70-349
renewal

NORTHWESTERN UNIVERSITY
EVANSTON – CHICAGO

OFFICE OF RESEARCH SAFETY

B-106 WARD BUILDING
303 EAST CHICAGO AVENUE
CHICAGO, ILLINOIS 60611

July 22, 1983

U.S. Nuclear Regulatory Commission
Material Licensing Branch
Division of Fuel Cycle and Material Safety
Washington, D.C. 20555

Re: SNM-330

83 JUL 25 A8:

Dear Sir/Madam:

Northwestern University would like to renew its Special Nuclear Material license, SNM-330. Northwestern University is a non-profit, educational institution and the material requested under this license is to be used for teaching and training purposes. Therefore, no application fee is required, as specified in 10CFR170.11.4.

Some changes have been made in the program since the former license application was submitted on June 30, 1978. These changes are identified below. There are no changes, however, in the quantity or type of material. The license limits should remain,

Plutonium:	Pu·Be sealed sources	112 grams
Uranium-235	Any form	1 gram

A new Radiation Safety Handbook has been printed to supercede the old Handbook of Radiological Operations. A copy of the new handbook is enclosed.

The Radiation Safety Committee membership is described in a letter to your office dated December 6, 1982. Changes in committee memberships occur in the fall at Northwestern University and when the new member/s are appointed, we will notify you.

The facilities have changed somewhat. Room B959 in the Technological Institute, Evanston campus has now been designed to house the sealed sources (Pu·Be) covered under this license. A sketch of this room is enclosed. When the sources are needed for experimentation, they are used in Room B970, described in previous licenses. This laboratory, B970, is a nuclear engineering teaching laboratory, and houses the sub-critical reactor. This laboratory and the sealed Pu·Be sources remain under the direction of Dr. Donald Eggen, Professor, Mechanical and Nuclear Engineering Department. Dr. Eggen's curriculum vitae has been submitted previously.

The primary equipment used for neutron surveys is the PRS2P/NRD-Rem Ball with a BF3 detector. Other instruments in the Evanston office are described on the attached inventory. Calibration procedures are also enclosed. Surveys are performed on room B959 on a monthly basis. Room B970 is inspected on a quarterly basis. Records of room surveys are maintained in the Evanston office, Technological Institute, Room B911.

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Personnel dosimeters, either neutron Trak-etch or P1 badges, are supplied by R.S.Landauer, Jr., Inc. on a monthly basis. Dosimeter reports are sent to Dr. Eggen, the Evanston radiation safety office, and the permanent record maintained in the files on the Chicago campus.

Leak tests on all sealed sources, if in use, are carried out at 6-month intervals, as specified in the license, dated August 21, 1978. Copies of these tests are maintained on the Evanston campus.

No waste materials are generated under this license, but any wastes generated would be handled by ADCO Services, Inc., Tinley Park, Illinois.

Please disregard Appendices A, B, C, and D submitted in license application dated June 30, 1978.

If additional information is needed, please contact Dr. David R. Miller, Radiation Safety Officer at the address shown above.

Yours truly,

David R. Miller

David R. Miller, Director
(Radiation Safety Officer)

Appendix B

Instrument List - Evanston Campus

I.D. NO.	INSTRUMENT	MODEL #	# AVAIL.	RAD. DETECT.	RANGE	USE
SN 843	VICTOREEN Ion Chamber	440	1	β, γ, x	0-3 mR/hr to 0-300 mR/hr $2mg/cm^2$	survey of sealed source areas
SN 2050		740F	1	β, γ, x	0-25mR/hr to 0-25k mR/hr 0.00025" mylar window	survey of sealed source areas
SN 1856	EBERLINE Gas Prop. counter (with TP-1, AC-21, 21B)	PAC-4G-3	1	$\alpha, \beta, {}^3H$	0-500x10^3 c/min $0.85\ mg/cm^2$	lab survey 3-H wipes
RS 058	NUCLEAR CHICAGO Prop. counter	8700	1	$\alpha, \beta, {}^3H$	10^6 cpm Q-gas	wipe test of packages; sealed sources; lab wipes
RS100	EBERLINE (geiger)	E-120G	1	α, β, γ, x	0-700 c/min.to 0-70x10^3 c/min; $1.7\ mg/cm^2$ end window	lab survey; detection of x-ray diffraction leakage
RS 019	EBERLINE	PRM-5-3 w/ SPA-3 (Scint.-NaI)	1	β, γ, x	0-500x10^3 c/min	125-I, 131-I, 123m-Te, 57-Co, surveys
	EBERLINE	PRS-2P/NRD SN: 297	1	neutrons	ratemeter: 10cpm to 999,999cpm dose ratemeter: 0.00001 to 99,900	Surveying Nuclear Eng. labs

