

Hercules Incorporated
Research Center
Wilmington, DE 19899
(302) 995-3000

April 11, 1985

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License No. 07-00222-02
Docket No. 030-03851
Control No. 02724

John E. Glenn, Ph.D., Chief
United States Nuclear Regulatory Commission
Region I
Division of Radiation Safety and Safety
Nuclear Materials Safety Section B
631, Park Avenue
King of Prussia, Pennsylvania 19406

Dear Sir:

This communication is in response to your letters dated February 1, 1985, and March 19, 1985, concerning the renewal of Hercules License No. 07-00222-02. The additional information that you requested is given below:

1. We had a convenient arrangement with the University of Delaware for calibrating the radioactivity survey meters. However, since you informed us that the University does not possess a license to perform such a service, we have decided to obtain instrument calibrations from William B. Johnson Associates, Montville, New Jersey, 07045.

2. The Packard 460C and Packard Tricarb 3320 liquid scintillation spectrometers are calibrated for the measurement of radioactivity by the external standardization method using certified standards supplied by New England Nuclear (NEN), Boston, Massachusetts, and traceable to the National Bureau of Standards. Calibration certificates supplied by NEN for current ^{14}C and ^3H standards are attached (Attachments 1 and 2).

To ensure proper functioning of the liquid scintillation spectrometers, the instruments are covered by a Preventive Maintenance Program with Packard Instrument Company, which provides biannual cleaning of the photomultiplier tubes and optimization of the instrument operations. After every maintenance check-up, the instrument is calibrated using solutions prepared from the NEN standards mentioned above. The calibration procedure is given below:

To a series of ten counting vials containing 12-15 ml of counting solution (cocktail), a known amount of a standard radionuclide (NEN standard) is added, followed by the addition of 0-30 μl of nitromethane, a quencher. The count rate in each sample is determined, using the instrument setting for the external standardization method of calibration. The efficiency of counting in the above sample is determined by the formula $E = \text{cpm observed} / \text{dpm added}$. The calculated % efficiency is plotted against the Spectral Index of the external standard for the Packard 460C instrument and the external

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standardization reading for the Packard Tricarb 3320 instrument. Examples of calibration curves for the Packard Tricarb 3320 are attached (Attachments 3 and 4) in which a toluene based cocktail was used. The Packard 460C is a microprocessor controlled instrument and the calibration curves are stored in the instrument memory. The internal standardization method is also used when the external standardization method is not applicable. Please note that for the past 8 years, we have employed ^{14}C and ^3H radionuclides exclusively.

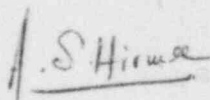
3. Leak tests for sealed sources are conducted every six months by a procedure described below and test samples are counted in the Packard liquid scintillation counter.

Cotton swabs wet with alcohol are used to wipe surfaces in the designated areas such as housing, entrance, and exit. The cotton swabs are then placed in marked counting vials indicating the designated areas, 15 ml of counting medium is added to each vial, and the mixture counted in the Packard Tricarb 3320 liquid scintillation counter using the settings included in Table 1.

4. We ship to K. S. Processing liquid scintillation counting vials containing ^{14}C and ^3H radionuclides only. After each counting is completed, the data are critically evaluated to maintain compliance with 10 CFR 20306 and only the samples with <0.05 microcuries per gram of medium are shipped. Realistically, we never have $>10,000$ cpm in a counting vial.

5. On your recommendation, we will survey laboratories using millicurie quantities of ^3H and ^{14}C by conducting wipe tests on a weekly basis and survey meter checks for ^{14}C on a daily basis.

Sincerely,



A. S. Hirwe, Ph.D.
Radiation Protection Officer

ASH:tlc
3730H

TABLE 1

<u>Sealed Source</u>	<u>Energy of β-Particle</u>	<u>Settings Used</u>	<u>% Gain</u>	<u>Window</u>
^{63}Ni	0.07 MeV	^{13}C and ^3H	^{14}C - 8% ^3H - 50%	^{14}C - 35-1000 ^3H - 50-1000
Promethium	0.225 MeV	^{14}C and ^{36}Cl	^{14}C - 8% ^{36}Cl - 2%	^{14}C - 35-1000 ^{36}Cl - 50-1000
Chlorine	0.714 MeV	^{36}Cl	^{36}Cl - 2%	^{36}Cl - 50-1000

Attachment 1

CERTIFICATE OF RADIOACTIVITY CALIBRATION

Carbon-14 Reference Source
NES-006

Half-Life: 5730 + 40 years
Lot Number: 0060283A

The activity of Carbon-14 was found to be 4.0×10^5 dpm/ml in February 1983.

