

Terre Haute Regional Hospital

Radiation
Oncology
Department

601 Hospital Lane
Terre Haute, Indiana 47802
(812) 232-0021
Ext. 1630, 1631

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Certified Rad. Ther.
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Radiation
Physicist

June 20, 1985

United States Nuclear
Regulatory Commission
Washington, D.C. 20555

RECEIVED BY LFMB	
Date	July 5 th
Log	7/5/85
By	CP
Orig. To	LFMB
Action Compl.	CP

Dear Sirs:

Please find enclosed an evaluation of a Radiation Protection Survey completed following modification of an entry door frame of the cobalt teletherapy treatment facility and installation of a superficial therapy treatment unit in this same facility.

Along with this report are included copies of source head leakage measurements and initial and recent source leak test results.

This report is filed in connection with our recently renewed NRC License 13-09649-01 and in accordance with the rules, regulations, and recommendations set forth in NCRP 49 and NRC 10 CFR 20.

If there are any questions regarding this survey report, please contact me.

Sincerely,

Jennifer Hann, M.S.

Jennifer Hann, M.S.
Certified Radiological Physicist

cc: Region III Office
USNRC
cc: Administration
Department Manager
Radiation Oncologist

U.S. N.R.C.
FEE MGMT. BRANCH

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13-09649-01 PDR

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Report of Radiation Protection Survey
Terre Haute Regional Hospital
AECL Theratron-780 Cobalt Teletherapy Unit

Report of survey performed in conjunction with modification of entry door frame and installation of GE Maximar 100 KV superficial treatment machine in Northeast corner of treatment room.

Location: Department of Radiation Oncology
Terre Haute Regional Hospital
601 Hospital Lane
Terre Haute, IN 47802

NRC License: 13-09649-01 Expiration: January, 1989

Unit Type: Atomic Energy of Canada Limited Theratron-780
Teletherapy Unit, Serial No. 232.

Source Type: AECL Cobalt 60 Type C-146, diameter 1.5 cm,
Serial No. S3520, with an activity of 8760
Curies on 27 July 1983. Installed on 10
September 1983. Copy of most recent leak
test from Health Physics Associates is
attached as well as copies of initial leak tests.

Absorbed Dose Rate: On date of installation, 10 September 1983,
absorbed dose rate measured as 203.84 rad/min.
in air @ 80.5 cm from source, source-trimmer
distance of 45 cm. Measurements performed
with standard Baldwin-Farmer chamber (with
NBS traceable calibration) with 0.5 cm acrylic
build-up cap centered in 10 X 10 cm² field set
@ 80 cm SSD. Most recent monthly output check
measured under identical conditions agrees
within 0.5% with value determined by source
decay of the initial rate.

Instrumentation: All survey measurements are performed with a
Picker GM counter with a range of 0.0 - 50 mR per
hr. and a Keithley 36100 Survey Meter with a
range of 0.1 - 20 R/hr. Both instruments
have been recently calibrated.

Electrical Interlocks: The treatment room has only one entrance and
this door is equipped with an electrical
interlock which shuts off the primary radiation
beam whenever the door is opened during machine
operation. Further, operation will not resume
until the door closes and the machine is re-
activated from the control console. Proper
interlock function is tested by opening the
door during operation and noting the prompt
cessation of radiation, and by confirming that

operation does not continue until the control console is reactivated and the door is closed.

Electrical
Stops:

With the headlock inactivated, the machine's electrical stops limit the use of the primary radiation beam to a direction not exceeding 5° clockwise and 90° counter clockwise from vertical. These switches are functioning properly. A special case exists for treating patients on stretchers. In this instance, the gantry is rotated 90° clockwise and the head is rotated 165° counter clockwise. This is the only configuration with the headlock inactivated in which machine operation is enabled.

Emergency Off
Switches:

Emergency switches on the console, hand control and gantry housing properly terminate machine operation.

Treatment
Timing Device:

The automatic timing device which retracts the source to the safe position at the end of a preset treatment period is functioning properly.

Beam Off/On
Indicators:

Red lights indicating beam "on" conditions are located on the control console and above the entrance to the treatment room. In addition, the radiation monitor within the room is clearly visible through the leaded glass window in the entry door. The condition indicators and radiation monitor are functioning properly.

Patient
Monitoring:

From the control console area, audio communication with the patient and visual monitoring via closed circuit television are maintained during treatment. Also, the patient may be visually monitored through the entrance door leaded glass window and wide angle mirror arrangement.

Warning
Signals:

Conventional Radiation Area signs are posted on the door to the treatment room. Also, copies of NRC Form 3, Notice to Employees, are posted in areas of common employee access. Emergency Procedures directions are posted over the control console for immediate reference in event of source retraction failure. These procedures are also practiced periodically by those employees directly involved with radiation therapy treatment.

Source Housing: With the source in the "off" position, measurements are made at one meter from the source. The maximum reading is 0.7 mR/hr. These measurements are shown in attachment 2. Attachment 3 is included for comparison with initial values measured by AECL service engineers at the time of source installation on 10 September 1983.

Survey Summary: Figure 1 is a floor plan of the treatment room; in other views, cross-sectional diagrams of the treatment room are shown (Figures 2 and 3). In each figure, the surveyed areas are labelled appropriately and correspond to the subsequent figures illustrating the values actually measured under survey conditions. The survey is conducted with "worst case" parameters as outlined by NCRP #49: a patient mimicking phantom (25 X 25 X 25 cm³ phantom supplemented with additional padding) is set up with the largest field size at the normal 80 cm SSD. A general sweep to pinpoint areas of high readings (relative to background) is initially performed with the GM counter, and this sweep is then followed by a point by point measurement of a meter-grid imposed upon the survey area.

All wall surveys covered at least a seven foot height, as per NCRP 49. At the control console, access to areas above the false ceiling is controlled by the chief technologist and allowed only during periods when the machine is not operating. Particular attention is paid to those areas noted as relatively high. A Keithley 36100 Survey Meter with minimal energy dependence is used for this stage of the survey.

