



50-274

Department of the Interior
US Geological Survey
Box 25046 MS-974
Denver CO, 80225

March 14, 2014

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington DC 20555

Subj: Response to RAI dated January 29, 2014, regarding R-113 license amendment request (TAC No. ME9424)

Gentlemen:

The attached pages are submitted in response to your Request for Additional Information dated January 29, 2014. Please contact me if you need additional information.

The proposed wording of the revised license is provided on the next page.

Sincerely,

A handwritten signature in cursive script that reads "Tim DeBey".

Tim DeBey
USGS Reactor Supervisor

I declare under penalty of perjury that the foregoing is true and correct.
Executed on 03/14/2014

Copy to:
Vito Nuccio, Reactor Administrator, MS 911
USGS Reactor Operations Committee

A020
NR

PROPOSED text of Revised License

2. ...

B. Pursuant to the Act and 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," in connection with operation of the facility to receive, possess and use (but not separate):

- (1) up to 9 kilograms of contained uranium-235 enriched to less than 20 percent in the isotope uranium-235 in the form of TRIGA reactor fuel;
- (2) up to 15 grams of contained uranium-235 of any enrichment in the form of neutron detectors; and
- (3) up to 2 grams of special nuclear material of any enrichment in reactor-based experiments, calibration of radiation detectors, and reference sources for reactor based programs.

C. Pursuant to the Act and Title 10, Chapter 1, CFR, Part 30, "Rules of General Applicability to Licensing of Byproduct Material", in support of the operation of the facility:

1. to receive, possess and use:

- a. up to 3 curies of sealed americium-beryllium in a single neutron source for reactor startup use;
- b. up to 10-curies of sealed polonium-beryllium in a single neutron source for reactor startup use;
- c. up to 10 mCi of byproduct material (atomic number 1 to 88) that will be irradiated in the reactor after receipt; (Note: following irradiation, if >99% of the radioactivity in the material has been produced in the GSTR, the byproduct material will then be considered to be entirely GSTR-produced.)
- d. up to 5 Ci of byproduct material used in reactor-based experiments, calibration of radiation detectors, and reference sources for use in reactor-based analytic techniques; and
- e. up to 10 mCi of byproduct material contained in TRIGA (non-fuel) reactor parts and components received for use under R-113 from other TRIGA facilities (Note: following use, if activation of these non-fuel parts and components results in >99% of the radioactivity in any item being produced in the GSTR, the byproduct material in the item will then be considered to be entirely GSTR-produced.);

2. to receive, possess, and use, but not to separate, any amount of byproduct material contained in TRIGA fuel elements that are transferred to license R-113 after use in other reactor facilities;

3. to possess and use, but not to separate, any byproduct material as may be produced by operation of the reactor.

D. Pursuant to the Act and Title 10, Chapter 1, CFR (Code of Federal Regulations), Part 40 (10 CFR 40), "Domestic Licensing of Source Material", in support of the operation of the facility:

1. to receive, possess and use up to 10 mCi of source material for reactor-based experiments, calibration of radiation detectors, and reference sources for use in reactor-based analytic techniques.

Responses to RAI Questions

Response to Question 1:

It is proposed that License Condition Paragraph 2.C. be amended as follows in order to specifically indicate that source material is authorized under Part 40 of 10CFR.

2.C. Pursuant to the Act and Title 10, Chapter 1, CFR, Part 30, "Rules of General Applicability to Licensing of Byproduct Material", in support of the operation of the facility:

1. to receive, possess and use: . . .

c. up to 10 mCi of byproduct material (atomic number 1 to 88) that will be irradiated in the reactor after receipt; (Note: following irradiation, if >99% of the radioactivity in the material has been produced in the GSTR, the byproduct material will then be considered to be entirely GSTR-produced.)

and,

2.D. Pursuant to the Act and Title 10, Chapter 1, CFR (Code of Federal Regulations), Part 40 (10 CFR 40), "Domestic Licensing of Source Material", in support of the operation of the facility:

1. to receive, possess and use up to 10 mCi of source material for reactor-based experiments, calibration of radiation detectors, and reference sources for use in reactor-based analytic techniques.

