RESPONSE TO NRC REQUEST FOR INFORMATION

ON CONTROL OF HEAVY LOADS

FOR

DUANE ARNOLD ENERGY CENTER

IOWA ELECTRIC LIGHT AND POWER COMPANY

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Prepared by: Bechtel Associates Professional Corporation

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CONTROL OF HEAVY LOADS AT THE DUANE ARNOLD ENERGY CENTER

I. INTRODUCTION

This report is provided in response to an NRC request for information on the control of heavy loads at the Duane Arnold Energy Center (DAEC). Specifically, this report provides the information requested in the NRC letter dated December 22, 1980, D. Eisenhut to All Licensees of Operating Plants, Enclosure 3, Section 2.1, General Requirements for Overhead Handling Systems; Section 2.2, Specification Requirements for Overhead Handling Systems Operating in the Reactor Building; and Section 2.3, Specific Requirements for Overhead Handling Systems Operating in Plant Areas Containing Equipment Required for Reactor Shutdown, Decay Heat Removal, or Spent Fuel Pool Cooling. The response to Enclosure 3, Section 2.1, previously submitted to the NRC in the report on the control of heavy loads at the DAEC dated July 20, 1981, has been revised for inclusion in this report. Changes to this response have been identified with revision bars located in the margin on each affected page. This report supersedes the previous response to the NRC on the control of heavy loads at the DAEC.

NUREG 0612, Section 5.1.1, identifies several guidelines related to the design and operation of overhead load-handling systems in nuclear power plants located near the reactor core, spent fuel pool, and equipment required for plant shutdown. A review of overhead load-handling systems installed at the DAEC has been performed to determine the extent of potentially hazardous load-handling operations at the DAEC, and the extent of compliance with specific load-handling guidelines given in NUREG 0612, Section 5.1.1. This report documents the results of this review, and how the guidelines of NUREG 0612 will be satisfied at the DAEC.

II. DEFINITIONS

The following definitions, adapted from NUREG 0612, have been used in this report.

A. HANDLING SYSTEM

All load-bearing components used to lift a load, including cranes or hoists, the lifting device, and interfacing load lift points

B. HEAVY LOAD

Any load carried in a given area of the plant that weighs more than the combined weight of a single fuel assembly and the fuel grapple (approximately 1,000 pounds)

C. HOT FUEL

Fuel that was at power sufficiently long so if the fuel were damaged, offsite doses due to release of gap activity could exceed one-fourth of 10 CFR 100 limits

D. LOAD HANG-UP EVENT

The act in which the load block and/or load is stopped by a fixed object during hoisting, thereby possibly overloading the hoisting system

E. SAFE LOAD TRAVEL PATH

A path defined for transport of a heavy load that will minimize adverse effects if the load is dropped, in terms of releases of radioactive material and damage to safety systems. This path is administratively controlled by procedures and/or clearly outlined by markings on the floor where the load is to be handled. It may also be enforced by mechanical stops and/or electrical interlocks.

F. SAFE SHUTDOWN EQUIPMENT

Safety-related equipment and associated subsystems that would be required to bring the plant to cold shutdown conditions or provide continued decay heat removal following the dropping of heavy load. Safety functions that should be preserved are capability to maintain reactor coolant pressure boundary, capability to reach and maintain subcritical removal of decay heat, and capability to maintain integrity of components whose failure could result releases in excess of 10 CFR 100 limits.

G. SPECIAL LIFTING DEVICE

A lifting device that is designed specifically for handling a certain load or loads, such as the strongback for the reactor vessel head or the lifting device for the spent fuel cask

H. SPENT FUEL

Fuel that has been irradiated in the core and is considered no longer sufficiently active to be of use in powering the reactor, and therefore is soon to be, or already has been, removed from the reactor. It generally has an enrichment of less than 0.9 weight percent U-235.

I. TWO-BLOCKING EVENT

The act of continued hoisting to the extent that the upper head block and the load block are brought into contact and, unless additional measures are taken to prevent further movement of the load block, excessive loads will be created in the rope reeving system, with the potential for rope failure and dropping of the load.

J. CRITICAL LOAD

Any lifted heavy load whose uncontrolled movement could adversely affect safe shutdown equipment or spent fuel, resulting in potential offsite doses which exceed 10 CFR 100 limits.

III. RESPONSE TO NRC REQUEST FOR INFORMATION

2.1 GENERAL REQUIREMENTS FOR OVERHEAD HANDLING SYSTEMS

Question 2.1-1

Report the results of your review of plant arrangements to identify all overhead handling systems from which a load drop may result in damage to any system required for plant shutdown or decay heat removal (taking no credit for any interlocks, technical specifications, operating procedures, or detailed structural analysis).

Response

A review of the DAEC plant arrangement has been performed to identify overhead handling systems from which a heavy load drop could result in damage to systems required for plant shutdown or decay heat removal. DAEC plant structures included in this review of overhead handling systems were the reactor building, turbine building, HPCI/RCIC building, control building, radwaste building, offgas retention building, offgas stack, machine shop, pumphouse, and intake structure. Overhead handling systems located in these structures have been identified, and are listed in Table 1, Hoists and Cranes at the Duane Arnold Energy Center. Overhead handling systems included in Table 1 are shown on the DAEC equipment location drawings, Figures 1 through 8.

Handling systems considered in this review included only permanently installed overhead cranes, gantry cranes, jib cranes, and monorail-mounted and fixed hoists. Because the control building, intake structure, and offgas stack have no permanently installed cranes or hoists, these structures were not considered any further.

Heavy loads handled by each overhead handling system have also been identified. Heavy loads handled by the reactor building crane were listed, including the load identification, load weight, designated lifting device (if used), and the handling procedure. For the turbine building crane, heavy loads were identified, including the load weight and designated lifting device. For each monorail-mounted or fixed hoist, heavy loads and the load weight (if known) were identified. Approximate dimensions of the largest heavy load for each crane or hoist were used to determine the load path limits for that crane or hoist. These limits were determined based on the assumption that if a load drop occurred, the dropped load would be oriented with the longest side of the load extending horizontally from the crane or hoist hook location.

Systems required for plant shutdown and continued decay heat removal at the DAEC were identified using the categories of systems defined in Regulatory Guide 1.29, Position C.1. Systems excluded from these categories were those systems or portions of systems required solely for emergency core cooling, post-accident containment heat removal, post-accident containment atmosphere cleanup, and boron injection. The list of systems considered in this review of overhead handling systems is included in Table 2, Systems Considered in Review of Potential Heavy Load Drops at the Duane Arnold Energy Center. Equipment and components included in these systems which are located in the reactor building and turbine building in the path of heavy loads or one floor below the path of heavy loads have been identified, and are shown in Figures 10 through 37. These figures include identification by cross-hatching of:

1. Safety-related structures, and mechanical safe shutdown equipment

2. Piping and valves in safe shutdown systems

3. Safety-related conduit and trays

Overhead handling systems at the DAEC, including cranes and hoists, from which a load drop could result in damage to any system required for plant shutdown or decay heat removal are identified in Table 3, Overhead Handling Systems Located in the Vicinity of Safe Shutdown Equipment. Included in this table are the equipment number, handling system identification, floor elevation located immediately below the handling system, capacity and type of the handling system, and the figure showing the location of the handling system. Cranes and hoists included on this list have been identified without consideration for:

1. Electrical or mechanical interlocks which could prevent the movement of a crane or monorail hook (carrying a heavy load) over spent fuel, the reactor core, or safe shutdown equipment

2. Operating procedures which are used to control the movement of a heavy load along a safe load path

3. The fact that a crane or hoist is located in an area of the plant, such as the drywell or suppression pool, which is inaccessible during normal plant operation

4. The fact that a crane or hoist may typically be used for lifting a load or loads only when the plant is in the shutdown or refueling mode of operation

Additionally, it has been assumed that if a heavy load is dropped, it is capable of penetrating or damaging the floor beneath the handling system, with subsequent damage to safe shutdown equipment located below the floor. This assumption will be further evaluated as part of the work in response to Sections 2.2 and 2.3 of Enclosure 3 (see Introduction).

<u>Question 2.1-2</u>

Justify the exclusion of any overhead handling system from the above category by verifying that there is sufficient physical separation from any load-impact point and any safety-related component to permit a determination by inspection that no heavy load drop can result in damage to any system or component required for plant shutdown or decay heat removal.

<u>Response</u>

Overhead handling systems identified at the DAEC as having sufficient physical separation from any load impact point and any safe shutdown equipment such that no heavy load drop could result in damage to any system required for plant shutdown or decay heat removal are listed in Table 4, Overhead Handling Systems at the DAEC Not Located in the Vicinity of Safe Shutdown Equipment.

Included on this table are:

1. Overhead handling systems located in the offgas retention building, machine shop, radwaste building, and cooling tower structures, because there is no safe shutdown equipment located in these structures

2. The monorail located in the chlorine room of the pumphouse, because the chlorine room is located on the opposite end of the pumphouse from the RHR/ emergency service water pump room

3. Handling systems, including the refueling platform hoists, jib cranes on the refueling floor, and the CRD removal hoist, because these handling systems are not capable of handling heavy loads

4. The radial and side gate hoists which are located outside of the intake structure because these are permanently installed hoists used only for raising and lowering the sand control gates

5. Monorails located in the reactor building and turbine building, as identified in Table 4, that are capable of handling heavy loads, but are not located near or above any safe shutdown equipment

Question 2.1-3

With respect to the design and operation of heavy load-handling systems in the reactor building and those load-handling systems identified in the response to Question 1 above, provide your evaluation concerning compliance with the guidelines of NUREG 0612, Section 5.1.1. The following specific information should be included in the reply:

a. Drawings of sketches sufficient to clearly identify the location of safe load paths, spent fuel, and safety-related equipment.

