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AUG 24 1992

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Gentlemen:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

WATTS BAR NUCLEAR PLANT (WBN) - PROPOSED CHANGES TO FINAL SAFETY ANALYSIS REPORT (FSAR) FOR RADIATION PROTECTION DESIGN FEATURES (TAC 63647)

Enclosed for NRC staff review are proposed changes to Section 12.3 of WBN's FSAR describing radiation protection design features. These changes primarily incorporate updated radiation zone information showing the anticipated radiation levels at various locations within the plant based on the most recent TVA calculations. Also, the changes provide a few clarifications discussed in a telephone conversation on February 20, 1991, with Mr. Roger Pedersen and Mr. Peter Tam of the NRC staff.

Please note that the proposed FSAR changes to Section 12.3 address some of the requirements in the new 10 CFR 20 rule, which will go into effect on January 1, 1994, for standards for protection against radiation. However, further FSAR changes will also be necessary to address all of the new requirements completely. TVA expects to revise WBN's FSAR accordingly as corporate policies and procedures are developed to implement the new 10 CFR 20 rule.

The enclosed preliminary changes to Section 12.3 are planned to be incorporated into the FSAR as part of Amendment 72. A notation to this effect has been included on each page. This should allow time for NRC staff review and additional coordination reviews within TVA before finalizing the changes to Section 12.3.

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If you have any questions, please telephone John Vorees at (615) 365-8819.

Sincerely,

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Proposed Changes to FSAR for Radiation Protection Design Featues

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ENCLOSURE

(Proposed Changes to FSAR Section 12.3)

12.3 RADIATION PROTECTION DESIGN FEATURES

12.3.1 FACILITY DESIGN FEATURES

~~Maintaining occupational radiation exposures as low as reasonably achievable (ALARA) has been an objective throughout the design of the Watts Bar Nuclear Plant. Since the issuance of Regulatory Guide 8.8, special emphasis has been placed on meeting this objective.~~ Some specific design features to limit in-plant radiation exposures are provided in the following Sections.

Instruments and components which require frequent maintenance or calibration are located in the lowest practicable radiation fields. This practice serves the twofold purpose of reducing exposure to operations personnel as well as lessening radiation damage to this equipment.

Penetrations of shielding and containment walls are located and designed so as to minimize exposures. Details of design considerations in the location of shield wall penetrations are provided in Section 12.3.2.2.

Radiation sources and routinely occupied areas are separated wherever possible. In particular, pipes or ducts containing potentially highly radioactive fluids do not pass through routinely occupied areas. Long runs of radioactive piping are restricted to shielded pipe chases. In addition, an effort is made to assure that piping entering an equipment cubicle serves only the equipment housed in that cubicle.

Design features are incorporated to minimize the spread of contamination and to facilitate decontamination in the event spillage occurs. Floor drains are provided in equipment cubicles to prevent the spread of radioactive liquids. Tight fitting doors with seals are utilized in access ways to cubicles housing radioactive gas handling equipment or equipment which processes high temperature fluids. If the doors are louvered, they are equipped with back draft dampers. Walls and floors in these areas are coated with special materials which are easily cleaned in case excessive leakage of contaminants has occurred.

The layout of ducts and pipes is designed to minimize buildup of contamination. Lengthy runs of horizontal radioactive piping are avoided where possible. Vents and drains on piping are located so as to minimize potential crud traps.

The Ventilation system is designed to ensure control of airborne contaminants and for easy access and service to keep doses as low as reasonably achievable (ALARA) during alterations, maintenance, decontamination, and filter changes. Air flow patterns are controlled throughout the plant such that cleaner areas are exhausted to areas of higher potential airborne radioactivity which are then exhausted to the atmosphere through air cleanup units. Air cleanup units are designed for ease of maintenance and to facilitate removal of filters to minimize personnel exposure from contaminated filters. Ventilation system design in plant buildings is discussed in Section 9.4.

A sufficient number of radiation monitoring devices are located throughout the plant to assist in the control of personnel exposure. Wherever practicable, area and airborne radioactivity monitoring equipment with local readout is included in areas to which personnel normally have access. Portable instrumentation supplements the stationary equipment. The locations of radiation monitors are discussed in detail in Sections 11.4 and 12.3.4.

Where practicable, shielding is provided between radiation sources and areas to which personnel may have normal or routine access, and shielding is designed for maintaining doses ALARA. In the case of waste evaporators, the design includes component arrangement such that those components which may require periodic maintenance are shielded from the components most likely to be high radioactive sources. Movable shielding and convenient means for its utilization are available for use where permanent shielding is needed but impractical. Details of shielding design are discussed in Section 12.3.2.

Remote handling equipment is provided wherever it is needed and practicable. Valves with remote operators are used in plant areas when manual operation is frequently required. Valve and valve gallery locations are discussed in Section 12.3.2.2. Provisions are made to remotely remove certain cartridge filters which are potentially highly radioactive. Remote handling equipment is used to package and transfer liquid and solid waste products. Remote handling equipment is also used to transfer new fuel and spent fuel assemblies.

Sampling is performed so exposures will be ALARA during such routine operations as sampling off-gas, primary coolant, and liquid waste. The waste gas analyzer equipment has been separated into two cabinets to allow shielding of readout and calibration equipment from piping and valves which contain radioactive gases. Liquid sampling from highly radioactive components is routed to a hot sampling room.

All radiation protection features, such as shielding, are designed to allow normal plant operations to continue unimpeded when radioactivity inventories are at design levels. The development of the design levels employs very conservative assumptions such as operation with 1.0 percent failed fuel.

Layouts of the Containment and surrounding Shield Buildings and of the Auxiliary, Control, and Turbine Buildings are provided in Figures 12.3-1 through 12.3-19. While generally to scale, these drawings cannot be scaled to determine accurately the thickness of concrete shield walls. Shield wall thicknesses are therefore tabulated in Table 12.3-6.

The layouts provide the radiation zone designations including zone boundaries and maximum expected radiation levels during all phases of normal plant operation. Refueling/shutdown radiation levels will be no higher and in most areas will be much lower than those shown. These layouts show elevations and room numbers for reference to Table 12.3-6, so that shield wall thickness may be readily determined for any location. The layouts also show controlled access areas, decontamination areas, the location of the on-site laboratory for analysis of chemical and radioactivity samples and the location of the counting room. The locations of area radiation monitors are tabulated according to elevation and nearest position coordinates in Table 12.3-4. Airborne radioactivity monitors are tabulated in Table 12.3-5 and hand and foot, and special radiation monitors are tabulated in Table 12.3-7. These elevations and position coordinates are readily locatable on the layout drawings, Figs. 12.3-1 through 12.3-19. The design basis radiation level in the counting room during normal operation is an external exposure rate of not more than 0.1 mrad/hr.

12.3.2 <u>Shielding</u>

12.3.2.1 <u>Design Objectives</u>

The design objectives of the plant shielding are the following:

1. During normal operation, including anticipated operational occurrences, to restrict annual doses to on-site occupational workers, including construction workers, to the 10 CFR 20 limits or to NCRP recommendations in cases for which 10 CFR 20 may not provide specific limits. The operational limits used at Watts Bar are given in Table 12.3-1. These limits also apply to visiting radiation workers employed at other TVA facilities when they are assigned to this plant on a temporary basis. For visiting radiation workers who are not normally TVA employees, the whole body dose limits are:

    a. 5 rem/year in accordance with the provisions of 10CFR20 paragraph 20.1201 if dose records are supplied for the individual(s) for the current calendar year. The dose permitted shall be adjusted to account for previous exposure so that the total dose received shall not exceed the 5 rem/calendar year.

    b. TVA may, in accordance with the provisions of 10CFR20 paragraph 20.1206, "Planned Special Exposures", authorize a radiation worker to receive doses in addition to and accounted for separately from the doses received under the limits specified in a. above provided that the following conditions are satisfied.

        1) The Planned Special Exposure is an exceptional situation where no alternatives that might avoid the higher exposure are available or are impractical.

2) TVA and the employer(1) specifically authorizes the planned Special Exposure, in writing, before the exposure occurs.

3) Before a planned Special Exposure, TVA ensures that the individuals are: a) informed of the purpose of the planned operation; b) informed of the estimated doses and associated potential risks and specific radiation levels or other conditions that might be involved in performing the task; and c) Instructed in the measures to be taken to keep the dose ALARA considering other risks that may be present.

4) Prior to permitting an individual to participate in a planned Special Exposure, TVA ascertains prior doses as required by 10 CFR 20 paragraph 20.2104(b) during the lifetime of the individual(s) involved.

Design maximum whole body exposure rates, except in the case of certain maintenance and refueling functions and during inspections, do not exceed 0.1 rem/hr and in most cases they are much less. The maximum dose rate in each instance is determined by the 10CFR20 annual limit, by the required exposure time, by previous dose during the current year and by anticipated subsequent maximum dose during the year.

2. To limit on-site whole body dose to visitors to 0.1 rem per year.

3. To restrict off-site exposures in accordance with the As Low As Reasonably Achievable (ALARA) provisions in 10 CFR 50.

4. To limit, under accident conditions, the off-site exposure from activity in the containment so that the total exposure from this source and from airborne radiation will not exceed the 10 CFR 100 exposure limits.

5. To satisfy the requirements of 10 CFR 50, Appendix A, Criterion 19. Sufficient radiation protection is provided to permit access and occupancy of the Main Control Room under accident conditions without personnel receiving excessive radiation exposure. The design also provides limited access, defined in Section 12.3.2.2, to other plant areas during accident conditions. The sum of the doses an operator receives during any such extra-control room visits and those received while gaining access to and occupying the Main Control Room will not exceed exposures of 5 rem whole body.

Note: (1) If the worker(s) is(are) not employed by TVA.

12.3.2.2 Design Description

Plant Shielding

Expected frequency, duration of occupancy, and access controls determine what exposure rates will be allowed in all interior and other on-site areas in order to assure that shielding design objectives are met. Each area is classified as one of five types listed in Table 12.3-2.

In numerous cases where access requirements are expected to range from almost continuous occupancy to a few hours per week (access types II and III), shielding is required to achieve acceptable exposure rate levels. The shielding design level in Table 12.3-2 is the exposure rate for which any shielding provided is designed.

Shield Walls

Presented in this section are the criteria for the erection of the plant shield walls and for penetration through these walls. The calculational methods used to determine the thickness and other dimensions of the shield walls are given at the end of this Section.

Many structural walls also serve a shielding requirement which often sets the wall thickness. Some walls serve only a shielding function. Most of these shielding walls are cast in place up to within 2 inches of the ceiling above. When necessary, this gap between wall and ceiling is filled over part of the wall thickness with grout. Those shield walls or portions of shield walls that are subject to removal for equipment repair or replacement are constructed of solid concrete blocks.

Except for two applications, which are cited in later subsections, the poured concrete shield walls throughout the plant are ordinary concrete with a minimum density of 145.0 lb/ft^3.

Areas where design whole body exposure rates are between 0.005 and 0.05 rem/hr are always shielded unless they are remote from general access areas or unless the exposure rates will exist for very short times. Shield walls are always erected around any plant component or piping if design level activity at any time in plant life can result in exposure levels greater than 0.050 rem/hr unless they are remote from general access areas. In many cases, particularly when the design exposure rates are toward the upper end of this range, shield walls are erected around these areas even though one of the conditions exists that could justify simply designating the unshielded areas as radiation areas and following the area identification and entry requirements given in Table 12.3-2.

Access to many equipment enclosures is provided through the shield walls of the compartments. In these cases, the effectiveness of the shield walls in limiting exposure rates outside the equipment enclosures is maintained by providing labyrinth entrances. Access to some equipment enclosures, principally filter, and demineralizer is through the floor above. In these cases, the removable concrete floor slab that provides the entrance generally has the same thickness as the cubicle walls.

The design criterion for shield wall penetrations in the Auxiliary Building, such as those for piping and ventilation ducts, is to locate them whenever practical so that their effect on the whole body exposure rates in accessible areas outside the shielded enclosure is minimized. Often this criterion is satisfied by locating the penetrations as nearly as possible to the corners and to the ceiling of the shielded enclosure. In using this technique, however, consideration is given to the increased length of piping sources that may result. If direct or reflected radiation passing through the penetrations of a shield wall creates a radiation area outside the wall, the criteria given for the erection of shield walls are used to establish the necessity for a wall to shield this area.

The following general shielding considerations are employed in the arrangement of Shield Building penetrations:

1. Where practical, most penetrations of the Shield Building except those that connect the Shield Building to a shielded enclosure in the Auxiliary Building, are opposite unpenetrated areas of the crane wall. This arrangement adequately shields outside areas and areas inside the Auxiliary Building from sources inside the containment shell during normal operation. When this arrangement is not used, shadow shields are provided to eliminate radiation streaming from major sources inside the containment to areas outside the Shield Building.

2. Radiation sources in the annulus between the containment and the Shield Building are located behind unpenetrated portions of the Shield Building or behind the Shield Building penetrations that connect the Shield Building to shielded enclosures in the Auxiliary Building.

3. Penetrations of crane wall sections that provide necessary shielding for containment areas accessible during power operation are avoided.

4. Shadow shields are provided at Shield Building penetrations that connect the Shield Building to unshielded areas where access cannot be completely controlled during accident conditions.

Valve and Valve Operating Stations

The following arrangements are used for manually operated valves that control process equipment function:

1. Valves are located and operated in the enclosure with the controlled equipment. This arrangement is used only when design level activities in the equipment and piping and anticipated occupancy for valve operation are such that acceptable exposure limits will not be exceeded. This arrangement is not used if the whole body exposure rate at the valve is greater that 0.1 rem/hr. The limit imposed in the case of each valve depends on expected occupancy requirements and is generally much less than 0.1 rem/hr. Another requirement for using this arrangement is that sources and piping in the equipment enclosure can be sufficiently removed, without economic penalty, to allow valve maintenance or that design activities are low enough to keep personnel doses under acceptable levels during valve maintenance without source removal. (Source removal can involve pumping or draining a liquid, venting a gas, flushing demineralizer resin, or replacing a filter cartridge). For this purpose, the acceptable whole body exposure rate is 0.006 rem/hr. To perform maintenance for an 8-hour shift at an average dose rate above this level, an employee needs the approval of his supervisor, the Health Physicist or his authorized representative, and the Shift Supervisor.

2. Valves are located and operated in a radiation area outside the equipment enclosure. With this arrangement, whole body exposure rates at the valve must be less than 0.1 rem/hr, and generally much lower limits are set.

3. In the third type of arrangement, valves are located in the equipment enclosure but are operated from behind a shield wall. For this arrangement, whole body exposure rates at the valve operating station must be less than 0.015 rem/hr. The exposure limitation during valve maintenance are the same as those for the first arrangement.

4. In this arrangement, valves are located in a valve gallery. Generally, a number of valves share a valve gallery. Typically, these are most of the valves that serve a few identical or similar plant components. One side of the valve gallery is formed by a shield wall which separates the valves from the process equipment. The opposite side of the gallery is a shield wall which is penetrated by either extension stem arrangements joining valves to hand-wheel operators or by flexible shaft controls.

   The extension stem is solid metal and the annular space between extension stem housing and shield wall sleeve is grout filled. With this arrangement, the effectiveness of the shield wall between valves and handwheel operators is virtually undisturbed and the whole body exposure rates at the handwheel are less than 0.001 rem/hr. The flexible shaft control is used in the case of a few filters. In some cases, ducts for the shafts follow an oblique or curved path through the wall to prevent direct radiation streaming from high intensity sources. The design whole body exposure level outside the valve gallery for this arrangement is 0.0025 rem/hr.

The first design objective of the valve gallery is to allow valve maintenance without first removing the sources from the process equipment. Some of the design guides to achieve this objective are the following:

a. Penetrations through the shield wall between the equipment enclosures and valve gallery are as near the ceiling and as close to the corner of the equipment enclosures as practical.

b. Piping runs in the gallery, that will contain radioactive fluid when the control valve is isolated for maintenance, are kept as short as practical.

c. Excessive annular spaces between pipe and pipe sleeve in the wall between equipment and valves are avoided.

With these precautions, it is expected that the design objective of 0.006 rem/hr whole body exposure rate will be achieved when the process equipment contains up to a significant fraction of design level activity. The design objective should be achieved in most cases even when the process equipment contains design level activity. As an outside limit, the design assures an exposure rate of less than 0.1 rem/hr in the valve gallery during valve maintenance without removal of the process equipment sources. Even at exposure levels of 0.1 rem/hr some valve inspection and maintenance would be possible.

A second objective for locating some of the valves in valve galleries instead of in the equipment enclosures is that even after removal of the process sources, the remaining activity on the inside walls of the equipment and/or high contamination levels in the enclosure may require extensive decontamination work before valve maintenance if the valve is located in the enclosure.

A third objective for locating control valves in valve galleries is that this arrangement provides a second shield between process equipment and general access areas. This is a worthwhile consideration when any unanticipated shielding deficiencies can result in high exposure rates.

Another advantage is that, in the unlikely event of valve operator failure, the valve gallery arrangement allows limited direct operation at the valve location until maintenance is performed.

Most of the advantages of locating hand-operated valves in valve galleries also apply to the location of remote-manual (motor-operated or pneumatically-operated) valves in valve galleries.

Manually operated valves used to isolate, drain, or vent process equipment such as pumps that contain relatively small amounts of activity are generally located and operated in the enclosure with the equipment. As a rule, remoting the valve and/or its operation from the equipment is a design consideration only when one or both of the following conditions can exist: (1) the anticipated dose from the process equipment during valve operation is significant and (2) the anticipated dose received from the equipment during valve maintenance is significant and large compared with that which could be received if a remote valve station were used.

A valve is never used to isolate, drain, or vent process equipment located and operated in the enclosure with the equipment if the whole body exposure level is greater than 0.1 rem/hr. The limit selected for each valve depends on the expected occupancy time at the valve station and is generally much less than 0.1 rem/hr. If anticipated exposure rates are too high to allow location and manual operation of the valve in the enclosure with the equipment, one of the following procedures is used: (1) the operation of the valve is from behind a shield wall which limits the whole body exposure rate at the operating location to less than 0.015 rem/hr or (2) the valve is located in a valve gallery and operation of the valve is from behind the valve gallery wall which restricts the whole body exposure rate at the valve operating location to 0.0025 rem/hr. Typically, these valves share a valve gallery with the equipment control valves.

Motor-operated or pneumatic valves that isolate, drain, or vent process equipment are located in valve galleries if process equipment activity levels could be high enough to prohibit emergency access to the valves.

Primary and Secondary Shielding

The primary shield consists of the following parts:

1. Shield elements inside the reactor pressure vessel. These elements, which are the core baffle, the core barrel, the thermal shield, and water annuli, provide a water shield and a steel shield, each several inches thick.

2. The reactor pressure vessel.

3. A concrete structure surrounding the reactor vessel from the floor at the 702.78 foot elevation to the floor at the 725.12 foot elevation. The concrete thickness is 5 feet 9 inches on the radius through each of eight out-of-core neutron detector slots. On all other radii, the concrete thickness opposite the active fuel is 8 feet 6 inches. There is an opening in the shield at each of the eight primary coolant pipes. Four

of the openings start at the vessel flange surface elevation of 725.12 feet and go down to elevation 712.71 feet. The other four openings extend from the vessel flange surface to elevation 692.00 feet.

That part of the opening above each pipe is filled during power operation with a removable plug. Removal of the plugs during shutdown allows inspection of the weld joints between the primary coolant pipes and the reactor vessel nozzles. Inspection time available will be very limited since exposure levels under pressure vessel equilibrium Co-60 and Fe-59 activity conditions will be on the order of 10 rem/hr at the bottom of the opening and 1 rem/hr at the top.

Except across the refueling canal, the primary concrete structure extends upward at reduced thickness (minimum is 2'6") from the 725.12 feet elevation to the operating floor (elevation 756.63 feet). (The blowout panels in this upper structure are located just under the floor at elevation 756.63 feet. The panels extend from elevation 754.13 feet down to elevation 749.63 feet. With this arrangement, radiation from the reactor vessel that penetrates the blowout panel area is attenuated by at least one reflection off concrete before it reaches accessible plant areas outside the primary concrete). The upper part of the primary concrete shielding is completed by the walls of the refueling canal which extend upward from elevation 709.23 feet, by the control rod drive missile shield and by a gate which spans the refueling canal from elevation 756.63 feet down to elevation 725.12 feet. The control rod drive missile shield and the gate are removed during refueling. The primary shielding makes possible necessary access inside the crane wall during shutdown.

The secondary shield consists principally of the crane wall, the Shield Building, the concrete operating floor at elevation 756.63 feet, and the concrete structures which combine with the crane wall to enclose those sections of the steam generators and the portion of the pressurizer that extend above elevation 756.63 feet.

In addition to their providing biological radiation protection, the primary and secondary shielding are arranged and structured to provide additional shielding functions such as:

1. The primary shielding elements inside the vessel attenuate neutron flux sufficiently to prevent excessive radiation damage to the reactor vessel.

2. The primary shielding prevents excessive radiation damage to plant components from neutron and gamma radiations, and the secondary shielding prevents excessive radiation damage to plant components from gamma radiation.

3. The metal and water inside the pressure vessel and the pressure vessel itself serve to reduce the heat flux from neutron and gamma radiation at the vessel outer surface.

Cooling necessary to avoid high temperatures and possible dehydration in the surrounding concrete is, thus, an easier task.

4. Parts of the primary and secondary shields serve as portions of the divider, necessary for the ice condenser containment, between lower and upper containment compartments.

5. The Shield Building, which is part of the secondary shielding, is also part of the double containment.

Personnel enter and leave the containment vessel through either of two personnel air locks. To protect (from primary coolant system radiation) personnel entering the containment through the airlock from the platform at elevation 716.00 feet, heavy concrete with density 218.0 lb/ft^3 is used in a section of the crane wall. With the reactor at significant power levels, personnel access to the lower compartment, which is access type IVa, will be prohibited except under cases of extreme emergency. During full power operation, the upper compartment and the ice condenser upper plenum, access type IVa areas, will be entered infrequently but as necessary for upper compartment inspection and ice bed and ice condenser inspection and maintenance. The Seal Table and Instrument Room, which are access type IV areas, will be entered routinely during full power operation. The accumulator rooms, ventilation equipment rooms, and tunnel area outside the crane wall will be entered from the seal table and instrument room only as needed and as radiation and airborne contamination permit. Some of these rooms contain access type IVa areas. Access to the annulus between the containment vessel and the Shield Building is not normally required during power operation; however, access, if necessary, is through a hatch. Most annulus areas are access type IV areas although some areas opposite crane wall penetrations are access type IVa areas.

Auxiliary Building Shielding

Shielding in the fuel handling area of the Auxiliary Building is discussed in a following subsection. The balance of the shielding in the Auxiliary Building protects personnel, during normal operation including anticipated operational occurrences, from the components and piping of the following systems and facilities:

1. Chemical and Volume Control System (CVCS).

2. Waste Disposal Systems (WDS)

3. Residual Heat Removal System (RHR)

4. Spent Fuel Pool Cooling and Cleanup System (SFPCCS)

5. Sampling System collection and analysis facilities.

The hot instrument shop and decontamination area enclosures furnish some minimal shielding, but their main function is to minimize the spread of contamination.

The Auxiliary Building shielding is designed to limit whole body exposure levels in accessible corridors and open spaces in the building to 1.0 mrem/hr (access type II); however, exceptions occur at certain shield wall penetrations. If the exposure rate at a penetration exceeds 5.0 mrem/hr, the procedures in Table 12.3-2 for designating radiation areas apply. Auxiliary Building shielding is also designed so that equipment areas may be entered for maintenance without shutdown of adjacent operating systems or system equipment. Satisfying this requirement results in a high degree of compartmentalization in the building.

Most piping carrying fluid of high specific activity is routed through shielded pipe chases. The pipe chase walls have a minimum thickness of 27 inches of concrete, which will reduce the whole body exposure rate from a 14-inch residual heat removal (RHR) system pipe carrying reactor coolant water to 1.0 mrem/hr . Somewhat higher exposure rates from pipe chase sources may exist for short time periods. An example is the exposure rate, calculated to be 4 mrem/hr, from spent resin piping during the backflushing of demineralizer resins. Pipe chases run along the A-5 and A-11 coordinate lines from elevation 676.0 ft. to elevation 757.0 ft. (See Figures 12.3-4, 12.3-8, 12.3-10 and 12.3-12). The Pipe chase areas are enlarged at one end between the floors at elevation 713.0 feet and elevation 737.0 feet to form Shield Building penetration areas. Most radioactive fluid carrying pipes running from the containments to the Auxiliary Building pass through these pipe chase sectors which extend from approximately Az 270 degrees to approximately Az 300 degrees (See Figure 12.3-3). Another pipe chase runs along the fuel transfer canal and adjoins the A-5 and A-11 line pipe chases between the floors at elevation 713.0 feet and elevation 737.0 feet. A concrete partition in this pipe chase along the A-8 line, between units, inhibits the spread of contamination from one unit to the other should a pipe rupture occur.

Fuel Transfer Shielding

During fuel transfer operations, the refueling canal and the region above the open reactor vessel are filled with borated water to elevation 749.12 feet. The water level in the fuel transfer canal and spent fuel pit, which are in the Auxiliary Building, is also at elevation 749.12 feet. The bottom of the refueling canal is at elevation 709.23 feet in the fuel assembly tilting device area and at elevation 713.87 feet elsewhere. A fuel assembly is transferred from the reactor vessel through the refueling canal toward the Auxiliary Building. It travels in a fuel transfer tube from the containment to the fuel transfer canal in the Auxiliary Building, and it is then moved into a storage location in the adjacent spent fuel pool. The reactor cavity filtration system assures water clarity in the reactor cavity during refueling.

