

Experience Review on Recycling of Cable generated Decommissioning of NPPs

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1. Introduction

The permanent shutdown and decommissioning of NPPs (nuclear power plants) has been growing steadily in the world. The number of permanent shutdown NPPs is totally 189 and decommissioned NPPs are 21 in the world. In Korea, Kori-1 and Wolsong-1 have permanent shutdown and 10 NPPs will come to an end of lifetime as a 40 years until 2029 based on NPPs lifetime.

Therefore, Korea government, research institute, university and industry have conducted development of various technology and legal related decommissioning. But, Korea has only experience of decommissioning for experimental reactor (TRIGA MARK-3). Therefore, in order to decommissioning of NPPs in Korea, review of various technologies is necessary for decommissioning of NPPs in the world.

Especially, among various issues during decommissioning of NPP, most important issue is decommissioning waste. According to literature of previous decommissioned NPPs, period and cost for decommissioning of NPPs are impacted by decommissioning waste. In the world, various technologies of recycling for metal generated decommissioning of NPPs have been conducted. But technologies of recycling for cable generated NPPs are still inadequate.

In this study, it was investigated that classification of cable using NPPs and applied technologies of cable for decommissioning of NPPs.

2. Technology of Recycling for NPP Cable

2.1 Design of cable

NPP cable is an assembly of one or more conductors running side by side or bundled. Main components consist of copper conductor to carry power or control signals and insulating cover to isolate the conductor.

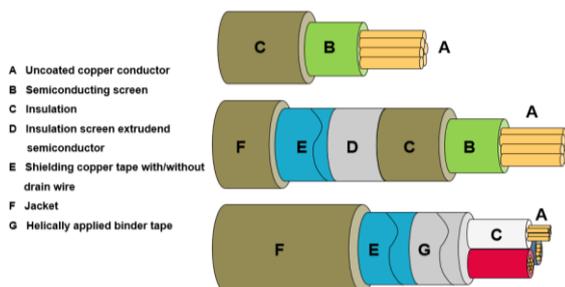


Fig. 1. Configurations of cable designs used in NPPs

Other components typically consist of semiconductor screen, binder tape and jacket. Mechanical protection mainly be conducted by jacket while insulation provides electrical insulation.



Fig. 2. Cross section of cable and structure of cable [1]

2.2 Layout and volume of cable

Layout of cable for NPP is not designed to inspection of cable lengths. Cable trays and conduits are designed to protect cable from environmental effect and impacts from workers and equipment that may move inside building at NPPs.

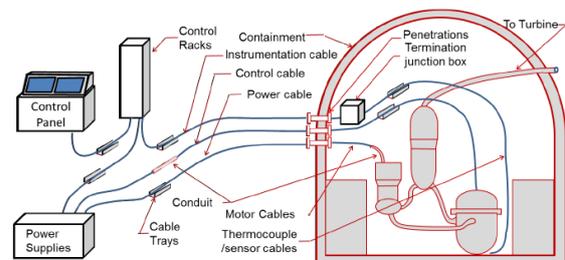


Fig. 3. Typical layout of cable system [2]

Typically, the end of cable can be accessed at termination box and control panel, but many cables do not necessarily follow the human access paths. Therefore, it is difficult to determine the exact length of cable before decommissioning of NPPs.



Fig. 4. NPP cable and cable tray [2]

Cable generated decommissioning are mostly CW (Clean Waste), but some of the waste is radioactive waste. Cables classified as radioactive waste are mostly contaminated with only surface of jacket. It is mainly classified as LLW (Low Level Waste) due to the radiation of dust attached to the surface of jacket as the main cause of contamination.

According to data from the CEA (Commissariat à l'énergie atomique et aux énergies alternatives), it is known that cables generated decommissioning account for about 10% of total volume of VLLW (Very Low Level Waste) of NPPs.

Also, according to recent literature on decommissioning of Kori-1 in Korea, the expected volume of cable and expected volume of cable using reduction during decommissioning of Kori-1 are as shown in the table 1 [3].

Table I: Expected waste of cable generated during decommissioning of Kori-1

Waste classification	Waste types	Expected volume (ft ³)	Expected volume using reduction (ft ³)
CW	Cable, concrete, metal, etc.	139,526	147,687
ILW	Cable	763	1
LLW	Cable	2,931	4

Cable generated during decommissioning of NPPs are composed of compactible waste (insulation) and non-compactible waste (copper), it is possible to minimize the amount of radioactive waste through decontamination.

In the case of cables generated decommissioning of NPPs, the copper is reused and recycled by removal of sheath, and sheath including insulation and jacket is disposed of according to waste classification.

2.3 Experience of recycling for cable

Most of the cable recycling system have been separate cable insulation from internal copper wires using mechanical process in shredding facilities.

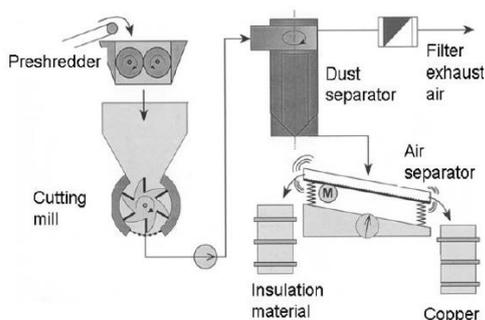


Fig. 5. Process of cable insulation separation system [4]

According to DOE report, NUKEM copper cable recycling system consists of shredding, grinding, separating and filtering.



Fig. 6. Copper cable recycling system (NUKEM) [5]

The recycling of contaminated cable was conducted with two types of cables in the area of non-radiation. And this process was produced with three kinds of final products.

Table II: Contamination on the cables

	Loose contamination	Fixed contamination
Material	Phosphorescent powder	Cesium nitrate
Method	Dust onto the surface of the cable	Apply latex paint after use pressurized sprayer



Fig. 7. Final product using recycling cable system (dust, insulation and copper) [5]

3. Conclusions

Review on the experience of recycling cable show that waste of cable generated during decommissioning of NPPs are expected to have large effect of reduction. But, many studies are needed because there is a lack of recycling of cable generated during decommissioning of NPPs.

In particular, the removal of insulation from internal copper is actively studied, but there is a lack of research on pre-treatment and radiation detection.

In order to a successful decommissioning of NPPs in Korea, pre-treatment before recycling cable system and radiation detection before and after recycling cable system research are needed.

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