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COG11.1 Code Features for Shielding and Criticality Safety Analyses

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Presentation Outline

- Introduction of COG,
- COG Modeling for 9975 Packaging,
- Nuclear Criticality Safety Evaluation,
- Radiation Shielding Application,
- Use of RadSrc option in COG,
- Conclusion



COG 11.1

- Modern, general purpose, high-fidelity, multi-particle, Monte Carlo transport code,
- Can solve complex 3-D shielding, and criticality safety problems,
- Code Features includes:
 - Multiple cross section library options,
 - Surface-of-revolution option,
 - Repeated structure modeling options,
 - Automatic time dependent photon source option.



COG Modeling of 9975 Container



- Content: 4.4 kg Pu-239 with 100 g polyethylene,
- Surface-of-revolution option used for curved geometry such as PCV and SCV,
- ENDF/B-VII.1 Cross section data library



Nuclear Criticality Safety Analysis (Normal Conditions of Transport)



Case	9975 SARP/SCALE	COG
Dry, Infinite Array	0.8734 ± 0.0015	0.8780 ± 0.0015
Flooded, Single, Infinite Water Reflection	0.9311 ± 0.0016	0.9302 ± 0.0015



Nuclear Criticality Safety Analysis (Hypothetical Accident Conditions)



HAC 5 x 5 x 2 Array

9975 SARP k-eff $\pm 1\sigma = 0.8605 \pm 0.0014$ COG k-eff $\pm 1\sigma = 0.8602 \pm 0.0016$



Radiation Dose Application



Content: 4.4 kg Pu Oxide

Dose Rate Comparison (mrem/hr)*

Detector		MCNP	COG
Тор	Neutron	8.97	9.19
	Photon	0.09	0.04
Bottom	Neutron	146.9	170.0
	Photon	2.75	1.77
Side	Neutron	151.9	146.7
	Photon	3.11	2.75

*MCNP and COG Results are ± 5%

RadSrc option in COG



Content: 1 gram Am-241 at the Bottom

Photon Dose Rates after a 1000-day decay

ORIGEN + MCNP (2 Codes, 2 Steps) COG using the RadSrc Option (1 Code, 1 Step)

Dose Rate Comparison for 1000-day Decay

Detector		MCNP	COG
Bottom	Photon	3.76E-5	2.85E-5
Side	Photon	2.79E-5	2.01E-5

Conclusions

- COG can be applied to SARP preparation in the areas of criticality safety and radiation dose assessment,
- Demonstrated that 1-step radiation dose calculations are feasible with the COG RadSrc option,
- COG11.1 is distributed through the Radiation Safety Information Computational Center (RSICC),
- COG11.1 also distributed through the OECD NEA Data Bank,
- For additional details, visit http://cog.llnl.gov

