MATERIALS LICENSE

Amendment No. 41

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

OFFICIAL RECORD COPY

Licensee	
1. Department of the Army U.S. Army Communications - Electronics Command AMSEL-SF-RER 2. Fort Monmouth, New Jersey 07703-5024	In accordance with the letter dated April 11, 1997, 3. License Number 29-01022-06 is amended in its entirety to read as follows: 4. Expiration Date February 28, 2005 5. Docket or Reference No. 030-05248

6. Byproduct, Source, and/or Special Nuclear Material	7. Chemical and/or Physical Form	8. Maximum Amount that Licensee May Possess at Any One Time Under This License
A. Any byproduct material with atomic numbers 1 through 83	A. Any	A. Not to exceed 1 curie per radionuclide and 10 curies total
B. Any byproduct material with atomic numbers 84 through 95	B. Any	B. Not to exceed 1 millicurie total
C. Cesium 137	C. Sealed sources	Exempt C. curies
D. Cobalt 60	D. Sealed sources	D. curies
E. Strontium 90	E. Sealed sources	E. 5 curies
F. Hydrogen 3	F. Accelerator targets	F. 30 curies
G. Uranium (Natural or Depleted)	G. Any	G. 5 kilograms
H. Thorium (Natural)	H. Any	H. 10 kilograms
I. Americium 241	I. Any	I. 1 millicurie
J. Plutonium 238	J. Sealed sources	J. 10 microcuries
K. Polonium 210	K. Any	K. 10 microcuries
L. Californium 252	L. Sealed source	Exempt L. curie
M. Cesium 137	M. Sealed sources (J.L. Shepherd Model 6810)	M. curies

9. Authorized use

A. through L. Research and development as defined in 10 CFR 30.4; for training and instrument calibrations; analysis of test samples as a service for other persons as defined in 10 CFR 20.1003(a)(11).

M. For use in a J.L. Shepherd Model 81-14Q calibrator.

CONDITIONS

10. Licensed material may be used only at the licensee's facilities located at the U.S. Army Communications - Electronics Command, Fort Monmouth, New Jersey.

ML 10

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License number 29-01022-06

Docket or Reference number 030-05248

Amendment No. 41

11. A. Licensed material shall be used by, or under the supervision of, individuals designated in writing by the Radiation Safety Committee, Joseph M. Santarsiero, Chairman.

B. The Radiation Safety Officer for this license is Joseph M. Santarsiero.

12. Licensed material shall not be used in or on human beings.

13. A. Sealed sources and detector cells containing licensed material shall be tested for leakage and/or contamination at intervals not to exceed six months or at such other intervals as are specified by the certificate of registration referred to in 10 CFR 32.210, not to exceed three years.

B. Notwithstanding Paragraph A of this Condition, sealed sources designed to emit alpha particles shall be tested for leakage and/or contamination at intervals not to exceed three months.

C. In the absence of a certificate from a transferor indicating that a leak test has been made within six months prior to the transfer, a sealed source or detector cell received from another person shall not be put into use until tested.

D. Each sealed source fabricated by the licensee shall be inspected and tested for construction defects, leakage, and contamination prior to any use or transfer as a sealed source.

E. Sealed sources and detector cells need not be leak tested if:

(i) they contain only hydrogen-3; or

(ii) they contain only a radioactive gas; or

(iii) the half-life of the isotope is 30 days or less; or

(iv) they contain not more than 100 microcuries of beta and/or gamma emitting material or not more than 10 microcuries of alpha emitting material; or

(v) they are not designed to emit alpha particles, are in storage, and are not being used. However, when they are removed from storage for use or transfer 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 or detector cell shall be stored for a period of more than 10 years without being tested for leakage and/or contamination.

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License number: 29-01022-06
Docket or Reference number: 030-05248
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F. The 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 and the source or detector cell shall be removed immediately from service and decontaminated, repaired, or disposed of in accordance with Commission regulations. The report shall be filed within five days of the date the leak test result is known with the U.S. Nuclear Regulatory Commission, Region I, ATTN: Chief, Nuclear Materials Safety Branch, 475 Allendale Road, King of Prussia, Pennsylvania 19406. The report shall specify the source or detector cell involved, the test results, and corrective action taken.

