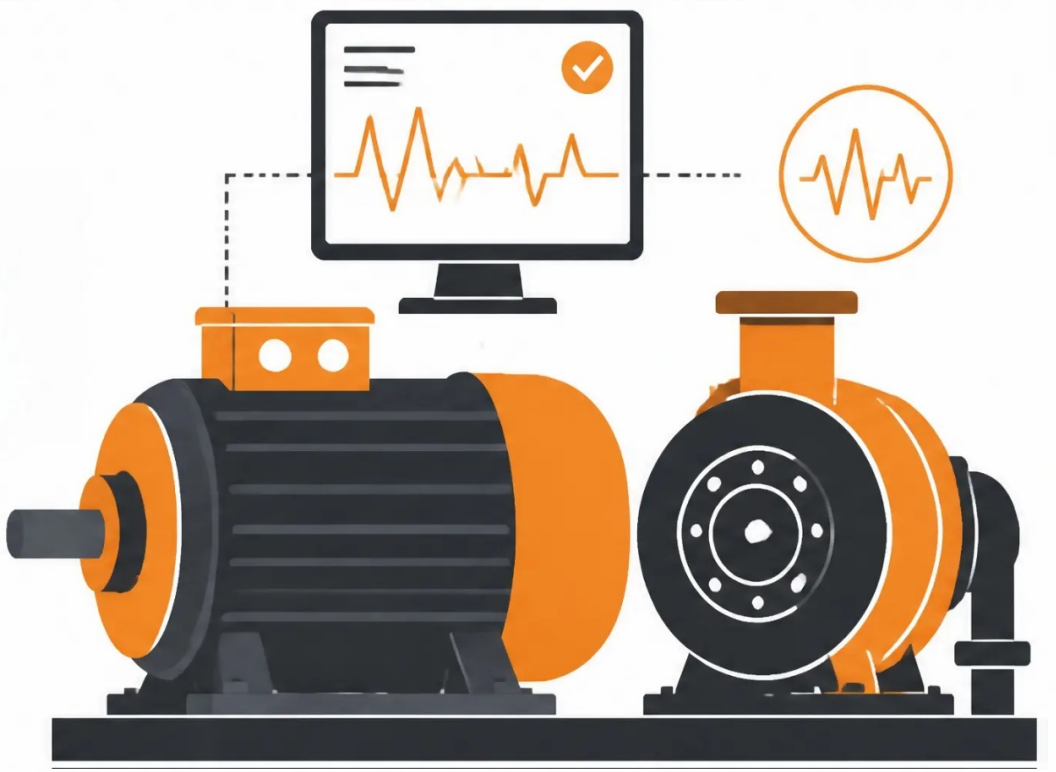
SOLAR
WAREHOUSE PTE LTD

Solar Warehouse PTE LTD — Condition Monitoring Services

Smarter Machines, Lower Costs

How Electrical Signature Analysis Protects Critical Infrastructure.



We detect faults before they become failures — and we price the difference.

www.solarwarehouse.sg

Unplanned Equipment Failure Is Expensive

42%

of industrial plant downtime is caused by rotating equipment failure

$50K–$250K

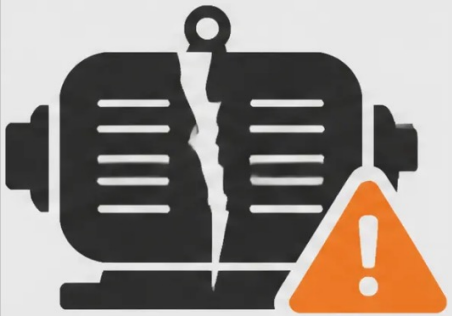
lost every hour of unplanned downtime in production value

70%

of bearing failures are detected too late — after performance has already degraded

Traditional vibration monitoring requires physical sensors on rotating machinery. It misses electrical root causes and cannot quantify energy waste.

There is a better way.



