FGH

Certified
Radiation
Physicists

Fields Griffith Hubbard
and Associates, Inc.

1141 Honfleder Road
Glencoe, Illinois 60022
312 835-4433

Western Regional Office
2483 Wrappoonwa
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Theodore Fields M.S. FACR CHP
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Michael V. Broadbent Ph.D. MACR
Francis E. Gannon M.S.

Exhibit 3

August 22, 1981

U.S. Nuclear Regulatory Commission
Radioisotopes Licensing Branch
Division of Materials and Fuel Cycle
Facilities Licensing
Washington, D.C. 20555

RE: License #13-02047-03

Dear Sir,

On August 14, 1981, a cobalt 60 source was installed in the AECL Theratron Jr. Unit at St. Margaret's Hospital, Hammond, Indiana.

Enclosed please find copy of the survey report. This material is to fulfill the requirements of condition 18 of the above license.

Yours truly,

Charles R. Griffith, M.S., F.A.C.R.

CG/mg

cc: Regional Directory
U.S. Nuclear Regulatory Commission
Regional Office of Inspection
799 Roosevelt Road
Glen Ellyn, Illinois 60137

TELETHERAPY SURVEY REPORT

Table I

1 Institution: Name St. Margaret's Hospital

Address 25 Douglas Avenue

City Hammond State Indiana Zip 46320

N.R.C. License # 13-02047-03

2 Surveyor: Name Charles R. Griffith

Address [redacted]

City [redacted] State [redacted] Zip [redacted]

Certification Amer. Board of Radiology

3 Teletherapy Unit: Mfr A.E.C.L. Model Theratron Jr. Serial 70

Teletherapy Source: Mfr Neutron Product Model NPI-20-1900W

4 Date of Source Installation 8-13-81

5 Date of Survey 8-14-81

6 Survey Instruments:

Mfr	Model	Cal. Date	Cal Method
Victoreen	440	1-29-81	Health Physics Int., Northbrook, Il
Victoreen	660	10-26-80	Victoreen, BOC, Cleveland

7 Source Strength: Curies 1650 Date 6-1-81

8 Output: R/min 105.4 at 55 cm for 10 X 10 field on 8/14/81

9 Leakage Radiation: See Table II $(105.4)(.60)(.55)^2(1.05) = 20.10$ R/hr

10 Beam Orientation Limits & Method of Limitation

Source head permanently fixed to beam absorber. No head angulation or tilt.

11 Maximum Radiation Levels, Adjacent Areas, Rotation With Beam Stop (See attached Survey Report)

12 Maximum Radiation Levels, Adjacent Areas Without Beam Stop (See Table IIIB)(Not Applicable)

13 Check List, Mechanical Functions:

a) Door Interlock OK (See attached)

b) Source "on-off" indicators; mechanical ---, lights OK(See Attached)

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

	Position No.	Radiation Level (mR/hr)
View A	1	5.0 *
	2	1.9
	3	1.5
	4	3.4
View B	5	2.0
	6	2.0
	7	2.7
	8	.2.2
View C	9	2.4
	10	2.2
View D	11	2.4
	12	2.4
	13	2.0
	14	1.9

