Establishment the code for prediction of waste volume on NPP decommissioning

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1. Introduction

Interest in decommissioning activities in the nuclear industry is increasing these days. In particular, as the commercial nuclear power plants constructed in the early stage are coming to the end of life, studies on the decommissioning strategies are being carried out actively in Korea. Studies on the decommissioning of nuclear power plants are also actively being made in many countries. Especially in the United States and Japan, unique decommissioning strategies for their own situation are made. Estimation of the decommissioning costs and environmental conditions are needed to formulate the decommissioning strategies, and the prediction of the waste volume of decommissioning is necessary for this. However, the exact estimation of the decommissioning waste is very difficult to get by the nuclear power plant data alone. In practice, decommissioning waste volume can be estimated appropriately by finding the differences between prediction and actual operation and considering the operational problem or supplementary matters. So in the nuclear developed countries such as U.S. or Japan, the decommissioning waste volume is predicted on the basis of the experience in their own decommissioning projects. Because of the contamination caused by radioactive material, decontamination activity and management of radio-active waste should be considered in decommissioning of nuclear facility unlike the usual plant or facility. As the decommissioning activity is performed repeatedly, data for similar activities are accumulated, and optimal strategy can be achieved by comparison with the predicted strategy. Therefore, a variety of decommissioning experiences are the most important. In Korea, there is no data on the decommissioning of commercial nuclear power plants yet. However, KAERI has accumulated the basis decommissioning data of nuclear facility through decommissioning of research reactor (KRR-2) and uranium conversion plant (UCP). And DECOMMIS(DECOMMissioning Information Management System) was developed to provide and manage the whole data of decommissioning project. Two codes, FAC code and WBS code, were established in this process. FAC code is the one which is classified by decommissioning target of nuclear facility, and WBS code is classified by each decommissioning activity. The reason why two codes where created is that the codes used in DEFACS (Decommissioning Facility Characterization management System) and DEWOCS (Decommissioning Work-unit productivity Calculation System) are different from each other, and they were classified each purpose. DEFACS which manages the facility needs the code that categorizes facility characteristics, and DEWOCS which calculates unit productivity needs the code that categorizes decommissioning waste volume. KAERI has accumulated decommissioning data of KRR-2 and developed DEMOS(DEcommissioning MOdeling System) and DEPES(DEcommissioning Process Establish System) using these data. These systems may be able to help to establish decommissioning strategy of nuclear power plant. We tried to apply research reactor data to OPR-1000 which is commercial nuclear power plant. But code for research reactor was not consistent when applying to nuclear power plant. The decommissioning activity of nuclear power plant is basically performed by the unit facility or room. In order to apply research reactor data, each WBS code is needed to apply to the object of each facility. This means that one FAC code may have several WBS codes. However, current codes in DECOMMIS are hard to map WBS code to FAC code one by one, and are specialized to research reactor. So it is difficult to apply to nuclear power plant directly. In order to solve this problem, the common code that can be adapted to commercial nuclear power plant as well as to research reactor is required. It may be inferred from the mapping data in the case of mismatching, or it can be applied with some modifications in the case of similar facility. In this paper, the establishment method of the code which uses the research reactor data in decommissioning project of nuclear power plant was studied.

2. Methods and Results

In this section process to make codes are described.

2.1 Find WBS Code

The first necessary task is to find out the WBS codes that match to FAC codes. WBS Code consists of activities, so a variety of activities can be included in decommissioning any facility. For example, Reactor Tank is divided into top, bottom, and floor by the current facility code. However, in decommissioning activity there is no activity as "Dismantling tank", should be composed of WBS code such as 'Carried equipment', 'Ready to work', 'Cutting tank', 'Tank decontamination', 'Cleaning', etc. About other facilities, like the above WBS Code shall consist of a variety of

facilities, including the contents of each are detailed decommissioning activities. In this process, the WBS code may contain the redundant code, and when the code is duplicated it is classified. The reading of WBS code that applies to FAC code is based on the daily report which was made during the decommissioning project. This process is the most important because one FAC code may include several WBS codes and one WBS code consists of many daily report. A daily report consists of work content, used equipment, labor type, working time, etc. In some cases, WBS Code contains lots of daily report so that may spend long time for classification and collecting. Especially, classification is the most important because it should be checked one by one (one WBS code can contain several facility information).

2.2 Make Common Code

The second activity is to make common code. Common code can be made by nuclear facility(reactor vessel, steam generator, etc), equipment which are commonly used in nuclear power plant, nuclear lab, general industrial facilities(cooler, air conditioning machine, etc). For example, steam generator can be coded 'STM', air conditioning machine can be coded 'ACM' regardless of the location or type. Current data stored in DECOMMIS is specialized to research reactor, so the work to make it in common is needed. Now, we have facility data of commercial nuclear power plant 'OPR-1000' and finished encoding. So we made common code to compare OPR-1000's facility code with KRR-2's facility code. Common code basically contains machinery, piping, crane and truck and nuclear facility, and some items for which decommissioning environment vastly vary were classified with material. The number of codes created like this are 235, and these are still being modified in consultation with experts. Fig. 1. Shows sorted code of OPR-1000.

