GENERAL ATOMICS

INTERNAL CORRESPONDENCE

DATE: 18 April 2019 **IN REPLY REFER TO:**

TO: Decommissioning Project Files DDI:001:JSG:19

FROM: J. S. Greenwood 18 Apr 19

SUBJECT: Update to 06/30/2019 and Application of Radionuclide Scaling Factors for Bldg. 21

REFERENCE: GA Procedure Doc. No. DDP-1.2, "Gamma Counting on the Canberra Gamma Ray Spectrometer", Current Issue.

Radionuclide Scaling Factors (RSFs) have recently been updated for use in the radiological characterization of GA low-level radioactive waste bound for disposal at the Nevada National Security Site. These RSFs will be applied to gamma spectral analysis results obtained from individual waste packages or representative samples of waste matrices, generated during decommissioning operations at GA Bldg. 21, to determine the activity levels of certain beta and/or alpha emitting radionuclides present in the waste matrix. Gamma counting is performed by the Reference procedure, or outsourced to a QA-approved analytical laboratory. This memorandum documents the new current RSFs for this building, updated to 06/30/2019, and further describes the method to be utilized for the application RSFs to the radioactive characterization analytical results on Low-Level radioactive Waste (LLW) containers obtained by direct counting or off-site gamma spectral analyses on representative waste matrix samples.

Direct gamma counting of LLW containers quantifies only gamma-emitting radionuclide results in the waste matrix. Radionuclide Scaling Factors are applied to gamma counting results in order to determine the activity levels of certain beta and/or alpha emitting radionuclides present in the waste matrix. The Radionuclide Scaling Factors utilized for this characterization are facility-specific, and are applied to gamma counting results based on the facility of origin which generated the LLW during decommissioning operations. This memorandum specifically addresses the application of recently updated RSFs for GA Bldg. 21 (updated to a reference decay date of 06/30/2019).

The application of RSFs to gamma counting results is achieved using a facility-specific Spreadsheet, which incorporates current applicable RSFs. The Spreadsheet automatically performs all required arithmetic calculations, and generates a Radionuclide Activity Summary report for individual LLW containers. An example template of the facility-specific Radionuclide Activity Summary Spreadsheets to be utilized for waste from Bldg. 21 is provided herein as Attachment 2. NOTE: This attached Spreadsheet template has been completed for an example waste package "RMTR #00000" which contains the following nuclide quantities:

Co-60:	1 mCi	Th-232:	1 g
Cs-137:	1 mCi	U-235:	1 g
		U-238:	1 g

To complete the Radionuclide Activity Summary Spreadsheet for an individual waste container, proceed as follows:

1) Select the facility-specific Spreadsheet based on the building of origin of the waste contents of the container, as shown on the RMTR of interest.
2) Enter the RMTR number on the Spreadsheet header.
3) From the Gamma-Counting analytical results for the waste package (obtained from either DDP-1.2 or results obtained from a QA-approved analytical laboratory), enter all reported activites (in mCi) for gamma-emitting nuclides into the Spreadsheet; for Th-232, U-235, and U-238, input reported gram quantities into the Spreadsheet. Note that the shaded cells of the template Spreadsheet is intended for data entry.

4) The Spreadsheet will automatically apply Radionuclide Scaling Factors, and report calculated activity levels (in mCi) as necessary, and will also report Total Activity and percent of Total Activity for individual reported nuclides.
5) If the analytical results reports a quantity of U-235 and no U-238, assume that the U-235 enrichment is 19.9%; therefore calculate the quantity of U-238 by the following equation: (g U-238) = [(g U-235)/0.199)] – (g U-235). Enter this calculated gram quantity of U-238 in the Spreadsheet.
6) If the analytical results for waste from Bldg. 21 report U-235 or Th-232, use the previously developed site-wide Radionuclide Scaling Factors to obtain the mCi of U-234 and U-236 (from U-235) or mCi Th-230 (from Th-232).
7) Sign and date the completed report.

Independent Review:
Data and calculations were found to be complete, accurate, and valid, and conclusions found to be correct.

Independent Reviewer: D.W. Hill 18 April 2019 Date

Attachments:
1) Radionuclide Scaling Factors for Bldg. 21 Radioactive Waste, Updated to 06/30/2019.
2) Radionuclide Activity Summary Template, Using Bldg. 21 Radionuclide Scaling Factors Updated to 06/30/2019.

