

Development of Automatic Quality Check Software in Mailbox Declaration For Nuclear Fuel Fabrication Plants

Min-Su KIM^{a*}, Hye Won SHIM^a, Seong Yeon Jo^a, Kwang Yeol LEE^b, Myoung Jin BAN^b

^aKorea Institute of Nuclear Nonproliferation and Control, 1534 Yuseong-daero, Yuseong-gu, Daejeon, 305-348

^bNeo Soft Technology, 820 Expotel, 44, Dunsan-daero 117 beon-gil, Seo-gu Daejeon, 302-834

*Corresponding author: kms@kinac.re.kr

1. Introduction

Short Notice Random Inspection (SNRI) at nuclear fuel fabrication facility in Korea has been implemented since 2007. This has been conducted in order to verify a nuclear material flow in and out of a fabrication facility. SNRI is a new IAEA safeguards inspection regime for bulk handling facility, which utilizes random inspection through a mailbox system. Its main objective is to verify 100% of the flow components of the safeguarded nuclear material at such a facility. To achieve the SNRI objective, it is required to provide daily mailbox declaration, by a facility's operator, to the IAEA with regard to information, such as the receipt and shipment of nuclear materials. Mailbox declarations are then later compared with accounting records so as to examine the accuracy and consistency of the facility operator's declaration at the time of the SNRI.

The IAEA has emphasized the importance of accurate mailbox declarations and recommended that the ROK initiate its own independent quality control system in order to improve and maintain its mailbox declarations as a part of the SSAC activities. In an effort to improve the transparency of operational activities at fuel fabrication plants and to satisfy IAEA recommendation, an automatic quality check software application has been developed to improve mailbox declarations at fabrication plants in Korea.

2. Background

Up to now, mailbox data collected from accounting system of nuclear fuel fabrication facility was converted into mailbox declaration format manually by the facility operator and declared to the IAEA. In spite of the fact that there is a high possibility of occurrence of mailbox declaration error due to the large amount of nuclear material flow data and the way how facility operator declares, systematic quality control system of safeguards regulatory authority (SRA) to ensure the quality of facility declaration was absent. So far, mailbox declarations have been transmitted directly to the IAEA without any systematic quality control of the SRA.

Since the cornerstone of the IAEA's SNRI approach is based on a daily declaration of nuclear material inventory changes into the mailbox declaration, the accurate mailbox declarations is highly crucial for SNRI

implementation. Incorrect mailbox declaration may affect the effectiveness and efficiency of verification activities during the SNRI. If unexpected errors of mailbox data are occurred during the SNRI, nuclear material inventory list need for SNRI verification cannot be established properly therefore IAEA inspector's NDA measurement verification activities could be delayed until the errors are corrected. Therefore, efficiency of SNRI activities which is introduced to improve effectiveness and efficiencies of the IAEA inspection at the fuel fabrication plant can be affected negatively by the low quality of mailbox declarations. The facility's operation schedules and material balance evaluation process on that facility may be affected by the quality of mailbox declarations eventually.

The ROK has recognized the importance of high quality of mailbox declarations and began its project to develop automatic quality check software application. Developed software application can check for errors in mailbox declarations made by a facility operator in real time, and then automatically send notification messages to those personnel in charge so as to confirm the results.

3. Overview of Quality Check Software Application

In this section, the automatic quality control software application at nuclear fuel fabrication plants is described.

2.1 Hardware/Software Configuration Requirement

QC software application is developed using C#. It requires hardware such as a desktop PC with the following minimal configuration:

- 1 GHz or faster processor
- 512 MB of RAM
- 2.2GB of available hard disk space

With regard to the operating system and pre-requisite software, QC software application demands:

- Windows 7 SP1, Windows Server 2008 R2 SP1(x64), Windows Server 2008 SP2(x86)
- MS® SQL Server® 2012 Express database Engine
- .NET Framework 4.5

2.2 Main Functions

QC software application has been focused on functionality around the following areas:

- Conversion and generation of database files from the operator's data

Daily mailbox declarations made by the facility operator should be done in a pre-defined text, "comma separated value" (CVS) form, which include various transaction information of nuclear material in order to establish the population of inventory flow items. Each transaction record pertains to one item and describes the item's attributes and history.

