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R. J. SCHULZ ASSOCIATES
P.O. BOX 3153, STONY CREEK STATION
BRANFORD, CONNECTICUT 06405

MS 16
P5

November 15, 1985

Jenny M. Johansen, M.S.
Nuclear Materials Section B
Division of Engineering and Technical Programs
United States Nuclear Regulatory Commission
Region I, 631 Park Avenue
King of Prussia, PA 19406

Re: Control #17132

Dear Ms. Johansen,

Pursuant to our conversation on or about October 21, 1985, I am submitting copies of the original data and calculations to determine the information required by CFR 35.21 and CFR 35.22. The data enclosed was used to determine:

1) Dose rate as function of field size; 2) congruence; 3) uniformity and dependence on beam orientation: 4) timer accuracy; 5) accuracy of distance measuring devices; 6) full calibration according to SCRAD; and 7) dose rate expressed at monthly intervals.

The enclosed "periodic spot check" procedure was established to verify each of the items in 35.22. It is performed at least monthly and verified within 2 weeks.

I certainly hope this information is sufficient.

Sincerely,

A G Agostinelli

Alfred G. Agostinelli
Radiological Physicist

AGA:krm

encs.

Stanford Cobalt 5/18/84

Picker C-10 Fixed head.

- PTW #1, Keithley #2 (616, 6169) : $N_c = 5.636$ ~R/C
- Poly phantom

To be Done
- ✓ ① Interlocks
- ✓ ② Measuring devices
- ✓ ③ Coll. & crosshairs
- — ④ Lite vs beam
- ✓ ⑤ Timer Acc.
- ✓ ⑥ Output @ 10^2
- ⑦ Output Factors.

T = 21.5
P = 30.00" = 762.0 mm hg
TPC = 0.996

✓ ① All interlocks function properly per monthly spot check method.

✓ ② The integral mechanical distance indicator touches plastic as per monthly check. Light intersects X-hair @ "80 cm" on ODI. Also plastic ie mech is @ 17.6cm from collimator surface.

✓ ③ Collimator, crosshair rotates about itself within 1 mm - light is still dim on one edge, but still discernable.

✓ (4) Lite vs beam film – ok – will scan

(5) & (6) – Output & TA.

PTW with BU – center @ 80.0 cm, 10 x 10 field @ 80. K-2 10^{-9}c scale

A – $Rd_{1\,min}$ = 28.5, 28.5 } $\overline{28.1}$ (A)
Rd_{2m} = 56.5, 56.6 }

T.A.

B $Rd_{1\,min}$ (5 OFFS) = 29.8, 29.8 } $\overline{29.3}$ (B)
$Rd_{2\,min}$ (5 OFFS) = 59.1, 59.1 }

$$TA = \frac{B-A}{5A-B} = \frac{29.8-28.5}{5(28.5)-29.8} = 0.012\ m = 0.19.5\ cm$$

SAME as usual

SSR40:

$(\bar{Rd}_2 - \bar{Rd}_1)(TPC)(N_c)(f)(T)(A)(IS)$

$(56.6 - 28.5)(0.996)(5.631)(0.965)(1.036)(0.985)\left(\frac{80}{80.5}\right)^2$

= 153.4 rads/min @ dmax for 10 x 10 cm field @ 80.0 cm SSD

② Check Output Factors
PTW # 1 @ "dmax" in full poly phantom
@ 80

Field Size @ 80	RO 10^{-9} C	O.F.
10^2	29.1, 29.2	1.00
8^2	28.4, 28.4	0.974
6^2	27.7	0.950
4^2	26.9, 27.0	0.924
10^2	29.1_5	1.0
12^2	29.6_5	1.017
15^2	30.3	1.039
18^2	30.8 -	1.057
20^2	31.2 31.2	1.070
10^2	29.1_5	1.0

} V.G. ok

THE STAMFORD HOSPITAL

PICKER COBALT-60 RADIATION THERAPY UNIT

CALIBRATION REPORT FOR JULY, AUGUST AND SEPTEMBER 1985

A. 80.0 CM SSD

FIELD SIZE	RADS/MIN @ MAX (0.5 CM) (1) JULY	AUGUST	SEPTEMBER
4^2 = 16 cm^2	119.4	118.1	116.8
5^2 = 25 cm^2	120.9	119.5	118.2
6^2 = 36 cm^2	122.7	121.4	120.1
7^2 = 49 cm^2	124.4	123.1	121.7
8^2 = 64 cm^2	125.8	124.4	123.1
9^2 = 81 cm^2	127.9	126.5	125.1
10^2 = 100 cm^2	129.2	127.8	126.4
11^2 = 121 cm^2	130.3	128.8	127.4
12^2 = 144 cm^2	131.4	130.0	128.6
13^2 = 164 cm^2	132.6	131.2	129.7
14^2 = 196 cm^2	133.9	132.5	131.0
15^2 = 225 cm^2	134.2	132.7	131.3
16^2 = 256 cm^2	135.1	133.6	132.2
17^2 = 289 cm^2	136.2	134.7	133.2
18^2 = 324 cm^2	136.6	135.1	133.6
19^2 = 361 cm^2	137.2	135.7	134.2
20^2 = 400 cm^2	138.1	136.6	135.1

(1) THE OUTPUT IS STATED IN RADS TO TISSUE AND INCLUDES FULL BACKSCATTER. BASED ON CALIBRATION OF 5/18/85

A.G. Agostinelli

A.G. AGOSTINELLI
RADIOLOGICAL PHYSICIST
R. J. SCHULZ ASSOCIATES

AGA:KRM

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Monthly Spot Check Procedures

R. J. SCHULZ ASSOCIATES
P.O. BOX 3153, STONY CREEK STATION
BRANFORD, CONNECTICUT 06405

The Stamford Hospital

Cobalt-60

Safety, Alignment and Output Check

A. Beam on/off indicators.

1) Check "beam off" light indicators: in room on wall; over door to room; "operation indicator" on Primalert room monitor; and green light on console.

2) Turn beam on and check all flashing "beam on" indicators; on machine; on wall in room; above door to room; on the console; and on the Primalert.

B. Door Interlocks.

1) With the beam on, open the door slightly to check if the door interlock shuts off the beam.

2) With the beam off, time set on the timer and the door ajar, try to turn the beam on to check that the beam will not go on.

3) Close the door and check that the beam may only go on after resetting at console.

C. Timer Check.

1) Let the beam turn off normally to check that the timer shuts the beam off when zero time is reached.

2) With zero time set, attempt to turn the beam on to check that it will not come on.

D. Emergency off switches.

1) With the beam on, see that the emergency off bar on the console shuts off the beam.

E. Alignment of distance measuring device.

-- Set a 10 x 10 cm field at 80 cm.
-- Raise the table until it stops automatically.
-- Place the spacer on the table with mattress removed.
-- Place the alignment jig on the spacer.
-- Center the 10 x 10 cm field.
-- Set the Optical Distance indicator to 80 cm.
-- The arrow should intersect the cross hairs (within 2mm).

F. Light vs. Radiation Field - Congruence.

1. Place a ready pack of RP/V film between the alignment jig and the spacer; align the 10 x 10 cm light field on the 10 x 10 wires on the jig.

2. Irradiate to approximately 80 rads.

3. When developed, the radiation beam should be within 3mm of the light beam (i.e., the wires).

G. Output Check.

1. Set a 10 x 10 cm field at 80 cm.

2. Place the output jig in the center of the field on the spacer (with the couch fully raised).

3. Place the blue diode in the center of the field. Read the diode on the Nuclear Associates Diode Dosemeter.

4. Irradiate for 1 minute.

5. The reading multiplied by ~~0.75~~ 0.72 should be within 5% of the posted output for the month, for a 10 x 10 cm field.

To calculate this value:

$$\frac{100\ [\ (\text{Reading})\ (\sout{0.75}\ 0.72) - \text{Posted}\ ]}{\text{Posted}} = \pm \_\_\_\_\_\_ \%\ \text{deviation}$$

For example, on July 5, 1983, the reading was 111, and the posted output was 83.5. Therefore:

$$\frac{100\ [\ (111)\ (\sout{0.75}\ 0.73) - 83.5\ ]}{83.5} = -\ 0.3\%\ \text{deviation}$$

H. Timer Accuracy.

1. Irradiate the diode as in the output check. This is Reading A (Rd_a).

2. Repeat the irradiation, turning the beam off 4 times during the 1 minute irradiation. When the beam shuts off it will have had 5 on-off cycles. This is Reading B (Rd_b).

Timer Accuracy (TA) is determined by the following:

$$TA = \frac{Rd_b - Rd_a}{5\ Rd_a - Rd_b}$$

For example:

A 1-minute irradiation with one on-off cycle readings 153 (Rd_a).

A 1-minute irradiation with 5 on-off cycles reads 159 (Rd_b).

$$TA = \frac{159 - 153}{5\ (153) - 159} = 0.01 \text{ min}$$

$$0.01 \text{ min} \times 60 \frac{\text{sec}}{\text{min}} = 0.59 \text{ sec}$$

Alfred G. Agostinelli
Radiological Physicist
R. J. Schulz Associates

Date	Initial	A Indicator	B Interlock	C Timer	D Emergency	E Alignment	F Light / Ra[illegible]	G - Output Check Meter Reading	Chart Dose Rate	% Dev.	H Timer Accuracy	Physicist Review

The following is a description of methods used in complying with 10 CFR 35.21 regarding full calibration measurements of a teletherapy unit:

A. The Stamford Hospital Cobalt unit is calibrated in accordance with the recommendations of the Scientific Committee on Radiation Dosimetry (SCRAD) of the American Association of Physicists in Medicine (Phys. in Med. & Bio. 1971 vol. 16).

