

APPENDIX C: UNIVERSAL X-RAY ROOM

C.1 Definition of Universal X-Ray Room. "The universal X-ray room shall be capable of accepting all routine radiographic, fluoroscopic, and tomographic equipment, up to 1200 ma, 150 kvp, regardless of manufacture, during initial installation and subsequent replacement actions with little, if any, facility modification. The procedures shall be performed unencumbered and without any restriction of system components, patient size, or any known procedure that any installed X-ray equipment can perform now or in the future." This definition does not apply to digital radiography, special procedure rooms, C-arms, or angiography rooms.

C.2 Criteria.

C.2.1 Planning and Programming. The universal room shall be a maximum of 28 net m<sup>2</sup> (300 net square feet) including space for equipment, control booth, and circulation. Critical room dimensions and layouts are given in Figure C-1. Utilities distribution methods may be modified for use in projects utilizing IBS concepts when implemented (see Section 19).

C.2.2 Electrical Raceway System. An extensive raceway system is provided so the universal room will accept any manufacturer's equipment without additional raceways, facility modifications, or use of exposed wiring. The raceway system consists of trench floor ducts, lay-in wall ducts, and ceiling cable trays as shown on Figure C-1 and C-2.

C.2.2.1 Floor ducts are bottom-type trench duct, with nominal 90 mm (3.5 in.) by 300 mm (12 in.) 250 mm (10-inch) tub with a 300 mm (12-inch) wide, 8 mm (1/4-inch) thick steel cover plate. Cover plate must be installed flush with and have the same tile insert as the floor. Provide a gasket on the cover plate to maintain water tightness.

C.2.2.2 Wall ducts are nominal 10 mm (3.5 in.) by 250 mm (10 in.) with 300 mm (12-inch) wide flush mounted cover plates finished to match the walls. Wall duct must be UL listed for enclosure of wiring to x-ray machines (reference C-a).

C.2.2.3 Ceiling cable trays are nominal 10 mm (3.6 in.) by 300 mm (12 in.) 80 mm (3-inch) load depth NEMA Class 12A ladder type installed above the finished ceiling. Wall duct, nominal 10 mm (3.5 in.) by 250 mm (10 inch), may be used in lieu of cable trays.

C.2.2.4 Partitions must be provided in all ducts and cable trays to separate high and low voltage cables.

C.2.3 Electrical Service Requirements. Each universal room must have adequate power service to insure that all X-ray equipment can be installed without additional facility related electrical work. All feeder conductors will be copper.

C.2.3.1 Power Quality. The facility power system must provide the specified nominal voltage (480 V or 240 V) plus or minus 5 percent to each universal room. Special power conditioning equipment, if required, should be identified and provided with the X-ray installation.

C.2.3.2 Three-Phase Rooms. If the room will receive three-phase X-ray equipment, provide 150 amp, 480 volt, three-phase (3-wire and ground) service to the room. Provide an adjustable trip, 150 amp, 3-pole, shunt trip circuit breaker in a NEMA 1, flush mounted enclosure.

C.2.3.3 Single-Phase Rooms. If the room will receive single-phase X-ray equipment, provide 150 amp, 240 volt, single-phase (3-wire and ground) service to the room. Provide an adjustable trip, 100 amp, 2-pole, shunt trip circuit breaker in a NEMA 1, flush mounted enclosure.

C.2.3.4 Emergency Shutdown. Provide a large, clearly identified push-button to actuate the shunt trip circuit breakers, and disconnect all power to the X-ray machine and accessories.

C.2.3.5 120/208 Volt Auxiliary Panelboard. If required by using Military Department, provide a 120/208 volt, single-phase, 100 amp panelboard with a 50 amp shunt trip main breaker to support the single-phase loads in each room. Provide a 20-pole-space panelboard with at least two 20 amp 2-pole circuit breakers, and five 20 amp 1-pole circuit breakers. This panelboard may be served from the nearest general purpose 120/208V transformer; a dedicated stepdown transformer may be provided and fed from the 480V service in 3-phase rooms. (Calculations should be based on 180 amp maximum demand for 3-phase rooms, and 300 amp maximum demand for single-phase rooms.)

