ACCEPTANCE REVIEW MEMO

Licensee: Hawaii Agriculture Research Center

License No.: 53-00515-01 **Docket No.:** 030-06839

Mail Control No.: 470798

Type of Action: Amend **Date of Requested Action:** 12-02-05

Reviewer Assigned: **Date Assigned to Reviewer:** 12-20-05

Reviewer(s) Who Performed Review: Gaines

Response Received	Deficiencies Noted During Acceptance Review
	1.
	2.
	3.
	4.

Reviewer's Initials: _____ **Date:** _____

Branch Chief's and/or SR. HP's Initials: _____ **Date:** _____

☐Yes ☐No Action - decommissioning notification should be issued within 30 days.

☐Yes ☐No Termination request < 90 days from date of expiration

☐Yes ☐No Action to be expedited

_____Medical emergency

_____Licensee in noncompliance (i.e. no RSO, location of use/storage not on license, radioactive material in possession not on license)

_____National Security

_____Other (_____)

Branch Chief's and/or Sr. HP's Initials: _____ **Date:** _____

SISP Review

☐Yes ☒No **Non-Publicly Available, Sensitive** if <u>any</u> item below is checked

_____Radionuclides, forms, and quantities

_____Location of RAM

_____Building drawings with locations of RAM

_____Security of RAM (locks, alarms, etc.)

_____SS&D Catalog information

_____Specifics of Emergency Plan (routes to and from RAM, response to security events, etc.)

_____Safeguards Information

Branch Chief's and/or Sr. HP's Initials: AJG **Date:** 12/20/05

ADG

HAWAII AGRICULTURE RESEARCH CENTER

FORMERLY HAWAIIAN SUGAR PLANTERS' ASSOCIATION
99-193 AIEA HEIGHTS DRIVE, SUITE 300, AIEA, HAWAII 96701-3911
TELEPHONE: (808) 487-5561 FAX: (808) 486-5020
http://www.hawaiiag.org/harc

December 2, 2005

Nuclear Materials Licensing Branch
U.S. Nuclear Regulatory Commission, Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

Dear License Reviewer:

Subject: License Amendment
NRC License No. 53-00515-01
Docket No. 030-06839

We have discontinued use of the caged restricted area located within the experimental greenhouse at the Kunia Substation. We have surveyed the area and performed RESRAD calculations to demonstrate that the site meets the 25 mrem/yr dose limit for unrestricted use. We are requesting that this area be released for unrestricted use. Details about the past use of this area, survey results, and RESRAD calculations are contained with the enclosed Decommissioning Survey report.

If you require any additional information, please contact our Radiation Safety Consultant, Ronald Frick, at 808-373-7009.

Thank you for your prompt consideration of this license amendment.

Sincerely,

Stephanie A. Whalen
President and Director,
Experiment Station

SAW:cp
Enclosures

DEC 0 3 2005

470798

NRC FORM 313 U.S. NUCLEAR REGULATORY COMMISSION
(8-1999)
10 CFR 30, 32, 33
34, 35, 36, 39 and 40

APPLICATION FOR MATERIAL LICENSE

APPROVED BY OMB: NO. 3150-0120 EXPIRES: 10/31/2005

Estimated burden per response to comply with this mandatory information collection request, 7.4 hours. Submittal of the application is necessary to determine that the applicant is qualified and that adequate procedures exist to protect the public health and safety. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjst@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0120), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

DIVISION OF INDUSTRIAL AND MEDICAL NUCLEAR SAFETY
OFFICE OF NUCLEAR MATERIALS SAFETY AND SAFEGUARDS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-001

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:

IF YOU ARE LOCATED IN:
CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND, MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, PENNSYLVANIA, RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

LICENSING ASSISTANT SECTION
NUCLEAR MATERIALS SAFETY BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PA 19406-1415

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

SAM NUNN ATLANTA FEDERAL CENTER
U.S. NUCLEAR REGULATORY COMMISSION, REGION II
61 FORSYTH STREET, SW, SUITE 23T85
ATLANTA, GA 30303-8931

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION III
801 WARRENVILLE RD.
LISLE, IL 60532-4351

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEVADA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, OREGON, PACIFIC TRUST TERRITORIES, SOUTH DAKOTA, TEXAS, UTAH, WASHINGTON, OR WYOMING, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TX 76011-8064

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTIONS.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*

- [ ] A. NEW LICENSE
- [x] B. AMENDMENT TO LICENSE NUMBER 53-00515-01
- [ ] C. RENEWAL OF LICENSE NUMBER _____

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include Zip code)*

Hawaii Agriculture Research Center
99-193 Aiea Heights Drive, Suite 300
Aiea, HI 96701

3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

Same as 2.