G. The licensee is authorized to collect leak test samples for analysis by the licensee. Alternatively, tests for leakage and/or contamination may be performed by persons specifically licensed by the Commission or an Agreement State to perform such services.

14. Sealed sources or detector cells containing licensed material shall not be opened or sources removed from source holders by the licensee.

15. The licensee shall not acquire licensed material in a sealed source or device unless the source or device has been registered with the U.S. Nuclear Regulatory Commission pursuant to 10 CFR 32.210 or equivalent regulations of an Agreement State.

16. The licensee shall conduct a physical inventory every six months to account for all sealed sources and devices containing licensed material received and possessed under the license.

17. The licensee shall not use licensed material in field applications where activity is released except as provided otherwise by specific condition of this license.

18. This license does not authorize commercial distribution of licensed material.

19. The licensee is authorized to transport licensed material in accordance with the provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

MATERIALS LICENSE
SUPPLEMENTARY SHEET

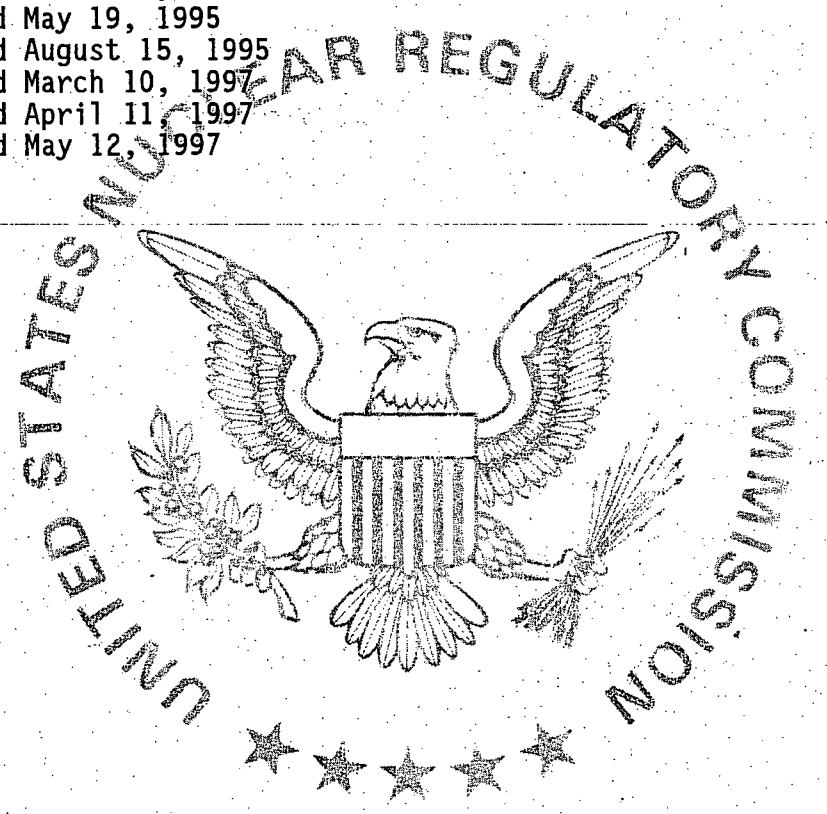
License number
29-01022-06

Docket or Reference number
030-05248

Amendment No. 41

20. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The Nuclear Regulatory Commission's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.

A. Letter dated February 15, 1995
B. Letter dated March 15, 1995
C. Letter dated May 19, 1995
D. Letter dated August 15, 1995
E. Letter dated March 10, 1997
F. Letter dated April 11, 1997
G. Letter dated May 12, 1997



Date MAY 27 1997

For the U.S. Nuclear Regulatory Commission
Original Signed By:
Steve W. Shaffer
By _____
Nuclear Materials Safety Branch
Region I
King of Prussia, Pennsylvania 19406

MAY 27 1997

Mr. Steven A. Horne
Director, Safety Risk Management
Department of the Army
U.S. Army Communications Electronics Command
AMSEL-SF-RER
Fort Monmouth, New Jersey 07703-5024

Dear Mr. Horne:

This refers to your license amendment request. Enclosed with this letter is the amended license.

