

Self-disposition of styrofoam by using ISOCS.

2013. 08

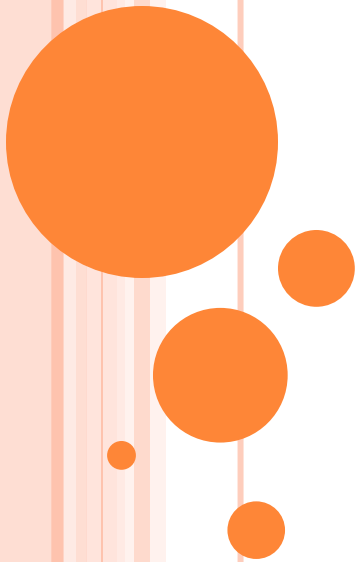
Korea Hydro & Nuclear Power Company
Seulki Kim

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Summary

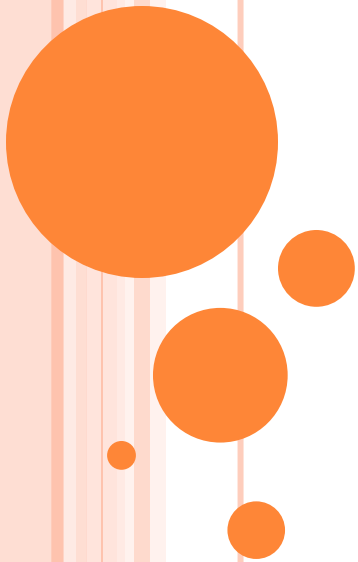


01 Summary

- New fuel box cushioning waste (styrofoam, 480m³) has been stored in the storage for absence of self-disposition method since 1998.
- No recycle and lack of storage space



Problem& Solution



02 Problem & Solution

- They were not contaminated, but it was very difficult to prove that they satisfied the self-disposition requirements.
- Representative sample : 1kg(1L) per 200kg(200L)
→ Regulatory agency's guideline
- Styrofoam 480m³ → It is necessary to analyze representative sample of 2,400.



02 Problem & Solution

○ Regulation guideline

Radioactive Nuclide	Radioactive Concentration* (Bq/g)	MDA (Bq/g)**
Co-60	0.1	0.01
Cs-137	0.1	0.01
U-235***	1	0.1

* IAEA Safety Series RS-G-1.7 Table 2

** MDA : Minimum detectable activity

*** U-235 : Natural radioactive nuclide



02 Problem & Solution

- Styrofoam : Low density material
→ It is difficult to meet the MDA guideline
- Actual analysing data

	Co-60 MDA(Bq/g)	Cs-137 MDA(Bq/g)
Sample 1L(13g)	1.06E-01	1.51E-01

- To satisfy the MDA guideline, we had to analyze more than 100,000 seconds for one sample.



02 Problem & Solution

- In common sampling method for gamma analysis,
 - $2,400 \text{ samples} \times 100,000 \text{ seconds} = 2,778 \text{ days}$
 $= 7.6 \text{ years}$

In order to reduce total counting time,
**we introduced the
ISOCS.**



02 Problem & Solution

- ISOCS : In-Situ Object Counting System
 - Portable HPGe Gamma Spectrometer
 - Ge detector, Collimators, portable MCA, laptop PC
 - Various sized and shaped objects
 - Regardless of place



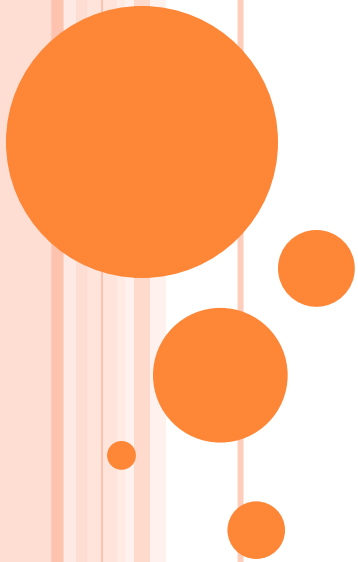
02 Problem & Solution

○ ISOCS specification

- Manufacturing company : Canberra
- Detector model : BE5030
- Material : P-type HPGe
- Useful energy range : 3keV ~ 3MeV
- Relative efficiency $\geq 50\%$
- Resolution $\leq 0.75\text{keV}@122\text{keV}$, $2.2\text{keV}@1.33\text{MeV}$

