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FAST TRACK NRC LICENSE AMENDMENT REQUEST

FOR

45-09001-01
03003330

RIVERSIDE REGIONAL MEDICAL CENTER
DEPARTMENT OF RADIOLOGY
500 J. CLYDE MORRIS BOULEVARD
NEWPORT NEWS, VIRGINIA 23601

NRC license number 45-09001-01

By

HAROLD PRUSSIA, BS, RTR, QM
RADIATION SAFETY OFFICER
(757) 594-2644

November 25, 2005

138016
NMSS/RGNI MATERIALS-002

PURPOSE OF AMENDMENT

This is an urgent request for an amendment to our current license to allow us to relocate and use the High Dose Remote afterloader (HDR) unit in the other originally licensed room as listed on our NRC license amendment request that was approved as amendment number 46. The proposed room is also used for Linear Accelerator treatments. In general we will use safety features in the proposed treatment room similar to our current design and practice.

The room in which the HDR unit currently resides is needed for immediate site renovation in preparation for another piece of capital equipment arriving first quarter 2006.

Also although not urgent, we would like to take this opportunity to request the removal of two authorized users and to provide diagrams of new use areas for CFR 200 isotopes at the campus located at

500 J. Clyde Morris Boulevard
Newport News, Virginia 23601

MAILING NAME, ADDRESS AND TELEPHONE NUMBER

No change. (Attn: Harold Prussia, Riverside Regional Medical Center, Department of Radiology, 500 J. Clyde Morris Boulevard, Newport News, Virginia 23601, telephone (757) 594-2644.)

CONTACT PERSON

The person to contact with regards to this notification is our Radiation Safety Officer, Harold Prussia, B.S. Mr. Prussia can be reached at the Riverside Cancer Treatment Center. He will be responsible for preparing all responses to any questions concerning use of byproduct material. Responses prepared by Mr. Prussia will be submitted to the Facility's certifying official, Grady W. Philips III, Riverside Regional Medical Center, for review, approval and submission to the NRC.

Telephone number of Harold Prussia is 757-594-2757

DELETION OF AUTHORIZED MEDICAL USER:

Please delete from our License the following:
Steven W. Falen, M.D., Ph.D. and J. Frank Sanderson, M.D.

NEW USE AREAS:

We would like to change our High Dose Rate (HDR) Remote Afterloader use area and storage location from the current room to an adjacent linear accelerator room called Linac 2. The new

room is constructed similarly to the previous room. The room is a single floor vault with no occupancy above or below the room. The density of the poured concrete is 147 pounds per cubic foot.

Appendix 1a. Contains the facility diagrams for the area of the proposed HDR treatment room
Appendix 1b. Barrier calculations
Appendix 1c. Provides a description of safety features of the proposed treatment room:
Appendix 2 shows location of a Nuclear Medicine camera in the EKG department. The camera location and patient injection areas are indicated in the appendix.