I.D. NO.	INSTRUMENT	MODEL #	# AVAIL.	RAD. DETECT.	RANGE	USE
	VICTOREEN					
	Dosimeter/ Charger	906	1			
	Dosimeter	541R	3		0-200mR	
	Dosimeter	541F	1		0-200mR	
	Dosimeter	883	1		0-500mR	
	Dosimeter	050	1		0-5 R	

The following does not belong to the Radiation Safety Office but is readily available for our use:

	VICTOREEN					
	Ion Chamber	470A	4	β, γ, x	0-3mR or mR/hr to 0-1000 R/hr to 1R integral	x-ray machine survey. teaching labs
	Well counter					

Northwestern University

Calibration Procedure, Evanston campus

A. Ion chambers, geiger counters, portable gas flow proportional counters:

1. Pertinent information (instrument type, manufacturer, model numbers and serial numbers of both meter and probe, and calibration date), is recorded on the calibration data form.

2. Physical inspection of the instrument for mechanical damage. Instrument is cleaned if necessary.

3. Battery check, using "battery check" switch on the instrument. In cases where the batteries are low, they are checked with the Triplett Model 630A volt-ohmmeter (20 000 ohms/volt) or equivalent. Low voltage batteries are replaced as needed.

4. Where applicable (as stated in specific instrument manuals) circuit bias and/or tube voltages are checked using the volt meter.

5. The input voltage threshold sensitivity is determined using the Eberline MP-1 Mini Pulser, which has a continuously variable voltage output for this purpose.

6. The instrument is placed in the 137Cs radiation field, at distances appropriate for a "two-points-per-scale" calibration. The two points on each scale are separated by at least 50% of the scale. For example, on a 0-100mR/hr scale, 80mR/hr and 20mR/hr are calibration points. If nonlinearity of the meter is found, the two points are adjusted such that the average fractional deviation is equal for both high and low ends of the scale. If the measured exposure rate differs at any point by greater than or equal to 10% but less than 20%, a calibration graph, chart, or correction factor is attached to the instrument. Instruments are removed from service for repair and recalibration when measured exposure rates deviate by greater than or equal to 20% from the true exposure rate.

7. For G.M. and other pulse counting meters the Eberline Pulser, MP-1, is used to calibrate the electronics. This instrument has a range of from 1.0c/min to 1.6×10^6c/min at an accuracy of +/-0.1%. The output pulse has a 0.2 u-sec rise time, a 0.2 usec window width and a 3 usec fall. This is not the sole means of calibration; the survey meters are also exposed to the radiation field.

8. The portable gas flow proportional counters (PAC4G3/AC21B) are calibrated with ^{99}Tc plated sources at 280+/-10, 3460+/-100, 33 900+/-1000, and 283 500+/-8 500 cpm (ea), as certified by the manufacturer, Eberline Instrument Corp. These sources are NBS traceable and the total estimated error is +/-3%. The activities correspond to count rates which lie approximately in the midpoint of each range on the Lin-Log scales.

Calibration Procedure, Evanston Campus

B. Nuclear Chicago Gas Flow Proportional Counter

1. The counter is checked for voltage plateau using the Nuclear Chicago Ra(D+E) source, or other appropriate source.

2. The counter is checked for reproducibility by means of a Chi-square statistical analysis. At least 20 repeated measurements are made for this analysis.

3. Counting efficiencies are determined using the NEN Beta source set #NES200 A (NBS traceable) reference sources.

C. An appropriate check source is counted in specified geometry for each instrument. This information is recorded on the calibration form.

D. Calibration frequency is semi-annually.

E. Calibration Sources:

1. NEN Beta Source Set #NES200 A

2. 137Cs, Nuclear Associates Model 726,99.2 mCi(3/30/78) serial number 158.

3. 99Tc Electroplated Beta Source Set, Eberline serial numbers 7644, 7645, 7646, and 7647, calibration date 3/14/77.

F. Health Physics: The 137Cs source is constructed with a built-in timer which returns the source automatically into the source housing at the end of the specified duration of exposure. The field is limited such that an operator behind the source is not exposed to the direct beam. Doors to the calibration facility are locked if possible and are posted with the correct radiation warning signs. Personal dosimetry is used (film badge). An accessory survey meter is kept on hand during the calibration procedure. Protective clothing is worn.