Response

Figures 9a through 9p identify the location of spent fuel, the reactor core, and safe load paths for heavy loads handled above the refueling floor of the reactor building. Figures 10 through 37 identify safe shutdown equipment located in the reactor building and turbine building in and one floor below the path of heavy loads. Figures identifying safe shutdown equipment in the control building, pumphouse, intake structure, and offgas stack have not been included because there are no permanently installed cranes or hoists located in these structures.

Question 2.1-3 (continued)

b. A discussion of measures taken to ensure that load-handling operations remain within safe load paths, including procedures, if any, for deviation from these paths.

Response

Procedures are used to control the handling of loads by the reactor building crane and the refueling platform above the refueling floor of the reactor building. These procedures define the path of movement that is to be followed for each load handled by these cranes. As a part of the interim work for the control of heavy loads completed at the DAEC, these procedures were reviewed and revised, as necessary, to ensure that the load paths defined in the procedures were safe load paths.

Safe load paths are paths that:

1. Follow structural floor members, beams, or concrete walls, where practical, such that if the load is dropped, the structure is more likely to withstand the impact

2. Minimize crane hook, miscellaneous tool movement, and the movement of heavy loads over the reactor core, spent fuel pool, and safe shutdown equipment whenever possible

Additionally, procedures for handling heavy loads above the refueling floor include inspection hold and witness points to allow DAEC quality control personnel to verify that heavy loads are handled in accordance with these procedures.

Finally, DAEC administrative control procedures have been revised, as appropriate, to ensure that design change operations and maintenance activities which require handling heavy loads are reviewed and procedures are developed, as necesssary, to define safe load paths. Also, the deviations from these defined safe load paths must be reviewed and documented by written procedures approved by the DAEC Operations Committee for the handling of heavy loads along paths other than safe load paths.

We believe that these measures minimize the potential for heavy loads handled above the refueling floor of the reactor building, if dropped, to impact irradiated fuel in the reactor vessel and spent fuel pool or to impact safe shutdown equipment in the reactor building.

The handling of heavy loads with the turbine building crane and with monorail-mounted or fixed hoists is currently done without the use of written procedures. Procedures which cover the handling of heavy loads by cranes and hoists in the vicinity of safe shutdown equipment will be written, if necessary, as determined in the long-term review of the control of heavy loads. The results of this review will be included in the response to Sections 2.2 and 2.3 of Enclosure 3.

Question 2.1-3 (continued)

c. A tabulation of heavy loads to be handled by each crane which includes the load identification, load weight, its designated lifting device, and verification that the handling of such load is governed by a written procedure containing, as a minimum, the information identified in NUREG 0612, Section 5.1.1(2).

Response

Table 5, Reactor Building Crane Heavy Loads, is a listing of heavy loads handled by the reactor building crane. This table includes identification of each load, the load weight, the designated lifting device, and identification of the procedure for handling the load. Procedures referenced on this table are existing procedures which were revised, as necessary, as part of the interim work for the control of heavy loads at the DAEC, to include:

- Identification of the required equipment
- Inspections (and acceptance criteria) required before movement of a heavy load
- The steps and proper sequence to be followed in handling the load
- Safe load paths for the movement of heavy loads

Table 6, Turbine Building Crane Heavy Loads, is a listing of heavy loads handled by the turbine building crane, including the load identification, load weight, and designated lifting device (if used). As discussed previously, no written procedures exist which cover handling of heavy loads with this crane.

Table 7, Miscellaneous Hoist/Monorail Heavy Loads, is a listing of heavy loads handled by hoists located above safe shutdown equipment in the reactor building and turbine building, including the load identification and load weight. No written procedures exist which cover handling of heavy loads with these hoists.

Question 2.1-3 (continued)

d. Verification that lifting devices identified in the response to Question 2.1-3.c above comply with the requirements of ANSI N14.6-1978 or ANSI B30.9-1971, as appropriate. For lifting devices where these standards, as supplemented by NUREG 0612, Section 5.1.1(4) or 5.1.1(5), are not met, describe any proposed alternatives and demonstrate their equivalency in terms of load-handling reliability.

Response

1. Special Lifting Devices

Special lifting devices used in handling heavy loads at the DAEC include:

Special Lifting Device	Loads Handled
a. Head strongback	Drywell head Reactor vessel head
b. Dryer-separator sling	Steam dryer Steam separator
c. Rotor lifting beam	High-pressure turbine rotor Low-pressure turbine rotor A Low-pressure turbine rotor B

These special lifting devices were designed and fabricated before issue of ANSI N14.6-1978, and may not meet the requirements in this standard. However, the fabrication methods used for these lifting devices met the intent of this standard. Additionally, proof-testing, dimensional testing, and nondestructive examination were completed for the head strongback and dryer-separator sling prior to shipment to the DAEC.

For loads handled using these lifting devices, an analysis will be performed to evaluate the consequences of a postulated load drop. If the results of this analysis, which will be documented in the response to Sections 2.2 and 2.3 of Enclosure 3, indicate that the consequences of dropping any of these loads are unacceptable, then a stress analysis of the special lifting device will be performed. Should this stress analysis indicate that the lifting device does not comply with ANSI N14.6-1978, Section 3.2.1.1, as supplemented by NUREG 0612, Section 5.1.1(4), modifications will be made, as necessary, to improve the reliability of the lifting device.

In addition to the lifting devices described above, a special lifting device may also be used at some future date to handle a spent fuel shipping cask at the DAEC. Prior to handling a spent fuel shipping cask, arrangements will be made with the shipping cask supplier to ensure that the lifting device and cask lifting lugs meet the requirements of ANSI N14.7-1978.

Testing and maintenance of these special lifting devices will be performed in accordance with the requirements given in ANSI N14.6-1978, Section 5, Acceptance Testing, Maintenance, and Assurance of Continued Compliance. These requirements include:

a. Implementation of the responsibilities of Iowa Electric as the owner or user of special lifting devices

b. Acceptance testing of any new or modified special lifting devices in accordance with Section 5.2

c. Testing to verify continuing compliance in accordance with Section 5.3.1, except that the frequency of testing will be once every 5 years. In addition, testing will be performed prior to the next refueling outage at the DAEC. This is based on the consideration that these lifting devices are only used approximately four times every refueling outage, and that the option of proof-testing would increase the usage of these devices by 25%. We believe that the recommendations for testing in ANSI N14.6-1978 are intended primarily for high-usage lifting devices; therefore, an exception to these requirements is justified at the DAEC.

d. Maintenance and repair

e. Nondestructive testing procedures, personnel qualification, and acceptance criteria in accordance with Section 5.5

2. Other Lifting Devices

A review of other lifting devices used at the DAEC, including ropes, slings, and cables, is in process to determine the extent that the design, fabrication, and proof-testing methods used comply with the guidelines of ANSI B30.9-1971, as supplemented by NUREG 0612, Section 5.1.1(5).

Additionally, if compliance with the above standards cannot be verified for a particular sling, then the sling may be proof-tested to demonstrate its equivalency in terms of load handling reliability, or the sling may be replaced with one which meets the guidelines stated above.

Inspection, maintenance, repair, or replacement of these lifting devices will be performed at the DAEC as required by ANSI B30.9-1971.

Question 2.1-3 (continued)

e. Verification that ANSI B30.2-1976, Chapter 2-2, has been invoked with respect to crane inspection, testing, and maintenance. Where any exception is taken to this standard, sufficient information should be provided to demonstrate the equivalency of proposed alternatives.

Response

1. Inspection

A new DAEC inspection procedure has been prepared to define and document the visual inspection requirements which must be performed on the DAEC reactor building and turbine building crane when either of these cranes is used. Inspections are performed each shift, daily and weekly, whenever the cranes are in use. This inspection procedure ensures that the "frequent" inspection requirements identified in Chapter 2-2 of ANSI B30.2-1976 are satisfied and properly documented.

Additionally, new DAEC annual crane inspection procedures for the reactor building and turbine building cranes have also been prepared. These procedures ensure that the "periodic" inspection requirements identified in Chapter 2-2 of ANSI B30.2-1976 are satisfied and properly documented.

2. Testing

After installation of the reactor building crane and turbine building crane was completed, and prior to initial use, operational tests and rated load tests were performed in accordance with the technical requirements included in the purchase specification for the turbine and reactor building cranes for the DAEC. Testing requirements identified in this technical document include operational tests which meet the intent of, and rated load tests which are identical to, testing requirements stated in Chapter 2-2 of ANSI B30.2.0-1976.

After acceptance testing and initial operation of the reactor building crane, a complete nondestructive examination of all main hoist lifting components and structural members and a full field test were performed after an apparent overloading of the crane. A report on this incident, including the results of the inspection and testing performed on the crane, was sent to the USAEC by Letter IE-73-1438, C.W. Sandford (Iowa Electric) to D.F. Knuth (USAEC) dated November 19, 1973.

