Report of Cobalt-60 Teletherapy Unit
Annual Full Calibration
(Following Source Replacement)

The Jewish Hospital of St. Louis
Department of Radiation Oncology
216 South Kingshighway Blvd.
St. Louis, Missouri 63108

March 11, 1994

Performed by:
Eric E. Klein, M.S.

Assisted by
Virgil Willcut, M.S.

OUTLINE OF COBALT 60 TELETHERAPY UNIT FULL CALIBRATION

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COBALT 60 TELETHERAPY UNIT FULL CALIBRATION

1. **Institution:**

The Jewish Hospital of St. Louis
Department of Radiation Oncology
216 S. Kingshighway Blvd.
St. Louis, MO. 63108

2. **Unit:**

A.E.C.L. Eldorado 76 Co-60 Teletherapy Unit, S.N. 003
Neutron Products Inc. 1.5 cm Diameter, Cobalt-60 Source
Installed 3/10/94, Catalogue #NPI 15 6000W S.A. T1289
Source Activity 5850 Ci as of 3/1/94
NRC License No. 24-00063-10

3. **Report Objectives**

The cobalt-60 unit is calibrated in air at least once a year following the recommendations set down in the AAPM TG-21 Protocol. Daily, weekly and monthly checks are also performed on the Cobalt-60 unit. Individual logbooks are maintained recording these checks.

The last full calibration was performed on March 31, 1993.

During this annual full calibration measurements of the following parameters were made. The acceptance criteria is listed for each parameter.

Parameters	Criteria
Equipment safety/interlocks	operational
Accuracy of distance indicators	0.5% effect on absorbed dose
Radiation/Light field congruence	±3 mm
Beam uniformity	±5% central ray
Timer linearity	2% effect on tumor dose
Timer error	1% effect on calibration
Radiation output calibration	±2% of that in clinical use
Field size dependence	±2% of that in clinical use
Depth dose factors	±2% of that in clinical use
Wedge, Bolus, Comp filter Factors	±2% effect on tumor dose

4. Operation Controls and Patient Monitoring System

4.1 Console Controls - The key switch, timer set, and timer-on controls operated correctly. The "beam-on", "beam-off" and machine "reset" at the console functioned correctly.

4.2 Controls in Therapy Room - The collimator moved smoothly over the full range of allowed field sizes. The head rotated smoothly. The head vertical motor functioned correctly.

4.3 Patient Monitoring System - A complete view of the patient is obtained via a video camera with a monitor located at the console. Direct communication with the patient is available via an intercom system also at the console.

4.4 The last 5 year inspection was done on **March 10, 1994**. A copy of the inspection certificate is on file in the Physics Office.

4.5 The last continuing education session for therapy technologists and residents was conducted in **August of 1993**. An emergency drill was conducted in **August of 1993 and in February and March 0f 1994.**. A copy is on file in the Physics Office.

5. Locks, Interlocks, Warning Devices and Emergency Off Switch

5.1 The room door lock functions properly and security precautions are maintained.

5.2 With the beam on, opening the entrance door properly returned the source to the beam off position. Upon closing the door the beam did not come on until the beam-on condition was properly reset at the console. This was confirmed by observing the movement of the treatment indicator rod on the video monitor. Beam on could not be initiated while the door was open.

5.3 Red/green lights on the console and lights above (and to the side of) the room door correctly indicated the beam on/off conditions in the operator area. This was confirmed by observing the response of the treatment indicator rod on the video monitor. Correct function of the red/green lights on the gantry to indicate the beam on/off conditions in the treatment room are in camera view and were verified. The beam condition indicating rod is observable, and correctly indicated the beam on/off conditions

5.4 The radiation area monitor is a PRIMALERT 10, (NUCLEAR ASSOCIATES, Inc.), Model #05-433 with battery pack. It is mounted in the treatment room and is functioning properly. Backup auxiliary power was also checked by disconnecting the AC source and observing the "battery on" light and correctly monitoring the exposure when the check source was placed against the test area of the detector. The video camera was swiveled to observe the monitor flashing during Co-60 beam-on operation. Red LED remained on ~ 30s after being unplugged. Operation indicator remained functioning.

5.5 The "Emergency-Off" button at the console with the beam ON was tested and found to function correctly. The "Emergency-Off" button on the control pendant with beam OFF, was tested and found to function correctly.

5.6 There is no limit for head angulation and this was verified at head angles 90°, 180° and 270°. The gantry head angulation lock is functioning.

6. Required Posted Materials

6.1 The therapy room was properly posted with a "Caution-Radiation Area" sign and a "Radiation Materials" sign.

6.2 Emergency instructions with telephone numbers of responsible personnel are posted in clear view.

6.3 Form NRC-3 "Notice to Employees" is posted. The locations of parts 19 and 20 of 10 CFR and the NRC license for the hospital are available upon request.