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Ronald Frick

TELEPHONE NUMBER

808-373-7009

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL
a. Element and mass number; b. chemical and/or physical form; and c. maximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.

9. FACILITIES AND EQUIPMENT.

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

12. LICENSEE FEES *(See 10 CFR 170 and Section 170.31)*
FEE CATEGORY 3M | AMOUNT ENCLOSED $0

13. CERTIFICATION. *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, , 32, 33, 34, 35, 36, 39, AND 40, AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

CERTIFYING OFFICER – TYPED/PRINTED NAME AND TITLE	SIGNATURE	DATE
Stephanie Whalen, President and Director	Stephanie A Whalen	12/2/05

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	AMOUNT RECEIVED $	CHECK NUMBER	COMMENTS
APPROVED BY				DATE	

PRINTED ON RECYCLED PAPER

Gamma Corporation
850 West Hind Drive #214, Honolulu, HI 96821
Phone (808) 373-7009
FAX (808) 373-7017

Decommissioning Survey

Facility: Hawaii Agriculture Research Center - Kunia Substation

Address: Kunia Road
Kunia, HI 96759

Survey Area: Kunia Greenhouse

Survey date: September 16, 2005

Performed By: Ronald Frick, M.S., CHP, DABR

Background: This 16' by 19' caged area is located within a 4,000 square foot greenhouse. The area is enclosed by wire fencing on all sides. The floor area is a concrete slab with a dry sump drain on one side. The area was established as a restricted area in 1975, and has been used for agricultural experiments involving C-14. A review of records indicates that this area has been used for 3 experiments involving C-14. The activity involved is as follows:

1978-1980: 2.09 mCi C-14
1993: 4.7 mCi C-14
1995: 4.7 mCi C-14

The total activity involved is approximately 11.5 mCi C-14.
For these experiments, C-14 was applied to the soil within several large planter boxes inside the caged area. At the conclusion of these experiments, contaminated soil and plant material was sent to a disposal site. The last shipment of contaminated soil and waste was made in May 1998. There were no intentional releases of C-14 during these experiments.

This area will no longer be used for experiments involving byproduct material. There are no immediate plans to demolish the current greenhouse. Upon decommissioning, the area will be used for storage or other agricultural experiments not involving use of byproduct material.

Instrumentation: Scan surveys were performed with a Bicron Analyst survey meter with a 100 cm^2 B-100 beta scintillation probe. The detection efficiency for C-14 betas is 8.2%, as measured using a NBS traceable 0.198 µCi C-14 planchette source (NES-200A, lot #200A010582A). The average background count rate is 300 cpm. Assuming the surveyor can discriminate 100 cpm above natural background, the minimum detectable activity for scan surveys is 1220 dpm/100 cm^2. This meter was last calibrated on 1/26/05 (see enclosed certificate).

Wipe samples were made using pieces of filter paper. The wipe samples were then placed in counting vials with 10 ml of counting solvent, and analyzed using the Packard liquid scintillation counter. Detection efficiency for C-14 (0.964) was determined using a C-14

scintillation standard. Minimum detectable activity for a 1 minute count (17.3 net dpm for C-14) was determined using the following equation:
where average background was 9 cpm.

$$MDA(dpm) = \frac{2.71 + 4.65\sqrt{CR_B}}{\varepsilon \sqrt{t}}$$

Efficiency determinations are attached.

Survey Guidelines: Subpart E of 10 CFR 20, Radiological Criteria for License Termination, states that "A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable". NRC NUREG-1757, *Consolidated NMSS Decommissioning Guidance*, provides tables which list the residual surface contamination in dpm/100 cm^2 for radionuclides which would result in a TEDE of less than 25 mrem/year for a building occupancy scenario. For C-14, the permissible surface contamination is 3,700,000 dpm/100 cm^2. NUREG 1556, Vol 7, *Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope*, sets the removable and non-removable contamination limits for beta-gamma emitters at 1000 and 5000 dpm/100 cm^2, respectively. However, the facility's in-house removable contamination limit is set at 200 dpm/100 cm^2.

Based on these documents, we have set a removable contamination guideline of 200 dpm/100 cm^2 for all beta-gamma emitters and a surface contamination guideline of 5,000 dpm/100 cm^2 for all beta-gamma emitters. These contamination levels are above the minimum detectable activities of the survey equipment used, and can be reasonably achieved using standard decontamination methods.

For the evaluation of the soil surrounding the caged area, NUREG-1757 lists a C-14 screening level of 12 pCi/g. We have elected to demonstrate through calculations that the maximum annual dose to an individual due to potential releases of C-14 from this area are now below 25 mrem per year.

Survey Description: Scan surveys of all areas of the caged area, and the area immediately surrounding the caged area, were performed using the Bicron Analyst survey meter with a 100 cm^2 B-100 beta scintillation probe. Wipe samples (100 square centimeters minimum) were taken in the numbered locations indicated on the attached survey diagram.