Average value 2.4 (See amendment 5 License 13-02047-03

Maximum value 5.0

Instrument used Victoreen 440

Calibrated 1-29-81

RHA 1890

Curies 1650

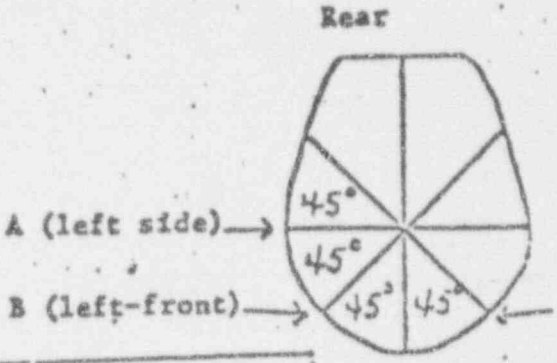
& Date 6-1-81

Manufacturer's name & model # of teletherapy unit AECL

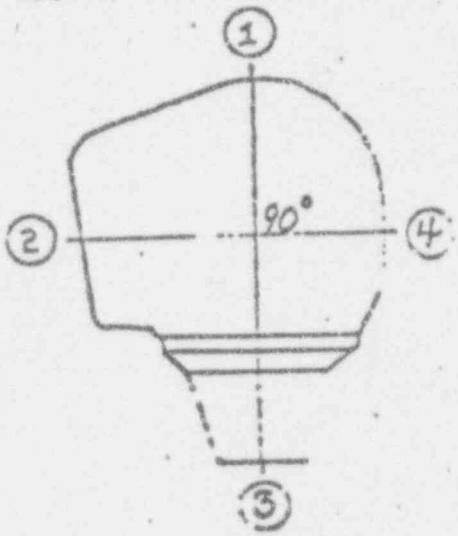
Theratron Jr.

* Allows an average of 3 mr/hr.

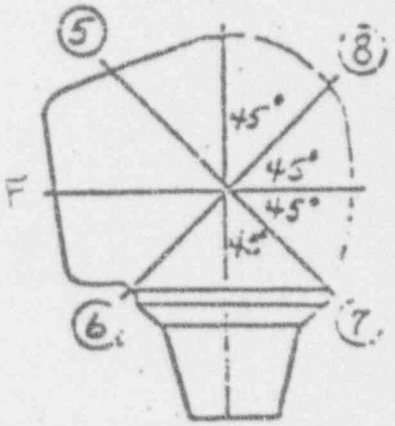
Top View - Showing orientation of Views A through D



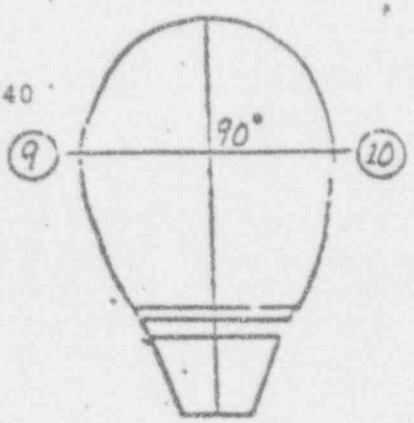
View A - Vertical from left side



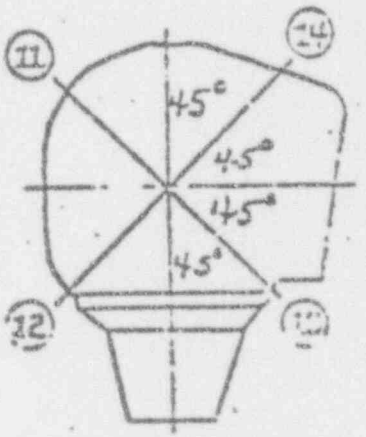
View B - Vertical from left-front



View C - Vertical from front



View D- Vertical from right-front



Certificate of

Standardization of X-Ray Machine

FOR

ST. MARGARPT'S HOSPITAL

25 Douglas, Hammond, Indiana 46320

BY

THEODORE FIELDS, M.S., F.A.C.R. (Assoc.)

CHARLES R. GRIFFITH, M.S., M.A.C.R. (Assoc.)

