



ST. MARY'S MEDICAL CENTER

3700 Washington Avenue · Evansville, Indiana 47750 · (812) 479-4000

March 29, 1984

James R. Mullauer, M.H.S.
Radiation Specialist
United States Nuclear Regulatory
Commission Region III
799 Roosevelt Rd.
Glen Ellyn, IL 60137

Dear Mr. Mullauer:

As per our telephone conversation of 3-28-84, I am
sending you the following:

- 1 - Survey meters calibration report of April 20, 1983
- 2 - New source calibration and survey report of
February 19, 1982
- 3 - Cobalt-60 full calibration report of November 16,
1983

I will be glad to provide any additional information
you may need.

Sincerely,

S. m. Shah

Saiyid M. Shah, Ph.D.
Physicist

SMS/kd

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APR 2 1984

ARNOLD SORENSEN
Certified Radiological Physicist
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7666 EDGE DALE DRIVE
NEWBURGH, INDIANA 47630
Phone (812) 853-2653

CERTIFICATE OF INSTRUMENT CALIBRATION

For: **ST MARY'S MEDICAL CENTER**
EVANSVILLE IN

Instrument:

Manufacturer EBERLINE

Type GM

Model No. E-120

Serial No. 2531

Calibration Data:

Scale	Exposure rate (mR/hr)	Instrument reading (mR/hr)	Exposure rate (mR/hr)	Instrument reading (mR/hr)	Exposure rate (mR/hr)	Instrument reading (mR/hr)
0-0.5	0.16	0.21	0.36	0.40		
0-5	1.61	1.7	2.9	3.2		
0-50	15	19	31	34		

Comments:

Accurate on all scales

Calibration Source:

Nuclide

Cs-137

Activity
or

Exposure Rate at Specified Distance

*1.24 mg Ra Equivalent
18.3 mg Ra Equivalent*

Calibration
Accuracy

*5%
5%*

APR 2 1984

Calibrated by

Arnold Sorensen

Date

4/20/83

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CERTIFICATE OF INSTRUMENT CALIBRATION

For: **ST MARY'S MEDICAL CENTER**
EVANSVILLE IN

Instrument:

Manufacturer EBERLINE

Type GM

Model No. E-120

Serial No. 5290

Calibration Data:

Scale	Exposure rate (mR/hr)	Instrument reading (mR/hr)	Exposure rate (mR/hr)	Instrument reading (mR/hr)	Exposure rate (mR/hr)	Instrument reading (mR/hr)
0 to 0.5	0.36	0.38	0.16	0.18		
0 to 5	1.61	1.6	2.9	2.9		
0 to 50	15	18	31	35		

Comments:

Accurate on all scales

Calibration Source:	<u>Nuclide</u>	Activity or Exposure Rate at Specified Distance	Calibration Accuracy
	<u>Cs-137</u>	1.24 mg Ra. Equivalent	5%
		18.3 mg Ra Equivalent	5%

Calibrated by Arnold Sorensen

Date 4/20/83

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CERTIFICATE OF INSTRUMENT CALIBRATION

For: ST. MARY'S MEDICAL CENTER
EVANSVILLE IN

Instrument:

Manufacturer VICTOREEN
 Type GM
 Model No. 498
 Serial No. 513

Calibration Data:

Scale	Exposure rate (mR/hr)	Instrument reading (mR/hr)	Exposure rate (mR/hr)	Instrument reading (mR/hr)	Exposure rate (mR/hr)	Instrument reading (mR/hr)
0-1	0.36	0.30	0.72	0.65		
0-10	2.9	2.2	6	5.5		
0-100	31	25	61	55		
0-1000	380	400				

Comments: Accurate on all scales

Calibration Source:	<u>Nuclide</u>	Activity or <u>Exposure Rate at Specified Distance</u>	<u>Calibration Accuracy</u>
	<u>Cs-137</u>	<u>1.24 mg Ra Equivalent</u>	<u>5%</u>
		<u>18.4 mg Ra Equivalent</u>	<u>5%</u>

Calibrated by

Arnold Sorensen

Date

4/20/83

February 19, 1982

1) Location of Teletherapy Unit

St. Mary's Medical Center
Division of Radiation Oncology
3700 Washington Avenue
Evansville, Indiana 47750

2) Radiation Machine

The Cobalt 60 machine is a Theratron 780, S.N. 83, manufactured by the Atomic Energy of Canada, Limited. The 2 cm diameter source was installed on February 19, 1982. The source is an Atomic Energy of Canada Limited part number C-146G9095, S.N. 1365 (6,675 Ci as of January 13, 1982).