6.4 Operating instructions for the unit are located at the console.

7. Wipe Test Results

7.1 Wipe test were performed on **May 11, 1993 and on October 26, 1993** by the Washington University Radiation Safety Office for the previous source. The new source was wipe tested on **Feb 28, 1994** by Neutron Products. Copies of the test results are on file in the Physics Office. The results of these tests indicate the presence of less than 0.0001 microcuries of removable contamination and meet accepted standards of radiation safety.

8. Radiation - Light Field Congruence

8.1 Ready pack X-TL Films under 0.5 cm Solid Water were exposed for 10 cm x 10 cm fields at 80 cm SFD (collimator settings of 180 (normal for treatment), 90, and 270 degrees). Films were also taken for head swivel at 90° and 270°, 80 cm SFD, collimator setting at 180 degrees). Optical density profiles obtained from these films indicated that all radiation field and light field central axes were in congruence to within + 3 mm. The widths and lengths of 50% values agreed well with the light field edges (see attached scans).

9. Beam Uniformity

9.1 Beam uniformity was checked using the films listed in paragraph 8.1. The results indicate that the beam is uniform at all orientations tested. (See attached graphs).

9.2 A 10 x 10 field size was set and rotated about beam center with collimator rotation, the field and crosshair shifted by no more than 1.0 mm through 180°.

10. Distance and Field Size Indicators

10.1 The aluminum SSD indicator for 80 cm measures 43.0 cm (vs. nominal at 43.0 cm). The room indicator measures 63.1 cm (vs. nominal of 63.0 cm). The source to top of block tray distance is 57.0 cm. The ODI was adjusted after source replacement.

Mechanical Distance	ODI	Block Tray to Mechanical Indicators
80.0 cm	80.0	23.0 cm
100.0 cm	-----	43.0 cm

10.2 The field size indicators are accurate within ± 2 mm for 80 cm and 100 cm SSD.

80cm SSD

Field size set (cmxcm)	Measured Field Size (cmxcm)
5x5	5x5
10x10	10x10
20x20	20x20
30x30	30.0x30.1

100cm SSD

Field size set (cmxcm)	Measured Field Size (cmxcm)
10x10	10x9.9
15x15	15x14.9
25x25	25x24.8
35x35	35x34.8

11. Timer Constancy/Linearity and Timer Error

11.1 The timer constancy/linearity was checked using a stopwatch and ion chamber readings and found to be acceptable. Normalized reading is charge reading divided by time corrected. Results are as follows.

Set (min.)	Time Corrected	Stopwatch (min)	Rdg	Rdg Normalized	Digital
1.0	0.99	1.003	2.687	1.000	1.02
2.0	1.99	2.002	5.402	1.000	2.02
3.0	2.99	3.002	8.121	1.001	3.03

11.2 Timer error was measured to be a negative 0.010 min, calculated according to the following formula:

$$\alpha = \frac{M_1 - M_2}{M_2 - 3M_1} \times 1 \text{ min.}$$

M_1 is the reading in 3 min, M_2 is the accumulated reading in 3 times 1.00 min. The previous values was a negative 0.02 min.

12. Source Output Calibration

12.1 Output calibration in air was made according to the AAPM TG.21 protocol. The dose rate (rad/min) in free space for the calibration field size (10 cm x10 cm) was measured using a Keithley electrometer (Model 602, S.N. 316065) in conjunction with a PTW Farmer chamber Model N23333, (30-352, S.N. 705). The cobalt-60 exposure calibration factor for this system is R/Rdg at 22°C and 760 mmHg on the 10 x 10^{-8} coulomb scale. This factor was assigned by the AAPM Accredited Dosimetry Calibration Laboratory in Nashville, Tennessee on September 07, 1993 and has been adjusted for the 1.1% in the roentgen by the NBS effective January 1, 1986.

The sensitive volume of the chamber was centered at distances of 80.0 cm from the source. A 10 cm x 10 cm field was used as the calibration field size. The temperature was determined using a laboratory thermometer graduated in steps of 0.2°C. The barometric pressure was determined using an aneroid barometer in which the accuracy had previously been determined by comparison to a Fisher Scientific U.S. Signal Corp. type mercury barometer graduated in steps of 1 mm Hg. The calculated dose rates in free space for 80 cm SSD are given in Table I and the calculated dose rates in free space for 100 cm SSD are given in Table II.

12.2 The following is an example of the calculation of absorbed dose rate in free space (muscle tissue) on the central axis for a 10 cm x 10 cm field at 80.5 cm for the vertical (0 degree) beam, with the collimator at 0 degrees, with blocking tray in place.