Response to Question 2:

The basis for the proposed 10 mCi limit for byproduct and/or source material to be irradiated in the reactor after receipt is addressed below for byproduct materials and source materials.

The classic receipt of byproduct material to be irradiated involves target materials that are used as radiation sources and are periodically re-irradiated. These sources are activated, allowed to decay during their use, re-irradiated and reused. This irradiation/decay cycle can be repeated many times. Since any given irradiation cycle may be done at a reactor facility outside of the USGS, the byproduct material contained in those target materials needs to be transferred from the user to the USGS reactor upon receipt. After irradiation, the target materials will be transferred to the user and placed on the user's license. The 10 mCi level has been historically shown to be sufficient to allow the facility to perform the current and postulated activities of this type.

The receipt of source material to be irradiated has traditionally involved research on fission products, and the mass of source material received has always been <100 grams per sample. Assuming a maximum of 20 such samples would give a natural uranium mass of 2 kilograms or ~2 mCi and a natural thorium mass of 2 kilograms or ~0.4 mCi. Thus a 10 mCi limit would allow the receipt of more than 2 kilogram of uranium plus 2 kilogram of thorium and is therefore a reasonable and adequate limit for the facility to perform the current and postulated activities of this type.

Response to Question 3:

The types of byproduct and/or source materials authorized for irradiation in the reactor after receipt will be atomic numbers 1 to 88 (byproduct material) along with thorium and uranium (source material).

The general types of experiments or uses in the reactor for these byproduct and/or source materials include basic research, isotope production, and re-irradiation of target materials. The types of basic research performed typically involve neutron activation analysis and geochronology of earth materials. Some of these materials contain measurable quantities of source materials. Isotope production may be for research or testing purposes, and target materials may contain small quantities of byproduct and/or source materials. The re-irradiation of target materials always includes the receipt of licensed materials within the targets. The licensed materials may be the target material and/or the container that holds the material. For example, a target may include a stainless steel capsule with Co-60 that was produced at another reactor facility.

Response to Question 4:

It is proposed that License Condition Paragraph 2.D. be added as follows in order to specifically indicate that source material is authorized under Part 40 of 10CFR.

D. Pursuant to the Act and Title 10, Chapter 1, CFR (Code of Federal Regulations), Part 40 (10 CFR 40), "Domestic Licensing of Source Material", in support of the operation of the facility:

1. to receive, possess and use up to 10 mCi of source material for reactor-based experiments, calibration of radiation detectors, and reference sources for use in reactor-based analytic techniques.

Response to Question 5:

The quantities of byproduct material and source material to be used in reactor-based experiments, calibration of radiation detectors, and reference sources for use in reactor-based analytic techniques are not to exceed 5 Ci of byproduct material and 10 mCi of source material. A list of the associated materials currently in use at the reactor facility is attached as Table 1. The materials in Table 1 fall within the proposed limits of 5 Ci of byproduct material and 10 mCi of source material. The largest single source in the Table is the 1.4 Ci Cs-137 calibration source. The remainder of the items in Table 1 have a total of <12 mCi activity. The materials in Table 1 are the materials that have been traditionally required for effective operation of the GSTR and associated experimental facilities. The proposed limits give a reasonable margin to allow for replenishment of decaying sources and the addition of new reference and calibration sources as may be required for continued operation of the facility.

Further basis for the 10 mCi limit on source material is given in the response to Question 2.

Response to Question 6:

The types of byproduct and/or source materials authorized to be used in reactor-based experiments, calibration of radiation detectors, and reference sources for use in reactor-based analytic techniques are atomic numbers 1 to 88 (byproduct material) along with thorium and uranium (source material). The

materials given in Table 1 are currently in use at the reactor facility. They include various sizes and configurations of sealed and unsealed licensed materials to be used in reactor-based experiments, calibration of radiation detectors, and reference sources for use in reactor-based analytic techniques. Typical uses include calibration of portable radiation survey meters, personnel dosimeters, the continuous air monitor, the argon monitor, the swipe counter, radiation area monitors, contamination monitors, and gamma spectrometers.