DIPLOMATES – AMERICAN BOARD OF RADIOLOGY, AMERICAN BOARD OF HEALTH PHYSICS, A.I.A.S.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Technique	Monitor	Peak Kilo-Volts	Primary Volt Meter With Load	Auto Trans-former 1-14-82	HVL IN MM	Milli-Amperes	Distance CM	Added Filter in MM FIELD SIZE	Roentgens Per Minute in Air	9-14	10-14	11-14	12-14
				112.4			50	5x5	118.8	117.5	116.2	114.9	113.7
				119.6				8x8	126.4	125.0	123.6	122.3	120.9
				120.7				10x10	227.5	126.1	124.7	123.4	122.0
				124.5				12x12	131.6	130.2	128.7	127.3	125.9
				125.0				14x14	132.1	130.6	129.2	127.8	126.4
				92.9			55	5x5	98.2	97.1	96.1	95.0	94.0
				98.9				8x8	104.5	103.4	102.2	101.1	100.0
				99.8				10x10	105.4	104.2	103.1	101.9	100.9
				103.0				12x12	108.8	107.6	106.4	105.3	104.8
				103.7				15x15	109.6	108.4	107.2	106.0	104.9
				78.1			60	5x5	82.5	81.6	80.7	79.8	78.9
				83.1				8x8	87.8	86.8	85.9	84.9	84.0
				83.9				10x10	88.6	87.6	86.6	85.7	84.8
				85.2				10x12	90.0	89.0	88.0	87.1	86.1
				86.5				12x12	91.4	90.4	89.4	88.4	87.5
				87.2				15x15	92.1	91.1	90.1	89.1	88.1