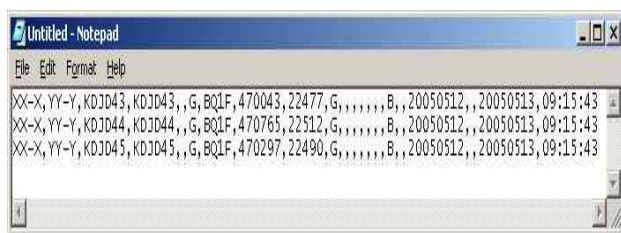


Fig. 1. Example of CVS format mailbox declaration

Once a mailbox declaration (in the form of a CVS text file) is received, it is then converted into a database file (DBF) format and merged with existing DBF creating a new DBF. All of the declared operator's data are accumulated and stored as one DBF. The DBF is a widely used database file format to manage and store structured data.

- Automatic quality check of operator's data when mailbox declaration is received

The DBF file is then processed to insure that an operator's declared data complies with the correct format and value. During the QC process, grammars of transaction code are checked. Nuclear material transaction codes used in mailbox declaration are A, B, D, S and R. Each transaction codes has the following meanings.

- ✓ *A(Arrival) : date of receipt of material*
- ✓ *B(Birth) : product material completed and moved to storage or feed material become available for verification*
- ✓ *D(Death) : feed material is moved into the process or product material is packed for shipment*
- ✓ *S(Shipment) : date of shipment of material*
- ✓ *R(Return) : material returned from storage or process*

Each stratum subject to mailbox declarations has its specific transaction sequence so this sequence is verified during QC process.

All flow material in the bulk handling facility need to remain in-residence for a minimum finite period of time, so that every item experiences a finite risk of being selected for verification. Therefore, residence time of nuclear materials is also checked during QC process.

- Reporting of QC result

If an error is found, it is then listed and reported automatically to the person in charge of mailbox declaration (via e-mail and mobile text messaging) so that appropriate action can take place. For this, business SMS messaging service using application programming interface directly linked to the QC software is applied.

2.4 QC Software Application Operation System

The mailbox declaration is sent to both the IAEA and the SRA by the facility operator as a signed and encrypted attachment to an e-mail. Once the e-mail is detected at the designated SRA's e-mail account, a mailbox QC software application extracts the file. Next, a QC software application automatically checks the quality of operator's mailbox declaration by focusing on the grammar of the nuclear material transaction and residence time. When this process is completed, the QC result is then sent by e-mail to the SRA and the facility operator as confirmation. The processed mailbox declaration is stored in as a DBF, which will later be used to verify the inventory of the nuclear facility and create a verification item list.

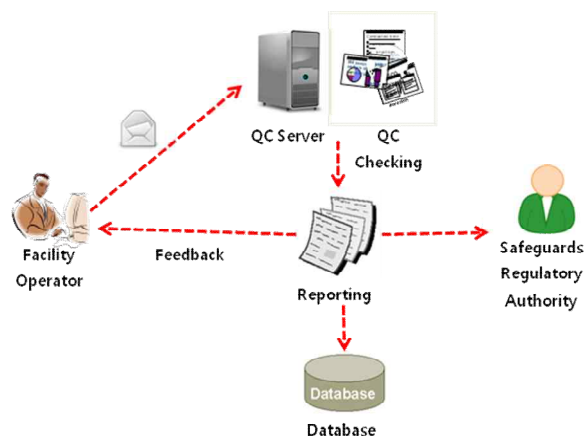


Fig. 2. General description of mailbox declaration quality control system

3. Conclusions

The ROK and the IAEA have recognized the importance of providing good quality mailbox declaration for an effective and efficient SNRI at fuel fabrication plants in Korea. The SRA developed an

automatic quality check software program in order to provide an independent QC system of mailbox declaration, as well as to improve the quality of mailbox declaration.

Once the automatic QC system is implemented, it will improve the quality of an operator's mailbox declaration by examining data before sending it to the IAEA. The QC system will be applied to fuel fabrication plants in the first half of 2014.

REFERENCES

- [1] I. Tsvetkov, et al. Implementation of SNRI at Japanese Low Enriched Uranium (LEU) Facilities – The Experience Gained and an Inspectorate Perspective, IAEA-SM-367/8/05
- [2] SG-SGOA-4144, Implementation Procedure for SNRI under Integrated Safeguards at Korea Nuclear Fuel Fabrication Plant, 2011
- [3] IAEA SGIT, Common Inspection On-site Software Package User Manual, Oct. 2001.