In reviewing the survey results presented in table 1 and illustrated in the appropriate figures, it can be seen that no measurements exceeded 1.6 mR/hr. (for purposes of this report, 1 mR = 1 mrem dose equivalent). Over a normal treatment week no one present in any area adjacent to the treatment room could receive over 0.4 mrem (non-controlled) or 12 mrem (controlled).

Conclusion:

This Radiation Protection Survey demonstrates that operation of this unit complies with standards and regulations presented in NCRP 49 and NRC 10 CFR 20.

Jennifer Hann, M.S.
Jennifer Hann, M.S.,
Certified Radiological Physicist

Ralph E. Fisher R.T.T.
Ralph E. Fisher, R.T.T.,
Radiation Oncology Department Manager

Jerry Dooley, Assoc. Admin.
Jerry Dooley,
Associate Administrator



CERTIFICATE OF RADIOACTIVITY WIPE/LEAK TEST

HEALTH PHYSICS ASSOCIATES LTD. CONSULTANTS IN RADIATION SAFETY

3304 COMMERCIAL AVENUE / NORTHBROOK, IL 60062 / PHONE: 312 564-3330

Name Terre Haute Regional Hospital

Test Due, on/or Before _____

Address 601 Hospital LaneNRC License # 13-09649-01City Terre Haute State IN Zip 47802Expiration Date JAN. 89

State License # _____

Expiration Date _____

Equipment Manufacturer AECL Model No. Theratron 780 Serial No. 232Isotope Co 60 Curiage 8760 Date 7/27/83 Source Serial No. S3520Individual performing test RALPH E. FISHER Date 14 Dec. 1984This test was performed in accordance with H.P. Associates instructions included in this kit, No. 7022Ralph E. Fisher

(Signature of Individual Performing Test)

(To be filled out by Health Physics Associates)

DATE SAMPLE RECEIVED 12/20/84 DATE SAMPLE PROCESSED 12/20/84

TEST DATA

Sample	CPM (Net)	Microcuries
1	M	M
2	M	M
3	M	M
Standard <u>Co60</u>	<u>60520</u>	<u>0.0657</u>

CPM — Counts Per Minute
DetectedM — Less than 0.0001
Microcuries

CONCLUSION:

Results of this test do not indicate the presence of reportable removable radioactivity. In accordance with prevailing regulations, this test should be performed again before 6/14/85Jean Delaney
Approved for Health Physics Associates



ATOMIC ENERGY OF CANADA LIMITED - COMMERCIAL PRODUCTS

REPORT OF ROUTINE WIPE TEST FOR CONTAMINATION

P&S 42934

IMPORTANT:

Sources shall be tested for leakage at intervals not to exceed six months.
Records of test results shall be kept in units of microcuries and maintained for inspection by the appropriate Licensing Authority.

CUSTOMER LOCATION:

Terre Haute Regional Hospital
601 Hospital Lane
Terre Haute, Indiana 47802

MODEL & SERIAL NO. T780 #232DATE OF TEST (M): Aug 19 83

DESCRIPTION OF SOURCE(S) TESTED:

Source in Rack ☐
Drawer hole ☒
Collimator ☐

for ^{60}Co ☒ , ^{137}Cs ☐ , ^{238}U ☐

Survey Meter Used: Berthold RATO/F

Serial No. _____

	A		B	
Instrument Sensitivity:	400 c/min	=	0.05 μCi	^{60}Co <input type="checkbox"/>
	1000 c/min	=	0.05 μCi	^{137}Cs <input checked="" type="checkbox"/>
	350 c/min	=	0.005 μCi	^{238}U <input type="checkbox"/>

Calibration Date: Aug 19 83

Leak Test(s) Performed:

- ☒ 1. Routine wipe contamination test as detailed in the Facility Instruction and Maintenance Manual or Field Service Instructions.
- ☐ 2. Other test(s) as described on reverse side.

Gross Wipe Reading = _____ c/min
Background Reading = _____ c/min

Net Wipe Reading = _____ c/min \times (B) _____ μCi = _____ μCi
(A) c/min

Test Evaluation:

- ☒ 1. NEGATIVE - Test showed less than reportable limit.
- ☐ 2. POSITIVE - Readings and initial corrective action to be detailed on reverse side.

It is hereby certified that the test(s) indicated above have been carried out under the supervision of the undersigned.
Conversion to S.I. Radiological units $0.01 \mu\text{Ci} = 1.95 \text{ kBq}$ and $1 \text{ mrem} = 10 \mu\text{Sv}$.

Signed [Signature]Date Aug 19 1983Title [Signature]

LEAK TEST CERTIFICATE ATTESTATION D'ÉTANCHÉITÉ

ORDER No.
N° DE COMMANDE

P&S 42934

DATE 1983 August 16

DESCRIPTION OF SOURCE TESTED
DESCRIPTION DES SOURCES VERIFIÉES

One Cobalt-60 Teletherapy Source 1.5 CM. Active Diameter, AECL Type C 146
Une source de téléthérapie au Cobalt-60, 1.5 CM de diamètre actif, EACL, Type C

Serial No. S-3520 Other
N° de série Autre

LEAK TESTS PERFORMED
ÉPREUVES D'ÉTANCHÉITÉ EFFECTUÉES

RESULTS OF TESTS
RÉSULTATS DES ÉPREUVES

(See reverse for description of tests)
(Voir verso pour description des épreuves au verso)

- ☒ 1. THE DRY WIPE TEST, PROCEDURE DG-0065
ÉPREUVE PAR FROTTEMENT À SEC, PROCÉDÉ DG-0065
- ☐ 2. OTHER TESTS (AS DESCRIBED BELOW)
AUTRES ÉPREUVES (DÉCRITES CI-APRÈS)