Calculation Factors	VALUE 80 cm	VALUE 100 cm
M (1) for 1.00 min in air at 80.0 cm for 10 cm x 10 cm for vertical beam	2.687	0.876
x Exposure calibration factor	56.22	56.22
x C_{tp} (2) 22.2°C 753 mm Hg	1.005	1.005

xISQ = Inverse square factor	0.988	0.990
x A_{eq} = attenuation factor for Co-60	0.989	0.989
x f = dose to water per roentgen for Co-60	0.971	0.971
x Conversion factor, from water to muscle tissue	0.990	0.990
x Ion recombination factor	1.000	1.000
x decay factor	1.008	1.010
x 1/(time+α)	0.9985	0.9985
= Absorbed dose rate (cGy/min) in free space at 80.5 cm as calculated for 3/15/1994.	143.9	90.3

NOTES:
(1) M = dosimeter reading at temperature t and pressure p.

(2) Temperature-pressure correction factor

$$C_{tp} = \frac{273.16 + 22.0}{295.16} \times \frac{760}{753.0}$$

12.3 A weekly silicon diode check is performed in a polystyrene phantom jig at 1.0 cm depth. A 10-x10 field size at 80 cm SSD for 1.0 minute is used. The diode and electrometer is calibrated to 1 cGy/unit. On the day of calibration the diode reading was 142 cGy/min which is slightly lower than the calibrated value of 143.8 cGy/min.

12.4 The dose rate with the plastic tray removed is equal to the dose rate for the tray in place divided by 0.960. The measured value was 0.960.

13. Dose Rate vs. Field Size

13.1 The variation in absorbed dose rate in free space (muscle tissue) versus field size was determined for 80.5 cm and 100.5 cm with tray in place. Results are shown in Tables I and II. Values are for 15 March 1994. The Field size factors are also displayed.

Table I: Dose Rate in Free Space (Muscle) at 80.5 cm (Tray in place)

FS (cm) at surface	Relative FSF (norm to 10x10)	Dose in Free Space @ 80.5 cm
5x5	.964	138.8
6x6	.970	139.6
7x7	.978	140.7
8x8	.986	141.9
9x9	.993	142.9
10x10	1.000	**143.9**
11x11	1.007	145.0
12x12	1.011	145.5
13x13	1.019	146.6
14x14	1.025	147.4
15x15	1.029	148.0
16x16	1.032	148.6

17x17	1.036	149.1
18x18	1.041	149.8
19x19	1.044	150.2
20x20	1.047	150.7
21x21	1.050	151.1
22x22	1.053	151.5
23x23	1.054	151.6
24x24	1.056	151.9
25x25	1.058	152.3
26x26	1.060	152.5
27x27	1.060	152.5
28x28	1.061	152.7
29x29	1.062	152.8
30x30	1.061	152.7
31x31	1.061	152.6
32x32	1.061	152.7
33x33	1.060	152.5
34x34	1.060	152.5

Table II: Dose Rate in Free Space (Muscle) at 10.5 cm (Tray in place)

FS (cm) at surface	Relative FSF (norm to 10x10)	Dose in Free Space @ 100.5cm
6x6	.979	88.4
7x7	.983	88.7
8x8	.989	89.3
9x9	.996	89.9
10x10	1.000	**90.3**
11x11	1.006	90.8
12x12	1.012	91.3
13x13	1.015	91.6
14x14	1.020	92.0
15x15	1.023	92.4
16x16	1.029	92.8
17x17	1.033	93.3
18x18	1.038	93.7
19x19	1.041	94.0
20x20	1.048	94.6
21x21	1.048	94.6
22x22	1.053	95.1
23x23	1.057	95.4
24x24	1.059	94.6
25x25	1.062	95.9
26x26	1.064	96.0
27x27	1.065	96.2
28x28	1.068	96.4
30x30	1.071	96.7

32x32	1.074	96.9
34x34	1.076	97.1
36x36	1.077	97.3
38x38	1.077	97.3
40x40	1.077	97.3
42x42	1.077	97.3

14. Depth Dose Comparisons

14.1 Depth dose measurements were made using a 40 cm x 40 cm "solid water" phantom and the system described in 12.1. The percent depth dose was checked at depths of 1.0, 5.0, 10.0 and 20.0 cm for field sizes of 10x10 cm^2 and 30x30 cm^2 at 80 cm SSD and 20x20 cm^2 and 40x40 cm^2 at 100 cm SSD The measured data were normalized to the 1 cm percentage depth dose values in BJR Supp. 17 and the results indicated acceptable agreement.

