Design of support modules required for the establishment of the radioactive waste certification program

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1. Introduction

For optimized quality management of RAdioactive Waste (RAW), the Nuclear Safety and Security Commission (NSSC) has revised related laws and the Korea Radioactive Waste Agency (KORAD) is reestablishing the acceptance criteria. In addition, the waste generator is required to operate a Waste Certification Program (WCP) for enhanced waste safety management. In order to accept this demand, design requirements were derived through business analysis based on the waste acquisition, delivery procedure and the requirements of experts. Based on the full cycle radioactive waste support process, a characterization support module for waste certification was designed.

2. Methods and Results

2.1. Analysis of requirements for RAW WCP

2.1.1. Domestic radioactive waste delivery and acceptance laws

○ NSSC's Regulations for the Delivery of Low- and Intermediate-Level Radioactive Waste

The legal system and technical standards related to radioactive waste disposal in Korea are based on the NSSC's Nuclear Safety Act (enacted on July 25, 2011) [1] and the Ministry of Trade, Industry and Energy (MTIE)'s Radioactive Waste Management Act [2] of for the promotion of nuclear energy. The Nuclear Safety Act is divided into technical standards for nuclear facilities, etc. and radiation safety management, and the Radioactive Waste Management Act presents technical standards and procedures according to the legal system related to radioactive waste treatment, disposal, and waste delivery and acceptance.

○ Regulations on the acceptance method of the MTIE

The Ministry of Trade, Industry and Energy's Regulations on How to Acquire Radioactive Waste are based on the provisions of Article 13 (2) of the Radioactive Waste Management Act and Article 4 (2) and (6) of the Enforcement Decree of the Radioactive Waste Management Act.

○ Acceptance Criteria of Radioactive Waste Management Agency

According to the Technical Standards for the Operation of the Low- and Intermediate-Level Radioactive Waste Disposal Facilities, the KORAD established the Criteria for the acceptance of a underground disposal facility for Low- and Intermediate-Level Radioactive Waste [3]. Based on this report, a report on Guidelines for Establishing of the Low- and Intermediate-Level Radioactive Waste Certification Program [4] was published.

2.1.2. WCP business analysis of radioactive waste.

The Korea Atomic Energy Research Institute (KAERI) had studied the WCP and had been published detailed characteristics identification procedures and quality verification procedures as official procedures.

○ Preparation for disposal of radioactive waste

In the process of preparing for the disposal of radioactive waste, it is important to establish a quality guarantee and sample collection plan for the waste packaging work and obtain certification. A sample collection plan should be established in advance to investigate the characteristics of the waste drum, and a quality assurance plan and sample collection plan should be established in consultation with the KORAD.

○ Identifying characteristics and preparation of takeover requests

The characteristics of the packaged drum are recorded and managed according to the characteristics of the disposal waste specified in KORAD's "Criteria for the acceptance of a underground disposal facility for Low- and Intermediate-Level Radioactive Waste" [4] in accordance with the delivery and acceptance of the waste.

○ Delivery and acceptance of RAW

The delivery and acceptance of the waste proceed in the following order: filling out an application for acceptance request, a preliminary inspection at the place of origin, loading the waste packaging rate, delivering and receiving, and disposing of unsuitable packaging.

2.2. Radioactive Waste WCP Support Process Design

A process for each radioactive waste characterization requirement was designed. The DFD (Data Flow Diagram) used in the design is a diagram designed by schematically illustrating the procedure of the characterization process, the data transmitted during the process, and the data storage. The figure represented by D represents data store, and the oval represents each procedure. And the transaction between the process and the data store is represented by an arrow, and the data flow is shown on the line. Figure 1 shows the general requirements characterization process designed with DFD.

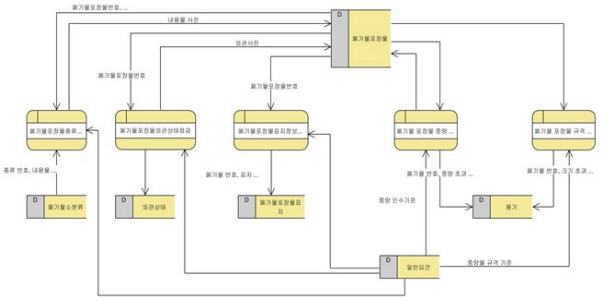

Fig. 1. Characterization process of general requirements

2.3. Characterization support module design for WCP of RAW

The waste property standards dealt with in the waste acceptance criteria were divided into 6 major categories (general requirements, solidification and immobilization requirements, radiological requirements, physical requirements, chemical requirements, and biological requirements), and 18 sub-categories under this major classification. Based on the characterization identification procedure, the characterization support module was designed.

2.3.1. Module for identifying characteristics of general requirements

In the general requirements, acceptance criteria can be divided into waste type, packaging, packaging container, and weight and size of waste packaging. In the radioactive waste management procedure, waste packages are subdivided so that the type, appearance state, label information, weight, and specifications can be checked, and records are managed in the radioactive waste drum generation record book.