Please review the enclosed document carefully and be sure that you understand and fully implement all the conditions incorporated into the amended license. If there are any errors or questions, please notify the U.S. Nuclear Regulatory Commission, Region I Office, Licensing Assistance Team, (610) 337-5093 or 5239, so that we can provide appropriate corrections and answers.

Thank you for your cooperation.

Sincerely,

Original Signed By:
Steve W. Shaffer

Steve W. Shaffer
Division of Nuclear Materials Safety

License No. 29-01022-06
Docket No. 030-05248
Control No. 124486

Enclosure:
Amendment No. 41

DOCUMENT NAME: C:\TYPING\COVER.LTR\29-01022.06
To receive a copy of this document, indicate in the box: "C" = Copy w/o attach/encl "E" = Copy w/ attach/encl "N" = No copy

OFFICE	DNMS/RI	N	DNMS/RI					
NAME	Shaffer SWS							
DATE	05/27/97		05/ /97		05/ /97		05/ /97	

OFFICIAL RECORD COPY ML 10

DEPARTMENT OF THE ARMY
HEADQUARTERS, US ARMY COMMUNICATIONS-ELECTRONICS COMMAND
AND FORT MONMOUTH
FORT MONMOUTH, NEW JERSEY 07703-5000

MS 16
J-5

REPLY TO
ATTENTION OF

Directorate of Safety Risk Management 12 May 1997

U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406-1415

Attention: Mr. Steven Shaffer
Decommissioning and Laboratory Branch

This refers to U.S. Nuclear Regulatory Commission (NRC) License Number 29-01022-06, Docket Number 030-05248, Mail Control Number 124486, our April 11, 1997 license amendment request, and to your May 6, 1997 telephone conversation between Mr. Barry J. Silber, CECOM Directorate of Safety Risk Management, and Mr. Steven Shaffer, NRC Region I.

The following additional information is provided as a result of the above May 6, 1997 telephone conversation. This information augments our April 11, 1997 license amendment request to authorize the use of radiation sources in [ ] of Fort Monmouth's Charles Wood Area.

a. The information originally provided to you in our letter of 15 August 1995 regarding the use of the J.L. Shepherd Model 81-14Q Calibrator also applies to the use of this calibrator in [ ].

b. A radiation survey of the exterior of [ ] will be performed with the J.L. Shepherd Model 81-14Q Calibrator in the exposed position, upon installation of this calibrator, and the results of this survey will be provided to your office.

c. We do not anticipate using the Californium 252 sealed source, authorized under Conditions 6K, 7K, 8K and 9K of this license, [in]. However, should we require the use of Californium 252 in this facility, a radiation survey of the building exterior, with this source in the exposed position, will be performed upon installation of this source utilizing appropriate neutron radiation survey instrumentation. The results of this survey will be provided to your office.

Your expeditious processing of this amendment request is appreciated.

Parks Ex 2

124486

OFFICIAL RECORD COPY ML 10

MAY 15 1997

Our Point of Contact is Mr. Joseph M. Santarsiero or Mr. Barry J. Silber, Facsimile on (908) 532-6403 or (908) 542-7161; Voice on (908) 427-4427/3112.

Sincerely,

Joseph M. Santarsiero

JOSEPH M. SANTARSIERO
Acting Director, Safety
Risk Management

Copy Furnished:

Commander, U.S. Army Materiel Command, ATTN: AMCSF-P,
5001 Eisenhower Avenue, Alexandria, Virginia 22333-0001

PERSON CALLED:	ORGANIZATION:	TELEPHONE NUMBER:
Barry Silber	Department of the Army Fort Monmouth	908-427-3112 Ext. 6440
LICENSE NUMBER:	**DOCKET NUMBER:**	**MAIL CONTROL NUMBER:**
29-01022-06	030-05248	124486

PERSON CALLING:

Steve W. Shaffer (610) 337-5256
USNRC Region I FAX Numbers
475 Allendale Road (610) 337-5269 or
King of Prussia, PA 19406 (610) 337-5393

SUBJECT: Letter dated April 11, 1997

SUMMARY: I requested the following information be submiited regarding this action.