After the fuel transfer has begun, the principal radioactive sources in the proximity of the fuel assembly transfer path are the following: (1) activity in the water which is a mixture of reactor coolant and water from the refueling water storage tank and (2) the fission product inventory in the fuel assembly being transferred. The activity in the water will not normally be above 0.01 μCi/cc of nontritium activity when a fuel assembly is moved from the vessel. A concentration of 0.01 μCi/cc of Cs-137 produces, via Ba-137m gamma decay, a calculated radiation level of approximately 2.5 mrem/hr at 3 feet above the water surface and less than this at occupied locations in the refueling areas. If the activity is above this level, it will be reduced to this level with the Spent Fuel Pool Cooling System Equipment (SFPCCS).

The minimum water shield above the active fuel region of a spent fuel assembly as it moves from the reactor vessel to the storage position in the spent fuel pool is 10.5 feet except when the assembly is in the fuel transfer tube. The design of the transfer equipment incorporates restraints to assure that this minimum water shield is maintained. The calculated exposure rate to a person at the water surface resulting from a fuel assembly at its maximum elevation during transfer is less than 1.0 mrem/hr. Except for an emergency passageway under the fuel assembly tilting device in the refueling canal (See Figure 12.3-17), the transfer of spent fuel assemblies does not generate any high radiation areas in accessible plant areas. The maximum shielding between the fuel assembly and the emergency passageway is 3 feet 0 inch of heavy concrete (density = 218 lb/ft^3). The whole body dose rate in the passageway is approximately 210 mrem/hr. The minimum shielding inside the primary containment between fuel assembly and personnel on the floor at elevation 716.0 feet is 1 foot of water and over 5.5 feet of ordinary concrete. The corresponding maximum whole body exposure level is about 5 mrem/hr. During fuel assembly transfer, the region in the annulus between the steel containment and the Shield Building is protected from the fuel assembly by concrete and water equivalent to more than 6 feet of concrete. A small access opening is provided through the shielding in the annulus to allow for inspection of the fuel transfer tube. This opening is normally filled with solid concrete blocks which are removed only when access for inspection purposes is required. A radiation streaming gap between the steel containment and the concrete on each side of it in the vicinity of fuel transfer tube is avoided by offsetting the concrete and attaching to each side of the steel containment a steel ring. Similarly, offsets in the Shield Building concrete and in the Auxiliary Building wall in the area of the transfer tube are used to avoid a direct streaming path between these two structures.

When the spent fuel assembly is outside the Shield Building, during passage through the Auxiliary Building wall and fuel transfer canal to the spent fuel pool, it is shielded by a minimum of 6 feet of concrete or by a minimum of 10 feet 6 inches of water. Spent fuel pool concrete walls which separate spent fuel assemblies in their storage locations from the Auxiliary Building access area at elevation 692.0 feet are 7 feet thick.

Turbine Building and Service Building

Activity in the Turbine Building occurs only in the event of steam generator primary-to-secondary leakage. Almost the entire Turbine Building is an access type I area. For an extreme case of primary-to-secondary leakage of 1 gpm per unit, some accessible areas immediately adjacent to the condenser vacuum exhaust system, including the HEPA filters and charcoal adsorber train, could be access type III areas.

Also located in the Turbine Building are condensate demineralizers and associated regeneration equipment. This equipment is adequately shielded to maintain maximum dose rates in controlled access areas to 1.0 mrem/hr. Cubicles in which condensate demineralizers and associated equipment are located are generally designed for type III or IV access (see Figures 12.3-11 and 12.3-13).

There are several areas of low activity level in the Service Building, such as the Waste Baler Room, Dirty Laundry Room, Health Physics Laboratory, and Radiochemical Laboratory Filter Room. Enclosures about these areas furnish necessary shielding, but their principal purpose is to minimize the spread of contamination.

Outside Areas

Except for the following, all areas outside the plant buildings are either access type I or II areas during normal operation including anticipated operational occurrences.

1. For short periods of time when solid waste shipping is imminent, the casks will be outside. The number of casks allowed outside at any one time is controlled and depends on the exposure rates from each cask. The maximum exposure rate from each cask satisfies the provisions of 49 CFR 173. Access to the outside region where these casks are located during the short pre-shipment periods is controlled. The type of control required depends on the designated access type, which in turn is established by the exposure rate.

2. During solid waste and spent fuel shipment, the area immediately adjacent to the train will be an access type IV area.

3. There are six outside tanks that contain radioactive liquids: Two refueling water storage tanks, two primary water storage tanks, and two condensate storage tanks. The activity in each is low level, and no shielding is required. Maximum whole body exposure rates at the site boundary from these tanks are $6.0X10^{-6}$ mrem/hr, $6.0X10^{-6}$ mrem/hr and $3.0X10^{-5}$ mrem/hr, respectively, for a refueling water storage tank, a primary water storage tank, and condensate storage tank.

Shielding For Accident Conditions

Some shielding provided for normal operation also has a function during accident conditions. However, other shielding has a function during accident conditions only. This accident shielding is required to serve two functions: (1) it must restrict the exposure at the site boundary from activity in the containment to a small fraction of 10 CFR 100 limits and (2) it must attenuate exposure rates at interior and other on-site locations from activity in the containment to levels which will allow required access. Requirements are the following:

1. Continuous Main Control Room occupancy is required.

2. Visits of several minutes duration into the shutdown board rooms to operate breakers and switches must be possible. For these visits which may occur at any time after the start of accident conditions, the operator will wear anti-contamination clothing and have breathing protection.

3. The capability must be provided to enter, at 24 hours after a LOCA, an ESF equipment room such as an RHR pump cubicle for repairs while the redundant unit is in operation. The design criterion is that the exposure for eight hours residence in the equipment room will not exceed 3 rem. (The design does not take credit for this maintenance in satisfying requirements such as meeting the single failure criterion. The capability is provided only to make a non-planned emergency repair.)

4. Since a single crew cannot remain in the Main Control Room for the duration of the accident, it must be possible to make the trip from the site boundary to the Main Control Room sometime after 24 hours without receiving an excessive dose.

5. The diesel fuel will have to be replenished during the course of the accident. The on-site storage allows about 7 days of operation.

The Shield Building is the principal structure that limits exposure at the site boundary and at site exterior locations from activity in the Containment. The Shield Building also, in concert with other shields, limits exposure levels at interior and other on-site locations. The accident shielding functions of the Shield Building are shared by the structures that shield its penetrations, such as the steam line penetrations, the personnel hatches, the equipment hatch, ventilation ducts, and the many smaller penetrations. Some of the structures that shield the Shield Building penetrations are Auxiliary Building external walls. These and other Auxiliary Building walls and the Auxiliary Building ceilings further attenuate radiation from sources within the Containment to improve accessibility during accident conditions.

The ESF equipment compartment shielding provides for emergency maintenance. (To make possible this maintenance, the equipment will be drained before the maintenance begins and the operator will wear anti-contamination clothing and have breathing protection). In the case of ESF equipment, such as the RHR pumps which also operate during normal operation, the shielding required for normal operation is controlling.

The Main Control Room is shielded so that the integrated whole body dose from external sources (activity inside the primary containment, in the passing cloud and in surrounding rooms) obtained during occupancy following a loss-of-coolant accident would be a very small fraction of 5.0 rem. The major portion of the whole body dose can then come from the airborne activity within the Main Control Room. (The dose from this airborne activity which is more difficult to limit than that from the external sources is discussed in Chapter 15 which considers integrated exposures in the Main Control Room under accident conditions from all sources).

In the Main Control Room's shielding design, sufficiently thick walls, ceiling, and floor are provided. In addition, special attention is given to the doorways. Shield doors are provided at the entrances from the Turbine Building to attenuate radiation from the radioactive cloud which is assumed to occupy the Turbine Building.

Analysis shows that shield doors at the small entrances from the Main Control Room to the Auxiliary Building are not necessary.

Shielding Calculations

Shielding required to reduce the exposure rates based on conservative source strengths in known source geometries to design objective values, were determined with hand calculation and/or with the SDC computer code. A computer program is used to solve the equations for the whole body beta and gamma dose rates from airborne activity. The program also provides the whole body gamma exposure rate after attenuation by a shield. Both the hand calculations and the computer codes employ the point-to-point kernel integration method. The SDC code 1 integrates the basic exponential attenuation point kernel over the various geometries to provide the uncollided gamma-ray flux. Many of the integrations found in the Reactor Shielding Design Manual [2] are utilized. Exposure rates are obtained by multiplying the uncollided flux by the product of a flux-weighted buildup factor and a dose-conversion factor. The hand calculations generally employ the more conservative procedure of multiplication of the buildup factors for the different materials between source point and exposure point.

When reflected gamma rays are important contributors to exposure rates, as in the case of labyrinth design and in the case of some shield penetrations, the angularly and energy distributed source strengths at the reflection surface are calculated using albedo techniques.

Condensate Demineralizer Waste Evaporator Building

Components of the Condensate Demineralizer Waste Evaporator are contained in a specially designed building adjacent to the Auxiliary Building near the on-site packaging area. Each component of the processing package is located in separately shielded compartments with the potentially more highly radioactive equipment further separated from equipment with less potential for radioactive contamination. Access to the building is designed for an Access type III (Radiation Area) with radioactive components located in areas designed for Access Types IVa and IVb (High Radiation Area). The design dose equivalent rate outside equipment cubicles is 1.0 mrem/hr. For areas generally accessible on a routine basis. Layout of the building showing radiation protection design features is provided on Figure 12.3-7

12.3.3 Ventilation

The plant ventilation systems are designed to assure that air will flow from areas of low potential airborne radioactivity to areas of higher airborne radioactivity. Concentration of radioactive material in areas routinely occupied are kept below the Derived Air Concentrations DACs that would exceed the Annual Limits on Intake (ALIs) given in Table 1 of Appendix B to 10 CFR 20. Additionally, (in accordance with the provisions of 10 CFR 20 paragraph 20.1701) the systems reduce concentrations of airborne radioactivity in areas not normally occupied, but where maintenance or in-service inspection has to be performed. The Ventilation System has the capacity to reduce the concentrations of airborne activity to keep the (DACs) at levels that allow necessary personnel occupancy with intakes below the ALIs given in Table 1 of Appendix B to 10 CFR 20.

12.3.3.1 Airflow Control

The Watts Bar Nuclear Plant ventilation systems are designed to supply air to the relatively cleaner plant areas and to exhaust air from areas of potentially higher airborne radioactivity levels. Major plant areas that could be subjected to radiation contamination, and their associated air exhaust flow rates, are shown in Table 12.3-3. Air that is removed from potentially contaminated areas following an accident is passed through are cleanup units and exhausted to the environment.

12.3.3.2 Typical System

The following is an illustrative example of the air cleanup system design. This typical system is designed to provide fresh, clean air inflow to and removal of potentially contaminated air from the Auxiliary Building to assure personnel comfort and safety during normal plant operations.

The Auxiliary Building general ventilation supply subsystem has a major impact on the personnel protection features incorporated in the design of the ventilation system. To control airborne activity, the Auxiliary Building ventilation supply air is delivered to clean areas and areas of general personnel occupancy. This air is then routed to areas of progressively greater contamination potential by natural pressure gradients induced by the exhaust system. Air is supplied as follows:

	Area	Supply Rate ft^3/min
El. 782	Control Rod Drive Equipment Rooms	1,406
El. 757	Fuel Handling Area	30,049
	EGTS Room	2,050
	Blowdown Treatment Room	2,050
	Waste Packaging Area	7,200
	CDWE Building	1.200
El. 737	Penetration Rooms	11,089
	General Areas	37,737
	Hot Instrument Shop	1,250
El. 730	Condensate Demineralizer Waste Evaporator Building	1,200
El. 713	General Areas	30,459
	Cask Loading Area	3,338
	Nitrogen Storage Area	2,903
	Post Accident Sampling Facility	1,450
	Penetration Rooms	14,633
El. 692	General Areas	36,460
	Penetration Rooms	6,201
	Spent Resin Tank Room	750
	Cask Decon Tank Room	2,039
El. 676	General Areas	8,000

Air is exhausted from the Auxiliary Building as shown in Table 12.3-3 and in Section 9.4. In all cases, except for the Hot Instrument Shop, EGTS Room, Blowdown Treatment Room Waste Packaging Area, Cask Loading Area, Fuel Transfer Valve Area, Nitrogen Storage Area, Spent Resin Tank Room, Cask Decontamination Room, Fuel Handling and the Penetration Rooms air supplied to the above relatively clean areas is allowed to follow natural flow paths to air exhausts in areas of potentially greater contamination. Because of its potentially higher levels of radioactivity and requirements for personnel access, the areas listed above are provided with both air supply and air exhaust. The exhaust from the Hot Instrument Shop is from a hooded area over the potentially higher radioactive areas, clean outside air is supplied to the Auxiliary Building air supply system through 102 filter cells in parallel at each inlet plenum. Each cell is rated at 1450 cfm total. The rated efficiency of each cell is 85% based on the NBS atmospheric dust spot test. Each filter bank is provided with a static pressure differential indicating gauge. See Figure 12.3-16 for the general layout plan of this system. The exhaust air during normal operation is released to the outside through the Auxiliary Building vent.

12.3.3.3 Additional Radiation Controls

The ventilation system is designed so that filters containing radioactivity will not create a radiation exposure hazard to personnel in normally occupied areas. Normally, waste filters containing radioactive contaminants will be removed from the filter housings, transported to the waste packaging area, and stored in appropriate shipping containers to await shipment to a disposal site. Filters with especially high levels of contamination may be transported to and temporarily stored in the shielded filter storage area. Although the basic design of the air cleanup units was completed prior to the publication of Regulatory Guide 1.52, good general compliance with the requirements of Section 4 of that document has been accomplished. See Section 6.5.1 for specific compliance with these requirements.

12.3.4. Area Radiation and Airborne Radioactivity Monitoring Instrumentation

12.3.4.1 Area Radiation Monitoring Instrumentation

12.3.4.1.1 Objectives and Design Basis

The area monitoring system assists in compliance with 10 CFR 50, Appendix A, General Design Criteria 19, 63, and 64.

Monitors are provided throughout the plant to monitor exposure rates and to warn personnel of increasing radiation levels. Monitors are placed as follows:

1. In areas where personnel routinely work without continuous Health Physics surveillance if the area is or could become a radiation area during normal operation.

2. In a few selected locations in the Auxiliary Building to provide knowledge of any increasing trends in general plant exposure rate levels. These monitors also provide warning of hazardous airborne noble gas concentrations.

3. In specific areas where exposure rates are normally low but in which high exposure rates could occur under postulated anticipated operational occurrences or accident conditions.

4. At locations outside the Shield Building at which detected exposure rates can provide a measure of airborne concentrations in the containment under postulated accident conditions

5. In the control room to indicate exposure rates during accident conditions

12.3.4.1.2 Operation Characteristics

Table 12.3-4 lists the physical location (by building elevation and coordinates), type of detector, and detector range of each area monitor. The specific location may be found on Figures 12.3-4 through 12.3-12 using the coordinates given in the Table. Other characteristics of the Area Radiation Monitoring System are given in the following Sections.

12.3.4.1.2.1 Area Monitor Detector

The area monitors employ Geiger-Mueller type gamma detectors. Each detector has its own independent high-voltage power supply located on panel 0-M-12 in the Main Control Room.

12.3.4.2.2 Main Control Room Rate Meter (O-M-12)

Ratemeters are of solid-state construction containing an adjustable solid state, high-voltage power supply. Countrate to voltage conversion is accurate to ± 3 percent

Visual and audio alarms are provided for high radiation and instrument malfunction on panel O-M-12

For relaying a high radiation alarm condition, each ratemeter chassis has one set of double pole, double throw (DPDT) contacts rated at 0.5 ampere when at 140 volts DC. For relaying an instrument malfunction alarm, each ratemeter chassis has a single pole, double throw (SPDT) contact rated at 0.5 ampere when at 120 volts AC; 2.0 amperes when at 30 volts DC. The power supplied to each ratemeter chassis is 117 volts AC ± 10 percent, 60 Hz ± 1 Hz.

12.4.1.2.3 Local Indicator-Alarm Panel

Each monitor has a locally mounted panel on which there is a local indicator, and a local visual and audio high radiation alarm and a power-on light.

12.4.1.2.4 Multipoint Recorders (Main Control Room - 0-M-12)

The area monitors are recorded on either a 24-point recorder (Unit 1 and common monitors) or a 12-point recorder (Unit 2 monitors). The recorders are supplied with 117 volts ± 10 percent, 60 Hz ± 1 percent

12.3.4.1.2.5 Monitor Sensitivity and Range

The ranges of the instrumentation provided are given in Table 12.3-4. The area monitors set points, adjustable over the entire range, will be determined by the Radiation Control group when an established operating background is obtained.

12.3.4.1.3 Calibration and Maintenance

Each monitor is checked quarterly with an operational test for functional performance. A complete calibration and performance check is performed at least once per 18 months on each monitor. The radiation analyzer module is verified to produce a linear logarithmic response over its entire range by performing a bench calibration of the module during the 18 month calibration.

Twenty-two of the twenty-four area monitors listed in Table 12.3-4 detect ambient gamma radiation levels in the range, 10^{-1} mR/hr to 10^{4} mR/hr. The detector for each of these 22 channels is a G-M tube. A check source, consisting of 1 μCi ±30% of Cl-36, is provided in each detector assembly to provide a means of rapidly performing a source response check.

Two of the twenty-four area monitors listed in Table 12.3-4 detect ambient radiation levels in the range, 10^{-1} to R/hr to 10^{4} R/hr. One of these is located outside each upper compartment personnel hatch air lock. Each of the two monitors employs two halogen-quenched G-M tubes. Operation is in the mean current mode rather than in the pulse counting mode. Current resulting from gamma radiation detected by one of the tubes, is a logarithmic function of ambient field intensity over the range 10^{-1} R/hr to above 10^{0} R/hr.

Current resulting from gamma radiation detected by the other tube, is a logarithmic function of ambient field intensity over the range, 10^{0} R/hr to 10^{4} R/hr. Each channel is provided with a means by which an operational channel check can be rapidly performed. The means for this check consists of a circuit which causes the radiation level indicated on the readout module to increase when the function switch on the readout module is rotated to the CHECK SOURCE position. The 18 month calibrations over the range for the two accident monitors are performed electronically. The electronic calibration consists of verifying the response to several values of supplied current. One point on the range is verified by using the same portable nuclide source with which the 22 low range area monitors are calibrated.

With the shield removed from a calibration source of Cs-137, a predetermined response is produced.

Calibration and analog channel operational tests verify that instrument malfunction is alarmed on down scale ratemeter trip. Alarm on reaching the monitor setpoint is annunciated.

12.3.4.2 Fixed Airborne Radioactivity Monitoring Systems

12.3.4.2.1 Design Basis

The airborne radioactivity monitoring systems are one of the plant features provided to comply with 10 CFR 50, Appendix A, General Design Criteria 19, 63, and 64, and with paragraphs 20.1502 and 20.1204 of 10 CFR 20. Adequate systems are provided to comply with 10 CFR 20 paragraph 20.1204.

Each of the systems monitors an air space to which one or more of the following description are applicable.

1. Spaces in which there is during normal operation, a potential for airborne concentrations at DAC levels which when integrated over a normal 40 hr/wk and 50 wk/yr would exceed the ALI of any isotope or mixture of isotopes and for which there are requirements for either (a) frequent (i.e., once per shift) visits, each of which is for a duration of at least several minutes, or (b) infrequent but routine visits of at least an hour's duration.

2. Spaces in which there is during normal operation, a potential for airborne concentrations at DAC levels which when integrated over a normal 40 hr/wk and 50 wk/yr would be considerably higher than the ALI of any isotope or mixture of isotopes and for which monitoring systems can be supplied in lieu of provision for safely taking and analyzing grab samples for airborne activity prior to personnel entry.

3. General spaces (e.g., spaces outside shielded equipment rooms) of buildings that contain equipment which bears, in process fluids, potentially significant radioactivity. (Although the plant ventilation systems normally supply clean air upstream of the spaces containing potential leakage points, monitoring is provided to detect airborne activity in the event of malfunction of the ventilation systems).

4. Spaces which have requirements for routine occupancy into which significant airborne activity may be introduced directly (e.g., physical barriers to its introduction do not exist). If an existing physical barrier consists of a ventilation system, consideration is given to the magnitudes of possible airborne concentrations should the ventilation system malfunction.

5. Spaces in which habitable conditions must be guaranteed at all times, even during accident conditions.

12.3.4.2.2 Airborne Monitoring Channels

Some of the process and effluent radiation monitoring systems provide useful information about the airborne activity within the plant buildings. These systems, described in Section 11.4, are the following:

1. Containment Building lower and upper compartment air monitors, and

2. Service Building ventilation monitor.

In addition to these process and effluent monitors, there are 11 channels for monitoring airborne particulate activity. These channels are listed in Table 12.3-5. The table also lists, in the case of each channel, the criteria which establish the need for continuous airborne activity monitoring.

Although a physical barrier to the introduction of radioactivity from the spent fuel pool to the spent fuel pool area is presented by the air curtain across the pool (Section 9.4.2.1), consideration of the possible levels of air borne concentrations in the event of a malfunctioning of equipment makes prudent the provision for airborne monitoring in accordance with Criteria as indicated in Table 12.3-5.

Monitoring of the Auxiliary Building airborne activity during accident conditions is accomplished with the eight airborne monitoring systems that monitor the Spent Fuel Pool Area, the two Sample Rooms, the Holdup Valve Gallery General Area, the Decontamination Area, the Safety Injection Pump General area and the two Waste Packaging Areas.

The primary Containment Buildings are monitored during accident conditions with the containment building lower and upper compartment air monitors (Section 11.4). These monitors will be placed on line during accident conditions as soon as containment atmospheric conditions permit. Detection of airborne activity in the range 10^{-1} to 10^{4} R/hr during accident conditions is provided by the area monitor (See Section 12.3.4.1) located outside of each upper compartment airlock.

The locations of the eleven assigned airborne monitors that are in the Auxiliary, Reactor and Control Buildings can be determined by their respective coordinates from Table 12.3-5 applied to Figures 12.3-4, 12.3-8, 12.3-10, 12.3-12, and 12.3-15.

12.3.4.2.3 Operational Characteristics

Each channel has a detector assembly into which a continuous air sample is drawn. Particulates are removed by a moving tape filter and particulate radioactivity is detected by a beta scintillation detector. Local indication, recording, and alarms are provided. The channels are also recorded and alarmed in the control room. Each channel has a local single-pen recorder, local log ratemeter, local high radiation and malfunction (low flow, tape tear, etc.) alarms, and high radiation and malfunction multipoint recorder in the Main Control Room.

12.3.4.2.4 Component Description

Detectors

The detector units employ beta scintillation detectors and built-in preamplifiers. The crystals are able to detect beta radiation of an energy level of 0.2 MeV and above.

Filter Transport System

The filter transport mechanism can be operated in the continuous advance mode or programmed for step advance. Two speeds of operation are provided in the continuous mode. Step programming is adjustable between 1 and 24 hours with elapsed time of movement to the next point not to exceed 15 seconds. A filter tape tear alarm is provided with visual and audio alarms locally. A filter tape tear alarm also initiates an instrument malfunction alarm in the Main Control Room.

Local Ratemeter

The log ratemeter is a solid-state device with a range of 10^1 to 10^7 cpm. It is equipped with a solid-state power supply with adjustable high voltage between approximately 500 and 1200 volts. The time constant is 1.08 minutes at 10 cpm and 23 msec at 10^7 cpm. The accuracy of the electronics is ± 3 percent. The drift does not exceed 1 percent per month. The indicating meter has scale markings for cpm and high voltage. Two outputs for an external recorder and computer are provided, 0-1 volt and 0-100 millivolt, respectively. A function switch is provided on the ratemeter chassis.

Alarms are provided for high radiation, signal failure, flow failure, and power failure. The alarms are both visual and audible in the Main Control Room on high radiation and instrument malfunction. One annunciator window for high radiation and one window for instrument malfunction are provided.

A high radiation alarm is relayed with one set of DPDT contacts rated at 0.5 ampere, 120 volts AC; 2.0 ampere at 30 volts DC. Each instrument malfunction alarm is relayed with SPDT contacts rated at 0.5 ampere at 120 volts AC, 2.0 ampere at 30 volts DC.

Multipoint Recorder (0-M-12)

The air particulate monitor outputs are recorded on a common 12-point recorder. Power supply to the recorder is 117 volts ± 10 percent, 60 Hz ± 1 percent.

Local Recorders

The local recorder at each unit is a Leeds and Northrup Company model M, single-pen recorder. This recorder has solid-state electronics. Each recorder has direct-reading indicating scales calibrated from 10^1 to 10^7 cpm.

The recorders are general-purpose, pullout or plug-in type, which permits removal of recorders from the monitor assembly. The removal of recorders does not upset loop circuits impedance and/or inputs to other devices.

Pumping System

The pump is a positive displacement, dry vane type. The pumping system has automatic flow regulation within ± 5 percent accuracy to a preset value which is in the range of 4 to 10 cfm. A flow indicator is also provided. Visual and audible alarms for high and low flow are provided at the enclosure. An instrument malfunction alarm is provided in the Main Control Room.