In the future, should any repairs or modification be made to the reactor building crane or turbine building crane, the cranes will be retested in accordance with the requirements identified in Chapter 2-2 of ANSI B30.2.0-1976. However, in performing the rated load test included in ANSI B30.2.0-1976, Section 2-2.2.2, the load path used for the test load shall also conform to the requirements in NUREG 0612, Section 5.1.1(1).

3. Maintenance

A preventive maintenance program has been established for the reactor building crane and turbine building crane, based on the manufacturer's recommendations, to ensure that maintenance of these cranes complies with the requirements in Chapter 2-2 of ANSI B30.2-1976.

Question 2.1-3 (continued)

f. Verification that crane design complies with the guidelines of CMAA Specification 70 and Chapter 2-1 of ANSI B30.2-1976, including the demonstration of equivalency of actual design requirements for instances where specific compliance with these standards is not provided.

Response

Overhead cranes at the DAEC included in the scope of this request are the reactor building crane and the turbine building crane.

A review of the design of the DAEC reactor building crane and turbine building crane has been completed by Harnischfeger to determine the extent that the design of these cranes complies with the guidelines of CMAA Specification 70 and Chapter 2-1 of ANSI B30.2-1976.

This review indicated that the design of the reactor building and turbine building cranes complies with ANSI B30.2.0-1976, except as follows:

1. Welding procedures and welding operator qualifications used for load-sustaining members were in accordance with the American Welding Society, Structural Welding Code, AWS D2.0, instead of AWS D1.1, as required by ANSI B30.2.0-1976, Section 2-1.4.1.

2. Branch circuit protection and overcurrent protection for the bridge and trolley control circuit transformer secondary, in accordance with the National Electrical code (NEC), Section 610-42 (1981), were not provided as required by ANSI B30.2.0-1976, Section 2-1.10.1.a. Additionally, Harnischfeger's records are inadequate to determine if live part clearance requirements of the NEC, Section 610-57 were met. However, the above items were not required by the NEC at the time of manufacture.

3. The arrangement of the pendant pushbutton station does not exactly conform to ANSI B30.2.0-1976, Chapter 2-1, Figure 4, as required by Section 2-1.10.3.k of the standard.

4. Pushbuttons for the switch for the leads from the runway conductors which, when opened, set the holding brakes, are mounted on the bridge platform instead of the operator's cab, as required in ANSI B30.2.0-1976, Section 2-1.10.5.b. However, a magnetic mainline contactor provided and mounted on the bridge platform has start-stop pushbuttons in the operator's cab.

Additionally, the design review of the turbine building and reactor building cranes indicated that these cranes comply with CMAA Specification 70, 1975, except as listed below:

1. Welding design and procedures conformed to American Welding Society (AWS) Structural Welding Code, AWS D2.0, instead of AWS D14.1, as required by CMAA Specification 70, Section 3.2.

2. Calculation of torsional forces, as described in CMAA Specification 70, Section 3.3.2.1.3, was not done. However, a sufficient factor was applied in calculating shear forces to allow for torsional forces.

3. Electrical equipment furnished for these cranes did not meet the requirements of the National Electrical Code (NEC), 1981, Article 610, as required by CMAA Specification 70, Section 5.1.3. However, electrical equipment furnished did meet the requirements of the NEC in effect at the time of manufacture of the cranes.

4. For the turbine building crane only, the trolley frame auxiliary girt meets EOCI 61 requirements, but does not meet the requirements of CMAA Specification 70, Section 3.7.

5. For the turbine building crane only, the estimated trolley wheel load exceeds the wheel load allowed in CMAA Specification 70, Table 4.11.3, by approximately 1.6%.

6. Electrical safety features do not meet the requirements of ANSI B30.2.0, as required by CMAA Specification 70, Section 5.6.10 (refer to the discussion above regarding compliance to ANSI B30.2.0-1976).

7. Orientation of pushbuttons on floor-operated pendant pushbutton stations does not conform exactly to the arrangement specified in CMAA Specification 70, Section 5.8.1. Additionally, stop pushbuttons are black, instead of red, as required by CMAA Specification 70, Section 5.8.3.

If is felt that the above exceptions to compliance with ANSI B30.2-1976, and CMAA Specification 70-1975 do not degrade the load handling reliability of either crane, and therefore are considered to be acceptable.

Question 2.1-3 (continued)

g. Exceptions, if any, taken to ANSI B30.2-1976 with respect to operator training, qualification, and conduct.

Response

No exceptions have been taken to ANSI B30.2-1976 with respect to operator training, qualification, and conduct.

A new procedure has been prepared which contains all of the elements necessary to establish a program for crane operator training, qualification, and operator conduct in accordance with Chapter 2-3 of ANSI B30.2-1976, Overhead and Gantry Cranes. The crane operator training program includes a practical operating examination and an oral examination, conducted by the mechanical maintenance supervisor or the operations department supervisor, to demonstrate that a crane operator has 1) a general knowledge of the material included in the procedure and 2) the ability to operate the crane while handling heavy loads in a safe manner.

In addition to the above, the procedure for the reactor building and turbine building crane operator training, qualifications, and operating practices has been revised to include the load sway and approach to crane stops problems encountered at the DAEC. These problems have been addressed by adding safe bridge crane operating precautions to the procedure. The first precaution states that a crane operator should decrease the speed of motion of the crane trolley as crane limits are approached to minimize the amount of load sway. Also, slower trolley speeds are required when large loads are being handled by the cranes or, as necessary, to control load sway. The second precaution requires that an operator approach the crane runway stops at a sufficiently slow speed that the crane may be stopped before contacting the runway stops, and without reliance on the crane brakes.

2.2 SPECIFIC REQUIREMENTS FOR OVERHEAD HANDLING SYSTEMS OPERATING IN THE REACTOR BUILDING

Question 2.2-1

Identify by name, type, capacity, and equipment designator, any cranes physically capable (i.e., ignoring interlocks, moveable mechanical stops, or operating procedures) of carrying loads over spent fuel in the storage pool or in the reactor vessel.

Response

Cranes located above the refueling floor of the reactor building at the DAEC which are capable of carrying loads over spent fuel in the spent fuel pool or in the reactor vessel are listed below:

Equipment Number	Service	Capacity	Type
1H-001	Reactor building crane	100-ton main hoist, 5-ton auxiliary hoist	Overhead bridge crane
1H-006	Jib crane for refueling facility channel handling	200-pound	Manual cable hoist/jib crane
1H-011	Jib crane for refueling facility floor and service platform	1,000-pound	Electric cable hoist/jib crane
1H-207	Refueling platform fuel grapple hoist	1-ton	Electric cable hoist
1H-208	Refueling platform frame-mounted auxiliary hoist	1,000-pound	Electric cable hoist
1H-209	Refueling platform monorail-mounted auxiliary hoist	1,000-pound	Electric cable hoist

Question 2.2-2

Justify the exclusion of any cranes in this area from the above category by verifying that they are incapable of carrying heavy loads or are permanently prevented from movement of heavy loads over stored fuel or into any location where, following any failure, such load may drop into the reactor vessel or spent fuel storage pool.

Response

Hoists and cranes located above the refueling floor of the reactor building which are excluded from further consideration include the refueling facility channel handling jib crane, the refueling facility floor and service platform jib crane, and the fuel grapple hoist and auxiliary hoists on the refueling platform. These hoists, with the exception of the fuel grapple hoist, have a rated capacity of 1,000 pounds or less, and are therefore considered incapable of carrying heavy loads (note that this is based on the definition of a heavy load for the DAEC, which is any load that weighs more than the combined weight of a single fuel assembly and the fuel grapple). However, because the fuel grapple hoist, which has a rated capacity of 2,000 pounds, is only used for handling fuel assemblies or other loads which weigh less than the weight of one fuel assembly, the fuel grapple hoist is not considered to handle heavy loads.

The reactor building crane is the only crane located above the refueling floor of the reactor building which is capable of carrying heavy loads over spent fuel stored in the spent fuel pool or the reactor vessel.

Question 2.2-3

Identify any cranes listed in Question 2.2-1 above which you have evaluated as having sufficient design features to make the likelihood of a load drop extremely small for all loads to be carried and the basis for this evaluation (i.e., complete compliance with NUREG 0612, Section 5.1.6 or partial compliance supplemented by a suitable alternative or additional design features). For each crane so evaluated, provide the load-handling system (i.e., crane-load-combination) information specified in Attachment 1.

Response

The existing DAEC reactor building crane, including special lifting devices, slings, and interfacing load lift points for all loads handled by this crane, does not meet the requirements of NUREG 0612, Section 5.1.6, Single-Failure-Proof Handling Systems. However, analyses performed for certain loads handled by the reactor building crane in areas of the refueling floor other than over the spent fuel pool or the reactor vessel indicate that unacceptable damage to safety-related equipment may occur if the load is dropped. Therefore, the reactor building crane will be upgraded to make the likelihood of a load drop extremely small.