NEGATIVE

DATE OF COMPLETION OF TESTS
ÉPREUVES TERMINÉES LE

FOR THE COMPANY
POUR LA SOCIÉTÉ

1983 August 16

D. Bradley
Source Production Department
Service de la production des sources



Atomic Energy
of Canada Limited

Commercial Products

P.O. Box 8800
Postal Station J
Ottawa, Canada
K2A 3W3

L'Énergie Atomique
du Canada, Limitée

Produits Commerciaux

C.P. 8800
Succursale Postale J
Ottawa, Canada
K2A 3W3



RADIATION SURVEY REPORT

Teletherapy Head - Beam Off

P&S 42934

Customer Terre Haute Regional HospitalLocation 601 Hospital Lane, Terre Haute, Indiana 47802Model Theratron 780Serial Number 232

SOURCE DATA

Serial No. S3520 Diameter 1.5 cm Curies 8760 cobalt 60
Measured Output 131.4 +3% Rmm(ICRU) Measurement Date 1983 July 27
Maximum Unit Output -152.6 +5% Rmm Rated Capacity 213 Rmm(ICRU)

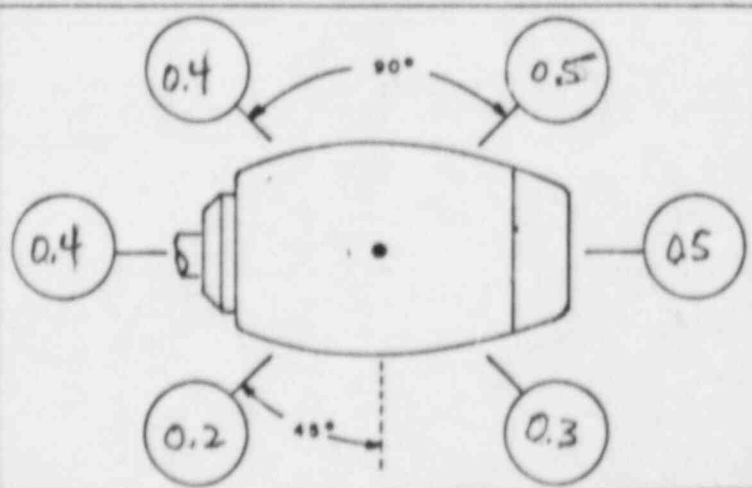
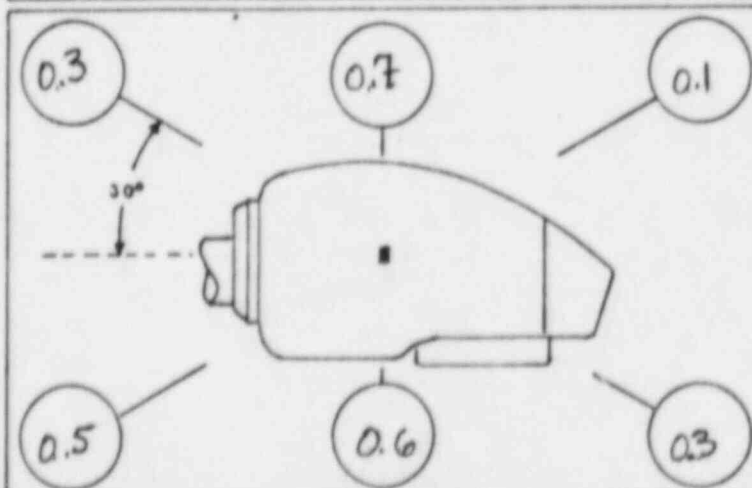
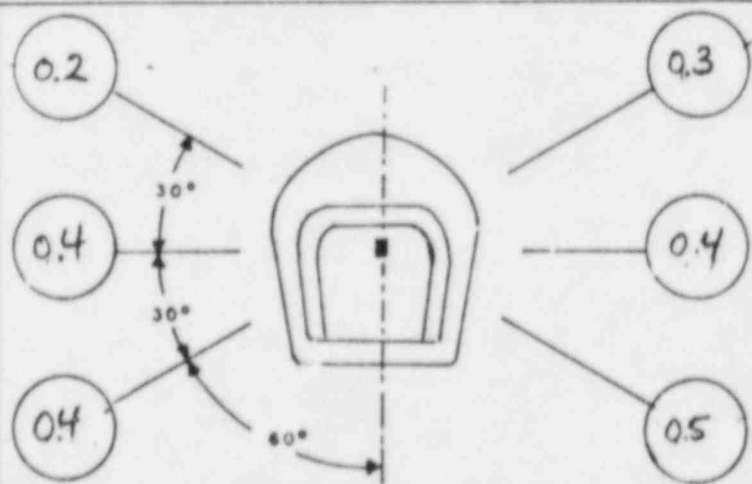
Survey Meter KeithleyModel 36100

Serial No. _____

Calibration Date 9/84Supplementary Shielding: Donut ☒Air Cylinder End ☒Other ☐HEAD SURVEY PERFORMED BY J. Klann, M.S.Date 6/19/85

NOTES

1. Values at each point are averaged over a 100 square centimetre area in accord with recommendations NCRP Report 33.
2. Values are in mR/h at 1 metre from the source.
3. This report is based on values measured at 18 points and is for compliance verification only. Report is not to be used as a substitute for comprehensive 26 point survey originally performed under controlled conditions at the factory in accord with recommendations NCRP Report 33.
4. Average of values at all 26 points is equal to, or less than, 2 mR/h.
5. No measured value exceeds 10 mR/h.