All metallic parts except the pump in contact with the sampled medium are austenitic stainless steel. All tubing connections are compression-type fittings and adaptable to screwed or socket-welded fittings.

The pumps are designed for use with 117 volts AC, ± 10 percent, single phase, 60 Hz ± 1 Hz.

12.3.4.2.5 Sensitivity, Range and Set Point

In a background of 1.0 mR/hr, each of the particulate monitors has a sensitivity of 3.4×10^{-11} μCi/cc of I-131. The upper limit of the detector range corresponds to 2.0×10^{-5} μCi/cc of I-131.

12.3.4.2.6 Calibration and Maintenance

The calibration procedure for the air particulate monitors is described below.

Each detector has a built-in check source (Cl-36, strength 0.5 μCi) which is operated locally from a control on the unit chassis. Each detector is checked weekly using its built-in check source.

A calibration check at least every 18 months will be performed on each monitor. The calibration procedure includes:

1. Recalibration of each monitor using a portable calibration unit, and check local ratemeter and recorder response to one activity level from a portable calibration source.
2. Trip the upscale and downscale ratemeter set points and check the respective annunciation (high radiation or instrument malfunction) functions.
3. Electronically recalibrate the local ratemeters and main and local recorders.
4. Verify that 'Instrument malfunction' annunciation is initiated on downscale ratemeter trip or loss of power.
5. Verify that 'High Radiation' annunciation is initiated on upscale ratemeter trip.

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12.3.4.4.3 Laundry Monitors

The laundry monitor is a radiation monitoring device for providing visual and aural warning when the radiation contamination of the laundry exceeds a preset level. A built-in alarm remains energized until the alarm reset button is pushed and the meter is manually reset below the preset level. The laundry monitors are located in the laundry room of the Service Building.

12.3.4.5 Local Ratemeter Radiation Monitors

Figures 12.3-1 through 12.3-9 also show locations of local ratemeter radiation monitors. The primary difference between the local ratemeter radiation monitors and the area radiation monitors described in Section 12.3.4.1 is that the local ratemeter radiation monitors (friskers) are for local personnel scanning and the area radiation monitors are for area monitoring. 53

The local ratemeter is a small, compact count ratemeter operated by AC line or by a Ni-Cd battery which is continuously trickle charged while the unit is plugged into the line. Battery condition may be checked on the control panel. The monitor is used with a Geiger-Mueller detector and can, with minor modifications, be used with an appropriate scintillation detector. The radiation count rate is read out on a front panel meter with 0 to 500 counts per minute full scale. Three switch selected ranges of X1, X10, and X100 are provided. A high limit alarm is also provided, adjustable over the scale of the meter. The alarm, when actuated, does not interrupt or effect the meter reading and is a locking type which will continue to alarm until the reset switch is depressed. An audible indication is integral and the loudness can be controlled from no sound to maximum.

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REFERENCES:

1. SDC, A Shielding - Design Calculation Code for Fuel- Handling Facilities (RSIC Code Package CCC-60). 53

2. Reactor Shielding Design Manual, Theodore Rockwell III, D. Van Nostrund Company, Incorporated, New York, N. Y., 1956.

3. ANSI N13.10-1974, Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents.

4. WBNTSR-077 R1 "Radiation Zones"

5. 10CFR20 May 1991

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TABLE 12.3-1

LIMITING DOSE TO OCCUPATIONAL WORKERS INCLUDING CONSTRUCTION WORKERS AND VISITING RADIATION WORKERS

	Maximum Annual Dose in Rem
Whole body[a]; head and trunk (including male gonads), arms above the elbow, and legs above the knee.	5
Extremities; (Hands and forearms, feet and ankles and legs below the knees)	50
Skin of whole body (Shallow Dose)[b]	50
Lens of the Eye	15

(a) Deep dose equivalent ($H_{(d)}$)-Applies to external whole body exposure. It is the dose equivalent at a tissue depth of 1 cm (1000 mg/cm^2).

(b) Shallow dose equivalent ($H_{(s)}$)-Applies to the external exposure of the skin or an extremity. It is taken as the dose equivalent at a tissue depth of 0.007 centimeter (7 mg/cm^2) averaged over an area of 1 square centimeter.

TABLE 12.3-2
ACCESS CONTROL AREAS

AREA TYPE	ZONE*	ACCESS TYPE*	DOSE EQUIVALENT RATE rem/hr	SHIELDING DESIGN LEVEL rem/hr	AREA IDENTIFICATION AND ENTRY REQUIREMENTS
Unlimited Access Continuous occupancy	I	I	0 - 0.00025	-	Note 1
Radiological Control Area Regulated Access	II	II	0.00025 - 0.0025	0.001	Note 2
Radiation Area Regulated Access	III	III	0.0025 - 0.1	0.015	Note 3
High Radiation Area (Controlled Access)	IV	IV	0.1 - 1.0		Note 4
High Radiation Area (Restricted Access)	IVa	IVa	1.0 - 100		Note ~~4~~5
High Radiation Area (Restricted Access)	IVb	IVb	100 - 500		Note ~~4~~5
Very High Radiation Area (Restricted Access)	V	V	All above 500		Note ~~5~~6

* Zones and Access Types are based on shield design estimates. Actual posting will depend on operational dose rates determined by radiological surveys of the affected areas. Radiological assessments for posting will be made according to the WBNP Radiological Control Program.

Notes

1. Access Type I areas within the site boundary are under the Site Administrative Control. These areas may be subject to radiological control and access limitations from time to time if conditions warrant.

2. Access Type II areas in the Auxiliary Building are under Radiological Control. These areas are conspicuously posted with a sign or signs bearing the words "RADIOLOGICAL CONTROL AREA". Areas outside the Auxiliary Building which, from time to time, due to plant operations such as demineralizer loading, resin transfer, temporary storage of radioactive materials, or processing waste for shipment etc., reach or exceed Type II radiation levels may, at the discretion of Radiological Control Personnel, depending on the location, the length of time the area is expected to be at that level, and other factors which affect control requirements, be posted as a Radiological Control Area.

3. Access Type III areas are under Special Radiological Control requiring a RADIATION WORK PERMIT. These areas are conspicuously posted with an additional sign or signs bearing the words "CAUTION RADIATION AREA"

5 ~~4~~. Access ~~Type IV~~ Types IVa and IVb areas are under Special Radiological Control requiring a solid or wire mesh door which is maintained locked except when access to the area is required. Entry to these areas requires a radiation survey and special personnel monitoring. The doors to these areas can always be opened from the inside. Large areas, such as containment, where no enclosure exists for purposes of locking, and where no enclosure can be constructed around the individual/area, shall be barricaded, conspicuously posted with a sign or signs bearing the words "CAUTION HIGH RADIATION AREA", and have a warning device such as a flashing light.

6 ~~5~~. Same as Note 4. except that continuous radiation control monitoring is required and that the RADIATION sign or signs will bear the words "GRAVE DANGER VERY HIGH RADIATION AREA".

4. Access Type IV areas are under Special Radiological Control. These areas shall be barricaded and conspicuously posted as a "HIGH RADIATION AREA."

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TABLE 12.3-4

LOCATION OF PLANT AREA RADIATION MONITORS

Monitor No.	Location Building and Elevation		Building Coordinates	Area	Range
1 RE-90-1	Auxiliary	El. 757.0	A5-W	Spent Fuel Pool Area	10^{-1} to 10^{4} mR/hr
1 RE-90-2	Auxiliary	El. 757.0	A5-W	Personnel Air Lock	10^{-1} to 10^{4} R/hr
0 RE-90-3	Auxiliary	El. 729.0	A6-y	Waste Packaging Area	10^{-1} to 10^{4} mR/hr
0 RE-90-4	Auxiliary	El. 713.0	A2-q	Equipment Decon Area	10^{-1} to 10^{4} mr/hr
0 RE-90-5	Auxiliary	El. 737.0	A9-v	Spent Fuel Pool Pump Area	10^{-1} to 10^{4} mr/hr
1 RE-90-6	Auxiliary	El. 737.0	A5-s	Comp Clg Ht Exch Area	10^{-1} to 10^{4} mR/hr
1 RE-90-7	Auxiliary	El. 713.0	A5-W	Sample Room	10^{-1} to 10^{4} mR/hr
1 RE-90-8	Auxiliary	El. 713.0	A4-t	Aux FW Pumps Area	10^{-1} to 10^{4} mR/hr
0 RE-90-9	Auxiliary	El. 692.0	A5-W	Waste Evap Cnds Tk Area	10^{-1} to 10^{4} mR/hr
1 RE-90-10	Auxiliary	El. 692.0	A4-t	Reac Mov Bd Area	10^{-1} to 10^{4} mR/hr
0 RE-90-11	Auxiliary	El. 676.0	A7-u	Cntmt Spray & RHR Pump Area	10^{-1} to 10^{4} mR/hr
1 RE-90-59	Reactor	El. 756.63	Az 315°	Cntmt Refueling Floor	10^{-1} to 10^{4} mR/hr
1 RE-90-60	Reactor	El. 756.63	Az 225°	Cntmt Refueling Floor	10^{-1} to 10^{4} mR/hr
1 RE-90-61	Reactor	El. 736.0	Az 88°	Lower Compt Inst Rm.	10^{-1} to 10^{4} mR/hr
0 RE-90-63	Turbine	El. 713.0	T1-K	Laundry Room	10^{-1} to 10^{4} R/hr
0 RE-90-135	Control	El. 757.0	C7-q	Main Cntl Rm Rad Mon	10^{-1} to 10^{4} mR/hr
0 RE-90-230	Turbine	El. 685.0	T8-E	Condensate Demin Area	10^{-1} to 10^{4} mR/hr
0 RE-90-231	Turbine	El. 685.0	T8-E	Condensate Demin Area	10^{-1} to 10^{4} mR/hr
1 RE-90-271	Reactor	El. 806.0	Az 180°	Upper Cont High Range	10^{-1} to 10^{8} R/hr
1 RE-90-272	Reactor	El. 806.0	Az 180°		Per Pair
1 RE-90-273	Reactor	El. 728.0	Az 170°	Lower Cont High Range	10^{-1} to 10^{8} R/hr
1 RE-90-274	Reactor	El. 728.0	Az 170°		Per Pair
2 RE-90-1	Auxiliary	El. 757.0	A11-W	Spent Fuel Pool Area	10^{-1} to 10^{4} mR/hr
2 RE-90-2	Auxiliary	El. 757.0	A11-W	Personnel Air Lock	10^{-1} to 10^{4} R/hr
2 RE-90-6	Auxiliary	El. 737.0	A11-s	Comp Clg Ht Exch Area	10^{-1} to 10^{4} mR/hr
2 RE-90-7	Auxiliary	El. 713.0	A11-W	Sample Room	10^{-1} to 10^{4} mR/hr
2 RE-90-8	Auxiliary	El. 713.0	A12-t	Aux FW Pumps Area	10^{-1} to 10^{4} mR/hr
2 RE-90-10	Auxiliary	El. 692.0	A12-t	Reac Mov Bd Area	10^{-1} to 10^{4} mR/hr
2 RE-90-59	Reactor	El. 756.63	Az 315°	Contmt Refueling Floor	10^{-1} to 10^{4} mR/hr
2 RE-90-60	Reactor	El. 756.63	Az 225°	Contmt Refueling Floor	10^{-1} to 10^{4} mR/hr
2 RE-90-61	Reactor	El. 736.0	Az 88°	Lower Compt Inst. Rm.	10^{-1} to 10^{4} mR/hr
2 RE-90-271	Reactor	El. 806.0	Az 360°	Upper Cont High Range	10^{-1} to 10^{8} R/hr
2 RE-90-272	Reactor	El. 806.0	Az 360°		Per Pair
2 RE-90-273	Reactor	El. 728.0	Az 7°	Lower Cont High Range	10^{-1} to 10^{8} R/hr
2 RE-90-274	Reactor	El. 728.0	Az 7°		Per Pair

TABLE 12.3-5

AIRBORNE PARTICULATE ACTIVITY MONITORING CHANNELS

Monitor No.	Location Building and Elevation		Building Coordinates	Area	Range	Location criteria[1]
0-RE-90-12	Aux Bldg.	El. 757.0	A8-x	Spent Fuel Pool Area	10^1 to 10^7 cpm	(4)
1-RE-90-14	Aux Bldg.	El. 713.0	A6-W	Sample Room Unit 1	10^1 to 10^7 cpm	(1)
2-RE-90-14	Aux Bldg.	El. 713.0	A10-W	Sample Room Unit 2	10^1 to 10^7 cpm	(1)
0-RE-90-15	Aux Bldg.	El. 713.0	A8-t	Holdup Valve Gallery General Spaces	10^1 to 10^7 cpm	(3)
0-RE-90-16	Aux Bldg.	El. 713.0	A2-r	Decontamination Area	10^1 to 10^7 cpm	(4)
0-RE-90-17	Aux Bldg.	El. 692.0	A8-u	Safety Injection Pump General Spaces	10^1 to 10^7 cpm	(3)
1-RE-90-62	Reac Bldg.	El. 716.0	Az 272°	Lower Compartment Unit 1 Instrument Room	10^1 to 10^7 cpm	(1), (2)
2-RE-90-62	Reac Bldg.	El. 716.0	Az 272°	Lower Compartment Unit 2 Instrument Room	10^1 to 10^7 cpm	(1), (2)
0-RE-90-13	Aux Bldg.	El. 729.0	A8-y	Waste Packaging Area	10^1 to 10^7 cpm	(1)
0-RE-90-105	Cntl Bldg.	El. 755.0	c5-q	Main Control Room	10^1 to 10^7 cpm	(5)
0-re-90-138	Aux Bldg.	El. 729.0	A10-y	Waste Packaging Area	10^1 to 10^7 cpm	(1)

1 Criteria numbers correspond to those in Paragraph 12.3.4.2.1

TABLE 12.3-6

SHIELD WALL THICKNESS

ROOM NUMBER AND ELEVATION	NORTH WALL THICKNESS	SOUTH WALL THICKNESS	EAST WALL THICKNESS	WEST WALL THICKNESS	REF. DRAWING
ELEV. 674′ 0"					
A1	Concrete Fill	2′ 0"	2′ 3"	3′ 9" / 4′ 3"	41N366-1 41N328-1
A2	Concrete Fill	2′ 0"	4′ 3"	2′ 3"	41N328-1 41N366-1
ELEV. 676′ 0"					
A2	5′ 0"	3′ 0"	3′ 0"	5′ 0"	41N306-1 41N473-1 41N470-1
A3	5′ 0"	4′ 0"	3′ 0"	3′ 0"	41N306-1 41N473-1 41N470-1
A4	5′ 0"	2′ 0"	2′ 6"	3′ 0"	41N306-1 41N373-1 41N309-1 41N470-1
A4a	2′ 0"	4′ 0"	2′ 6"	3′ 0"	41N306-1 41N373-1 41N309-1
A5	1′ 2"	3′ 0"	1′ 2"	1′ 2"	41N309-1 41N307-4
A10	2′ 0"	2′ 0"	2′ 3"	3′ 9"	41N366-1 41N309-1

Added by Amendment 72

TABLE 12.3-6

SHIELD WALL THICKNESS

ROOM NUMBER AND ELEVATION	NORTH WALL THICKNESS	SOUTH WALL THICKNESS	EAST WALL THICKNESS	WEST WALL THICKNESS	REF. DRAWING
A11	2′ 0"	2′ 0"	2′ 3"	3′ 9"	41N366-1 41N309-1
A12	2′ 0"	2′ 0"	3′ 9"	2′ 3"	41N366-1 41N309-1
A13	2′ 0"	2′ 0"	3′ 9"	2′ 3"	41N366-1 41N309-1
ELEV. 692′ 0"					
A3	3′ 6"	4′ 0"	3′ 6"	3′ 0"	41N330-1 41N310-1 41N368-1 41N473-1
A4	1′ 0"	1′ 0"	3′ 0"	1′ 0"	41N368-1 41N310-1
A5	3′ 6"	4′ 0"	3′ 0"	3′ 6"	41N310-1 41N470-1
A9	3′ 0"	2′ 0"	3′ 6"	2′ 0"	41N368-1 41N330-1
A10	3′ 0"	2′ 0"	2′ 0"	3′ 6"	41N368-1 41N330-1
A11	2′ 2"	2′ 0"	2′ 0"	2′ 0"	41N368-1
A15	2′ 3"	4′ 0"	2′ 6"	4′ 0"	41N328-2 41N368-2 41N337-1

Added by Amendment 72

TABLE 12.3-6

SHIELD WALL THICKNESS

ROOM NUMBER AND ELEVATION	NORTH WALL THICKNESS	SOUTH WALL THICKNESS	EAST WALL THICKNESS	WEST WALL THICKNESS	REF. DRAWING
A16	4′ 0"	2′ 3"	2′ 6"	4′ 0"	41N328-2 41N368-2
A18	2′ 0"	1′ 6"	1′ 6"	2′ 0"	41N368-1
A21	2′ 0"	2′ 0"	2′ 0"	2′ 0"	41N368-1
A22	3′ 0"	2′ 0"	3′ 6"	2′ 0"	41N368-1 41N330-1
A23	3′ 0"	2′ 0"	2′ 0"	3′ 6"	41N368-1 41N330-1
A29	2′ 3"	3′ 6"	2′ 3"	2; 3"	41N368-1 41N310-1 41N470-1
A30	2′ 3"	3′ 6"	2′ 3"	3′ 0"	41N368-1 41N330-1 41N470-1
A31	3′ 0"	3′ 6"	3′ 0"	3′ 0"	41N368-1 41N330-1
ELEV. 713′ 0"					
A6	3′ 0"	4′ 0" / 3′ 0"	2′ 3" / 4′ 0"	1′ 6"	41N370-1 41N315-2 41N344-3
A7	4′ 0"	4′ 0"	2′ 3"	4′ 0"	41N315-2 41N370-1

Added by Amendment 72

TABLE 12.3-6

SHIELD WALL THICKNESS

ROOM NUMBER AND ELEVATION	NORTH WALL THICKNESS	SOUTH WALL THICKNESS	EAST WALL THICKNESS	WEST WALL THICKNESS	REF. DRAWING
A9	4′ 0"	2′ 0"	4′ 0" /3′ 0"	2′ 0"	41N370-1
A10	2′ 3"	2′ 6"	2′ 3"	2′ 3"	41N370-1
A11	2′ 3"	2′ 3"	2′ 3"	2′ 6"	41N370-1
A12	2′ 3"	2′ 3"	2′ 3"	2′ 6"	41N370-1
A13	2′ 3"	2′ 3"	0′ 6" / 1′ 0"	2′ 6"	41N370-1 41N373-1
A14	2′ 3"	2′ 3"	2′ 6"	0′ 6" / 1′ 0"	41N370-1 41N373-1
A15	2′ 3"	2′ 3"	2′ 6"	2′ 3"	41N370-1
A16	2′ 3"	2′ 3"	2′ 6"	2′ 3"	41N370-1
A17	2′ 3"	2′ 6"	2′ 3"	2′ 3"	41N370-1
A18	4′ 0"	2′ 0"	2′ 0"	4′ 0" / 3′ 0"	41N370-1
A19	3′ 0"	4′ 0" / 3′ 0"	1′ 6"	2′ 3" / 4′0"	41N370-1 41N315-1 41N344-3
A20	4′ 0"	4′ 0"	4′ 0"	2′ 3"	41N370-1 41N315-1
A22	1′ 9"	1′ 9"	1′ 9"	1′ 9"	41N370-1
A23	1′ 6" / 1′ 0"	2′ 6" / 1′ 0"	1′ 6"/1′ 0"	1′ 0"	41N370-1
A24	1′ 9"	2′ 6"	2′ 1"	2′ 6"	41N370-1

Added by Amendment 72

TABLE 12.3-6

SHIELD WALL THICKNESS

ROOM NUMBER AND ELEVATION	NORTH WALL THICKNESS	SOUTH WALL THICKNESS	EAST WALL THICKNESS	WEST WALL THICKNESS	REF. DRAWING
A25	2′ 6"	3′ 0"	2′ 6"	2′ 6"	41N370-1 41N315-2
A26	2′ 6"	3′ 0"	2′ 6"	2′ 6"	41N370-1 41N315-2
A28	6′ 0"	2′ 3"	2′ 3" / 2′ 6"	3′ 0"	41N358-1 41N315-2
A29	6′ 0"	2′ 3"	3′ 0"	2′ 3" / 2′ 6"	41N358-1 41N315-2
ELEV. 713′ 0" DEMIN PITS					
P1	1′ 0"	3′ 0"	1′ 0"	2′ 6"	41N370-1
P2	2′ 6"	3′ 0"	2′ 6"	2′ 6"	41N370-1
P3	2′ 3"	3′ 0"	2′ 6"	2′ 6"	41N370-1
P4	2′ 6"	3′ 0"	2′ 6"	2′ 6"	41N370-1
P5	2′ 6"	3′ 0"	2′ 6"	2′ 6"	41N370-1
P6	2′ 6"	3′ 0"	2′ 6"	2′ 0"	41N370-1
P7	1′ 0"	3′ 0"	2′ 0"	1′ 0"	41N370-1

Added by Amendment 72

TABLE 12.3-6

SHIELD WALL THICKNESS

ROOM NUMBER AND ELEVATION	NORTH WALL THICKNESS	SOUTH WALL THICKNESS	EAST WALL THICKNESS	WEST WALL THICKNESS	REF. DRAWING
P8	1′ 0"	3′ 0"	1′ 0"	1′ 0"	41N370-1
P9	4′ 0"	3′ 3"	3′ 0"	3′ 0"	41N370-1
P10	4′ 0"	2′ 6"	3′ 0"	2′ 6"	41N370-1
P11	4′ 0"	2′ 6"	2′ 6"	2′ 6"	41N370-1
P12	4′ 0"	2′ 6"	2′ 6"	2′ 6"	41N370-1
P13	4′ 0"	4′ 0"	4′ 0"	4′ 0"	41N370-1
P14	4′ 0"	4′ 0"	4′ 0"	4′ 0"	41N370-1
P15	3′ 3"	4′ 0"	4′ 0"	3′ 3"	41N370-1
P16	4′ 0"	2′ 6"	2′ 6"	2′ 6"	41N370-1
P17	4′ 0"	2′ 6"	2′ 6"	2′ 6"	41N370-1
P18	4′ 0"	2′ 6"	2′ 6"	3′ 0"	41N370-1
P19	4′ 0"	3′ 3"	3′ 0"	3′ 0"	41N370-1
P20	3′ 3"	4′ 0"	3′ 3"	4′ 0"	41N370-1
P21	4′ 0"	4′ 0"	4′ 0"	4′ 0"	41N370-1
P22	4′ 0"	4′ 0"	4′ 0"	4′ 0"	41N370-1
ELEV. 713′ 0" BATS FILTER					
	1′ 6"	4′ 0"	1′ 6"	1′ 6"	41N370-6

Added by Amendment 72

TABLE 12.3-6

SHIELD WALL THICKNESS

ROOM NUMBER AND ELEVATION	NORTH WALL THICKNESS	SOUTH WALL THICKNESS	EAST WALL THICKNESS	WEST WALL THICKNESS	REF. DRAWING
ELEV. 729′ 0"					
A3	2′ 9"	2′ 0" / 1′ 6"	2′ 9"		41N388-1
A4	2′ 6"	4′ 6" / 3′ 6"	2′ 9"	2′ 6"	41N388-1
A5	4′ 6" / 3′ 6"	1′ 6"	2′ 9"	2′ 9"	41N337-1 41N388-1
ELEV. 737′ 0"					
A5	3′ 0"	3′ 0"	2′ 3" / 2′ 6"	3′ 0"	41N318-2
A7	2′ 3"	3′ 0"	2′ 3"	2′ 6"	41N372-1
A8	2′ 3"	3′ 0"	2′ 6"	2′ 3" / 2′ 6"	41N372-1
A9	3′ 0"	3′ 0"	3′ 0"	2′ 6"	41N318-1
A15	1′ 6"	1′ 6"	1′ 6"	1′ 6"	41N372-2
A16	1′ 6"	1′ 6"	1′ 6"	1′ 6"	41N372-2
ELEV. 730′ 6"					
DE3	2′ 0"	2′ 0"	2′ 0"	2′ 0"	41W391-7
DE4	2′ 0"	2′ 0"	2′ 0"	2′ 0"	41W391-7
DE5	2′ 0"	2′ 0"	2′ 0"	2′ 0"	41W391-7
DE6	2′ 0"	2′ 0"	2′ 0"	2′ 0"	41W391-7