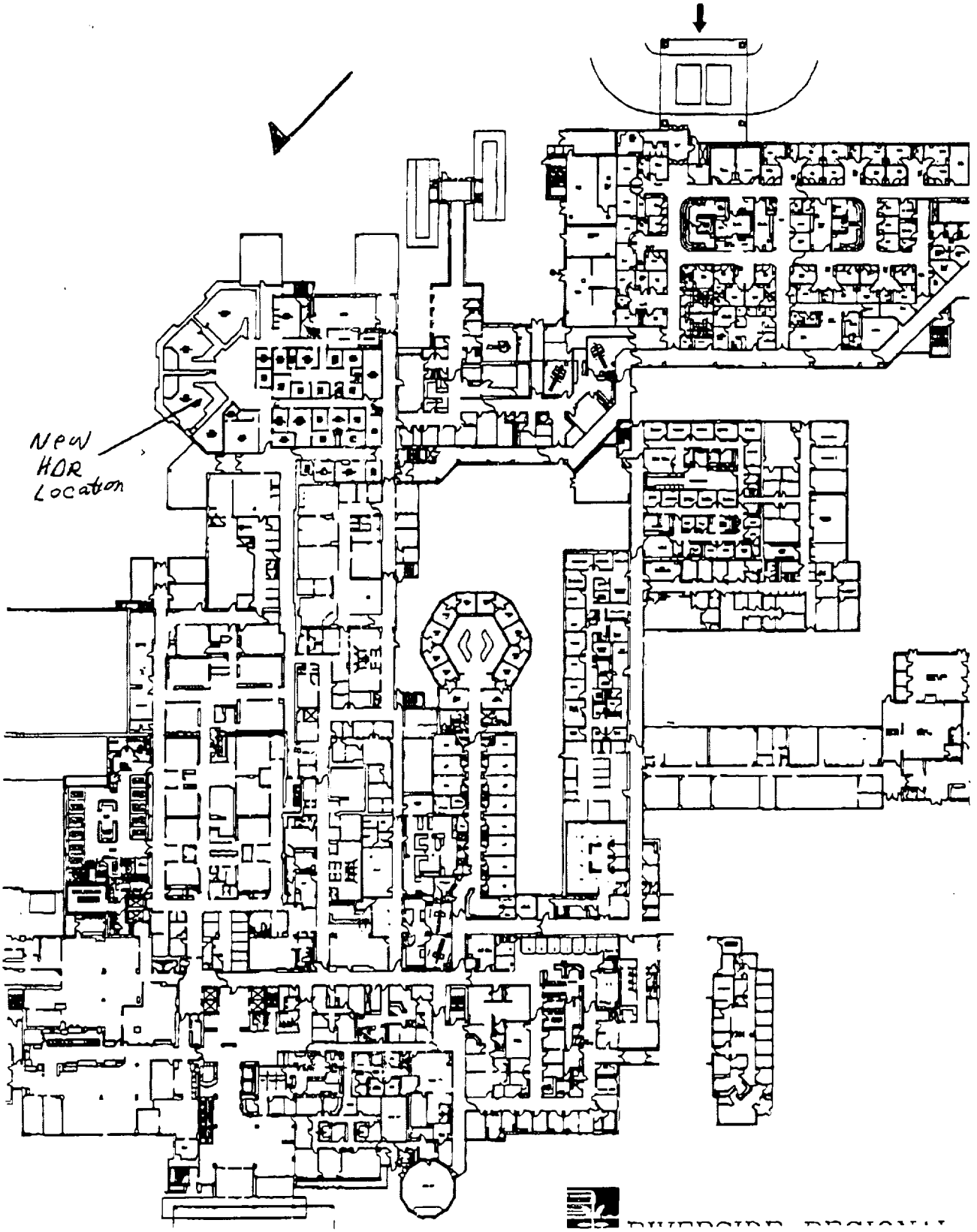
CERTIFICATION

THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

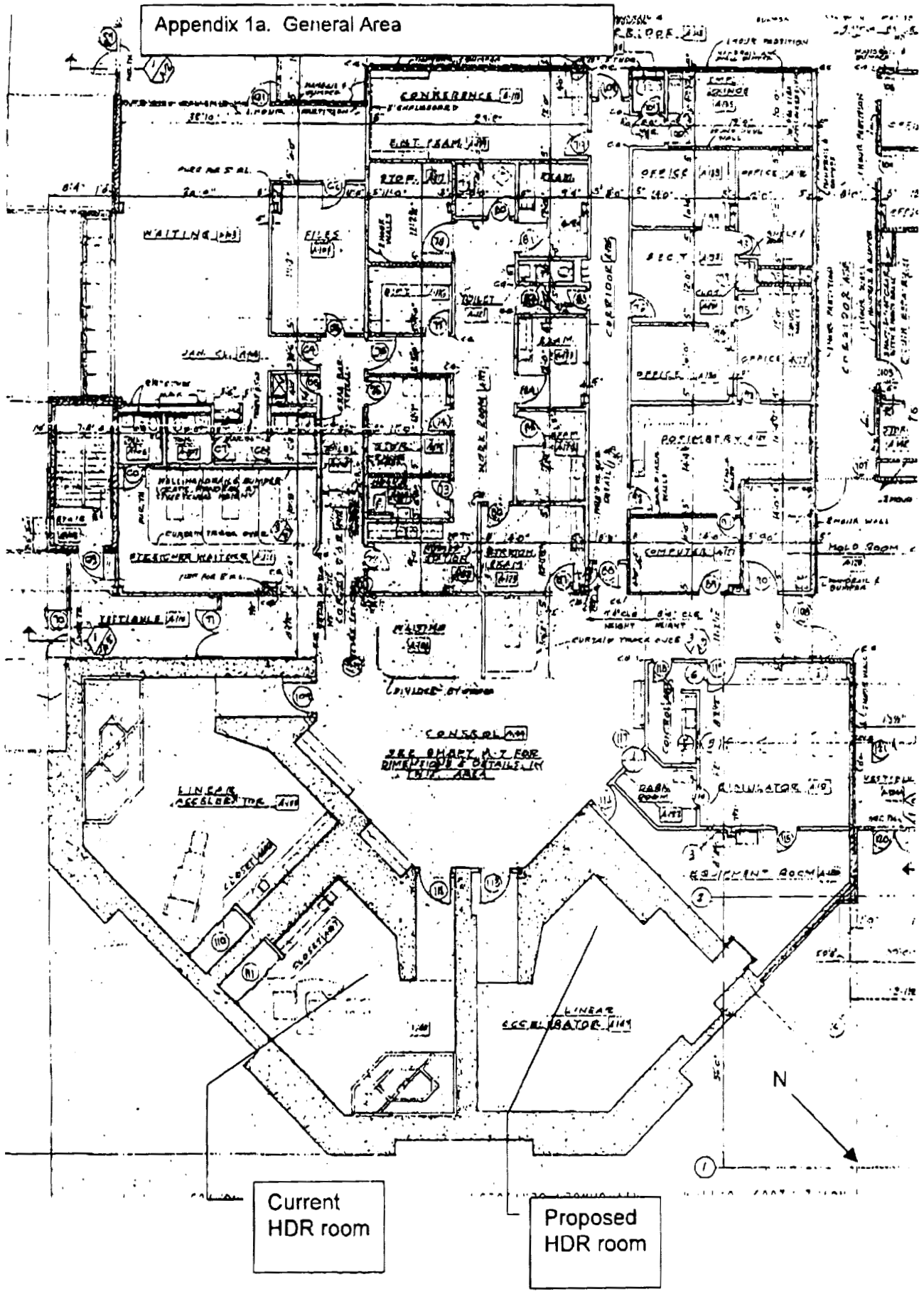
THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFIY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32,33, 34, 35, 36, 39, AND 40, AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