An example of this method as used on May 18, 1984 at the time of the most recent source replacement on the Picker-C-10 cobalt unit at Stamford Hospital, follows.

The equipment used was a PTW Lucite wall Farmer chamber (model 30-351, SN. A197). The cobalt exposure factor, N_c, for this chamber was obtained from NBS on November 4, 1982, its value is 5.636×10^9 R/c at 22°C and 1 Atm. The electrometer was a Keithley 616 with a 6169 ion chamber interface.

The center of the chamber with cobalt build-up cap was placed in air at 80 cm from the source. This distance was determined using the mechanical distance indicator provided by the manufacturer. Using a 10 cm x 10 cm field at 80 cm, several exposures of 2 min and 1 min were made. The 1 minute readings were subtracted from the 2 minute readings in order to eliminate any effects of timer/shutter error. The reading was multilpied by the appropriate factors to obtain the dose in rads to tissue (water) in a full phantom, at d_{max} (0.5 cm) for a 10 cm x 10 cm field at 80 cm was determined to be 153.5 rads/min.

From: $(\overline{Rd}_{2min} - \overline{Rd}_{1min})(TPC)(N_c)(f)(T)(A)(IS)$

where TPC = 0.996 = Temperature/pressure correction (21.5°C, 762.0 mmhg)

$N_c = 5.636 \times 10^9$ R/c = NBS supplied Cobalt exposure factor

f = 0.965 = exposure-to-dose conversion factor for water

T = 1.036 = tissue - air ratio (BSF)

A = 0.985 = "Attenuation factor"

I = 0.988 = Inverse square from 80.0 to 80.5 cm

$\overline{Rd} = 28.1 \times 10^{-9}$ C

The variation of output with field size was determined by placing a Farmer chamber at 5 mm depth in a 30 cm x 30 cm x 30 cm polystyrene phantom. Readings were taken as a function of field size from 4 cm x 4 cm to 20 cm x 20 cm which is the full range if the Johns-McKay collimator on the Picker C-10.

The data was plotted and normalized to a 10 cm x 10 cm field. These output factors were used to determine the dose rate at d_{max} as a function of field size and are incorporated in the monthly calibration report which is used for therapy calculations. A decay factor of 0.98905 per month is used and the output is checked monthly with a diode dosimeter.

This effect was also checked taking "in air" measurements with a Farmer chamber including build-up cap as a function of field size. These in turn were multiplied by the standard BJR Supplement 11 cobalt backscatter factors. The results, normalized to a 10 cm x 10 cm field compare favorable with the directly measured output factors. These factors are checked yearly.

B. The congruence between radiation field and light field was checked using RP/v film, and an alignment jig containing lead wires which describe a 10 cm x 10 cm square. The light beam was set to the wires and the film exposed. The resulting film shows the congruence to be within 3 mm. This technique is used during the monthly spot checks. An example of a recent film is enclosed.

C. The uniformity of the beam as a function of beam direction was done using film. A series of films of a 20 cm x 20 cm field was taken at 0°, 90°, 180° and 270° gantry angles. Each film was perpendicular to the central axis of the beam at approximately 5 mm depth with sufficient scatter. The four resulting films were then scanned in the front-to-back and left-to-right directions. The optical density (OD) of the central 16 cm x 16 cm area was noted. The OD was then converted to dose using a dose response curve determined with the same batch of film developed at the same time as the field uniformity films.

The resulting data shows that the cobalt unit has essentially the same uniformity regardless of gantry angle (i.e. beam direction).

Gantry Angle	Front OD / CAX OD	Back OD / CAX OD	Left OD / CAX OD	Right OD / CAX OD
0°	0.95	0.97	0.95	0.98
90°	0.94	0.96	0.95	0.97
180°	0.95	0.97	0.96	0.98
270°	0.94	0.95	0.94	0.97

The above ratio of off-axis to central axis optical densities are all within a few percent of each other at any gantry angle demonstrating that the uniformity does not change with beam direction.

This is to be expected with the newer solid sources as opposed to the older style "loose" pellets. This parameter is checked yearly.

D. The timer accuracy was determined by both acquiring readings as a function of time and plotting this data and also the multiple shut-off method, i.e.

$$\text{Timer accuracy} = \frac{B - A}{5A - B}$$

where A = a one minute reading with 1 shut-off

B = a one minute reading with 5 shut-offs

On 5/18/84 the results were as follows:

$$A = 28.0 \times 10^{-9} C \text{ and } B = 29.28 \times 10^{-9} C$$

Then TA = 0.012 mm = 0.69 sec.

This value has been consistent with this machine for years and is checked monthly. The error is very small and incorporated into clinical use when appropriate.

E. The distance measuring devices supplied with the machine include a mechanical distance indicator as well as an optical distance indicator. These two methods of determining SSD are compared daily and verified monthly with an independent method. (see monthly spot check program section E.)

APPRAISAL

DATE: May 23, 1984

1. Applicant: Stamford Hospital
Address: Shelburne Road, P. O. Box 9317
City: Stamford State: CT 06904

2. Control No. Continuation of 17132
Lic. #06-06697-01 (Region I)

3. Department

4. Name and title of trained individual
Alfred G. Agostinelli

5. Type Program:
- [ ] Private practice
- [ ] Private practice in hospital
- [X] Institutional

6. Review:
- [X] First
- [ ] Second

7. Previous application control No.(s)

8. Remark on checked items:
- [ ] A. All radioisotopes and uses stated in application
- [ ] B. Use of ______ for ______
- [X] C. Training and experience of user "Qualified Expert"
- [ ] D. Dosage(s) indicated
- [ ] E. Clinical techniques and procedures outlined
- [ ] F. Type patient used (i.e., terminal, infants, normal)
- [ ] G. Other

Send to:
1. Edward W. Webster, Ph.D.
2. Peter R. Almond, Ph.D. ✓

9. Action of Subcommittee on Human Applications:
- [ ] Approve
- [ ] Disapprove

Remarks: We have usually required copies of actual calibration and spot check data including all calculations that we did. I'm sure Mr. Agostinelli is well qualified, but before I can approve him, I would like to see the data and not just the forms used.

RECEIVED-REGION I
1984 JUN 11 PM 2:00

6/7/84
(Date of approval)

Signature [signature]
(Member of subcommittee)

APPRAISAL

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Send to:
1. Edward W. Webster, Ph.D. ✓
2. Peter R. Almond, Ph.D.

9. Action of Subcommittee on Human Applications:

☐ Approve ☒ Disapprove

Remarks: This application contains no personally measured data which indicate that the applicant can perform a primary calibration of a teletherapy unit, or can perform a spot check set of tests which meet the requirements of 10CFR35.21 (full calibration) and of 10CFR35.22 (spot-check) respectively. Other than in these vital matters, his credentials are acceptable.

June 14 1984
(Date of appraisal)

Signature Edward W. Webster
(Member of subcommittee)

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November 15, 1985

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To be Done
- ✓ ① Interlocks
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TPC = 0.996

✓① All interlocks function properly per monthly spot check method.

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✓③ Collimator, crosshair rotates about itself within 1 mm - light is still dim on one edge, but still discernable.

✓ (4) LiTe vs beam film - ok - will scan

(5) & (6) - OutpuT & T.A.

PTW with B.U. - center @ 80.0 cm, 10 x 10 field @ 80. K-2 10^{-9}c scale

A - $Rd_{1\,min}$ = 28.5, 28.5 } $\overline{28.1}$ (A)
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② Check Output Factors

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V.G. ✓

THE STAMFORD HOSPITAL

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A.G. Agostinelli (signature)

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For example, on July 5, 1983, the reading was 111, and the posted output was 83.5. Therefore:

$$\frac{100\ [\ (111)\ (\overset{0.73}{\cancel{0.75}}) - 83.5\ ]}{83.5} = -\ 0.3\%\ \text{deviation}$$

H. Timer Accuracy.

1. Irradiate the diode as in the output check. This is Reading A (Rd_a).

2. Repeat the irradiation, turning the beam off 4 times during the 1 minute irradiation. When the beam shuts off it will have had 5 on-off cycles. This is Reading B (Rd_b).

Timer Accuracy (TA) is determined by the following:

$$TA = \frac{Rd_b - Rd_a}{5\ Rd_a - Rd_b}$$

For example:

A 1-minute irradiation with one on-off cycle readings 153 (Rd_a).