Added by Amendment 72

TABLE 12.3-6

SHIELD WALL THICKNESS

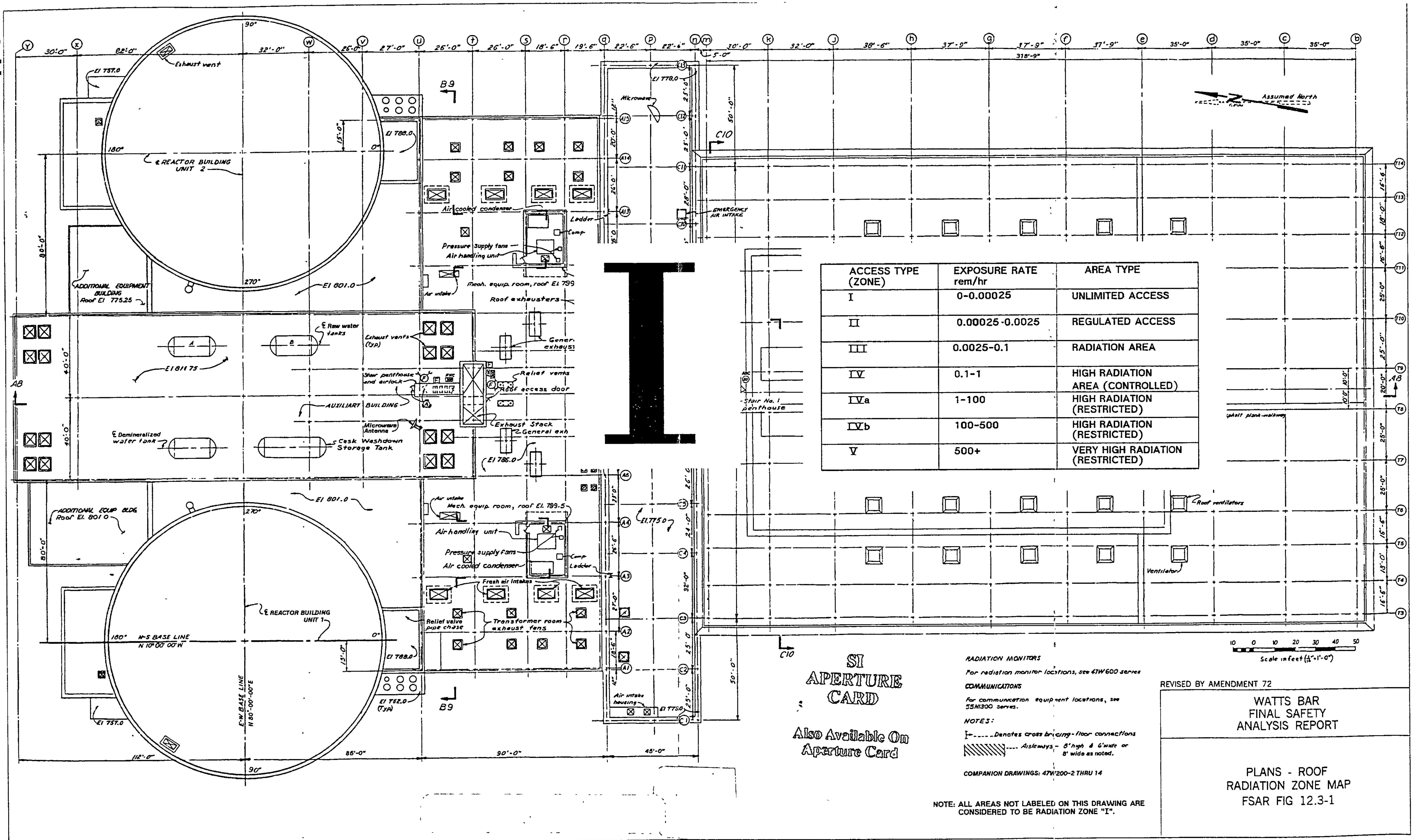
ROOM NUMBER AND ELEVATION	NORTH WALL THICKNESS	SOUTH WALL THICKNESS	EAST WALL THICKNESS	WEST WALL THICKNESS	REF. DRAWING
ELEV. 750′ 6"					
DE2	2′ 0"	2′ 0"	2′ 0"	2′ 0"	41W391-7
DE3	2′ 0"	2′ 0"	2′ 0"	2′ 0"	41W391-7
DE4	2′ 0"	2′ 0"	2′ 0"	2′ 0"	41W391-7
ELEV. 685′ 0" UNIT 1 TURB. BLD. CON DEMIN	1′ 3"	1′ 3"	1′ 3"	8′ 6"	41N233-3 41W238-2
ELEV. 685′ 0" UNIT 2 TURB. BLD. CON DEMIN	1′ 3"	1′ 3"	8′ 6"	1′ 3"	41W238-2 41N233-3
ELEV 685′ 0" UNIT 1/2 TURB BLD. CON DEMIN NEUT TANK	1′ 3"	1′ 3"	1′ 3"	1′ 3"	41W233-3

Added by Amendment 72

TABLE 12.3-7

Hand and Foot, and Special Radiation Monitors

Monitor No. Detector	Location Building and Elevation		Building Coordinates	Area	Range	Type of
0-RE-90-22	Aux Bldg.	El. 713.0	A1-q	Service Building Entrance	10^1 to 10^5 mR/hr	RD-1
0-RE-90-23	Aux Bldg.	El. 713.0	A1-q	Service Building Entrance	10^1 to 10^5 mR/hr	RD-1
0-RE-90-56	Serv Bldg.			Laundry Room	0 To 1000 cpm	RD-1
0-RE-90-57	Serv Bldg.	El. 713.0		Service Building Corridor	0 To 5000 cpm	RD-1
0-RE-90-58	Serv Bldg.	El. 713.0		Service Building Corridor	0 To 5000 cpm	RD-1
Portal Monitors						
0-RE-90-50				Visitors Gate House	0 to 20000 cpm	GM Tube
0-RE-90-51				Employee Gate House	0 To 20000 cpm	GM Tube
Hand and Foot Monitors						
0-RE-90-52	Serv Bldg.	El. 713.0	S2-SM	Service Building Entrance	0 To 500 cpm 0 To 50000 cpm	GM Tube GM Tube
0-RE-90-55	Serv Bldg.	El. 713.0	S2-SM	Service Building Entrance	0 To 500 cpm 0 To 50000 cpm	GM Tube GM Tube
0-RE-90-53	Aux Bldg.	El. 737.0	A5-x	Auxiliary Building	0 To 500 cpm 0 To 50000cpm	GM Tube GM Tube
0-RE-90-54	Aux Bldg.	El. 757.0	A5-u	Service Building Entrance	0 To 500 cpm 0 To 50000 cpm	GM Tube GM Tube



ACCESS TYPE (ZONE)	EXPOSURE RATE rem/hr	AREA TYPE
I	0-0.00025	UNLIMITED ACCESS
II	0.00025-0.0025	REGULATED ACCESS
III	0.0025-0.1	RADIATION AREA
IV	0.1-1	HIGH RADIATION AREA (CONTROLLED)
IVa	1-100	HIGH RADIATION (RESTRICTED)
IVb	100-500	HIGH RADIATION (RESTRICTED)
V	500+	VERY HIGH RADIATION (RESTRICTED)

RADIATION MONITORS

For radiation monitor locations, see 47W600 series

COMMUNICATIONS

For communication equipment locations, see 55N1300 series.

NOTES:

Denotes cross bracing - floor connections

Aisleways - 8' high & 6' wide or 8' wide as noted.

COMPANION DRAWINGS: 47W200-2 THRU 14

NOTE: ALL AREAS NOT LABELED ON THIS DRAWING ARE CONSIDERED TO BE RADIATION ZONE "I".

SI APERTURE CARD

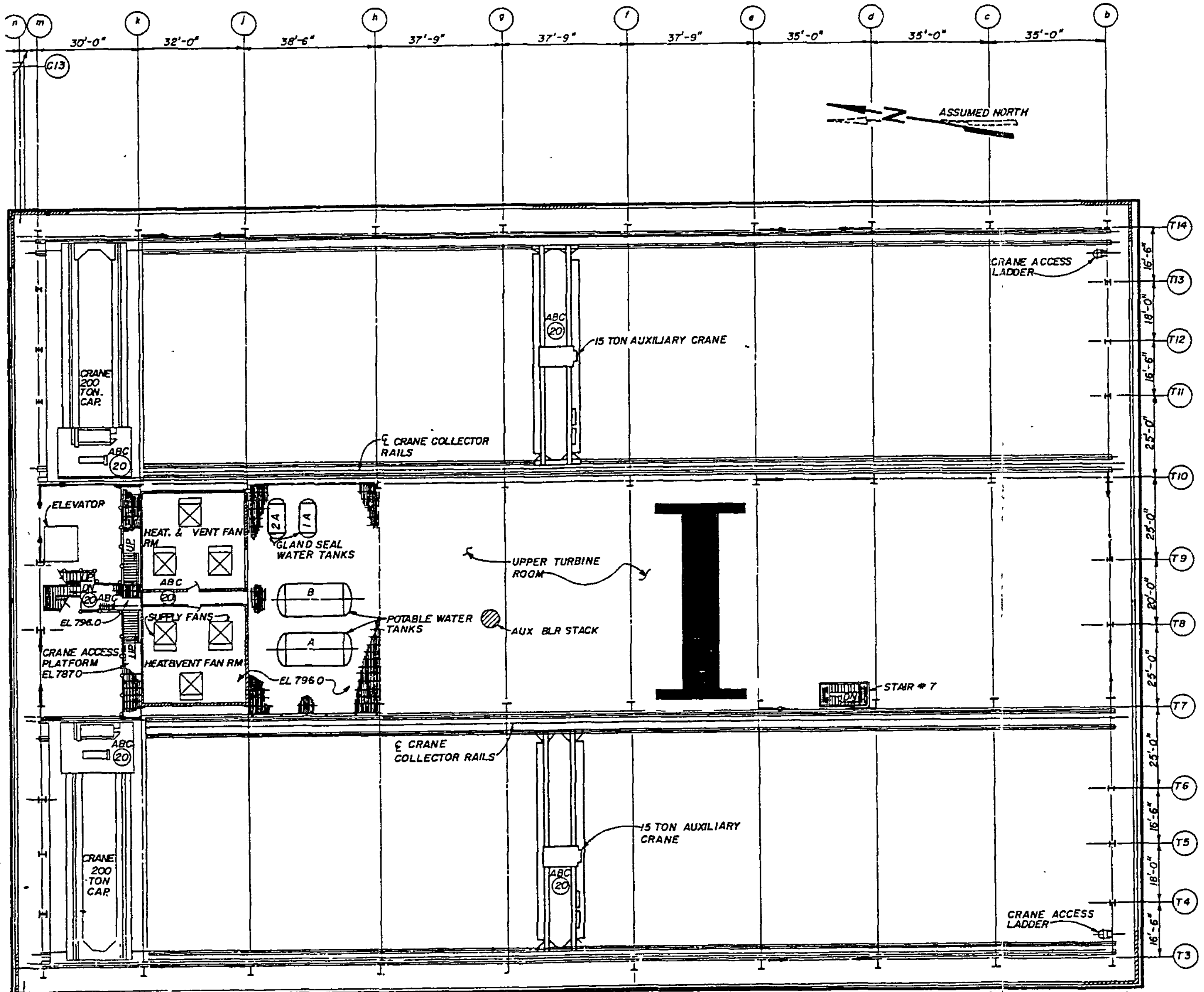
Also Available On Aperture Card

REVISED BY AMENDMENT 72

WATTS BAR FINAL SAFETY ANALYSIS REPORT

PLANS - ROOF RADIATION ZONE MAP FSAR FIG 12.3-1

9208280146-01



FIRE PROTECTION SERVICES

- FCMS -- FIRE CONTROL STATION MANUALLY ACTUATED SYSTEM
- F --- WYE HOSE CONNECTION
- F ----- FIRE PROTECTION PUMP START STATION
- HR 150 -- FIRE HOSE REEL, NO. INDICATES LENGTH IN FEET
- HC 250 -- FIRE HOSE CART, NO. INDICATES LENGTH IN FEET
- FHC 100 -- FIRE HOSE CABINET, NO. INDICATES LENGTH IN FEET
- 100 -- FIRE EXTINGUISHER, WHEELED CO_2 TYPE, NO. INDICATES CAPACITY IN POUNDS
- DP -- FIRE EXTINGUISHER, WHEELED DRY POWDER TYPE 140 TO 150 POUNDS CAPACITY
- FHR 100 -- 1½" FIRE HOSE RACK, NO. INDICATES LENGTH IN FEET
- FCAS -- FIXED FIRE CONTROL STATION-AUTOMATIC SPRINKLER SYSTEM
- FC-WS FIXED FIRE CONTROL STATION-WATER SPRAY SYS
- FC-CO2 FIXED FIRE CONTROL STATION-CARBON DIOXIDE SYS
- 20 DP ABC FIRE EXTINGUISHER, DRY CHEMICAL TYPE, NO. INDICATES CAPACITY IN POUNDS
- 10 -- MULTIPURPOSE TYPE FIRE EXTINGUISHER, NO. INDICATES CAPACITY IN POUNDS
- 15 -- CO_2 FIRE EXTINGUISHER, NO. INDICATES CAPACITY IN POUNDS
- 20 ABC H --- MULTIPURPOSE HALON TYPE FIRE EXTINGUISHER NO. INDICATES CAPACITY IN POUNDS

MECHANICAL SERVICES

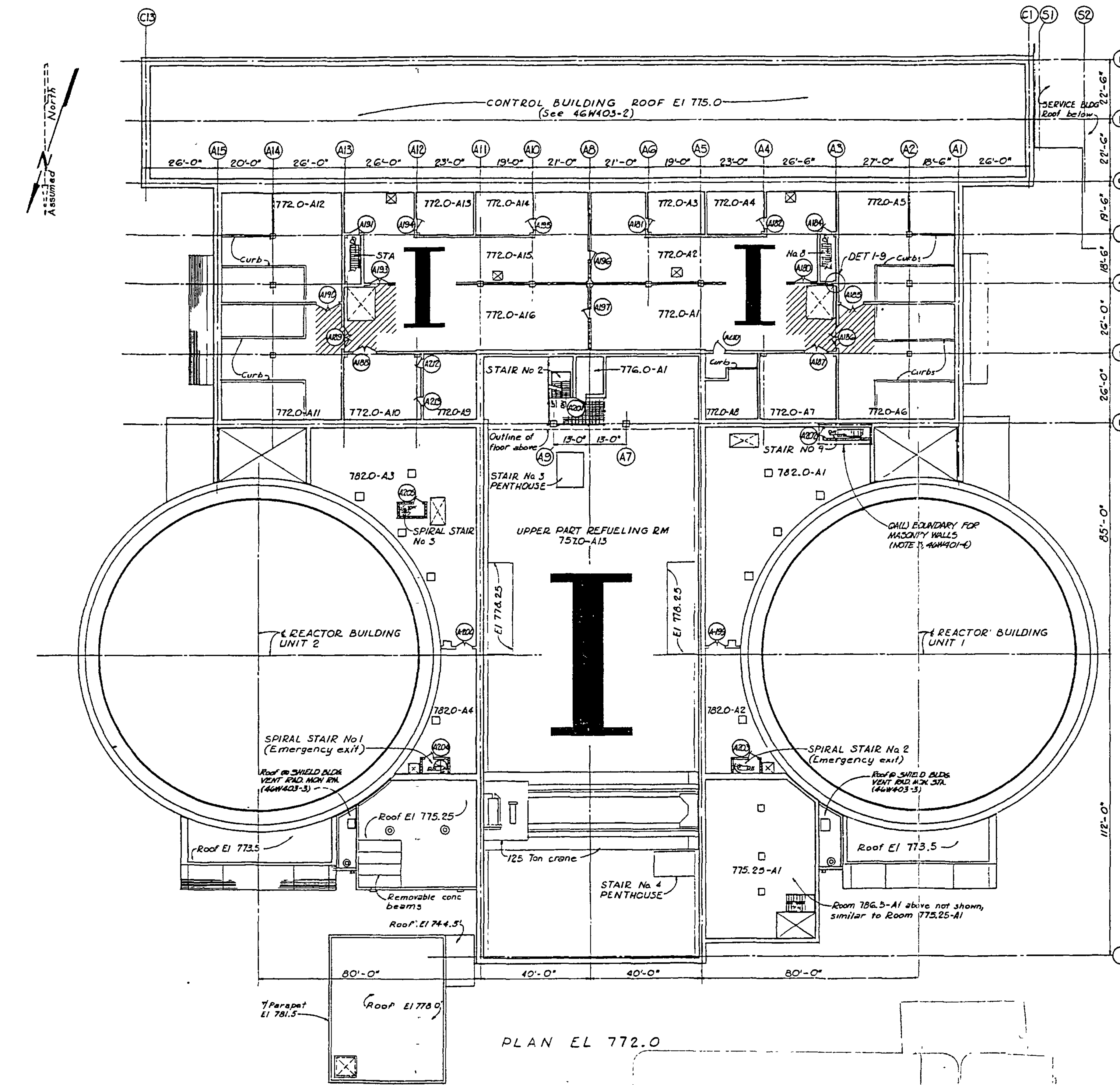
- A --- 1" AIR HOSE VALVE
- DW --- 1" DEMINERALIZED WATER HOSE VALVE.
- RW --- 1" RAW WATER HOSE VALVE

NOTE: ALL AREAS NOT LABELED ON THIS DRAWING ARE CONSIDERED TO BE RADIATION ZONE "I".

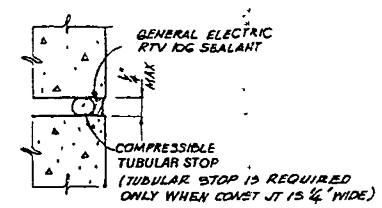
REVISED BY AMENDMENT 72

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

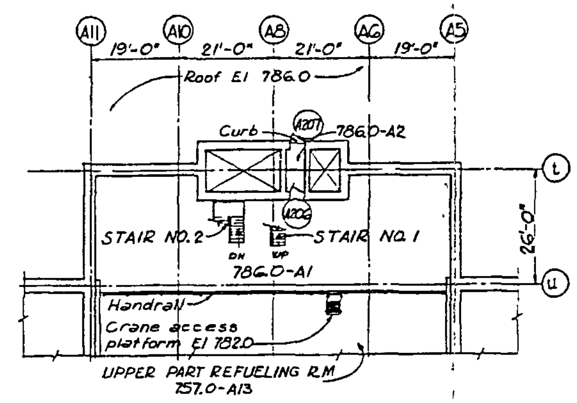
PLAN EL 772.0 & ABOVE
RADIATION ZONE MAP
FSAR FIG 12.3-2



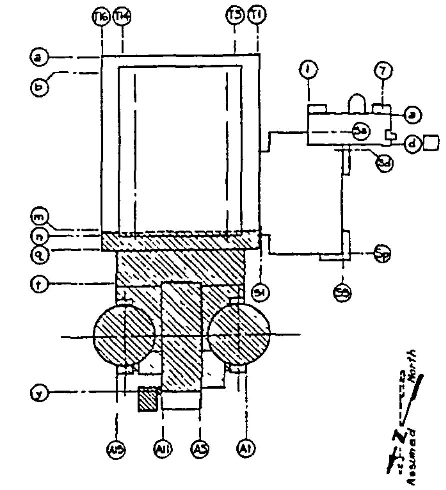
PLAN EL 772.0



DETAIL 1-9
TYPICAL VERTICAL CONST. JT AS REQD
SCALE 12" = 1'-0"



PLAN EL 786.0



KEY PLAN

NOTES
1 For concrete block walls reinforced for earthquake loading see 46W405-4,7 & 8

SI
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CARD

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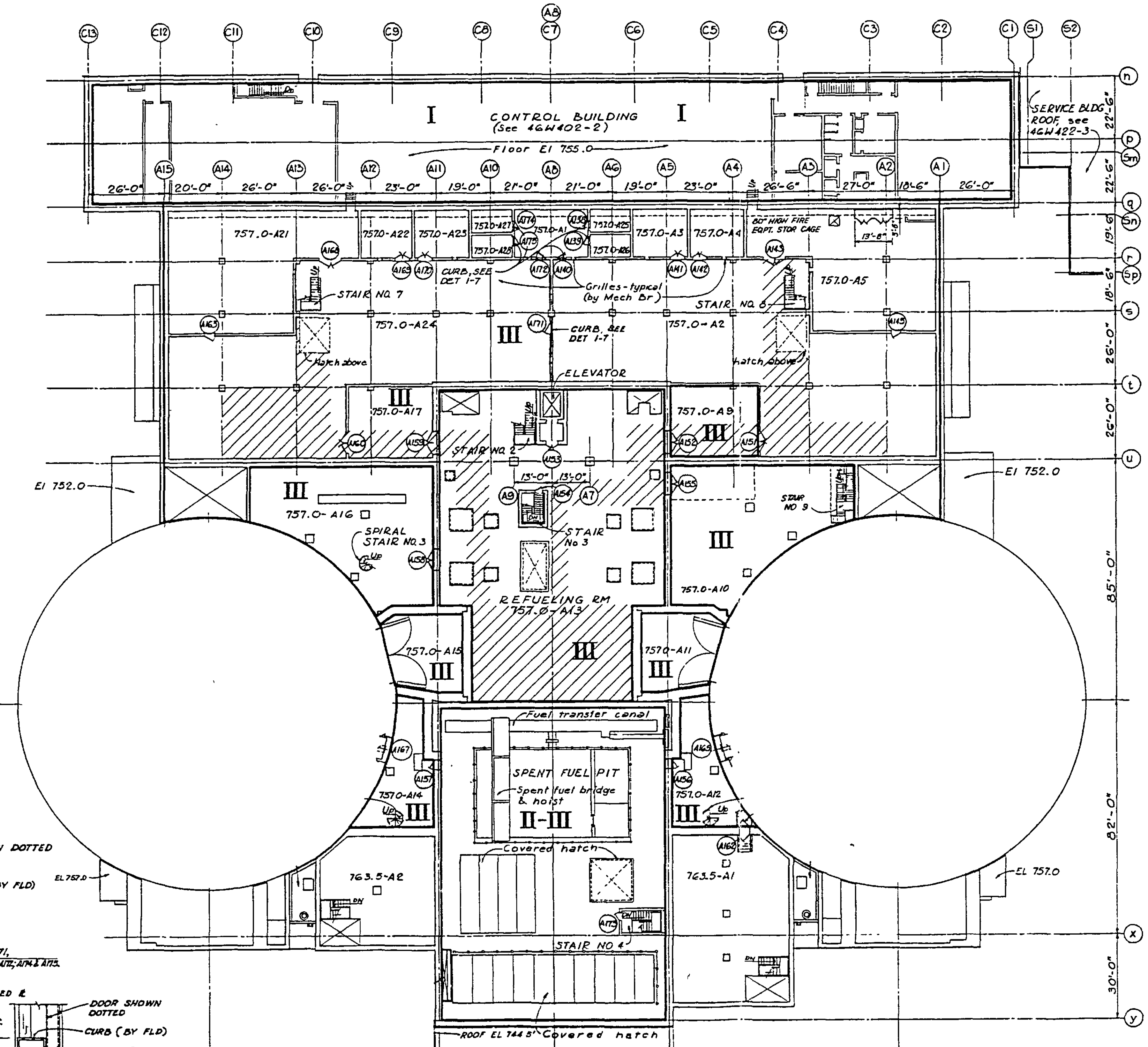
ROOM FINISH SCHEDULE							
ROOM NO	ROOM NAME	FLOOR	BASE	WALLS	SUSPD CLG FINISH	SUSPD CLG ELEV	REMARKS
772.0-A1	480V Board Rm 1A	Conc	—	Conc	—	—	
772.0-A2	480 V Board Rm 1B	Conc	—	Conc	—	—	
772.0-A3	125V Vital Batt Rm II	Conc	—	Conc	—	—	
772.0-A4	125V Vital Batt Rm I	Conc	—	Conc	—	—	
772.0-A5	480V Transformer Rm 1B	Conc	—	Conc	—	—	
772.0-A6	480V Transformer Rm 1A	Conc	—	Conc	—	—	
772.0-A7	Mech Equipment Rm.	Conc	—	Conc	—	—	
772.0-A8	Fifth Vital Batt & Bd Rm	Conc	—	Conc	—	—	SEE 46W452-6
772.0-A9	HEPA Filter Plenum Rm	Conc	—	Conc	—	—	
772.0-A10	Mech Equipment Rm	Conc	—	Conc	—	—	
772.0-A11	480V Transformer Rm 2B	Conc	—	Conc	—	—	
772.0-A12	480V Transformer Rm 2A	Conc	—	Conc	—	—	
772.0-A13	125V Vital Batt Rm IV	Conc	—	Conc	—	—	
772.0-A14	125V Vital Batt Rm III	Conc	—	Conc	—	—	
772.0-A15	480V Board Rm 2B	Conc	—	Conc	—	—	
772.0-A16	480V Board Rm 2A	Conc	—	Conc	—	—	
775.25-A1	Ice Machine Equip Rm	Conc	—	Conc	—	—	
776.0-A1	Elevator Machine Rm	Conc	—	Conc	—	—	
782.0-A1	Control Rod Drive Equip Rm	Conc	—	Conc	—	—	
782.0-A2	Pressure Htr Transf Rm 1	Conc	—	Conc	—	—	
782.0-A3	Control Rod Drive Equip Rm	Conc	—	Conc	—	—	
782.0-A4	Pressure Htr Transf Rm 2	Conc	—	Conc	—	—	
786.0-A1	Fan Room	Conc	—	Conc	—	—	
786.0-A2	Roof Access Air Lock	Conc	—	Conc	—	—	
786.0-A3	Mech Equip Rm	Conc	—	Conc	—	—	46W403-2
786.0-A4	Mech Equip Rm	Conc	—	Conc	—	—	46W403-2
786.5-A1	Package Chiller Equip Rm	Conc	—	Conc	—	—	
	STAIR No. 7	—	—	Conc	—	—	
	STAIR No. 8	—	—	Conc	—	—	
	STAIR No 9	—	—	Conc & conc blk	—	—	46W405-4
	SPIRAL STAIR No 1	—	—	Conc & conc blk	—	—	46W405-4
	SPIRAL STAIR No 2	—	—	Conc & conc blk	—	—	46W405-4
	SPIRAL STAIR No 3	—	—	Conc & conc blk	—	—	46W405-4

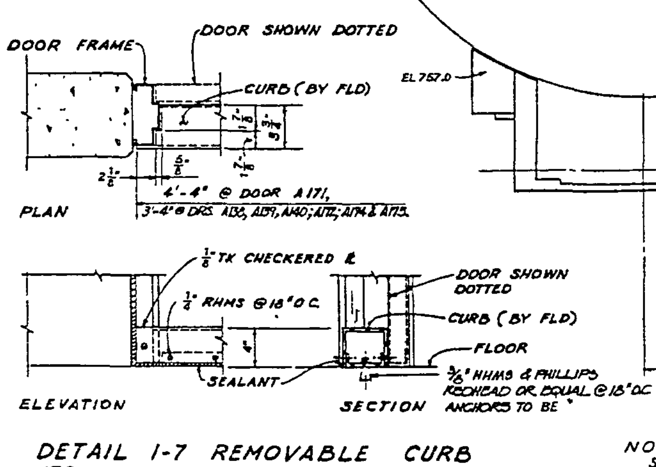
NOTE: ALL AREAS NOT LABELED ON THIS DRAWING ARE CONSIDERED TO BE RADIATION ZONE "I".

