

PAPER • OPEN ACCESS

Research on Intelligent Diagnosis Technology of Emergency Diesel Generator in Nuclear Power Plant Based on New Monitoring Method

To cite this article: Yong Zhou *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **677** 032074

View the [article online](#) for updates and enhancements.

You may also like

- [Health Condition Identification and Quantitative Assessment of Emergency Diesel Generator Sets Based on Back Propagation Neural Network and Mahalanobis Distance](#)
Zhijun Han, Chaozhang Liu, Yonggang Xu et al.
- [The impact decades-long dependence on hydropower in El Niño impact-prone Zambia is having on carbon emissions through backup diesel generation](#)
Imaduddin Ahmed, Priti Parikh, Graham Sianjase et al.
- [Research and Improvement on Characteristics of Emergency Diesel Generating Set Mechanical Support System in Nuclear Power Plant](#)
Yang Zhe



ECS
The
Electrochemical
Society
Advancing solid state &
electrochemical science & technology

DISCOVER
how sustainability
intersects with
electrochemistry & solid
state science research

Research on Intelligent Diagnosis Technology of Emergency Diesel Generator in Nuclear Power Plant Based on New Monitoring Method

Yong Zhou¹, Yongfei Liang¹, Rui Li^{2,*}

¹Daya Bay Nuclear Power Operations and Management Co., Ltd., Shenzhen, China

²China Nuclear Power Technology Research Institute Beijing Division, Beijing, China

*Corresponding author e-mail: li_rui@cgnpc.com.cn

Abstract. As the emergency power source of nuclear power plant, the emergency diesel generator sets need to provide power for the safety system of nuclear power plant after all external power sources of nuclear power plant are lost, to ensure the safe shutdown of nuclear power plant and prevent the leakage of radioactive materials to the environment. In view of the critical role of emergency diesel generator sets in ensuring the safe operation of the power station, high reliability is needed. Therefore, how to accurately monitor the state of diesel engine and how to diagnose the faults has become an urgent problem to be solved. In this paper, status monitoring system for diesel engine is designed and developed based on LabVIEW and new monitoring method to realize real-time and continuous collection during the operation of the diesel engine, intensive collection during the alarm process, and data display and storage. It can provide data support for fault diagnosis. The operation results show that the system has high reliability and meets the requirements of field inspection, regular test and fault analysis.

1. Introduction

As internal power standby emergency of nuclear power plant, emergency diesel generator sets mainly provide emergency power supply for safety equipment to ensure the effective power supply and reduce the probability of core melt [1]. According to the regulation, under accident conditions, diesel generator must achieve the rated speed and rated voltage at the beginning of the received signal for 10 seconds. And it must connect to the load devices according to sequence automatically, so as to ensure the safety of nuclear reactor scram and prevent the important equipment damaged.

In order to ensure the normal operation of the emergency diesel generator sets, the emergency diesel generator sets should be in hot standby state during the operation of the nuclear power plant. In addition, regular monthly tests are required. Due to regular test, most data can't be saved, while a few data is saved by temporarily connected recorders and some data is read by on-site instruments. In order to obtain continuous data and to judge the status of the diesel generator, this paper develops a status monitoring system based on a new monitoring method and LabVIEW [2]. This paper acquires the key parameters by the original sensors and new sensors and analyze aging trend, which is useful for operation, management and maintenance of emergency diesel generator sets.



2. System Function

Through the original sensors, the system can acquire analog signals (including voltage, current, liquid level, speed, power, etc.), digital signals and temperature signals. The vibration signals can be monitored by adding vibration sensors. The system is mainly composed of three parts, which are the status monitoring system (including fault recorder 021CR, liquid level cabinet 003CR, graph recognition system identifying 001PP and 002PP), vibration acquisition systems (300CR and 800CR), and temperature patrol detectors (350ZC and 850ZC). The specific schematic diagram is as follows:

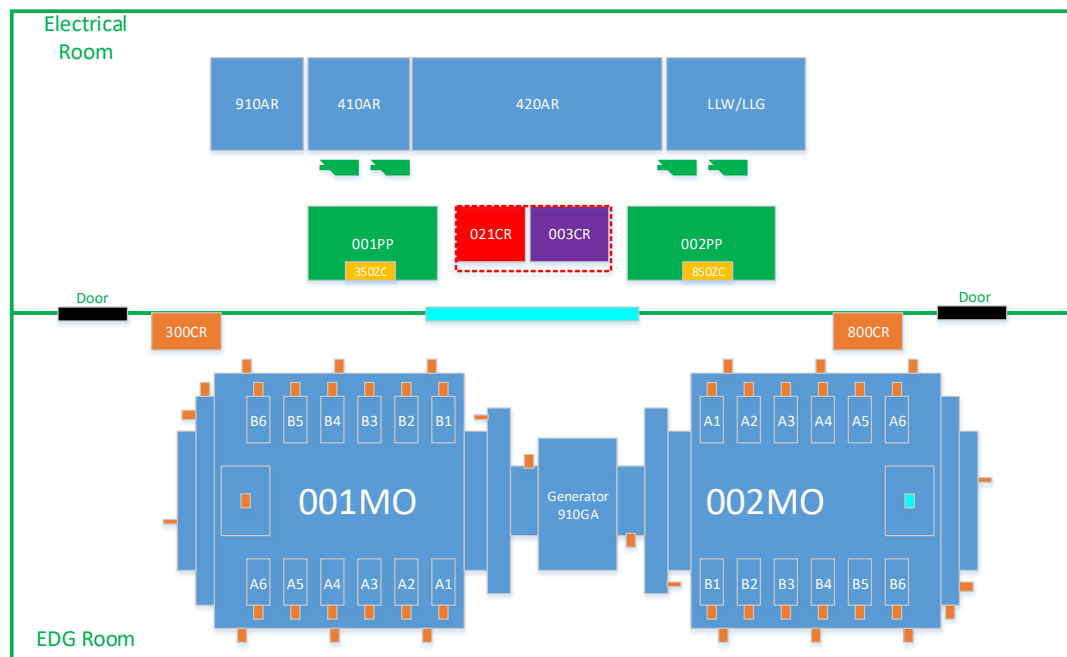


Figure 1. System diagram

Local signals enter the data acquisition equipment through the isolation modules. The data are processed for storage, display and data analysis.

3. Hardware Design

The main equipment is the status monitoring cabinet, which has server, fault recorder, graph recognition equipment, liquid level display instrument, isolation modules, industrial PC, display, switch, UPS and so on. Vibration acquisition cabinets and temperature patrol detectors are transmitted to the status monitoring cabinet through a network cable and then enter the server through the switch. The status monitoring cabinet is designed as a musical instrument platform. The server is used for large-capacity data storage. Monitoring software is run in the industrial PC and the display provides man-machine interface.

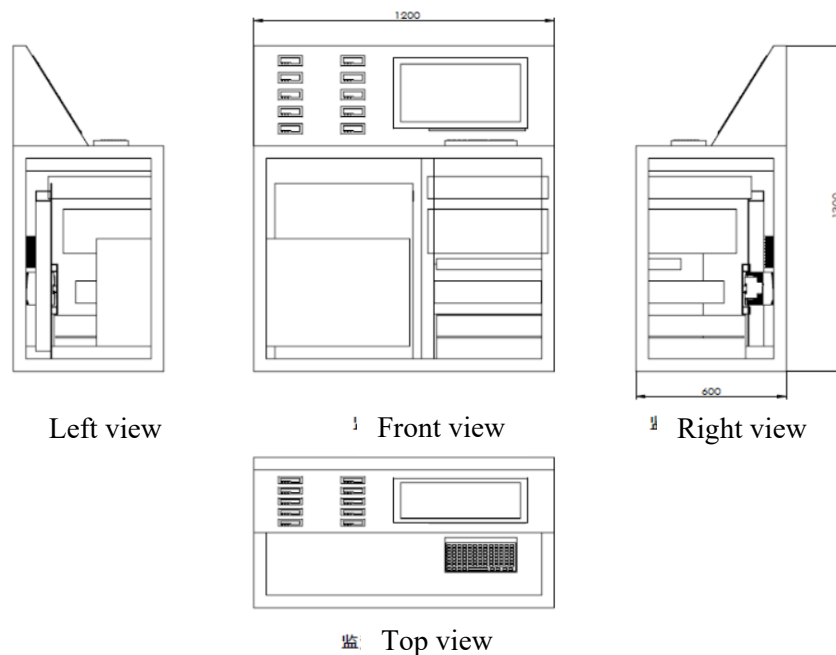


Figure 2. Cabinet diagram

4. Software Design

4.1. Overall Design

Software is mainly divided into data acquisition module, data communication module, data display module, fault analysis and diagnosis module, data storage module. The data from the data acquisition module and the fault analysis and diagnosis module is saved to the database through the data communication module. Users can find the status of the equipment through the data display module.

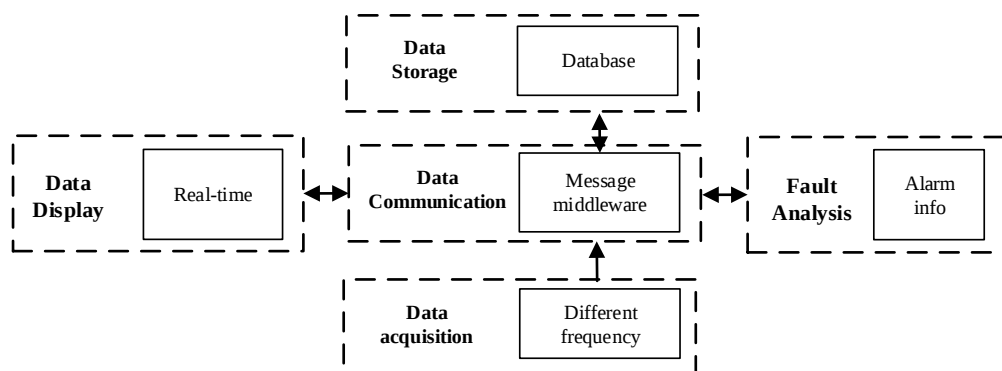


Figure 3. Software system diagram

4.2. Data Acquisition

This module is divided into three stations, which are status monitoring cabinet, vibration signal cabinet and temperature patrol instrument. The status monitoring cabinet is responsible for analog and digital signals, the vibration signal cabinet is responsible for vibration signals, and the temperature patrol instrument is responsible for temperature signals. The frequency supports 1Hz-100kHz.

