

The Failure Type Analysis System and Identification Methods for Digital Facilities

Songhae Ye*, Chanho Sung

KHNP CRI, 70, 1312eon-gil, Yuseong-daero, Yuseong-gu, Daejeon, 34101, Korea

*Corresponding author: songhae.ye@khnp.co.kr

1. Introduction

This paper describes the failure type analysis system and identification methods for digital facilities. In more detail, we will introduce the system and methods for analyzing the failure type in digital equipment that can quickly and accurately identify the failure types that have occurred by cataloging the failure type in digital equipment. Recently, nuclear power plants have been expanding their application of digital new technologies for the discontinuation of existing facilities and improvement of facilities. In the case of new nuclear power plants, digital systems are being expanded to the entire instrument and control system. In general, digital systems are difficult to analyze and manage the causes of failure because various phenomena, such as transients, errors, and failures, temporary occurrence and disappearance. The digital failure type analysis system presented in this paper is utilized for maintenance by classifying and managing various digital failure types. In addition, a new digital system failure can be analyzed quickly through comparative analysis.

2. Establishment of Failure Type Analysis System

This section describes the need for development, implementation methods, and analysis methods of failure type analysis systems of digital facilities. Three analysis processes and common digital failure types are presented as digital failure analysis methods in nuclear power plants.

2.1 Necessity of Failure Analysis for Digital Facilities

In general, digital systems are prone to transient, error, etc. failures temporarily occurring and then disappearing. Therefore, it is difficult to analyze the cause of failure and manage the failure history for digital facilities in nuclear power plants. Failure analysis for digital systems means identifying the cause of failure occurrence in order to identify the mechanism in case of failure. In order to analyze the cause of failure, a tool or means is required to classify and systematically manage the same and similar failure phenomena. The purpose of analysis and database of failure types is to detect them early before new failures occur. In the event of a failure, the proper countermeasures shall be taken by expediting judgment according to the location of the failure and the state of the facility. As a result, it is required to analyze failure types and establish systems to ensure reliability of the plant's digital facilities.

2.2 Configuration of Failure Type Analysis System

In the event of a failure of a digital facility, there is a failure information input part that is entered manually or automatically. Failure information includes location information, time information, and status information of the failed equipment. The entering failure type information is classified as the failure type among the multiple types of failure previously classified in the failure type decision part. Classified failure information is sent to the storage area, and if none of the multiple failure types is applicable, the new type failure is delivered to the insertion part to store. The results of the analyzed failure type can be checked through the display. Thus, the failure type analysis system enables the storage of the failure history and the analysis of the failure type and cause of the new failure through the stored failure history. The following figure 1 illustrates the conceptual diagram of the failure type analysis system described above.

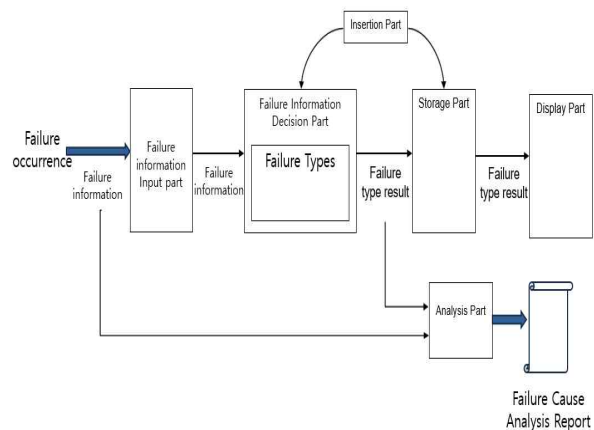


Fig. 1. Conceptual Diagram of Failure Type Analysis System.

In the event of a failure of a digital facility, the type of failure can be determined accurately and swiftly according to the failure criteria classified by multiple types. In addition, the reliability of the digital system can be secured by systematically storing and managing the failure analysis results by database. The classified digital facility failure analysis information is automatically updated in the system and can be used for maintenance. In addition, if a new fault does not correspond to an existing defined fault type, it can be added as a new failure type.

2.3 Failure Analysis Methods

If a digital facility fails, information such as location, time, and state of the facility is entered into the failure type analysis system and the type of failure entered will be determined. Figure 2 shows the process of determining the type of failure in the failure type analysis system and storing and managing the results as a flowchart.

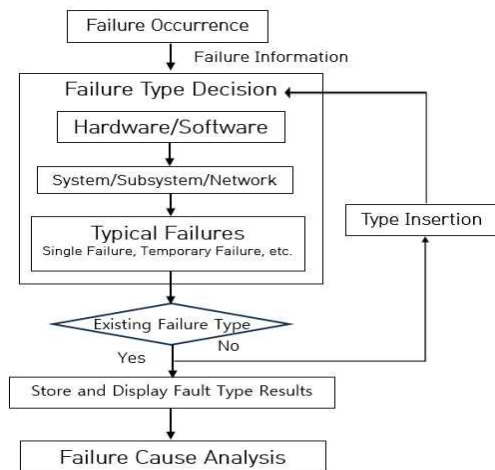


Fig. 2. Digital Failure Cause Analysis Process.

The cause analysis of digital faults will go through three processes. The first step is to identify whether the type of failure is hardware or software. The second step is to classify whether the location of the failure is the system, the auxiliary system, or the communication network part. The final step is to classify the failure according to the type. The types of failures in digital systems can be classified as single failure, transient failure, common cause failure, and potential failure. A single failure affects only one channel in a multi-channel channel. For example, one hardware failure occurred on one channel of a multi-channel. Instantaneous failure means that the failure symptoms are temporarily occurring and then disappearing. Failure effects do not persist but may affect other channels or devices. Common cause failure means failure of at least two devices or systems due to the same cause. Generally, multiple devices or channels should be considered when designing the same device and channel. Common cause failures can be caused by design errors, operation errors, environmental errors, and human errors. Potential common cause failure means a temporary failure that can cause failure of at least two devices or systems by the same cause. Failure effects do not persist but may affect other channels or devices.

3. Conclusions

Domestic nuclear power plants have been expanding their application of digital new technologies for the discontinuation of existing facilities and improvement of facilities. Digital systems are prone to transients and errors, and some failures are temporarily occurring and then disappearing. Therefore, it is difficult to analyze the cause of failure and manage the failure history for digital facilities in nuclear power plants. This paper classifies digital facility failures in nuclear power plants as multiple types, and introduces fault type analysis systems and methods to store and manage failure history including the newly occurring faults. In conclusion, to enhance the reliability of digital facilities in nuclear power plants, failure type analysis and system establishment are required.

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