CERTIFYING OFFICER—NAME AND TITLE	SIGNATURE	DATE
Grady Philips III Senior Vice President Riverside Regional Medical Center		11/25/05

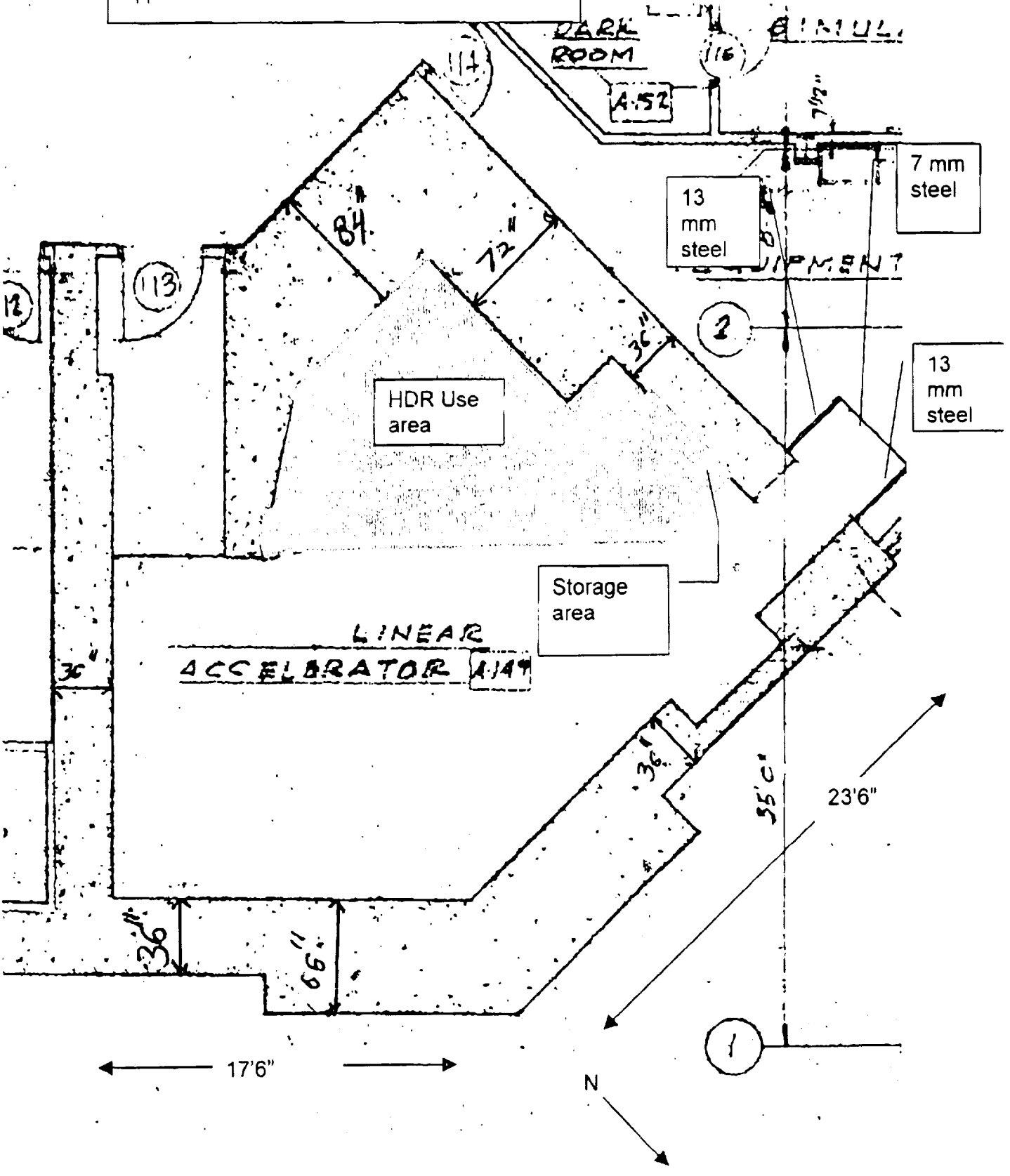
Appendix 1a. HDR General floor plan



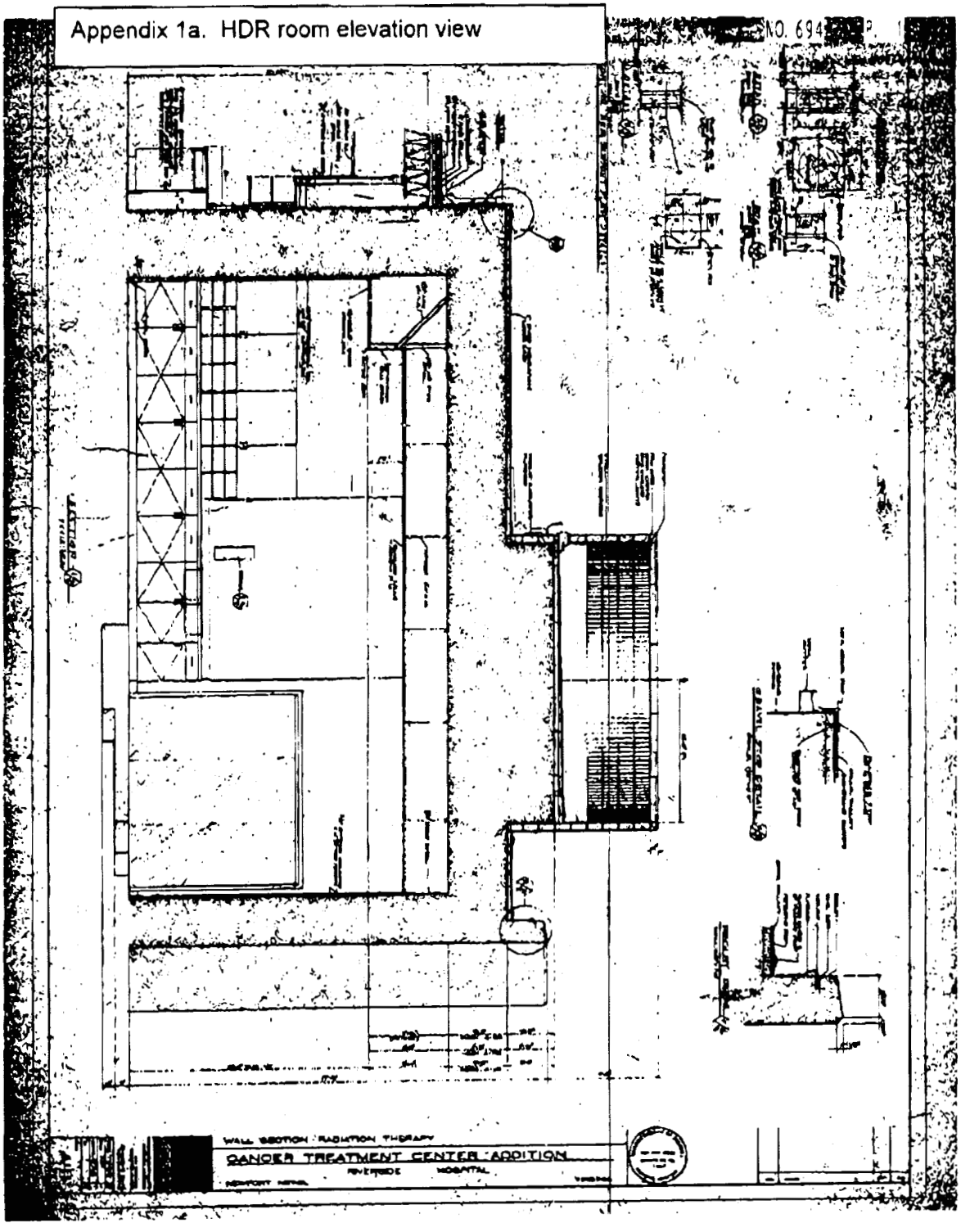
Appendix 1a. General Area



Appendix 1a. HDR room



Appendix 1a. HDR room elevation view



Appendix 1c Shielding calculations:

Riverside Regional Medical Center
Calculated Dose Equivalents Outside the Treatment Room

