Human Factors Engineering Evaluation of the Integrated NIMS Software Display for Hanbit Units 3&4

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1. Introduction

The NIMS (NSSS Integrity Monitoring System) is installed for detecting conditions that indicate the occurrence of abnormal faults in the pressure boundary of reactor coolant system. The NIMS consists of four (4) monitoring systems: LPMS (Loose Part Monitoring System), ALMS (Acoustic Leakage Monitoring System), IVMS (Internal Vibration Monitoring System) and RCPVMS (Reactor Coolant Pump Vibration Monitoring System). The NIMS software should be run in the same type of operating system, so the users should not be difficult in operation. Therefore, the display design of the NIMS software should be applied to human factors engineering. Fig. 1 shows components of the NIMS software display for Hanbit Units 3&4.

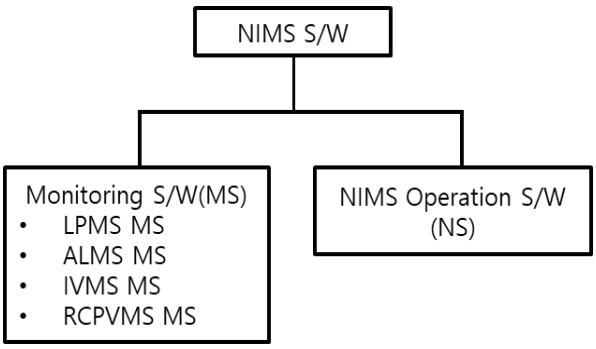

Fig. 1. Components of NIMS Software Display

To enable the operators to use the NIMS software without any human errors, we evaluated human-factors engineering of the integrated NIMS software display for Hanbit Units 3&4.

2. Methods

The availability assessment and suitability assessment of the human factors engineering for Integrated NIMS software display for Hanbit Units 3 & 4 were performed. In each assessment, Human Engineering Discrepancies (HEDs) were derived and improvements for each HED were suggested.

2.1 Availability Assessment

The availability assessment is to ensure that the NIMS software display is available for the operator to successfully accomplish their tasks. In order to assess the availability, the requirements of design document [1] that verified the availability of the NIMS software display were reviewed. The main requirements are to be checked as follows.

- Display the operation status on overview screen
- Display the real-time operation data and stored event data

The checklist for availability assessment for the NIMS software display was composed of 65 items. The NIMS software display designed was evaluated by each item of checklist whether they were properly implemented. As a result of the availability assessment, the HEDs were derived for inappropriate items.

2.2 Suitability Assessment

The suitability assessment is to ensure that the NIMS software display is designed to be convenient for the operator's task performance, reflecting the human engineering design criteria. For this purpose, the following categories applicable to the digital display among the fields shown in NUREG-0700 (Rev.2) [2] were selected for the assessment.

- Display Formats
- Display Elements
- Display Pages
- User Interface

The checklist for suitability assessment was composed of 269 detailed items in 4 categories. The NIMS software display screens designed were evaluated by each item of checklist. As a result of the suitability assessment, the HEDs were derived for inappropriate items.

3. Results

3.1 Results of Availability Assessment

The results of the availability assessment on the integrated NIMS software display for Hanbit Units 3 & 4 are shown in Table 1. 61 items out of 65 items were adequate and 4 HEDs was derived. The contents of HEDs are as follows.

- Absence of display indicating fixed/floating thresholds
- Absence of display a tool for baseline impact test
- Absence of display indicating high/low limit on the test screen
- Absence of display to set the data logging interval

Table 1. Results of Availability Assessment

Display	Number of Items	Appropriate items	Inappropriate items
LPMS	14	12	2
ALMS	30	29	1
IVMS	4	4	0
RCPVMS	13	12	1
NS	4	4	0
Total	65	61	4

3.2 Results of Suitability Assessment

The results of the suitability assessment on the integrated NIMS software display for Hanbit Units 3 & 4 are shown in Table 2. 48 NIMS software display screens were evaluated based on 269 detailed items in the checklist. 14 screens were suitable and 34 screens were needed to be improved. The contents of HEDs are summarized as follows.

- Typo
- Unnecessary abbreviations
- Inconsistent with user convenience
- Absence of units
- Absence of scale marking in the graph
- Absence of labels
- Discrepancy of decimal places

Table 2. Results of Suitability Assessment

Display	Appropriate Screens	Inappropriate Screens
LPMS	2	9
ALMS	2	10
IVMS	2	4
RCPVMS	1	7
NS	7	4
Total	14	34

4. Conclusions

In this study, the human factors engineering evaluation of Integrated NIMS software display for Hanbit Units 3 & 4 was performed in the areas of availability assessment and suitability assessment. Although effectiveness validation is required in the future, any significant problem was not found in the human factors engineering of the NIMS software display, and several items to be corrected were discovered in the assessments. The HEDs derived in each assessment were improved during the evaluation. The Integrated NIMS software display was improved with these results, and thus the requirements of design document have been satisfied. Therefore, it is considered that the Integrated NIMS software display for Hanbit Units 3 & 4 has been appropriately developed for human factors engineering.

REFERENCES

[1] KHNP, Technical Specification of Integrated NIMS Cabinet for HANBIT Units 3 & 4 (Rev.2)
[2] US NRC, NUREG-0700, Rev.2, Human-System Interface Design Review Guidelines, May 2002.