2.3.2. Modules for identifying characteristics of solidification/immobilization requirements

The requirements for solidification and immobilization are divided into solidification and immobilization requirements in the acquisition standard, but the KAERI does not include liquid homogeneous waste such as concentrated waste, waste resin, sludge, etc. In addition, the immobilization of nonhomogeneous wastes such as waste filters and Dry Active Waste (DAW) suggests a procedure to check whether they are subject to characteristics because wastes that meet the requirements for immobilization are not generated.

2.3.3. Modules for identifying characteristics of radiological requirements

Radiological requirements in acceptance criteria include nuclides and radioactivity concentrations, disposal concentration limits, surface dose rates, critical safety and surface contamination. In the radiological requirement, radioactive waste samples are collected by reflecting this, and main nuclides and radioactivity concentrations are analyzed and then characterized. Surface dose rate measures the surface dose rate for a total of 12 points left/right/front/rear for the upper/middle/lower part of the package. The surface contamination characteristic test is to measure the surface contamination level by measuring 300 cm^2 or more of the surface of the package using smear paper.

2.3.4. Modules for identifying characteristics of physical requirements

Physical requirements call for particulate matters, fill rate, and free-standing water properties. The filling rate is managed after taking pictures of each stage (25%, 50%, 75%, 100%) during drum packaging. When the packing is completed, it is checked whether the fill rate is satisfied, and in the case of homogeneous waste such as soil, the fill rate of 50% and 100% must be satisfied. When the characterization is completed, confirmation is indicated on the characterization result record sheet.

2.3.5 Modules for identifying characteristics of chemical requirements

Characterization of the chemical requirements, which are hazardous substances in wastes, checks whether disposal-restricted substances (corrosive, explosive, flammable, ignitable substances, gas-generating substances, biohazard substances, etc.) are included in the waste classification. When taking a picture of waste, check it once more and record and manage it in the characterization result record sheet. However, for chelating agents that require specialized analysis, the characteristics of chelating agents, etc., are identified by entrusting them to a specialized chemical department.

2.4. Design of process inquiry screen based on waste acceptance criteria

Based on the important characterization modules described in Section 2.3, it was programmed to search the waste acceptance criteria process. Figure 2 shows the process of inquiring about the general requirements of the waste to be disposed of.

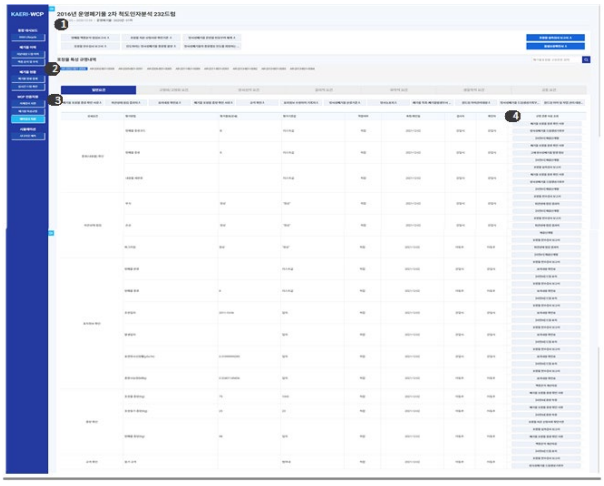

Fig. 2. For general requirements, inquiring screen for a preliminary inspection of the waste

① A list of documents pertaining to the order of delivery is displayed, click to download
② If you click the drum number you want to inquire about, you can view each checklist list.
③ Click 'Tab' of General Requirements
④ A list of relevant documents for each drum-related requirement is displayed, click to download

2.5. Result and Consideration

The dashboard was designed so that the characterization of waste related to the acceptance criteria described in Chapter 2 could be inquired in real-time. Figure 3 shows the drum aggregation status by order of disposal and delivery in charts and data.

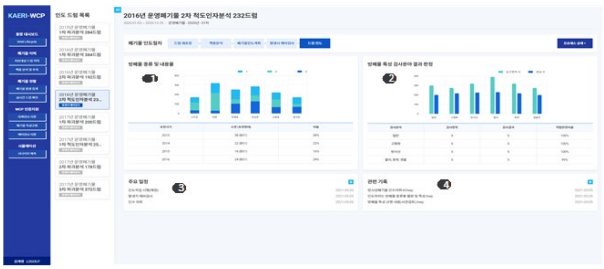

Fig. 3. Inquiry screen for the integrated dashboard
The contents explained in the figure are as follows.

① Inquire about the type of waste and its contents by chart and data aggregation for each disposal delivery order
② Select "Delivery Drum List" on the left to view the results of the characterization of the waste properties of the corresponding drum to be delivered in charts and data aggregation
③ check the main schedule
④ Check related records

3. Conclusions

The requirements for optimized quality control of radioactive waste and the tasks and requirements necessary for reestablishing radioactive waste acceptance criteria were analyzed the module to be able to support characterization for the waste certification program was designed. As a result of the research, an environment was prepared in which the six characterizations could be searched in real-time on the integrated dashboard.

Hereby, the legal regulatory requirements for the waste certification program and the basic requirements for delivering waste managed by the Korea Atomic Energy Research Institute to KORAD were successfully established.

REFERENCES

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