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Development on The Optimal Operational Power-Plant's Supporting-System

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Abstract

Japanese thermal power plants on heavy-duty have been in highly reliability and availability that are over 90% because of threshold monitoring system. The threshold monitoring system with thousands of PID sensors like pressure, temperature, flow etc. is traditional method to monitor conditions of each plant and alert warnings in case of anomaly condition as the sensor data of equipment over the set value. However, these thresholds are set based on plant design and past results conducted analysis of troubleshooting, that is difficult to set and time-consuming work. In addition, the coverage of the threshold monitoring are not comprehensively but limited.

In this paper, we propose a brand-new early failure detection/analysis system named "TOPS", which stands for "The Optimal operational Power-plant's Supporting-system". TOPS comprehensively monitors operational conditions with which process data and supports plant operators to detect failure of power plants in early stage. TOPS consists of a data storage server, which is connected with LAN among facilities of power plants, and two of core AI engines that are SIAT (System Invariant Analysis Technology) and QCE (Quality Control Engine).

SIAT detects anomalies in early stage as follows: (1) Constructing an invariant model, which extracts relations between every combinations of sensors from thousands of PID sensors under normal plant condition. (2) Estimating the current sensor values from the related sensor data using the constructed invariant model. (3) Finding broken invariants, where residual error exceeds that under normal condition. (4) Monitoring the anomaly score which count a number of broken invariants to detect anomalies in early stage.

QCE produces the most effective sensors in ranking on failure as follows: (1) Extracting various statistical features of time-series data for thousands of PID data. Here, the statistical

features include moving average, standard deviation, power spectrum, and so on in addition to original data. (2) Evaluating the each feature contribution to the important KPI change on failure comprehensively using three different types of rankers, which produce sensor ranking with important feature information to analyze major factors on anomaly extracted by SIAT.

We inspected the validity of SIAT by using the past trouble data of thermal power plants. SIAT could show the failures before no less than 10 hours compared with the alarm of the power plants.

We have applied TOPS to conventional and combined-cycle thermal power plants since last December. Furthermore, TOPS could detect failures in early stage for other types of power plants. (398 Words)