DESCRIPTION OF THE SOURCE

Chemical Composition:	^{14}C Toluene
Volume:	Approximately 10 milliliters
Physical Form:	10 cc Combi-Vial
Temperature at Calibration:	20° C

DECAY SCHEME

β^- 156 keV maximum
49 keV average

INTENSITY (%)

100

Reference: A Handbook of Radioactivity Measurements Procedures, NCRP Report No. 58, November 1978.

METHOD OF CALIBRATION

Aliquots of the solution were calibrated by liquid scintillation counting. The counting efficiency was determined using equal aliquots of a ^{14}C -toluene solution certified by the National Bureau of Standards for New England Nuclear under P.O. No. 34004.

New England Nuclear Corporation participates in a National Bureau of Standards-Atomic Industrial Forum measurement assurance program in order to insure the continuing traceability of NEN's radioassays to the NBS.

ERRORS

Random Errors (99% confidence level)
Precision of the NEN measurements

$\pm 1.3 \%$

Systematic Errors

Accuracy of the NBS standard
Pipetting Errors

$\pm 2.0 \%$
 $\pm 0.2 \%$

Overall Error

1.3 + 2.0 + 0.2 = $\pm 3.5 \%$

Richard Carr

BY: Richard Carr, Supervisor
Calibrated Sources Group
Nuclides & Sources Operations

RADIOACTIVE MATERIAL

The radioactive material described or contained herein is exempt from NRC or agreement state licensing requirements. Not for human use. Introduction into foods, beverages, cosmetics, drugs or medicinals, or into products manufactured for commercial distribution is prohibited. Exempt quantities should not be combined.



New England Nuclear

549 Albany Street, Boston, Massachusetts 02118

CALL TOLL-FREE 800-225-1572 Telex 94-0996
(In Massachusetts and International 617-482-9595)

Attachment 2

CERTIFICATE OF RADIOACTIVITY CALIBRATION

Tritium Reference Source NES-004

Half-Life: 12.35 ± 0.01 yrs.

Lot Number: 0040884

The activity of Hydrogen-3 was found to be 2.22×10^6 disintegrations per minute per milliliter on August 6, 1984.

DESCRIPTION OF THE SOURCE

Chemical Composition: ^3H -Toluene
Volume: Approximately 10 milliliters
Physical Form: 10ml combi-vial
Temperature at Calibration: 20°C

DECAY SCHEME

	Intensity (%)
B^- max. 18.60 keV	
avg. 5.68	100

Reference: *A Handbook of Radioactivity Measurements Procedures*, NCRP Report No. 58, November 1978.

METHOD OF CALIBRATION

Aliquots of the solution were calibrated by liquid scintillation counting. The counting efficiency was determined using equal aliquots of the National Bureau of Standards tritiated toluene standard SRM 4947.

ERRORS

Random Errors (99% confidence level)

Precision of the NEN measurement $\pm 2.0\%$

Systematic Errors

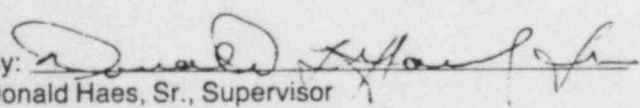
Accuracy of the NBS standard $\pm 0.82\%$

Pipetting errors $\pm 1.0\%$

Overall Error

$2.0 + 0.82 + 1.0 = \pm 3.82\%$

By:


Donald Haes, Sr., Supervisor
Calibrated & Reference Sources Group
Nuclides & Sources Operations

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NEN Medical Products

331 Treble Cove Road, N. Billerica, MA 01862

Call TOLL FREE 800-225-1572 Telex 94-0996
(In Massachusetts & International: 617-482-9595)

Calibration - Quench Curve
15ml R-1 100ul¹ Toluene
Standard Quenched with
Nitromethane