92.1 (HVL) (38) = 1990 R/MA

109.6 (HVL) (55) = 1990 R/MA

Charles R. Griffith

DATE 8-14-81	MACHINE	1141 Hohlfelder Road
	MAKE Theratron Jr.	Glencoe, Illinois 60022
©1970 CG/mg	TYPE AECL	Phone: 835-4433 - Area Code 312

AREA SURVEY

Field Size: 15x15 at 55cm SAD
Water phantom in beam

Conditions:

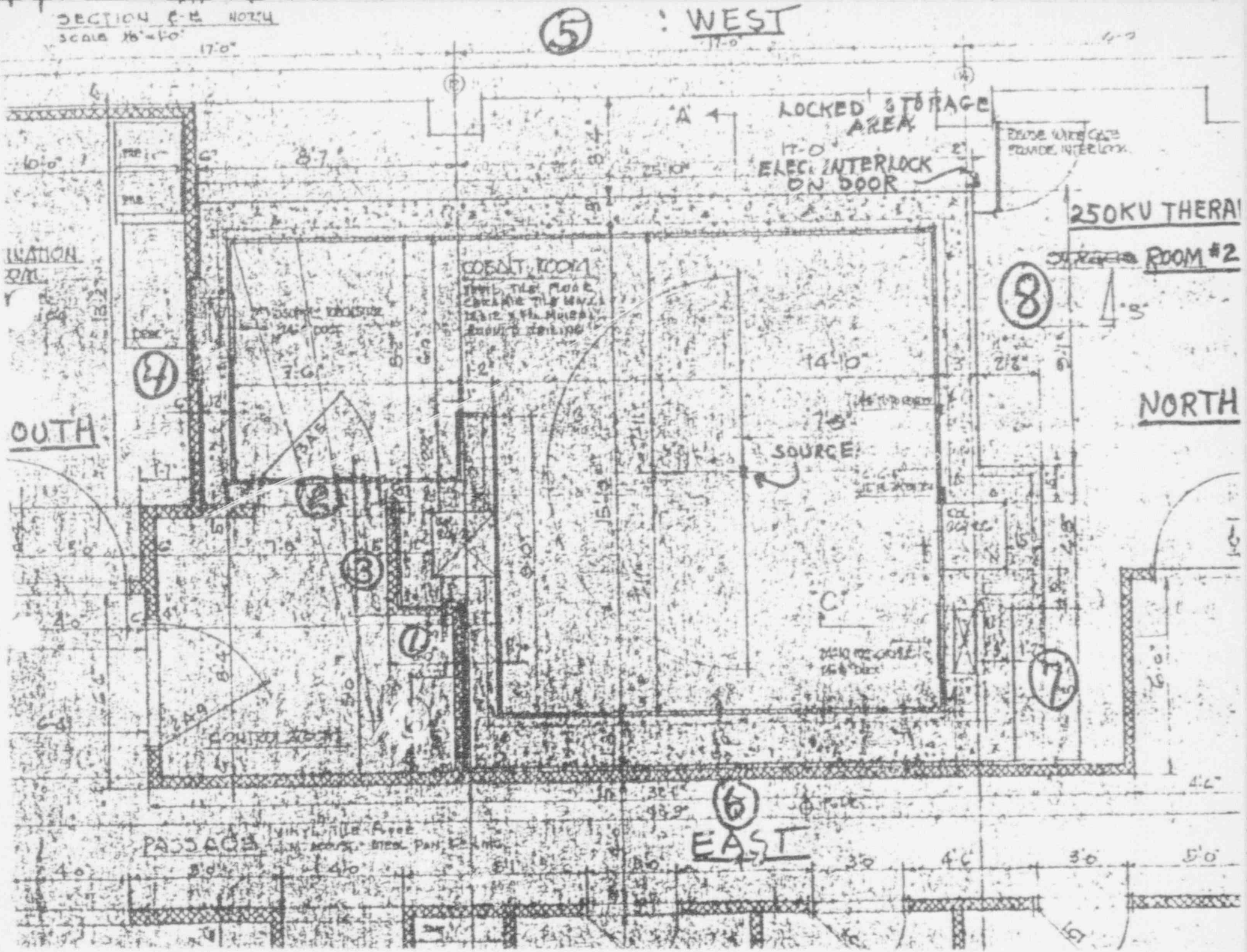
1. Beam vertical towards floor
2. Beam 315° - 35° scatter towards east wall 6
3. Beam 270° - horizontal towards east wall 6
4. Beam 230° - 35° scatter towards ceiling
5. Beam 180° - vertical towards ceiling
6. Beam 90° - horizontal towards west wall 5
7. Beam 45° - 35° scatter towards west wall 5

