SEP 9 1996 (20) Sta. 37

ENGINEERING DATA TRANSMITTAL

1. EDT 619200

2. To: (Receiving Organization)	3. From: (Originating Organization)	4. Related EDT No.:
Distribution	Criticality and Shielding	619200
5. Proj./Prog./Dept./Div.:	6. Design Authority/ Design Agent/Cog. Engr.:	7. Purchase Order No.:
SNF	F. Schmittroth	N/A
8. Originator Remarks:		9. Equip./Component No.:
Approval/Release		N/A
		10. System/Bldg./Facility:
11. Receiver Remarks: 11A. Design Baseline Document? [ ] Yes [X] No		12. Major Assm. Dwg. No.:
		N/A
		13. Permit/Permit Application No.:
		N/A
		14. Required Response Date:

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-SNF-ANAL-012		0	Activity of TRIGA Core Components	X N/A	1	1,2	

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION
(See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN	(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN
		Design Authority			
		Design Agent			
1	1	Cog.Eng. F. Schmittroth 9-30-96 H0-35			
1	1	Cog. Mgr. J. Greenborg 9/30/96 H0-35			
		QA			
		Safety			
		Env.			

18.	19.	20.	21. DOE APPROVAL (if required) Ctrl. No.
F. Schmittroth 9-30-96		J. Greenborg 9/30/96	[ ] Approved
Signature of EDT Originator Date	Authorized Representative for Receiving Organization Date	Design Authority/ Cognizant Manager Date	[ ] Approved w/comments
			[ ] Disapproved w/comments

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Activity of TRIGA Core Components

F. Schmittroth
Westinghouse Hanford Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

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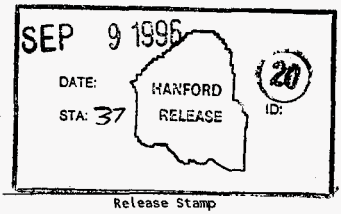
Key Words: TRIGA Activity

Abstract: The activity of TRIGA core components was estimated.



Release Stamp

Janis Bishop 9-9-96
Release Approval Date

Approved for Public Release

ACTIVITY OF TRIGA CORE COMPONENTS

1.0 INTRODUCTION

Activities for two groups of TRIGA core components are estimated: three stainless steel clad boron-carbide control rods and eleven aluminum clad graphite reflectors. The maximum measured contact dose rates are 50 mrem/hr for the control rods and 14 mrem/hr for the reflectors.

None of the materials in either group of elements are expected to activate significantly. The likely source of the measured dose rate is ^{60}Co activity. Cobalt 60 can occur from activation of trace cobalt impurities in stainless steel. Activation of copper, a common aluminum alloy, can also produce ^{60}Co. Abrasion and contamination from other components is another possible source.

2.0 CALCULATIONS

A rough estimate of the magnitude of cobalt activity that gives the measured dose rate was found as follows.

The unattenuated photon flux (the greater than 1 MeV photons from ^{60}Co are highly penetrating) from a cylindrical surface source is given by (Jaeger 1968)

$$\phi = \frac{S_A R}{2(a+R)}\left[F(\phi_1, k) + F(\phi_2, k)\right]$$

where S_A is the surface source density, R is the radius of the cylinder, and a is the distance from the cylinder centerline. The function F and its arguments are defined in the reference which gives a value near 0.3 for points near the surface of the cylinder (see Figure 6.8.-5).

This result can be used to relate the photon flux Φ to an equivalent flux Φ_o a distance x from a point source (equivalent in the sense of having a common total source strength):

$$\phi = \left(\frac{0.6}{a+R}\right)\frac{1}{h}(x^2\phi_o)$$

where h is the height of the cylinder.

The same equation relates the measured dose rate D_m to an equivalent point source dose rate D_o. In turn, the dose rate from a point source is related to the source activity, A, by the specific gamma-ray constant, Γ:

$$x^2 D_o = \Gamma A$$

Combining these results gives the desired activity as

$$A = \frac{h(a+R)}{0.6\Gamma} D_m$$

For dimensions typical of a TRIGA component (h=50 cm, and a≈R=1.8 cm), the factors that relate the point and cylindrical geometries give a factor of 300. Together with a value of Γ for ^{60}Co (Jaeger 1968) of 13.2 (R cm^2)/(h mCi) the following table was constructed:

			--- Activity, mCi ---	
Component	N	mrem/hr	single element	total
Control rods	3	50	1.15	3.4
Reflectors	11	14	0.32	3.5

3.0 REFERENCES

R. G. Jaeger, et.al., 1968, Engineering Compendium on Radiation Shielding, Springer-Verlag, New York, NY.

CHECKLIST FOR INDEPENDENT TECHNICAL REVIEW

DOCUMENT REVIEWED Activity of TRIGA Core Components

AUTHOR(s) F. A. Schmittroth

I. Method(s) of Review

( ) Input data checked for accuracy
(X) Independent calculation performed
(X) Hand calculation
( ) Alternate computer code:
( ) Comparison to experiment or previous results
( ) Alternate method (define)

II. Checklist (either check or enter NA if not applied)

(X) Task completely defined
(X) Activity consistent with task specification
(X) Necessary assumptions explicitly stated and supported
(X) Resources properly identified and referenced
(X) Resource documentation appropriate for this application
(X) Input data explicitly stated
(X) Input data verified to be consistent with original source
(X) Geometric model adequate representation of actual geometry
(X) Material properties appropriate and reasonable
(X) Mathematical derivations checked including dimensional consistency
(X) Hand calculations checked for errors
(X) Assumptions explicitly stated and justified
(NA) Computer software appropriate for task and used within range of validity
(NA) Use of resource outside range of established validity is justified
(NA) Software runstreams correct and consistent with results
(NA) Software output consistent with input
(X) Results consistent with applicable previous experimental or analytical findings
(X) Results and conclusions address all points and are consistent with task requirements and/or established limits or criteria
(X) Conclusions consistent with analytical results and established limits
(X) Uncertainty assesment appropriate and reasonable
(NA) Other (define)

III. Comments:

IV. REVIEWER: DATE: 30 Aug 96

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	Criticality and Shielding	Date August 29, 1996
Project Title/Work Order		EDT No. 619200
Activity of TRIGA Core Components		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
J. O. Dittmer	N2-02	X			
J. Greenborg	H0-35	X			
A. L. Ramble	A3-38	X			
F. A. Schmittroth	H0-35	X			
Central Files (2)	A3-88	X			