Response to Question 7:

The amendment request does not propose to increase the mass limit of special nuclear material currently authorized under license R-113 in TRIGA fuel. All TRIGA fuel elements received at the GSTR will be possessed under the existing SNM limit for TRIGA fuel at the facility. The fuel possessed at the GSTR will continue to be of low strategic significance, and therefore, within our current license and security plan. The SNM contained in TRIGA fuel elements possessed at the facility may be utilized but not separated. The proposed wording for SNM authorized on the license is:

- B. Pursuant to the Act and 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," in connection with operation of the facility to receive, possess and use (but not separate):
- (1) up to 9 kilograms of contained uranium-235 enriched to less than 20 percent in the isotope uranium-235 in the form of TRIGA reactor fuel;
 - (2) up to 15 grams of contained uranium-235 of any enrichment in the form of neutron detectors; and
 - (3) up to 2 grams of special nuclear material of any enrichment in reactor-based experiments, calibration of radiation detectors, and reference sources for reactor based programs.

Response to Question 8:

The types of nonfuel TRIGA parts that are proposed to be received at the facility include items such as fuel handling tools, source shields, sample handling apparatus, and sample tubes. These items could contain activation products, either from direct activation or from fixed contamination that was transferred from other items. The proposed limit of 10 mCi would be approximately equal to irradiation of 15 g of stainless steel in the rotary specimen rack for 8 hours, followed by a month of decay. It would also be approximately equivalent to about 25 g of aluminum 6061 alloy irradiated in the rotary specimen rack for 40 hours, followed by a month of decay. Longer decay times would allow an increase in neutron fluence and/or material mass. For example, a one year decay time would allow the aluminum mass to be up to ~9 kg. Since most of the items that might be received would be made of stainless steel or aluminum, and since the postulated mass values, neutron fluence values, and decay times seem reasonable for the types of items that would be expected to be transferred to the facility, it is concluded that 10 mCi is a reasonable limit for this request.

The nonfuel TRIGA parts will be accounted for separately from any TRIGA fuel that is received from other facilities. In addition, it is proposed that: following use, if activation of these non-fuel parts and components results in >99% of the radioactivity in any item being produced in the GSTR, the byproduct material in the item will then be considered to be entirely GSTR-produced.

Response to Question 9:

Approval of the requested license amendment will not require any changes to the facility's Emergency Plan or Security Plan. The Radiation Protection Program has two new sections proposed, Sections 8.3.4 and 8.3.5 (see below). These sections add requirements for periodic leak testing of sealed sources and inventory of licensed material.

8.3.4 Material Leak Testing

Sealed sources that are not byproduct material produced by the reactor shall be tested for leakage and/or contamination at intervals not to exceed 6 months or at such other intervals as specified by the certificate of registration referred to in 10 CFR 32.210. Sealed sources designed to emit alpha particles shall be tested for leakage and/or contamination not to exceed 3 months. Sealed sources need not be tested if they are in storage and not being used. However, when they are removed from storage for use, or transferred to another person, and have not been tested within the required leak test interval, they shall be tested before use or transfer. No sealed source shall be stored for a period of more than 10 years without being tested for leakage and/or contamination. This requirement does not apply to the reactor startup neutron source.

The leak test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. If the test reveals the presence of 0.005 microcurie or more of removable contamination, a report shall be filed with the U.S. Nuclear Regulatory Commission in accordance with 10 CFR 30.50(c)(2), and the source shall be removed immediate from service and decontaminated, repaired, or disposed of in accordance with Commission Regulations. The report shall be filed within 5 days of the date the leak test result is known. The report shall specify the source involved, the test results, and the corrective action taken. Records of leak test results shall be kept in units of microcuries and shall be maintained for inspection by the Commission. Records may be disposed of following Commission inspection.

8.3.5 Material Inventory

Licensed sources that are not byproduct material produced by the reactor shall be inventoried every 6 months, to account for all licensed sources received and possessed. Records of inventories shall be maintained for at least 5 years from the date of the most recent inventory and shall include the radionuclides, quantities, manufacturer's name and model numbers (if applicable), and the date of the inventory.

Response to Question 10:

Approval of the requested license amendment will not require any changes to the facility's Technical Specifications.