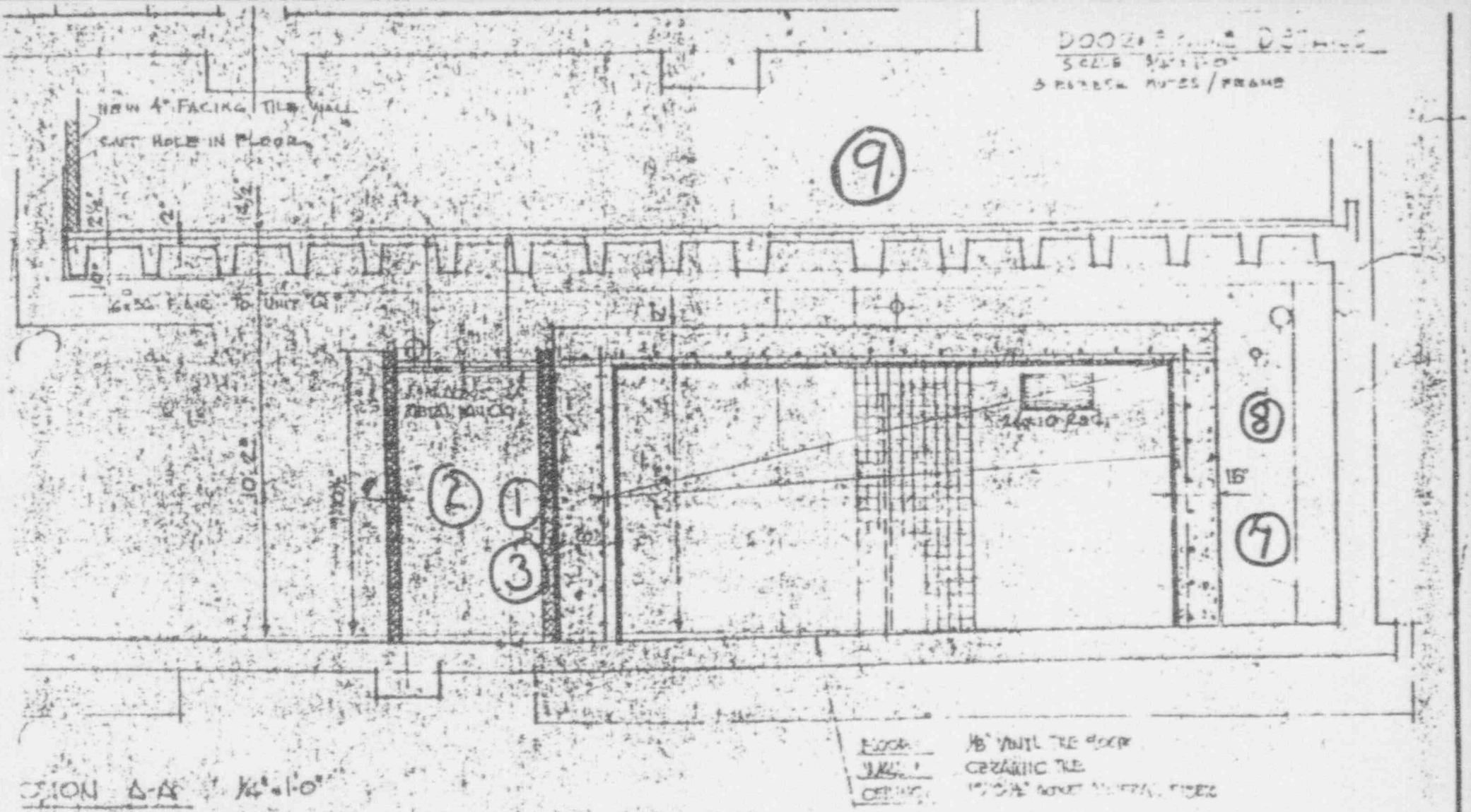
Values shown are maximum for the area and the conditions indicated.