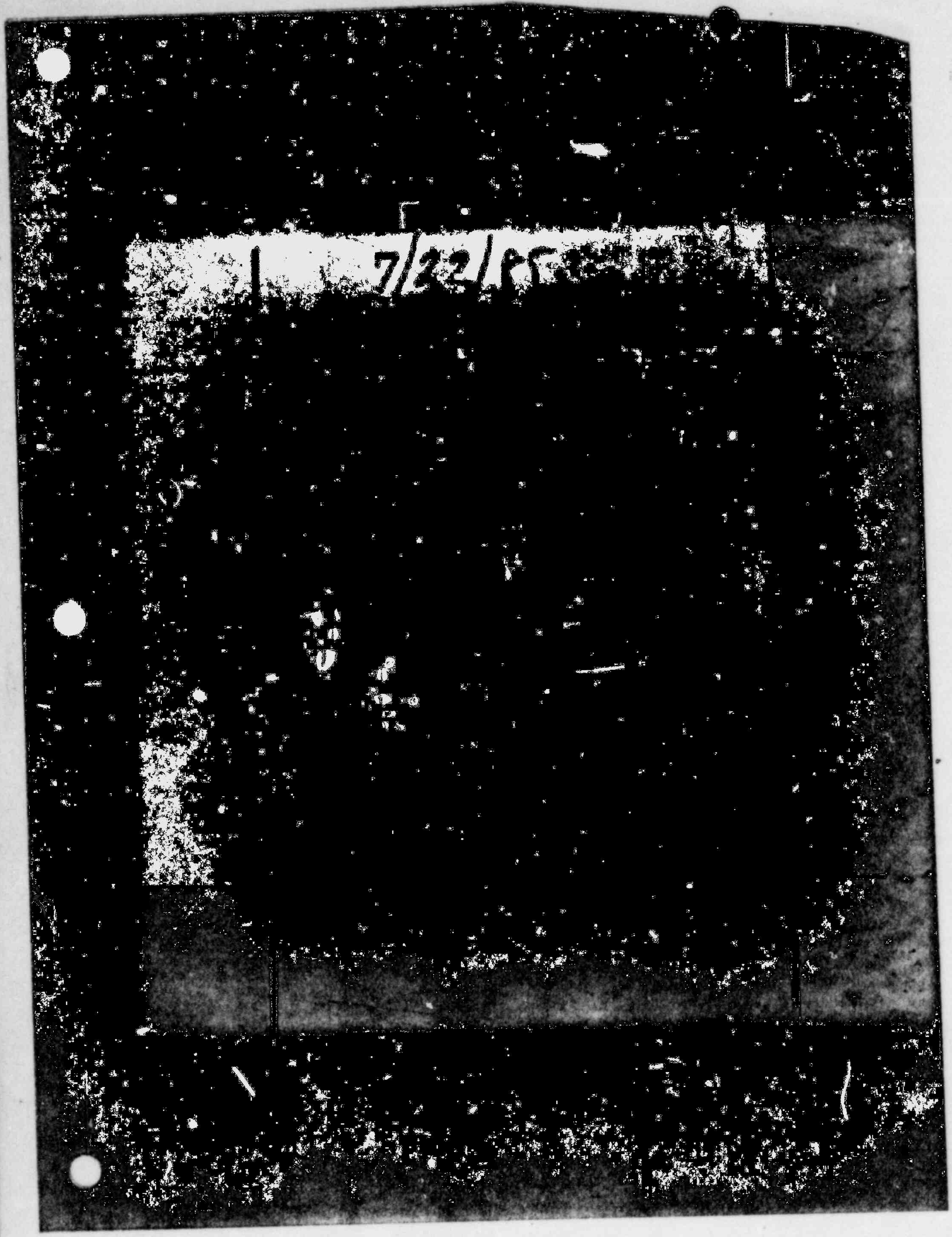
A 1-minute irradiation with 5 on-off cycles reads 159 (Rd_b).

$$TA = \frac{159 - 153}{5\ (153) - 159} = \begin{array}{l} 0.01 \text{ min} \\ 0.01 \text{ min} \times 60 \frac{\text{sec}}{\text{min}} = 0.59 \text{ sec} \end{array}$$

A. G. Agostinelli Jr.

Alfred G. Agostinelli
Radiological Physicist
R. J. Schulz Associates

Date	Initial	A Indicator	B Interlock	C Timer	D Emergency	E Alignment	F Light / Ra[illegible]	G - Output Check Meter Reading	Chart Dose Rate	% Dev.	H Timer Accuracy	Physicist Review


7/22/85

The following is a description of methods used in complying with 10 CFR 35.21 regarding full calibration measurements of a teletherapy unit:

A. The Stamford Hospital Cobalt unit is calibrated in accordance with the recommendations of the Scientific Committee on Radiation Dosimetry (SCRAD) of the American Association of Physicists in Medicine (Phys. in Med. & Bio. 1971 vol. 16).

An example of this method as used on May 18, 1984 at the time of the most recent source replacement on the Picker-C-10 cobalt unit at Stamford Hospital, follows.

The equipment used was a PTW Lucite wall Farmer chamber (model 30-351, SN. A197). The cobalt exposure factor, N_c, for this chamber was obtained from NBS on November 4, 1982, its value is 5.636×10^9 R/c at 22°C and 1 Atm. The electrometer was a Keithley 616 with a 6169 ion chamber interface.

The center of the chamber with cobalt build-up cap was placed in air at 80 cm from the source. This distance was determined using the mechanical distance indicator provided by the manufacturer. Using a 10 cm x 10 cm field at 80 cm, several exposures of 2 min and 1 min were made. The 1 minute readings were subtracted from the 2 minute readings in order to eliminate any effects of timer/shutter error. The reading was multiplied by the appropriate factors to obtain the dose in rads to tissue (water) in a full phantom, at d_{max} (0.5 cm) for a 10 cm x 10 cm field at 80 cm was determined to be 153.5 rads/min.

From: $(\overline{Rd}_{2min} - \overline{Rd}_{1min})(TPC)(N_c)(f)(T)(A)(IS)$

where TPC = 0.996 = Temperature/pressure correction (21.5°C, 762.0 mmhg)

$N_c = 5.636 \times 10^9$ R/c = NBS supplied Cobalt exposure factor

f = 0.965 = exposure-to-dose conversion factor for water

T = 1.036 = tissue - air ratio (BSF)

A = 0.985 = "Attenuation factor"

I = 0.988 = Inverse square from 80.0 to 80.5 cm

$\overline{Rd} = 28.1 \times 10^{-9}$ C

The variation of output with field size was determined by placing a Farmer chamber at 5 mm depth in a 30 cm x 30 cm x 30 cm polystyrene phantom. Readings were taken as a function of field size from 4 cm x 4 cm to 20 cm x 20 cm which is the full range if the Johns-McKay collimator on the Picker C-10.

The data was plotted and normalized to a 10 cm x 10 cm field. These output factors were used to determine the dose rate at d_{max} as a function of field size and are incorporated in the monthly calibration report which is used for therapy calculations. A decay factor of 0.98905 per month is used and the output is checked monthly with a diode dosimeter.

This effect was also checked taking "in air" measurements with a Farmer chamber including build-up cap as a function of field size. These in turn were multiplied by the standard BJR Supplement 11 cobalt backscatter factors. The results, normalized to a 10 cm x 10 cm field compare favorable with the directly measured output factors. These factors are checked yearly.

B. The congruence between radiation field and light field was checked using RP/v film, and an alignment jig containing lead wires which describe a 10 cm x 10 cm square. The light beam was set to the wires and the film exposed. The resulting film shows the congruence to be within 3 mm. This technique is used during the monthly spot checks. An example of a recent film is enclosed.

C. The uniformity of the beam as a function of beam direction was done using film. A series of films of a 20 cm x 20 cm field was taken at 0°, 90°, 180° and 270° gantry angles. Each film was perpendicular to the central axis of the beam at approximately 5 mm depth with sufficient scatter. The four resulting films were then scanned in the front-to-back and left-to-right directions. The optical density (OD) of the central 16 cm x 16 cm area was noted. The OD was then converted to dose using a dose response curve determined with the same batch of film developed at the same time as the field uniformity films.

The resulting data shows that the cobalt unit has essentially the same uniformity regardless of gantry angle (i.e. beam direction).

Gantry Angle	Front OD CAX OD	Back OD CAX OD	Left OD CAX OD	Right OD CAX OD
0°	0.95	0.97	0.95	0.98
90°	0.94	0.96	0.95	0.97
180°	·0.95	0.97	0.96	0.98
270°	0.94	0.95	0.94	0.97

The above ratio of off-axis to central axis optical densities are all within a few percent of each other at any gantry angle demonstrating that the uniformity does not change with beam direction.

This is to be expected with the newer solid sources as opposed to the older style "loose" pellets. This parameter is checked yearly.

D. The timer accuracy was determined by both acquiring readings as a function of time and plotting this data and also the multiple shut-off method, i.e.