3) Report Objectives

- 3.1 General condition of the unit.
- 3.2 Safety aspects.
- 3.3 Distance measuring devices.
- 3.4 Radiation-light field congruance and uniformity of radiation field.
- 3.5 Timer Accuracy.
- 3.6 Output calibration.
- 3.7 Field size dependence.
- 3.8 Percent Depth Dose.

4) Description of Measurement and Calculative Techniques

- 4.1 Measurements were done with a Capintec Electrometer Model 192AX, S.N. 9C902, and a Capintec Ionization chamber (Model PR06C, S.N. CII63421) with a lucite build-up cap of this 16 mm diameter thickness. The correcting potential on the chamber was +299 volts. The Cobalt 60 exposure correction factor for the dosimetry system is 0.998 R/rdg at 22°C and 760 Torr. This factor was assigned by the Regional Calibration Laboratory at Victoreen Corporation, Cleveland, Ohio, on October 14, 1980.
- 4.2 Timer error is determined by using the technique described in the article by Orton, C.G. and Sieberg, J.B., "The Measurement of Teletherapy Timer Error", Physics in Medicine and Biology, 17, (1972), 198-205.
- 4.3 Determination of the absorbed dose rate was done by making exposure measurements in air and then converting to absorbed dose using the appropriate factors as described in Appendix A.
- 4.4 Measurement of the percent depth dose was done using a 30cm x 30cm x 30cm water phantom. The data was normalized to 1.0cm depth and compared to the published data listed in BJR Supplement number 11, (also normalized to 1.0 cm).
- 4.5 Coincidence of light field and radiation field was determined by irradiation of field localization films in a plane perpendicular to the central axis under conditions of adequate electron build-up. The uniformity of the radiation fields were determined based on optical density measurements. The edge of the radiation field is defined as the position of 50% of the dose on the central ray.

5) Results of Measurements

5.1 General condition of the unit - The general condition of the unit was good. The key switches all function properly. The mechanical timer and the digital timer were all working properly. The patient monitor was operating satisfactorily. The room was clean and in good order.

5.2 Safety Aspects of the Unit

5.2.a The room door has a lock which is operational.

5.2.b The room interlock shuts off the radiation when the door is open. The beam cannot be turned on unless positive action is taken at the control console.

5.2.c Interlock for head angulation was working properly. The beam could be turned on only in the following position of the treatment head:

5.2.d Red and white door warning lights indicated beam on and off conditions were tested and are working properly.

5.2.e The radiation monitor which indicated beam on and off conditions inside the room was tested and is working properly.

5.2.f Emergency instructions are posted inside and outside the room.

5.2.g The following NEC notices to employees were posted.

SEE ATTACHED FORMS

5.3 Distance Measuring Devices

5.3.a The 80 and 100 cm mechanical distance indicators were found to be accurate to within ± 2 mm. The lengths of the individual rods measured were 48.5 cm and 68.4 cm respectively.

5.3.b Optical Distance Indicator - the 80 and 100 cm Optical was found to be accurate to within ± 5 mm.

Cobalt 60 Teletherapy Unit
New Source Calibration
February 19, 1982

5.4 Radiation Field and Light Field

- 5.4.a Light Field/Field Size Indicator Agreement: Field sizes (5 x 5, 10 x 10, 20 x 20) set by the indicator were within 2 mm of actual field size.
- 5.4.b Central axis crosswire movement with collimator rotation: The crosswire image depicting the central axis was marked on a piece of graph paper. The collimator was then rotated 90 degrees clockwise in the position of the crosswires marked. The collimator was then rotated 180 degrees counter clockwise in the position of the crosswire mark. In all cases, deviation from the initial central axis position was less than 1 mm.
- 5.4.c Coincidence of light field and radiation field: Localization film irradiated showed that alignment of light field and radiation field was within 3 mm on all sides. The basic field is symmetrical. Please see Figure I.

5.5 Timer Accuracy and Timer Error Test

- 5.5.a The following times were set on the mechanical timer measured with a stop watch.

<u>SET TIME</u>	<u>MEASURED TIME</u>
0.5 min.	.5 min.
2.0 min.	2.0 min.

- 5.5.b Timer error was calculated using the following formula:

$$\text{Alpha} = (M1 - M2/M2 - 4M1) \times t$$

Where M1 and M2 equal the average readings for 1 minute exposure with 1 and 4 times shutter ON/OFF conditions. A timer error of -1.01 minutes was measured. This agreed with the previously measured timer value.