REVISED BY AMENDMENT 72

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
AUXILIARY, REACTOR & CONTROL BUILDINGS
PLAN EL 772.0, 782.0 & 786.0
RADIATION ZONE MAP
FSAR FIG 12.3-3

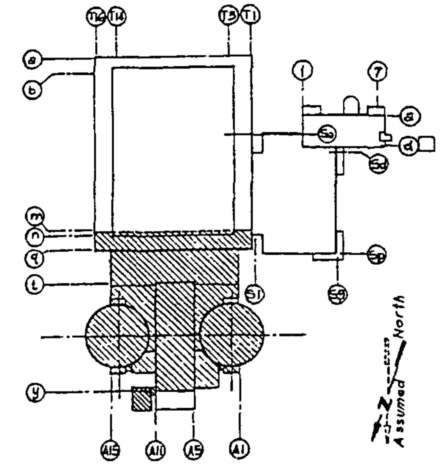




DETAIL 1-7 REMOVABLE CURB
N.T.S

NOTES
Symbol: indicates removable block by Civil Branch

Scale = 1/4" = 1'-0"



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CARD

Also Available On
Aperture Card

ROOM FINISH SCHEDULE

ROOM NO.	ROOM NAME	FLOOR	BASE	WALLS	SUSPD CLG FINISH	SUSPD CLG ELEV.	REMARKS
757.0-A1	Auxiliary Control Room	Conc	—	Conc	—	—	
757.0-A2	6.9KV & 480V Shutdown Bd Rm A	Conc	—	Conc	—	—	
757.0-A3	125V Vital Batt Bd Rm II	Conc	—	Conc	—	—	
757.0-A4	125V Vital Batt Bd Rm I	Conc	—	Conc	—	—	
757.0-A5	480V Shutdown Bd Rm 1B	Conc	—	Conc	—	—	
			—		—	—	
			—		—	—	
757.0-A9	Personnel & Equip Access	Conc	—	Conc	—	—	
757.0-A10	Spare	Conc	—	Conc	—	—	
757.0-A11	Reactor Bldg Equip Hatch	Conc	—	Conc	—	—	
757.0-A12	Reactor Bldg Access Rm	Conc	—	Conc	—	—	
757.0-A13	Refueling Room	Conc	—	Conc	—	—	
757.0-A14	Reactor Bldg Access Rm	Conc	—	Conc	—	—	
757.0-A15	Reactor Bldg Equip Hatch	Conc	—	Conc	—	—	
757.0-A16	Emer Gas Treatment Filter	Conc	—	Conc	—	—	
757.0-A17	Personnel & Equip Access	Conc	—	Conc	—	—	
757.0-A21	480V Shutdown Bd Rm 2A	Conc	—	Conc	—	—	
757.0-A22	125V Vital Batt Bd Rm IV	Conc	—	Conc	—	—	
757.0-A23	125V Vital Batt Bd Rm III	Conc	—	Conc	—	—	
757.0-A24	6.9KV & 480V Shutdown Bd Rm B	Conc	—	Conc	—	—	
757.0-A25	Aux Control Inst Rm 1A	Conc	—	Conc	—	—	
757.0-A26	Aux Control Inst Rm 1B	Conc	—	Conc	—	—	
757.0-A27	Aux Control Inst Rm 2A	Conc	—	Conc	—	—	
757.0-A28	Aux Control Inst Rm 2B	Conc	—	Conc	—	—	
	Stair No 3	Conc	—	Conc	—	—	
	Stair No 4	Conc	—	Conc	—	—	
763.5-A1	Ice Bin Equipment Rm	Conc	—	Conc	—	—	
763.5-A2	UHI Equipment Rm	Conc	—	Conc	—	—	

9208280146-04

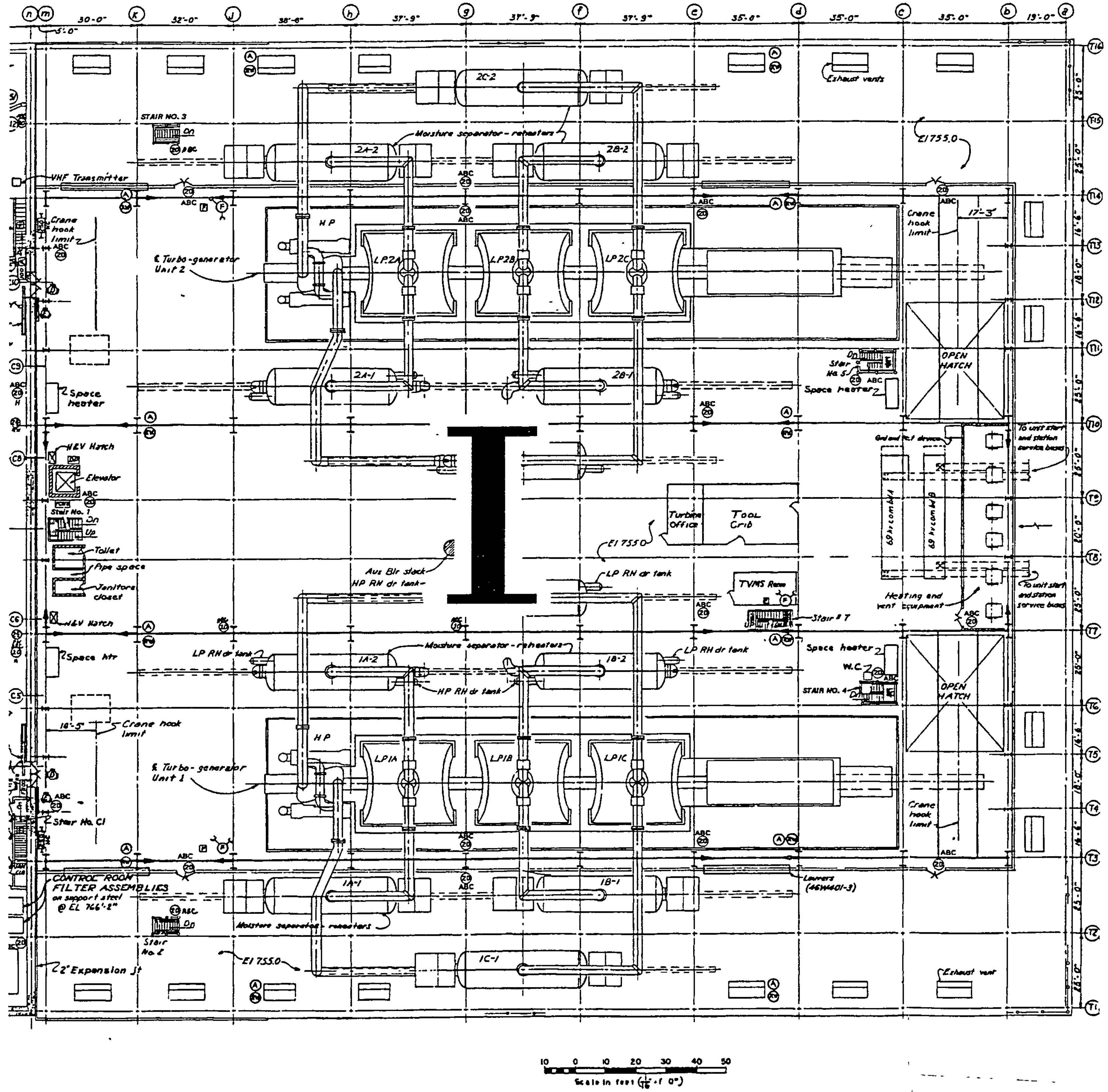
NOTE: ALL AREAS NOT LABELED ON THIS DRAWING ARE CONSIDERED TO BE RADIATION ZONE "I".

REVISED BY AMENDMENT 72

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
AUXILIARY, REACTOR & CONTROL BUILDING
PLAN EL 755.0 & 757.0
RADIATION ZONE MAP
FSAR FIG 12.3-4

COMPUTER GRAPHICS FILE NO.
RASTER: FSAR_FIG_12.3-5_R1
VECTOR: FSAR_FIG_12.3-5_R1



SI APERTURE CARD

Also Available On Aperture Card

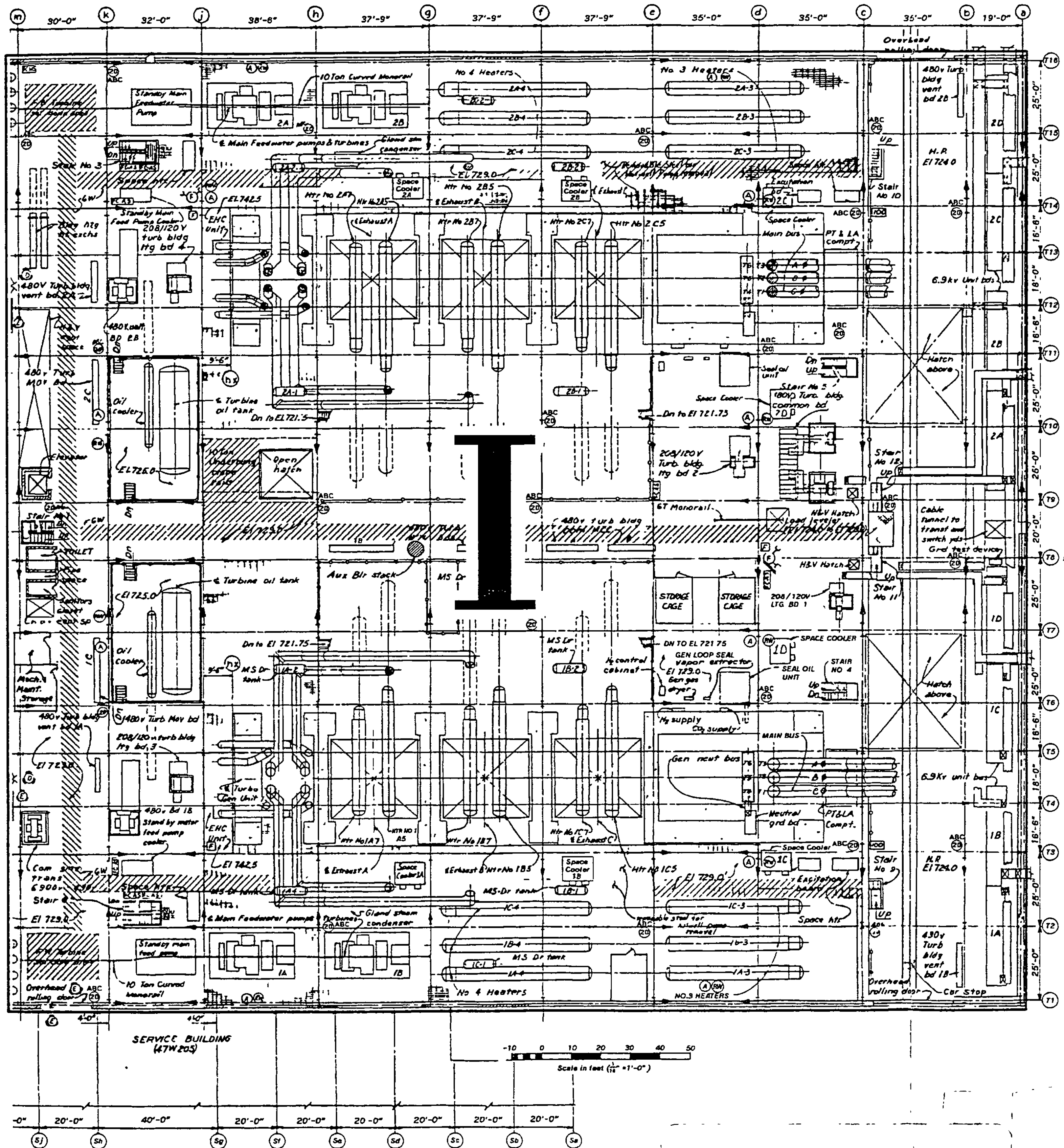
NOTE: ALL AREAS NOT LABELED ON THIS DRAWING ARE CONSIDERED TO BE RADIATION ZONE "I".

REVISED BY AMENDMENT 72

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
PLAN-EL 757.0 & EL 755.0
RADIATION ZONE MAP
FSAR FIG 12.3-5

9208280146-05



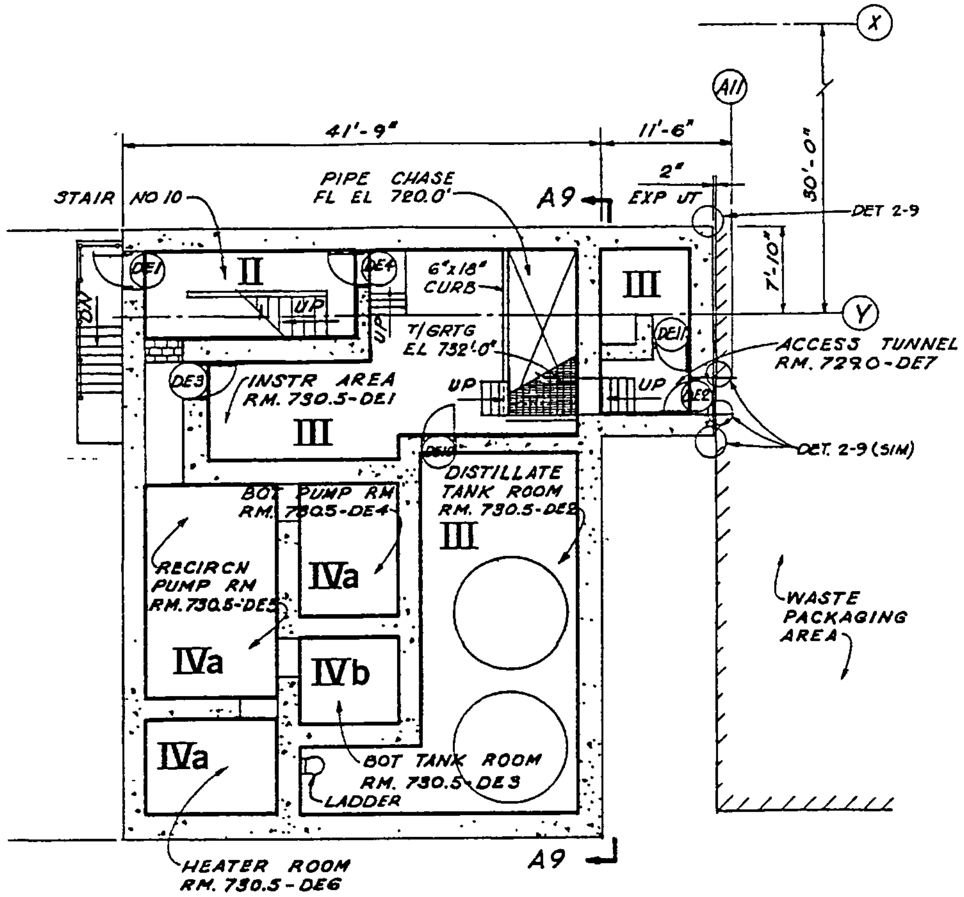
NOTE: ALL AREAS NOT LABELED ON THIS DRAWING ARE CONSIDERED TO BE RADIATION ZONE "I".

REVISED BY AMENDMENT 72

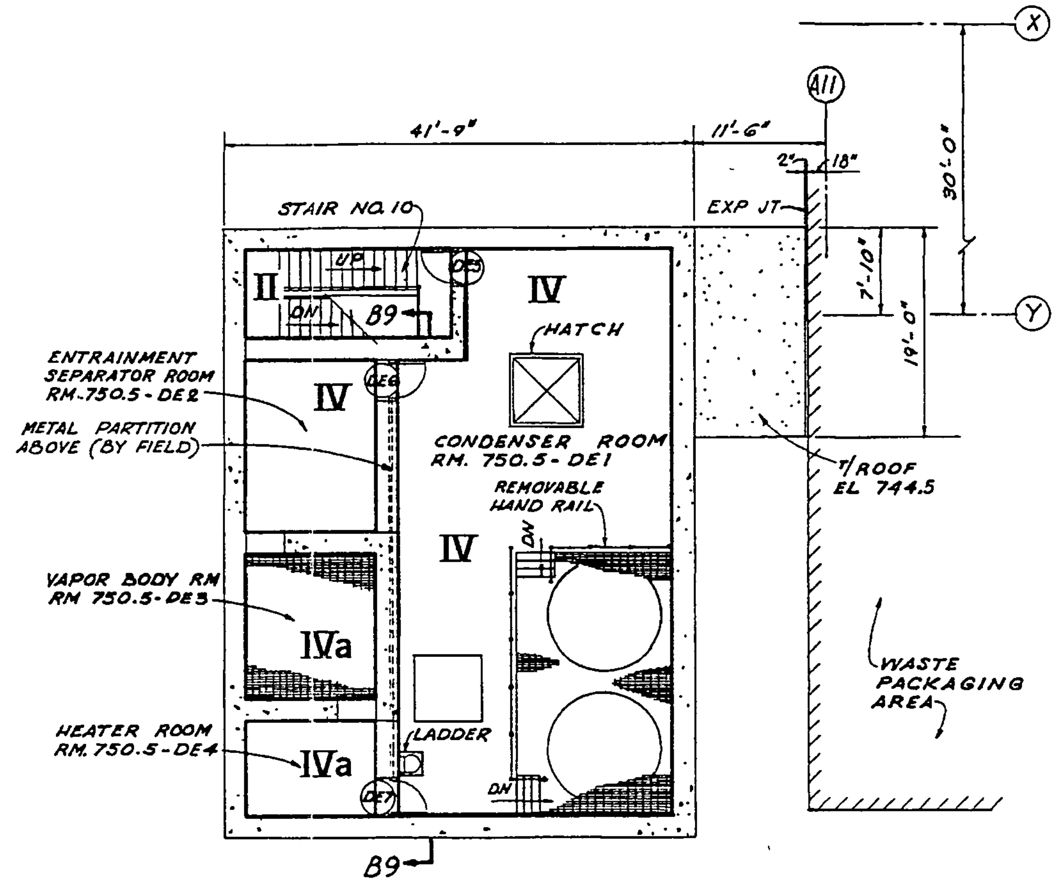
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
PLAN-EL 737.0 & EL 729.0
RADIATION ZONE MAP
FSAR FIG 12.3-6

9208280146-06



PLAN EL 730.5



PLAN EL 750.5

SI APERTURE CARD

Also Available On Aperture Card

ROOM FINISH SCHEDULE							
...ON NO	ROOM NAME	FLOOR	BASE	WALLS	SUSPD CLG FINISH	SUSPD CLG ELEV	REMARKS
...5-DE1	INSTRUMENT AREA	CONC	—	CONC	—	—	
...5-DE2	DISTILLATE TANK	CONC	—	CONC	—	—	
...5-DE3	BOTTOM TANK RM	CONC	—	CONC	—	—	
...5-DE4	BOTTOM PUMP RM	CONC	—	CONC	—	—	
...5-DE5	RECIRCN PUMP RM	CONC	—	CONC	—	—	
...5-DE6	HEATER ROOM	CONC	—	CONC	—	—	
...0-DE7	ACCESS TUNNEL	CONC	—	CONC	—	—	
	STAIR NO. 10	CONC	—	CONC	—	—	
...5-DE1	CONDENSER ROOM	CONC	—	CONC	—	—	
...5-DE2	ENTH SEPARATOR	CONC	—	CONC	—	—	
...5-DE3	VAPOR BODY ROOM	CONC	—	CONC	—	—	
...5-DE4	HEATER ROOM	CONC	—	CONC	—	—	

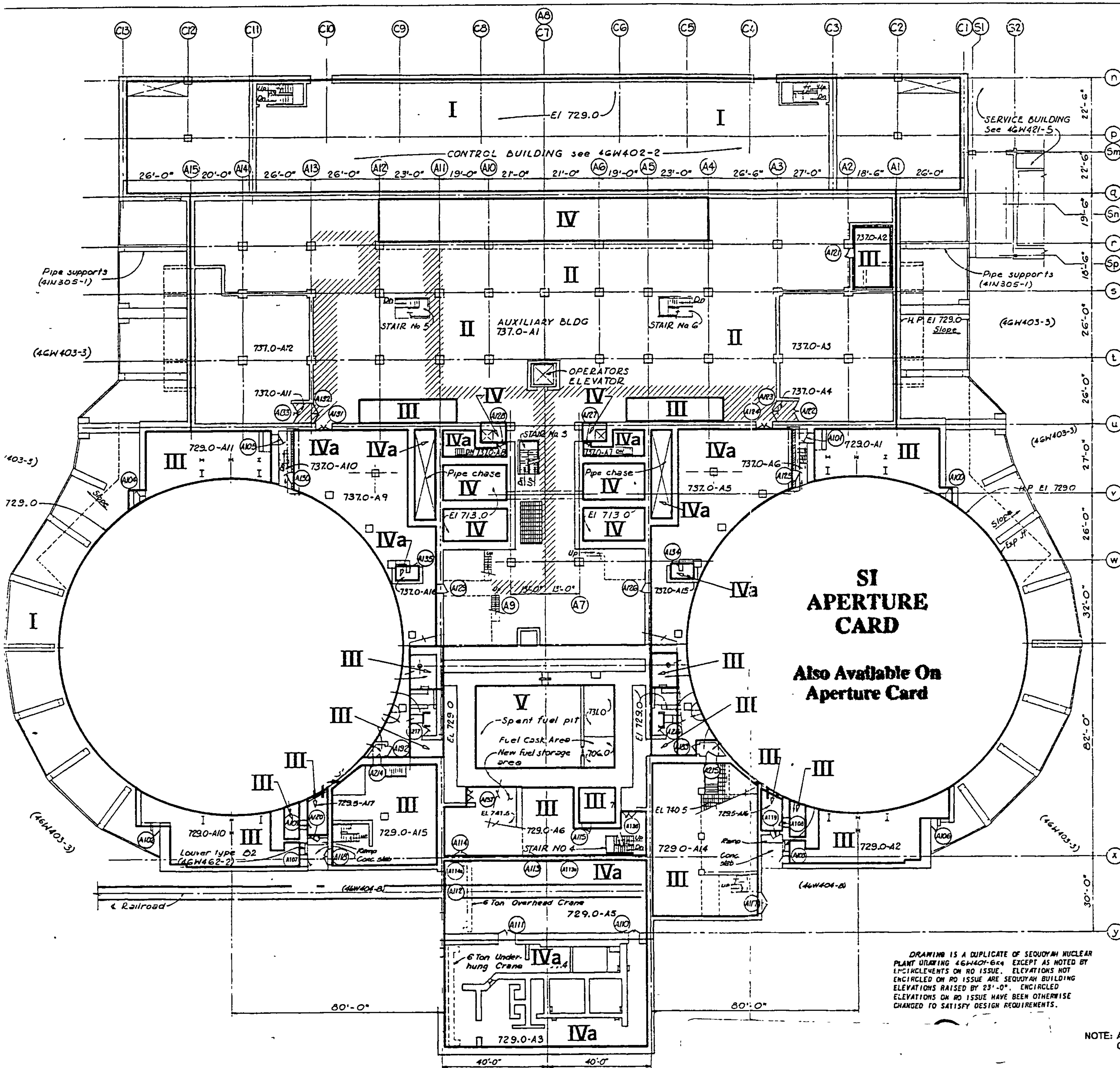
NOTE: ALL AREAS NOT LABELED ON THIS DRAWING ARE CONSIDERED TO BE RADIATION ZONE "I".