MAX READING $\rightarrow 0.7 \text{ mR/hr}$ AVE RDG $\rightarrow 0.4 \text{ mR/hr}$ 

RADIATION SURVEY REPORT

Teletherapy Head - Beam Off

P&S 42934

Customer Terre Haute Regional Hospital

Location 601 Hospital Lane, Terre Haute, Indiana 47802

Model Theratron 780

Serial Number 232

SOURCE DATA

Serial No. S3520 Diameter 1.5 cm Curies 8760 cobalt 60
 Measured Output 131.4 +3% Rmm(ICRU) Measurement Date 1983 July 27
 Maximum Unit Output 152.6 +5% Rmm Rated Capacity 213 Rmm(ICRU)

Survey Meter BERTHOUD

Model RATE F

Serial No. 1714

Calibration Date Aug 18, 83

Supplementary Shielding: Donut ☒

Air Cylinder End ☒

Other ☐

HEAD SURVEY PERFORMED BY W. AUGER / D. TIGHE

Date Sept 9, '83

NOTES

1. Values at each point are averaged over a 100 square centimetre area in accord with recommendations NCRP Report 33.
2. Values are in mR/h at 1 metre from the source.
3. This report is based on values measured at 18 points and is for compliance verification only. Report is not to be used as a substitute for comprehensive 26 point survey originally performed under controlled conditions at the factory in accord with recommendations NCRP Report 33.
4. Average of values at all 26 points is equal to, or less than, 2 mR/h.
5. No measured value exceeds 10 mR/h.

MAX RDG $\rightarrow 1.5 \text{ mR/hr}$ AVE RDG $\rightarrow 0.5 \text{ mR/hr}$

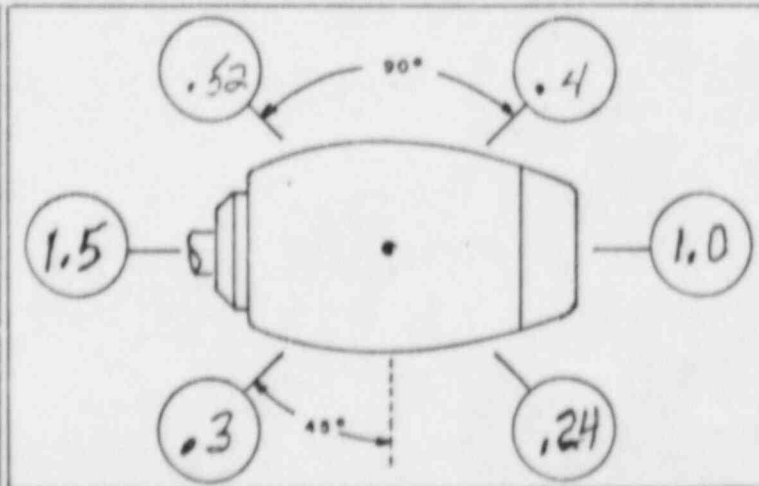
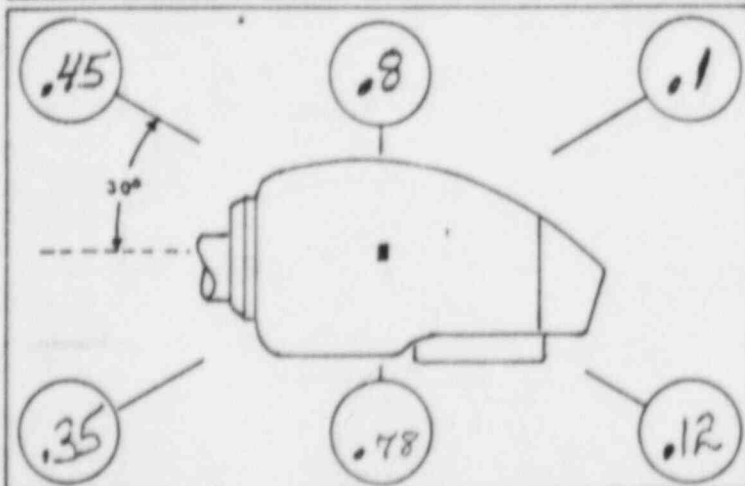
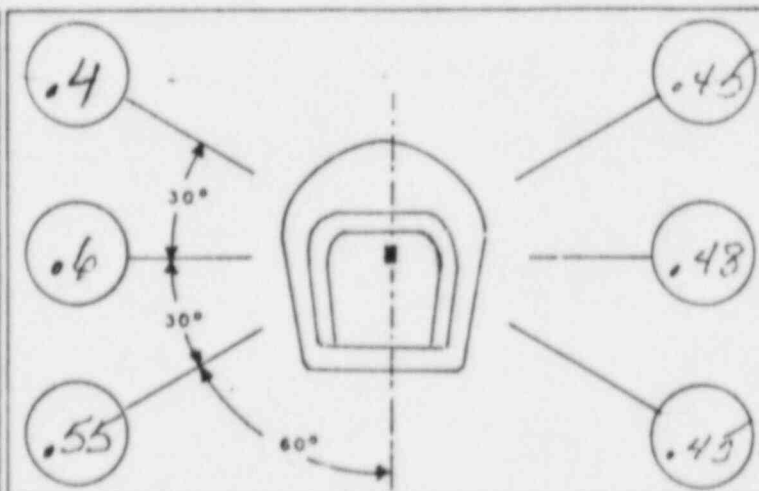


TABLE 1: SUMMARY OF WEEKLY DOSE EQUIVALENT ACCUMULATIONS

Area	Area Designation	Gantry Angle (Increasing Clockwise, °)	Maximum Measured Dose Equivalent Rate (mrem/hr)	Occupancy Factor (T)	Use Factor (U)	Modified Maximum Dose Equivalent Rate* (mrem/hr)	Resultant Weekly Dose Equivalent** accumulation mrem/wk)
1	Controlled	0	0.3	1	1	0.3	4.5
		45	1.4		$\frac{1}{4}$	0.35	5.3
		55	1.6			0.4	6.0
		65	1.3			0.33	4.9
		90	1.6		$\frac{1}{2}$	0.8	12.0
		135	1.6		$\frac{1}{4}$	0.4	6.0
		180	0.6		1	0.6	9.0
		270	<		$\frac{1}{2}$	<	<1.5
2	Controlled	0	<	1	1	<	<1.5
		45	<		$\frac{1}{4}$	<	<1.5
		90	<		$\frac{1}{2}$	<	<1.5
		135	0.2		$\frac{1}{4}$	0.05	<1.5
		180	<		1	<	<1.5
		270	<		$\frac{1}{2}$	<	<1.5
3	Noncontrolled	0	<	1/16	1	<	<1.5
		90	0.4		$\frac{1}{2}$	0.013	<1.5
		180	0.1		1	0.006	<1.5
		270	0.1		$\frac{1}{2}$	0.003	<1.5
4	Noncontrolled	0	<	1/16	1	<	<1.5
		180	<		1	<	<1.5
		270	<		$\frac{1}{2}$	<	<1.5
		315	<		$\frac{1}{4}$	<	<1.5
		Special	0.5			0.008	<1.5
5	Noncontrolled	0	<	1/16	1	<	<1.5
		180	<		1	<	<1.5
		270	<		$\frac{1}{2}$	<	<1.5
		315	<		$\frac{1}{4}$	<	<1.5
		Special	0.2			0.003	<1.5