Table III

80cm SSD: Field Size: 10 cm x 10 cm

Depth	Measured	Chart	% Difference Measured/Chart
1.0	98.1	98.1	0.0
5.0	78.4	78.3	0.1
10.0	55.8	55.7	0.1
20.0	26.7	26.6	0.1

80cm SSD: Field Size: 30 cm x 30 cm

Depth	Measured	Chart	% Difference Measured/Chart
1.0	98.5	98.5	0.0
5.0	81.6	82.1	0.5
10.0	61.7	62.6	0.9
20.0	32.7	34.7	2.0

100cm SSD: Field Size: 20 cm x 20 cm

Depth	Measured	Chart	% Difference Measured/Chart
1.0	98.6	98.6	0.0
5.0	82.1	83.0	0.9
10.0	62.4	63.3	0.9
20.0	33.2	34.5	1.3

100cm SSD: Field Size: 40 cm x 40 cm

Depth	Measured	Chart	% Difference Measured/Chart
1.0	98.7	98.7	1.000
5.0	83.6	84.4	0.8
10.0	64.9	66.3	1.4
20.0	36.1	38.9	2.8

15. Wedges, Bolus, and Compensating Filters

15.1 Wedge transmission factors were not measured as wedges are not used with this unit.

15.2 Bolus measurements were made using a 40 cm x 40 cm "solid water" phantom and the system described in 12.1. For a 10 cm x 10 cm field size and 80 cm from source to center of ion chamber's buildup cap, measurements were taken for the following settings, using "super flab" bolus (Mick-radio)

Set	$\overline{Rdg}$	Normalized
0 cm bolus & 6 cm solid water	1.802	1.000
0.5 cm bolus & 5.5 cm solid water	1.799	0.998
1.0 cm bolus & 5.0 cm solid water	1.800	0.999

15.3 Compensating Filter (CF) transmission factors were not measured as CF's are not used with this unit.

16. Radiation Safety

16.1 An area survey was performed with a Victoreen, Model 450B, S/N 680, calibrated in July of 1993. All readings in the areas outside of the Cobalt room (A37) (door, console Simulator, etc.) on the ground floor were **< 0.1 mR/hr**. A survey was also performed on the ground level above the Cobalt room with readings all **< 0.5 mR/hr**. The Cobalt beam was on irradiating a solid water phantom of $40x40x26cm^3$ dimensions.

17. Recommendations

17.1 Continue daily checks (form attached).

17.2 Continue weekly light/radiation field congruence checks.

17.3 Continue to have unit spot checked monthly (form attached) and calibrated annually. *Note: A monthly check was performed in early March (with previous source) to maintain regulatory compliance.*

17.4 The next wipe test is due on or before **August 28, 1994**.

17.5 The next five year inspection is due on or before **March 10, 1999**.

17.6 The next full calibration must be performed on or before March 11, 1995.

17.7 **Institute new timer error for time calculations of -0.01 minutes.**

Date of Measurements:

March 11, 1994

Measurements and Report by:

Eric E. Klein, M.S.
Instructor in Physics
of Radiation Oncology

Reviewed by:

James A. Purdy, Ph.D.
Professor and Associate Director
Radiation Oncology Center

THE JEWISH HOSPITAL OF ST. LOUIS
AECL ELDORADO 76 COBALT-60 TELETHERAPY UNIT
RADIATION OUTPUT (DOSE RATE IN FREE SPACE AT 80.5 CM)

As of: Mar 15, 1994

Use from: Mar ~~18~~ 14, 1994 to: Mar 31, 1994

LEXAN Blocking Tray In — 80 cm SSD — Trimmers at 45 cm

Side of Equivalent Square Field (cm)	Rad/min in Free Space (Dfs)	Side of Equivalent Square Field (cm)	Rad/min in Free Space (Dfs)
5	138.8	20	150.7
6	139.6	21	151.1
7	140.7	22	151.5
8	141.9	23	151.6
9	142.9	24	151.9
10	143.9	25	152.3
11	145.0	26	152.5
12	145.5	27	152.5
13	146.6	28	152.7
14	147.4	29	152.8
15	148.0	30	152.7
16	148.6	31	152.6
17	149.1	32	152.7
18	149.8	33	152.5
19	150.2	34	152.5

$$\text{Given Dose (GD)} = \frac{\text{Tumor Dose(TD)} \times 100}{\text{PDD}}$$

$$\text{Treatment Time} = \frac{\text{Given Dose (GD)}}{\text{Dfs} \times \text{PSF}}$$

Note:

(1) Set timer for 0.01 minutes more than calculated.

(2) Percent depth dose data and equivalent square data based on BJR Supplement 17.

