmitting data to an on-premise server for secure processing and storage. The Crowsensor dashboard provided intuitive, real-time visualization and analytics.

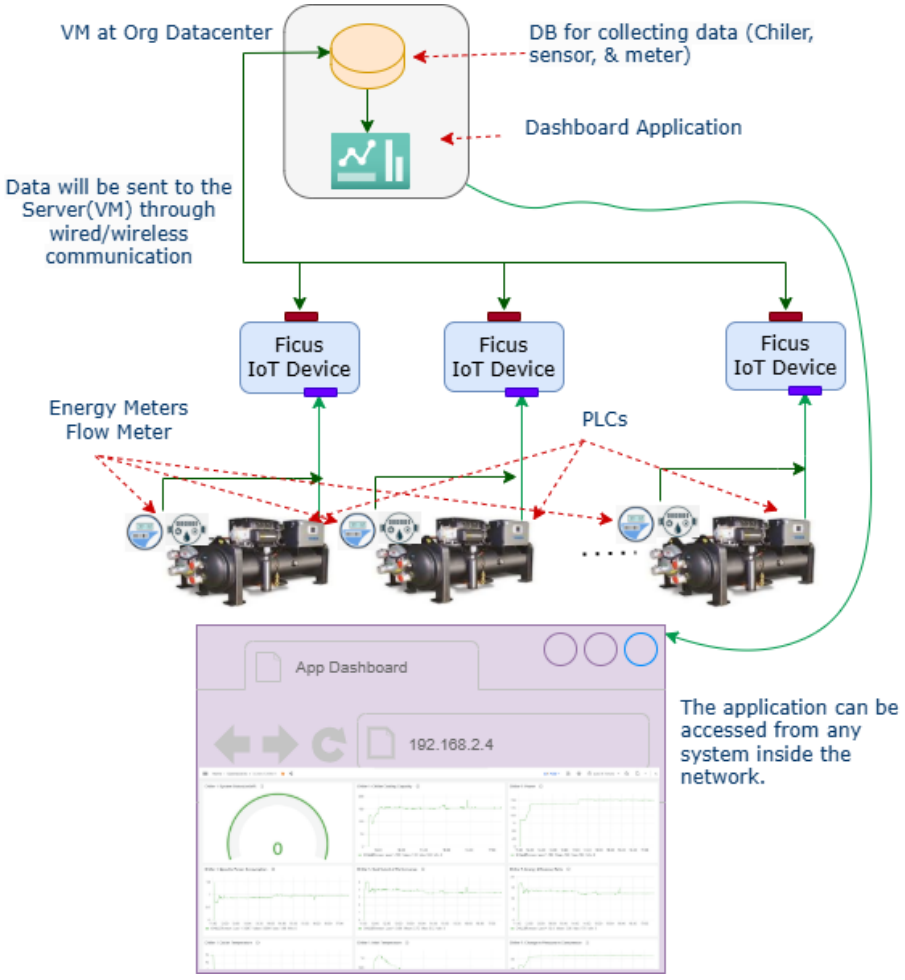

Image 1: Above image shows the solution architecture

Technical Highlights

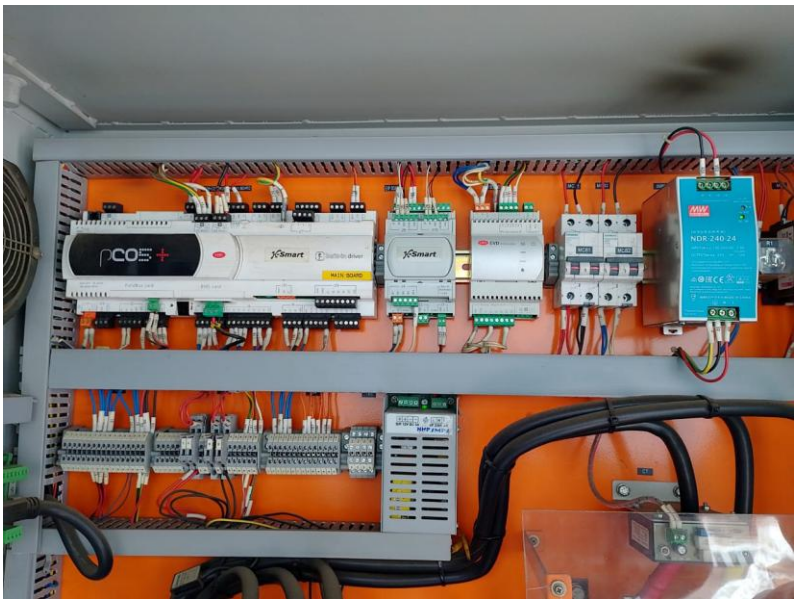

Image 2: Above image shows the Chiller PLC panel

Image 3: Above image shows the Ficus Device Installed on the Chiller Panel

- **On-Premise Hosting:** Ensured data sovereignty and low-latency processing within the customer's secure network.

