

Development of Program Evaluating the Effects on the Secondary Side of Steam Generator due to Foreign Objects

Yoo Hyun Ju, Choi Sung Nam

KEPRI, Nuclear Power Lab., 103-16 munji-Dong, Yuseong-Gu, Daejeon, 305-380, Korea
yoofive@nate.com

1. Introduction

When materials such as metal are into the secondary side of steam generator, they, so called foreign objects, may have influences on the integrity of the steam generator tubes. They cause the tube wear due to the relative motion between the tubes and foreign objects and the tube impact due to flow. The best way to avoid the effects is to remove all the foreign objects. However, it is not easy to remove the foreign materials thoroughly due to their condition such as the location. If the locations of the foreign materials are in the middle of tube bundle and the tube arrangement of the steam generator is the triangle type, the equipment such as FOSAR(Foreign Object Search and Retrieval) can not reach their locations.

If the foreign materials stick together with the tubes or tube sheet, they can not be removed. In the case of operating the steam generator with the foreign materials, the licensee must prove that the materials do not affect the tube integrity and do not threaten the pressure boundary with the analytical method.

Considering the wear and impact by the foreign materials, KEPRI(Korea Electric Power Research Institute) developed the methodology to evaluate the foreign materials analytically. This methodology was described with a computer program in order to obtain the fast results. The program informs whether the tubes have the structural integrity when the foreign material strikes the tubes. Moreover, this gives us the remaining life of the steam generator tubes. In this paper, the program, which evaluates the effects of the foreign objects in the secondary side of steam generator, is introduced.

2. System Description

The general configuration of the system is introduced here. It followed by a more detailed description of the system configuration and main functions.

2.1 General Configuration of System

A program for evaluating the effects of the foreign objects in the secondary side of steam generator is developed according to the phase systematic software lifecycle that process user request analysis and system design, coding the main functions and verification test.

User's requirement and target data for application program were defined and analyzes at the phase of user requirement analysis. The system design phase is processed design of database and user interface, main function etc... Program proving may be verified through the comparison process with program results and hand calculated results.

The software is developed using Java language and Oracle Database. It runs under the Windows XP operation environment.

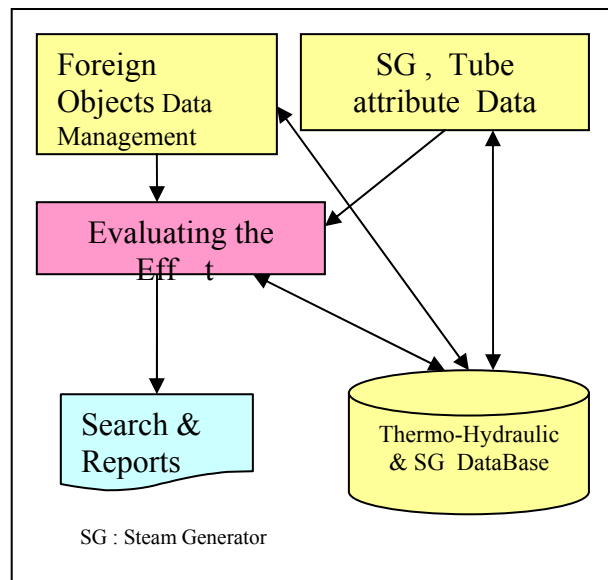


Figure 1. General configuration for the system architecture

We collected and examined various data and analyze user's requirements, and designed the system for each NPP specification.

2.2 Subsystem and main functions

Each subsystem and their main function are following:

- SG, Tube attributes Data Management:
 - Manage each NPP steam generator and tube's attributes.
 - Offer tube's discernment functions which exert the size and effect of found foreign objects.
- Foreign Objects Data Management: foreign objects discernment and attributes management

- Evaluating the Effects: Effect estimated for each tube by foreign objects
- Foreign Objects Data Management:
 - Foreign objects and contact tube discernment.
 - Right angle a contact point of power (FN) calculation .
 - Wear amount per surface (Vw) calculation .
 - Calculation the 40% wear amount(or plugging criteria) and tube life.
 - Maximum wear is calculated to the end of a term when it is more than 40%.
 - Tube's integrity decision.
 - Target foreign objects are assumed a plate or a circular Bar.
- Search and Reports :
 - Search for tube's zone
 - Classification of foreign objects
 - Results report & Print(PDF)

REFERENCES

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Figure 2. Main Window for Program Evaluating the Effects on the Secondary Side of Steam Generator due to Foreign Objects

3. Conclusion

In this paper, the program, which evaluates the effects of the foreign objects in the secondary side of steam generator, is introduced. Tube zone DBs, thermo-hydraulic DBs and vibration DBs for domestic steam generators were developed. Also, tube material wear coefficients at the operating pressure and temperature of steam generator driving temperature are contained in the program. This program was developed for the engineers worked in the site. Therefore, it is very comfortable to use. The results of the program relate to the steam generator integrity assessment.

The improvement of this system will be maintained continuously for extending other useful factor.