Condition		1	2	3	4	5	6	7
Area (See Drawing)								
Restricted 1 & 3	Control wall	M	M	M	M	M	M	M
Restricted 2	Room door	M	M	M	M	M	M	M
Unrestricted 4	South wall	M	M	M	M	M	M	M
Restricted 5	West wall	M	M	M	M	M	M	M
Unrestricted 6	East wall	M	1	M	M	M	M	M
Unrestricted 7 & 8	North wall	M	M	M	M	M	M	1.5
Unrestricted 9	Ceiling	M	M	M	M	M	M	M

M = $\leq$ 0.25 mR/hr

The radiation levels aobve meet the requirements specified in Sec. 20.101 Title 10, Part 20, Code of Federal regulations and Sec. 20.105(b) of 10 CFR 20.


SECTION E-E NORTH
SCALE 3/8"=1'-0"
5
: WEST
17'-0"
LOCKED STORAGE AREA
17'-0"
ELEC. INTERLOCK ON DOOR
250KV THERA
ROOM #2
8
NORTH
COBALT ROOM
TILE FLOOR
14'-10"
SOURCE
4
OUTH
2
3
1
C
7
6
EAST
PASSAGE
8'7"
7'-6"
15'-0"
3'-0"
4'-6"
5'-0"



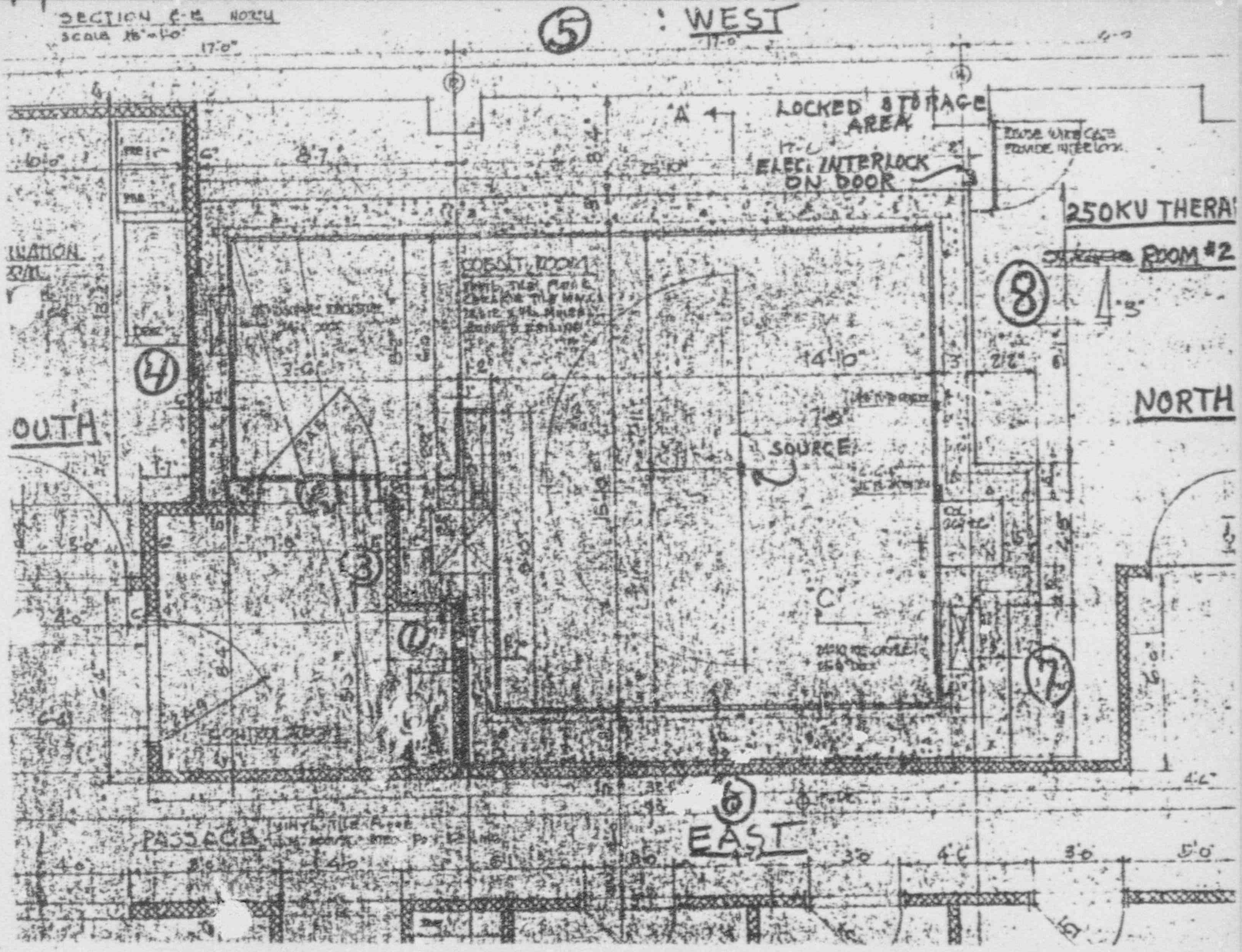
SECTION A-A 1/4"=1'-0"