Additionally, lifting devices which are used in handling heavy loads with the reactor building crane in the vicinity of spent fuel will also be upgraded unless it has been shown, by analysis, that the postulated drop of a heavy load would not result in fuel damage. For heavy loads which must be handled near or over the spent fuel pool, lifting devices used in handling these loads will be upgraded. Heavy loads included in this category are the reactor vessel service platform, invessel work platform, spent fuel pool refueling slot plugs, spent fuel pool gates, and the spent fuel shipping cask pool gate.

For heavy loads handled in the vicinity of the reactor vessel, analyses of certain postulated load drops have previously been completed. These analyses, documented in the DAEC FSAR, indicate that the postulated drop of the steam dryer or steam separator over the reactor vessel would not result in damage to fuel assemblies or a loss of water from the reactor vessel. For some other loads handled over the reactor vessel, analysis of postulated load drops in other areas concluded that unacceptable damage to safety-related equipment may occur. Loads included in this category are the reactor well plugs, dryer-separator canal plugs, drywell head, and reactor vessel head. Because the lifting devices used in handling these loads will be upgraded, a drop of one of these loads over the reactor vessel is not postulated.

Additionally, some loads, such as the stud tensioner, head stud rack, and the vessel head insulation, are handled over the reactor vessel only when the vessel head is in place. Analysis of a drop of these loads were scoped by the reactor vessel head drop analysis (also documented in the DAEC FSAR). For the reactor vessel service platform and invessel work platform, slings used in handling these loads will be upgraded because of the potential for a load drop over the spent fuel pool. Therefore, a drop of either of these loads over the reactor vessel need not be considered. Finally, the cattle chute shield, which is carried near an open reactor vessel, has the potential, if dropped, to damage fuel in the reactor. Therefore, slings used for lifting this load will also be upgraded.

Information regarding how these lifting devices will be upgraded is provided in the response to Question 2.3-2.c.

The load-handling system information specified in Enclosure 3, Attachment 1, Single-Failure-Proof Handling Systems, will be provided for the reactor building crane and all loads to be carried over the reactor vessel and spent fuel pool, after design changes for the reactor building crane, lifting devices, and load lift points have been finalized.

<u>Question 2.2-4</u>

For cranes identified in Question 2.2-1 above not categorized according to Question 2.2-3, demonstrate that the criteria of NUREG 0612, Section 5.1, are satisfied. Compliance with Criterion IV will be demonstrated in response to Section 2.3 of this request. With respect to Criteria I through III, provide a discussion of your evaluation of crane operation in the reactor building and your determination of compliance. This response should include the following information for each crane:

a. Where reliance is placed on the installation and use of electrical interlocks or mechanical stops, indicate the circumstances under which these protective devices can be removed or bypassed and the administrative procedures invoked to ensure proper authorization of such action. Discuss any related or proposed technical specifications concerning the bypass of such interlocks.

b. Where reliance is placed on the operation of the standby gas treatment system, discuss present and/or proposed technical specifications and administrative or physical controls provided to ensure that these assumptions remain valid.

c. Where reliance is placed on other site-specific considerations (e.g., refueling sequencing), provide present or proposed technical specifications and discuss administrative or physical controls provided to ensure the validity of such considerations.

d. Analyses performed to demonstrate compliance with Criteria I through III should conform to the guidelines of NUREG 0612, Appendix A. Justify any exception taken to these guidelines, and provide the specific information requested in Attachments 2, 3, or 4, as appropriate, for each analysis performed.

Response

As discussed in the response to Question 2.2-3, the alternative of upgrading the reactor building crane load-handling system has been chosen to ensure that the potential for a load drop occurring over the spent fuel pool is extremely small. For the reactor vessel area, analysis of postulated load drops for some loads over the reactor vessel indicated that no fuel damage would occur. For other loads carried over the reactor vessel, the alternative of upgrading the handling system has been selected. No additional analyses have been performed to demonstrate compliance with Crtieria I through III of NUREG 0612, Section 5.1.

2.3 SPECIFIC REQUIREMENTS FOR OVERHEAD HANDLING SYSTEMS OPERATING IN AREAS CONTAINING EQUIPMENT REQUIRED FOR REACTOR SHUTDOWN, DECAY HEAT REMOVAL, OR SPENT FUEL POOL COOLING

Question 2.3-1

Identify any cranes listed in Question 2.1-1 above which you have evaluated as having sufficient design features to make the likelihood of a load drop extremely small for all loads to be carried and the basis for this evaluation (i.e., complete compliance with NUREG 0612, Section 5.1.6 or partial compliance supplemented by a suitable alternative or additional design features). For each crane so evaluated, provide the load-handling system (i.e., crane-load-combination) information specified in Attachment 1.

Response

There are no overhead handling systems at the DAEC capable of carrying heavy loads over safety-related equipment which meet the requirements of NUREG 0612, Section 5.1.6, for all loads to be carried.

Question 2.3-2

For any cranes identified in Question 2.1-1 not designated as single-failure-proof in Question 2.3-1, a comprehensive hazard evaluation should be provided which includes the following information:

a. The presentation in a matrix format of all heavy loads and potential impact areas where damage might occur to safety-related equipment. Heavy loads identification should include designation and weight or cross-reference to information provided in Question 2.1-3.c. Impact areas should be identified by construction zones and elevations or by some other method such that the impact area can be located on the plant general arrangement drawings.

Response

Overhead handling systems capable of carrying heavy loads over safe shutdown equipment at the DAEC are listed in Table 3. Tables 5, 6, and 7 identify heavy loads handled by these overhead handling systems. Information from these tables, including the load identification and load weight, have been presented in a matrix format. Additionally, the impact area location and elevation, the safety-related equipment which could be impacted, and the hazard elimination category have been included for each load. The criteria for elimination of a load as a hazard has been made on the basis of the following:

a. Crane travel for a load/impact area combination is prohibited by electrical interlocks or mechanical stops.

b. System redundancy and separation preclude loss of capability of the system to perform its safety-related function following a load drop in the area.

c. DAEC-specific considerations eliminate the need to consider a load/equipment combination.

d. The likelihood of a handling system failure for a load is extremely small (i.e., single-failure-proof).

e. An analysis demonstrates that a crane failure and load drop will not damage safety-related equipment.

The load/impact area matrix sheets, including the hazard elimination criteria, are attached to this report (Appendix A). A description of the hazard elimination for each load considered follows in the responses to Questions 2.3-2.b, 2.3-2.c, and 2.3-2.d.

Question 2.3-2 (continued)

b. For each interaction identified, indicate which of the load and impact area combinations can be eliminated because of separation and redundancy of safety-related equipment, mechanical stops and/or electrical interlocks, or other site-specific considerations. Elimination on the basis of the aforementioned consideration should be supplemented by the following specific information:

1. For load/target combinations eliminated because of separation and redundancy of safety-related equipment, discuss the basis for determining that load drops will not affect continued system operation (i.e., the ability of the system to perform its safety-related function).

2. Where mechanical stops or electrical interlocks are to be provided, present details showing the areas where crane travel will be prohibited. Additionally, provide a discussion concerning the procedures that are to be used for authorizing the bypassing of interlocks or removable stops, for verifying that interlocks are functional prior to crane use, and for verifying that interlocks are restored to operability after operations which require bypassing have been completed.

3. Where load/target combinations are eliminated on the basis of other site-specific considerations (e.g., maintenance sequencing), provide present and/or proposed technical specifications and discuss administrative procedures or physical constraints invoked to ensure the validity of such considerations.

Response

1. Turbine Building Crane (1H-003)

Safety-related equipment located in the turbine building which could be damaged by the postulated drop of a heavy load includes the diesel generators and associated subsystems; turbine-generator reactor protection system (RPS) instrumentation; electrical cable tray (Division I) and embedded conduit (Division II) which contain control and power cables for the RHR service water, emergency service water, and river water supply systems; and the bus ducts for the startup transformer. Most heavy loads lifted with the turbine building crane, including turbine-generator components, are handled only when the reactor is shut down. Because the turbine-generator RPS instrumentation is not required once the reactor is shut down, a load drop which damaged this instrumentation would not affect the ability to maintain core cooling. Loads that may be handled with the turbine building crane during normal plant operation, such as a radwaste shipping cask or liner, would not be carried over the location of this instrumentation because of the height of the shield wall around the turbine-generator. Therefore, a load drop which could damage this instrumentation during normal operation is not postulated.

Reactor shutdown and continued decay heat removal require that at least one division of RHR service water, emergency service water, and the river water supply systems remain operational. Therefore, a load drop in the turbine building which damaged both divisions of safety-related cables for these systems would be unacceptable. Division I cables for these systems are routed through cable trays located above the lowest floor of the turbine building adjacent to the north turbine building wall. Division II cables for these systems are routed through conduit embedded in the north end of the turbine building foundation slab. Analyses of postulated load drops on the north end of the turbine building indicated that the load would penetrate the upper two floors of the turbine building. The analyses also showed that although damage to the Division I cable trays may occur, the Division II conduits embedded in the slab would be unaffected (additional information regarding this analysis has been provided in the response to Question 2.3-2.d). Therefore, at least one division of RHR service water, emergency service water, and the river water systems would be operational following a load drop in this area.