$$\text{Timer accuracy} = \frac{B - A}{5A - B}$$

where A = a one minute reading with 1 shut-off

B = a one minute reading with 5 shut-offs

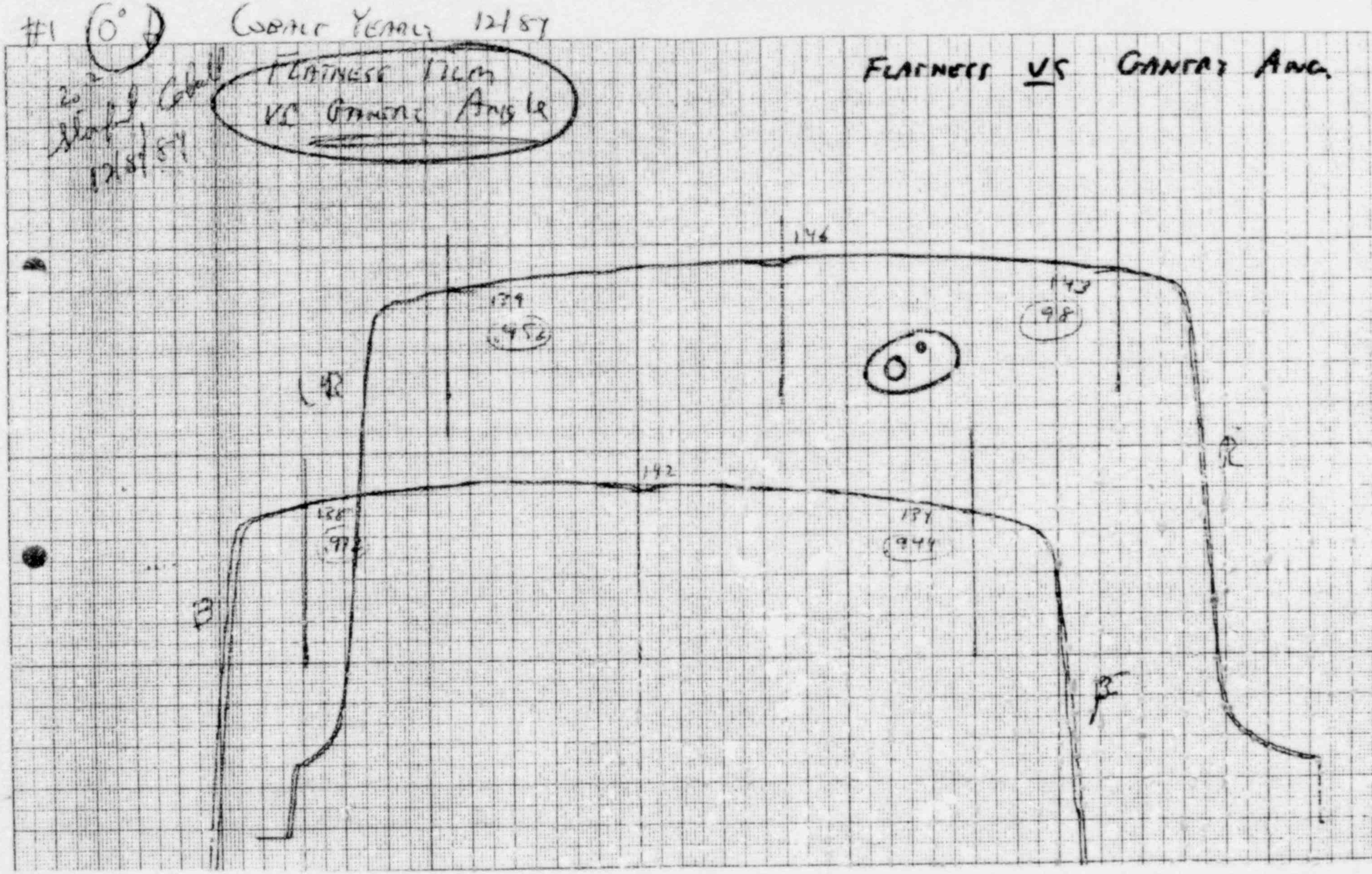
On 5/18/84 the results were as follows:

$$A = 28.0 \times 10^{-9} C \text{ and } B = 29.28 \times 10^{-9} C$$

Then TA = 0.012 mm = 0.69 sec.

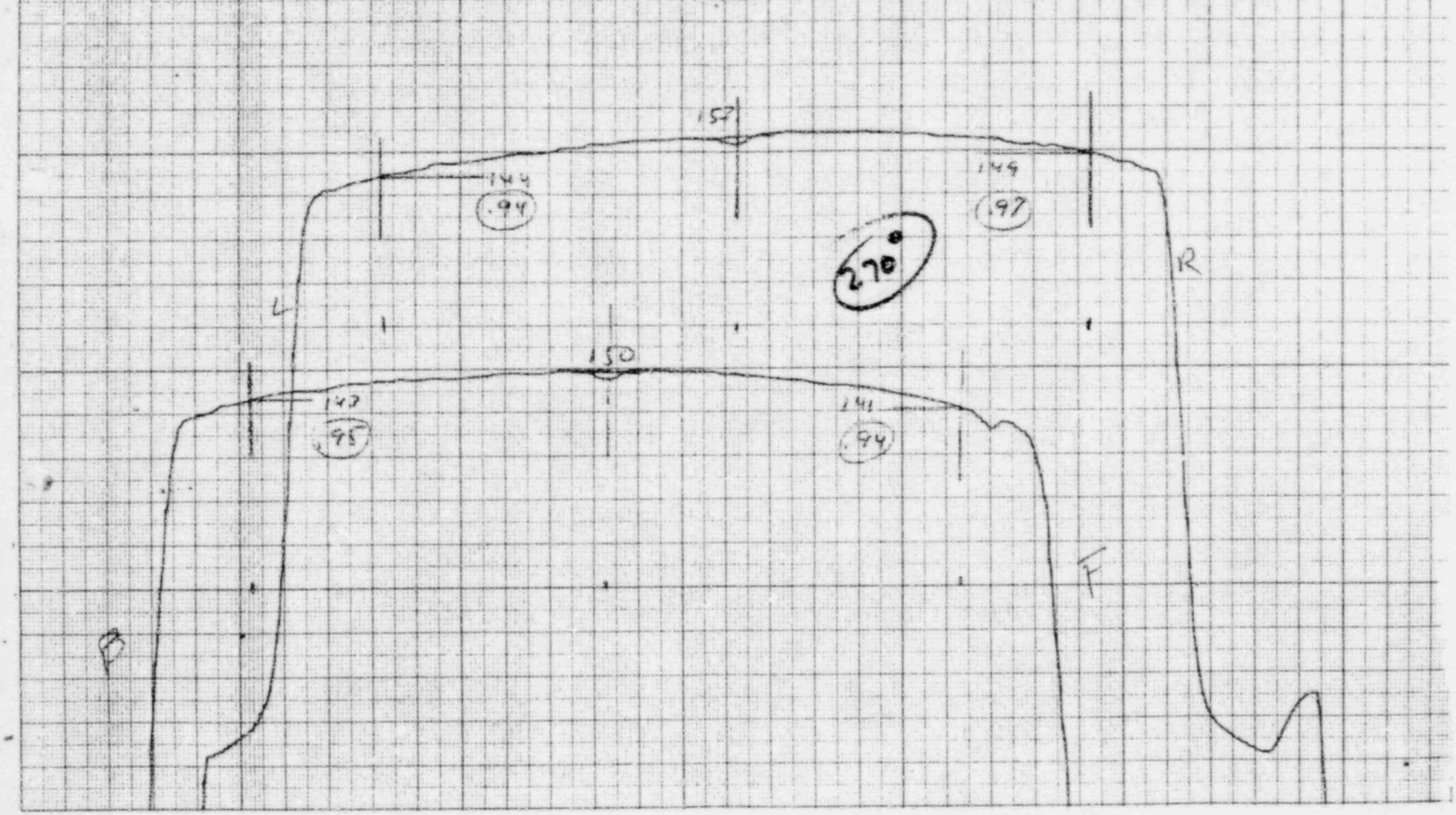
This value has been consistent with this machine for years and is checked monthly. The error is very small and incorporated into clinical use when appropriate.

E. The distance measuring devices supplied with the machine include a mechanical distance indicator as well as an optical distance indicator. These two methods of determining SSD are compared daily and verified monthly with an independent method. (see monthly spot check program section E.)


#1 0°
Cobalt Yearly 12/87
Flatness Film VS Gantry Angle
Flatness VS Gantry Ang.
12/8/87
146
139
.952
143
.98
0°
142
138
.972
137
.944