APPROVED

ADDITIONS AND ALTERATIONS

ST. MARGARET HOSPITAL

25 DOUGLAS STREET, HAMMOND, INDIANA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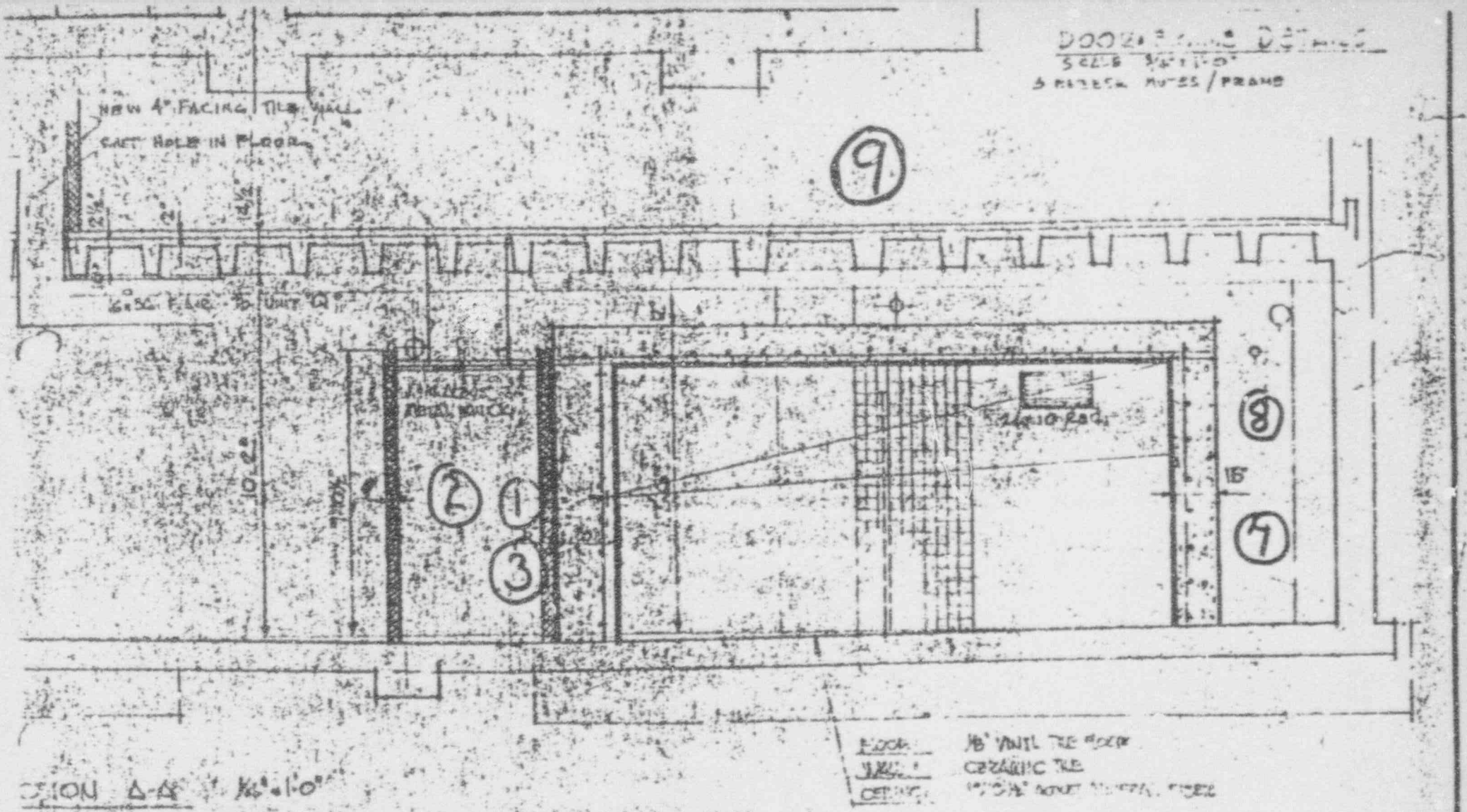
ROOM #2
8
NORTH
COBALT ROOM
SOURCE
14'-0"
4
3
2
1
7
6
EAST
SOUTH
PASSAGE
CONTROL ROOM



SECTION A-A 1/4"=1'-0"

APPROVED

ADDITIONS AND ALTERATIONS

ST. MARGARET HOSPITAL

25 DOUGLAS STREET, HAMILTON, INDIANA

FIELDS, GRIFFITH & ASSOC., INC.
CERTIFIED PHYSICISTS
AMERICAN BOARD OF HEALTH PHYSICS
AMERICAN BOARD OF RADIOLOGY
1141 HOHLFELDER ROAD
GLENCOE, ILLINOIS 60022
AREA 312 835-4433

PROTOCOL

TESTING OF "ON-OFF" INDICATORS OF GAMMA-BEAM TELETHERAPY UNITS

The test shall consist of the following steps:

i) begin with the power off

ii) turn on the power and activate unit (but not beam)

iii) check all indicators on control, above door, on unit and monitor (if a monitor is available).

iv) if all indicators indicate beam is "off" enter room with radiation detecting device (i.e. survey meter or chirpee). Note: the detecting device is not needed if an independent monitor is installed.

v) determine whether the radiation levels are consistent with the beam being off.

vi) exit room, close door

vii) activate beam

viii) repeat iii)

ix) turn beam off

x) repeat iii)

Units whose behaviour fully comply with the items below are designated "OK"

NCRP Report #33 item 4.2.1(d) 5 "There *shall* be on the housing and on the control panel a warning device that plainly indicates whether the beam is 'ON' or 'OFF'."