Survey Results: Scan surveys identified no areas distinguishable from background radiation levels. All wipe samples were well below the trigger level of 200 dpm/100 cm^2. Tabulated wipe results are attached.

Evaluation of Soil Surrounding Caged Area: To determine the maximum dose to an individual due to potential releases of C-14 from the caged area, we have assumed that all activity used in these experiments contaminated an area of soil within a 4 meter wide perimeter surrounding the cage. Assuming a depth of 2 meters, the initial concentration based on a total activity of 11.5 mCi would be approximately 26 pCi/g. For this calculation, it is assumed this release occurred in May 1998, when the last of the contaminated soil was shipped for disposal. Version 6.3 of the RESRAD code was used with all default settings, including an initial C-14 concentration of 100 pCi/g. The attached printout shows the maximum dose of 132 mrem/yr would occur at 4.28 years. At 7 years (May 2005), the dose has dropped below 0.03 mrem/yr. The projected dose continues to drop to zero, and never increases.

Conclusion: Residual contamination within the caged area and surrounding soil is below the levels which would result in a member of the critical group receiving a TEDE greater than 25 mrem/year. Residual contamination within the caged area is also below the ALARA levels published in NRC guidance documents, and below facility trigger levels. It is recommended that this area be released for unrestricted use.

Efficiency Determination - Scan Surveys

C-14 Planchette, activity = 0.198 µCi
Beta yield = 40% window absorption, effective dpm=263736
Measured cpm = 21630 cpm

$$Detection\ Efficiency = \frac{31580\ cpm}{0.01524\ \mu Ci \times 2.22x10^{6}\ dpm/\mu Ci \times 2\ betas/dis.}$$

Detection Efficiency = 0.082

Efficiency Determination - Liquid Scintillation Counter

C-14 Standard activity = 0.048 µCi
Activity = 107100 dpm
Measured cpm = 103287 cpm
Detection efficiency = 96%

Certificate of Calibration

Facility	Gamma Corporation		Dept.			Batteries ■ OK ☐ Replaced	
Mfgr/Model	Bicron Analyst	S/N	B798M	Probe	B-100	Detector Voltage	1192

☐ Calibrated with Cs-137 radiation source with NIST traceable output: 44.8 mR/hr @ 1 meter on 10/6/95.
☐ Calibrated with electronic pulser for scales below 0.1 mR/hr.
☒ Calibrated with electronic pulser for all scales.

Range (cpm)	Calculated Value	As Found Value	Accepted Value	Correction Factor	Corrected Value	% Error
X1000	400000	396000	396000	1.0	396000	1%
X1000	100000	92000	92000	1.0	92000	8%
X100	40000	40000	40000	1.0	40000	0%
X100	10000	10000	10000	1.0	10000	0%
X10	4000	3950	3950	1.0	3950	1%
X10	1000	998	998	1.0	998	0%
X1	400	390	390	1.0	390	3%
X1	100	99	99	1.0	99	1%

Detector Type	☐ G.M. ■ Plastic Scint. ☐ NaI Scint. ☐ Proportional ☐ Ion Chamber
Detector Exposure Orientation	☐ Parallel ■ Perpendicular ☐ Internal
Condition Received	■ In tolerance ☐ Out of tolerance
Comments:	Sr-90 efficiency = 48.4% C-14 efficiency = 8.2%

Calibrated by: Ryan Best

Review: _____ Date: 1/31/05

Check Source Reading	Sr-90 = 31,900 cpm
Calibration Date	January 26, 2005
Calibration Due	January 26, 2006

Acceptable tolerance is stated as ±10% of calculated value at each calibration point.

Gamma Corporation
850 West Hind Drive, Suite 214, Honolulu, HI 96821

HARC Decommissioning samples
Samples taken on September 16, 2005
Samples analyzed on 10/31/05