Verified by:

Eric E. Klein, M.S.
Radiation Oncology Physicist

Approved for Clinical Use:

James A. Purdy, Ph.D.
Professor and Chief
Physics Section

THE JEWISH HOSPITAL OF ST. LOUIS
AECL ELDORADO 76 COBALT-60 TELETHERAPY UNIT
RADIATION OUTPUT (DOSE RATE IN FREE SPACE AT 80.5 CM)

As of: Mar 15, 1994

Use from: ~~Mar 18, 1994~~ 14 to: Mar 31, 1994

LEXAN Blocking Tray In — 80 cm SSD — Trimmers at 45 cm

Side of Equivalent Square Field (cm)	Rad/min in Free Space (Dfs)	Side of Equivalent Square Field (cm)	Rad/min in Free Space (Dfs)
5	138.8	20	150.7
6	139.6	21	151.1
7	140.7	22	151.5
8	141.9	23	151.6
9	142.9	24	151.9
10	143.9	25	152.3
11	145.0	26	152.5
12	145.5	27	152.5
13	146.6	28	152.7
14	147.4	29	152.8
15	148.0	30	152.7
16	148.6	31	152.6
17	149.1	32	152.7
18	149.8	33	152.5
19	150.2	34	152.5

$$\text{Given Dose (GD)} = \frac{\text{Tumor Dose(TD)} \times 100}{\text{PDD}}$$

$$\text{Treatment Time} = \frac{\text{Given Dose (GD)}}{\text{Dfs} \times \text{PSF}}$$

Note:

(1) Set timer for 0.01 minutes more than calculated.

(2) Percent depth dose data and equivalent square data based on BJR Supplement 17.

Verified by:

Eric E. Klein, M.S.
Radiation Oncology Physicist

Approved for Clinical Use:

James A. Purdy, Ph.D.
Professor and Chief
Physics Section

TELETHERAPY SOURCE CERTIFICATION

This certifies that the cobalt-60 source:

Model Number: NPTT-Series
Catalog Number: NPI-15-6000W
Serial Number: T-1289
Containing **5850** curies as of **March 1, 1994**

was fabricated by Neutron Products, Inc. in accordance with NPI Specification P-4, per Drawing Number A200057, and was leak tested by the helium pressurization bubble test and found to be leak free. The source was wipe tested and the removable activity was .046 and .0002 microcuries, from the inner and outer encapsulations, respectively. The completed source was wipe tested on 2-28-94.

Performed and certified by:

Jeffrey W. Corun, Manager
Hot Cell Operations

Reviewed and approved by:

Marvin M. Turkanis
Radiation Safety Officer
Date 3/8/94

NEUTRON PRODUCTS, INC.

22301 Mt. Ephraim Road, Dickerson, MD 20842
301/349-5001 FAX 301/349-5007

REPORT OF "FIVE YEAR INSPECTION"

This is to certify that the Atomic Energy of Canada, Ltd. (AECL) teletherapy unit, Model Eldorado 76, Serial Number 3, containing a cobalt-60 source, Model Number NPTT-Series, Catalog Number NPI-15-6000W, Serial Number T-1289, and located at Jewish Hospital of St. Louis, Waldheim Ambulatory Care Center, 4932 Forest Park Boulevard, St. Louis, Missouri 63110 was inspected on MARCH 10, 1994 by Steve Johnson in accordance with the requirements of Maryland License MD-31-025-03 for a "five year inspection" to provide assurance of the proper function of the source drive mechanism.

Signed R S Johnson Date MARCH 10, 1994

The following parts were replaced:

1 - DETENT PIN
1 - RIDER RING
1 - CORD REEL (CUSTOMER STOCK)
1 - FIELD LAMP (CUSTOMER STOCK)
1 - KEYSWITCH (CUSTOMER STOCK)

The following nonstandard service was performed:

KEYSWITCH INSTALLATION

CUSTOMER'S COPY

neutron PRODUCTS inc

Facility Name: Jewish Hospital of St. Louis
Waldheim Ambulatory Care Center
4932 Forest Park Boulevard
St. Louis, Missouri 63110