TABLE 1: (CONTINUED)

Area	Area Designation	Gantry Angle (Increasing Clockwise, °)	Maximum Measured Dose Equivalent Rate (mrem/hr)	Occupancy Factor (T)	Use Factor (U)	Modified Maximum Dose Equivalent Rate* (mrem/hr)	Resultant Weekly Dose Equivalent Accumulation mrem/wk
6	Noncontrolled	180	0.1	1/16	1	0.006	<1.5
		225	<		$\frac{1}{4}$	<	<1.5
		270	<		$\frac{1}{2}$	<	<1.5
		315	<		$\frac{3}{4}$	<	<1.5

Occupancy and Use Factors and also Area Designations assigned as per rules and conditions established in NCRP #49.

The normal treatment workload (W) is determined conservatively to be 57,600 R/wk @ a meter. The parameters used to determine this workload include: 60 patients/day @ 2 treatments/pt, approximately 1.5 min/tmt (300 rad total), 5 day/wk. The beam "on" time resulting from these conservative values is 15 hr/wk.

*Modified Rate = Maximum Rate X T X U

**Resultant Accumulation = Modified Rate X beam "on" time

FIG 1: TREATMENT ROOM LAYOUT

ORTHOVOLTAGE
ROOM EAST WALL

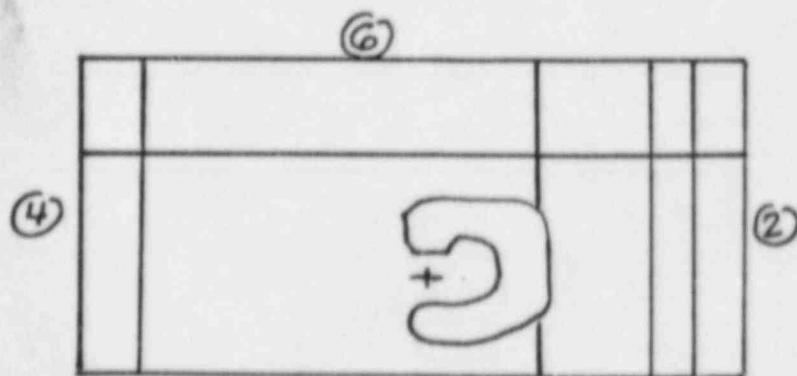
COBALT
CONTROL PANEL
CORNER WALL

NORTH OUTSIDE (5) WALL

WAITING ROOM NORTH WALL

(6) COBALT ROOM ROOF

FIGS. 2 & 3: CROSS-SECTIONAL VIEWS



NOTES: SCALE IS $\frac{1}{8}'' = 1'$ FOR
THESE AND ALL OTHER FIGURES.
THE TREATMENT MACHINE DEPICTED
IN FIGS. 2 & 3 IS STRICTLY
REPRESENTATIONAL AND IS NOT
DRAWN TO SCALE.

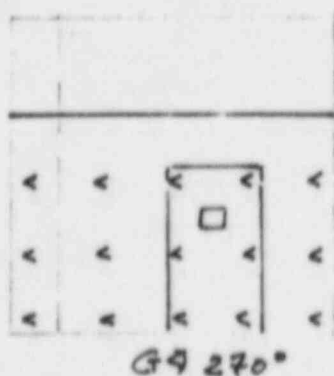
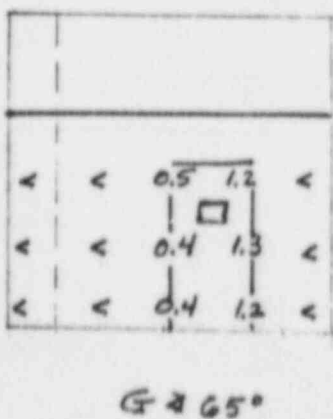
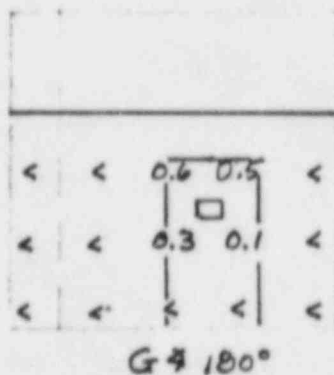
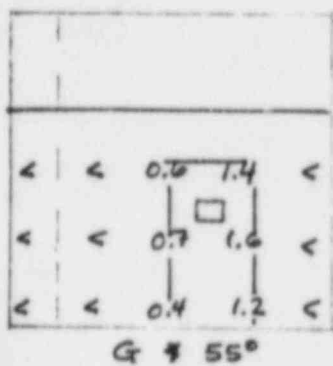
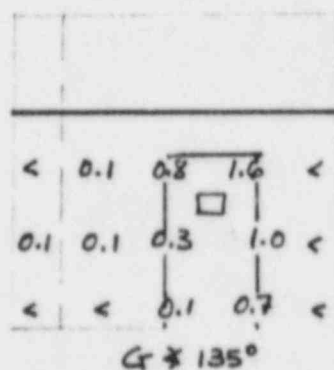
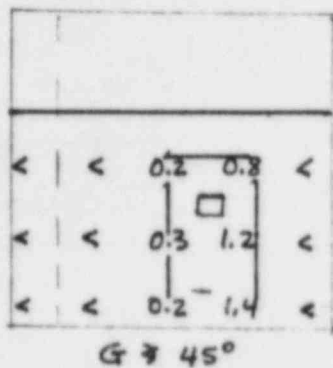
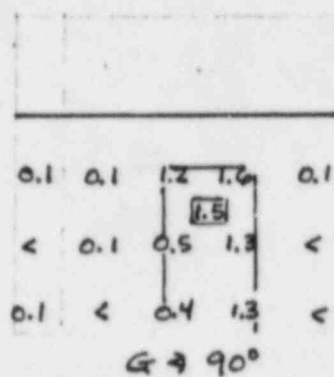
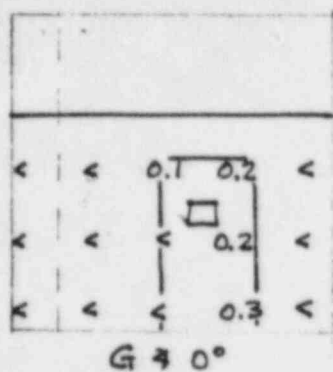