8% Gain Window 35-1000

8/18/84

46 1512

External
Standard

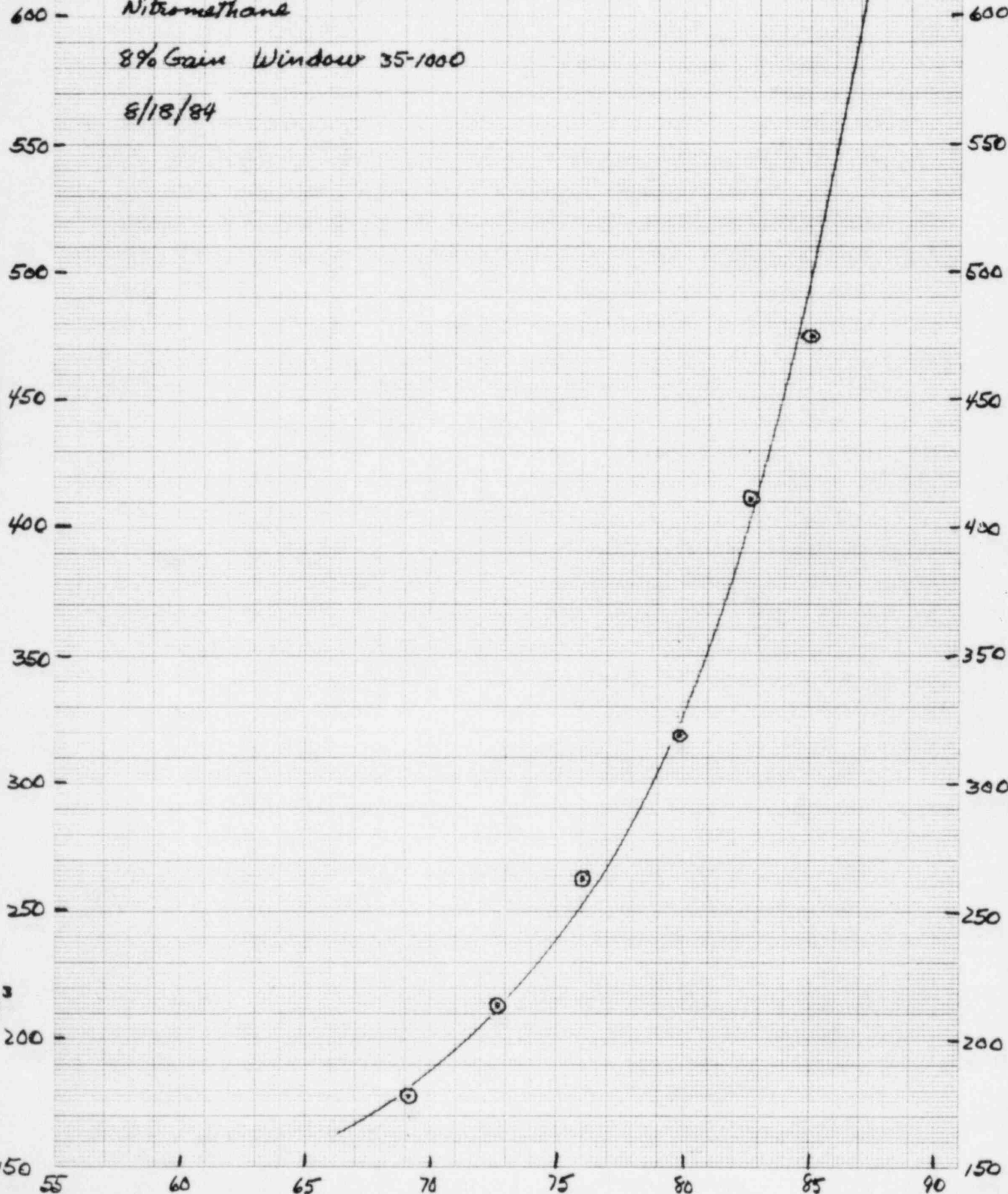
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HEUFFEL & ESSER CO. MADE IN U.S.A.

K₀Σ

x 10³

150 55 60 65 70 75 80 85 90 150

% Efficiency



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K.E. 10 X 10 TO 1/2 INCH 7 X 10 INCHES
KEUTEL & ESSER CO. MADE IN U.S.A.