Electrical Signature Analysis: The Motor Tells Its Own Story

THE METHOD

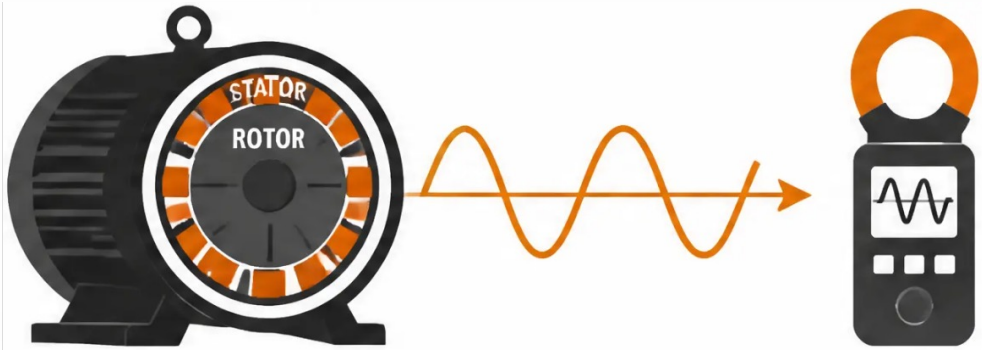
How We Measure

- *Clamp-on CTs installed at the motor control panel*
- *Motor stays running — zero shutdown required*
- *No sensors mounted on rotating parts*
- *Works on VFD, soft-starter, DOL, and star-delta motors*

Measurement takes under 30 minutes per motor.
The motor never knows we were there.

THE SCIENCE

What the Signal Reveals



The air gap between rotor and stator acts as a magnetic transducer

Every bearing defect, gear fault, belt slip, and impeller imbalance creates a unique current signature

We decode that signature — without ever touching the machine

One clamp-on measurement. Full system health picture.

Three Layers of Intelligence in One Measurement.

VSA

Voltage Signature Analysis

- Upstream from the motor
- Detects power supply faults
- Utility disturbances
- Upstream machine interference

CSA

Current Signature Analysis

- Downstream from the motor
- Motor health, shaft, gearbox
- Belt, pump, fan — all driven equipment
- Rotor bar & eccentricity detection (MCSA subset)

PQA

Power Quality Analysis

- Power quality at the supply level
- Phase unbalance detection
- Harmonics — 2nd through 5th
- Power factor & loose connection

One clamp-on measurement. Full system health picture.

What We Detect — 12 Fault Classes, One Measurement.

Fault Type	Detection Signal	Industry Risk Level
Broken / Cracked Rotor Bars	MCSA sideband dB level	HIGH
Stator Winding Short	VSA + CSA phase imbalance	HIGH
Static / Dynamic Eccentricity	Rotor bar harmonic sidebands	MEDIUM
Bearing Defect — Outer Race	Current modulation at BPFO	HIGH
Bearing Defect — Inner Race	Current modulation at BPFI	HIGH
Gear Mesh Anomaly	GMF = Teeth × Shaft Speed	MEDIUM
Belt Slip	f_belt = v_belt + L_belt	MEDIUM
Belt Misalignment	Belt frequency sidebands	MEDIUM
Impeller / Blade Pass	BPF = Blades × Shaft Speed	MEDIUM
Phase Unbalance	PQA negative sequence	MEDIUM
Harmonic Distortion (THD)	FFT to 5th harmonic	LOW–MED
Power Factor Degradation	Reactive power ratio	HIGH

One clamp-on measurement. 12 fault classes detected. Zero process intrusion.

Rotor Health – 7-Level Severity Assessment

← Better — Critical →

> 60 dB	EXCELLENT	No action required
54 – 60 dB	GOOD	Continue monitoring
48 – 54 dB	MODERATE	Increase monitoring frequency
42 – 48 dB	DEVELOPING	Plan maintenance soon
36 – 42 dB	BROKEN BARS	Schedule inspection
30 – 36 dB	MULTIPLE BREAKS	Take action immediately
< 30 dB	SEVERE	Urgent intervention required

Every Report Includes:

A rotor dB score

A severity rating

A recommended action

Written in plain English

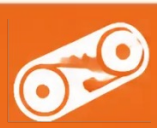
Solar Warehouse PTE Ltd – Condition Monitoring Services

Rotor dB levels measured via Motor Current Signature Analysis (MCSA) – sideband attenuation relative to fundamental supply frequency.

We Don't Just Find Faults — We Price Them

Every defect costs money. We show you exactly how much.