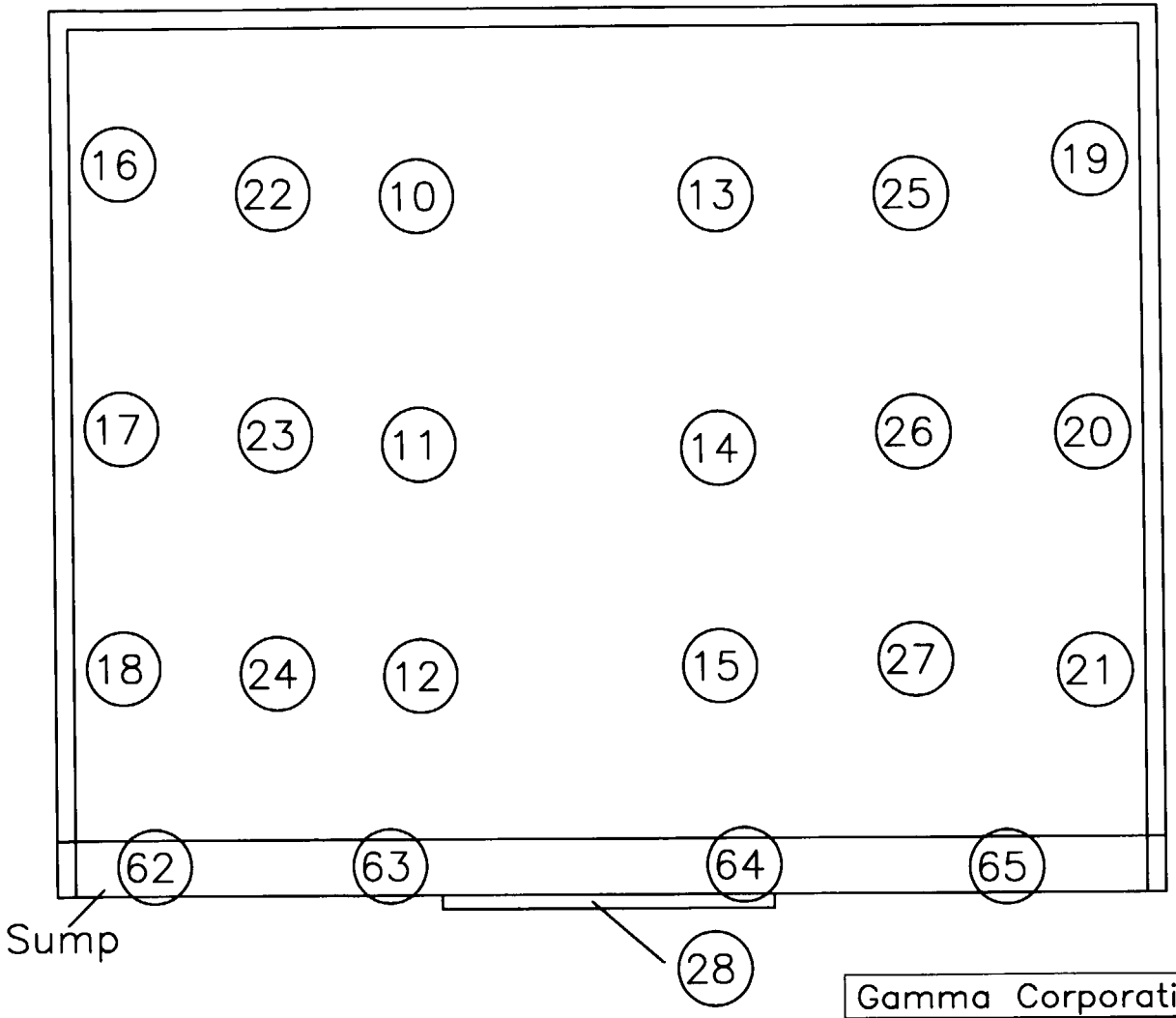
Sample#	ChA cpm	ChB cpm	ChA+ChB cpm	Net dpm C-14
1	3	10	13	<17.3
2	2	14	16	<17.3
3	6	11	17	<17.3
4	2.5	8.5	11	<17.3
5	3	16.5	19.5	<17.3
6	2.15	11.9	14.05	<17.3
7	3	15	18	<17.3
8	1.7	10.3	12	<17.3
9	3	7	10	<17.3
10	3	11	14	<17.3
11	8.8	12	20.8	<17.3
12	8.2	10.8	19	<17.3
13	4.3	11.8	16.1	<17.3
14	6	13	19	<17.3
15	4	10.8	14.8	<17.3
16	6	13	19	<17.3
17	6	9	15	<17.3
18	6	13	19	<17.3
19	9.9	13	22.9	<17.3
20	3	15	18	<17.3
21	4	4	8	<17.3
22	7	11	18	<17.3
23	3	12	15	<17.3
24	9	10	19	<17.3
25	3.8	8.2	12	<17.3
26	2	11	13	<17.3
27	1	10	11	<17.3
28	4	14	18	<17.3
29	3	5.9	8.9	<17.3
30	5	2	7	<17.3
31	4.8	12.2	17	<17.3
32	4	6	10	<17.3
33	5	8	13	<17.3
34	8	10	18	<17.3
35	9.8	11.2	21	<17.3
36	6	10	16	<17.3
37	6	10	16	<17.3
38	10	11	21	<17.3
39	7	10	17	<17.3
40	9	11	20	<17.3
41	10	11	21	<17.3
42	9	11	20	<17.3
43	4.4	15.8	20.2	<17.3
44	9.3	14.7	24	<17.3
45	3	14	17	<17.3
46	5	9	14	<17.3
47	9.6	16.4	26	18