Assumptions

- The maximum permissible HDR source activity, 10 Curie Ir-192.
- An exposure rate constant 0.466 R/hr/Ci at one meter = 5020 mR/hr/Ci at one foot.
- A typical HDR treatment time of 10 minutes (for a 10 Curie source).
- A maximum of 2 treatments in any one hour. This results in a maximum workload
  Wt = 3.3 Curie-hrs in any time period **t** = 1 hour.
- **An average of no greater than 15 treatments per week. This results in a yearly workload**
  Wt = 1300 Curie-hrs in a time period **t** = 1 year.
  (1 MammoSite patient with 10 treatments + 5 other HDR treatments)
- The broad beam transmission (TR) of Ir-192 based on ICRP Publications 15 and 21:
  For steel, HVL = 13 mm.
  TR = 0.64 through nominal 7 mm steel at an angle of incidence of 34°
  TR = 0.36 through nominal 13 mm steel at an angle of incidence of 47°
  For concrete, 1st TVL = 18.3 cm, 2nd TVL = 14.4 cm, then TVL = 13.8 cm
  TR = 5.2×10^{-2} through nominal 6" concrete at an angle of incidence of 47°
  TR = 1.1×10^{-3} perpendicularly through 1 ½' concrete
  TR = 5.5×10^{-7} perpendicularly through 3' concrete
- All adjacent spaces are protected by at least 3' concrete with the two exceptions: beyond the "knockout," and beyond the "steel cage."
- The vault is at ground level, with no occupancy below or above.
- Unlike the vault, the adjacent space south of the vault does have offices below. The minimum distance from the source to a person in one of these offices is at least 10' through dry packed earth, having a concrete equivalence of 6.5'(density of earth = 1.5 g/cm2, density of concrete = 2.3 g/cm2).
- The door is struck only by scattered radiation. It was originally designed to intercept the stray radiation from a high energy linear accelerator, and has been shown to be sufficiently thick by previous surveys.
- The HDR source is restricted to the southern corner of the vault, south of a line from the end of the maze wall to the south edge of the steel cage (see diagram).
- The building's north exterior wall (west of the vault) is a combination of concrete block and brick, assumed to have a concrete equivalence of 6."

General Formula

The exposure **E** (mR) beyond a protective barrier at a distance **d** (feet) from the HDR source for a time period **t** is given by

$$E(\text{mR}) = \mathbf{5020\ mR/hr/Ci} \times \text{Wt (Ci-hr)} \times \frac{\text{TR}}{d^2} \times T$$

Appendix 1c Shielding calculations:

Here **Wt** is the workload for the appropriate time period **t**, **TR** is the barrier transmission, and **T** the occupancy factor. Since exposure E(mR) is almost identical to dose equivalent D(mrem), the formula above is also used to closely approximate dose equivalent, i.e., E(mR) ≅ D(mrem).

Yearly Dose Equivalent Beyond Concrete Barriers 3' Thick or Greater

All points one foot outside the concrete barriers will always be at least 5' from the source if the source is never closer than 1' from the barrier. The yearly dose equivalent at these locations (assuming full occupancy) is

$$D(mrem) = 5020 \times 1300 \times 5.5\times10^{-7} \times (1/5)^2 = \mathbf{0.14\ mrem}$$

Since the office below grade will always be even further from the source (10') with even more concrete equivalent shielding (10' earth = 6.5 concrete) the yearly dose equivalents are even lower at that location.

Yearly Dose Equivalent Beyond The "Knockout" in the North Wall

The "knockout" barrier is 1.5' concrete. A person 1 foot outside this barrier will always be at least 10' from the source. The yearly dose equivalent at these locations assuming T = 1/16 occupancy for this outside parking area is

$$D(mrem) = 5020 \times 1300 \times 1.1\times10^{-3} \times 1/16 \times (1/10)^2 = \mathbf{4.5\ mrem}$$

Yearly Dose Equivalent Outside the Building, Beyond the 13 mm "Steel Cage"

A ray path to a person outside, passing through the 13 mm steel "cage," yet missing all concrete barriers, strikes the 13 mm steel barrier at a minimum angle of incidence of 47°. It then strikes the 6" thick concrete equivalent exterior wall at the same angle. The effective thicknesses traversed are 19 mm steel and 8.8" concrete, with transmissions TR = 0.36 and TR = 5.2×10^{-2} respectively.

The shortest distance from the source to a person outside along this path is 14." Any other path through the 13 mm steel to the outside is both longer and with a greater oblique transmission path. The yearly dose equivalent in the outside parking area along this ray path assuming T = 1/16 occupancy is

$$D(mrem) = 5020 \times 1300 \times 0.36 \times 5.2 \times 10^{-2} \times 1/16 \times (1/14)^2 = \mathbf{39\ mrem}$$

Yearly Dose Equivalent Outside the Building, Beyond the 7 mm "Steel Cage"

A ray path to a person outside, passing through the 7 mm steel "cage," yet missing all concrete barriers, strikes the 7 mm steel barrier at a minimum angle of incidence of 34°. It then strikes the 6" thick concrete equivalent exterior wall at a severely oblique 66° angle. Assuming the more conservative 47° incidence above, the effective thicknesses traversed are 8.5 mm steel and 8.8" concrete, with transmissions TR = 0.64 and TR = 5.2×10^{-2} respectively.

