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CASE STUDY

Turning Geothermal Data Into Recovered Generation

How a geothermal power producer recovered lost renewable generation and improved plant revenue

RESULTS WITHIN EIGHT WEEKS

1.3MW
Generation recovered

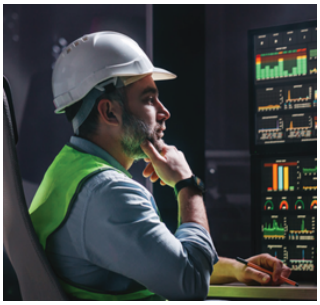
2,000 MWh
Historical loss identified

$138k
Revenue impact quantified

EXECUTIVE OVERVIEW ON EARLY DETECTION, PROACTIVE MAINTENANCE, AND GENERATION RECOVERY

Geothermal operators must protect reliable baseload generation while managing mature assets and tightly connected steam, turbine, condenser, and cooling systems. EtaPRO® was deployed to help a global geothermal producer identify developing problems earlier, quantify why they mattered, and support action before abnormal conditions became failures or sustained generation losses.

The digital transformation solution combined EtaPRO® Archive™, EtaPRO® Advanced Pattern Recognition (APR), and VirtualPlant™ in an integrated empirical and physics-based digital twin. The resulting workflow connected plant data, expected-behavior analytics and thermodynamic models to detect, diagnose, quantify, prioritize, act, and verify. By implementing EtaPRO, the geothermal producer reduced derates, outages, and major maintenance events and replaced manual analysis and fragmented data with a consolidated reliability monitoring platform.



A DIGITAL FOUNDATION FOR PROACTIVE OPERATIONS

- EtaPRO Archive consolidated operational and historical data for trending, event review and post-maintenance verification.
- EtaPRO APR compared actual multivariable behavior with learned normal behavior, exposing deviations that may remain within conventional alarm limits.
- EtaPRO VirtualPlant compared actual, expected and best-achievable performance, translating degradation into recoverable MW and lost MWh.
- A shared diagnostic environment helped operations, maintenance and management prioritize intervention using common technical and business evidence.

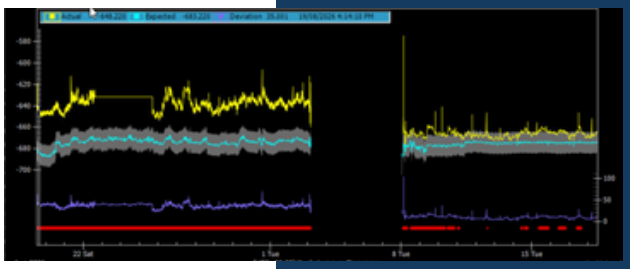
THE PRACTICAL DIFFERENCE: EtaPRO did more than indicate a parameter was high. It helped reveal when behavior was higher than expected, establish likely causes, quantify consequences and verify the result of corrective work.

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ACHIEVEMENT 1 | RECOVERING GENERATION FROM CONDENSER AIR IN-LEAKAGE

Detection and decision support

EtaPRO identified condenser pressure above its expected value for the unit operating condition. By correlating condenser behavior with load, process and cooling parameters, the team distinguished a real degradation from normal variation. Investigation identified air in-leakage, while the performance model translated the deviation into a measurable generation opportunity.



Condenser Vacuum Pressure

Risk avoidance and business impact

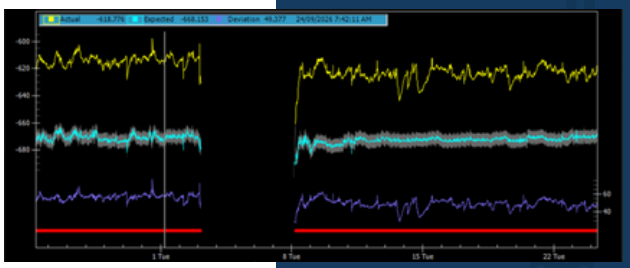
Early diagnosis reduced exposure to continued vacuum deterioration and accumulating generation loss. Corrective action recovered approximately 1.3 MW. Historical review indicated approximately 2,000 MWh of lost generation over the preceding period, valued at no less than US$138,000. If sustained continuously for one year, 1.3 MW represents an indicative value of approximately US$786,000 at the case-derived US$69/MWh. The annual figure is a scenario, not a guaranteed savings.



ACHIEVEMENT 2 | PREVENTING A CONDENSER PROBLEM FROM ESCALATING

Detection and decision support

On another unit, EtaPRO detected abnormal condenser pressure behavior relative to expected operation. The analysis supported a controlled inspection rather than continued operation until an alarm or forced event. Debris obstructing condenser flow was found and removed; EtaPRO then verified the improvement and showed that further performance recovery could still be required.



Condenser Vacuum Pressure



Risk avoidance and business impact

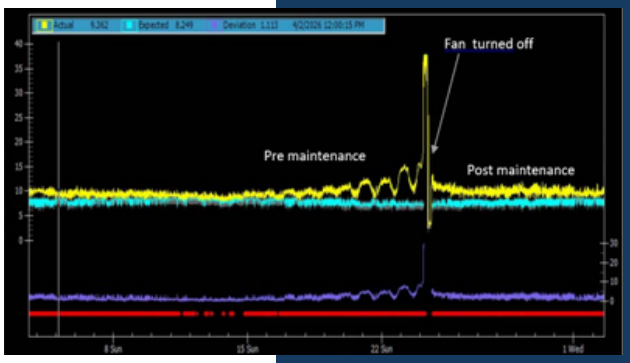
The intervention reduced exposure to rising condenser pressure, progressive derating, secondary damage, emergency repair and an unplanned shutdown. Potential avoided exposure is estimated at US$58,000 to US$531,000 under transparent outage, output and repair scenarios. The range is scenario-based, not guaranteed, and depends on failure progression, MW affected, outage duration and repair scope.