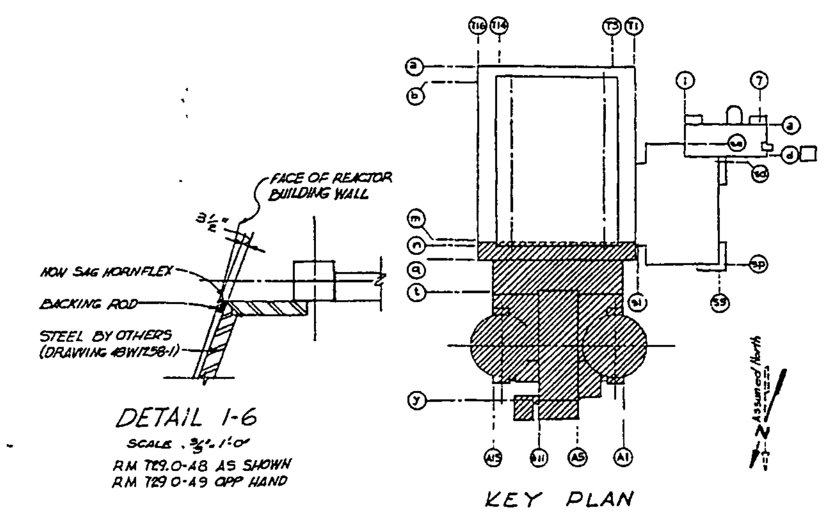
REVISED BY AMENDMENT 72

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNITS 1 & 2
RADIATION ZONE MAP
CONDENSATE DEMINERALIZER
FSAR FIG 12.3-7

9208280146-07





ROOM FINISH SCHEDULE							
ROOM No.	ROOM NAME	FLOOR	BASE	WALLS	SUSPD CLG FINISH	SUSPD CLG ELEV	REMARKS
729.0-A1	Main Steam Valve Room	Conc	——	Conc	——	——	
729.0-A2	Main Steam Valve Room	Conc	——	Conc	——	——	
729.0-A3	Waste Package Area	Conc	——	Conc	——	——	
729.0-A4	Waste Package Area	Conc	——	Conc	——	——	
729.0-A5	Cask Loading Area	Conc	——	Conc	——	——	
729.0-A6	N2 Storage Area	Conc	——	Conc	——	——	
728.0-A7	Cask Decontamination	Conc	——	Conc	——	——	
729.0-A8	Post Acc. Sample Rm	Conc	——	Conc	——	——	
729.0-A9	Post Acc. Sample Rm	Conc	——	Conc	——	——	
729.0-A10	Main Steam Valve Room	Conc	——	Conc	——	——	
729.0-A11	Main Steam Valve Room	Conc	——	Conc	——	——	
729.0-A12	Steam Valve Instr Rm A	Conc	——	Conc	——	——	
729.0-A13	Steam Valve Instr Rm B	Conc	——	Conc	——	——	
729.0-A14	UHI Equip	Conc	——	Conc	——	——	
729.0-A15	UHI Equip	Conc	——	Conc	——	——	
729.5-A16	Shield Bldg Vent Rad Mon Rm	Conc	——	Conc	——	——	
729.5-A17	Shield Bldg Vent Rad Mon Rm	Conc	——	Conc	——	——	
737.0-A1	Auxiliary Building	Conc	——	Conc	——	——	
737.0-A2	Hot Instrument Shop	Res Tile	Fac Tile	Fac Tile	*See note below		4GW452-5
737.0-A3	Htg & Vent	Conc	——	Conc	——	——	
737.0-A4	Air Lock	Conc	——	Conc	——	——	
737.0-A5	Ventilation & Purge Air	Conc	——	Conc	——	——	
737.0-A6	Air Lock	Conc	——	Conc & conc blk	——	——	4GW405-4
737.0-A7	Let Down Heat Exch	Conc	——	Conc	——	——	
737.0-A8	Let Down Heat Exch	Conc	——	Conc	——	——	
737.0-A9	Ventilation & Purge Air	Conc	——	Conc	——	——	
737.0-A10	Air Lock	Conc	——	Conc & conc blk	——	——	4GW405-4
737.0-A11	Air Lock	Conc	——	Conc	——	——	
737.0-A12	Heating & Vent	Conc	——	Conc	——	——	
737.0-A13	Air Lock	Conc	——	Conc	——	——	
737.0-A14	Air Lock	Conc	——	Conc	——	——	
737.0-A15	G F Fuel Detector Rm	Conc	——	Conc	——	——	
737.0-A16	G F Fuel Detector Rm	Conc	——	Conc	——	——	

* Ceiling in Hot Instrument Shop to have sand finish plaster and metal lath on concrete ceiling.

NOTES:
1. Symbol ▭ indicates removable blocks by Civil Branch
2. For concrete block walls reinforced for earthquake loading see 4GW405-4
3. Symbol ~~~~ indicates chain barrier, furnished and installed by Field

COMPANION DRAWINGS
4GW403-3, 4GW404-8.

Scale: 1/8" = 1'-0"

DRAWING IS A DUPLICATE OF SEQUOYAH NUCLEAR PLANT DRAWING 46W401-6R4 EXCEPT AS NOTED BY ENCIRCLEMENTS ON RO ISSUE. ELEVATIONS NOT ENCIRCLED ON RO ISSUE ARE SEQUOYAH BUILDING ELEVATIONS RAISED BY 23'-0". ENCIRCLED ELEVATIONS ON RO ISSUE HAVE BEEN OTHERWISE CHANGED TO SATISFY DESIGN REQUIREMENTS.

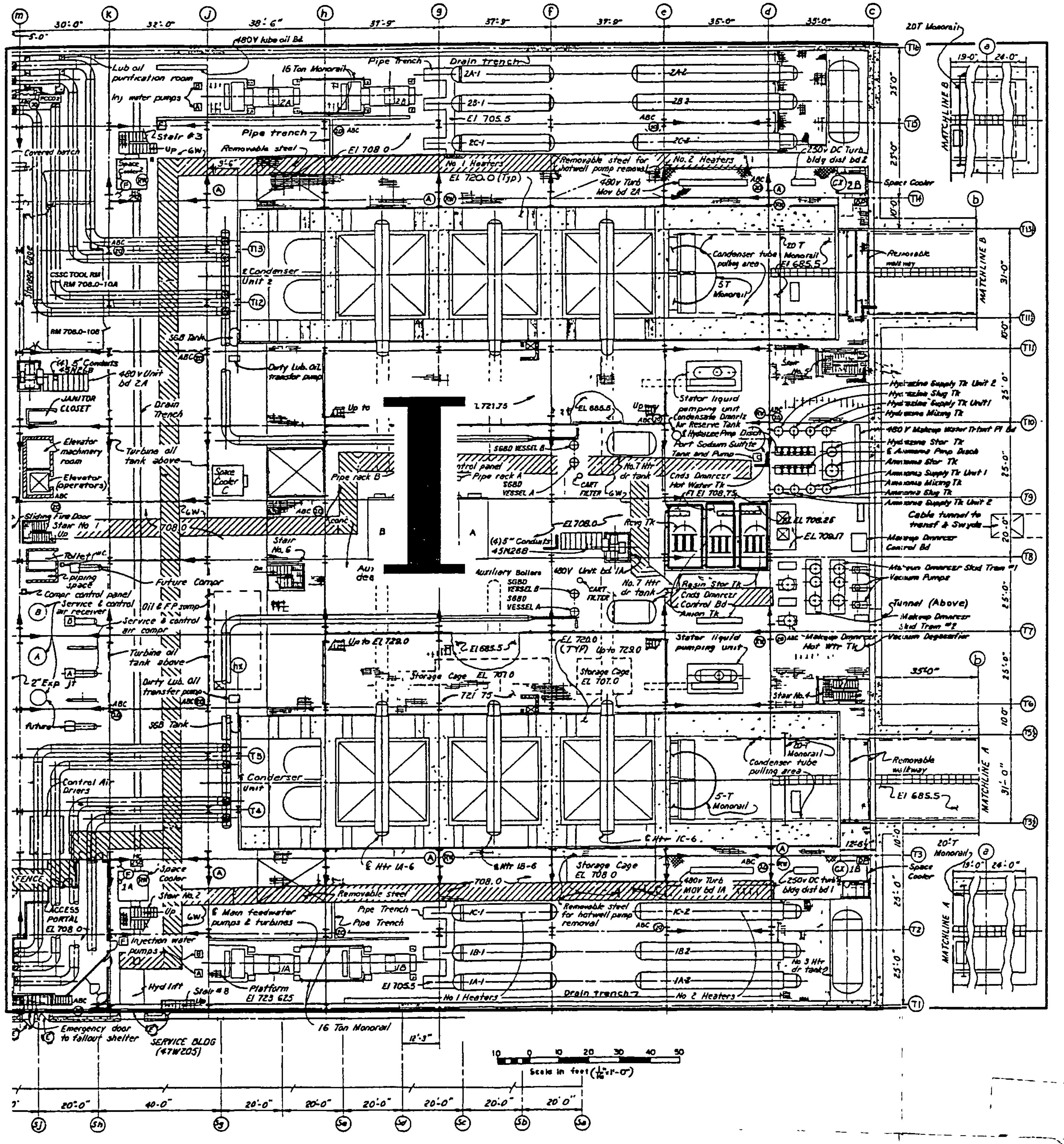
NOTE: ALL AREAS NOT LABELED ON THIS DRAWING ARE CONSIDERED TO BE RADIATION ZONE "I".

REVISED BY AMENDMENT 72

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
AUXILIARY, REACTOR & CONTROL BUILDINGS
RADIATION ZONE MAP
PLAN-EL 729.0 & 737.0
FSAR FIG 12.3-8

9208280146-08



NOTE: ALL AREAS NOT LABELED ON THIS DRAWING ARE CONSIDERED TO BE RADIATION ZONE "I".

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WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
PLAN-EL 713.0 & EL 708.0
FSAR FIG 12.3-9

9208280146-09

COMPUTER GRAPHICS FILE NO.
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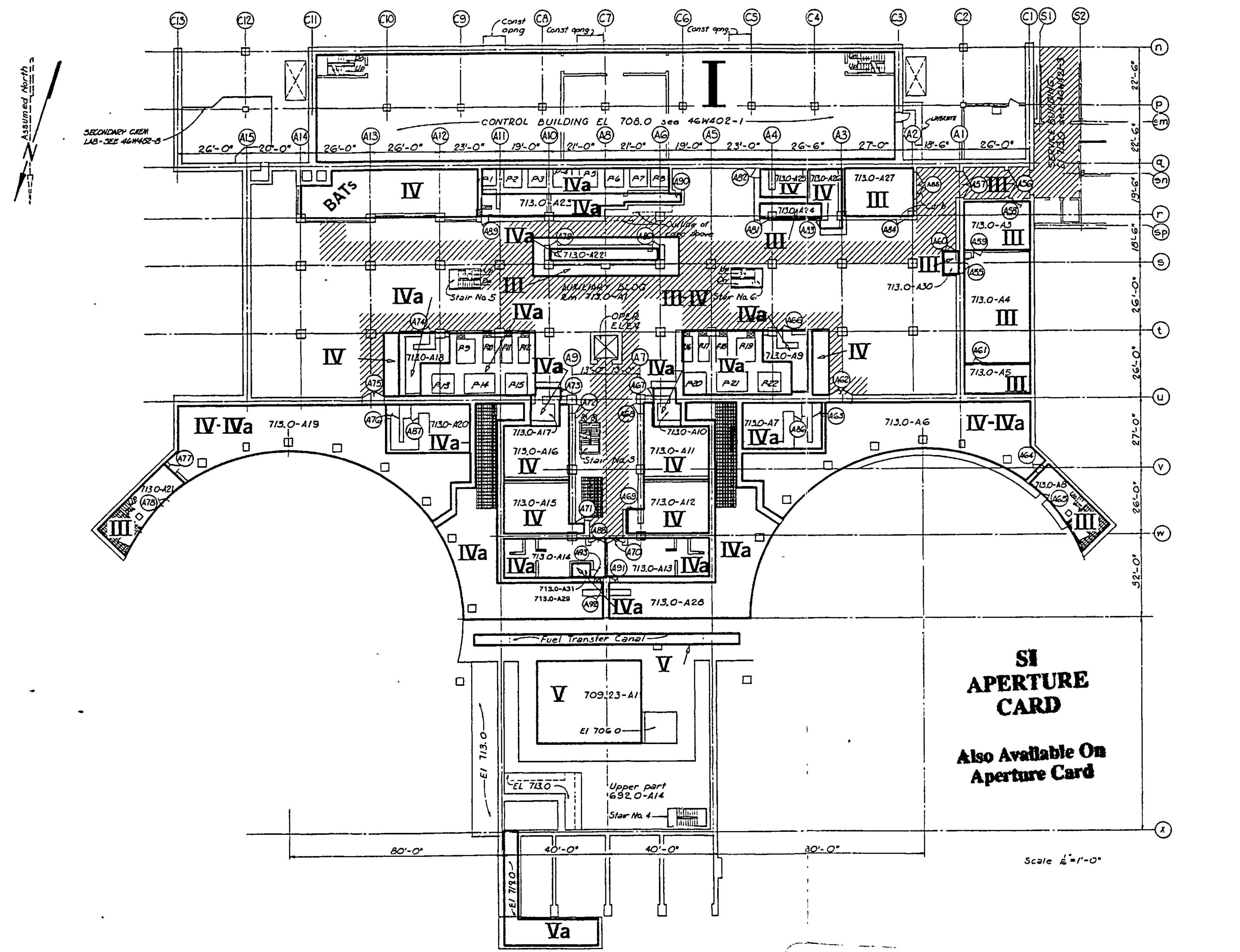
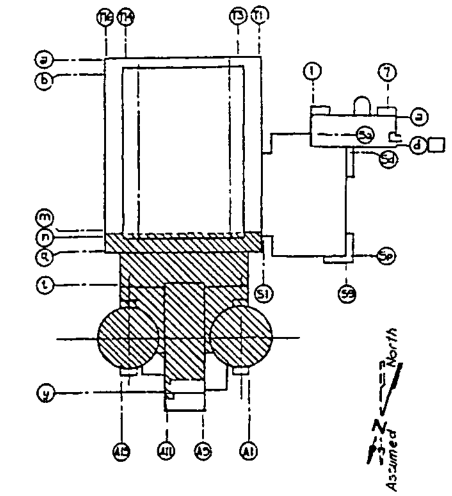
VECTOR: FSAR_FIG_12.3-10_R1



PIT FIN. SCHEDULE		
RM. NO.	FLOOR	WALLS
P-1	CONC.	CONC.
P-2	CONC.	CONC.
P-3	CONC.	CONC.
P-4	CONC.	CONC.
P-5	CONC.	CONC.
P-6	CONC.	CONC.
P-7	CONC.	CONC.
P-8	CONC.	CONC.
P-9	CONC.	CONC.
P-10	CONC.	CONC.
P-11	CONC.	CONC.
P-12	CONC.	CONC.
P-13	CONC.	CONC.
P-14	CONC.	CONC.
P-15	CONC.	CONC.
P-16	CONC.	CONC.
P-17	CONC.	CONC.
P-18	CONC.	CONC.
P-19	CONC.	CONC.
P-20	CONC.	CONC.
P-21	CONC.	CONC.
P-22	CONC.	CONC.



KEY PLAN

ROOM FINISH SCHEDULE

ROOM NO	ROOM NAME	FLOOR	BASE	WALLS	SUSPD CLG FINISH	SUSPD CLG ELEV	REMARKS
709.23-A1	Spent Fuel Pit	Conc	—	Conc	—	—	
713.0-A1	Auxiliary Building	Conc	—	Conc	—	—	
713.0-A2	Air Lock	Conc	—	Conc	—	—	
713.0-A3	Titration Room	Res tile	Vinyl tile	Conc	S.F plas	722'-0"	46W452-3
713.0-A4	Radiochemical Lab	Res tile	Vinyl tile	Conc	S.F plas	721'-0" & 722'-0"	46W452-3
713.0-A5	Counting Room	Res tile	Vinyl tile	Conc	S.F plas	721'-0"	46W452-3
713.0-A6	Pipe Gallery	Conc	—	Conc	—	—	
713.0-A7	Vol Control Tank Room	Conc	—	Conc	—	—	
713.0-A8	Reactor Bldg Access Rm.	Conc	—	Conc	—	—	
713.0-A9	Valve Gallery	Conc	—	Conc	—	—	
713.0-A10	Seal Water Heat Exchgr 1A	Conc	—	Conc	—	—	
713.0-A11	Heat Exchangers 1B	Conc	—	Conc	—	—	
713.0-A12	Heat Exchangers 1A	Conc	—	Conc	—	—	
713.0-A13	Sample Room I	Conc	—	Conc	—	—	46W452-6
713.0-A14	Sample Room II	Conc	—	Conc	—	—	46W452-6
713.0-A15	Heat Exchangers 2A	Conc	—	Conc	—	—	
713.0-A16	Heat Exchangers 2B	Conc	—	Conc	—	—	
713.0-A17	Seal Water Heat Exchgr 2A	Conc	—	Conc	—	—	
713.0-A18	Valve Gallery	Conc	—	Conc	—	—	
713.0-A19	Pipe Gallery	Conc	—	Conc	—	—	
713.0-A20	Vol Control Tank Room	Conc	—	Conc	—	—	
713.0-A21	Reactor Bldg Access Rm	Conc	—	Conc	—	—	
713.0-A22	Valve Gallery	Conc	—	Conc	—	—	
713.0-A23	CVCS Valve Gallery	Conc	—	Conc	—	—	
713.0-A24	WGC Valve Gallery	Conc	—	Conc	—	—	
713.0-A25	Waste Gas Comp B	Conc	—	Conc	—	—	
713.0-A26	Waste Gas Comp A	Conc	—	Conc	—	—	
713.0-A27	Decontamination Rm	Conc	—	Conc	—	—	46W461-3
713.0-A28	Pipe Chase	Conc	—	Conc	—	—	
713.0-A29	Pipe Chase	Conc	—	Conc	—	—	
713.0-A30	Air Lock	Conc	—	Conc	—	—	
713.0-A31	Waste Gas Analyzer	Conc	—	Conc	—	—	

NOTES:
Symbol: indicates removable blocks by Civil Branch

NOTE: ALL AREAS NOT LABELED ON THIS DRAWING ARE CONSIDERED TO BE RADIATION ZONE 'I'.

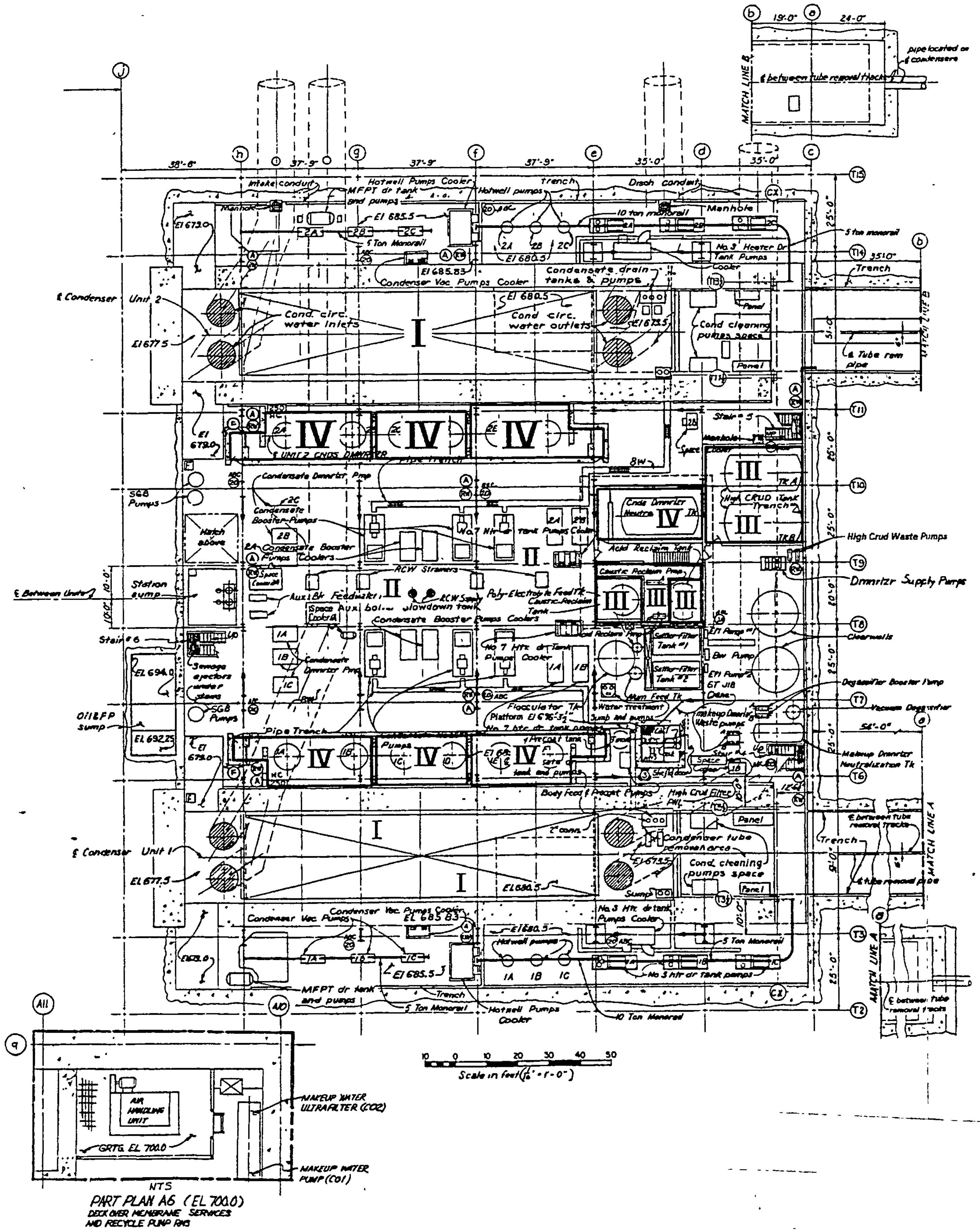
REVISED BY AMENDMENT 72

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
AUXILIARY REACTOR & CONTROL BUILDINGS
PLAN EL 708.0 & 713.0
RADIATION ZONE MAP
FSAR FIG 12.3-10

9208280146-10

COMPUTER GRAPHICS NO.
RASTER: FSAR_FIG_12.3-11_R1
VECTOR: FSAR_FIG_12.3-11_R1



SI APERTURE CARD

Also Available On Aperture Card

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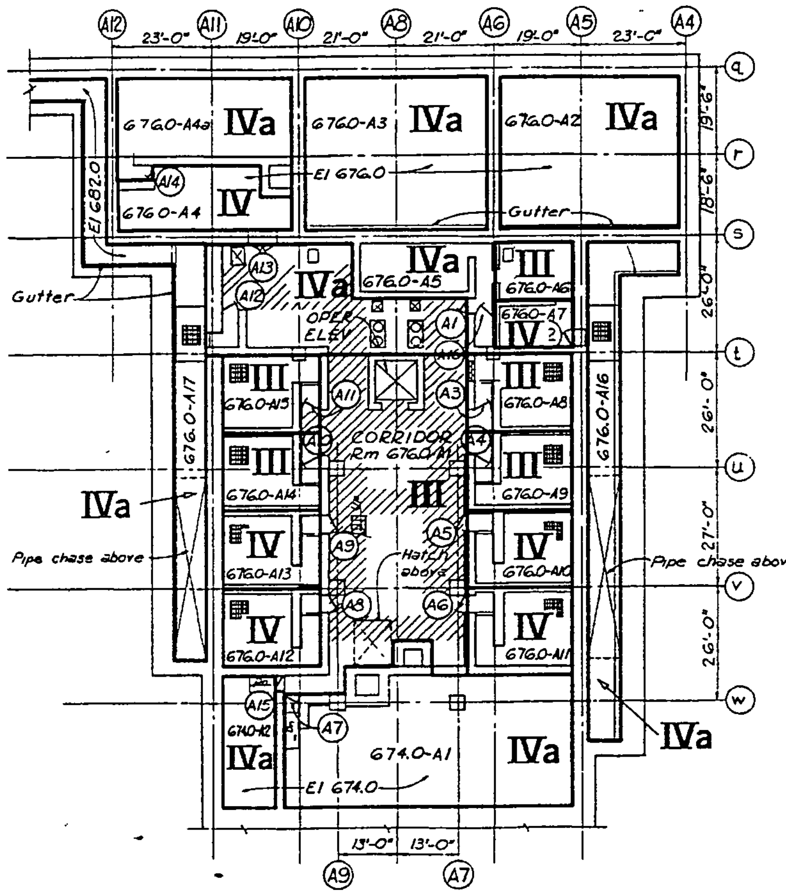
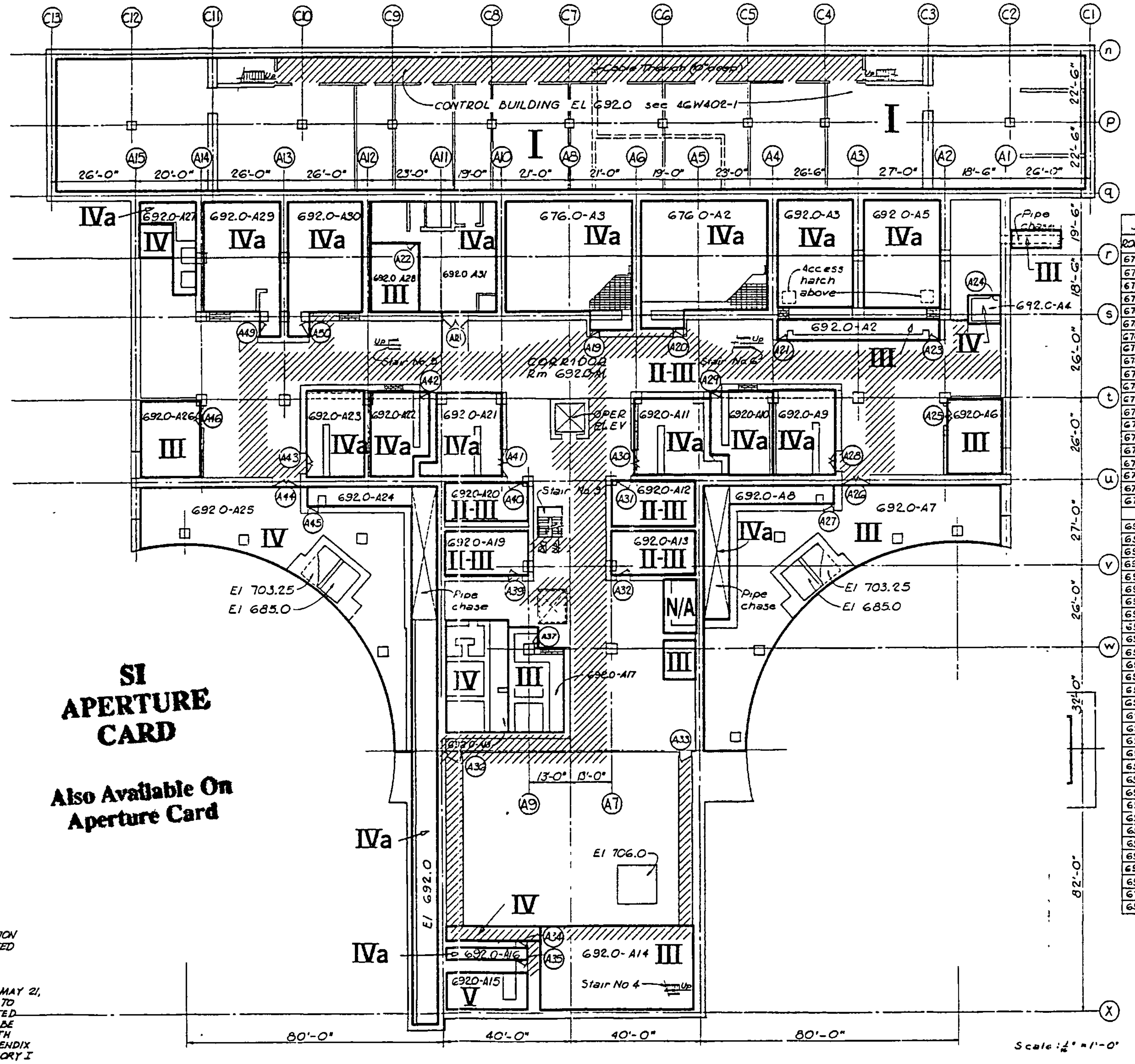
WATTS BAR FINAL SAFETY ANALYSIS REPORT
POWERHOUSE UNITS 1 & 2 PLAN - EL 685.5 FSAR FIG 12.3-11

