Optimum Method for Accommodation of Fire-Fighting Water in Control Building of 2^{nd} LILW Disposal Facility

Mu-gap Shin* and Young-hwan Kim
Korea Electric Power Corporation E&C, 269, Hyeoksin-ro, Gimcheon-si, Gyeongsangbuk-do, Republic of Korea
*mgshin@kepco-enc.com

1. Introduction

According to the NFPA801 (Fire Protection for Facilities Handling Radioactive Materials), the drainage of fire-fighting water from the fire suppression system has been considered in the design on the basis of accommodating maximum generation rate. In addition, minimum requirements for design of related equipment (e.q. pit, sump, sump pump) has been also described in the NFPA 801. For this reason, three options on how to accommodate and handle the fire-fighting water caused by fire in the control building of 2^{nd} LILW Disposal Facility have been reviewed.

2. Method for Accommodation of Fire-fighting Water

2.1 Liquid Waste Generated in the Control Building

According to the NFPA 801.5.10.2, the provisions for drainage design involved in handling radioactive materials in an area and associated drainage facilities shall be sized to accommodate the following.

a. The credible volume of discharge by the suppression system operation for 30 minutes where automatic suppression is provided throughout.
b. The volume based on a manual fire-fighting flow rate of 500 gpm for 30 minutes where automatic suppression is not provided.

The required capacity to accommodate drainage of fire-fighting water is 56 ton (500 gpm x 30 min) because there is no automatic suppression facility in the control building.

2.2 Option 1 – Transfer to Infiltration Waste Storage Sump

Option 1 is an active design and illustrated in Fig. 1. The capacity of the Control Building Drain Sump and Infiltration Water Storage Sump is respectively 5 ton and 125 ton. As the Infiltration Water Storage Sump can accommodate maximum generation rate of fire-fighting water, an operator can transfer fire-fighting water to the infiltration water storage sump by the change of flow direction in the discharge using remote control valve when the fire suppression system has been operated. In this case, it is necessary to increase the capacity of the control building drain sump pump, and flame retardant cable for the pumps and valves shall be adapted and guaranteed up to two hours in accordance with the fire retardant requirements. In addition, the operator shall additionally monitor the water level of control building drain sump even when a fire has occurred.

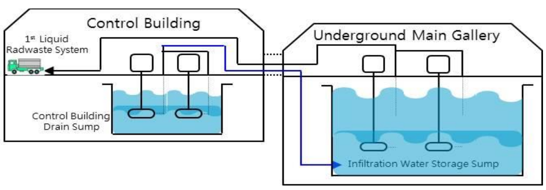

Fig. 1. Active Transfer to the Main Gallery.

2.3 Option 2 – Gravity Drainage to Infiltration Water Storage Sump

Option 2 is a passive design and illustrated in Fig. 2. As the floor elevation of the control building is 0.5 m higher than that of the underground main gallery, fire-fighting water can be drained from the control building to the underground main gallery through embedded piping by gravity at a flooding condition. Because the embedded piping is continuously sloped, the operator does not need to take any action. However, it is expected that the drain effect by gravity is low due to the little floor level difference between control building and underground main gallery considering the length of embedded piping (about 150 m). In addition, the control building, the underground main gallery and the connection tunnel are designed as individual basic structures and connected to the expansion joints between buildings. For this reason, the construction of structure adapting embedded piping is almost impossible because stress concentration is expected to be generated to the embedded piping when the earthquake or the ground subsidence is occurred.

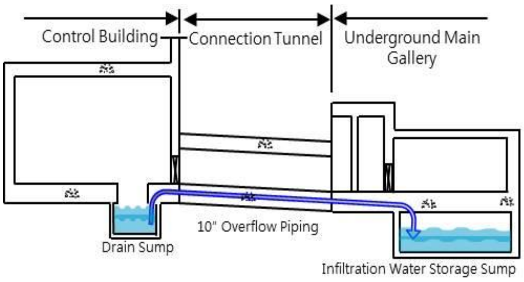

Fig. 2. Passive Transfer to the Main Gallery.

2.4 Option 3 – Accommodation in the Control Building Drain Sump

Option 3 is an accommodation design and illustrated in Fig. 3. To accommodate the maximum generation rate of fire-fighting water within the control building, independent and large sump pit is additionally constructed near the control building drain sump. The capacity of the sump pit is determined about 70 ton, considering the design and engineering margin. The fire-fighting water drained to the sump pit can be pumped using the flexible hose through manhole. As the sump pit is located below the sump pump room and equipment decontamination room, the fire-fighting water can be accommodated within the controlled area of the control building and it prevents the spread of potential radioactive material.

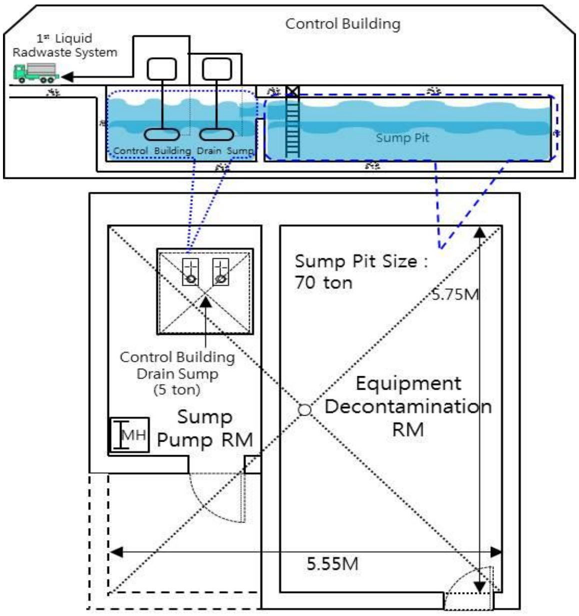

Fig. 3. Accommodation in the Control Building.

3. Conclusion

To meet the requirements of NFPA 801(Standard for Fire Protection for Facilities Handling Radioactive Materials), three options to accommodate of fire-fighting water have been reviewed. The Installation of independent sump pit (Option 3) is the best because construction is relatively easy and there is no possibility of potential radioactive material release to the environment.

REFERENCES

[1] Matterymarch Park, "Standard for Fire Protection For Facilities Handling Radioactive Materials", NFPA 801, Chapter 5 (2014).

[2] H.J. Na, M.G. Shin, Disposal Facility Operating Plan, KEPCO-E&C (2015).