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ACHIEVEMENT 3 | DETECTING COOLING-TOWER FAN VIBRATION BEFORE FAILURE

Detection and decision support

EtaPRO identified abnormal cooling-tower fan vibration while the condition was developing. Evaluation against operating state and cooling-system behavior helped distinguish a meaningful deviation from normal variation. The evidence supported controlled removal from service, targeted maintenance and return to operation after correction.



Cooling Tower Fan

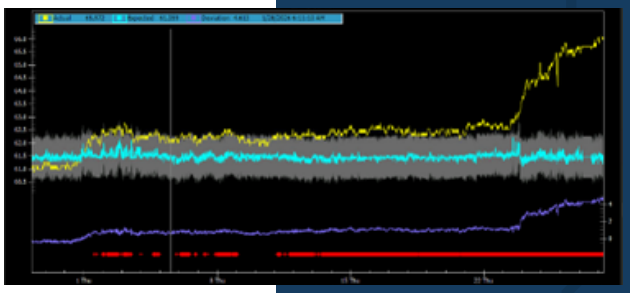
Risk avoidance and business impact

Earlier intervention reduced the risk of a fan, motor, bearing, gearbox or shaft damage and protected heat rejection capability. Scenario analysis indicates potential avoidance of approximately US$11,000 to US$135,000 in repair escalation and lost-generation exposure. Actual value depends on failure severity, derate, maintenance duration and repair scope and is not guaranteed.

ACHIEVEMENT 4 | DETECTING COOLING-WATER PUMP BEARING DEGRADATION BEFORE FAILURE

Detection and decision support

EtaPRO APR detected that cooling water pump motor bearing temperature had increased above its expected value for the prevailing operating condition. The early deviation provided warning before progression to bearing damage or pump failure. The plant flushed the service water circuit, changed over to the standby pump and raised a service request for inspection. Bearing temperature decreased by approximately 2°C following immediate action. Repair was completed, and the pump was held for an appropriate changeover opportunity.



CWP Temperature High

Risk avoidance and business impact

The controlled intervention reduced exposure to bearing, motor and pump damage, loss of cooling-water availability, unit derating and forced outage. Potential equipment repair exposure avoided is estimated at US$25,000 to US$120,000. This scenario is an estimate, is not guaranteed, and excludes generation derating and forced-outage impact and should be validated against work-order history, OEM quotations or comparable repair records.



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EXECUTIVE VALUE SUMMARY

Operational event	EtaPRO contribution	Business value
Condenser air in leakage	Detected abnormal behavior, supported diagnosis and verified recovery	1.3 MW recovered; 2,000 MWh and at least US$138,000 identified
Condenser obstruction	Supported controlled inspection and post repair verification	Potential US$58,000–US$531,000 exposure avoided
Cooling-tower fan vibration	Detected developing vibration; enabled condition based maintenance	Potential US$11,000–US$135,000 exposure avoided
CWP motor bearing temperature	APR detected temperature above expected behavior; enabled flushing, changeover and inspection	2°C reduction; potential US$25,000–US$120,000 repair exposure avoided

ETAPRO ADVANTAGE Detect the deviation. Diagnose the cause. Quantify the impact. Act before failure. Verify the result.

WHY IT MATTERS: REACTIVE RESPONSE TO PROACTIVE MAINTENANCE

These achievements show that **digital transformation is not defined by collecting more data**. Its value comes from moving the decision point earlier and converting technical deviations into actions that protect availability, output, and maintenance cost. EtaPRO supported the transition **from reactive response toward proactive maintenance** and condition based asset management through earlier indication, engineering context, quantified impact and post maintenance verification.

CLAIM AND METHODOLOGY NOTE

The 1.3 MW recovery, 2,000 MWh historical loss, at least US$138,000 revenue impact and 2°C temperature reduction are treated as case outcomes supplied for this paper. Annualized values and avoided-cost ranges are scenario estimates, not customer-certified realized savings. Customer, plant, country and unit identities have been removed. The US$25,000–US$120,000 CWP range is depending on individual plant conditions.



*These are potential and not guaranteed cost savings. Actual savings are dependent on a variety of human and equipment variables.

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WHY EtaPRO'S MONITORING AND DIAGNOSTICS PLATFORM IS UNIQUE

Enterprise reliability monitoring and diagnostics software needs to be expertly integrated across systems; new procedures established, documented, and customized for plant equipment and set up; clearly defined information roles and responsibilities; and more. Unfortunately, technologies can get purchased and then given to frontline personnel with little support or realized purpose.

Unlike other technologies, EtaPRO is a singular platform for fleetwide asset performance and reliability monitoring with AI-powered digital twins, advanced pattern recognition, a high-speed historian, and more. In addition, EtaPRO software includes engineering support to help power generation companies utilize plant data rapidly and effectively. From expertise, intuitive user interfaces (UIs), and adoption and training services, **plant personnel can rapidly use the software effectively to gain a more global view of data, alarms, and distinguish noise vs. what's critical**.



For more information on how EtaPRO is helping plants improve reliability and proactive asset management, visit www.etapro.com.

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