48	7	13	20	<17.3
49	3	17	20	<17.3
50	8.6	16.4	25	<17.3
51	8.4	8.7	17.1	<17.3
52	7	10	17	<17.3
53	8	11.5	19.5	<17.3
54	3.5	8.5	12	<17.3
55	5.2	11.8	17	<17.3
56	9	12	21	<17.3
57	6	10	16	<17.3
58	7	18.9	25.9	18
59	7	11	18	<17.3
60	10	12	22	<17.3
61	18	11.4	29.4	21
62	10	9	19	<17.3
63	14	17.7	31.7	24
64	11	13	24	<17.3
65	6	8	14	<17.3
C-14 std	21728	81559.7	103287.7	
Bkg	4	5	9	

C-14 Efficiency= 0.964

MDA= 17.3 dpm C-14

Greenhouse at Kunia Substation



SCALE (FEET)

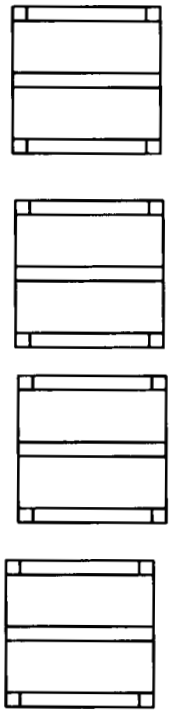
0 10 20

Gamma Corporation 850 W Hind Dr #116 Honolulu, HI 96821

APPROVALS	DATE	FACILITY
[redacted]		Kunia Greenhouse
[redacted]		ROOM
[redacted] R. Frick		Kunia Substation