C.2.3.6 Voltage Drop and Regulation. Total voltage drop in a branch circuit and feeder conductors must not exceed 2 percent from the facility distribution transformer to the X-ray rooms. Total voltage regulation of the distribution transformer, feeder, and branch circuit conductors must not exceed 5%. For circuits which serve only one room, calculations should be based on the maximum demand current of the single X-ray generator. For circuits which serve more than one room, calculation should be based on the maximum demand current of the two largest rooms. (Calculations should be based on 180 amp maximum demand for 3-phase rooms and 300 amp maximum demand for single-phase rooms.)

C.2.3.7 Distribution Transformers. Distribution transformers should not be dedicated solely to X-ray equipment. The voltage regulation is better if X-ray machines are connected to transformers which are partially loaded with other equipment. X-ray machines should always be connected line-to-line, never line-to-neutral.

C.2.3.8 Essential Power. Essential power for X-ray equipment, illumination, and duplex receptacles shall be in accordance with the

using Military Department guidance documents.

C.2.4 Warning Lights, Interlocks, and Illumination. Warning lights, interlocks, and illumination are to be provided in accordance with the Design Agent's guidance documents.

C.2.5 Structural Requirements.

C.2.5.1 Walls. Provide studs on either side of the vertical electrical raceways. Design walls to support 100 kg (220 pounds) vertical-to-horizontal pull. Double walls must be provided between adjacent x-ray rooms.

C.2.5.2 Ceiling Support System. Provide an overhead tube-mount support system in accordance with Figure C-3 with a load bearing capacity of 408 kg (900 pounds) vertical point load and 23 kg (50 pounds) per square foot uniformly distributed load. Spanning members should be mounted perpendicular to the centerline of the X-ray table and positioned at 650 mm (25-5/8) inches on center to provide 600 mm (2 feet) clear between members. The acoustical ceiling tiles are to be suspended from the structural grid. Bottom of members should be flush with the finished ceiling.

C.2.6 Case Work.

C.2.6.1 Case work shall be as specified by the using Military Department.

C.2.6.2 A hand sink with hot and cold water and drain will be provided.

C.2.7 Radiology Shielding.

C.2.7.1 As a minimum:

a) Comply with the design requirements of NCRP Report No.49 (reference C-b), and certify as advised by NCRP Report No.102 (reference C-c.) and by the using Military Department Procedures.

b) Lead shielding shall be **1.6** mm (1/16 inch) lead or lead equivalent up to 2100 mm (7 feet) above the finished floor. Penetrations through the shielding should be avoided. [Rev. Apr 03]

c) Where possible, lead shielding shall be applied to exterior side of wall partitions, i.e., laminated behind gypsum board for protection.

C.2.7.2 Use of modular shielding for operator's booth is permitted.

C.2.7.3 All ductwork, grilles, registers, and diffusers shall be

located at a height higher than 2100 mm (7 feet) clear above the finished floor. Thermostat transmission lines shall be routed to avoid penetration of shielding.

REFERENCES

- C-a. Underwriters Laboratories (UL), Electrical Construction Materials Directory, (current edition).
- C-b. National Council on Radiation Protection and Measurements (NCRP), Report No. 49, "Structural Shielding Design and Evaluation for Medical Use of X Rays and Gamma Rays of Energies Up to 10 Mev (1976)." NCRP Publications, 7910 Woodmont Avenue, Suite 1016, Bethesda, MD 20814.
- C-c. National Council on Radiation Protection and Measurements (NCRP), Report No. 102, "Medical X-Ray, Electron Beam and Gamma-Ray Protection For Energies Up to 50 Mev (Equipment Design, Performance and Use) (1989)." NCRP Publications, 7910 Woodmont Avenue, Suite 1016, Bethesda, MD 20814.