Belt Slip + Misalignment — 181 kW Motor



$5,544

/ year wasted

Single belt slip and misalignment condition — energy lost, not worked

Bearing + Impeller Losses — Pump Motor

$5,469

/ year wasted

+ 38.5 tonnes CO_2 avoided per year

Bearing Losses — 1.6 MW Wind Turbine Generator

2.43 kW

detected via current signature alone

No nacelle entry. No sensors. No shutdown.

181 kW Motor — Full Annual Electrical Cost

$130,320

total annual electrical cost

5% fault-driven efficiency loss = $6,500/yr saved after ESA

ROI on a single ESA survey: detected faults typically pay back the survey cost within 30 days.

Our Service Process — 4 Steps, Zero Downtime.

1 INSTALL

- Clamp-on CTs installed at MCC panel
- Under 30 minutes
- Motor stays running — zero shutdown

2 MEASURE

- Voltage + current waveforms captured
- Full spectral analysis
- Resolution to < 0.1 Hz

3 ANALYSE

- Fault frequencies identified
- Severity scored per fault class
- Energy losses quantified in kW and $/yr

4 REPORT

- Plain-language report delivered
- Fault type · Severity · Energy cost
- Recommended action + priority level

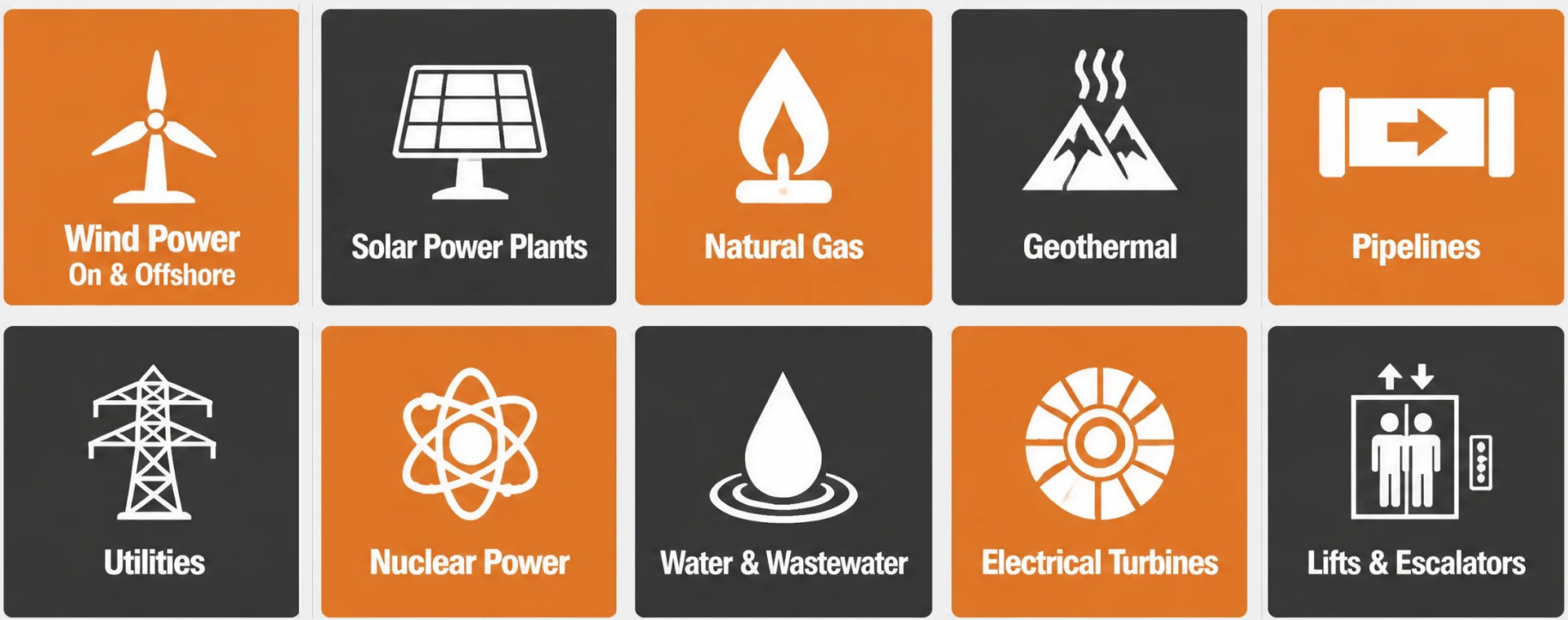
SURVEY MODE
Scheduled periodic campaigns

CONTINUOUS MODE
Permanent installation with live alarms

EMERGENCY
48-hr rapid diagnostic deployment

10 Industries. One Platform. No Shutdown Required.

Clamp-on. Non-intrusive. Zero process interruption.



