Development of Integrated Inspection Support System on In-Service Test of NPPs

Sang-Kyu Lee [a*], Chang-Seok Ko [a], Nam-Seok Kim [a], O-Hyun Keum [a], Deok-Yong Song [b], Byung-Sub Han [b]

[a] Korea Institute of Nuclear Safety
[b] Enesys Co. Ltd.
[*]Corresponding author:sklee@kins.re.kr

1. Introduction

All components such as pumps and valves that are necessary for safety operation shall be tested to demonstrate that they will perform required function satisfactorily in service. The testing program based on In-service Test (IST) of nuclear power plant is intended to assess the operational readiness of the components. To assess the operational readiness of safety related components effectively, the integrated inspection support system on IST is developed. This system is designed to manage a performance data of components which are acquired by in-service test. Furthermore, the system provides to carry out not only probabilistic safety assessment (PSA) but also computational fluid dynamics (CFD) analysis. As a preliminary stage, a web-based integrated inspection support system for Young-Gwang NPP 5&6 which is one of KSNP has been developed. For construction of database, all the equipment was reviewed and selected by IST program, and functional structures were generated for designing database architecture. Also, a simplified P&ID was created by evaluating original P&ID and PSA diagrams. All these things were integrated in a web-based GUI system including drawing browser and could be applied to safety analysis of NPPs.

2. Methods and Results

The system framework of integrated inspection support system is illustrated in Fig. 1. There are two sub-systems. One is a web-based management system with a database including simplified P&IDs, equipment information, and its test results. The other one is a safety analysis system to carry out PSA and CFD analysis with database. This paper focused on the web-based management system as a preliminary stage of this project.
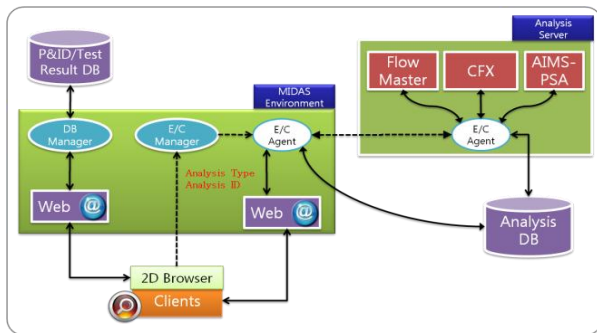
2.1 Database Construction for IST equipment

All the systems and equipment in Young-Gwang NPP 5&6 were reviewed by IST program. 651 valves and 35 pumps were selected and used to construct database. For designing database architecture, a functional structure of equipment was created by analyzing various kinds of test procedures, guidance and results. Fig. 2 shows an example of functional structure for pump.
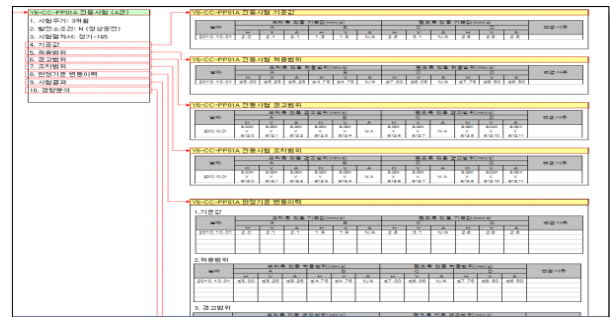

Fig. 2 Functional structure of pump for designing database architecture

2.2 Creation of Simplified P&ID with Browser

A simplified P&ID was created by evaluating original P&ID and PSA diagrams. In the present system, as only focusing on equipment related to IST and PSA, original P&IDs were simplified for improving readability and helping to understand systems. In the purpose of visualization for simplified P&IDs, the drawing browser which can support all vectors and bitmaps with high resolution was also developed. Fig. 3 illustrates a simplified P&ID for the auxiliary feed water system on newly developed drawing browser.
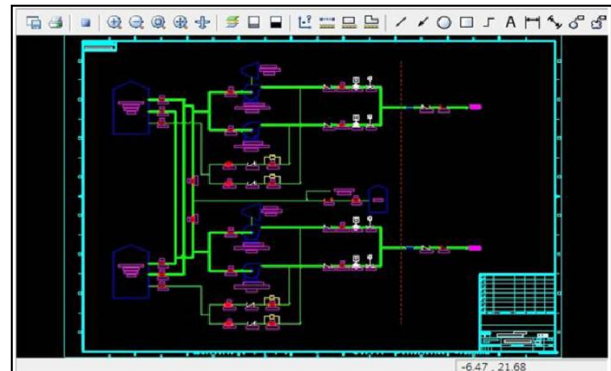

Fig. 1 The system framework of integrated inspection support system

Fig. 3 Simplified P&ID for the auxiliary feed water system on developed drawing browser

2.3 Development of an Integrated GUI System

A graphical user interface (GUI) of inspection support system was developed. The database of simplified P&IDs and equipment information including test results was connected to the integrated GUI System. This system was established on web environment and designed for users to access necessary information in convenient. In this system, users can be searching and analyzing lots of data, such as test results, reference values, permission ranges, etc. It is also possible to investigate a tendency of test results and it is easy to check abnormal condition of systems. The integrated GUI system and an example of trend analysis are shown in Fig. 4 and 5, respectively.
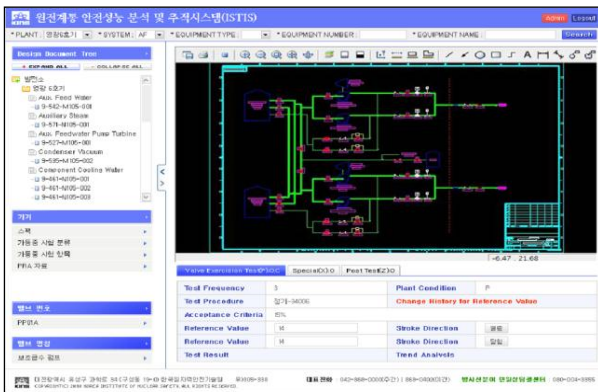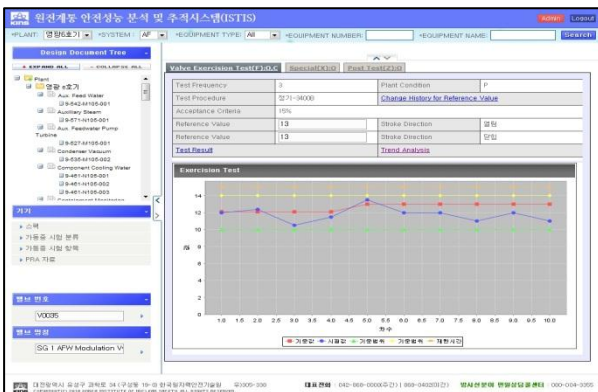

Fig. 4 Integrated GUI of inspection support system

Fig. 5 An example of trend analysis

3. Conclusions

The present paper represents the first stage of developing an integrated inspection support system on in-service test of NPPs. The construction of database with equipment information based on IST program and the design of functional architecture were carried out. A simplified P&IDs with drawing browser were created and implemented to the integrated inspection support system for improving readability and user convenience. By use of this system, it is possible to manage performance data obtained on in-service test, and analyze its tendency. Additionally, as applying a safety analysis using PSA and CFD methods in the second stage of this project, safety improvement of NPPs will be accomplished.

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