October 1, 1991

INSPECTION CHECKLIST

Unit Model: AECL Eldorado 76 Serial No.: 3

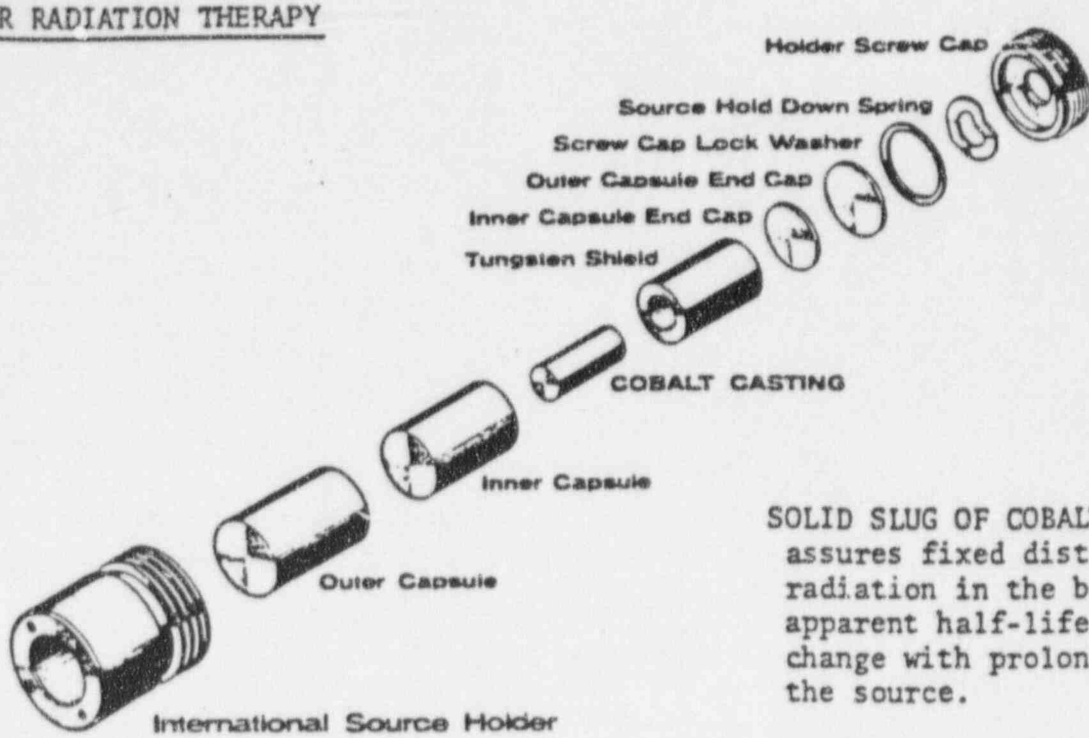
Operation	Prior to Transfer*	Subsequent to Transfer**
1. Determine operating history	X	
2. Head movement	X	X
3. Electrical and mechanical source condition - indicator check	X	X
4. Manual source/shutter return	X	X
5. Timer	X	X
6. Source holder/shutter movement check	X	X
7. Pneumatic activating system	X	X
N/A 8. Mercury shutter system	X	X
N/A 9. Stand and stretcher	X	X
10. Protective source housing, beam-off leakage (confirm measured by medical physicist)		X
11. Source-surface distance (SSD)		X
12. Beam orientation	X	X
13. Congruence of light and radiation fields		X
14. Full calibration (confirm performed by the medical physicist)		X
15. Facility door interlock	X	X
16. Teletherapy units with moving source drawer	X	X
N/A 17. Teletherapy units with moving shutter blocks	X	X
N/A 18. Teletherapy units with rotating shutter	X	X
19. Indicator light	X	X
20. Emergency shutoffs	X	X
21. Collimator	X	X

Note: *Circle all items not meeting attached criteria.
**Circle all items not meeting attached criteria after servicing.

Signature R. S. Johnson Date: 3-10-94

neutron products inc

COBALT-60 SOURCES FOR RADIATION THERAPY



SOLID SLUG OF COBALT-60 assures fixed distribution of radiation in the beam; the apparent half-life will not change with prolonged use of the source.

DOUBLE ENCAPSULATION, with or without internal heavy metal shield, is fabricated, seal-welded, leak-tested, and checked for external contamination to highest standards.

Source capsule holder is provided for any teletherapy machine, including INTERNATIONAL CAPSULE (as shown), SHIELDED DRAWER, or other holder as appropriate.

NEUTRON PRODUCTS sources and fabrication procedures have been approved for standard applications in beam therapy units. Licensed personnel provide installation and radiation surveys.

Prices quoted on request will cover FULL SERVICE --- shipping, rigging, installation, routine maintenance, removal and disposal of turn-in source. Special maintenance, calibration, leakage field surveys, reports to regulatory agency, and other services may be ordered.

For further information
please write or call:

neutron products inc

22301 Mt. Ephraim Road • P.O. Box 68 • Dickerson, Maryland 20842 USA • 301/349-5001
TWX: 710-828-0542 • FAX: 301/349-2433

TELETHERAPY HEAD SURVEY
(Source in "OFF" position.
Measurements ta[redacted] one meter
from source)

Position No.		Radiation Level (mR/hr)
View A	1	1.5
	2	0.2
	3	1.2
	4	1.8
View B	5	0.3
	6	0.8
	7	~~2.2~~ 0.3
	8	~~0.2~~ 0.3
View C	9	0.8
	10	0.8
View D	11	0.4
	12	0.4
	13	0.8
	14	0.4