Items Inside Caged Area

Planter Boxes



A
Inside:37,38
Outside:39,40
Bottom:41

B
Inside:42,43
Outside:44,45
Bottom:46

C
Inside:47,48
Outside:49,50
Bottom:51

D
Inside:52,53
Outside:54,55
Bottom:56

Trays

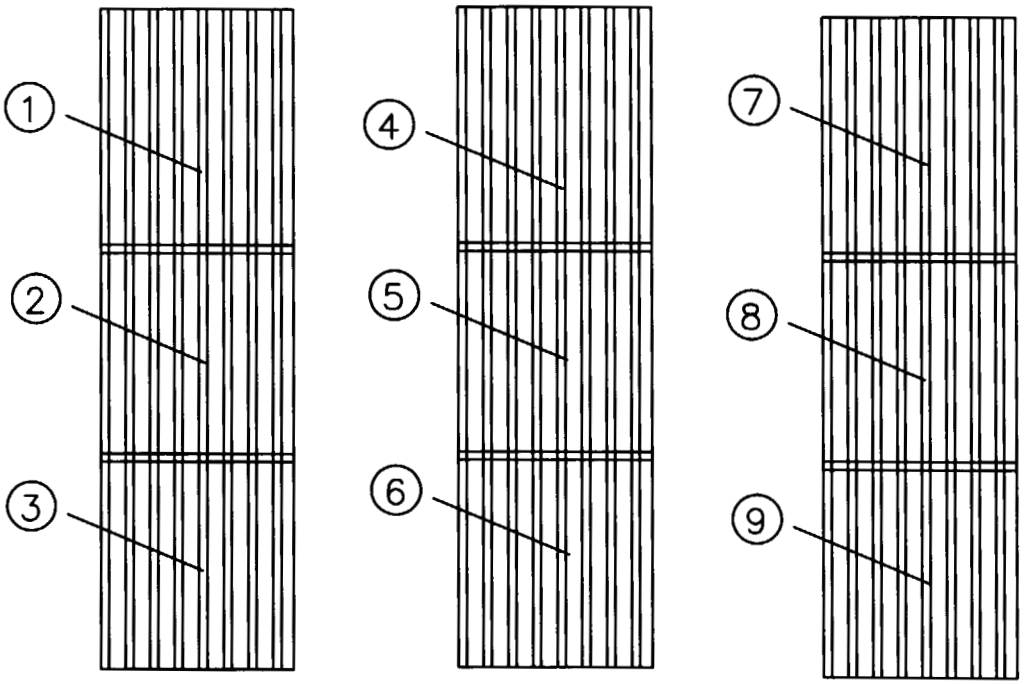
A
Top:29
Bot:30

B
Top:31
Bot:32

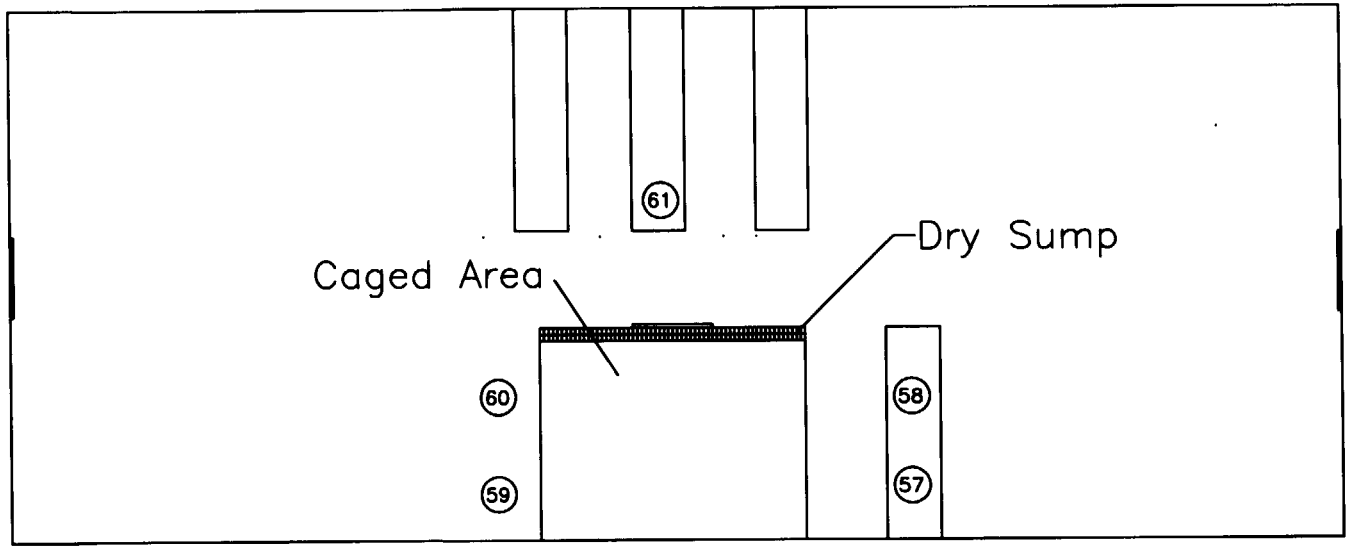
C
Top:33
Bot:34

D
Top:35
Bot:36

Wood Platforms



Greenhouse at Kunia Substation



SCALE (FEET)
0 10 20

Gamma Corporation 850 W Hind Dr #116 Honolulu, HI 96821

APPROVALS	DATE	FACILITY
DRAWN		Kunia Greenhouse
CHECKED		ROOM
R. Frick		Kunia Substation

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Time = 2.000E+00 11
Time = 4.000E+00 12
Time = 7.000E+00 13
Time = 8.000E+00 14
Time = 1.000E+01 15
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Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14	2.090E-06	2.090E-06	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	DCF3(1)
D-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(1,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	2.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	4.000E+00	1.000E+01	---	T(4)
R011	Times for calculations (yr)	7.000E+00	3.000E+01	---	T(5)
R011	Times for calculations (yr)	8.000E+00	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+01	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+01	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+02	0.000E+00	---	T(9)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): C-14	1.000E+02	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.790E-01	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.500E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.500E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
C14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	8.894E+01	0.000E+00	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	C-14	1.000E+02
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	2.000E+00	4.000E+00	7.000E+00	8.000E+00	1.000E+01	3.000E+01	1.000E+02	1.000E+03
TDOSE(t):	1.135E+02	6.379E+01	1.301E+02	1.319E+02	3.051E-02	5.033E-04	1.356E-07	0.000E+00	0.000E+00	0.000E+00
M(t):	4.539E+00	2.552E+00	5.205E+00	5.276E+00	1.220E-03	2.013E-05	5.423E-09	0.000E+00	0.000E+00	0.000E+00

Maximum TDOSE(t): 1.319E+02 mrem/yr at t = 4.284 ± 0.009 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.284E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	4.381E-12	0.0000	3.227E-10	0.0000	0.000E+00	0.0000	1.923E-06	0.0000	7.917E-07	0.0000	2.718E-07	0.0000	3.166E-11	0.000
Total	4.381E-12	0.0000	3.227E-10	0.0000	0.000E+00	0.0000	1.923E-06	0.0000	7.917E-07	0.0000	2.718E-07	0.0000	3.166E-11	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.284E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	3.039E+01	0.2304	8.289E+01	0.6283	0.000E+00	0.0000	1.208E+01	0.0916	2.331E+00	0.0177	4.239E+00	0.0321	1.319E+02	1.000
Total	3.039E+01	0.2304	8.289E+01	0.6283	0.000E+00	0.0000	1.208E+01	0.0916	2.331E+00	0.0177	4.239E+00	0.0321	1.319E+02	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	1.900E-04	0.0000	1.399E-02	0.0001	0.000E+00	0.0000	7.778E+01	0.6854	2.609E+01	0.2299	9.588E+00	0.0845	1.373E-03	0.000
Total	1.900E-04	0.0000	1.399E-02	0.0001	0.000E+00	0.0000	7.778E+01	0.6854	2.609E+01	0.2299	9.588E+00	0.0845	1.373E-03	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	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	1.135E+02	1.000
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	1.135E+02	1.000