4.3. Data Communication

This module is responsible for the storage of real-time data and alarm data, as well as the query and transmission of data. It has the functions of high throughput and low delay. It can process hundreds of thousands of messages per second at most, with the delay time not exceeding 100ms.

4.4. Data Display

This module is based on LabVIEW, which can be mainly divided into equipment status display, real-time and alarm display, alarm query, digital change query, curve display, multi-graph comparison and other functions.

4.5. Fault Analysis

The fault analysis module is used for monitoring abnormal data and getting alarm information when abnormal data is found. There are two main abnormal detection methods: fixed threshold detection and dynamic threshold detection.

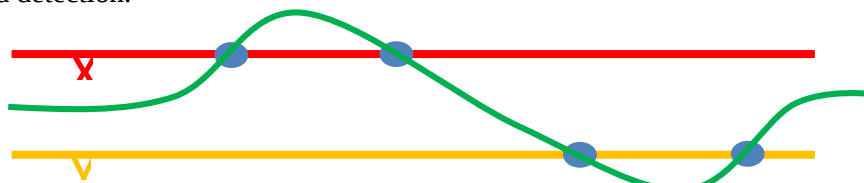


Figure 4. Fixed threshold detection diagram

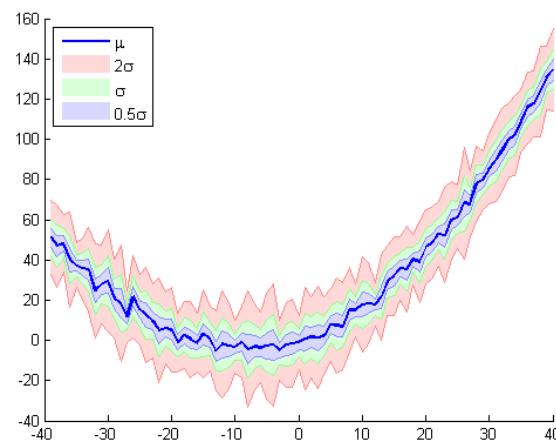


Figure 5. Dynamic threshold detection diagram

4.6. Data Storage

All data is stored in the database after being received by the data communication module. To facilitate data query and display, it is divided into the following parts:

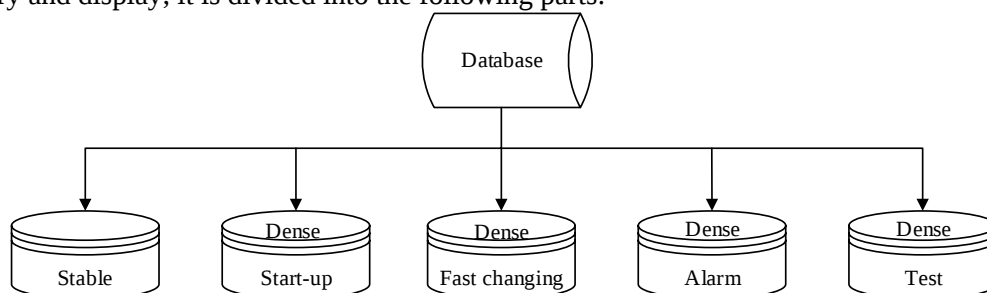


Figure 6. Data storage diagram

The stable operation data is stored in the way of one point per second, and the start-up data, fast changing data, alarm data and test data are stored in accordance with the original sampling rate.

5. Conclusion

The status monitoring system designed in this paper has the characteristics of high measurement accuracy, fast processing speed, large data storage capacity and accurate fault location [3]. It successfully solves the problems of limited monitoring tools, incomplete monitoring data, inability to acquire transient and timing change, single alarm mode and so on. This system has high reliability and is an important tool for field inspection and regular test, and also provides data support for fault diagnosis of emergency diesel generator sets.

References

- [1] L.Q.Zhang. Vibration treatment of emergency diesel engine in Daya bay and Lingao nuclear power plants. Shanghai Jiao Tong University, 2009.
- [2] Y.H.Yu. Research on monitoring and diagnosis of instantaneous rotating speed and thermal parameters of Marine diesel engine. Wuhan University of Technology, 2007.
- [3] H.L.Li.W. On-line monitoring of emergency diesel engine in nuclear power plant by fault recorder. Power automation equipment sensor world, 2001, 21(2), pp50-52.