No handling of the 99Tc electroplated beta sources is necessary.

Beta reference sources are used in planchets and are not handled with bare hands.

CALIBRATION OF 2PRS-2P/NRD

1. The instrument is splashproof but should be inspected to be as clean and dry as possible.
2. Battery check is performed by connecting a well-regulated power supply supplying an adjustable voltage between 5 volts and 7 volts, at 150mA, to the battery connector on chassis. Range switch is in the OFF position.
3. Adjust power supply to 5.75 volts and turn range switch to position A; battery legend should indicate BATT OK. Adjust power supply to 5.6 volts; battery legend should indicate ERROR.
4. Adjust BATT OK ADJ potentiometer R520 if necessary to give above indications.
5. To adjust high voltage connect an electrostatic voltmeter or any other instrument with an extremely high impedance, to capacitor C601 and place range switch in the HV position.
6. Adjust HV ADJ (front panel) for 1500 volts. If display does not indicate 1500 volts ± 5%, adjust VCO frequency, R515, potentiometer.
7. Adjust HV ADJ to 500 volts. If display does not indicate 500 ± 5% adjust VCO OFFSET, R516, potentiometer. Repeat as often as necessary for complete adjustment.
8. Next, the calibration boards and their control switches are adjusted and programmed.
9. For the calibration function to operate, the CALIB switch of the calibration board must be in the IN position and the function switch on the front panel must be in the RATE mode.
10. The SCALAR switch is not part of the calibration function. It provides a choice of readout for the scalar functions. In the STORE position the counts are stored and the display readout is updated at the completion of the timed cycle or when the range switch is placed in the STOP position. In the increment position the display is updated with each count.
11. Connect a pulse generator (Eberline MP-1) and set it at a rate of 100K cpm. Vary the time switch on the front panel from 0.5 min. to 5 min. and record instrument reading.
12. Set selector switch on RATE mode starting with A,B,C,D, as the input signal from the MP-1 is varied from 800 cpm, 8K cpm, 80K cpm and 800K cpm respectively.
13. Expose instrument to ^{252}Cf (NE 116) with a source strength of 8.31×10^{6} n/sec (3.685 ugm) on 1-26-78 and apply the inverse square law. Record instrument readings and distances.

Date 1/2 /78

SOURCE FABRICATED FOR: Northwestern University

Source Type University Long Source No. 116

Primary Source Encapsulation		Secondary Container	
No. of Source Capsules	1	Container Material	SS
Capsule Material	Pt-10% Ir	External Diameter	4.75 ± 0.05 mm
Inner Capsule Wall Thickness	0.25 ± 0.012 mm	External Length	48.50 ± 0.50 mm
Outer Capsule Wall Thickness	0.50 ± 0.012 mm	Active Length	15.00 ± 0.50
Closure Material	Fusion Weld	Closure Material	Fusion Weld

CLOSURE TEST

Method — Each source capsule is decontaminated after closure until all exterio surfaces are free of transferable contamination as determined by a wipe test. After decontamination the capsule is immersed in a helium atmosphere with a pressure of at least 30 pounds per square inch for a period of 30 minutes, then transferred to a helium leak detector. The leak detector has a minimum sensitivity of 2.8×10^{-5} cc helium per second.

Test Date — The finished source was found free of detectable leaks on 1/23/78.

SOURCE STRENGTH

Calibration — The source described above has been calibrated at the Savannah River Laboratory by comparing its strength to that of a ^{252}Cf source calibrated by the National Bureau of Standards. The comparison is made by counting on a BF_3 Neutron Detector. The ^{252}Cf content of the source is the effective or net californium content calculated from the emission rate and is given in equivalent weight units assuming 2.311×10^{6} neutrons per second per microgram of ^{252}Cf. Therefore, corrections for self absorption of neutrons in the capsule walls and isotopic content of californium are unnecessary by the source user.

Strength — The neutron emission rate of this source was found to be 8.516×10^{6} neutrons per second with a standard error of ± 3.0% an effective ^{252}Cf content of 3.685 µg with a standard error of ± 3.0% on 1-26-78.