Appendix 1c Shielding calculations:

The shortest distance from the source to a person outside along this path is 17." Any other path through the 7 mm steel to the outside is either longer or with a more oblique path through the steel. The yearly dose equivalent in the outside parking area along this ray path assuming T = 1/16 occupancy is

$$D(\text{mrem}) = 5020 \times 1300 \times 0.64 \times 5.2 \times 10^{-2} \times 1/16 \times (1/17)^2 = \mathbf{47\ mrem}$$

Summary of Yearly Dose Equivalents

All yearly dose estimates above are below the limits for radiation workers, both the regulatory limit of 5000 mrem/yr and the ALARA goal of less than 500 mrem/year. Similarly, all estimates are below the 100 mrem per year limit for the general public.

Dose Equivalent In Any One Hour

To derive the maximum dose equivalent outside the vault in any one hour, the calculations above are repeated but with the workload Wt changed from 1300 Curie-hrs for one year, to 3.3 Curie-hrs, the maximum for any one hour, and the occupancy factor is set to T=1.

One Hour Dose Equivalent Beyond Concrete Barriers 3' Thick or Greater
$D(\text{mrem}) = 5020 \times 3.3 \times 5.5\times10^{-7} \times (1/5)^2 = \mathbf{0.0004\ mrem}$

One Hour Dose Equivalent Beyond The "Knockout" in the North Wall
$D(\text{mrem}) = 5020 \times 3.3 \times 1.1\times10^{-3} \times (1/10)^2 = \mathbf{0.18\ mrem}$

One Hour Dose Equivalent Outside the Building, Beyond the 13 mm "Steel Cage"
$D(\text{mrem}) = 5020 \times 3.3 \times 0.36 \times 5.2 \times 10^{-2} \times (1/14)^2 = \mathbf{1.6\ mrem}$

One Hour Dose Equivalent Outside the Building, Beyond the 7 mm "Steel Cage"
$D(\text{mrem}) = 5020 \times 3.3 \times 0.64 \times 5.2 \times 10^{-2} \times (1/17)^2 = \mathbf{1.9\ mrem}$

At all locations, the maximum dose in any one hour is lower than the regulatory limit of 2 mrem in any one hour. Since the source will generally be located further from the walls than assumed above, the actual doses are expected to be lower than the maximums calculated above.

The Equipment Room

The equipment room is not sufficiently shielded, even if "partial" occupancy is assumed. The dose to someone in the equipment room during a typical HDR treatment can exceed 30 mrem (depending on location in the room), especially if the source is operated slightly north of the designated usage area. This far exceeds the regulatory limit of 2 mrem in any one hour.

Submitted by Ron Droege, M.S.

Appendix 1c. **Description of the room and safety features of the proposed treatment room:**

Prior to the first HDR treatment, radiation surveys and tests shall be performed in accordance with the following guidelines:

A radiation survey shall be made of the source housing, with the source in the shielded position. The maximum radiation levels at 20 centimeters from the surface of the source head shall not exceed 3 mR/hr.

A radiation survey shall be made of all areas adjacent to the treatment room with the source in the "irradiation" position. The survey shall clearly establish:

-that radiation levels in restricted areas are not likely to cause personnel exposure in excess of the limits specified in Title 10, Part 20, Code of Federal Regulations, "Standards for Protection Against Radiation" (10 CFR 20);

-that quantities of radiation in unrestricted areas do not exceed the limits specified in 10 CFR 20; and

-the intensity of the primary beam of radiation at a specified distance from the source.

-maximum allowed weekly and hourly workload.

-if needed, the allowed use area will be further restricted to comply with 10 CFR 20 limits in the unrestricted areas.

We will maintain records of the survey for inspection by the Nuclear Regulatory Commission

The HDR door shall be posted with signs indicating "Caution-Radioactive Material" and "Danger-Very High Radiation Area" or the equivalent.

The door shall be equipped with an electrical interlock system that causes the source to return to the shielded position immediately upon opening the door. The HDR BRAL interlock system shall be independent of any other unit's door interlock system. The interlock shall be connected in such a manner that the source cannot be placed in the irradiation position until the entrance door is closed and the source "on-off" control is reset at the control panel. Door interlocks shall be tested for proper operation each month of use.

Source-Position-Indicator (SPI) light shall be located either above the door or at the control console. This light shall be electrically connected to either the machine or a radiation monitor in the room such that the SPI light indicates when the source is moved from its storage position.