- **Custom Integration:** Ficus devices adapted to legacy PLC protocols, eliminating the need for costly hardware upgrades.

Data Visualization

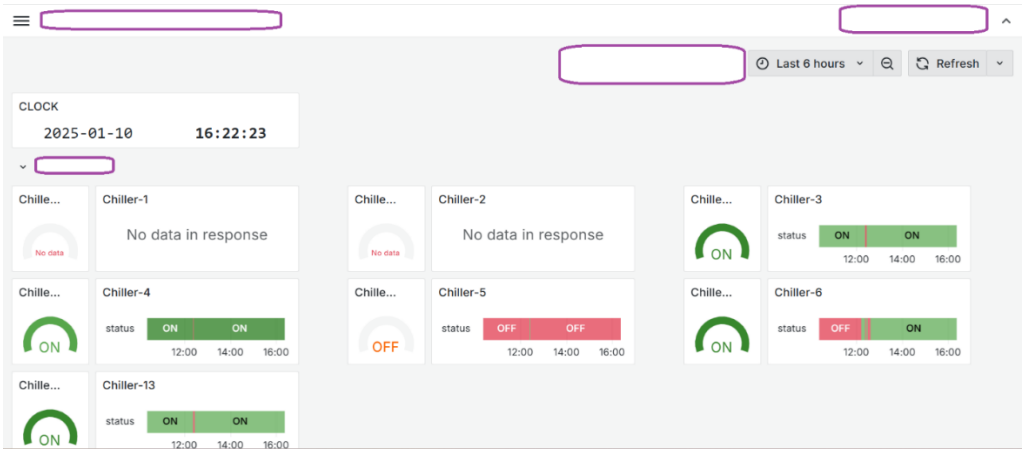

Image 4: Above image shows the dashboard screenshot

Image 5: Above image shows the dashboard screenshot

3. Results & Measurable Impact

Post-Intervention: SPC stabilized below 0.70 KW/TR

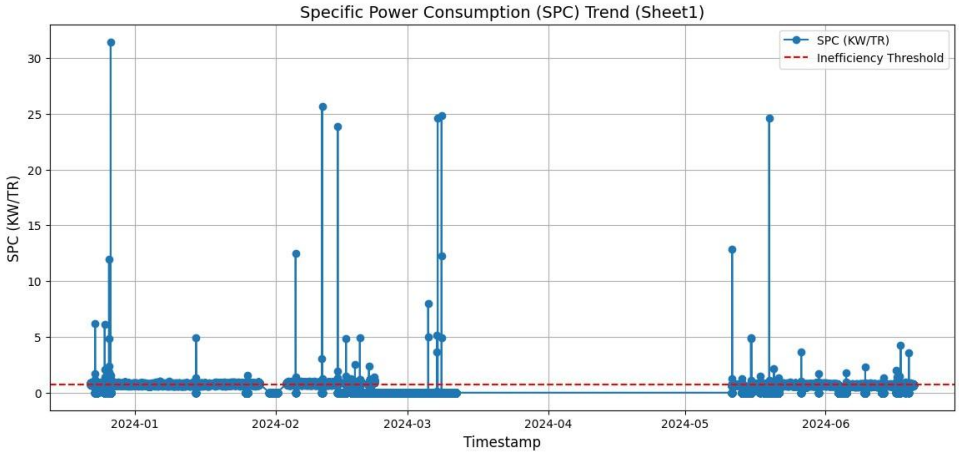

Figure 1: Monthly SPC trend with inefficiency threshold (0.75 KW/TR)

