

## Technical Review of Historical Site Assessment Experiences at U.S. Nuclear Power Plants

DongHee Lee \*, Wook Sohn, SukBon Yoon, JeongJu Kim  
Central Research Institute Korea Hydro and Nuclear Power Co. LTD, 1312-70 Yuseon-daero, Yuseong-gu  
Deajeon, 305-380, Korea

\*Corresponding author: donghee.lee@khnp.co.kr

### 1. Introduction

The Kori Unit 1, the first commercial nuclear power plant in Korea, will enter decommissioning about five years after its permanent shutdown which is scheduled this year. In order to start and end the decommissioning, it is essential to understand the radiological status of the Kori Unit 1. For example, the understanding of pre-decommissioning radiological status is needed as inputs to the development of the decommissioning plan, and that of post-decommissioning radiological status is needed for approval for license termination.

Related to decommissioning, the ultimate goal of the understanding of radiological status of a nuclear power plant is to release the plant from the regulatory control (site release) by demonstrating that the levels of residual radioactivity at the site meet the site release criteria. Generally, this demonstration is performed by implementing "Radiation Survey and Site Investigation (RSSI) process" for which four U.S government agencies including the Nuclear Regulatory Committee have developed the guideline MARSSIM [1]. This process uses a graded approach which starts with Historical Site Assessment (HSA) and is later followed by other surveys that lead to the final status survey (FSS).

The HSA, which is an detailed investigation to collect existing information describing a site's complete history in terms of radiological contamination from the start of site activities to the present time, should be performed as early as possible before a permanent shutdown occurs, because the HSA can be performed during operation and subsequent surveys whose planning needs inputs from HSA can be performed earlier. So, this paper aims to perform technical reviews on the HSA experiences at U.S. nuclear power plants, which must be a great contribution to the decommissioning of the Kori Unit 1.

### 2. HSA experiences at U.S. NPPs

Although there are several nuclear power plants with HSA experiences in U.S., cases of only two nuclear power plants (Maine Yankee and Connecticut Yankee) are described below because they represent the most complex situation such that they can cover various situation.

#### 2.1 Maine Yankee Nuclear Power Plant [2,3,4,5]

Maine Yankee, a single unit located in Maine, housed a three-loop PWR reactor rated at 860 MWe. It was first

commercial operated in December 1972 and operated for 25 years, and ended up operating in August 1997. Initial site characterization for decommissioning was begun in the fall of 1997 and ran through the spring of 1998. Historical information, including the 10CFR50.75, employee interviews, radiological incident files, pre-operational survey data, spill reports, special surveys (e.g., site aerial surveys, marine fauna and sediment surveys), operational survey records and annual radiological environmental reports (including sampling of air, groundwater, estuary water, milk, invertebrates, fish and surface vegetation) to the NRC were reviewed and compiled into the HSA. The information collected during all phases of site characterization, including the HSA, was used during decommissioning planning to achieve the following objectives:

- Determination of the radiological status of the site and facility to include identification of systems, structures, soils and water sources in which contamination exists
- Identification of the location and extent of any contamination outside the radiological restricted areas
- Estimate of the source term and radionuclide mixture to support decommissioning cost estimation and decision-making for remediation, dismantlement and radioactive waste disposal activities
- Selection of the instrumentation used for surveys and develop the quality assurance methods applied to sample collection and analysis
- Performance of dose assessment and FSS design
- Ensuring the radiation protection program addresses any unique radiological health and safety issues associated with decommissioning

In order to ensure a complete discovery of events involving spills, leaks or other operational occurrences which might have an effect on the radiological and chemical status of the site, Maine Yankee also interviewed terminating employees for any recollection of such events. During their final exit from the site, security personnel asked if the individual was aware of any radiological or other spills which may have occurred on-site. All plant areas were included in one of the survey groups/packages.

Maine Yankee, which ran for approximately 16 full power years, had an early history of fuel clad failures, which was known as a high source term plant. The auxiliary boilers and auxiliary condensate receiver also showed evidence of minor contamination from heat ex-

changer leakage which occurred early in the plant's operating history. The HSA, as supplemented, is a compilation of the approximately 140 potential events occurring over the 25 year operating history of the plant. About two thirds of these events were potential radiological issues with the other one third being chemical or hazardous material events. Key items identified in the HSA include:

- Location of a silt spreading area/construction debris landfill
- A waste neutralization tank drain line leak
- Contaminated soil on Bailey Point, south of the Industrial Area trailer park, in an area where contaminated soil had been stored
- Discrete particles throughout plant from reactor core barrel machining
- Contaminated soil in the ISFSI area, formerly known as the contractor parking lot
- Contaminated sumps and floor trenches in the Turbine Hall
- Radiological area sink and decontamination shower drains go to sewage treatment plant
- Contaminated sediment in the Forebay
- Snow from radiological area placed in ball field
- Very low levels of detectable residual radioactivity on Foxbird Island, RCA building roof, Equipment Hatch pit, and on the concrete block in the ball field dugouts
- Two large volume spills in the Containment Spray Building

## *2.2 Connecticut Yankee Nuclear Power Plant [2,6,7,8]*

The Connecticut Yankee Atomic Power Company owns Haddam Neck Plant also known as Connecticut Yankee. The Connecticut Yankee, a single unit facility located in Haddam Neck, Connecticut, housed a four-loop PWR rated at 590 MWe. It was first commercial operated in January 1968 and operated for 28 years, and ended up operating in December 1996. Initial characterization began following permanent cessation of operations in fall of 1997 and completed in the fall of 1999. Characterization included an HSA, and included hazardous and state-regulated non-radioactive contaminants. The initial characterization was performed to the guidelines of MARSSIM. The HSA was started in 1998 under the direction of the Haddam Neck Radiation Protection staff. In 1999, this task was transferred to Bechtel Power Corporation as the Decommissioning Operations Contractor (DOC). The HSA was completed in fall of 1999. The HSA consisted of review and compilation of site records including 10CFR50.75g documents, radiological incident files, survey records, and annual environmental reports to the NRC. The objective of document reviews was to identify events that caused the contamination of systems, buildings, external surfaces, sub-surface areas, or waterways, via atmospheric releases, liquid releases, or release of solid radioactive material.

The Haddam Neck records system was the primary source of information for the HSA process. During the preparation of the HSA, numerous individuals from the operating staff; the present staff; as well as vendors and contractors were informally interviewed to verify, provide or clarify data used to develop the HSA document. Additionally, 47 formal interviews, based initially on questionnaires filled out by employees regarding contamination issues, were conducted.

A review of radiological control procedures noted various primary documents which describe the control of radioactive materials and the prevention of its unintended release from the site. As of mid-2000, 364 spill events were documented with 226 events being radiological in nature. The following is a partial listing of historical events that were either know, or had the potential to impact the environment with radioactive contamination.

- Liquid releases typically led to ground contamination within the RCA.
- Failed fuel and primary to secondary leakage in the steam generators.
- Contamination of Soils
- Release of Radioactive Materials

As a result from site characterizations and investigations, approximately 93 acres of the plant site have been initially identified as Non-Impacted as defined in MARSSIM. For those portions of the site that have been identified to be impacted, approximately 50% of the survey areas have been initially identified as Class 1, 30% of the survey areas have been initially identified as Class 2, and 20% of the survey areas have been initially identified as Class 3.

## **3. Conclusions**

Since the Kori Unit 1 would be the first reactor to which HSA applies in Korea, KHNP, the licensee for the Kori Unit 1, should learn HSA-related experiences and lessons learned from the preceding nuclear power plants as much as possible.

The experiences from the two U.S nuclear power plants showed that the necessity for detailed information and amount of effort to conduct an HSA depends on the type of site, associated historical events, regulatory framework, and availability of documented information [9] and that, in addition to collecting information from the existing documents, interviews with appropriate personnel were of a great importance.

These experiences are expected to help not only the licensee to performance of HSA at Kori Unit 1 but also the regulator to review the results.

## **REFERENCES**

- [1] NRC, "Multi Agency Radiation Survey and Site Investigation Manual (MARSSIM) Revision1", NUREG-1575, 2000.
- [2] EPRI, "Capturing Historical Knowledge for Decommissioning of Nuclear Power Plants", 1009410, 2004.
- [3] NRC, "Maine Yankee Historical Site Assessment", ML012830192, 2001.
- [4] NRC, "Maine Yankee Historical Site Assessment Supplement", ML021130343, 2002.
- [5] NRC, "Maine Yankee License Termination Plan Revision 3", ML022970110, 2002.
- [6] NRC, "Haddam Neck License Termination Plan Revision 0", ML003732655, 2000.
- [7] NRC, "Haddam Neck License Termination Plan Revision 1", ML022490386, 2000.
- [8] NRC, "Haddam Neck Historical Site Assessment Supplement", ML012430208, 2001.
- [9] IAEA, "Energy Special-Present State and Future of World Decommissioning", Energy Culture, Vol.229, pp.3-8, 2014.