Fig. 4: Cobalt Control Panel Corner Wall

(1)

All values expressed in mrem/hr; < represents measurements below 0.1 mrem/hr.

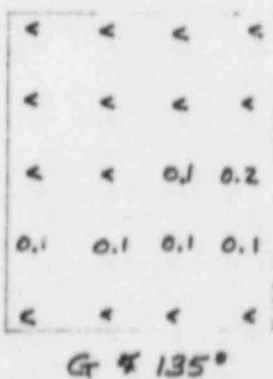
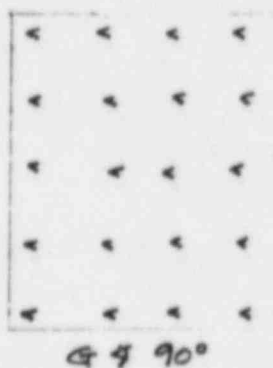
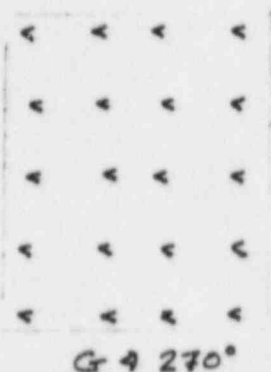
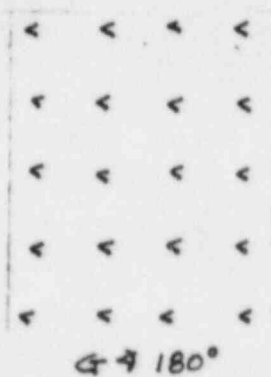
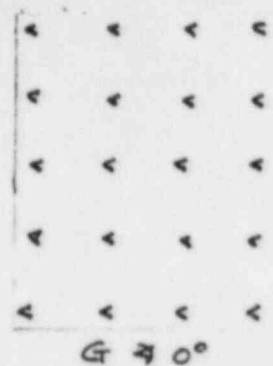


Fig. 5: Orthovoltage Room East Wall

(2)

All values expressed in mrem/hr; < represents measurements below 0.1 mrem/hr.

<	<	<	<	<	<	<	<
<	<	<	<	<	<	<	<
<	<	<	<	<	<	<	<

G 4 0°

<	<	0.3	0.3	0.1	<	<	<
<	<	0.2	0.4	0.1	<	<	<
<	<	0.2	0.3	0.1	<	<	<

G 4 90°

<	<	<	0.1	0.1	<	<	<
<	<	<	<	<	<	<	<
<	<	<	<	<	<	<	<

G 4 180°

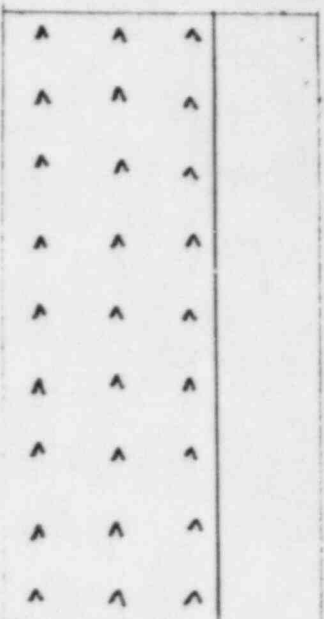
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<	<	<	<	<	<	<	<
<	<	<	<	<	<	<	<

G 4 270°

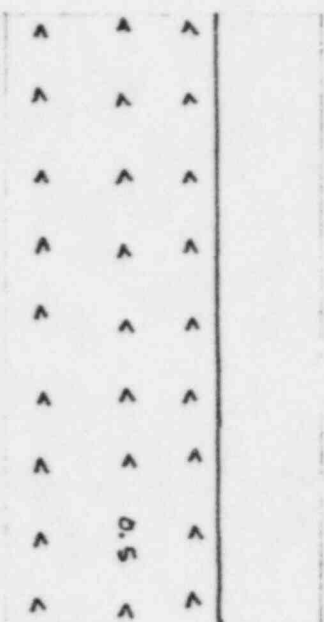
Fig. 6: Waiting Room North Wall

(3)

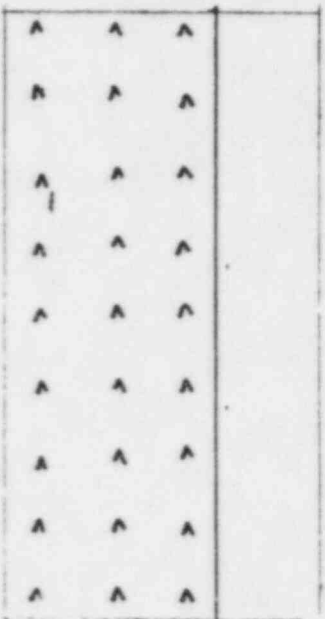
All values expressed in mrem/hr; < represents measurements below 0.1 mrem/hr.