J. M. Borwell

J. M. Borwell, Director
Nuclear Engg and Materials Section
Savannah River Laboratory
E. I. du Pont de Nemours

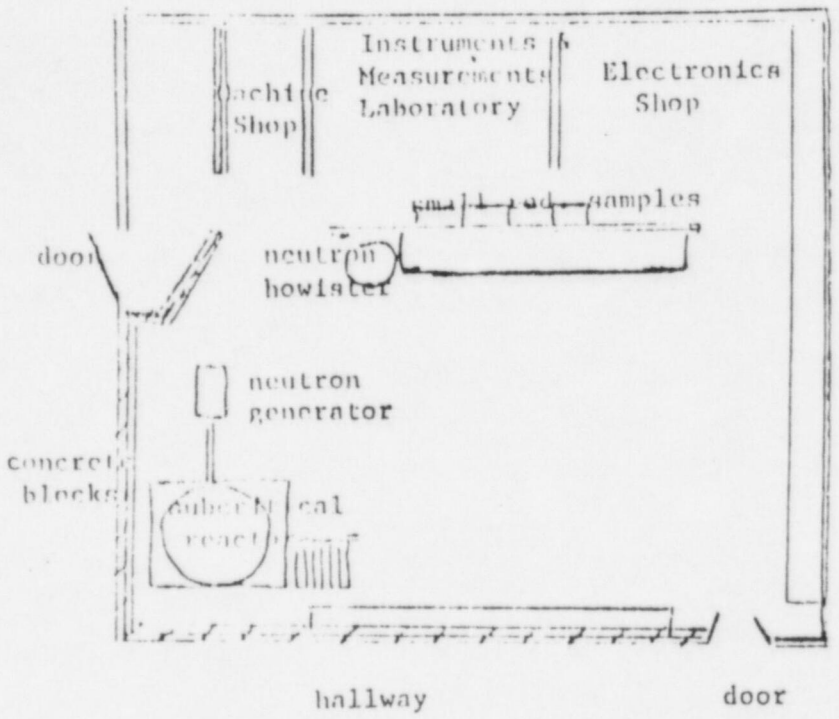


Figure 1 : Floor plan of B970 Technological Institute

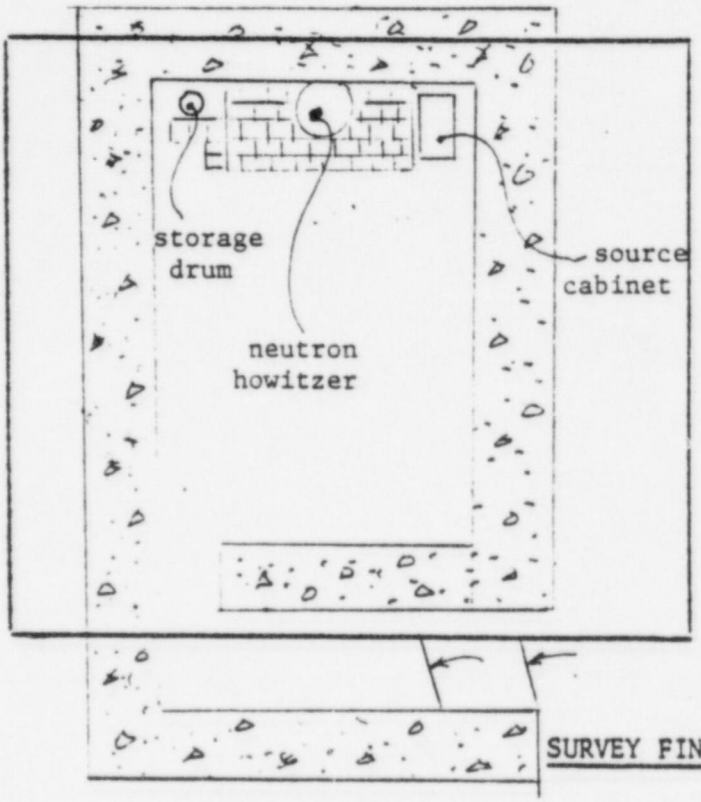
NORTHWESTERN UNIVERSITY

RADIOLOGICAL SAFETY SURVEY REPORT SHEET

BUILDING TECH ROOM B959 DATE _____ BY _____

Routine ☐ Spot Check ☐ Special ☐ Equipment ☐

Survey Instrument _____ Sources of Ionizing Radiation



TYPE	FORM	ACTIVITY
Cf- 252		
Pu-Be		
Co-60		

Ventilation: _____

Comments: _____

SURVEY FINDINGS

		mr/hr	mrem/hr	
	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	0			
Background				

RECOMMENDATIONS: _____