	A	B	C	D	E
1	코드	설명	가중치	코드별 합산무게(kg)	코드별 합산무게(t)
2	ABC	알파베타카운터(Alpa, Beta Cpounter)	0.30	1417.50336	1.418
3	ABSF	배관(알로이) 대구경		534.2202369	0.534
4	ACM	공조기(Air Conditioner)	1.00	1023066.368	1023.066
5	ADR	ADR Sys'	0.3	4282.2	4.282
6	ASE	보조설비계통 장비(Auxiliary System Equipment)	0.5	2756.770065	2.757
7	BAC	붕산농축기(Boric Acid Concentrator)	0.50	272253.4023	272.253
8	BC	Bench	0.10	481.76064	0.482
9	BOC	경계석(Boundary Concrete)	1.00	3815.5872	3.816
10	BT	배터리(Battery)	1	86719.67547	86.720
11	CAP	약품첨가설비(Chemical Addition Package)	0.7	171.2685556	0.171
12	CAS	케이싱(Casing)	0.10	28976.04	28.976
13	CBC	제어반점검판(Control Board Checker)	1.00	1104.30233	1.104
14	CBN	전열장(Cabinet)	1.00	4028.392424	4.028
15	CBS	배관(카본) 대구경		1438.243757	1.438
16	CCTVC	CCTV 제어기(Controller)	0.3	10339.56085	10.340
17	CDC	컴퓨터시스템(CDC, RMS) 콘솔	0.3	6002.60298	6.003
18	CDSM	Cement Drumming Station Mixer	0.50	1700.12856	1.700
19	CEA	제어봉집합체(Core Element Assembly)	0.90	364.6129457	0.365
20	CEACP	제어봉집합체 교체단(CEA Change Platform)	0.70	7102.3974	7.102
21	CEDM	제어봉구동장치(Control Element Drive Mechanism)	0.7	9399.344967	9.399
22	CEDMC	제어봉구동장치 냉각장치(CEDM Cooling System)	0.30	6078.761325	6.079
23	CL-C	큐비클 냉각기(Cubicle Cooler)	0.30	163576.3956	163.576
24	CL-CSS	Condenser Subcooler	0.30	18151.49879	18.151
25	CL-EC	여자기 냉각기(Exciter Cooler)	0.50	6488.496	6.488
26	CL-GH	발전기수소냉각기(Generator Hydrogen Cooler)	0.30	48.2810588	0.048
27	CPCBV	복수폴리싱 용이존 베드 배설(Condensate Polishing	1.00	353673.9	353.674
28	CPS-FWP	공기압축기(Compressor)	0.30	50.5467678	0.051
29	CPT	건조폐기물압축기(Dry Waste Compactor)	0.30	6544.88484	6.545
30	CR	기중기(Crane)	1.00	6213855.112	6213.855
31	CS	노심슈라우드(Core Shroud)	0.70	30119.53291	30.120
32	CSB	노심지지배럴(Core Support Barrel)	1.00	34705.98467	34.706
33	CSP	노심정지 플러그(Core Stop Plug)	1.00	4.95335	0.005
34	CSPT	천선관 지지대		521.3	0.521
35	CSS	배관(카본) 소구경		132.7557254	0.133
36	CT	계수기(Counter)	0.30	3365.987625	3.366
37	CT-WB	전신오염감시기(Whole Body Counter)	0.30	25101.3048	25.101
38	DAT	탈기기(Deaerator)	0.30	149094.8993	149.095
39	DC	Drum Conveyor	0.50	2390.102	2.390
40	DCMC	DC 전동제어기(DC Motor Controller)	0.30	17611.33763	17.611
41	DCMCC	디스플레이제어모듈(Displays Controls Module,DCM) 콘솔	0.3	3908.384376	3.908

Fig. 1. Common codes of OPR-1000

2.3 Apply common code to OPR-1000

Finally, the necessary data to dismantle each facility are extracted by applying the common code to OPR-1000. The information necessary for dismantle the facility, such as man power, equipment, time, waste volume, radiation treatment can be obtained. At present, applying the data of research reactor nuclear power plant is under progress, and each code from various methods are under study to improve the reliability. When this study is completed, it will be a lot helpful to the establishment of a decommissioning strategy. Fig.2. Shows Fac Codes that including several WBS Code.

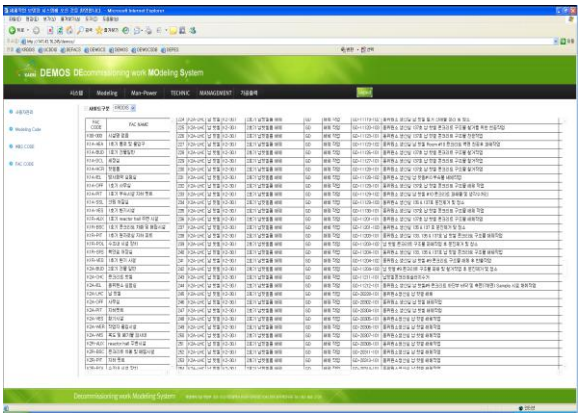

Fig. 2. Fac Code that including several WBS Codes using DEMOS

3. Conclusions

Method for prediction of the decommissioning waste volume was discussed on the basis of the domestic nuclear power plant, OPR-1000. Decommissioning experience is very important to apply to the estimation of decommissioning waste volume. So method for the estimation of decommissioning waste volume using common code that link OPR-1000 and KRR-2 was suggested. This research result will be helpful to reliable estimation of decommissioning waste volume and further estimation of the decommissioning cost and establishment of decommissioning strategies.

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