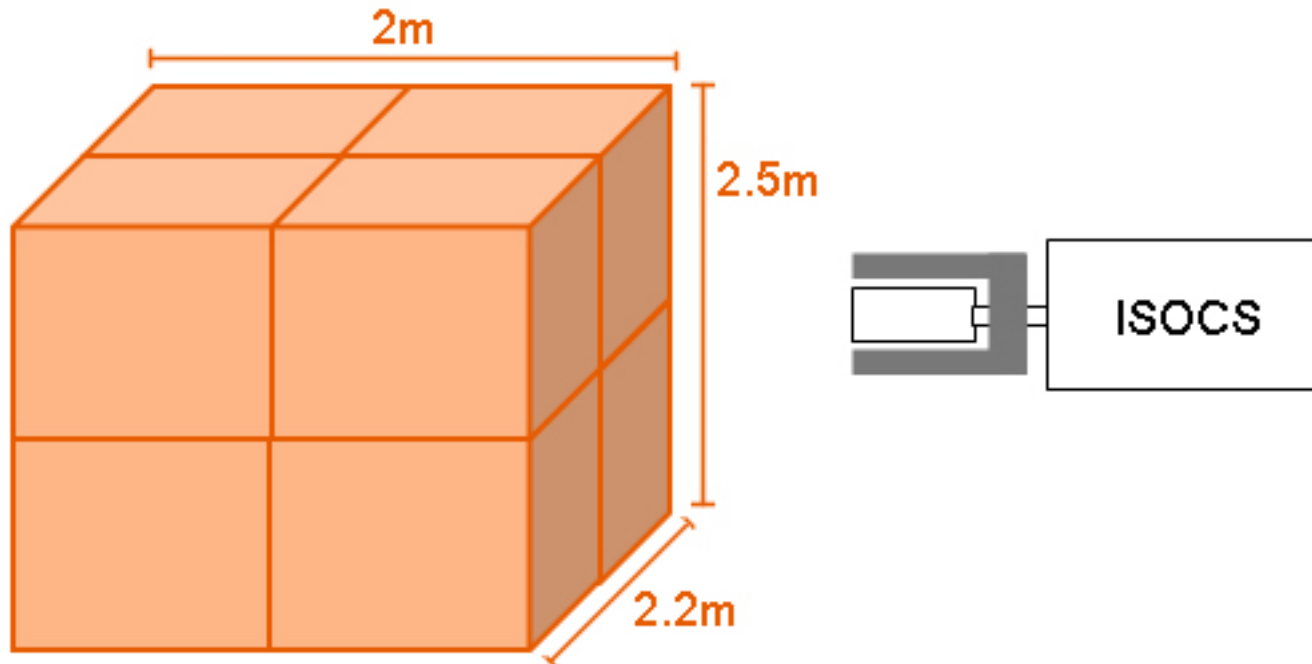


Performance



03 Performance

- We derived the efficient amount of styrofoam and geometry to meet the MDA guideline.
 - 8 bundles of styrofoam (2m x 2.2m x 2.5m)
 - The distance between styrofoam and detector : 50cm



03 Performance

- Measuring period : '12.10.11 ~ '12.10.24
- Counting time : 4,500 seconds
- Measuring efficiency : The use of modeling program in system (Geometry composer)
- The MDA of main radionuclide

	Co-60	Cs-137	U-235
Maximum Value(Bq/g)	8.866E-03	7.807E-03	9.541E-03

The result satisfied MDA guideline !



03 Performance



03 Performance

- In common sampling method for gamma analysis,
 - 2,400 samples x 100,000 seconds = 2,778 days
- By using ISOCS,
 - 44 SET* x 4,500 seconds = 198,000 seconds
 - * 1 SET : 8 bundles of styrofoam

Total analysis time



1/1200

03 Performance

- Reliability review of measurement of radioactivity by using ISOCS
 - The experiment to measure the reference source

Radio nuclide	Energy (keV)	Certified Value(Bq/g)	Measuring value(Bq/g)	Error(%)
Am-241	59.54	9,919	8,980	-9.5
Cd-109	88.03	32,067	29,660	-7.5
Co-57	122.06	1,143	1,110	-2.9
Cs-137	661.66	1,910	1,893	-0.9
Co-60	1173.23 1332.49	2,923	2,976	+1.8