- 5.6 Absorbed Dose Rate at 0.5 cm depth for these indicated field sizes, trimmers at 45 cm, vertical beam, with blocking tray, correct on March 15, 1982.

- 5.6.a 80 cm SSD

<u>FIELD SIZE cm x cm</u>	<u>RAD/MIN</u>
5 x 5	152.6
10 x 10	160.9
15 x 15	168.6
20 x 20	173.2
30 x 30	178.1

Cobalt 60 Telether Unit
New Source Calibration
February 19, 1982

Date of Measurements: _____

Measurements and Report by: Walter J. Kopecky, Ph.D.
Clinical Physicist
3700 Washington Avenue
Evansville, IN 47750

APPENDIX A

COBALT 60

Ionization Chamber	Capintec PR06C with lucite Cobalt-60 build-up cap
Phantom	in air
Source-chamber distance(cm)	80.0
Inverse square correction (ISC)	$(80.0/80.8)^2$
A _{eq}	0.985
f-factor	0.957
Back Scatter factor (BSF)	Field size dependent (10x10 cm ² field = 1.036)
Dosimeter reading/min (M) corrected to 22°C and 760 torr and corrected to 3/15/82	167.3
Cobalt correction factor (N _C)	.998
Absorbed dose per minute at the depth of maximum dose	see section 4.2 and Appendix B

Equations used in the calculation of absorbed dose per minute

$$D = M \times N_C \times A_{eq} \times f \times BSF \times ISC$$

$$= 167.3 \times .998 \times .985 \times .957 \times 1.036 \times .980 = 160.9$$

(Source in "OFF" position.
Measurements taken one meter
from source)

Top View - Showing orientation
of Views A through D

Position No.	Radiation Level (mS/hr)
View A 1	0.7
2	0.1
3	0.7
4	1.1

View B 5	0.6
6	0.6
7	0.1
8	0.4

View C 9	0.6
10	0.7

View D 11	0.6
12	0.2
13	0.7
14	0.6

Average value .6

Maximum value 1.1

Instrument used Eberline

Model E-120, S.N. 5290

104.8 RMM

Series 6675 Ci

6

Date 13 January, 1982

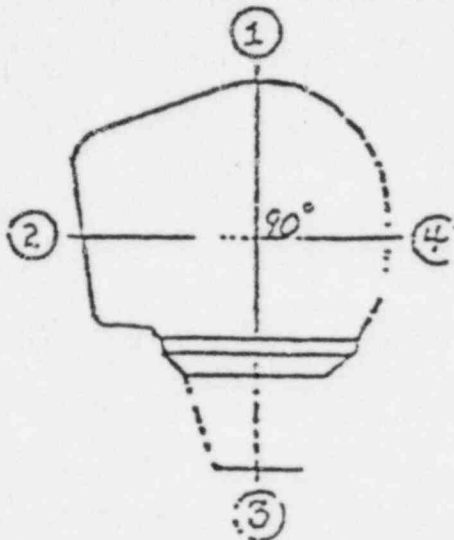
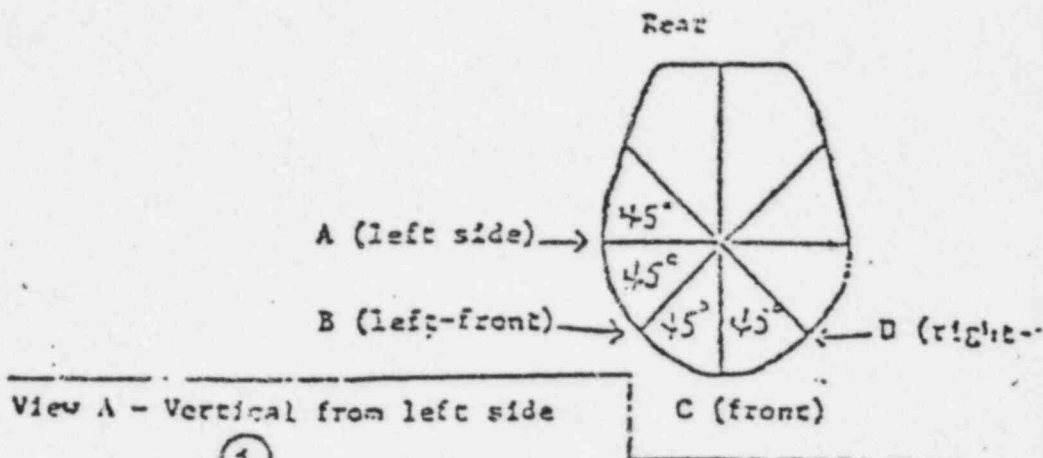
Manufacturer's