Finally, additional safety-related equipment located in the turbine building which may be required for reactor shutdown and continued decay heat removal includes the diesel generators with associated subsystems and embedded conduits, and the bus ducts for the startup transformer. However, because of physical separation, a load drop which damaged both diesel generators or the embedded conduits for both diesel generators could not also damage the startup transformer bus ducts. Further, a loss of offsite power simultaneous with a load drop has not been assumed. Therefore, if a dropped load resulted in damage to both diesel generators, offsite power would be available to the plant through either the startup transformer or the standby transformer (located adjacent to the reactor building). Similarly, a dropped load which damaged the startup transformer bus ducts would not affect power sources from the diesel generators or the standby transformer.

Based on the above analyses, the consequences of a load drop at any location within the turbine building crane travel area are considered to be acceptable. Therefore, no modifications will be made to the turbine building crane.

2. Steam Tunnel Area Monorails (1H-017)

Loads which may be handled by a hoist on any of three steam tunnel area monorails include major maintenance loads such as a main steam isolation valve or feedwater isolation valve, and miscellaneous maintenance loads, including motor operators and valve components. Safety-related equipment located in the steam tunnel which could be damaged by a postulated load drop includes main steam, HPCI, RCIC, and feedwater piping and valves. Safety-related equipment located below the steam tunnel monorail area in the torus room includes the suppression pool, and one division of RHR, RHR service water, and emergency service water piping.

Because of high radiation levels inside the steam tunnel and process piping conditions during normal operation, maintenance involving lifting heavy loads with a steam tunnel area monorail hoist would be only performed when the reactor is shut down. However, a load drop which damaged piping or valves in the steam tunnel would not impair the ability to maintain continued decay heat removal from the reactor using the RHR system. Should a dropped load penetrate or cause spalling of the floor, damage to equipment in the torus room would be limited to the suppression pool and to one division of the RHR, RHR service water, and emergency service water systems. However, continued core cooling could still be maintained using the undamaged train of the RHR system in the shutdown cooling mode of operation.

Based on the above, the consequences of a heavy load drop from any of the steam tunnel area monorails are considered to be acceptable.

3. Recirculation Pump Motor Hoist (1H-015A,B)

Each of the recirculation pump motor hoists are located inside the drywell directly over its associated recirculation pump motor. Maintenance on the recirculation pump which would require lifting a recirculation pump motor is only performed when the reactor is shut down. Following a postulated drop of a recirculation pump motor with the reactor shut down, damage to the recirculation pump and associated piping may result in a loss of coolant from the reactor vessel. However, an adequate source of makeup water to the reactor would be available from the RHR system through the undamaged recirculation loop, and from the core spray system. Therefore, the consequences of this load drop are considered to be acceptable.

4. Torus Monorail

The torus monorail, which is located inside of the torus, is used for lifting the torus-drywell vacuum breakers as well as miscellaneous maintenance loads inside the torus. Safety-related equipment which could be damaged by a load dropped from the torus monorail includes the torus, internal torus piping, and piping attached to the torus.

Because use of the torus monorail requires access to the torus, the monorail is only used when the reactor is shut down. Some loads, such as the torus-drywell vacuum breakers, may be handled with a normal water inventory in the torus. However, because of its low weight (900 pounds) and because of the drag encountered in falling through water, damage to the torus from a postulated drop of a vacuum breaker is considered unlikely. Loads other than the vacuum breakers are handled only after the torus has been drained and, if dropped, would not affect the ability to maintain decay heat removal from the reactor using the RHR system. Therefore, the consequences of a load drop from the torus monorail are considered to be acceptable.

Question 2.3-2 (continued)

c. For interactions not eliminated by the analysis of Question 2.3-2.b above, identify any handling systems for specific loads which you have evaluated as having sufficient design features to make the likelihood of a load drop extremely small and the basis for this evaluation (i.e., complete compliance with NUREG 0612, Section 5.1.6 or partial compliance supplemented by a suitable alternative or additional design features). For each so evaluated, provide the load-handling system (i.e., crane-load-combination) information specified in Attachment 1.

Response

As discussed in the response to Question 2.2-3, the reactor building crane, including special lifting devices, slings, and load lift points for all loads handled by the crane, does not meet the requirements of NUREG 0612, Section 5.1.6, Single-Failure-Proof Handling Systems. However, analyses completed for certain loads handled by the reactor building crane in areas of the refueling floor other than over the spent fuel pool or the reactor vessel indicate that unacceptable damage to safety-related equipment may occur if the load is dropped. Therefore, the reactor building crane, including lifting devices and load lift points for these loads, will be upgraded, as necessary, to make the likelihood of a load drop extremely small. The basis for this determination, and a discussion of the modifications that will be made, are provided below.

Analyses of postulated load drops from the reactor building crane above the refueling floor of the reactor building have been performed to evaluate the potential for a dropped load to damage equipment required for plant shutdown and continued decay heat removal. Heavy loads handled by the reactor building crane which were included in these analyses are listed in Table 5, Reactor Building Crane Heavy Loads. Although most of these loads are handled only when the reactor is shut down, certain loads are handled in areas where, if dropped, they could damage equipment required for long-term core cooling. Additionally, some loads, such as new fuel crates or a radwaste shipping cask, may be handled during normal plant operation. Therefore, the potential for damage to equipment required for plant shutdown was also considered.

Areas of the refueling floor where load drops have been considered are shown in Figure 9q, and include:

- The equipment laydown area directly west of the reactor well, dryer-separator storage pool, and spent fuel storage pool
- The dryer-separator storage pool
- The equipment laydown area directly north of the dryer-separator storage pool
- The equipment laydown area directly south of the spent fuel pool

In analyzing the consequences of a load drop on the refueling floor in terms of damage to structures, the following assumptions were used, where appropriate:

- The load is dropped in an orientation that causes the most severe consequences.
- The load is lifted no higher than required to adequately clear equipment located in the load path.
- The load may be dropped at any location along the safe load path defined for the movement of that load.

- The analysis was based on an elastic-plastic curve that represents a true stress-strain relationship.

- The analysis considered that all energy is absorbed by the structure and/or equipment that is impacted.

- Loads were not analyzed if their load paths and consequences are scoped by the analysis of some other load.

The results of the analyses for certain loads, including the reactor well plugs, dryer-separator canal plugs, drywell head, and reactor vessel head, indicate that these loads, if dropped from above the refueling floor, would penetrate the floor. Further, because of the large distance in which a dropped load and debris could accelerate, a dropped load which penetrates the refueling floor may successively penetrate the remaining four floors in the reactor building. Damage to safety-related equipment required for reactor shutdown and continued decay heat removal which may occur following a drop of one of these loads would be unacceptable.

To reduce the likelihood of a failure resulting in a dropped load, the reactor building crane will be upgraded. Modifications which will be made to the reactor building crane will meet, to the extent practical, the requirements of NUREG 0554, Single-Failure-Proof Cranes for Nuclear Power Plants, as supplemented by NUREG 0612, Appendix C, Modification of Existing Cranes.

Additionally, lifting devices used in handling heavy loads whose postulated drop has been shown to have unacceptable consequences will also be upgraded. These lifting devices and load lift points will be upgraded, as follows:

1. <u>Special Lifting Devices</u>

   Special lifting devices which are or may be used at the DAEC that will be upgraded, as necessary, include the head strongback and a spent fuel shipping cask lifting device. Loads which are handled with the head strongback include the drywell head and the reactor vessel head. As described above, analysis of a postulated drop of the drywell head or the reactor vessel head indicated that unacceptable damage to safety-related equipment may occur. The head strongback was manufactured prior to issue of ANSI N14.6-1978, and may not meet the requirements of this standard, including those of Chapter 6, Special Lifting

Devices for Critical Loads. Therefore, a stress analysis of the head strongback will be performed to evaluate the design safety factor used for this lifting device. If it is found that the design safety factor for the head strongback, based on the combined static and maximum dynamic loading on the lifting device, does not meet the requirements of NUREG 0612, Section 5.1.6(1)(a), the strongback will be modified, to the extent practical, to reduce the likelihood of a failure. Additionally, testing of the head strongback will be performed as described in the response to Question 2.1-3.d.

Additionally, a special lifting device may be used at some future date to lift a spent fuel shipping cask at the DAEC. Prior to handling a spent fuel shipping cask with the reactor building crane, arrangements will be made with the shipping cask supplier to ensure that the special lifting device meets the requirements of ANSI N14.6-1978, including Section 6, Special Lifting Devices for Critical Loads, as stated in NUREG 0612, Section 5.1.6(1)(a).

2. <u>Other Lifting Devices</u>

Slings are used for lifting most heavy loads with the reactor building crane. Analyses of the postulated drop of some of these loads indicated that unacceptable damage to safety-related equipment may occur. These loads include the reactor well plugs and the dryer-separator canal plugs. For other loads, although an analysis of a postulated drop has shown that no damage to safety-related equipment would occur, these loads may be handled near or over the reactor vessel or spent fuel pool. These loads, if dropped, may damage spent fuel in the reactor vessel or spent fuel pool, resulting in a release of radioactivity to the environment and the potential for criticality. Therefore, slings used for handling each of these loads will be upgraded, as necessary, to reduce the likelihood of a failure. Loads for which the slings will be upgraded are listed below:

a. Reactor well plugs
b. Dryer/separator canal plugs
c. Spent fuel pool refueling slot plugs
d. Service platform
e. Invessel work platform

f. Spent fuel pool refueling slot gates
g. Spent fuel shipping cask pool slot gate
h. Cattle chute shield
i. Jib crane for service platform
j. Hatches and plugs

Slings used for lifting these loads will be upgraded, to the extent practical, to meet the requirements of NUREG 0612, Section 5.1.6(1)(b), considering the combined static and maximum dynamic loading on the slings.