Average value .7 mR/hr

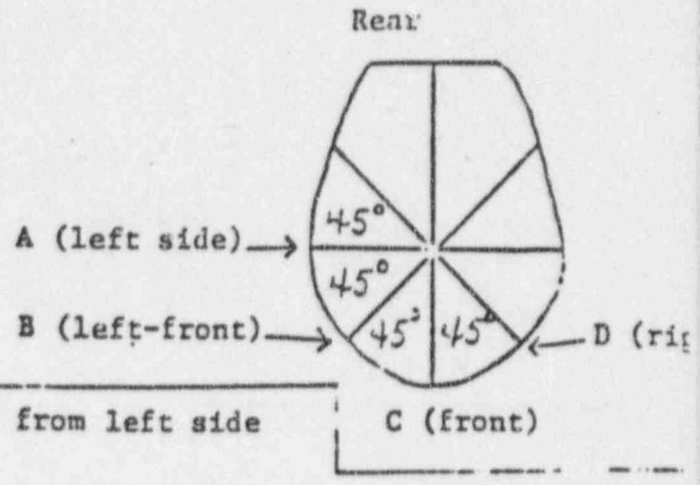
Maximum value 1.8 mR/hr

Instrument used Victoreen 450B S/N 680 Calib. 7/22/93

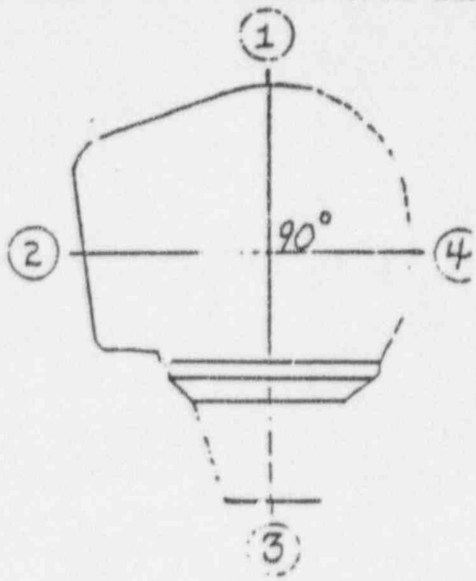
Curies & Date 5850 3/1/94

Manufacturer's name & model # of teletherapy unit Eldorado 76

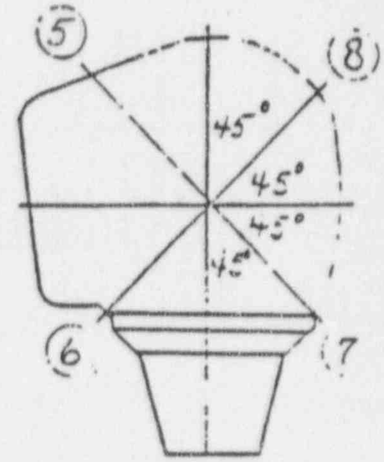
[redacted]Top View - Showing orientation of Views A through D



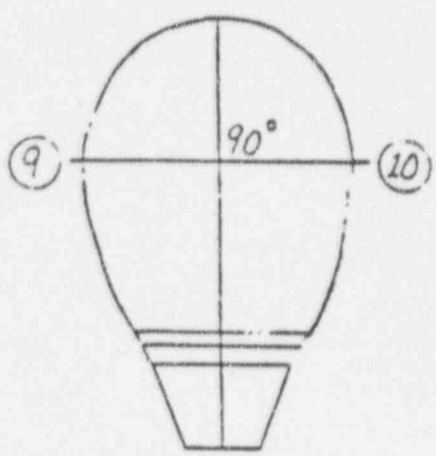
View A - Vertical from left side



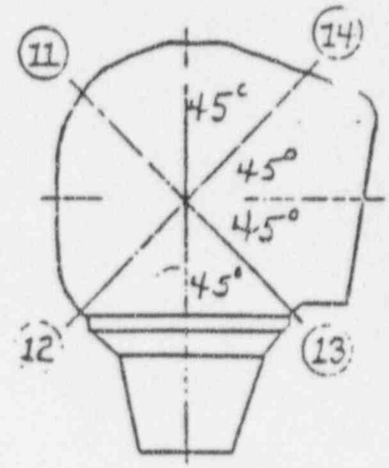
View B - Vertical from left-fr



View C - Vertical from front



View D- Vertical from right-f



TELETHERAPY SOURCE TRANSFER

This is to certify that a cobalt-60 source:

Model Number: NPTT-Series
Catalog Number: NPI-15-6000W
Serial Number: T-1289
Containing 5850 curies as of March 1, 1994

and which has been determined by helium pressure test and by wipe test to be leak free, has been installed in a teletherapy unit described as follows:

Manufacturer: Atomic Energy of Canada, Ltd. (AECL)
Model Number: Eldorado 76
Serial Number: 3

This source is hereby transferred from Neutron Products' Radioactive Materials License MD-31-025-03 to Jewish Hospital of St. Louis's Radioactive Materials License 24-00063-10.