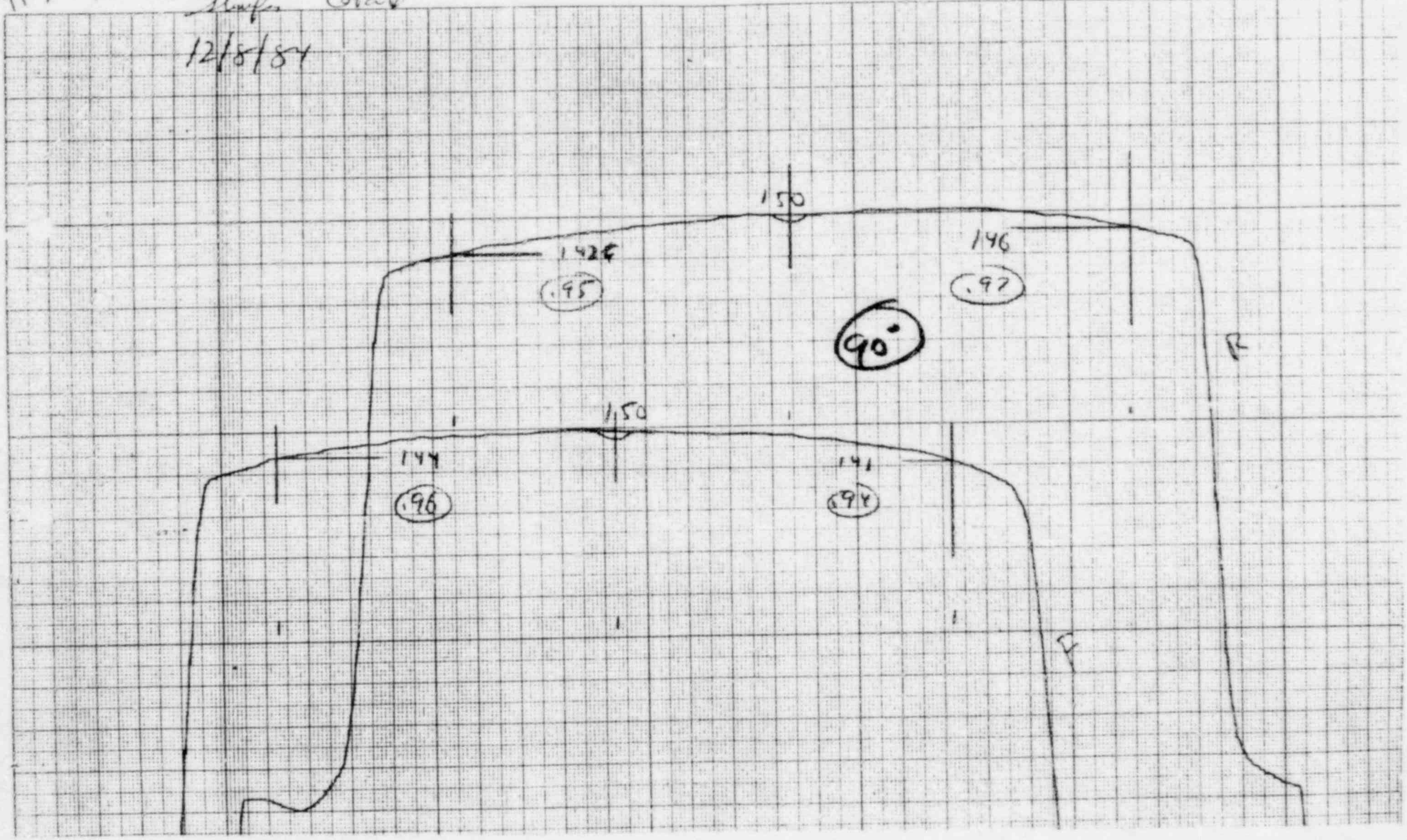
#2 270 Stanford Cobalt

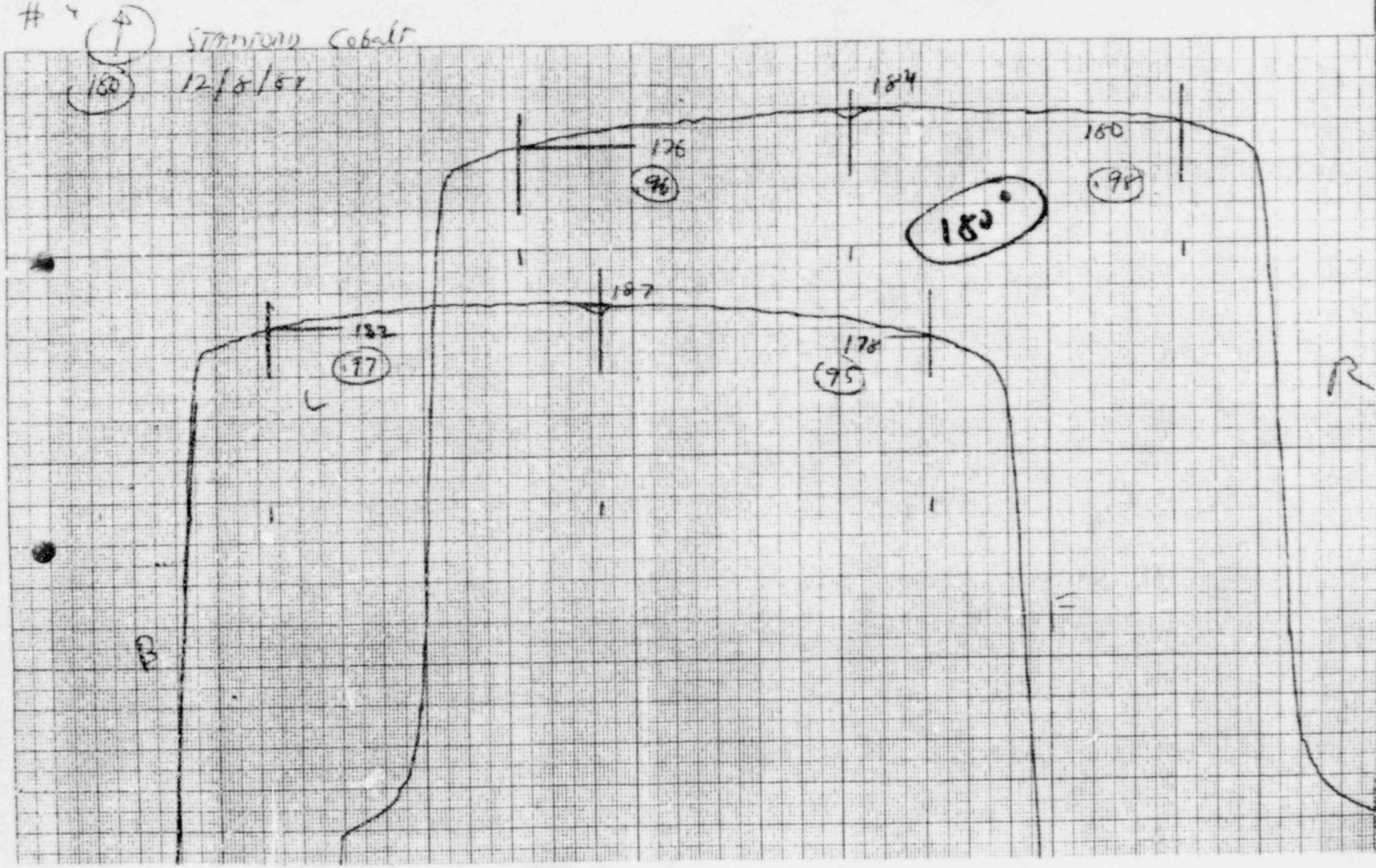
12/8/89



#3 (< 90°) Strafe Cutoff

12/8/84





STANFORD Cobalt
180
12/8/87
176
.96
184
180
.98
180°
187
182
.97
178
.95
L
R
B

NRC FORM 218 (4-76) NRCM 0240

U.S. NUCLEAR REGULATORY COMMISSION

TELEPHONE OR VERBAL CONVERSATION RECORD

DATE: 10/23/85

TIME: 9:10 ☒ A.M. ☐ P.M.

☐ INCOMING CALL ☒ OUTGOING CALL ☐ VISIT

PERSON CALLING	OFFICE/ADDRESS	PHONE NUMBER	EXTENSION
Johansen	USNRC Region I	215-337-5215	

PERSON CALLED	OFFICE/ADDRESS	PHONE NUMBER	EXTENSION
Agostinelli	Stamford Hosp.	203-785-2952	

CONVERSATION

SUBJECT: Submittal for Qualified expert

SUMMARY

Please submit the data for the measurement results for 1 full annual output calibration and 1 monthly spot check - This includes the raw numbers used. and the calculation showing any and all correction factors

REFERRED TO: CN 104334

☐ ADVISE ME OF ACTION TAKEN.

ACTION REQUESTED

Additional information to be submitted by licensee's physicist to be Q.E.

INITIALS: JmJ

DATE: 10/23/85

ACTION TAKEN

MS-15

INITIALS:

DATE:

NRC FORM 218 (4-76)

August 29, 1985

Jenny M. Johansen, M.S.
Nuclear Materials Section B
Division of Engineering and Technical Programs
United States Nuclear Regulatory Commission
Region I
631 Park Avenue
King of Prussia, PA 19406

Re: License No. 06-06697-01
Docket Nos. 030-00116
030-01265
Control No. 17132

Dear Ms. Johansen:

Unfortunately, too much time has elapsed since I replied to your last request (7/16/84) and as a result, Stamford Hospital has received a Notice of Violation regarding 10 CFR 35.25 requiring a licensee to maintain, for inspection by the commission, records of evaluation of their qualified expert.

In an attempt to obtain this approval I am resubmitting the information required by 35.24 (b) (footnote 2).

Sincerely,

A G Agostinelli

A. G. Agostinelli
Radiation Physicist

AGA:krm
enc.

cc: Mr. Rhoades, Stamford Hospital

DUPE OF

Applicant Sept 9

Check No.

Amount/Fee Category

Type of Fee Amendment

Date Check Rec'd

Received By

Rec'd LFMB 9/10/85

Dupe

FEE EXEMPT

Continuation of prev request

"OFFICIAL RECORD COPY"

ML10

104334

SEP 03 1985

A. G. AGOSTINELLI, B.S.
LAURENCE GRAY, M.S.
ROBERT C. LANGE, Ph.D.
JEROME A. MELI, Ph.D.
RAVINDER NATH, Ph.D.
S. C. ORPHANOUDAKIS, Ph.D.
ROBERT E. PETERSON, JR., B.S.
R. J. SCHULZ, Ph.D.

R. J. SCHULZ ASSOCIATES
P.O. BOX 3153, STONY CREEK STATION
BRANFORD, CONNECTICUT 06405

Amendment request for exception to Nulcear Regulatory Commission, Part 35.24 - "Qualified Expert"

The following information is provided in accordance with 35.24(b) in order that Mr. A.G. Agostinelli may be considered a qualified expert.

A. Name: Alfred G. Agostinelli
c/o R.J. Schulz Associates
Box 3153
Stony Creek Station
Branford, Connecticut 06405

Home address: 120 Braeside Drive
Hamden, Connecticut 06514

B. Training and Experience

1958-1962 - Manhattan College, Riverdale, New York
B.S. - Physics

1962 - Ontario Cancer Institute, Physics Division, Princess Margaret Hospital, Toronto, Ontario Canada. Two (2) months on-site training with physics staff.

1962-pres - Yale New Haven Hospital, New Haven, Connecticut
Physics Section, Department of Therapeutic Radiology

Current scientific and professional activities:

Maintain accurate instrumentation for x-ray and electron beam calibrations and prepare reports which include all of the data necessary for radiation therapy.

Assist physicians, dosimetrists and technicians in the solution of radiotherapeutic problems.

Develop quality assurance procedures, testing for conformance with equipment specifications.

Provide support and assistance for Radiological Engineering.

Design and supervise construction of devices used in radiation therapy.

Preparing dosimetry data for treatment planning computer and evaluation of the computer output for on-site and regional treatment planning services.