9208280146-11



PLAN EL 676.0

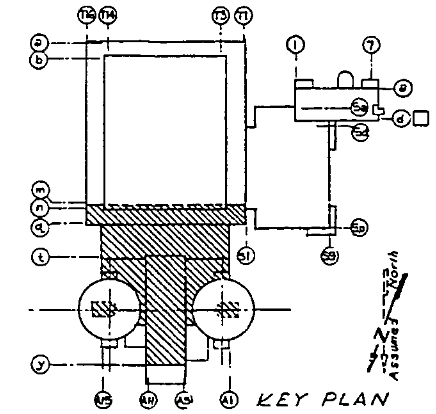


PLAN EL 692.0

SI APERTURE CARD

Also Available On Aperture Card

NOTES:
1. Symbol [symbol] indicates removable blocks by Civil Branch
2. Symbol [symbol] indicates chain barrier furnished and installed by Field
3. MASONRY WALLS & CEILINGS DESIGNATED AS QA(L) ON DRAWINGS FALL UNDER LIMITED FIRE PROTECTION PROGRAM. ALL CONSTRUCTION ACTIVITIES ASSOCIATED WITH THE ABOVE SHALL CONFORM TO 6-73 SPECIFICATIONS.
4. CONSTRUCTION SPECIFICATION G 21, RO, DATED MAY 21, 1957, APPLIES TO MASONRY INSTALLED PRIOR TO APRIL 20, 1983. ALL MASONRY WORK DESIGNATED AS QA(L) INSTALLED AFTER THIS DATE SHALL BE TESTED AND INSPECTED IN ACCORDANCE WITH CONSTRUCTION SPECIFICATION G 21, RO, APPENDIX A, "MASONRY WALLS LOCATED WITHIN CATEGORY I OR SAFETY RELATED STRUCTURES."



ROOM FINISH SCHEDULE

ROOM NO.	ROOM NAME	FLOOR	BASE	WALLS	SUSPD CLG FINISH	SUSPD CLG ELEV	REMARKS
674.0-A1	Waste Hold Up Tank	Conc	—	Conc	—	—	
674.0-A2	Waste Evap Feed Pump	Conc	—	Conc	—	—	
676.0-A1	Corridor	Conc	—	Conc	—	—	
676.0-A2	Hold-Up Tank Rm A	Conc	—	Conc	—	—	
676.0-A3	Hold-Up Tank Rm B	Conc	—	Conc	—	—	
676.0-A4	Floor Drain Coll Pump & Filter Rm	Conc	—	Conc	—	—	
676.0-A4a	Floor Drain Coll Tank Rm	Conc	—	Conc	—	—	
675.0-A5	Gas Stripper Feed Pump	Conc	—	Conc	—	—	
676.0-A6	Spare	Conc	—	Conc	—	—	
676.0-A7	Spare	Conc	—	Conc	—	—	
676.0-A8	Containment Spray Pump 1B-B	Conc	—	Conc	—	—	
676.0-A9	Containment Spray Pump 1A-A	Conc	—	Conc	—	—	
676.0-A10	RHR Pump Rm 1B-B	Conc	—	Conc	—	—	
676.0-A11	RHR Pump Rm 1A-A	Conc	—	Conc	—	—	
676.0-A12	RHR Pump Rm 2A-A	Conc	—	Conc	—	—	
676.0-A13	RHR Pump Rm 2B-B	Conc	—	Conc	—	—	
676.0-A14	Containment Spray Pump 2A-A	Conc	—	Conc	—	—	
676.0-A15	Containment Spray Pump 2B-B	Conc	—	Conc	—	—	
676.0-A16	Pipe Gallery	Conc	—	Conc	—	—	
676.0-A17	Pipe Gallery	Conc	—	Conc	—	—	
692.0-A1	Corridor	Conc	—	Conc	—	—	
692.0-A2	Valve Gallery	Conc	—	Conc	—	—	
692.0-A3	Gas Decay Tank Rm	Conc	—	Conc	—	—	
692.0-A4	Chemical Drain Tank Rm	Conc	—	Conc	—	—	
692.0-A5	Gas Decay Tank Rm	Conc	—	Conc	—	—	
692.0-A6	Aux Feedwater Pump 1A S	Conc	—	Conc	—	—	
692.0-A7	Pipe Gallery	Conc	—	Conc	—	—	
692.0-A8	Pipe Gallery & Chase	Conc	—	Conc	—	—	
692.0-A9	Charging Pump 1A-A	Conc	—	Conc	—	—	
692.0-A10	Charging Pump 1B-B	Conc	—	Conc	—	—	
692.0-A11	Charging Pump 1C	Conc	—	Conc	—	—	
692.0-A12	Safety Injection Pump 1B-B	Conc	—	Conc	—	—	
692.0-A13	Safety Injection Pump 1A-A	Conc	—	Conc	—	—	
692.0-A14	Cask Decontn Coll Tk Rm	Conc	—	Conc	—	—	
692.0-A15	Spent Resin Tank Rm	Conc	—	Conc	—	—	
692.0-A16	Valve Gallery	Conc	—	Conc	—	—	
692.0-A17	Hyperfiltration Demin Rm	Conc	—	Conc	—	—	
692.0-A18	CRT Storage Rm	Conc	—	Conc	—	—	
692.0-A19	Safety Injection Pump 2A-A	Conc	—	Conc	—	—	
692.0-A20	Safety Injection Pump 2B-B	Conc	—	Conc	—	—	
692.0-A21	Charging Pump 2C	Conc	—	Conc	—	—	
692.0-A22	Charging Pump 2B-B	Conc	—	Conc	—	—	
692.0-A23	Charging Pump 2A-A	Conc	—	Conc	—	—	
692.0-A24	Pipe Gallery & Chase	Conc	—	Conc	—	—	
692.0-A25	Pipe Gallery	Conc	—	Conc	—	—	
692.0-A26	Aux Feedwater Pump 2A S	Conc	—	Conc	—	—	
692.0-A27	Concentrate Filter	Conc	—	Conc	—	—	
692.0-A28	Hyperfiltration Eqpt Rm B	Conc		Conc			
692.0-A29	B A Evap Package Rm B	Conc	—	Conc	—	—	
692.0-A30	B A Evap Package Rm A	Conc	—	Conc	—	—	
692.0-A31	Hyperfiltration Eqpt Rm A	Conc	—	Conc	—	—	

THIS DRAWING IS A DUPLICATE OF SEQUOYAH NUCLEAR PLANT DRAWING 46W401-4R3 EXCEPT AS NOTED BY ENCIRCLEMENTS ON RO ISSUE. ELEVATIONS NOT ENCIRCLED ON RO ISSUE ARE SEQUOYAH BUILDING ELEVATIONS RAISED BY 23'-0". ENCIRCLED ELEVATIONS ON RO ISSUE HAVE BEEN OTHERWISE CHANGED TO SATISFY DESIGN REQUIREMENTS

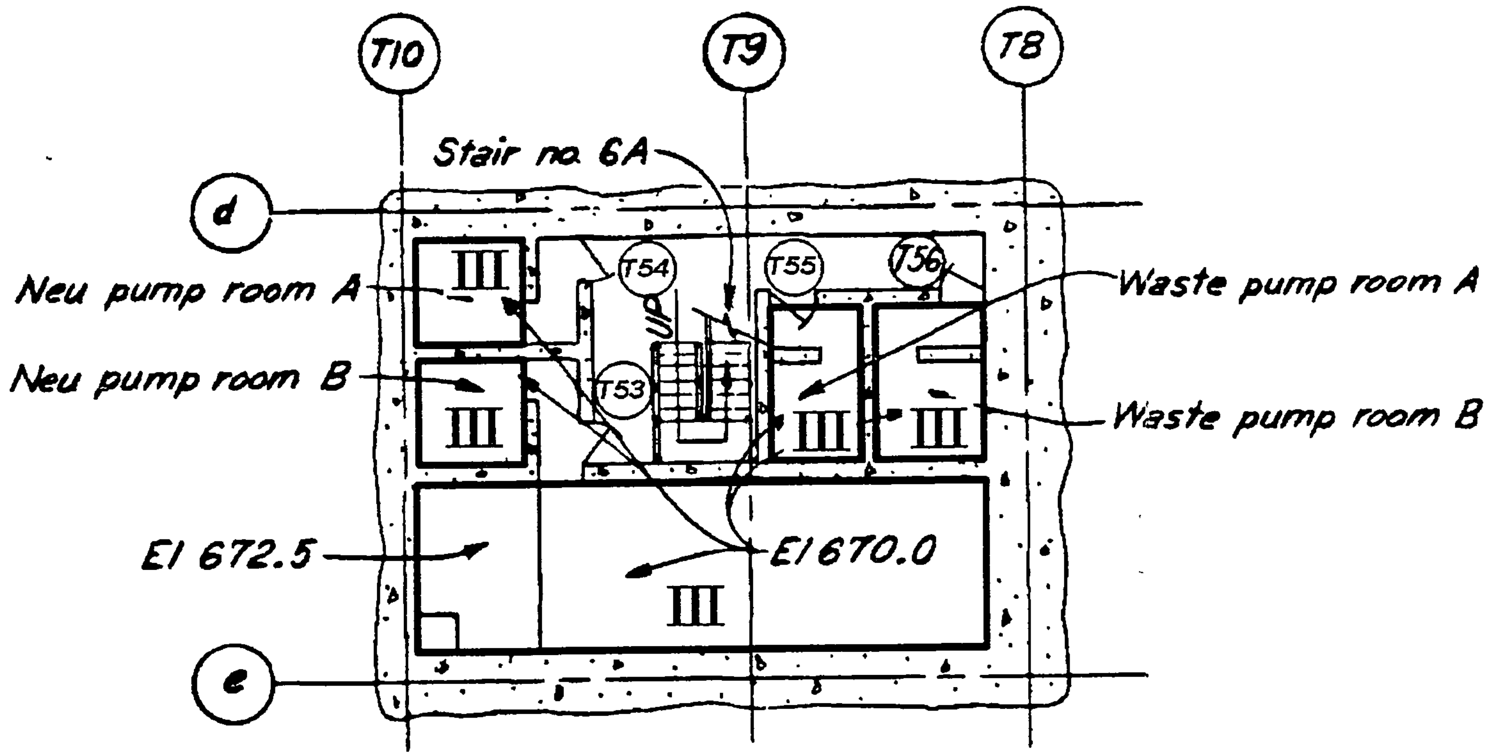
NOTE: ALL AREAS NOT LABELED ON THIS DRAWING ARE CONSIDERED TO BE RADIATION ZONE "I".

REVISED BY AMENDMENT 72

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
AUXILIARY REACTOR & CONTROL BUILDINGS
PLAN EL 676.0 & 692.0
RADIATION ZONE MAP
FSAR FIG 12.3-12

9208280146-12



PLAN EL 670.0
Not to scale

NOTE: ALL AREAS NOT LABELED ON THIS DRAWING ARE CONSIDERED TO BE RADIATION ZONE "I".

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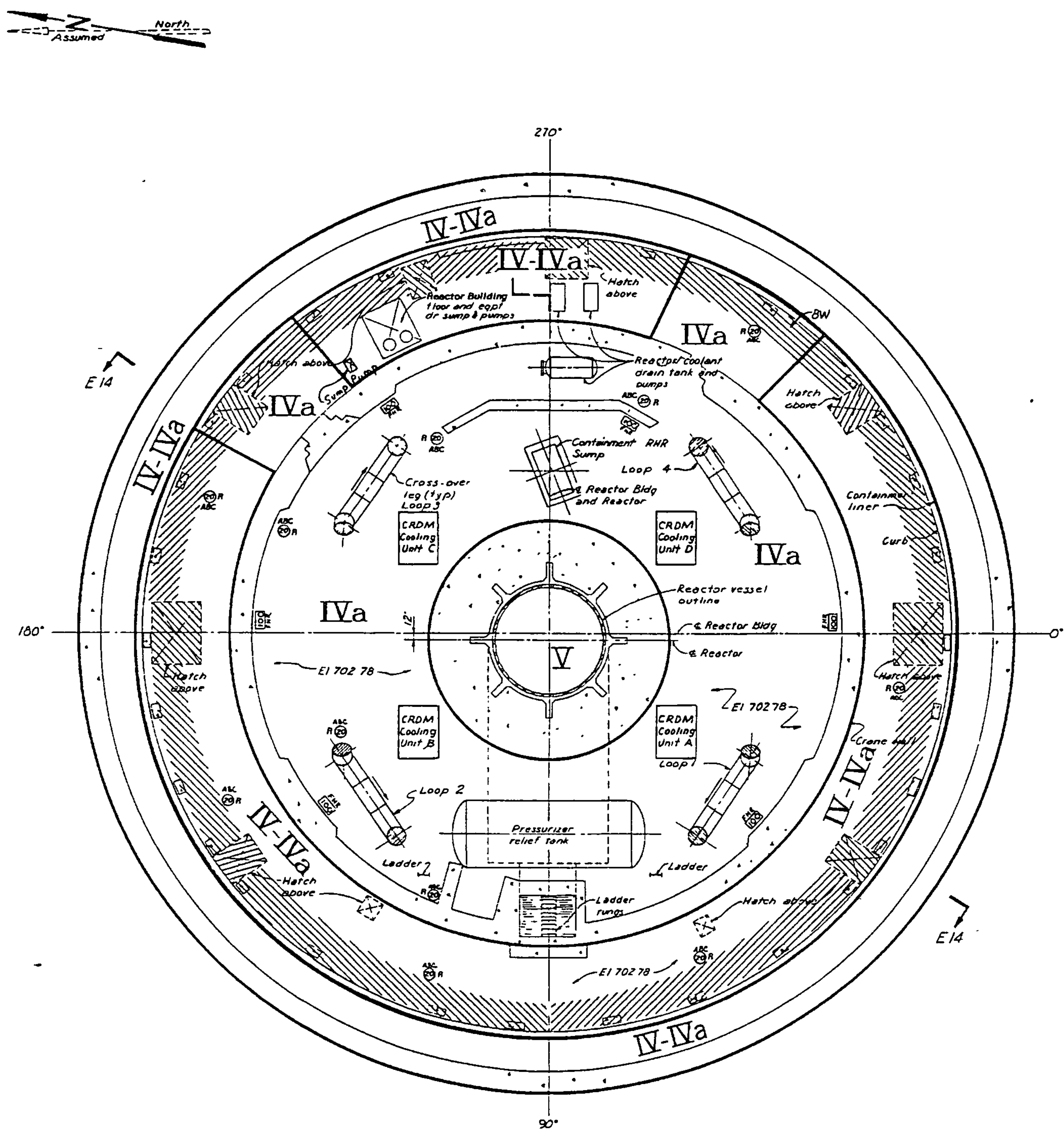
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
TURBINE BUILDING
PLAN EL 670.0
RADIATION ZONE MAP
FSAR FIG 12.3-13



PLAN - El 702.78 & ABOVE

SI APERTURE CARD

Also Available On Aperture Card

NOTE: ALL AREAS NOT LABELED ON THIS DRAWING ARE CONSIDERED TO BE RADIATION ZONE "I".

Scale in feet (⅛"=1'-0")

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WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

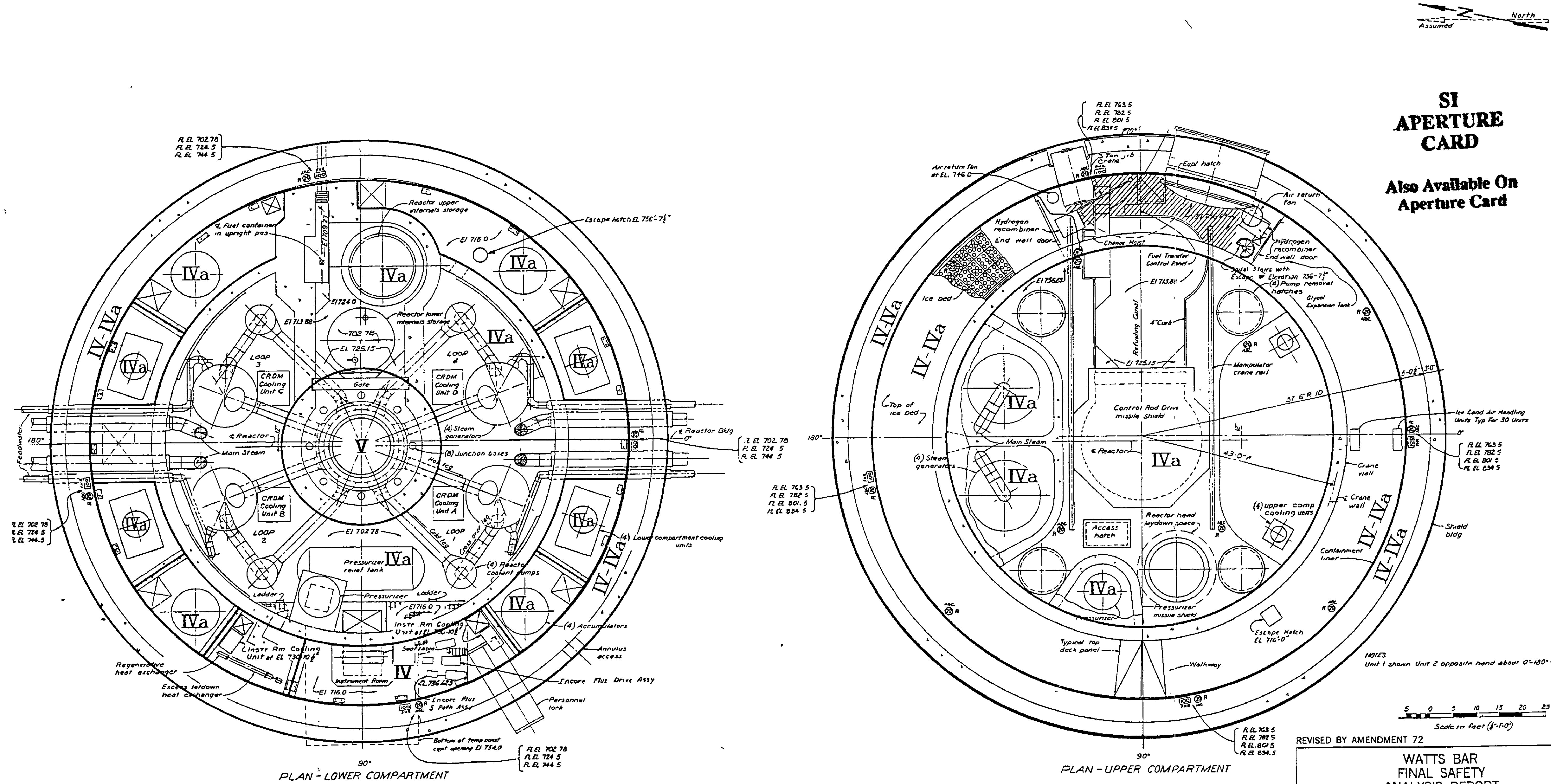
POWERHOUSE
UNITS 1 & 2
REACTOR BUILDING
RADIATION ZONE MAP
FSAR FIG 12.3-14

9208280146-14

COMPUTER GRAPHICS NO
RASTER: FSAR_FIG_12.3-15_R1
VECTOR: FSAR_FIG_12.3-15_R1

SI APERTURE CARD

Also Available On Aperture Card



NOTE: ALL AREAS NOT LABELED ON THIS DRAWING ARE CONSIDERED TO BE RADIATION ZONE "I".