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ATTACHMENT 1:
RADIONUCLIDE SCALING FACTORS FOR BLDG. 21 RADIOACTIVE WASTE
UPDATED TO 06/30/2019

Scaling Factors to Co-60 for Bldg. 21 (TRIGA Reactor Facility) Radioactive Waste

Nuclide	Half Life (yr)	Scaling Factor (Ci/Ci C60) 1/31/2002	**6/30/2019**	Ratio	Decay Constant	Decay Days
Fe55	2.73	0.341	**0.05339**	0.1566	0.000605	6359.00
Ni63	100	0.081	**0.53466**	6.6007	1.65E-05	
Co60	5.271				0.000313	

Scaling Factors to Cs-137 for Bldg. 21 (TRIGA Reactor Facility) Radioactive Waste

Nuclide	Half Life (yr)	Scaling Factor (Ci/Ci Cs137) 1/31/2002	**6/30/2019**	Ratio	Decay Constant	Decay Days
Sr90	29.1	0.814	**0.803649**	0.987284	5.67E-05	6359.00
Cs137	30.17				5.47E-05	

Scaling Factors to U-235 for Bldg. 21 (TRIGA Reactor Facility) Radioactive Waste

Nuclide	Half Life (yr)	Scaling Factor (Ci/g U235) 11/6/1998	**6/30/2019**	Ratio	Decay Constant	Decay Days
U234	2.44E+05	5.60E-05	**5.60E-05**	0.9999	6.77E-09	7541.00
U236	2.34E+07	2.89E-07	**2.89E-07**	0.999999	7.06E-11	
U235	7.04E+08				2.35E-12	

Scaling Factors to Th-232 for Bldg. 21 (TRIGA Reactor Facility) Radioactive Waste

Nuclide	Half Life (yr)	Scaling Factor (Ci/g Th232) 11/6/1998	**6/30/2019**	Ratio	Decay Constant	Decay Days
Th230	7.70E+04	5.84E-08	**5.84E-08**	0.9998	2.14E-08	7541.00
Th232	1.40E+10				1.18E-13	

ATTACHMENT 2:
RADIONUCLIDE ACTIVITY SUMMARY TEMPLATE,
USING BLDG. 21 RADIONUCLIDE SCALING FACTORS UPDATED TO 06/30/2019

RADIONUCLIDE ACTIVITY SUMMARY FOR BUILDING 21 WASTE
Waste Container - RMTR #00000

Nuclide	Grams	Scaling Factors (on 6/30/19)		Activity	% of Total Activity
		Value	Units	(mCi)	
H3	N/A	N/A	N/A		N/A
Cl36	N/A	N/A	N/A		N/A
Fe55	N/A	0.053390	mCi/mCi Co60	5.34E-02	1.55
Co60	N/A	N/A	N/A	1.00E+00	28.98
Ni63	N/A	0.534660	mCi/mCi Co60	5.35E-01	15.49
Sr90	N/A	0.803649	mCi/mCi Cs137	8.04E-01	23.29
Tc99	N/A	N/A	N/A		N/A
Cd109	N/A	N/A	N/A	0.00E+00	0.00
Sb125	N/A	N/A	N/A	0.00E+00	0.00
Ba133	N/A	N/A	N/A	0.00E+00	0.00
Cs134	N/A	N/A	N/A	0.00E+00	0.00
Cs137	N/A	N/A	N/A	1.00E+00	28.98
Eu152	N/A	N/A	N/A	0.00E+00	0.00
Eu154	N/A	N/A	N/A	0.00E+00	0.00
Pb210	N/A	N/A	N/A		N/A
Ra226	N/A	N/A	N/A	3.92E-04	0.01
Th230	N/A	5.84E-05	mCi/g Th232	5.84E-05	0.00
Th232	1.00E+00	N/A	N/A	1.10E-04	0.00
U234	N/A	5.60E-02	mCi/g U235	5.60E-02	1.62
U235	1.00E+00	N/A	N/A	2.16E-03	0.06
U236	N/A	2.89E-04	mCi/g U235	2.89E-04	0.01
U238	1.00E+00	N/A	N/A	3.36E-04	0.01
Pu238	N/A	N/A	N/A		N/A
Pu239	N/A	N/A	N/A		N/A
Pu242	N/A	N/A	N/A		N/A
Am241	N/A	N/A	N/A	0.00E+00	0.00
Am243	N/A	N/A	N/A		N/A
Total				3.45E+00	100.00

Analyst _____ Date _____

J. S. Greenwood