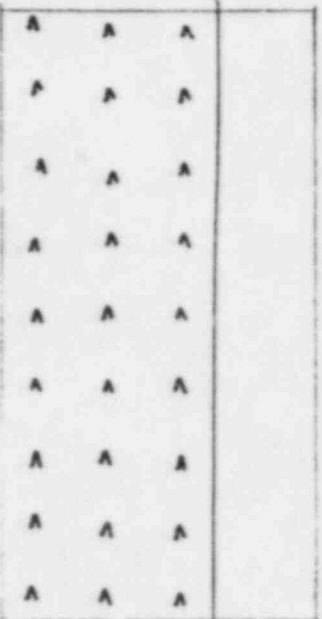
G 2 0°



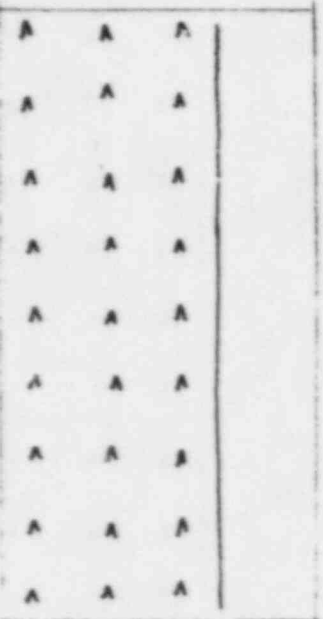
SPECIAL CASE: G 2 90°, H 2 165°
NO BACKSTOP



G 2 180°



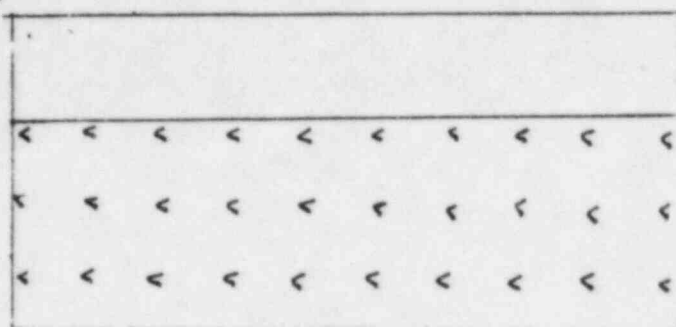
G 2 270°



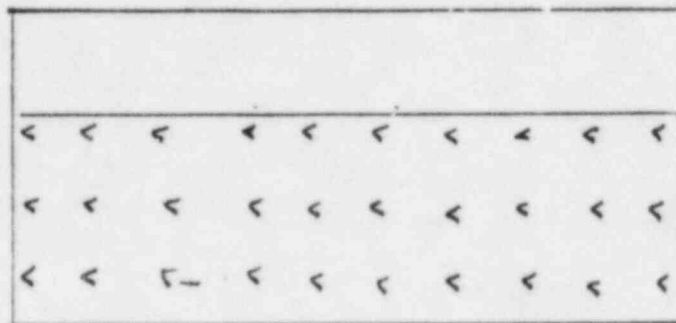
G 2 315°

Fig. 7: East Outside Wall (4)

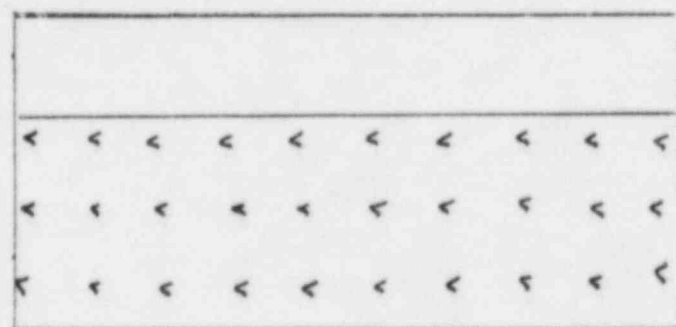
All values expressed in mrem/hr; < represents measurements below 0.1 mrem/hr.