Appendix 1c. **Description of the room and safety features of the proposed treatment room:**

A radiation-detection alarm monitor with remote display shall be installed that will indicate when the source has been moved into the "expose" position.

Two (2) Closed Circuit TV (CCTV) systems shall be installed that will permit the patient to remain under observation during treatment. If both CCTV's malfunction, then the equipment will not be used until at least one CCTV has been repaired.

A radiation-detection alarm monitor with remote display shall be installed that will indicate when the source has been moved into the "expose" position.

The operating computer will be secured when the unit is either unattended or not in use. The computer system will be secured by removal of the operating key.

A switch will be used that will prevent the use of both units at once.

Whenever the HDR device is unattended it will either be tethered to the room with a lock or placed in a locked cabinet.

Prior to treating the first patient on each day of use, checks will be performed and logged of all interlocks, source-position-indicator lights, safety systems, and alarm monitors.

An intercom system has been installed in the room that allows two-way communication.

New locks will be installed in the adjacent equipment room that is not part of the master key set. The key to the new locks will be kept on the key ring with the HDR key. By procedure and by key control the equipment room will have no occupancy when the HDR is in use. As needed appropriate signage will be installed on the equipment room doors.

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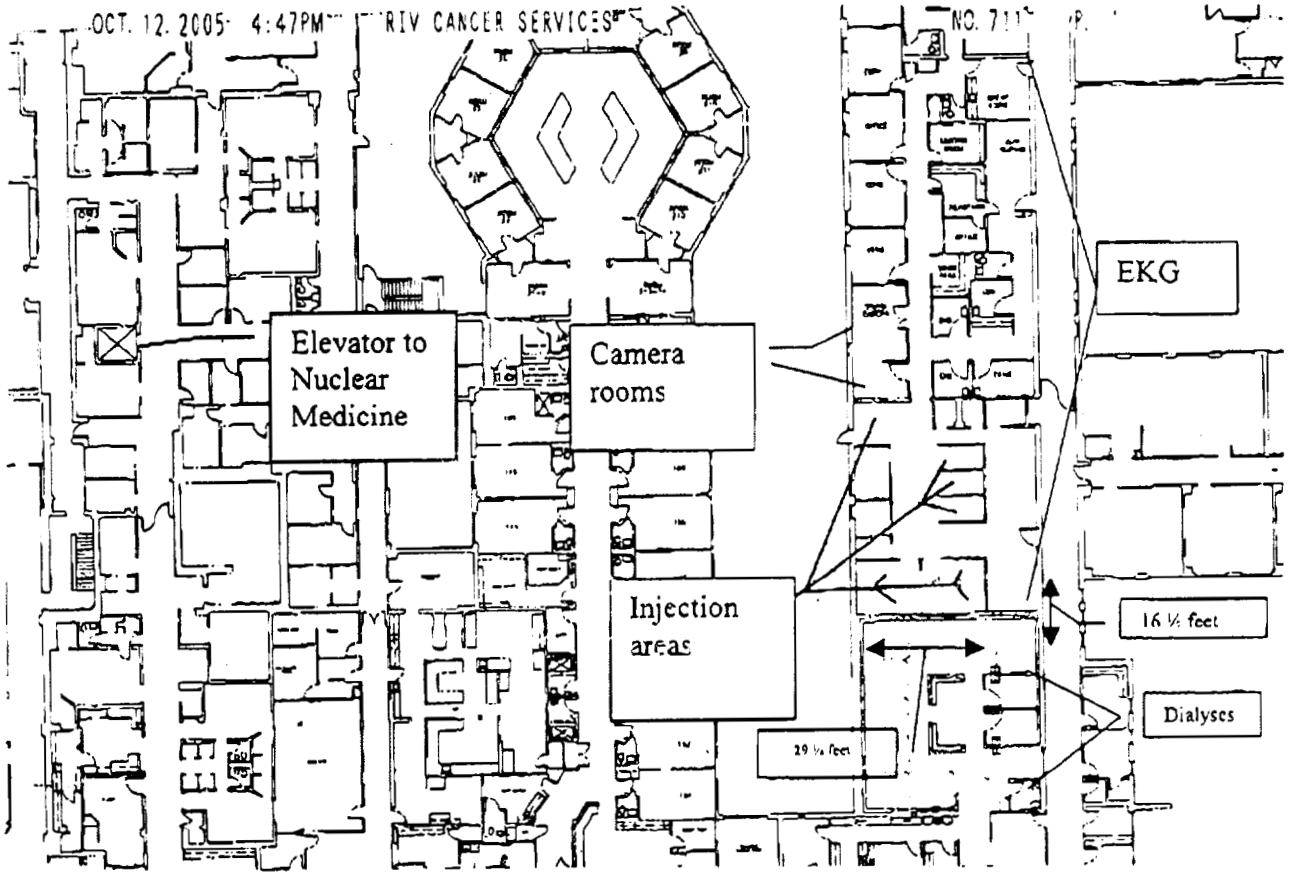
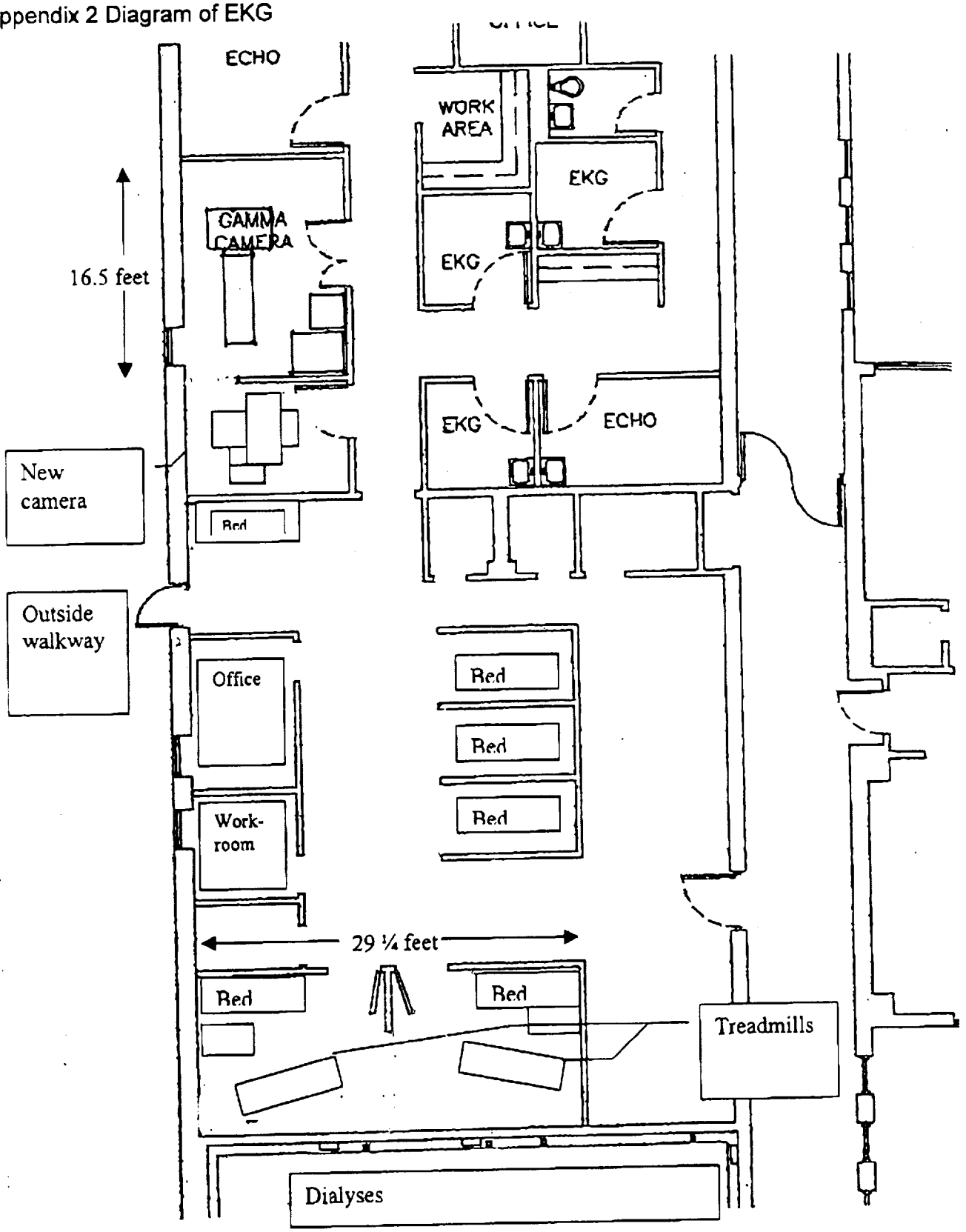
Appendix 2: Diagram of first floor and EKG.



Appendix 2 Diagram of EKG



This is to acknowledge the receipt of your letter/application dated

11/27/2005, and to inform you that the initial processing which *includes an administrative review has been performed.*

☒ Amendment 45-09001-01 There were no administrative omissions. Your application was assigned to a technical reviewer. Please note that the technical review may identify additional omissions or require additional information.

☐ Please provide to this office within 30 days of your receipt of this card

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A copy of your action has been forwarded to our License Fee & Accounts Receivable Branch, who will contact you separately if there is a fee issue involved.

Your action has been assigned **Mail Control Number** 139016.
When calling to inquire about this action, please refer to this control number.
You may call us on (610) 337-5398, or 337-5260.

NRC FORM 532 (RI)
(6-96)

Sincerely,
Licensing Assistance Team Leader