This will also certify that a cobalt-60 source, described as follows:

Model Number: NPI-15-6000W
Serial Number: T-894
Containing 2850 curies as of March 1, 1994

has been determined by a wipe test to be leak free and has been removed from the above teletherapy unit and transferred from Jewish Hospital of St. Louis's Radioactive Materials License 24-00063-10 to Neutron Products' License MD-31-025-03.

We have witnessed the inspection and operation of the above teletherapy unit after completion of the installation by Neutron Products, Inc. and have found the unit to be operating properly and safely.

Eric E. Klein [signature] | Robert S. Johnson [signature]
Neutron Products, Inc.

Date 3/10/1994 | Date MARCH 10, 1994

NEUTRON PRODUCTS inc

Independent Cobalt Output Measurement
Following Source Replacement

The Jewish Hospital of St. Louis
Department of Radiation Oncology
216 South Kingshighway Blvd.
St. Louis, MO 63108

March 31, 1994

Performed By:
Daniel A. Low, Ph.D.
Assisted By:
Virgil Willcut, M.S.

A check of the Cobalt-60 unit output was conducted using the Barnes ADCL-calibrated dosimetry system. This was in addition to the calibration conducted by Eric Klein on March 11, 1994. The dosimetry system consists of:

Keithley Electrometer, Model 602, S.N. 40772A
Data Precision DMM, Model 248, S.N. 21975
PTW (Farmer), Model 2505/3A, (0.6 ml graphite), S.N. 1456
Plastic buildup cap, S.N. 1456A
N_x factor in use for cobalt 10-08-1993 = 46.90 R/Rdg, assigned by ADCL K&S

A_{ion} = 0.999
P_{ion} = 1.001
TE = -0.11 min
Blocking tray in
10 x 10 cm field size
Source-to-chamber distance = 80.0 cm

$$D_{fs} = \frac{\overline{RDG}\, C_{tp}\, N_x\, A_{ion}\, P_{ion}\, f_{med}\, A_{eq}\,(INS)}{t + TE}$$

$$D_{fs} = \frac{3.164 \bullet 1.009 \bullet 46.90 \bullet 0.999 \bullet 1.001 \bullet (0.971 \bullet 0.99) \bullet 0.989 \left(\frac{80}{80.5}\right)^2}{1 - 0.011} = 142.14 \frac{cGy}{min}$$

The calibration conducted on 3/11/1994 resulted in a calibrated output rate of 143.9 cGy/min. There are 20 days between the two measurements. Therefore the activity based on the original measurement should be 0.993 times as great on March 31, or 142.9 cGy/min. Accounting for this, is a 0.5% difference between the two determinations. Therefore the two determinations agree.

Measurements and Report by:

Daniel A. Low, Ph.D.
Instructor
ABMP Certified Radiological Physicist

Virgil Willcut, M.S.

Reviewed by:

James A. Purdy, Ph.D.
Professor and Chief
Physics Section
ABR Certified Radiological Physicist

4/5/94
Date

Radiation Safety Committee Report
4 May 1994
^{60}Co-Teletherapy Source Exchange And 5 Year Inspection
Eric E. Klein, M.S.

On Thursday, March 10, 1994, Neutron Products, Inc. removed a cobalt-60 source (NPTT Series (NPI-125-6000W) #T-894) with an activity of 2850 Curies from our Teletherapy unit (Eldorado 76, #3) at Jewish Hospital The company installed a similar source (#T1289) into the same machine, that had an activity of 5850 Ci. All proper shipping and license paperwork were presented by the company.

A five year inspection was also performed by the same company. All aspects of the inspection were positive and the following parts were replaced; detent pin, rider ring, cord reel, field lamp, and key switch.

A head survey was performed after the new source was placed. The average value (one meter from the source) was 0.7 mR/hr. The maximum value was 1.8 mR/hr. An area survey was performed outside of the room, including street level. All surrounding area readings were < 0.5 mR/hr. The head and area survey were performed with a calibrated Victoreen ion chamber (450B, # 680).

A full calibration was performed using an independent calibration system (with a NIST traceable calibration), including generation of new output charts for calculational purposes was generated. It should also be noted that all patients who were under treatment while the old source was in place, had finished treatment. Therefore no recalculations had to be performed.

On the day following the source exchange, the NRC (Ms. Evelyn Mattson of Region III performed an inspection of Neutron Products.

On March 31, 1994, an independent calibration check was performed by an **independent** physicist (Daniel A. Low, Ph.D.) using an **independent** calibration system (with a NIST traceable calibration). The independent calibration confirmed the original calibration to within 0.5%.

All original, complete reports are located in the Physics office at Jewish Hospital in the Radiation Oncology Dept.

cc: James A. Purdy, Ph.D.