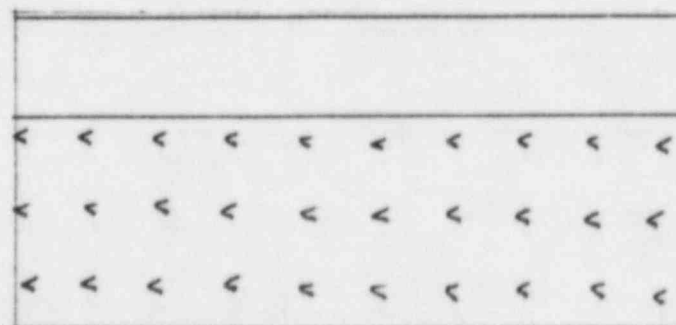
G 4 0°



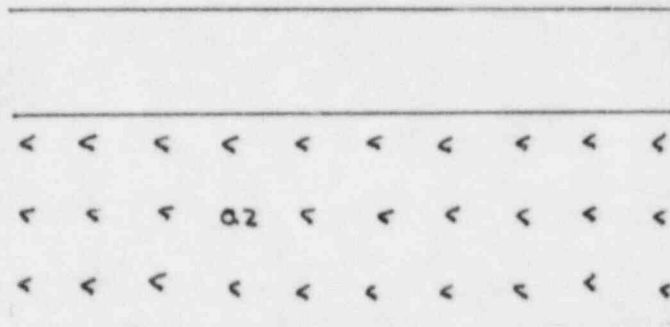
G 4 180°



G 4 270°



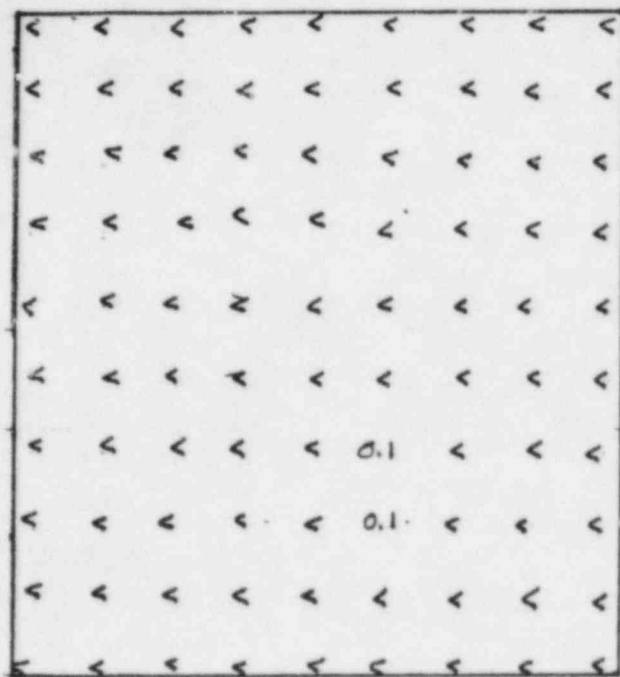
G 4 315°



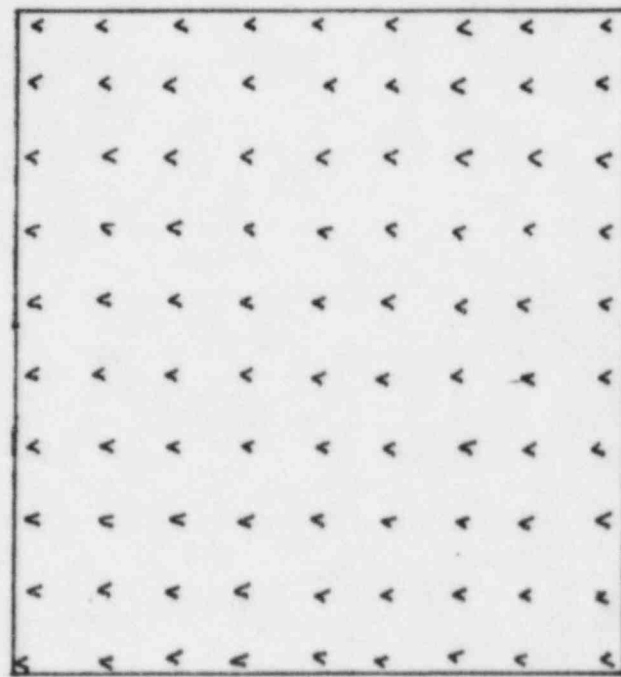
SPECIAL CASE: G 4 90°, H 4 165°
NO BACKSTOP

Fig. 8: North Outside Wall (5)

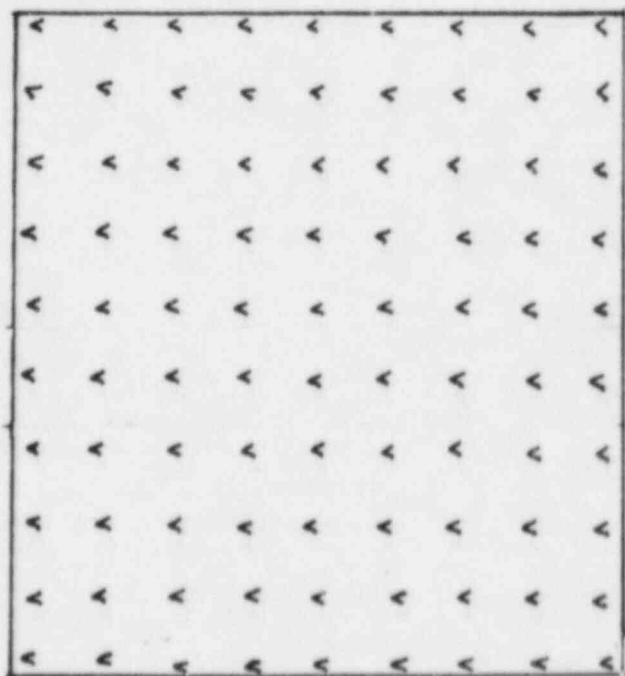
All values expressed in mrem/hr; < represents measurements below 0.1 mrem/hr.



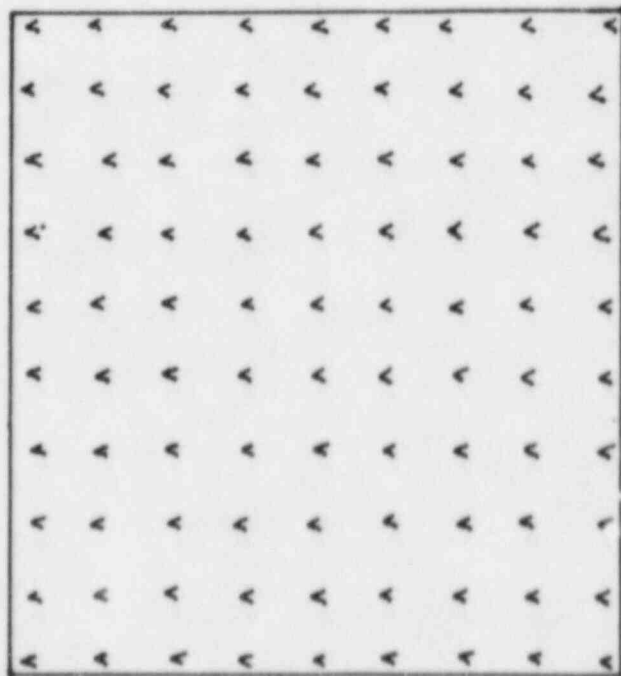
$\bar{G} \approx 180^\circ$



$G \approx 270^\circ$



$G \approx 225^\circ$



$G \approx 315^\circ$

Fig. 9: Cobalt Room Roof

(6)

All values expressed in mrem/hr; < represents measurements below 0.1 mrem/hr.