name & model #

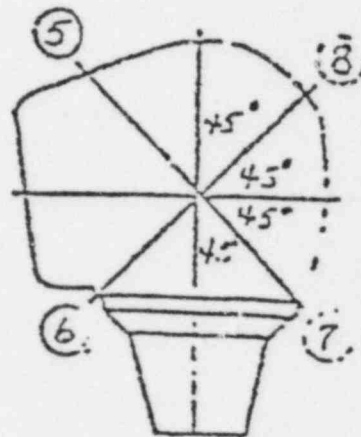
of teletherapy

unit AECL Theratron 780

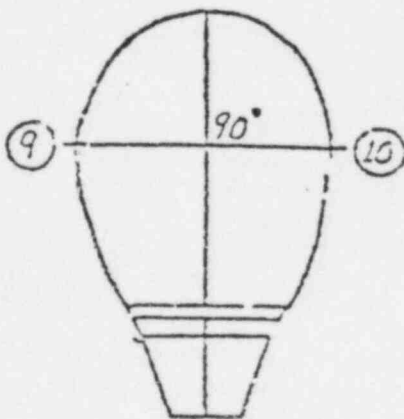
S.N. 83



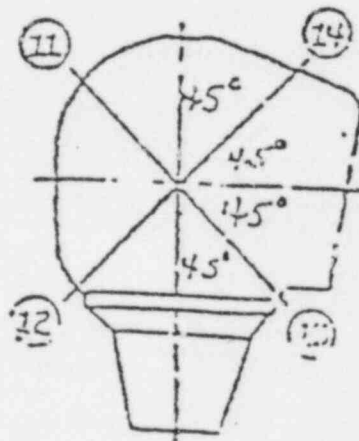
View B - Vertical from left-front



View C - Vertical from front



View D - Vertical from right-front



ST. MARY'S MEDICAL CENTER
Theratron 780

as of March 15, 1982
use from March 1, 1982 to March 31, 1982

80 cm SSD

Lucite Shadow Tray In

Trimmers at 45 cm

Side of Square field or equiv.(cm)	Rads/min at D _M at 80 cm SSD	Side of Square field or equiv.(cm)	Rads/min at D _M at 80 cm SSD
5	152.6	18	171.3
6	154.4	19	172.2
7	156.4	20	173.2
8	158.0	21	173.9
9	159.5	22	174.5
10	160.9	23	175.2
11	162.6	24	175.9
12	164.1	25	176.4
13	165.6	26	177.0
14	167.0	27	177.3
15	168.6	28	177.6
16	169.5	29	177.8
17	170.6	30-35	178.1

Timer error of -0.01 minutes not included.

Calculated by:

Walter Kozedy

Checked by:

John P. O'Donoghue

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COBALT-60 MACHINE COMPREHENSIVE CALIBRATION CHECK REPORT

DATE OF CHECK: November 16, 1983

INSTRUMENT: St. Mary's Capintec 192 Ser. No. 09C902 &
CII.63421 ion chamber.

INSTRUMENT SETUP: Ion chamber in air at 80 cm SAD
Trimmers at 45 cm, Tray in.

RESULTS:

Light-Beam congruence: OK
Range light check: Within ± 2 mm
Laser isocenter light: Within ± 2 mm
Safety devices check: All function correctly

In Air Measurements: Temp = 22 $^{\circ}$, At. P. = 749 mm, $TP_{cf} = 1.015$

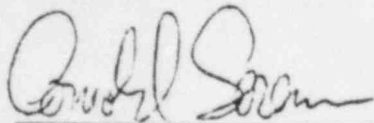
$$\frac{\text{Rads}}{\text{min}} \text{ at isocenter} = \left(\frac{\text{Reading}}{\text{min}} \right) (TP_{cf}) (N) (0.965) (0.985) \text{ where } N = 0.997$$

Field size at isocenter	Measured rads/min	Predicted rads/min
5 x 5	121.1	121.9
10 x10	126.0	126.3
20 x20	131.2	132.2
30 x30	133.3	133.9

Maximum difference is less than 1%

Timer error: -0.01 min

Beam symmetry with
gantry rotation: Varies by less than 1%



Arnold Sorensen, B.S., D.A.B.R.