ANSI N449-1974 item 4.1.1 "Electrical and Mechanical Source Condition indicators should accurately reflect the 'on-off' condition or position of the radioactive source."

ANSI N449.1-1978 item 4.2 "Source-condition Indicator (see 4.1.1 in ANSI N449-1974 (1)). The operability of 'on' and 'off' position indicators at the control console and on the machine head and stand shall be confirmed visually. The patient viewing system (closed circuit television or mirror) should be used for treatment room source 'on' condition checks."

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PROTOCOL

TESTING DOOR INTERLOCK OF GAMMA BEAM TELETHERAPY UNITS

The test shall consist of the following steps:

i) turn the teletherapy unit "ON"

ii) open the door

iii) ascertain whether the beam is on or off

iv) close the door

v) without touching the control panel determine whether the beam is on or off.

Units whose behaviour fully comply with the items below are designated "OK"

NCRP Report #33, item 4.2.2(d)8: "When the door to the treatment room is openned, the beam control mechanism shall automatically and rapidly return to the OFF position where it shall remain until the door is again closed and the machine is manually reactivated from the control panel."

ANSI N449-1974 "4.1.2 Facility Door Interlock. The electrical interlock on the entrance door to the teletherapy room shall cause the radiation beam control mechanism to automatically and rapidly returns to the "off" position. The machine control mechanism shall require manual reactivation from the control panel before resuming exposure."

ANSI N449.1-1978 "4.3 Door Interlock (see 4.1.2 in ANSI (1)). The test of the interlock shall be carried out by bringing the source to the "on" position, opening the door to break the interlock, and observing the sequence required to bring the source back to the "on" position. The interlock switch shall be adjusted such that any position other than the fully closed position of the door will break the circuitry and cause the source to return return to the safe condition. The machine control mechanism shall require manual reactivation from the control console before resuming exposure."

NRC Teletherapy Licenses, standard clause #17B "Each entrance to the teletherapy room shall be equipped with an electrical interlock system that will turn the teletherapy machine's primary beam of radiation off immediately upon opening of any entrance door. The interlock system shall be connected in such a manner that the teletherapy machine's primary beam of radiation cannot be turned on until all treatment room entrance doors are closed and the beam "on-off" control is reset at the control panel.

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PROTOCOL FOR CHECKING TREATMENT TIMER AND TIMER CORRECTION FACTOR

METHOD USED

☒

4.14.1 *Time Correction Term, Alpha (α).* The dosimeter with equilibrium cap is placed at the center of the field and the source turned "on" for a single irradiation (R_1). The dosimeter is zeroed and left at the same location for multiple irradiations before being read out (R_2). The total set times for single long and multiple short exposures need not be the same, but equality helps minimize errors due to instrument nonlinearity and operator error in setting times. The mathematical relationship used to calculate α, the time correction term, is:

$$\frac{R_1}{t_1 + \alpha} = \frac{R_2}{t_2 + n\alpha} \qquad \text{(Eq 1)}$$

$$\alpha = \frac{t_1 R_2 - t_2 R_1}{nR_1 - R_2}. \qquad \text{(Eq 2)}$$

$R_1 = 105.6$
$R_2 = 106.4$
$\alpha = \frac{1064 - 105.6}{2 \cdot 105.6 - 106.4} = .007$

When $t_1 = t_2$,

$$\alpha = \frac{t(R_2 - R_1)}{nR_1 - R_2} \qquad \text{(Eq 3)}$$

where

- α = effective time difference due to source "on—off" and timer "on—off" mechanisms
- R_1 = average of dosimeter readings for set time t_1
- R_2 = average of dosimeter readings for set time t_2 (n cumulative irradiations)
- t_1 = time for single long irradiation
- t_2 = time for cumulative irradiation
- n = number of irradiations during cumulative irradiation

The true time for the single long irradiation is $(t_1 + \alpha)$, where the time error may be positive or negative. If α is positive, the net irradiation time is longer than the timer setting; and vice versa. The time-corrected radiation intensity would be $R_1/(t_1 + \alpha)$.