Response to Question 11:

The licensing authority in NRC Materials License No. 05-01399-08 that cover the materials to be transferred (re: Table 1) are as follows:

Item 6.A.: Any byproduct material with Atomic Numbers between 1 through 83, inclusive, in any chemical or physical form.

Item 6.B.: Any byproduct material with Atomic Numbers 84 through 103, inclusive, in any chemical or physical form except sealed sources. (not to include any special nuclear material)

Item 6.G.: Any byproduct material as mixed fission products and/or irradiated materials and samples.

Item 6.H.: Cesium-137 in sealed source Amersham Model CDC93.

Item 6.I.: Any Special Nuclear Material in any chemical or physical form. (Not to exceed 10^4 times the applicable limits in Appendix B of 10 CFR Part 30 for unsealed material and 10^{12} times the applicable limits in Appendix B of 10 CFR Part 30 for sealed material.)

Item 9. :Authorized Use:

For Items under 6.A. and 6.B. : For use in research and development ...

For Items under 6.G: For use in research and development ...

For Item under 6.H.: For use in J.L. Shepherd and Associates Model 28-6B calibrator for calibration of licensee's survey instruments.

For Items under 6.I. through 6.K.: For use in research and development ...

Approval of the requested license amendment will maintain similar oversight conditions, but under the R-113 license instead of the Materials License. For example, inventories of licensed materials and leak tests of sealed sources will continue to be performed at the same periodicity and with the same leakage criterion as before.

TABLE 1 Inventory of Sources to be moved to Reactor License		
Isotope	Current Activity (Ci)	Serial #
Cd-109	1.87E-11	NA
Co-60	3.45E-08	NA
Sr-90	1.10E-08	S-75
Sr-90	3.89E-09	S-33
Am-241	7.32E-09	S-3512
Tc-99	6.22E-09	1795-94
Cl-36	2.70E-08	S-34
Cs-137	3.95E-06	104
Ra-226	5.35E-06	NA
Co-60	6.92E-07	RX-1
Co-60	6.92E-07	RX-2
Co-60	6.92E-07	RX-3
Co-60	6.92E-07	RX-4
Co-60	6.92E-07	RX-5
Co-60	6.92E-07	RX-6
Co-60	6.92E-07	RX-7
Co-60	6.92E-07	RX-8
Co-60	6.92E-05	NA
Co-60	4.76E-07	NA
Cs-137	2.81E-05	1164
Ra-226 Be	9.89E-03	762
Ra-226	1.04E-03	E-836
Cs-137	1.4	0170GN
Cs-137	4.27E-05	390
Co-60	1.72E-05	RX-13
Co-60	4.77E-06	RX-11
Co-60	4.77E-06	RX-12
Co-60	3.25E-05	RX-21
Co-60	5.19E-05	NA
Cd-109	3.31E-07	RX-19
Co-60	3.02E-06	RX-20
Co-60	3.11E-04	RX-14
Co-60	1.04E-04	RX-15
Co-60	5.58E-06	RX-9
Co-60	2.79E-06	NA
Co-60	2.79E-06	NA
Co-60	2.79E-06	NA
Co-60	2.79E-07	RX-17
Co-60	3.02E-06	NA
Co-60	1.19E-04	RX-16

Co-60	4.10E-07	H4-141
Ba-133	5.18E-07	H4-140
Cs-137	5.33E-08	H4-140
Cs-137	6.82E-05	631-2-2
Cd-109	2.90E-09	724-94
Co-57	1.24E-12	724-94
Te-123m	1.81E-18	724-94
Cr-51	4.21E-52	724-94
Sn-113	2.89E-18	724-94
Sr-85	1.98E-26	724-94
Cs-137	1.78E-07	724-94
Y-88	7.89E-19	724-94
Co-60	6.41E-08	724-94
Mixed	1.50E-06	71427-544
Co-60	1.50E-07	71427-544
Eu-152	6.55E-07	71427-544
Cs-137	2.20E-07	71427-544
Co-60	7.33E-08	1338
Cs-137	6.33E-07	1339
Cd-109	6.63E-09	631-2-1
Th-232	1.13E-07	812
Eu-152	9.62E-07	84693-544
Eu-152	9.52E-07	84692-544
Eu-152	9.62E-07	84691-544
UO ₂	6.91E-05	NA