1. Please confirm that you operate the irradiator as per your commitments provided in your letter dated August 15, 1995.

2. Please confirm that upon installation of the irradiator in [ ], a survey shall be performed of the building exterior with the source fully exposed and that the survey shall be submitted to the region.

3. In the event that your californium source is used in this Bldg. Please confirm that a survey of the Bldg. exterior shall be performed with this source fully exposed and that the survey shall be performed with a neutron sensitive survey instrument and the survey shall be submitted to the region.

ACTION REQUIRED/TAKEN: MILESTONE 15

SIGNATURE:	DATE:
Steve W. Shaffer	May 6, 1997

DEPARTMENT OF THE ARMY
HEADQUARTERS, US ARMY COMMUNICATIONS-ELECTRONICS COMMAND
AND FORT MONMOUTH
FORT MONMOUTH, NEW JERSEY 07703-5000

REPLY TO
ATTENTION OF

April 11, 1997

Directorate of Safety
Risk Management

U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, Pennsylvania 19406-1415

Attention: Licensing Assistance Section

This refers to U.S. Nuclear Regulatory Commission (NRC) License Number 29-01022-06, Docket Number 030-05248.

Conditions 6L, 7L, 8L, 9L and 10 of Amendment Number 39 dated August 23, 1995 currently authorizes the use of the J.L. Shepherd Model 81-14Q in [ ]. We are requesting an amendment to this license to authorize the use of this calibrator in [ ] of Fort Monmouth's Charles Wood Area. We are also requesting that this building be recognized as an authorized facility for usage of other low activity calibration/references sources as deemed necessary.

[ ] is constructed of poured concrete and concrete filled cinder block embedded with steel rebar, with steel sheet metal roof with steel crossmember support. This building has been designed and constructed to house our radiation counting laboratory, radiochemical laboratory, and radiation calibration range. The building also includes areas for instrument repair, laboratory storage and radiation storage. The building has provisions for heating and air conditioning (temperature controlled environment), is equipped with a wet fire suppression (water sprinkler) system and fire detectors. Access to the building is key controlled.

The radiation calibration range room has been constructed with a high density concrete shield wall, with a thickness of 40 inches and height of ten feet above the finished floor. The calibrator will only be used as indicated in Shield Wall Design Calculations for CECOM Directorate of Safety Risk Management

Portions Ex 2

124486
APR 17 1997

Ionizing Radiation Instrument Calibration Facility (enclosure 1). This assessment was originally based on the usage of a 450 curie Cobalt-60 calibrator. This design adequately addresses shielding and safety requirements for the use of a 450 curie Cobalt 60 or 130 curie Cesium 137 calibrator. At enclosure 2 is an engineering drawing of this building.

Your expeditious processing of this amendment request is appreciated.

Our Point of Contact is Mr. Joseph M. Santarsiero or Mr. Barry J. Silber, Facsimile on (908) 532-6403 or (908) 542-7161; Voice on (908) 427-4427/3112.

Sincerely,

Steven A. Horne
Director, Safety
Risk Management

Enclosures

Copy Furnished:

Commander, U.S. Army Materiel Command, ATTN: AMCSF-P, 5001 Eisenhower Avenue, Alexandria, Virginia 22333-0001

Shield Wall Design Calculations
Ionizing Radiation Instrument Calibration Facility
[ ] Fort Monmouth, NJ

Ex2

CECOM Directorate of Safety Risk Management

Performed by:
David Craig
Health Physics Consultant
IceSolv, Inc.

Shielding Requirement Overview: The ionizing radiation source that will be used in this facility is a 450 Curie, Cobalt-60 source. The source will be housed in a lead filled steel column with a beam port that will collimate the radiation into a beam approximately 20 feet wide and 9 feet high at a distance of 30 feet from the source. The radiation beam will strike the shield wall at a minimum distance of 25 feet. The shield wall must be constructed of material that will attenuate the radiation to a dose rate of less than 2 mrem/hr on the exterior surface. Typical construction concrete density was used in the shielding calculation. The presence of steel rebar was not considered because it would not significantly effect results. The concrete must be poured in a manner that prevents internal voids.