03 Performance

- The measuring data about 4 faces of styrofoam

MDA(Bq/g)	Co-60	Cs-137	U-235
Face #1	7.705E-03	7.379E-03	9.316E-03
Face #2	7.671E-03	7.323E-03	9.155E-03
Face #3	7.937E-03	7.310E-03	9.328E-03
Face #4	8.042E-03	7.313E-03	9.061E-03
Average	7.839E-03	7.331E-03	9.215E-03

03 Performance

- The result of radiation dose evaluation

Individual Dose (uSv/yr)		Collective Dose (man-Sv/yr)		Result
Evaluation criteria	Evaluation result	Evaluation criteria	Evaluation result	Satis- faction
10	3.69E-01	1	1.35E-05	



03 Performance

View - SUMMARY.REP

File Edit Help

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RESRAD, Version 6.5 T?Limit = 180 days 02/27/2013 16:02 Page 11

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\STYROFOAM_R1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mSv/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mSv/yr	fract.	mSv/yr	fract.	mSv/yr	fract.	mSv/yr	fract.	mSv/yr	fract.	mSv/yr	fract.	mSv/yr	fract.
Co-60	2.906E-04	0.8977	0.000E+00	0.0000	0.000E+00	0.0000	8.360E-06	0.0258	4.118E-07	0.0013	4.863E-08	0.0002	0.000E+00	0.0000
Cs-137	1.976E-05	0.0610	0.000E+00	0.0000	0.000E+00	0.0000	2.436E-06	0.0075	1.799E-07	0.0006	5.667E-08	0.0002	0.000E+00	0.0000
U-235	2.379E-07	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	1.639E-06	0.0051	1.407E-09	0.0000	2.866E-09	0.0000	0.000E+00	0.0000
Total	3.106E-04	0.9594	0.000E+00	0.0000	0.000E+00	0.0000	1.244E-05	0.0384	5.931E-07	0.0018	1.082E-07	0.0003	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mSv/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mSv/yr	fract.	mSv/yr	fract.	mSv/yr	fract.	mSv/yr	fract.	mSv/yr	fract.	mSv/yr	fract.	mSv/yr	fract.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.994E-04	0.9249
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.243E-05	0.0693
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.882E-06	0.0058
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.237E-04	1.0000

*Sum of all water independent and dependent pathways.

03 Performance

“세계 최고의 원자력 안전수준 확보로 국민신뢰 정착”



한국원자력안전기술원



수신자 한국수력원자력(주)사장(방사선안전팀장)

(경유)

제목 월성 2발전소(페스티로품) 자체처분계획서 검토결과 통보

1. 관련 : 한수원(주) 안전(방)74608-4503('11.09.28), 74608-773 ('12.02. 17), 74604-5255(' 12.11.15) 및 74604-1100('13.03.12)

2. 위 호와 관련하여, 귀사가 제출한 방사성폐기물 자체처분계획서 (페스티로품)를 관련 요건에 따라 검토한 결과, 다음과 같이 적합함을 통보합니다.

<자체처분 적합 통보 내용>

종 류	발생원	수 량[kg]	자체처분예정방법		
			방법	자체/위탁	장소
페스티로품	신연료박스	8,712	소각/매립	위탁	소외

끝.

선			지	
합			시	
공			결	번호 3843
람			수	일시 2013.04.15
			처	부서 방사선안전팀
			리	담당 임승준

한국원자력안전기술원장



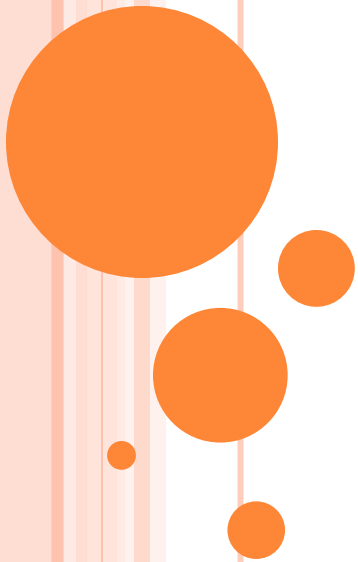
기안 서은진 실장 검토 정찬우 단장 전결 04/12
★◎직원

협조자

시행 방사성폐기물평가실-183(2013-04-12) 접수
우 305-338 대전광역시 유성구 과학로 34 (구성동 19-0)
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/ http://www.kins.re.kr
/ 공개

Conclusion



04 Conclusion

- In case of radioactivity measurement of **low-density material** such as styrofoam,

ISOCS could be

VERY USEFUL METHOD.



Thank you
for listening !