Member of American Association of Physicists in Medicine

Bibliography

1. Stedeford, B. and Agostinelli, A.G., Electron Therapy with a 6 MeV Linear Accelerator. Phys. Med. Biol., January 1966

2. Scientific exhibit at Radiological Society of North America, 1970. A Technique for Small Beam Isocentric Multiplaner X-Irradiation of the Pituitary. C. Von Essen, A.G. Agostinelli, and M.M. Kligerman

3. Schulz, R.J. and Agostinelli, A.G., Casting Beam Blocks for Radiotherapy. Technical Note, AAPM Quarterly Bulletin, December 1972

4. Son, Y.H., Silverman, H. and Agostinelli, A.G., 6 MeV Rotational Therapy with a Midline Shield for Superficial Skin Tumors. Radiology 116, 139-141, 1975

5. Schulz, R.J., McKiernan, F. and Agostinelli, A.G., Computer Generation of High-Energy X-ray Dose Distributions. Medical Physics, 3, No. 1, 1976

6. Doolittle, A.M., Berman, L.B., Vogel, G., Agostinelli, A.G., Skomro, C. and Schulz, R.J., An Electronic Patient-Contouring Device. Brit. J. Radiol. 50, 135-138, 1977

7. Gralla, E.J., Agostinelli, A.G., Russfield, A.B. and Folsch, E., Animal Model of Spontaneous Neoplasia Based on Lymph and Cells Collected from Thoracic Duct of Normal Dogs and Dogs with Malignant Lymphoma. Laboratory Animal Science, 27, No. 5, 866-878, 1977

8. Nath, R., Gignac, C.E., Agostinelli, A.G., Rothberg, S. and Schulz, R.J., A Semi-Empirical Model for the Generation of Dose Distributions Produced by a Scanning Electron Beam. Int. J. Rad. Onc. Biol. Phys., 6, 67-73, 1980

9. Nath, R., Agostinelli, A.G., Gignac, C.E. and Schulz, R.J., Improvement of Small-Field Penumbra and Dose Distributions on a 4 MV Accelerator. Int. J. Rad. Onc. Biol. Phys., 7, 957-959, 1981

10. Agostinelli, A.G., Beman, L., Vitali, P., Meli, J. and Schulz, R.J., A Dosimetry System for Whole-Body Electron Beam Therapy. Poster Session at 1983 AAPM Annual Meeting, 1983.

C. Calibration and Spot-Check Program Reports

The enclosures include: (1) a monthly output calibration report for the Stamford Hospital, Stamford, Connecticut. The measurements were made with an appropriately calibrated Farmer Chamber and the method

of dose calculation used was that of the AAPM SCRAD protocol of 1971, as requested in 35.21 (E). (2) a monthly spot-check program designed to comply with 35.22.

D. Written Endorsements

Enclosed letter from R.J. Schulz.

Sincerely,

A.G. Agostinelli
Radiological Physicist

AGA/krr

Yale University School of Medicine
DEPARTMENT OF THERAPEUTIC RADIOLOGY
Division of Radiological Physics

333 Cedar Street
New Haven, Connecticut 06510

February 14, 1984

License Management Branch
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

I am writing in support of Alfred G. Agostinelli's request to be recognized as a qualified expert by the NRC.

Mr. Agostinelli has been employed in the Department of Therapeutic Radiology of the Yale-New Haven Hospital since 1962. He has been a member of my staff and a close colleague since I assumed the directorship of the Physics Division in 1970. As a result of his many years of experience, the in-service training that I provide to all of my staff, and his participation in a wide variety of clinical research projects that are constantly underway in this department, he has developed into an extremely competent, reliable and knowledgable radiological physicist. I regard him as superior to the majority of board-certified radiological physicists that I encounter in the field and at scientific meetings.

In discussions with Mr. Agostinelli on the various aspects of calibrating and surveying teletherapy units, I have come to the conclusion that he is thoroughly conversant with NRC regulations as well as with all of the practical aspects of performing these types of measurements.

In summary, I strongly recommend Mr. Agostinelli as a competent and experienced radiological physicist, and that he be designated a qualified expert by the NRC.

Sincerely yours,

R.J. Schulz, Ph.D.
Professor of Therapeutic Radiology (Physics)
Certified Radiological Physicist, ABR

RJS/krr

Dupe ~~8404040517~~

A. G. AGOSTINELLI, B.S.
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ROBERT C. LANGE, Ph.D.
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R. J. SCHULZ ASSOCIATES
P.O. BOX 3153, STONY CREEK STATION
BRANFORD, CONNECTICUT 06405

The Stamford Hospital

Cobalt-60

Safety, Alignment and Output Check

A. Beam on/off indicators.

1) Check "beam off" light indicators: in room on wall; over door to room; "operation indicator" on Primalert room monitor; and green light on console.

2) Turn beam on and check all flashing "beam on" indicators; on machine; on wall in room; above door to room; on the console; and on the Primalert.

B. Door Interlocks.

1) With the beam on, open the door slightly to check if the door interlock shuts off the beam.

2) With the beam off, time set on the timer and the door ajar, try to turn the beam on to check that the beam will not go on.

3) Close the door and check that the beam may only go on after resetting at console.

C. Timer Check.

1) Let the beam turn off normally to check that the timer shuts the beam off when zero time is reached.

2) With zero time set, attempt to turn the beam on to check that it will not come on.

D. Emergency off switches.

1) With the beam on, see that the emergency off bar on the console shuts off the beam.

E. Alignment of distance measuring device.

-- Set a 10 x 10 cm field at 80 cm.
-- Raise the table until it stops automatically.
-- Place the spacer on the table with mattress removed.
-- Place the alignment jig on the spacer.
-- Center the 10 x 10 cm field.
-- Set the Optical Distance indicator to 80 cm.
-- The arrow should intersect the cross hairs (within 2mm).

F. Light vs. Radiation Field - Congruence.

1. Place a ready pack of RP/V film between the alignment jig and the spacer; align the 10 x 10 cm light field on the 10 x 10 wires on the jig.

2. Irradiate to approximately 80 rads.

3. When developed, the radiation beam should be within 3mm of the light beam (i.e., the wires).

G. Output Check.

1. Set a 10 x 10 cm field at 80 cm.

2. Place the output jig in the center of the field on the spacer (with the couch fully raised).

3. Place the blue diode in the center of the field. Read the diode on the Nuclear Associates Diode Dosemeter.

4. Irradiate for 1 minute.

5. The reading multiplied by ~~0.75~~ 0.72 should be within 5% of the posted output for the month, for a 10 x 10 cm field.

To calculate this value:

$$\frac{100\ [\ (\text{Reading})\ (\cancel{0.75}\ 0.72) - \text{Posted}\ ]}{\text{Posted}} = \pm \underline{\qquad}\ \%\ \text{deviation}$$

For example, on July 5, 1983, the reading was 111, and the posted output was 83.5. Therefore:

$$\frac{100\ [\ (111)\ (\cancel{0.75}\ 0.73) - 83.5\ ]}{83.5} = -\ 0.3\%\ \text{deviation}$$

H. Timer Accuracy.

1. Irradiate the diode as in the output check. This is Reading A (Rd_a).

2. Repeat the irradiation, turning the beam off 4 times during the 1 minute irradiation. When the beam shuts off it will have had 5 on-off cycles. This is Reading B (Rd_b).

Timer Accuracy (TA) is determined by the following:

$$TA = \frac{Rd_b - Rd_a}{5\,Rd_a - Rd_b}$$

For example:

A 1-minute irradiation with one on-off cycle readings 153 (Rd_a).

A 1-minute irradiation with 5 on-off cycles reads 159 (Rd_b).

$$TA = \frac{159 - 153}{5\,(153) - 159} = 0.01 \text{ min}$$

$$0.01 \text{ min} \times 60 \frac{\text{sec}}{\text{min}} = 0.59 \text{ sec}$$

A. G. Agostinelli

Alfred G. Agostinelli
Radiological Physicist
R. J. Schulz Associates

		Indicato	Interlock	Timer	Emergency	Alignment	Light /				Timer Accuracy	
								G - Output Check				
Date	Initial	A	B	C	D	E	F	Meter Reading	Chart Dose Rate	% Dev.	H	Physicist Review

The following is a description of methods used in complying with 10 CFR 35.21 regarding full calibration measurements of a teletherapy unit:

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From: $(\overline{Rd}_{2min} - \overline{Rd}_{1min})(TPC)(N_c)(f)(T)(A)(IS)$

where TPC = 0.996 = Temperature/pressure correction (21.5°C, 762.0 mmhg)

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C. The uniformity of the beam as a function of beam direction was done using film. A series of films of a 20 cm x 20 cm field was taken at 0^o, 90^o, 180^o and 270^o gantry angles. Each film was perpendicular to the central axis of the beam at approximately 5 mm depth with sufficient scatter. The four resulting films were then scanned in the front-to-back and left-to-right directions. The optical density (OD) of the central 16 cm x 16 cm area was noted. The OD was then converted to dose using a dose response curve determined with the same batch of film developed at the same time as the field uniformity films.

The resulting data shows that the cobalt unit has essentially the same uniformity regardless of gantry angle (i.e. beam direction).

Gantry Angle	Front OD / CAX OD	Back OD / CAX OD	Left OD / CAX OD	Right OD / CAX OD
0^o	0.95	0.97	0.95	0.98
90^o	0.94	0.96	0.95	0.97
180^o	0.95	0.97	0.96	0.98
270^o	0.94	0.95	0.94	0.97

The above ratio of off-axis to central axis optical densities are all within a few percent of each other at any gantry angle demonstrating that the uniformity does not change with beam direction.

This is to be expected with the newer solid sources as opposed to the older style "loose" pellets. This parameter is checked yearly.