Facility Layout: (See attached drawing)

The calibration source will be located on the center line of a 25 x 40 ft long room. The source will be positioned 30 to 35 feet from the down range outer surface of shield (Original plan was 33 to 35 feet to wall. Changes to calibration area resulting from location of the communications equipment room in the calibration rooms floor space will force relocation of the source. In any case the source will be no closer than 30 feet from the outer surface of the shield wall and the calculation is based on this position.).

Raytheon, Microshield calculations:

The calculation performed by Raytheon (85 cm) agrees with the attached calculation (86 cm) of wall thickness with buildup factor applied. The additional 18 cm of concrete (slightly less than one tenth value layer) desired for construction is

the product of conservative factors for calculation factor variances and possible differences in actual density of concrete poured at the site.

Conclusion

Construct the building using the 103 cm wall thickness. The 103 cm thickness is the product of the calculation of shield attenuation accounting for buildup factor and conservative factors that should cover any variances in actual construction.

Calculation Data:

Energy (Yield%) of Co-60 gamma rays	1.33 (100%), 1.17 (100%)
Source strength, Curies	450
Distance to outer shield wall from source, feet	30
Required dose rate at shield wall outside surface, mrem/hr	1.9
Density of concrete, gm/cm^3	2.35
Buildup factor (B)	14

μr, calculated using 0.1254 cm^{-1} for μ and 65.2 cm for r. Product μr = 8.17 interpolation into table A4.4 with energy (E_o) 1.33 MeV interpolation, results interpolation to arrive at B value (value 13.6 rounded up to whole number). Calculations and references used to arrive at values of μ and r follow.

μ, linear attenuation coefficient:

$\mu = \mu/\rho$ (mass absorbsion coefficient)[1] x ρ (density concrete)[2]
μ = 0.0557 cm^2g^{-1} x 2.25 g cm^{-3} = **0.1254 cm^{-1}**

r = Value calculated using the radiation attenuation equation without the buildup factor present $I_s = I_o e^{-\mu r}$, see attached calculations. = **65.2 cm.**

---

[1]Table A3.3, "Principles of Radiation Shielding", Arthur B. Chilton, J. Kenneth Shultis, Richard E. Faw, Prentice-Hall, Inc., Englewood Cliffs, NJ 07632

[2]Material Density table, page 66, "Radiological Health Handbook" U.S. Department of Health, Education, and Welfare (Public Health Service), Revised Edition January 1970.

Equations Used in Calculations.

1. Shield attenuation: $I_s = I_o B e^{-\mu x}$

   Where:

   I_s , outer wall shield dose rate. (given 0.0019 R/hr)

   I_o , outer wall unshielded dose rate. (6.72 R/hr)

   B , shield material buildup factor. (14)

   e , base natural log (2.718281828459)

   μ , shield material linear absorbsion coefficient factor for the radiation energy (0.1254 cm^{-1}).

   x , concrete shield thickness with buildup factor in centimeters. (to be solved for)

2. Point source dose rate at shielding wall outer surface. $\frac{0.5\ C\ E\ n}{r^2}$

   Where: This form of the equation is a development of the equation exposure rate (R/hr) = $\Gamma\ C/r^2$

   0.5 , derived constant from base equation.

   C , Source activity in curies.

   E , total photon energy (MeV/dis).

   n , yield fraction per disintegration.

   r , distance from source in meters.

Calculation of outer wall unshielded dose rate.

$$\frac{0.5\ C\ E\ n}{r^2}$$

Given:

C, 450 Ci, Cobalt 60
E, (1.33), (1.17), sum 2.5 MeV
n, 1.00 for both energies.
r, 9.15 meters (30 feet)

Solution:

$$\frac{0.5 * 450 * 2.5 * 1.00}{(9.15)^2} = \mathbf{6.72\ R/hr}$$

Calculation of wall thickness without buildup factor (B) to determine factor *r*.

$$I_s = I_o e^{-\mu r}$$

Given:

I_s, outer wall dose rate required, 0.0019 R/hr
I_o, inner wall dose rate 6.72 R/hr
e, 2.718281828459
μ, 0.1254 cm^{-1}

solve for: *r*, concrete wall thickness without buildup factor units, cm.

$$0.0019\ R/hr = 6.72\ R/hr * e^{-0.1254 * r}$$

$$\ln(0.0019 / 6.72) = -0.1254 * r$$

$$-8.17/-0.1254 = 65.2$$

r = **65.2 cm**

Calculation of wall thickness with BU factor of 14.