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	3.150E-06	0.0000	2.320E-04	0.0000	0.000E+00	0.0000	1.382E+00	0.0217	5.681E-01	0.0089	1.952E-01	0.0031	2.277E-05	0.000
Total	3.150E-06	0.0000	2.320E-04	0.0000	0.000E+00	0.0000	1.382E+00	0.0217	5.681E-01	0.0089	1.952E-01	0.0031	2.277E-05	0.000

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

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	1.468E+01	0.2301	3.874E+01	0.6073	0.000E+00	0.0000	5.408E+00	0.0848	8.531E-01	0.0134	1.970E+00	0.0309	6.379E+01	1.000
Total	1.468E+01	0.2301	3.874E+01	0.6073	0.000E+00	0.0000	5.408E+00	0.0848	8.531E-01	0.0134	1.970E+00	0.0309	6.379E+01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	5.207E-08	0.0000	3.835E-06	0.0000	0.000E+00	0.0000	2.284E-02	0.0002	9.397E-03	0.0001	3.228E-03	0.0000	3.763E-07	0.000
Total	5.207E-08	0.0000	3.835E-06	0.0000	0.000E+00	0.0000	2.284E-02	0.0002	9.397E-03	0.0001	3.228E-03	0.0000	3.763E-07	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	2.999E+01	0.2305	8.173E+01	0.6281	0.000E+00	0.0000	1.190E+01	0.0914	2.278E+00	0.0175	4.178E+00	0.0321	1.301E+02	1.000
Total	2.999E+01	0.2305	8.173E+01	0.6281	0.000E+00	0.0000	1.190E+01	0.0914	2.278E+00	0.0175	4.178E+00	0.0321	1.301E+02	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	1.408E-11	0.0000	1.037E-09	0.0000	0.000E+00	0.0000	6.178E-06	0.0000	2.544E-06	0.0000	8.734E-07	0.0000	1.017E-10	0.000
Total	1.408E-11	0.0000	1.037E-09	0.0000	0.000E+00	0.0000	6.178E-06	0.0000	2.544E-06	0.0000	8.734E-07	0.0000	1.017E-10	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	3.039E+01	0.2304	8.288E+01	0.6283	0.000E+00	0.0000	1.208E+01	0.0916	2.330E+00	0.0177	4.239E+00	0.0321	1.319E+02	1.000
Total	3.039E+01	0.2304	8.288E+01	0.6283	0.000E+00	0.0000	1.208E+01	0.0916	2.330E+00	0.0177	4.239E+00	0.0321	1.319E+02	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	6.104E-17	0.0000	4.496E-15	0.0000	0.000E+00	0.0000	2.680E-11	0.0000	1.105E-11	0.0000	3.791E-12	0.0000	4.411E-16	0.000
Total	6.104E-17	0.0000	4.496E-15	0.0000	0.000E+00	0.0000	2.680E-11	0.0000	1.105E-11	0.0000	3.791E-12	0.0000	4.411E-16	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	6.529E-03	0.2140	1.909E-02	0.6255	0.000E+00	0.0000	3.029E-03	0.0993	8.649E-04	0.0283	1.003E-03	0.0329	3.051E-02	1.000
Total	6.529E-03	0.2140	1.909E-02	0.6255	0.000E+00	0.0000	3.029E-03	0.0993	8.649E-04	0.0283	1.003E-03	0.0329	3.051E-02	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 8.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	9.887E-19	0.0000	7.282E-17	0.0000	0.000E+00	0.0000	4.341E-13	0.0000	1.790E-13	0.0000	6.144E-14	0.0000	7.145E-18	0.000
Total	9.887E-19	0.0000	7.282E-17	0.0000	0.000E+00	0.0000	4.341E-13	0.0000	1.790E-13	0.0000	6.144E-14	0.0000	7.145E-18	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 8.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	1.077E-04	0.2140	3.148E-04	0.6255	0.000E+00	0.0000	4.996E-05	0.0993	1.427E-05	0.0284	1.655E-05	0.0329	5.033E-04	1.000
Total	1.077E-04	0.2140	3.148E-04	0.6255	0.000E+00	0.0000	4.996E-05	0.0993	1.427E-05	0.0284	1.655E-05	0.0329	5.033E-04	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	2.568E-22	0.0000	1.891E-20	0.0000	0.000E+00	0.0000	1.128E-16	0.0000	4.656E-17	0.0000	1.597E-17	0.0000	1.856E-21	0.000
Total	2.568E-22	0.0000	1.891E-20	0.0000	0.000E+00	0.0000	1.128E-16	0.0000	4.656E-17	0.0000	1.597E-17	0.0000	1.856E-21	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	2.901E-08	0.2139	8.481E-08	0.6255	0.000E+00	0.0000	1.346E-08	0.0993	3.845E-09	0.0284	4.459E-09	0.0329	1.356E-07	1.000
Total	2.901E-08	0.2139	8.481E-08	0.6255	0.000E+00	0.0000	1.346E-08	0.0993	3.845E-09	0.0284	4.459E-09	0.0329	1.356E-07	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	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	0.000E+00	0.000
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	0.000E+00	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	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	0.000E+00	0.000
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	0.000E+00	0.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	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	0.000E+00	0.000
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	0.000E+00	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	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	0.000E+00	0.000
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	0.000E+00	0.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	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	0.000E+00	0.000
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	0.000E+00	0.000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract
C-14	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	0.000E+00	0.000
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	0.000E+00	0.000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	2.000E+00	4.000E+00	7.000E+00	8.000E+00	1.000E+01	3.000E+01	1.000E+02	1.000E+0
C-14	C-14	1.000E+00	1.135E+00	6.379E-01	1.301E+00	1.319E+00	3.051E-04	5.033E-06	1.356E-09	0.000E+00	0.000E+00	0.000E+0