D. The timer accuracy was determined by both acquiring readings as a function of time and plotting this data and also the multiple shut-off method, i.e.

$$\text{Timer accuracy} = \frac{B - A}{5A - B}$$

where A = a one minute reading with 1 shut-off

B = a one minute reading with 5 shut-offs

On 5/18/84 the results were as follows:

$A = 28.0 \times 10^{-9} C$ and $B = 29.28 \times 10^{-9} C$

Then TA = 0.012 mm = 0.69 sec.

This value has been consistent with this machine for years and is checked monthly. The error is very small and incorporated into clinical use when appropriate.

E. The distance measuring devices supplied with the machine include a mechanical distance indicator as well as an optical distance indicator. These two methods of determining SSD are compared daily and verified monthly with an independent method. (see monthly spot check program section E.)

THE STAMFORD HOSPITAL

PICKER COBALT-60 RADIATION THERAPY UNIT

CALIBRATION REPORT FOR JULY, AUGUST AND SEPTEMBER 1985

A. 80.0 CM SSD

FIELD SIZE	RADS/MIN @ MAX (0.5 CM) (1) JULY	AUGUST	SEPTEMBER
4^2 = 16 cm^2	119.4	118.1	116.8
5^2 = 25 cm^2	120.9	119.5	118.2
6^2 = 36 cm^2	122.7	121.4	120.1
7^2 = 49 cm^2	124.4	123.1	121.7
8^2 = 64 cm^2	125.8	124.4	123.1
9^2 = 81 cm^2	127.9	126.5	125.1
10^2 = 100 cm^2	129.2	127.8	126.4
11^2 = 121 cm^2	130.3	128.8	127.4
12^2 = 144 cm^2	131.4	130.0	128.6
13^2 = 164 cm^2	132.6	131.2	129.7
14^2 = 196 cm^2	133.9	132.5	131.0
15^2 = 225 cm^2	134.2	132.7	131.3
16^2 = 256 cm^2	135.1	133.6	132.2
17^2 = 289 cm^2	136.2	134.7	133.2
18^2 = 324 cm^2	136.6	135.1	133.6
19^2 = 361 cm^2	137.2	135.7	134.2
20^2 = 400 cm^2	138.1	136.6	135.1

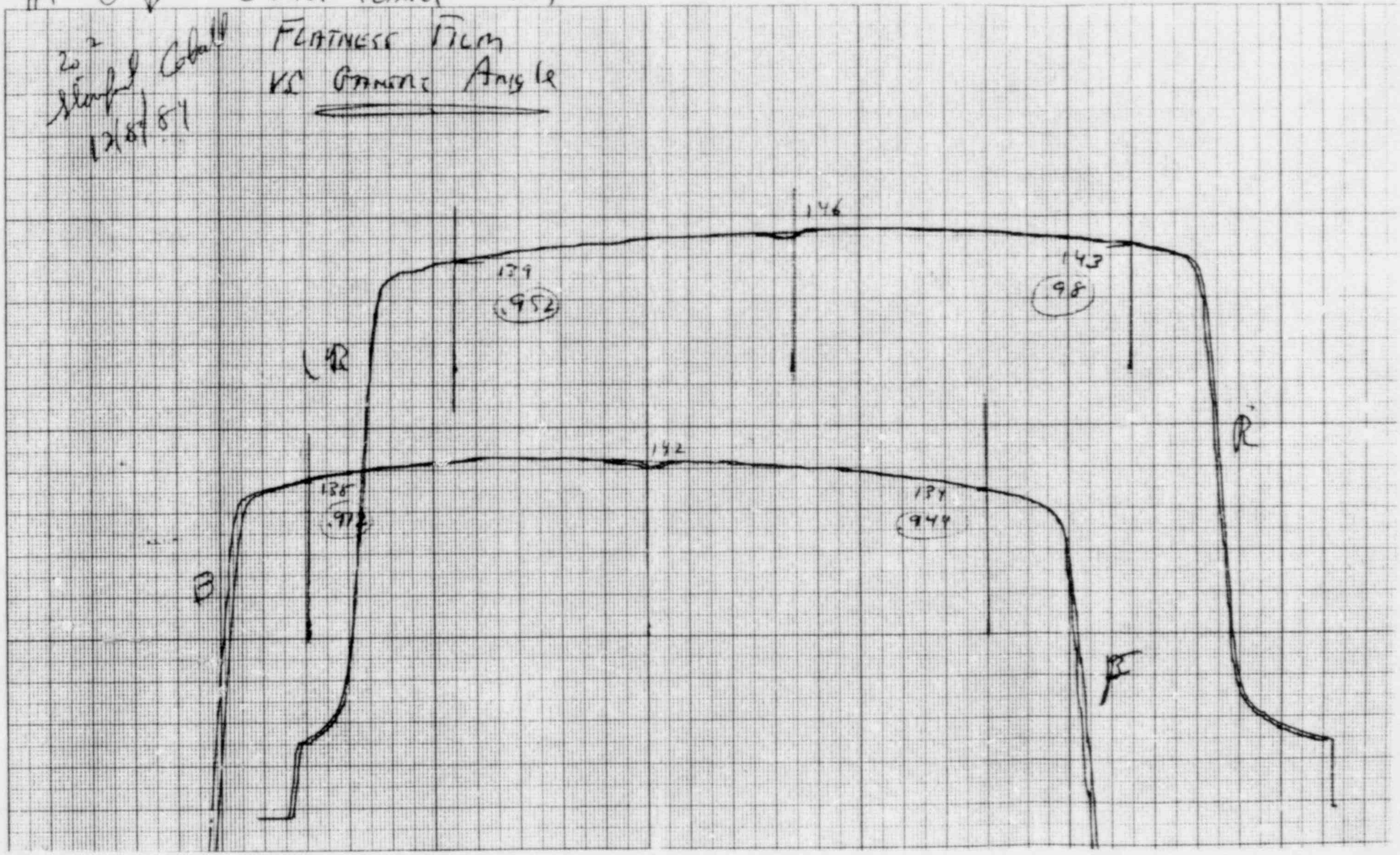
(1) THE OUTPUT IS STATED IN RADS TO TISSUE AND INCLUDES FULL BACKSCATTER.
BASED ON CALIBRATION OF 5/18/85

A.G. Agostinelli

A.G. AGOSTINELLI
RADIOLOGICAL PHYSICIST
R. J. SCHULZ ASSOCIATES

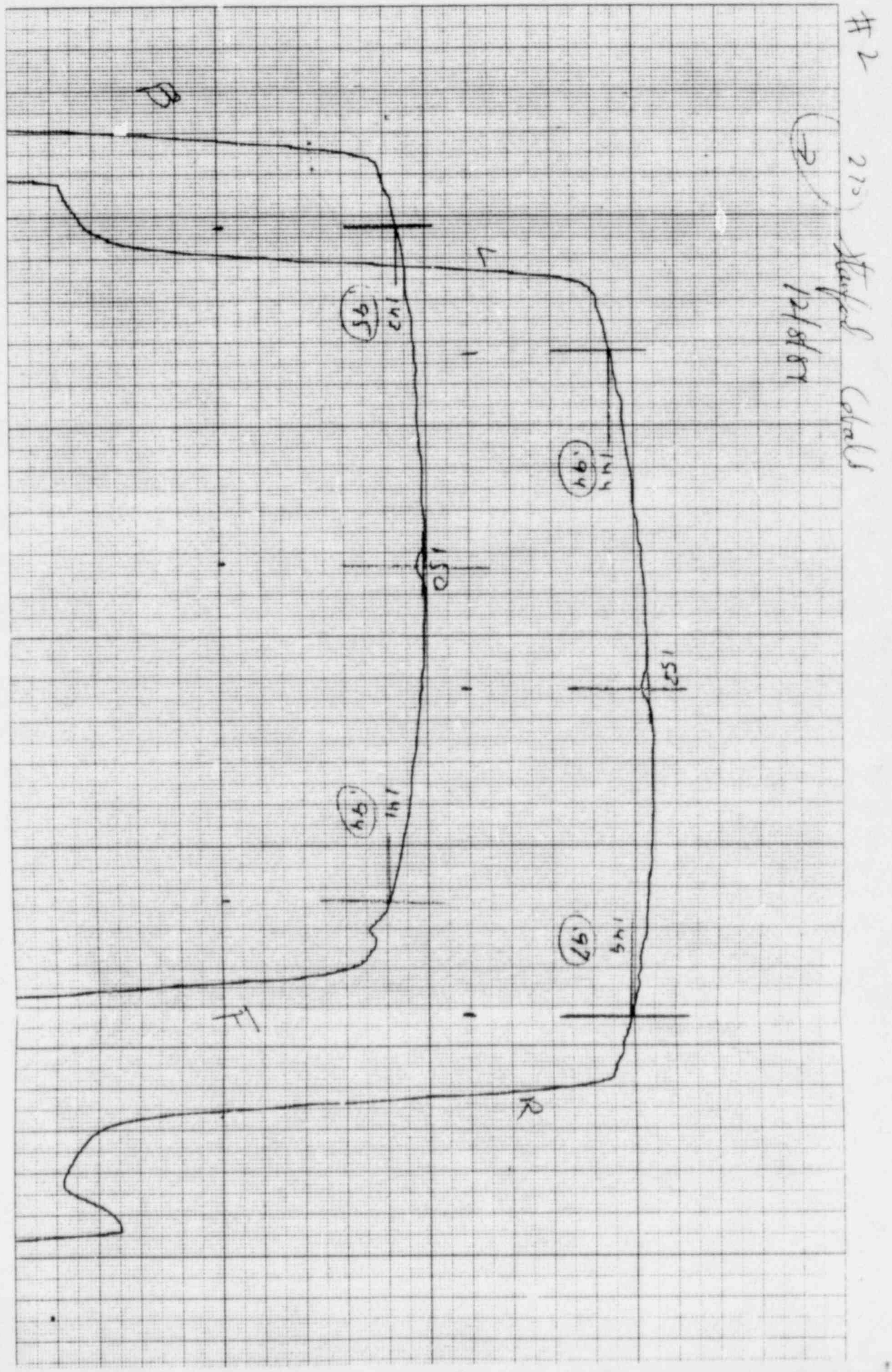
AGA:KRM

#1 0° ↓ Cobalt Yearly 12/87



NO. 340D-M DIETZGEN GRAPH PAPER
MILLIMETER

DIETZGEN CORPORATION
MADE IN U.S.A.



