Comparison of DCF values between ICRP 30 and ICRP 60 using RESRAD-RECYCLE

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1. Introduction

RESRAD-RECYCLE was developed by Argonne National Laboratory (ANL) to assess the radiological does for workers and the public, resulting from exposure to radionuclides. This program can assess the radiological doses resulting from the recycle of contaminated material or the reuse of contaminated equipment. RESRAD-RECYCLE includes 20 workers scenarios and 11 consumer products scenarios.

The Dose Conversion Factor (DCF) which is basically used for dose assessment is revising as time passes. RESRAD-RECYCLE applies the ICRP (International Commission on Radiological Protection) 30 value as default. But this value was outdated which was made in 1979. While time is passing by, ICRP made No. 60 recommendations in 1990 expanding the range of exposure control.

With the development of knowledge related to the interaction of radiation and the human body, methods of evaluating radiation effects have also been continued improvement by the ICRP.

In 1990, the ICRP issued ICRP 60 as a new recommendation on radiation dose standards and methods.

Korea Nuclear Safety Law is based on ICRP No. 60. So, DCF should be changed as well as the age group correction.

This paper analyzes the dose difference according to the change of DCF and the degree of the influence.

2. Methods and Results

2.1 RESRAD-RECYCLE Code

RESRAD-RECYCLE is a pathway assessment designed to calculate radiation doses and risks from the recycling of radioactive metal and surface contaminated material. This program is divided in to six steps: scrap delivery, scrap smelting, ingot delivery, product fabrication, product distribution, use of the finished products. RESRAD-RECYCLE includes a total of 41 exposure routes and 54 radionuclides pertinent to the recycling process for dose and risk assessment.

In this paper, we considered 21 worker scenarios excluding for the public because the receptor is worker for the restricted recycling.

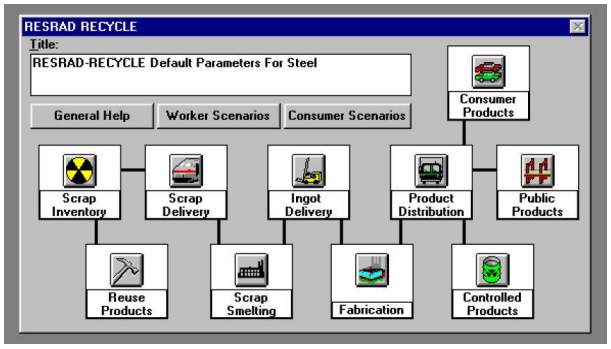

Fig. 1. Scope of RESRAD-RECYCLE

2.2 DCF Comparison with ICRP 30 and ICRP 60

The two internal radiation pathway (inhalation, ingestion) about ICRP 30 and 60 are shown in Table I. Generally, the inhalation and ingestion dose was lower in ICRP 60.

Table I: DCF of ICRP 30 and ICRP 60 (Sv/Bq)

Radio nuclides	ICRP 30 DCF		ICRP 60 DCF	
	Ingestion	Inhalation	Ingestion	Inhalation
Co-60	7.28E-09	5.91E-08	3.40E-09	7.10E-09
Cs-137	1.35E-08	8.63E-09	1.30E-08	6.70E-09
Sr-90	4.13E-08	3.54E-07	2.80E-08	3.00E-08

2.3 RESRAD-RECYCLE Parameters

Three representative radionuclides (Co-60, Cs-137, Sr-90) were selected and assessed for individual, collective and cumulative doses. The representative radionuclide (Co-60, Cs-137, Sr-90) concentration were conservatively assumed as 1Bq/g based on the exemption regulation of IAEA Safety Series 111-P-1.1 [3], estimated doses for the recycling of 100 tons of radioactive material were calculated. The results for the 21 scenarios are shown in Table II and Fig.2.

2.4 Calculation Results

The results of calculation using ICRP 60 DCF and ICRP 30 DCF are summarized in Table II.

Table II: Scenario Ranking Depending on DCF of ICRP 60 and 30 (μSv/yr)