In addition, a radwaste shipping cask may be lifted to the refueling floor of the reactor building at some future date for temporary storage in the dryer separator pool. Prior to lifting a radwaste shipping cask with the reactor building crane, measures will be taken to ensure that the slings used in handling the cask meet, to the extent practical, the requirements of NUREG 0612, Section 5.1.6(1)(b).

3. Load Lift Points

A review of the design of load lift points for all loads handled by the reactor building crane whose lifting device is to be upgraded, will be made to evaluate the design safety factor used for the lift points. If the review indicates that the factor of safety does not meet the requirements in NUREG 0612, Section 5.1.6(3), the load lift points may be modified, to the extent practical, to make the likelihood of a load drop extremely small.

The load-handling system information specified in Enclosure 3, Attachment 1, Single-Failure-Proof Handling Systems, will be provided for the reactor building crane for all loads for which the lifting devices will be upgraded after design changes for the reactor building crane, lifting devices, and load lift points have been finalized.

Question 2.3-2 (continued)

d. For interactions not eliminated in Questions 2.3-2.b or 2.3-2.c above demonstrate, using appropriate analysis, that damage would not preclude operation of sufficient equipment to allow the system to perform its safety function following a load drop (NUREG 0612, Section 5.1, Criterion IV). For each analysis so conducted, the following information should be provided:

1. An indication of whether or not, for the specific load being investigated, the overhead crane-handling system is designed and constructed such that the hoisting system will retain its load in the event of seismic accelerations equivalent to those of a safe shutdown earthquake.

2. The basis for any exceptions taken to the analytical guidelines of NUREG 0612, Appendix A.

3. The information requested in Attachment 4.

Response

1. Reactor Building Crane (1H-001)

Analysis of postulated load drops from the reactor building crane above the refueling floor of the reactor building have been performed to evaluate the potential for a dropped load to damage equipment required for plant shutdown and continued decay heat removal. These analyses concluded that for several loads, including the steam separator, steam dryer, stud tensioner, vessel head insulation, and new fuel crates, the consequences of a load drop would be acceptable.

The reactor building crane has been designed and constructed such that the crane will retain its load in the event of seismic accelerations equivalent to a safe shutdown earthquake.

The following exception was taken to the analytical guidelines of NUREG 0612, Appendix A:

> Analysis of a postulated drop of the steam dryer and steam separator considered that the load was dropped at a location along the safe load path for these loads. Specifically, analysis of a load drop over the dryer-separator pool was considered. Additionally, the analyses did not consider the fact that the dryer-separator pool is flooded while handling the steam separator.

The information requested in Enclosure 3, Attachment 4, Analysis of Plant Structures, has been provided for the steam dryer and steam separator in Appendix B.

2. Turbine Building Crane (1H-001)

As discussed in the response to Question 2.3-2.b.1, an analyses has been performed to evaluate the potential for a load, if dropped, to damage safety-related conduits embedded in the turbine building foundation slab. To postulate the maximum damage that could occur in this area, a dropped load which could fall unobstructed from above the turbine operating deck was considered. Specifically, the analysis postulated that the west reactor feedpump motor was dropped after being lifted above the turbine operating deck through the hatch. Safety-related conduits embedded at a depth of 3'-5" in the foundation slab are located near the area under the west reactor feedpump hatch. Results of this analyses concluded that no damage to these conduits would occur.

The turbine building crane has been designed and constructed such that the crane will retain its load in the event of seismic accelerations equivalent to a safe shutdown earthquake.

No exceptions have been taken to the analytical guidelines of NUREG 0612, Appendix A.

The information requested in Enclosure 3, Attachment 4, has been provided for the analysis of a reactor feedpump motor drop in Appendix B.

3. Shield Blocks and Personnel Lock Hoist (1H-013)

The shield block and personnel lock hoist (including a removable monorail section) is used for lifting and removing nine shield blocks and the personnel lock to provide access for the drywell equipment hatch. The nine concrete shield blocks range in weight from 10 to 19 tons; the personnel lock weighs 25 tons. Except for the personnel lock, there is no safety-related equipment located in the area of this hoist which could be impacted by a dropped load. Safety-related equipment located below this area in the torus room includes the suppression pool and one division of RHR (including the RHR shutdown cooling line), RHR service water, and emergency service water piping.

Because removal of the shield blocks and personnel lock violates primary containment, these loads are handled only when the reactor is shut down. If a load dropped from this hoist penetrated or seriously damaged the reactor building floor above the torus room, unacceptable damage to safety-related equipment could occur.

However, an analysis has been completed which indicates that a shield block, if dropped from its maximum height, would not penetrate or cause spalling of the floor. However, to preclude the possibility that the personnel lock, if dropped, would penetrate the floor, the height that this load is lifted above the floor will be limited. A new procedure will be written to cover handling of the shield blocks and personnel lock at the DAEC to ensure that these loads are handled in a safe manner, including limiting the height that these loads are lifted to a safe, practical distance.

Based on the above, the consequences of a load drop from the shield block and personnel lock hoist are considered to be acceptable.

The shield block and personnel lock hoist was not designed and constructed to retain its load in the event of seismic accelerations equivalent to a safe shutdown earthquake.

No exceptions were taken to the analytical guidelines of NUREG 0612, Appendix A.

The information requested in Enclosure 3, Attachment 4, for the analysis of the shield blocks has been provided in Appendix B.

4. <u>Spent Fuel Pool Gamma-Scan Collimator Port Hoist (1H-023)</u>

The gamma-scan collimator port hoist is located in the spent fuel pool skimmer tank area. There is no safety-related equipment located in the vicinity of this hoist. However, safety-related cable tray is located immediately below the floor of this area. An analysis has been completed which indicates that a postulated drop of the shield plug from its maximum height would not penetrate or cause spalling of the concrete floor. Therefore, the consequences of this load drop are considered to be acceptable.

The gamma-scan collimator port hoist was not designed and constructed to retain its load in the event of seismic accelerations equivalent to a safe shutdown earthquake.

No exceptions were taken to the analytical guidelines of NUREG 0612, Appendix A.

The information requested in Enclosure 3, Attachment 4, for the analysis of the gamma-scan collimator port shield has been provided in Appendix B.

5. <u>Fuel Pool Demineralizer Area Hoist (1H-018)</u>

The fuel pool demineralizer area hoist is used for lifting the shield plugs located above the fuel pool, floor drain, waste, radwaste collector, and cleanup filter/demineralizers. The shield plugs lifted by this hoist range in weight from 4-1/2 to 8-1/2 tons. There is no safety-related equipment located in the area of these demineralizer vessels. However, if a dropped load could penetrate or seriously damage the floor in this area, damage could occur to safety-related equipment located on the floors below. However, analysis has been completed which indicated that a shield plug, if dropped, would not penetrate or cause spalling of the floor in this area. Therefore, the consequences of a load drop in this area are considered to be acceptable.

The fuel pool demineralizer area hoist was not designed and constructed to retain its load in the event of seismic accelerations equivalent to a safe shutdown earthquake.

No exceptions were taken to the analytical guidelines of NUREG 0612, Appendix A.

The information requested in Enclosure 3, Attachment 4, for the analysis of a fuel pool demineralizer plug has been provided in Appendix B.

APPENDIX A

LOAD/IMPACT AREA MATRIXES

(49 pages)

Legend for Load/Impact Area Matrix Hazard Elimination Category

a. Crane travel for this area/load combination prohibited by electrical interlocks or mechanical stops.

b. System redundancy and separation precludes loss of capability of system to perform its safety-related function following this load drop in this area.

c. DAEC specific considerations eliminate the need to consider load/equipment combination.

d. Likelihood of handling system failure for this load is extremely small (i.e., the load handling system will be upgraded to meet, to the extent practical, the guidelines of NUREG 0612, Section 5.1.6).

e. Analysis demonstrates that crane failure and load drop will not damage safety related equipment.

