Supplemental Project Notice

ONLINE GAS TURBINE ASSESSMENT UTILIZING COMBUSTION DYNAMICS ALGORITHM FOR HEALTH MONITORING

Types of failures detected by health algorithm

PROJECT HIGHLIGHTS

- Online anomaly detection for protection against catastrophic combustion hardware failure
- Self-learning, no need for training data
- Intelligent instrumentation fault detection and avoidance

Key Research Question

This supplemental project is an implementation and utilization step for the EPRI combustion dynamics health algorithm effort. The previous work developed a basis for detecting combustion system changes, including instrumentation issues, tuning needs and hardware failures in dry, low NOx (DLN) gas turbines, based upon analysis of dynamic pressure data. This detection analysis approach is a significant advancement over the traditional threshold detection methodologies currently available with existing combustion dynamics monitoring systems (CDMS). The current health algorithm uses a self-learning method to detect data anomalies and then give overall assessments of engine health: (i) normal operation, (ii) instrumentation issues, (iii) tuning needs, and (iv) possible hardware problems. Note that even with autotuning, this system will be able to outline these health indications—including in cases where the autotuning system has not fully tuned out issues.

Objective

The objectives of this project are intended to provide an online health assessment tool to assist with asset protection, e.g., to investigate any data anomalies and identify potential or emerging problems thus avoid DLN combustion system damage/failure. Damage/failure modes should be detected during early formation stages so that they can be managed rather than forcing out the asset. In turn, during the monitoring implementation portion of the project, the team will work to enhance guidelines to avoid DLN combustion system failures and assist site by refining and implementing a basic user interface screen to assist with simplified response to combustion related anomalies.

Overall, in this field test effort we plan to assess site/utility's current utilization efforts with CDMS data, implement the health algorithm on one (1) unit for baseline effort (work scope dependent), and co-monitor site with a transitional time for utility to become (ideally) sole monitor of combustion dynamics health data. The primary focus will be on can-annular gas turbines with permanent CDMS installations.

Optionally with this supplemental is the offering of a Combustion Dynamics training course that can be performed with or without monitoring. This course can be set up separately from monitoring and will be based individually on scope as well.

Approach

The project team intends to use the dynamic pressure sensors, along with additional operation data, and the combustion dynamics health algorithm to record and analyze operating data over approximately 24 months of service.

Initially, the team will establish the algorithm and data flow for assisted monitoring for 12 months. During this time, adjustments will be considered for the user-interface screen at the site. The second 12 months, the Funder will utilize the interface and suggest alterations and receive assisted analysis when needed. The project team intends to continue to trend data from the on-line integrated monitoring and either lead (first 12 months) or assist (second 12 months) in analyzing the data to investigate any data anomalies and identify potential or emerging problems. In both cases the funder will have access to gas turbine combustion experts to interpret findings. The new learnings of this project will focus on developing/refining the site-centered user interface, with remote capabilities for off-site personnel to access, for quick, responsive interaction with the health algorithm data to assist with instrumentation maintenance, gas turbine tuning necessities, and identifying combustion hardware issues.

Research Value

The EPRI patented algorithm has been successfully demonstrated on multiple OEM E and, primarily, F class units with expandability for G, H, and J class units. This research implementation will give computer-aided assistance to utilize combustion dynamics data for engine health diagnostics.

Deliverables

- Progress updates
- Summary report

The non-proprietary results of this work will be incorporated into EPRI R&D Program 216 & 217, and made available to the public, for purchase or otherwise, through periodic updates of the algorithm as new learnings occur. Information that would identify companies and operating plants will be held as confidential to EPRI and the participating company.

Price of Project

Project costs are based upon 24-month effort for monitoring, with 50% due in year 1, and the remainder due in year 2.

Baseline Costs for One (1) Unit	$95,000/year ($190,000 total)
Optional Combustion Dynamics Training Course	$25,000

Costs are minimum estimates, actual costs may vary.

Project Status and Schedule

The project will begin at contract execution and will include two phases.

Phase 1 (12 months)

Establish the algorithm and data flow for assisted monitoring, with EPRI leading analysis.

Phase 2 (12 months)

User testing of interface, with EPRI supporting funder with monitoring.

Who Should Join

Anyone with can-annular gas turbines utilizing permanently installed CDM systems.

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

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