Scenario	Individual		Collective		Cumulative	
	ICRP 60	ICRP 30	ICRP 60	ICRP 30	ICRP 60	ICRP 30
Scrap Cutter	3.85E-02	4.01E-02	1.15E-07	1.20E-07	1.15E-07	1.20E-07
Scrap Loader	5.17E-02	5.22E-02	1.03E-07	1.04E-07	1.03E-07	1.04E-07
Scrap Truck Driver	4.45E-02	4.45E-02	2.23E-07	2.23E-07	2.23E-07	2.23E-07
Scrap Processor	3.90E-02	4.04E-02	1.17E-07	1.21E-07	1.17E-07	1.21E-07
Smelter Yard Worker	3.46E-01	3.55E-01	3.46E-06	3.55E-06	3.46E-06	3.55E-06
Smelter Loader	9.83E-02	1.00E-01	4.91E-07	5.02E-07	4.91E-07	5.02E-07
Furnance Operator	2.64E-01	2.67E-01	7.93E-07	8.01E-07	7.93E-07	8.01E-07
Baghouse Processor	1.91E-01	1.91E-01	1.91E-07	1.91E-07	1.91E-07	1.91E-07
Refinery Worker	2.43E-01	2.45E-01	7.28E-07	7.36E-07	7.28E-07	7.36E-07
Ingot Caster	9.75E-02	9.76E-02	1.95E-07	1.95E-07	1.95E-07	1.95E-07
Small Objects Caster	4.50E+00	4.50E+00	8.99E-06	8.99E-06	8.99E-06	8.99E-06
Slag Worker	2.25E-01	2.59E-01	2.25E-07	2.59E-07	2.25E-07	2.59E-07
Ingot Loader	5.26E-02	5.26E-02	1.05E-07	1.05E-07	1.05E-07	1.05E-07
Ingot Truck Driver	1.16E-01	1.16E-01	5.82E-07	5.82E-07	5.82E-07	5.82E-07
Storage Yard Worker	1.91E-01	1.91E-01	1.91E-06	1.91E-06	1.91E-06	1.91E-06
Sheet Maker	6.65E-03	6.68E-03	9.98E-08	1.00E-07	9.98E-08	1.00E-07
Coil Maker	3.27E-02	3.27E-02	3.27E-08	3.27E-08	3.27E-08	3.27E-08
Sheet Handler	6.63E-03	6.63E-03	1.33E-07	1.33E-07	1.33E-07	1.33E-07
Coil Handler	2.61E+00	2.61E+00	1.31E-05	1.31E-05	1.31E-05	1.31E-05
Product Loader	5.26E-01	5.26E-01	1.05E-06	1.05E-06	1.05E-06	1.05E-06
Product Truck Driver	1.86E-01	1.86E-01	9.32E-07	9.32E-07	9.32E-07	9.32E-07

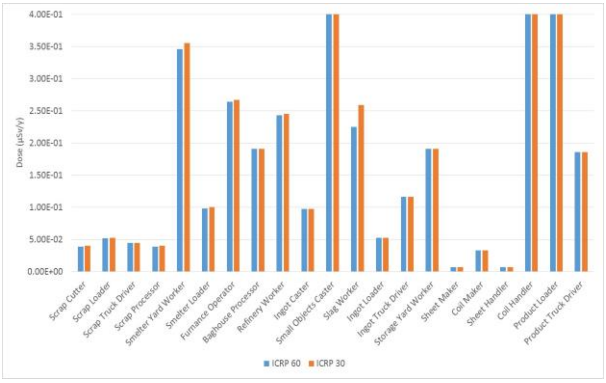

Fig. 2. Individual Effective Dose Equivalent of ICRP 60 and 30 (μSv/yr)

9 scenarios among the 21 scenarios, ICRP 30 and 60 results in the same value. The Small Objects Caster scenario has the largest value of 4.50E+00μSv/yr and the Sheet Handler scenario has the smallest value of 6.63E-03μSv/yr. The largest difference between the ICRP 30 and 60 scenario shows the Slag Worker scenario. In this scenario, the difference in value between ICRP 30 and 60 is 3.40E-02μSv/yr. Additionally, relative ratio in case of applying ICRP 60 compared to ICRP 30 are shown in Fig.3.

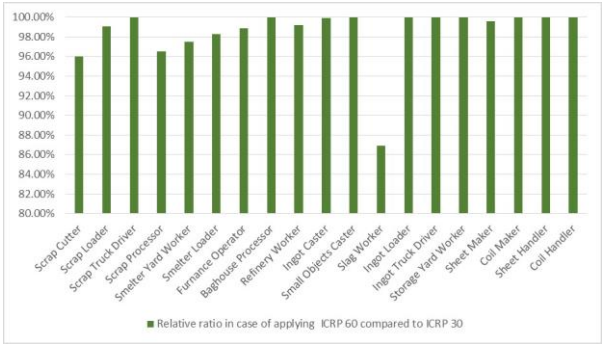

Fig. 3. Relative Ratio in Case of Applying ICRP 60 Compared to ICRP 30

The Slag Worker scenario shows the biggest difference of 86.87% compared to ICRP 30.

3. Conclusions

This paper compared internal radiation pathway (inhalation and ingestion) difference between ICRP 60 and ICRP 30 which is the default value of RESRAD-RECYCLE. In 11 scenarios among the 21 scenarios, the results were the same; the largest value of 4.50E+00μSv/yr was from the Small Object Caster scenario. The biggest difference between ICRP 30 and 60 was from the Slag Worker scenario, with reduction of 3.40E-02μSv/yr.

Of course, the difference between the values of ICRP 30 and ICRP 60 is insignificant. But the value after the revision were lowered.

4. Acknowledgement

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