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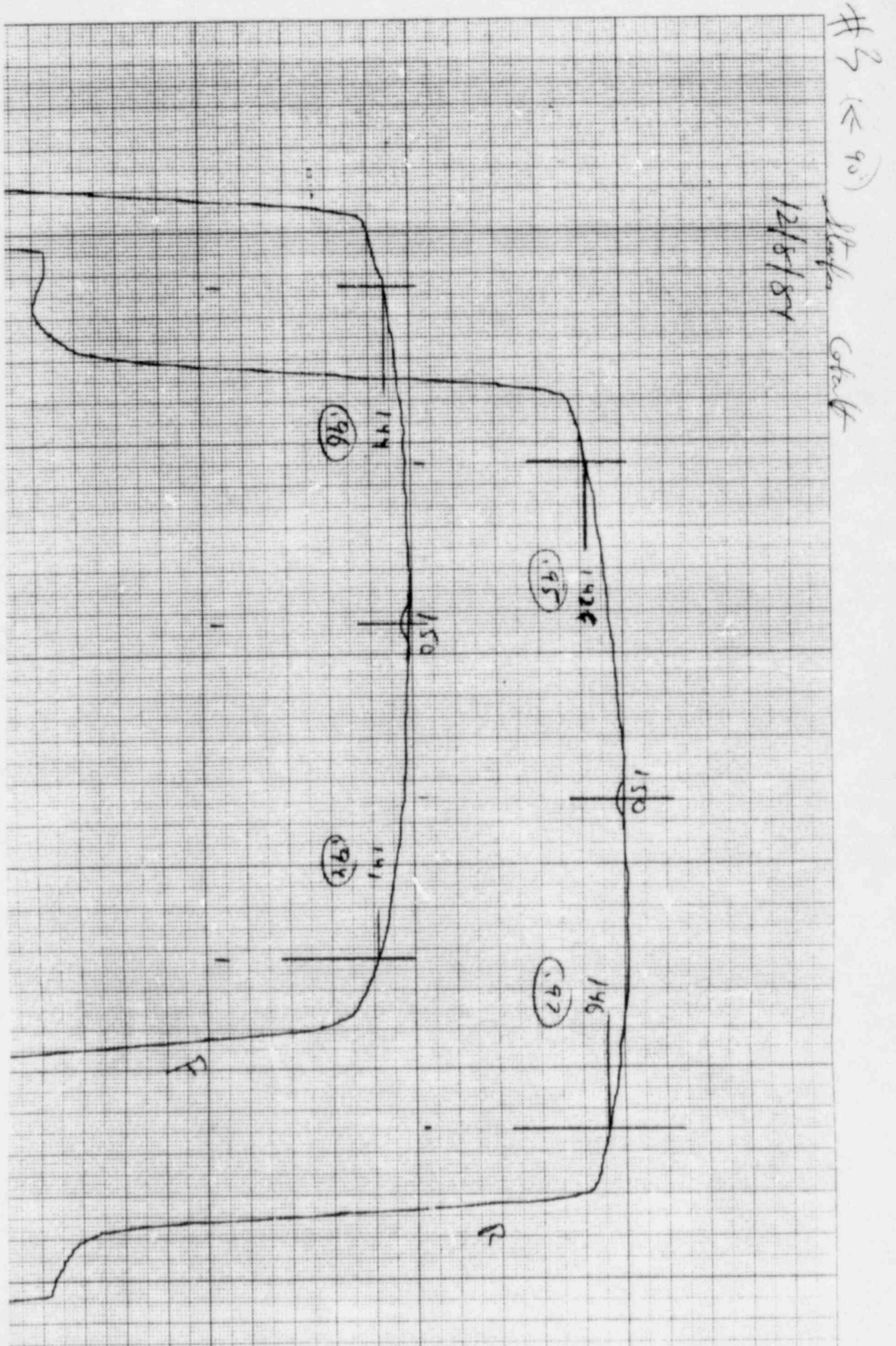
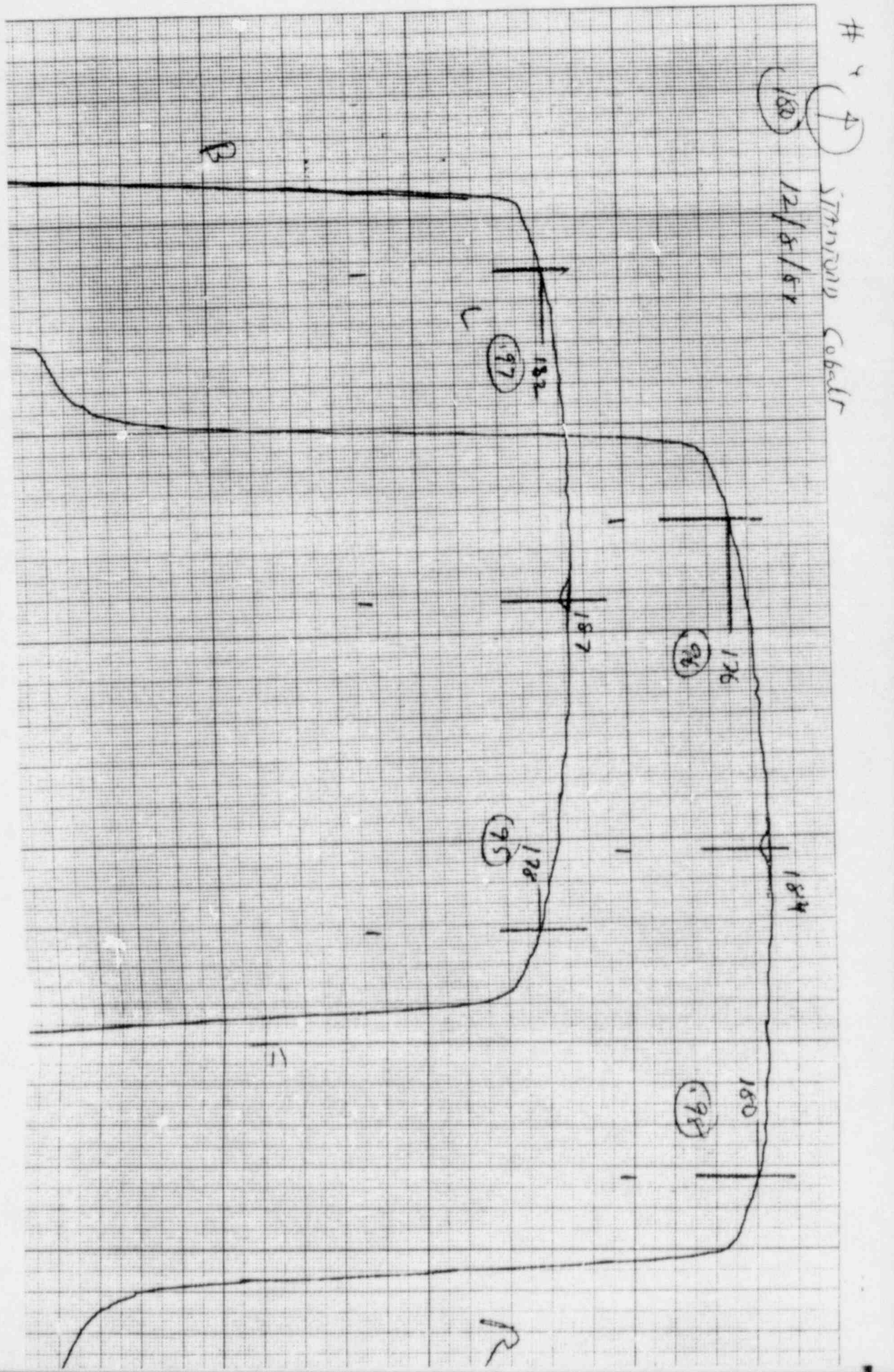
MILLIMETER

DIETZGEN CORPORATION
MADE IN U.S.A.




#4
100
12/8/81
Standard Cobalt
B
C
97
182
187
96
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95
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184
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180
R

BETWEEN: William O. Miller, Chief
License Fee Management Branch
Office of Administration

John E. Glenn, Chief
Nuclear Materials Section B
Division of Engineering and
Technical Programs

LICENSE FEE TRANSMITTAL

A. REGION I ~~No Fee Needed~~

1. APPLICATION ATTACHED

Applicant/Licensee: Stamford Hospital

Application Dated: 8/29/85

Control No.: 104334

License No.: 06-06697-01

2. FEE ATTACHED

Amount: 0

Check No.: 0

3. COMMENTS

reference control Number 17132
verified add'tl info (per J. Johnson)

Signed Brenda Platchek
Date 9/5/85

LMS 03 02300 2/86

B. LICENSE FEE MANAGEMENT BRANCH

1. Fee Category and Amount: 7A - no fee due

2. Correct Fee Paid. Application may be processed for:

Amendment ✓

Renewal ______

License ______

Signed [signature]
Date 9/30/85

REGION I FORM 213
(MARCH 1983)