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA	Column lines D-H, 7.1-11.1		
LOAD	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Reactor well plugs (upper plugs - 2 at 70 tons, 1 at 75 tons; lower plugs - 2 at 67.5 tons, 1 at 70 tons)	855'-0"	drywell, reactor vessel	d
	833'-6"	division I and II electrical conduit	
	812'-0"	division II electrical tray and conduit, division I electrical conduit, control building chillers, emergency service water piping	
	786'-0"	division I electrical tray and conduit, division II electrical conduit, standby gas treatment system	
	757'-6"	division II electrical tray and conduit, division I electrical conduit; CRD hydraulic control units, RHR system piping	
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping, RHR service water piping	

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA	Column lines E-H, 7.1-11.1		
LOAD	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Dryer/separator canal plugs (upper plug 65 tons; lower plugs 3 at 40 tons)	855'-0"	drywell, reactor vessel	d
	833'-6"	division I and II electrical conduit	
	812'-0"	division II electrical tray and conduit, division I electrical conduit, emergency service water piping	
	786'-0"	division I electrical tray and conduit, division II electrical conduit	
	757'-6"	division II electrical tray and conduit, division I electrical conduit; RHR system piping	
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping, RHR service water piping	

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA	Column lines D-G, 7.1-10.1		
LOAD	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Spent fuel pool refueling slot plugs (upper plug - 7.5 tons; lower plugs - 4 at 6.5 tons)	855'-0"	drywell, reactor vessel, spent fuel pool	d
	833'-6"	division I and I electrical conduit	
	812'-0"	division II electrical tray and conduit, division I electrical conduit, emergency service water piping	
	786'-0"	division I electrical tray and conduit, division II electrical conduit	
	757'-6"	division II electrical tray and conduit, division I electrical conduit, RHR system piping	
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping, RHR service water piping	

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines D-G, 7.1-10.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Drywell head (46 tons)	855'-0"	drywell, reactor vessel	d
	833'-6"	division I and II electrical conduit	
	812'-0"	division II electrical tray and conduit, division I electrical conduit	
	786'-0"	division I electrical tray and conduit, division II electrical conduit	
	757'-6"	division II electrical tray and conduit, division I electrical conduit, RHR system piping	
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping, RHR service water piping	

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines D-G, 7.1-11.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Vessel head insulation (3 1/2 tons)	855'-0"	reactor vessel	e
	833'-6"	division I and II electrical conduit	↓
	812'-0"	division II electrical tray and conduit, division I electrical conduit, control building chillers, emergency service water piping	↓
	786'-0"	division I electrical tray and conduit, division II electrical conduit, standby gas treatment system	↓
	757'-6"	division II electrical tray and conduit, division I electrical conduit, CRD hydraulic control units, RHR system piping	↓
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping, RHR service water piping	↓

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines F-H, 7.1-9.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Head stud rack (2.3 tons)	855'-0"	reactor vessel	c
	833'-6"	none	
	812'-0"	none	
	786'-0"	none	
	757'-6"	none	
	716'-9"	none	

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines E-G, 6.1-9.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Stud tensioner (6 tons)	855'-0"	reactor vessel	c
	833'-6"	none	e
	812'-0"	spent fuel pool cooling system piping and components	
	786'-0"	division I electrical tray and conduit, division II electrical conduit	
	757'-6"	division II electrical tray and conduit, division I electrical conduit, RHR system piping	
	716'-9"	suppression pool; RHR system piping and components, emergency service water piping, RHR service water piping	

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines D-G, 7.1-9.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Reactor vessel head (56 tons)	855'-0"	reactor vessel	d
	833'-6"	none	
	812'-0"	division II electrical tray and conduit, division I electrical conduit, spent fuel pool cooling system piping and components	
	786'-0"	division I electrical tray and conduit, division II electrical conduit	
	757'-6"	division II electrical tray and conduit, division I electrical conduit, RHR system piping	
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping, RHR service water piping	

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA	Column lines F-H, 7.1-10.1		
LOAD	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Steam dryer (24 tons)	855'-0"	reactor vessel, dryer separator storage pool	e
	833'-6"	none	↓
	812'-0"	division II electrical tray and conduit, division I electrical conduit, control building chillers, emergency service water piping	↓
	786'-0"	division I electrical tray and conduit, division II electrical conduit, standby gas treatment system	↓
	757'-6"	division II electrical tray and conduit, division I electrical conduit, CRD hydraulic control units	↓
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping	↓

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines F-H, 7.1-10.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Shroud head and steam separators (33.4 tons)	855'-0"	reactor vessel, dryer-separator storage pool	e
	833'-6"	none	
	812'-0"	division II electrical tray and conduit, division I electrical conduit, control building chillers, emergency service water piping	
	786'-0"	division I electrical tray and conduit, division II electrical conduit, standby gas treatment system	
	757'-6"	division II electrical tray and conduit, division I electrical conduit, CRD hydraulic control units	
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping	

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines E-G, 5.2-9.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Reactor vessel service platform (5 tons)	855'-0"	reactor vessel, spent fuel pool	d
	833'-6"	spent fuel pool cooling system piping and components	↓
	812'-0"	spent fuel pool cooling system piping and components	↓
	786'-0"	division I electrical tray and conduit, division II electrical conduit	↓
	757'-6"	division II electrical tray and conduit, division I electrical conduit, RHR system piping	↓
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping, RHR service water piping	↓

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines E-H, 5.2-8.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Jib crane for service platform (≤ 1 ton)	855'-0"	reactor vessel, spent fuel pool	d
	833'-6"	spent fuel pool cooling system piping and components	e
	812'-0"	spent fuel pool cooling system piping and components	
	786'-0"	division I electrical tray and conduit; division II electrical conduit	
	757'-6"	division II electrical tray and conduit, division I electrical conduit, RHR system piping	
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping, RHR service water piping	

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines E-G, 5.2-9.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
In-vessel work platform (1½ tons)	855'-0"	reactor vessel, spent fuel pool	d
	833'-6"	spent fuel pool cooling system piping and components	↓
	812'-0"	spent fuel pool cooling system piping and components	↓
	786'-0"	division I electrical tray and conduit, division II electrical conduit	↓
	757'-6"	division II electrical tray and conduit, division I electrical conduit, RHR system piping	↓
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping, RHR service water piping	↓

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA	Column lines D-G, 7.1-10.1		
LOAD	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Cattle chute shield (15.25 tons)	855'-0"	reactor vessel	d
	833'-6"	division I and II electrical conduit	
	812'-0"	division II electrical tray and conduit, division I electrical conduit, emergency service water piping	
	786'-0"	division I electrical tray and conduit, division II electrical conduit	
	757'-6"	division II electrical tray and conduit, division I electrical conduit, RHR system piping	
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping, RHR service water piping	

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines F-G, 7.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Spent fuel pool refueling slot gates (1 at 6 tons, 1 at 3 tons)	855'-0"	reactor vessel, spent fuel pool	d
	833'-6"	none	
	812'-0"	none	
	786'-0"	none	
	757'-6"	none	
	716'-9"	none	

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines $F\text{-}F_a$, 5.1-7.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Spent fuel shipping cask pool slot gate (1.05 tons)	855'-0"	spent fuel pool	d
	833'-6"	spent fuel pool cooling system piping and components	
	812'-0"	spent fuel pool cooling system piping and components	
	786'-0"	none	
	757'-6"	none	
	716'-9"	none	

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines D-F_a, 5.2-8.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Spent fuel shipping cask (65 tons)	855'-0"	spent fuel pool	d
	833'-6"	spent fuel pool cooling system piping and components	↓
	812'-0"	spent fuel pool cooling system piping and components	↓
	786'-0"	division I electrical tray and conduit, division II electrical conduit	↓
	757'-6"	division II electrical tray and conduit, division I electrical conduit, RHR system piping	↓
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping, RHR service water piping	↓

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines D-H, 5.2-9.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Hatches and shield plugs (equipment hatch sections - 5 at 2 tons; skimmer tank area plugs-2 at 4 tons, 1 at 3.5 tons; new fuel storage vault plugs-4 at 3 tons; reactor pool moisture separator area plug - 1 at 4 tons)	855'-0"	spent fuel pool	d
	833'-6"	spent fuel pool cooling system piping and components	
	812'-0"	spent fuel pool cooling system piping and components	
	786'-0"	division I electrical tray and conduit, division II electrical conduit	
	757'-6"	division II electrical tray and conduit, division I electrical conduit, RHR system piping	
	716'-9"	suppression pool; RHR system piping and components, emergency service water piping, RHR service water piping	

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines D-F, 5.2-8.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
New fuel crates (1 ton)	855'-0"	none	e
	833'-6"	none	↓
	812'-0"	division II electrical tray and conduit, division I electrical conduit, control building chillers, emergency service water piping, spent fuel pool cooling system piping and components	↓
	786'-0"	division I electrical tray and conduit, division II electrical conduit	↓
	757'-6"	division II electrical tray and conduit, division I electrical conduit, RHR system piping	↓
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping, RHR service water piping	↓

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines D-F, 6.1-10.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
LPRM strings and crate ($\leq$ 2.5 tons)	855'-0"	none	—
	833'-6"	none	—
	812'-0"	spent fuel pool cooling system piping and components	e
	786'-0"	division I electrical tray and conduit, division II electrical conduit	
	757'-6"	division II electrical tray and conduit, division I electrical conduit, RHR system piping	
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping, RHR service water piping	

LOAD/IMPACT AREA MATRIX

CRANE: Reactor Building Crane (1H-001)

LOCATION	Reactor Building (Refueling floor)		
IMPACT AREA / LOAD	Column lines D-H, 6.1-10.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Radwaste shipping cask (25 tons)	855'-0"	none	d
	833'-6"	none	
	812'-0"	division II electrical tray and conduit, division I electrical conduit, emergency service water piping, spent fuel pool cooling system piping and components	
	786'-0"	division I electrical tray and conduit, division II electrical conduit	
	757'-6"	division II electrical tray and conduit, division I electrical conduit, hydraulic control units, RHR system piping	
	716'-9"	suppression pool, RHR system piping and components, emergency service water piping, RHR service water piping	

LOAD/IMPACT AREA MATRIX

CRANE: Shield Blocks and Personnel Lock Hoist (1H-013)