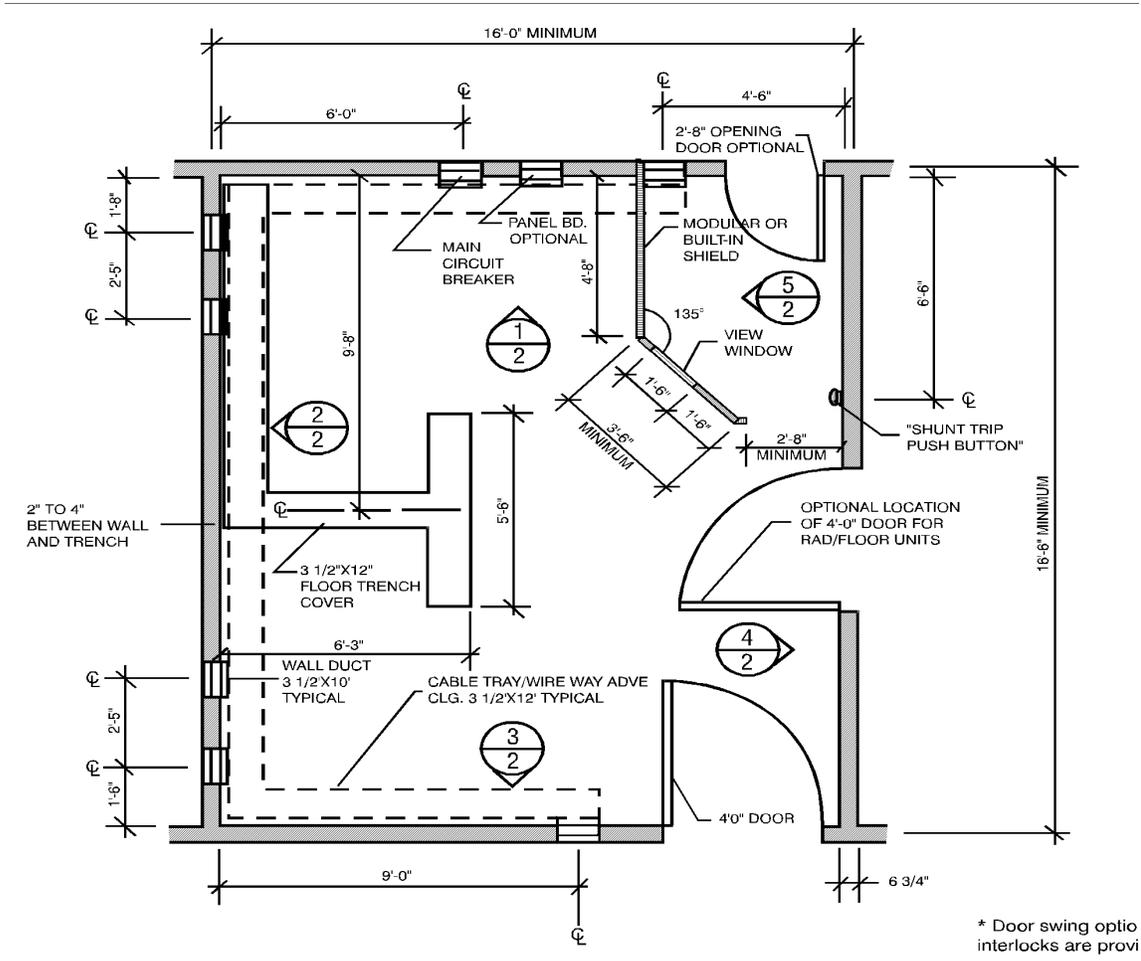
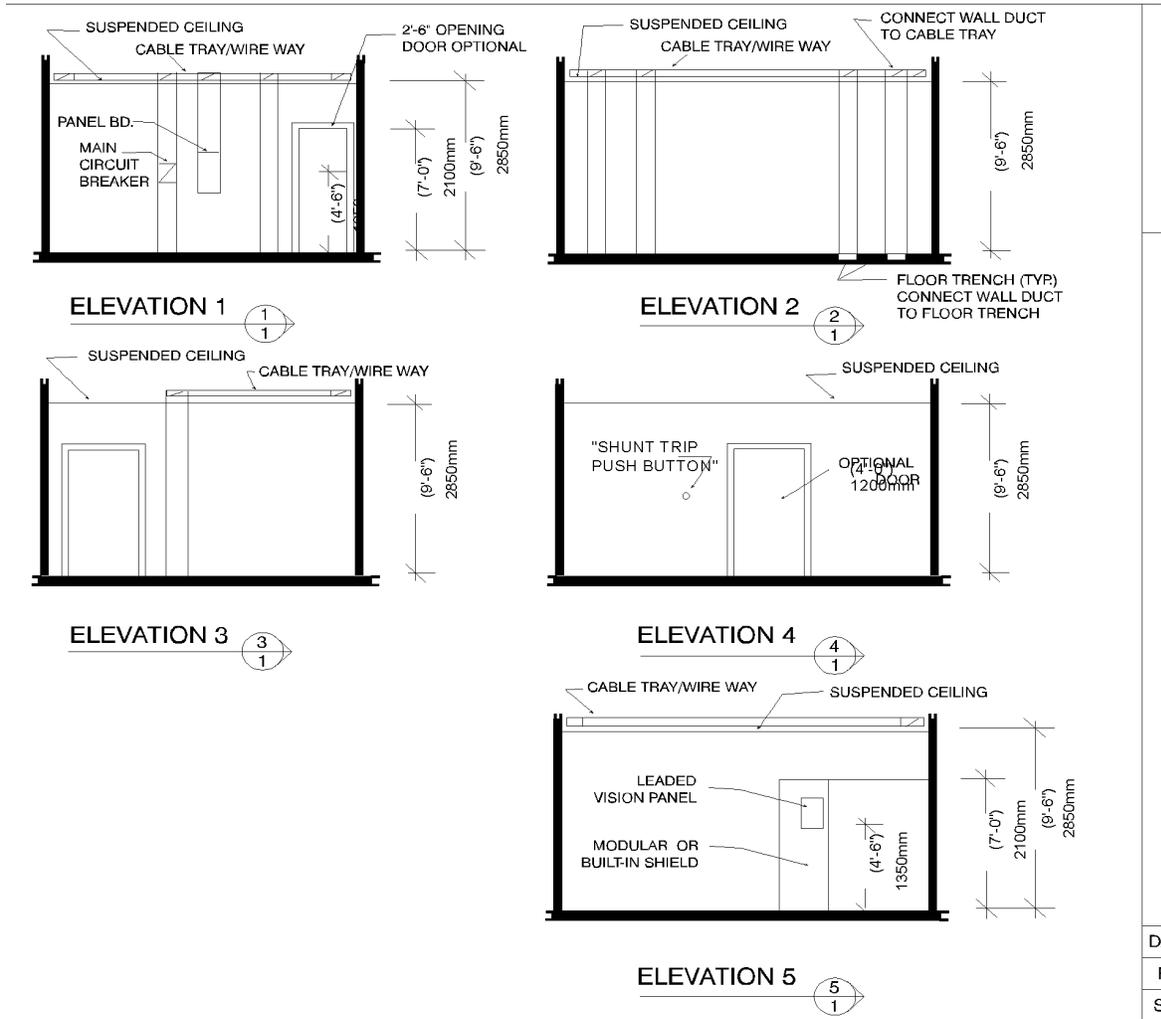