One measurement technology. Every rotating asset. Every industry.

Renewable Energy — Where Reliability Is Revenue

Wind Power

On & Offshore Generation

Generator Rotor Bar Health

MCSA analysis on high-voltage DFIG generators, 690V to 11kV

Planetary Gearbox

Gear mesh frequency analysis at every stage of the drivetrain

Main Bearing

Outer race fault detection at sub-1 Hz shaft speeds — no nacelle entry needed

Before / After Validation

Bearing replacement confirmed via ESA, not guesswork

Solar Power

Utility-Scale Plants

Tracker Drive Motors

Worm gear wear and bearing defect detection, zero downtime required

Inverter Cooling Fan Arrays

Bearing fault surveillance across hundreds of fans simultaneously.

Balance-of-Plant Pumps

Cavitation detection via blade pass frequency analysis

Inverter Transformer Health

Primary winding degradation identified through electrical signature

2.43 kW

Bearing losses detected on a 1.6 MW wind turbine via current signature alone — $15,000+ in avoided replacement costs if caught early.

High-Stakes Assets Demand Precise Monitoring

Natural Gas

Reciprocating compressors — crosshead and rod fault signatures detected through current waveform

Centrifugal compressors — impeller blade pass frequency monitored for imbalance and wear

Gas turbine generators — rotor eccentricity and stator winding leakage identified online

Pipeline booster stations — continuous rotor bar dB trending, no shutdown required

Geothermal

VFD-driven wellhead pumps — full ESA analysis without fixed-speed requirement

Steam turbine generators — stator health and bearing condition monitored online

High-temperature environments — CT measurement at MCC panel, no sensor in process area

Flash steam separators — impeller imbalance detected via blade pass frequency

Pipelines

Booster pump health — BPFO and BPFI bearing fault trending across multiple remote stations

Compressor stations — rotor bar dB scoring, phase unbalance, and power factor in one visit

Remote site deployment — ESA survey equipment connects at panel, no field wiring or process entry

Seasonal VFD variation — full spectral analysis valid at any operating speed, any season

From offshore gas platforms to remote pipeline stations — ESA works where traditional sensors cannot.

Safety-Critical Assets Need Certainty – We Deliver It

Nuclear Power

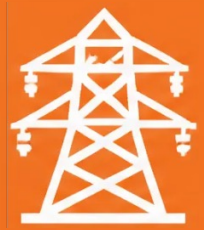
Safety-critical surveillance aligned with IEC 60780 / IEEE 323

Reactor coolant pump bearing health – BPFO, BPFI, and BSF trending

Feed pump and condensate pump – online blade pass and bearing diagnostics

Zero interference with reactor coolant boundary

Non-intrusive. Compliance-aligned.



Utilities & Grid

Transformer cooling fan arrays – bearing failure prevention at scale

High-voltage switchgear drive actuators – low-speed motor analysis

Grid-connected generator stator and rotor health monitoring

Substation auxiliary fleet surveillance

Fleet-wide visibility. Zero outages.

Water Treatment

Submersible pumps – bearing and impeller health without extraction

Aerator blowers 55–400 kW – rotor bar and bearing surveillance

Dewatering centrifuge drives – belt and gear diagnostics

Per-motor energy loss quantified for OPEX reduction and ESG reporting

Uptime assured. ESG data included.

One ESA platform. Three sectors. Zero compromise on safety.