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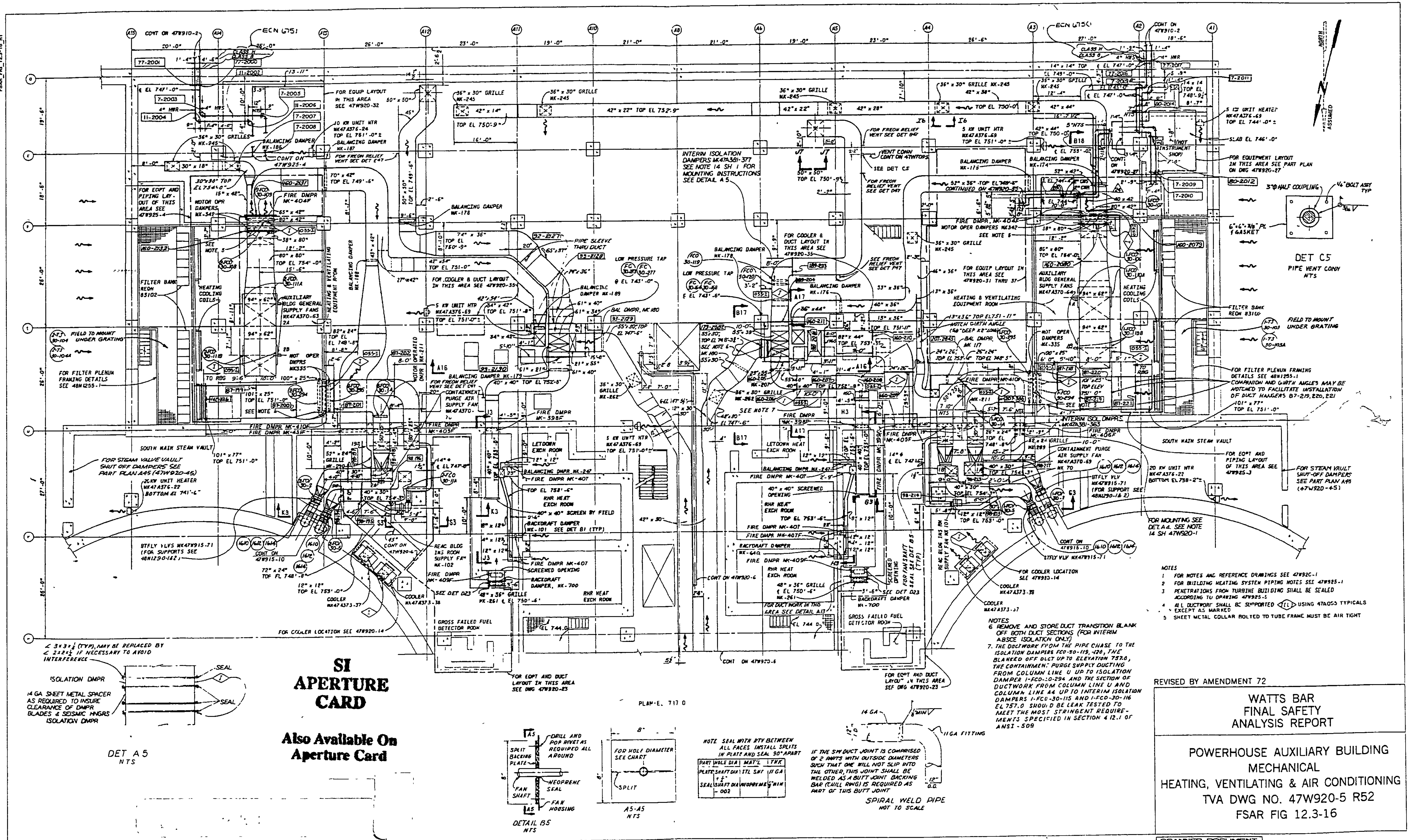
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
REACTOR BUILDING
RADIATION ZONE MAP
FSAR FIG 12.3-15

9208280146-15



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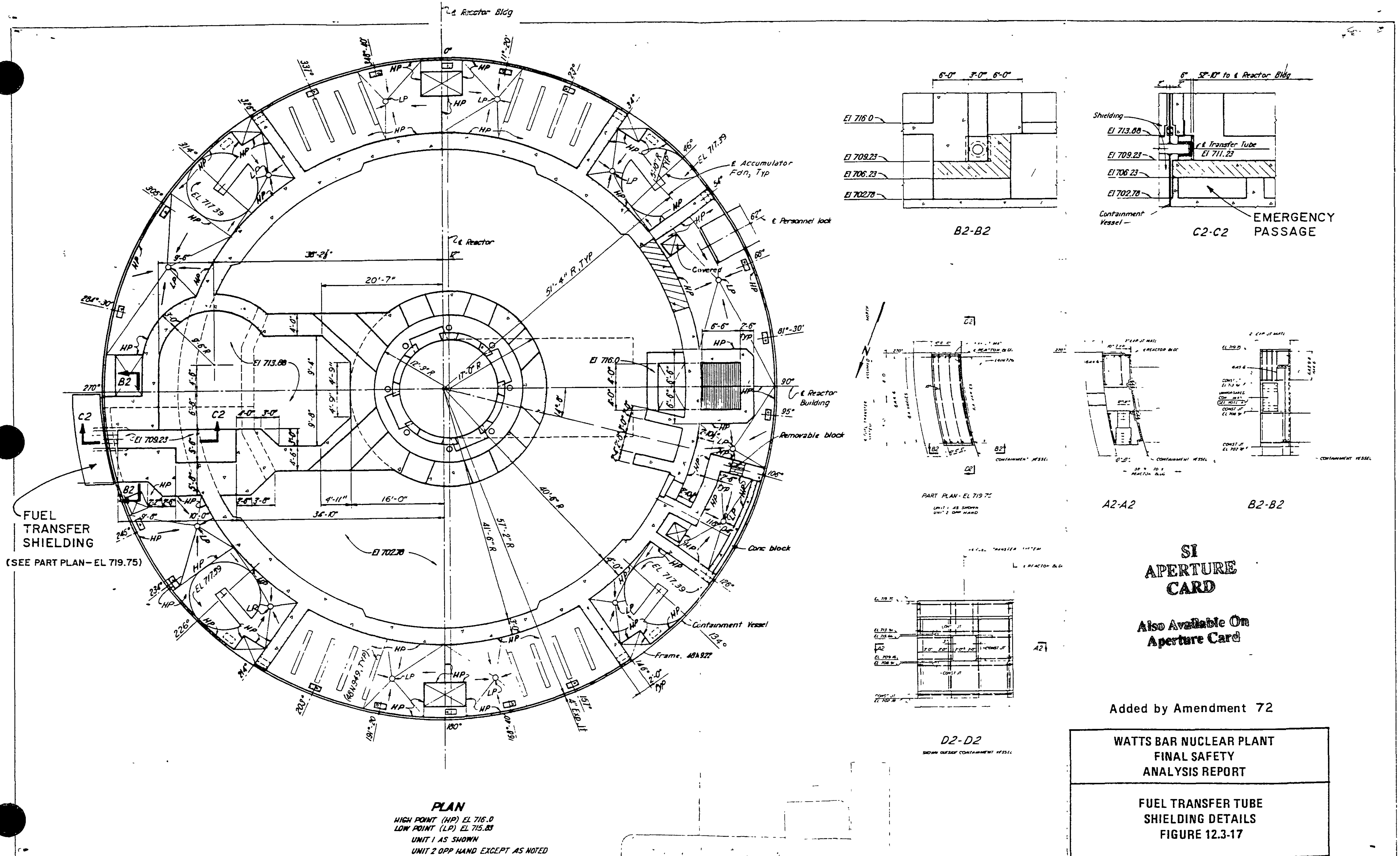

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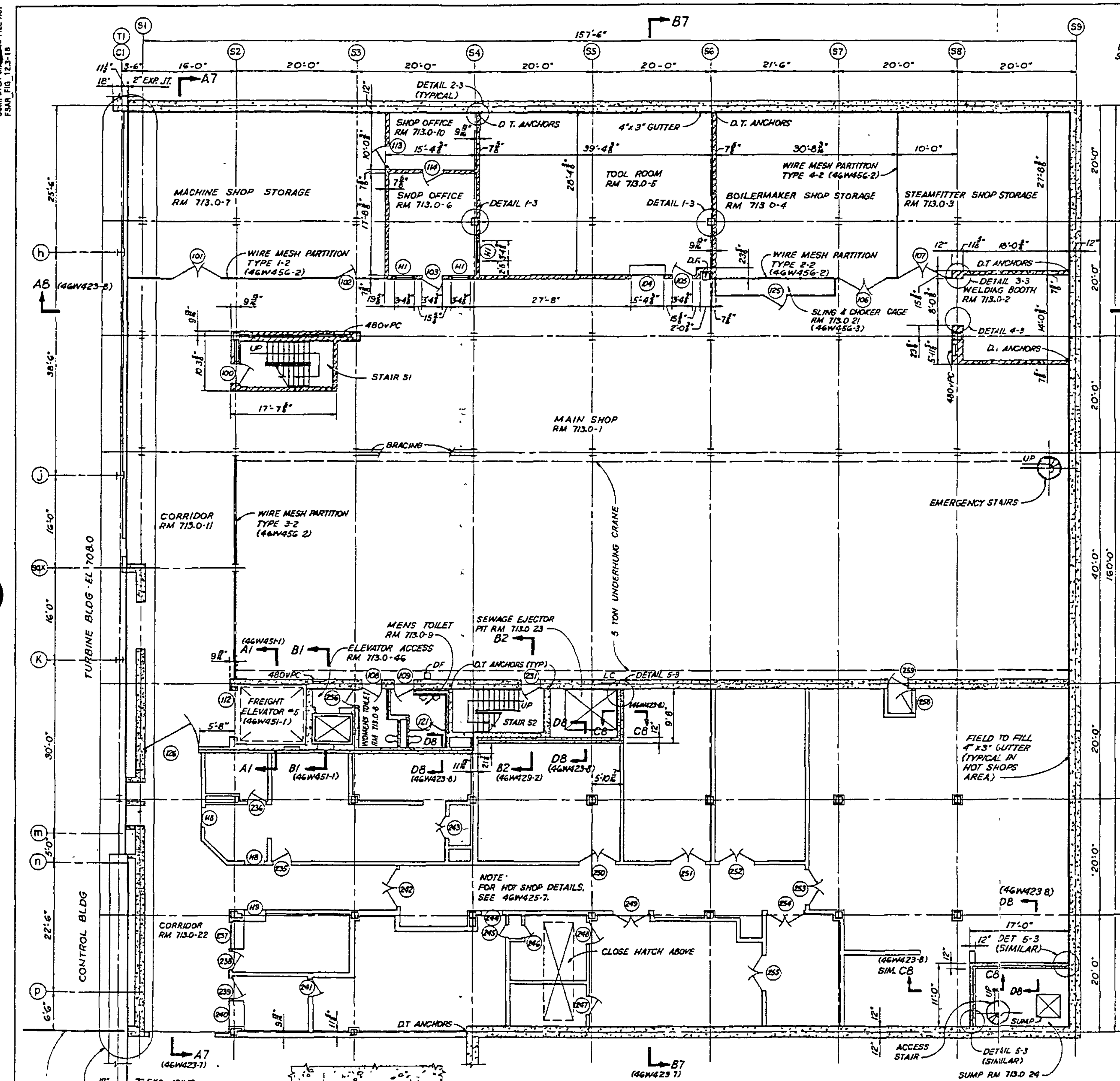
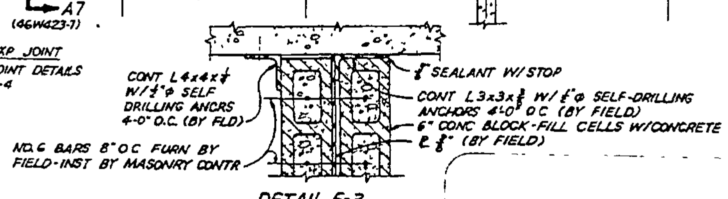
Added by Amendment 72

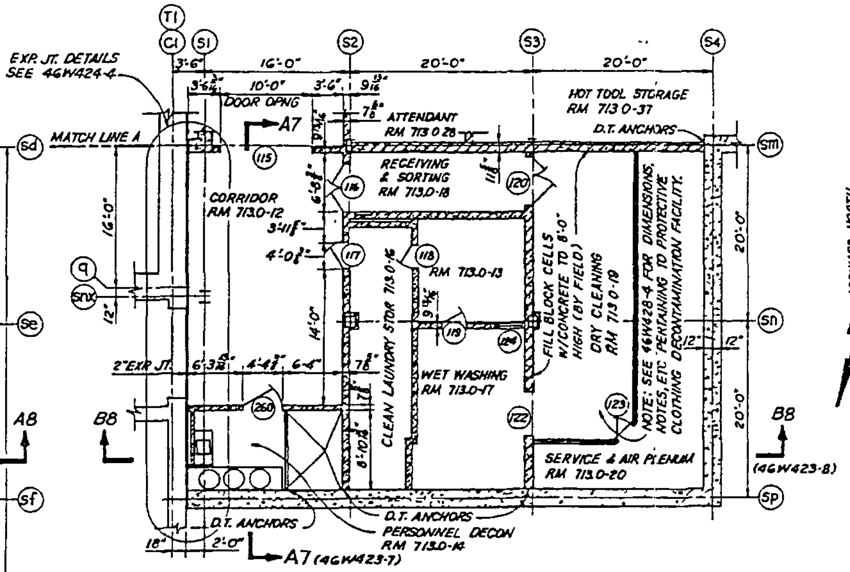
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

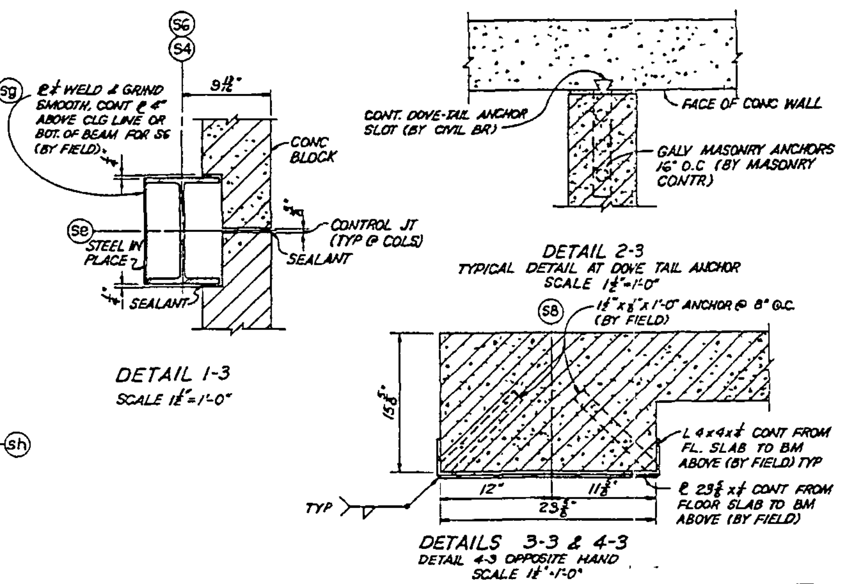
FUEL TRANSFER TUBE
SHIELDING DETAILS
FIGURE 12.3-17

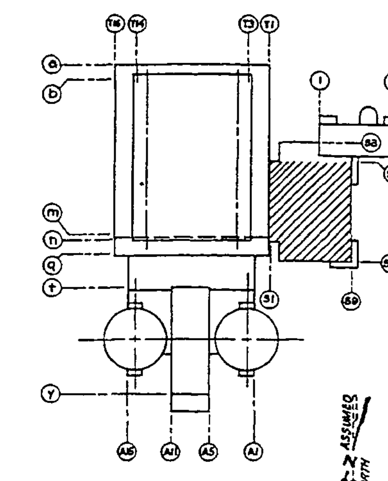




THIS DRAWING IS A DUPLICATE OF SEQUOYAH NUCLEAR PLANT DRAWING 46W421-3 R3 EXCEPT AS NOTED BY ENCIRCLEMENTS ON RO ISSUE. ELEVATIONS NOT ENCIRCLED ON RO ISSUE ARE SEQUOYAH BUILDING ELEVATIONS RAISED BY 23-0" ENCIRCLED ELEVATIONS ON RO ISSUE HAVE BEEN OTHERWISE CHANGED TO SATISFY DESIGN REQUIREMENTS







NOTES:

1. WHERE BRACING IS SHOWN BETWEEN COLUMNS AND THERE IS A DOUBLE WALL, USE MASONRY REINF. AT 16" O.C. VERTICALLY TO TIE THE TWO WALLS TOGETHER. SEE 46W423 SERIES.
2. MASONRY PARTITIONS ARE TO EXTEND TO BOTTOM OF DECKING OR BEAM ABOVE, EXCEPT IN AREA WHERE CEILING IS ON BOTH SIDES OF WALL, EXTEND PARTITION ONE COURSE ABOVE CEILING. SEE 46W423 SERIES
3. UNLESS OTHERWISE SHOWN OR NOTED. BOTTOM OF CONCRETE BLOCK MASONRY WALL UNITS ARE DIMENSIONED AS STARTING AT TOP OF FINISHED FLOOR WITH 3/8" JOINT
4. ALL INTERIOR MASONRY WALLS TO HAVE A MINIMUM 1/4" CLEARANCE AT STEEL COLUMNS AND BEAMS
5. FOR DRINKING FOUNTAIN RECESS, SEE 46W425-3.
6. FOR FLOOR SCORING IN ROOMS WITH MET. CEM., SEE 46W425-5

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ROOM FINISH SCHEDULE

ROOM NUMBER	NAME OF ROOM	FLOOR	BASE	WALLS	SUSPD CLG. FINISH	SUSPD CLG. ELEV	REMARKS
713 0-1	MAIN SHOP	MET. CEM.	—	CONC BLK & CONC	—	—	
713 0-2	WELDING BOOTH	MET CEM	—	CONC BLK & CONC	—	—	
713 0-3	STEAMFITTER SHOP STG	MET CEM	—	CONC BLK & CONC	—	—	
713.0-4	BOILERMAKER SHOP STG	MET CEM	—	CONC BLK & CONC	—	—	
713.0-5	TOOL ROOM	MET CEM	—	CONC BLK & CONC	—	—	
713.0-6	SHOP OFFICE	RES. TILE	VINYL	CONC. BLK	S.F. PLASTER	EL 721.0'	SEE 46W434-2
713.0 7	MACHINE SHOP STORAGE	MET CEM	—	CONC BLK & CONC	—	—	
713 0-8	WOMENS TOILET	CER TILE	CER TILE	CER TILE	CEM.PLAS	EL 721 0'	SEE 46W428 2
713.0-9	MENS TOILET	CER TILE	CER TILE FACE TILE	CER TILE FACE TILE	CEM PLAS	EL 721.0'	SEE 46W428-2
713 0-10	SHOP OFFICE	RES. TILE	VINYL	CONC BLK	S.F. PLAS	EL.721 0'	SEE 46W434 2
713 0-11	CORRIDOR	MET CEM	—	CONC BLK & CONC	—	—	
713.0 12	CORRIDOR	MET CEM	—	CONC BLK & CONC	—	—	
713.0 13	FOLDING ROOM	CONC.	—	CONC. BLK	—	—	SEE 46W428-4
713 0-14	PERSONNEL DECONT	CONC.	—	CONC BLK & CONC	CEM.PLAS	EL.720 11½"	SEE 46W428-5
713.0-16	CLEAN LAUNDRY STOR	CONC	—	CONC BLK & CONC	—	—	SEE 46W428-4
713.0-17	WET WASHING	CONC	—	CONC. BLK & CONC	—	—	SEE 46W428-4
S1	STAIR	MET CEM	—	CONC BLK	—	—	SEE 46W429-1
S2	STAIR	CONC.	—	CONC BLK	—	—	SEE 46W429-2
713 0 18	RECEIVING & SORTING	CONC.	—	CONC BLK	—	—	SEE 46W428 4
713 0-19	DRY CLEANING	MET CEM	—	CONC BLK & METAL	—	—	SEE 46W428-4
713.0 20	SERVICE & AIR PLENUM	CONC.	—	CONC/METAL	—	—	SEE 46W428-4
713 0 21	SLING & CHOKER CAGE	MET CEM.	—	WIRE MESH	—	—	SEE 46W456-3
713 0-22	CORRIDOR	MET CEM	—	CONC BLK & CONC	—	—	
713.0 23	SEWAGE EJECTOR	CONC.	—	CONC BLK & CONC	—	—	
713.0 24	SUMP ROOM	CONC.	—	CONC BLK & CONC	—	—	
713-0-46	ELEVATOR ACCESS	CONC	—	CONC BLK & CONC	GYP BD	EL 722'-4"	SEE 46W451-1

COMPANION DRAWING: 46W425-7 (HOT SHOP DETAILS)

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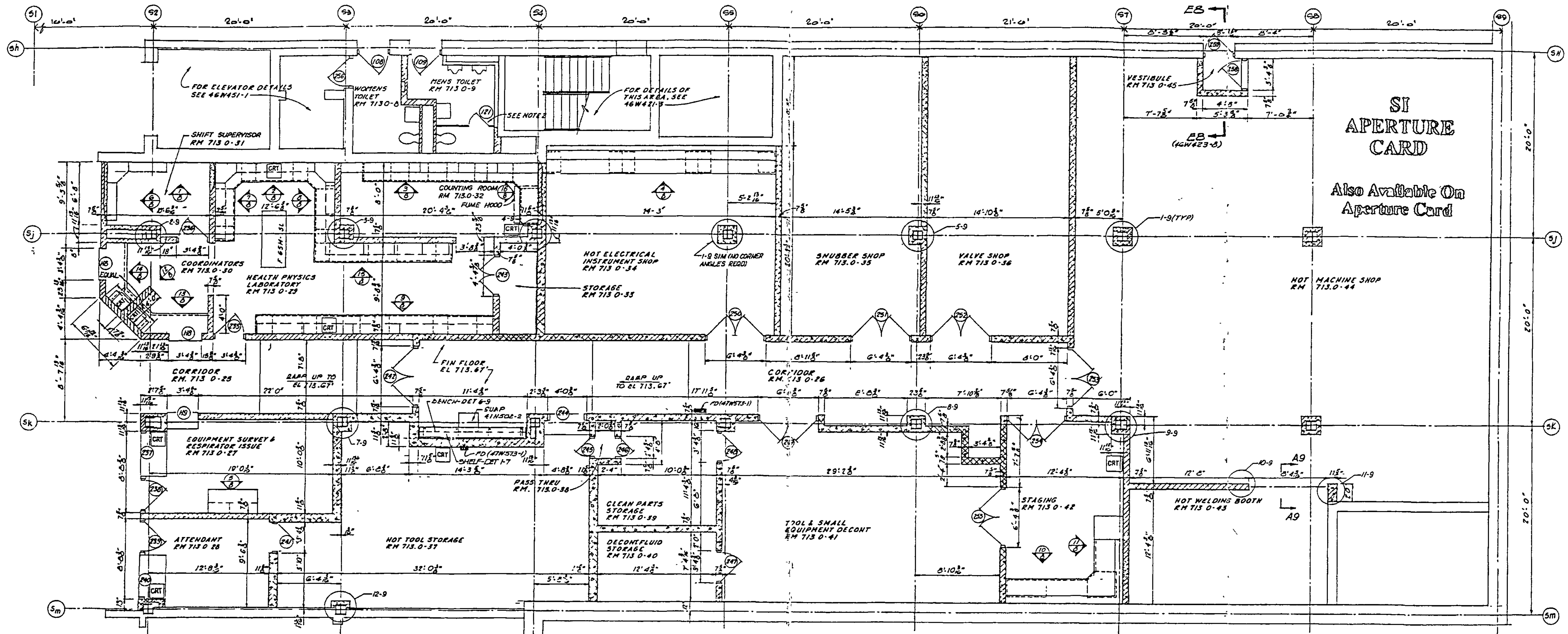
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
SERVICE BUILDING
RADIATION ZONE MAP
FSAR FIG 12.3-18

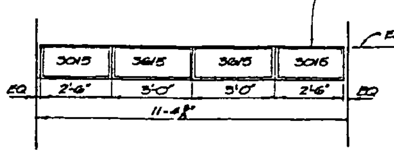
9208280146- 18



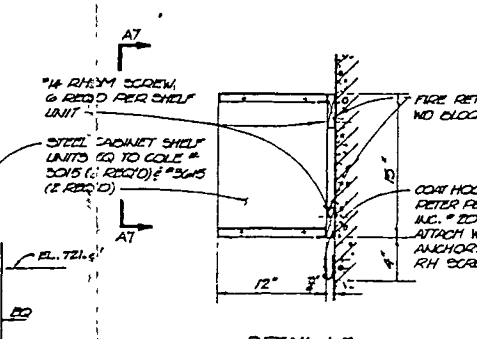
PLAN EL. 713.0'

ROOM NO	ROOM NAME	FLOOR	BASE	WALLS	CEILING MATERIAL	CEILING ELEVATION	REMARKS
713.0-25	CORRIDOR	CONC	—	CONC BLK	EXP MTL DECK	—	
713.0-26	CORRIDOR	CONC	—	CONC BLK	EXP MTL DECK	—	
713.0-27	EQPT SURV&RESPIRATOR ISSUE	CONC	—	CONC BLK	ACST TILE	722'-0"	
713.0-28	ATTENDANT	CONC	—	CONC BLK&CONC	ACST TILE	722'-0"	
713.0-29	HEALTH PHYSICS LAB	ASPH TILE	—	CONC BLK	ACST TILE	722'-0"	
713.0-30	COORDINATORS	ASPH TILE	—	CONC BLK	ACST TILE	722'-0"	
713.0-31	SHIFT SUPERVISOR	ASPH TILE	—	CONC BLK	ACST TILE	722'-0"	
713.0-32	COUNTING ROOM	ASPH TILE	—	CONC BLK	ACST TILE	722'-0"	
713.0-33	STORAGE	ASPH TILE	—	CONC BLK	ACST TILE	722-0"	
713.0-34	HOT ELEC/INSTR SHOP	CONC	—	CONC BLK	EXP MTL DECK	—	
713.0-35	SNUBBER SHOP	CONC	—	CONC BLK&CONC	EXP MTL DECK	—	
713.0-36	VALVE SHOP	CONC	—	CONC BLK&CONC	EXP MTL DECK	—	
713.0-37	HOT TOOL STORAGE	CONC	—	CONC BLK&CONC	EXP MTL DECK	—	
713.0-38	PASS THRU	CONC	—	CONC BLK	EXP MTL DECK	—	
713.0-39	CLEAN PARTS STORAGE	CONC	—	CONC BLK	EXP MTL DECK	—	
713.0-40	DECONTN FLUID STORAGE	CONC	—	CONC BLK&CONC	EXP MTL DECK	—	
713.0-41	TOOL & SMALL EQPT DECONTN	CONC	—	CONC BLK&CONC	EXP MTL DECK	—	
713.0-42	STAGING	CONC	—	CONC BLK&CONC	EXP MTL DECK	—	
713.0-43	HOT WELDING BOOTH	CONC	—	CONC BLK&CONC	EXP MTL DECK	—	
713.0-44	HOT MACHINE SHOP	CONC	—	CONC BLK&CONC	EXP MTL DECK	—	
714.0-45	VESTIBULE	CONC	—	CONC BLK&CONC	EXP MTL DECK		

NOTES:
1. FOR GENERAL NOTES, SEE 46W421-3.
2. TOILET STALL, DOOR & HARDWARE TO BE RELOCATED FROM RM 713 0-15
3. ALL FIELD LAID MASONRY SHALL BE INSTALLED IN ACCORDANCE WITH GENERAL CONSTRUCTION SPECIFICATION G-21 FOR MASONRY.



ELEVATION A7-A7
3/8"=1'-0"



DETAIL 1-7
1 1/2"=1'-0"

- EXISTING WALLS
- CONCRETE MASONRY UNITS HOLLOW UNITS - NO SHIELDING REQUIREMENTS, SEE NOTE 2, 46W421 3
- CONCRETE MASONRY UNITS SOLID UNITS TO 8'-0" ABOVE FINISH FLOOR, HOLLOW UNITS TO STEEL OR DECK ABOVE
- CONCRETE MASONRY UNITS SOLID UNITS TO STEEL OR DECK ABOVE

SCALE 1/4"=1'-0" EXCEPT AS NOTED

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WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

SERVICE BUILDING
MISCELLANEOUS DETAILS
HOT SHOP FACILITIES
RADIATION ZONE MAP
FSAR FIG 12.3-19

9208280146 - 19