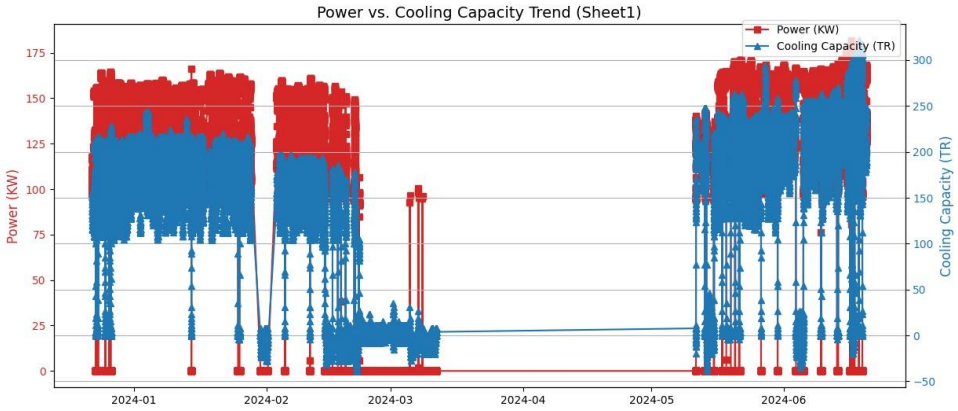

Figure 2: Power consumption versus cooling capacity trend

Key Outcomes:

- **Predictive Maintenance:** Chiller Cooling Capacity and Specific Power Consumption data gave important insight of Chiller performance.
- **Energy Optimization:** Setpoint recommendations resulted in energy savings.
- **Operational Efficiency:** Centralized dashboard reduced diagnostic time, streamlining maintenance and troubleshooting.

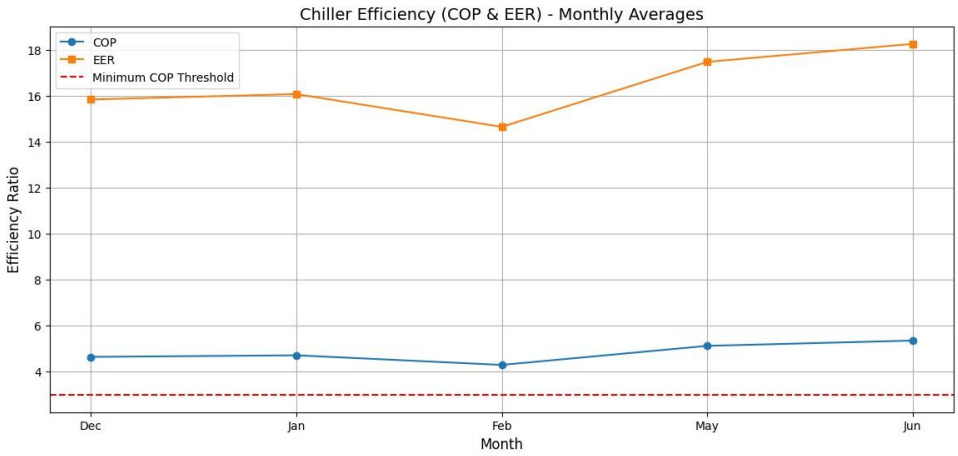

Figure 3: Monthly COP and EER trends with minimum threshold

Potential Cost Savings

Annual Savings = ΔPower × Hours × Rate = (162.83 − 139.56) × 8,760 × 10 = Rs. 2,037,492

Note: Actual cost saving may vary depending upon conditions on ground.

4. Why This Matters for Other Manufacturers

- **Scalable & Adaptable:** The solution can be extended to other HVAC assets, compressors, or pumps.
- **Rapid ROI:** Achieved a payback period of less than 12 months through operational efficiencies and energy savings.
- **Compliance & Security:** On-premise deployment ensures full compliance with industrial data governance standards.

Conclusion:
By leveraging Sisai IoT technology for real-time chiller monitoring and analytics, the customer transformed their maintenance strategy from reactive to predictive, significantly reducing costs and improving operational resilience. This case demonstrates the tangible benefits of IoT-driven optimization for large-scale manufacturing environments

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