

## Application Note

# Remote Health Monitoring for Air Traffic Control RADAR

**This Application Note describes persistent health monitoring and diagnostic solutions for remote Air Traffic Control (ATC) assets, including RADAR, navigational aids and communications facilities. Opportunities to reduce risk of failure, downtime, and operational costs are highlighted.**

Civilian and military Air Traffic Control (ATC) systems depend upon continuous performance of remote RADAR installations, navigation aids, and communications facilities. Typically lacking on-site engineers, and with a long service supply chain, they are at risk of surprise failure, extended downtime and high preventative maintenance and failure recovery costs. In particular:

- Remote ATC facilities of all kinds are susceptible to unmonitored grid power quality variations, and outages
- Rotating antenna RADAR systems are susceptible to unmonitored environmental and mechanical degradation
- On-time preventative maintenance (PM) is expensive and inefficient, lacking leading indicator data to optimize PM and part replacement intervals, and to preplan parts logistics
- On-site failure investigation, lacking expert remote fault isolation in advance, can result in increased downtime and cost.
- Backup power and UPS systems add an additional layer of operational risk, and are typically unmonitored
- Lack of centralized expert oversight impacts both service cost, system reliability, and fleet management efficiency



Figure 1: ATC RADAR scanner

The generic requirements for managing remote installations, such as ATC facilities, are:

- Fleet power and critical system operational status is centrally visible at all times
- Event and trend data to generate immediate actionable alerts
- Leading indicator sensors to enable fault avoidance and postponement, and for PM planning

- Comprehensive data and event capture to accelerate failure root cause analysis and recovery planning
- Simple installation, versatile configuration, and global network integration
- Field-proven solutions and partners

Fortunately, there is a tried and tested solution for these requirements, which has been deployed for diverse mission-critical global monitoring applications including ATC RADAR facilities.

## Powersides PQube 3: a field-proven solution for ATC Facility Monitoring

PQube 3, figure 2, is a versatile monitoring solution for power quality, load metering, and sensor telemetry, whose key characteristics include:

- Up to 14 AC source/load channels monitored by a single device
- Synchronized data capture across channels for unambiguous cause and effect determination
- Comprehensive power quality analysis per IEC 61000-4-30 Ed3 Class A
- Optional application-specific sensor modules: multi-axis vibration, pressure, temperature, humidity, fluid level, facility intrusion
- 4 AC or DC custom sensor channels per unit, with options for more
- Event triggers with programmable thresholds
- Immediate alert transmission and actionable data: e.g. waveforms, switching transients, power instability
- Daily, weekly and monthly trend reports on key power indicators, and on alerts: e.g. power, voltage, current, transients, outages, harmonics, emissions, imbalance etc.
- Multi-channel load metering per ANSI C 12.20 0.2%
- A range of backhaul solutions and protocols: ethernet, modem, Modbus, email, IOT
- Robust data security protocols
- Optional UPS modules to ensure critical data is captured and transmitted post-outage



Figure 2: Powerside PQube 3 Power Analyzer module

Powerside customers have deployed 50,000+ PQube 3 systems in a wide range of mission-critical applications.

The typical sensor/analysis suite for monitoring a remote ATC facility can include:

- Grid: Total facility load and comprehensive power quality
- Sub-load (motors, Variable Frequency Drives (VFD), RF, telecommunications, etc.): load and power quality
- Facility: temperature, humidity, intrusion detection
- Genset: output, power quality, fuel level, starter battery voltage/current
- Solar: output, power quality, storage current
- Scanner: gearbox and motor vibration, gearbox lubricant level

Other sensors may be added for specialised applications. These sensors and analytics support four broad use cases, table 1.

Use Case	Supporting Data & Information	Sensors							
		Power Consumption	Subload consumption	Power Quality	Temperature & Humidity	Genset/solar monitoring	Genset fuel, battery I/V	Gearbox vibration	Lubricant level
Operational Oversight "What is happening?"	Real time load, variation, and trends	x	x			x			
	Grid and/or backup feed status	x		x		x			
	Real time failure alerts, signature capture	x	x	x	x	x	x	x	x
	Facility ambient conditions				x				
Failure avoidance "What could go wrong?"	Grid and backup power quality events and trends	x		x		x			
	Documented genset and ATS performance tests	x	x	x	x	x	x		
	Radar scanner vibration and trends							x	
	Radar scanner lubricant level and trend								x
	Motor drive currents and trends		x						
	Genset fuel, battery voltage and charging current					x	x		
Failure recovery "Quick, what is the plan?"	Failure detection and fault isolation	x	x	x	x	x	x	x	x
	Root cause/corrective action plan, fast parts logistics	x	x	x	x	x	x	x	x
Preventative Maintenance "What needs attention, when?"	Remote PM: trend analysis	x	x	x	x	x	x	x	x
	On-condition PM scheduling and parts logistics	x	x	x	x	x	x	x	x

Table 1: Use Cases and Sensors for ATC RADAR and facility monitoring

Operational Oversight answers the most pressing questions for remote facilities; are systems running normally, and are there any immediate threats to normal operation? For the ATC case, the grid and backup power supply status and total load, sub-load, and gearbox vibration are primary indicators of normal operation. Genset output, fuel level and battery charge status, or solar output, indicate



Time-based Preventative Maintenance (PM) for un-monitored remote facilities can be inefficient and costly. Whilst low cost consumables, such as air filters, predictably need periodic replacement, more expensive components may wear at rates dependent on utilization as well as temperature and other factors. Remote analysis of trend and utilization data (e.g. hours run at temperature) enables optimum on-condition PM intervals, advanced scheduling and parts logistics, and higher uptime with lower parts and labor costs.

## Conclusion

Remote monitoring capability can make a major improvement in the reliability, uptime and cost of service for remote ATC facilities and assets. The right sensor suite can deliver leading indicators of electrical and mechanical failure, enabling optimised on-condition preventative maintenance. Immediate alerts and trend data provide real-time operational oversight, as well as new opportunities for failure avoidance and accelerated failure recovery. Powersides PQube 3 has been field tested and specified for ATC facility and RADAR monitoring.

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