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	2.000E+00	4.000E+00	7.000E+00	8.000E+00	1.000E+01	3.000E+01	1.000E+02	1.000E+03
C-14	2.203E+01	3.919E+01	1.921E+01	1.895E+01	8.193E+04	4.967E+06	1.844E+10	*4.455E+12	*4.455E+12	*4.455E+12

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 4.284 ± 0.009 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
C-14	1.000E+02	4.284 ± 0.009	1.319E+00	1.895E+01	1.319E+00	1.895E+01

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	2.000E+00	4.000E+00	7.000E+00	8.000E+00	1.000E+01	3.000E+01	1.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.135E+02	6.379E+01	1.301E+02	1.319E+02	3.051E-02	5.033E-04	1.356E-07	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	2.000E+00	4.000E+00	7.000E+00	8.000E+00	1.000E+01	3.000E+01	1.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.000E+02	1.659E+00	2.744E-02	7.430E-06	3.229E-11	5.234E-13	1.361E-16	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 2.90 seconds

DATE

This is to acknowledge the receipt of your letter/application dated 12-02-05, and to inform you that the initial processing, which includes an administrative review, has been performed.

☒ There were no administrative omissions. Your application will be assigned to a technical reviewer. Please note that the technical review may identify additional omissions or require additional information.

☐ Please provide to this office within 30 days of your receipt of this card:

The action you requested is normally processed within 90 days.

☐ A copy of your action has been forwarded to our License Fee & Accounts Receivable Branch, who will contact you separately if there is a fee issue involved.

Your action has been assigned **Mail Control Number** 470798.
When calling to inquire about this action, please refer to this mail control number.
You may call me at 817-860-8103.

Sincerely,

Colleen Murnahan
Licensing Assistant

NRC FORM 532 (RIV)
(9-2003)

BETWEEN:

License Fee Management Branch, ARM
and
Regional Licensing Sections

(FOR LFMS USE)
INFORMATION FROM LTS

Program Code: 03620
Status Code: 0
Fee Category: 3M
Exp. Date: 20150630
Fee Comments: _____
Decom Fin Assur Reqd: N

LICENSE FEE TRANSMITTAL

A. REGION

1. APPLICATION ATTACHED
   Applicant/Licensee: HAWAII AGRICULTURE RESEARCH CENTER
   Received Date: 20051209
   Docket No: 3006839
   Control No.: 470798
   License No.: 53-00515-01
   Action Type: Amendment

2. FEE ATTACHED
   Amount: _____
   Check No.: _____

3. COMMENTS

Signed Colleen Murnahan
Date 12/20/05

B. LICENSE FEE MANAGEMENT BRANCH (Check when milestone 03 is entered /__/)

1. Fee Category and Amount: _____

2. Correct Fee Paid. Application may be processed for:
   Amendment _____
   Renewal _____
   License _____

3. OTHER _____

Signed _____
Date _____

PITNEY BOWES

U.S. POSTAGE

1960 985532626

8021 $01.98 0 DEC 05 2005

7769 MAILED FROM ZIP CODE 96701

HARC

HAWAII AGRICULTURE RESEARCH CENTER
99-193 AIEA HEIGHTS DRIVE, SUITE 300
AIEA, HAWAII 96701-3911
http://www.hawaiiag.org/harc

Nuclear Materials Licensing Branch
U.S. Nuclear Regulatory
Commission, Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

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DEC - 9 2005
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