Vertical Transport — The Low-Speed Challenge Solved

Where standard vibration instruments fail, ESA delivers certainty

THE CHALLENGE

Standard Tools Go Blind Below 10 Hz

Elevator shaft speed: 0.406 Hz – just 24.4 RPM

Vibration instruments cannot resolve bearing fault frequencies at this speed

Faults grow undetected — until catastrophic seizure or full motor failure

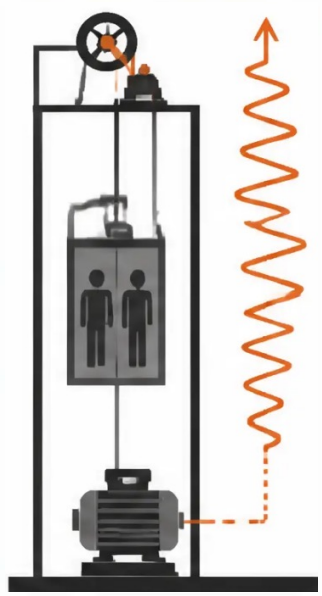
THE ESA SOLUTION

Sub-0.1 Hz Resolution. Through the VFD.

Clamp-on CTs at the MCC panel — no nacelle entry, no machine contact

Full current spectrum analysis at any operating speed — forward or reverse

Bearing fault frequencies resolved at shaft speeds as low as 0.406 Hz



25 HP • 414V

VFD-driven U-frame elevator motor — old installation, no maintenance records available

Worm Gear

2.5-tooth pinion : 108-tooth bull gear

Gear mesh frequency identified by manual tooth count — no drawings required

Fault Detected

6311 bearing — outer race fault + cage fault

Cause: lubrication deficiency – caught before structural seizure

Building managers: one ESA survey covers every lift and escalator in your entire estate portfolio.

Why Solar Warehouse PTE Ltd?

Full-Spectrum Detection

Electrical AND mechanical faults captured in a single measurement — nothing missed.

Sub-1 Hz Speed Capability

Validated down to 0.406 Hz shaft speed — elevators, cranes, and wind turbines included.

Quantified Energy Loss Reporting

Every fault costed in kW and $/yr — not just detected, but priced for ROI clarity.

VFD & Variable-Speed Compatible

Full analysis at any operating speed — forward, reverse, soft-start, or star-delta.

Non-Intrusive, Zero Downtime

Clamp-on CTs at the panel only — no shutdown, no process intrusion, no risk.

Singapore-Based Specialist Team

Rapid local deployment, MOM-aligned compliance, and regional industry expertise.

The Numbers Speak for Themselves.

SCENARIO	FAULT DETECTED	ENERGY LOSS	ANNUAL COST SAVED	SURVEY ROI
181 kW Belt Drive Motor	Belt slip + misalignment	7.7 kW	**$5,544 / yr**	Within 1 month
Pump Motor	Bearing + impeller losses	5.49 kW	**$5,469 / yr** **+ 38.5t CO_2**	Within 1 month
1.6 MW Wind Generator	Bearing defects (3 types)	2.43 kW	**$15,000+** ***avoided replacement***	**Immediate**
Elevator Drive	Outer race + cage fault	***Prevented seizure***	**Bearing swap vs. full motor & gear replacement**	**Immediate**

Average ESA survey cost: $3,000–$8,000. | Average fault found: saves $5,000–$15,000 per year. | ROI: Day 1.

Condition Monitoring Is Your Carbon Reduction Strategy

SINGLE PUMP MOTOR — ANNUAL IMPACT

38.5

tonnes CO_2 avoided per year

By fixing bearing and impeller losses in one pump motor

= Removing 8 passenger cars from the road annually

ENERGY EFFICIENCY = ESG COMPLIANCE

Every kW saved = reduced Scope 2 emissions

CO_2 equivalent calculations included in every report

Data-ready for sustainability disclosures and investor reporting

Our reports give your sustainability team the numbers they need — not estimates, not proxies. Measured data.

Regulatory and investor pressure for ESG disclosure is intensifying. Motor efficiency losses represent a measurable, addressable source of Scope 2 emissions. Solar Warehouse condition monitoring reports provide the quantified energy and carbon data your sustainability team needs.

Every fault we find is a carbon reduction opportunity — with a dollar figure attached.

Ready to Find Out What Your Machines Are Telling You?

A Solar Warehouse ESA survey takes 30 minutes per motor. The insights last a lifetime.

Book a Survey

Schedule an on-site ESA assessment for your facility

Request a Demo

See a live ESA report on a motor in your plant

Get a Proposal

Receive a tailored continuous monitoring proposal

We detect what other tools miss. We price what others ignore.

Solar Warehouse PTE Ltd | www.solarwarehouse.sg | contact@solarwarehouse.info | Singapore