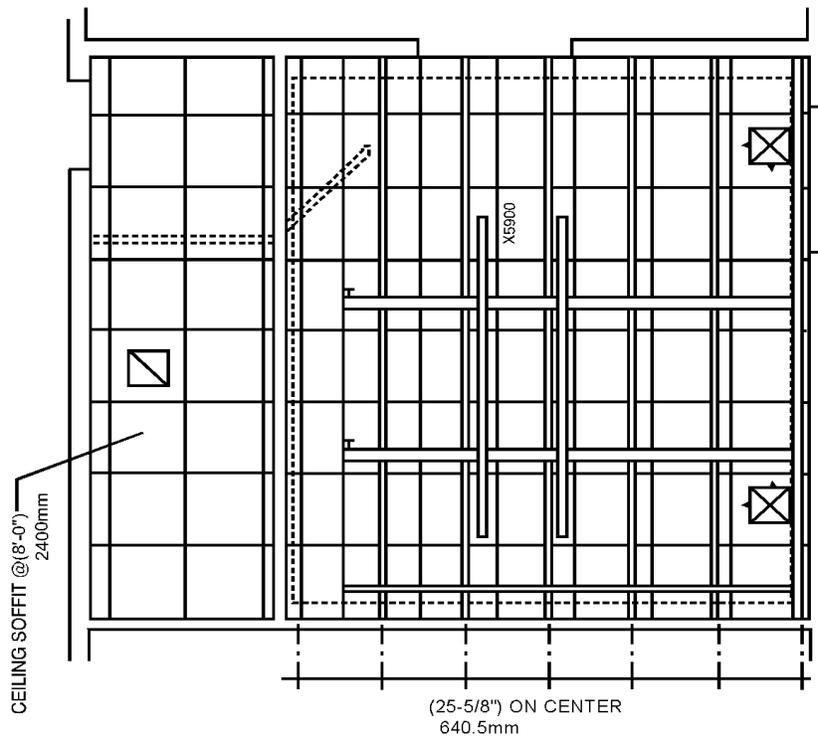
FIGURE C-1



D  
F  
S

FIGURE C-2

2



\* Door swing optional i  
interlocks are provided

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FIGURE C-3