$I_s = I_o B e^{-\mu x}$

$0.0019 \text{ R/hr} = 6.73 \text{ R/hr} (14) * e^{-0.1254 * x}$

$\ln(0.0019 / 94.08) = -0.1254 * x$

$x =$ **86.2 cm**

x = 86.2 cm, calculated wall thickness. 1.1 calculation variances and 1.1 conservative factor (wall density variances) practical construction **wall thickness 100 to 105 cm.**

Shield Wall Design Calculations
Addendum
Cesium 137

Calculation Data:

Energy (Yield%) of Co-60 gamma rays	0.662 (85%)
Source strength, Curies	130
Distance to outer shield wall from source, feet	30
Density of concrete, gm/cm^3	2.25
Buildup factor (B)	88

μr, calculated using 0.1753 cm^{-1} for μ and 101.6 cm for r. Product μr = 17.8 interpolation into table A4.4 with energy (E_o) 0.662 MeV interpolation, results interpolation to arrive at B value (value 87.7 rounded up to whole number). Calculations and references used to arrive at values of μ and r follow.

μ, linear attenuation coefficient:

$\mu = \mu/\rho$ (mass absorbsion coefficient)[3] x ρ (density concrete)[4]
μ = 0.0779 cm^{2}g^{-1} x 2.25 g cm^{-3} = **0.1753 cm^{-1}**

r = Value calculated using the radiation attenuation equation without the buildup factor present $I_s = I_o e^{-\mu r}$, = 101.6 **cm.**

---

[3]Table A3.3, "Principles of Radiation Shielding", Arthur B. Chilton, J. Kenneth Shultis, Richard E. Faw, Prentice-Hall, Inc., Englewood Cliffs, NJ 07632

[4]Material Density table, page 66, "Radiological Health Handbook" U.S. Department of Health, Education, and Welfare (Public Health Service), Revised Edition January 1970.

Equations Used in Calculations.

1. Shield attenuation: $I_s = I_o B e^{-\mu x}$

   Where:

   I_s , outer wall shield dose rate. (to be solved for)

   I_o , outer wall unshielded dose rate. (0.437 R/hr)

   B , shield material buildup factor. (88)

   e , base natural log (2.718281828459)

   μ , shield material linear absorbsion coefficient factor for the radiation energy (0.1753 cm^{-1}).

   x , concrete shield thickness with buildup factor in centimeters. (101.6 cm)

2. Point source dose rate at shielding wall outer surface. $\frac{0.5\ C\ E\ n}{r^2}$

   Where: This form of the equation is a development of the equation exposure rate (R/hr) = $\Gamma\ C/r^2$

   0.5 , derived constant from base equation.

   C , Source activity in curies.

   E , total photon energy (MeV/dis).

   n , yield fraction per disintegration.

   r , distance from source in meters.

Calculation of outer wall unshielded dose rate.

$$\frac{0.5\ C\ E\ n}{r^2}$$

Given:

C, 130 Ci, Cesium 137
E, 0.662 MeV
n, 0.85
r, 9.15 meters (30 feet)

Solution:

$$\frac{0.5 * 130 * 0.662 * 085}{(9.15)^2} = \underline{\mathbf{0.437\ R/hr}}$$

Calculation of wall thickness with BU factor of 88.

$$I_s = I_o e^{-\mu r}$$

Given:

I_s , outer wall dose rate required
I_o , inner wall dose rate 0.437 R/hr
e, 2.718281828459
μ, 0.1753 cm^{-1}
x = in cm

solve for: I_s , inner wall dose rate, R/hr

$$I_s \text{ R/hr} = 0.437 \text{ R/hr} * e^{-0.1753 * 101.6}$$

I_s = **7.1E-07 R/hr**

CALIBRATION ROOM

Ex 2