LOCATION	Reactor Building		
IMPACT AREA / LOAD	Column lines D-F, 5.1-7.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Shield Blocks (Four blocks - 19 tons, Three blocks - 10 tons, One block - 16 tons, One block - 12 tons)	757'-6"	Personnel lock	c
	716'-9"	Suppression pool, RHR pump suction crosstie/shutdown cooling piping, HPCI steam piping, emergency service water piping, RHR service water piping, RCIC pump suction piping, core spray pump suction from CST, electrical conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Shield Blocks and Personnel Lock Hoist (1H-013)

LOCATION	Reactor Building		
IMPACT AREA / LOAD	Column Lines D-F, 5.1-7.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Personnel lock (25 tons)	757'-6"	none	-
	716'-9"	same as above for shield blocks Note: Load lift height will be limited to preclude the possibility of floor failure if the load is dropped.	see note below

LOAD/IMPACT AREA MATRIX

CRANE: Recirculation Pump Motor Hoist (1H-005A)

LOCATION	Reactor Building (drywell)		
IMPACT AREA / LOAD	Column lines Fa-H, 8.1-9.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Recirculation pump motor (12 tons)	757'-6"	Recirculation pump, recirculation system piping, safety relief valve discharge piping, electrical conduit	b

LOAD/IMPACT AREA MATRIX

CRANE: Recirculation Pump Motor Hoist (1H-005B)

LOCATION	Reactor Building (Drywell)		
IMPACT AREA / LOAD	Column lines E-Fa, 7.1-8.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Recirculation pump motor (12 tons)	757'-6"	Recirculation pump, recirculation system piping, safety relief valve discharge piping, electrical conduit	b

LOAD/IMPACT AREA MATRIX

CRANE: Steam Valve Area Monorail

LOCATION	Reactor Building		
IMPACT AREA / LOAD	Column Lines H - J, 5.2 - 9.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
MSIV (2.33 tons), Feedwater isolation valve (4 tons), miscellaneous maintenance loads	757'-6"	Main steam, feedwater, RCIC steam, HPCI steam, RCIC discharge, and HPCI discharge piping; MSIV's, feedwater isolation valves	c
	716'-9"	Suppression pool, RHR pump suction piping, RHR pump discharge piping, RHR pumps, emergency service water piping, RHR service water piping, electrical conduit	b

LOAD/IMPACT AREA MATRIX

CRANE: Spent Fuel Pool Gamma Scan Collimator Port Hoist (1H-023)

LOCATION	Reactor Building		
IMPACT AREA / LOAD	Column Lines Fa - Gd, 5.1-6.1		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Gamma Scan Collimator Port Shield Plug (1/2 ton)	812'-0"	none	-
	786'-0"	electrical conduit and tray	e

LOAD/IMPACT AREA MATRIX

CRANE: Torus Monorail

LOCATION	Reactor Building (Torus)		
IMPACT AREA / LOAD	Inside Torus		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Vacuum breakers (1/2 ton), Miscellaneous loads ($\leq$ 3 tons)	716'-9"	Suppression pool, RHR and core spray piping, torus vent header, safety relief valve discharge piping	c

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
High-pressure turbine upper shell (68 tons)	780'-0"	RPS instrumentation	c
	757'-6"	startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
High-pressure turbine rotor (48 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column Lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
High pressure turbine diaphragms ($\leq$ 1.9 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducst, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column Lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Low pressure turbine A exhaust hood (65 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducst, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Low-pressure turbine A upper inner casing (49 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Low-pressure turbine A rotor (129 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Low pressure turbine B exhaust hood	780'-0"	RPS instrumentation	b
	757'-6"	Startup transformer bus ducts, diesel generators	c
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Low-pressure turbine B upper inner casing (49 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Low-pressure turbine B rotor (133 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Low pressure turbine diaphragms ($\leq$ 2.2 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Turbine main stop valve components ($\leq$ 20.5 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Turbine control valve components ($\leq$ 9 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Turbine combined intermediate valve components ($\leq$ 21 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Alterrex, including base and housing (25 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA	Column lines L-Q, 4-14		
LOAD	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Generator outer end shield (5 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Generator inner end shield (1.5 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Generator field (141 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Generator hydrogen cooler (1 ton)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Reactor feed pump motor (18 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

LOAD/IMPACT AREA MATRIX

CRANE: Turbine Building Crane (1H-003)

LOCATION	Turbine Building		
IMPACT AREA / LOAD	Column lines L-Q, 4-14		
	ELEVATION	SAFETY RELATED EQUIPMENT	HAZARD ELIMINATION CATEGORY
Radwaste liner (9 tons), Radwaste shipping cask with liner (25 tons)	780'-0"	RPS instrumentation	c
	757'-6"	Startup transformer bus ducts, diesel generators	b
	734'-0"	Division I electrical tray, Division II embedded conduit	e

APPENDIX B

ANALYSIS OF PLANT STRUCTURES

(10 PAGES)

ANALYSIS OF PLANT STRUCTURES

Load Drop Analysis - Steam Separator

1. Initial Conditions/Assumptions

   a. Load weight - 66,700 lbs.
   b. Impact area - 8.5 ft^2
   c. Drop Height - 6 feet
   d. Drop location - dryer separator storage pool
   e. Credit taken in analysis for the action of impact limiters - none
   f. Thickness of walls or floor slabs impacted - 3 feet
   g. Assumptions regarding drag forces caused by the environment - drag force neglected
   h. Load combinations considered - steam separator dead load plus impact load
   i. Material properties of steel and concrete - concrete compressive strength, 5,000 psi - reinforcing steel yield strength, 60,000 psi

2. Methods of Analysis

   The dryer-separator storage pool was analyzed for the postulated drop of the steam separator from the reactor building crane. The effect of the load drop on the dryer-separator storage pool concrete slab was evaluated using the conservation of energy and momentum theory described in Reference 1. The pool slab was the only structural component considered in this analysis (i.e., the strength of the structural steel below the pool slab was neglected). The slab was also checked for the local effects of perforation, penetration, and spalling using the methods described in Reference 2.

3. Conclusion

   Analysis of a postulated drop of the steam separator over the reactor vessel, documented in the DAEC FSAR, concluded that water leakage that could uncover the fuel would not occur. Analysis of a drop of this load over the dryer-separator pool concluded that the load would not penetrate the pool bottom slab, or cause spalling on the underside of the slab. If credit is taken for water in the dryer separator pool while the load is being handled, the resultant impact energy would be decreased. However, if any water leakage did result from this load drop, equipment required for reactor shutdown and decay heat removal would be unaffected. Therefore, damage to equipment which could occur following a drop of this load complies with NUREG 0612, Section 5.1, Criteria III and IV.

ANALYSIS OF PLANT STRUCTURES

Load Drop Analysis - Steam Dryer

1. Initial Conditions/Assumptions

   a. Load weight - 48,000 lbs.
   b. Impact area - 2.8 ft^2
   c. Drop height - 6 feet
   d. Drop location - dryer separator storage pool
   e. Credit taken in analysis for the action of impact limiters - none
   f. Thickness of walls or floor slabs impacted - 3 feet
   g. Assumptions regarding drag forces caused by the environment - drag force neglected
   h. Load combinations considered - steam dryer dead load plus impact load
   i. Material properties of steel and concrete - concrete compressive strength, 5,000 psi - reinforcing steel yield strength, 60,000 psi

2. Method of Analysis

   Analysis of this load was scoped by the analysis of the steam separator.

3. Conclusion

   The conclusion for the analysis of a postulated drop of the steam dryer is the same as that for the steam separator, except that the steam dryer is only handled in air.

ANALYSIS OF PLANT STRUCTURES

Load Drop Analysis - New Fuel Crates

1. Initial Conditions/Assumptions

   a. Load weight - 1850 lbs.
   b. Impact area - 0.8 ft^2
   c. Drop height - 100 ft
   d. Drop location - reactor building equipment hatch area
   e. Credit taken in analysis for the action of impact limiters - none
   f. Thickness of walls or floor slabs impacted - 3 feet
   g. Assumptions regarding drag forces caused by the environment - drag force neglected
   h. Load combinations considered - fuel crate dead load plus impact load
   i. Material properties of steel and concrete - concrete compressive strength, 5,000 psi - reinforcing steel yield strength, 60,000 psi

2. Method of Analysis

   The reactor building floor at elevation 757'-6" was analyzed for the postulated drop of a new fuel crate in the reactor building equipment hatch area from the refueling floor elevation (855'-0"). This analysis was based on the conservation of energy and momentum theory described in Reference 1. The local effects of perforation, penetration, and spalling of the slab were also evaluated using the methods described in Reference 2.

3. Conclusion

   Analysis of a postulated drop of a new fuel crate over the reactor building equipment hatch from the refueling floor elevation concluded that the load would not penetrate or cause spalling of the slab at elevation 757'-6". Therefore, damage to equipment which could occur following a drop of this load complies with NUREG 0612, Section 5.1, Criteria IV.

ANALYSIS OF PLANT STRUCTURES

Load Drop Analysis - Vessel Head Insulation

1. Initial Conditions/Assumptions

   a. Load weight - 7,000 lbs.
   b. Impact area - 4.0 ft^2
   c. Drop height - 7.5 feet
   d. Drop location - refueling floor - adjacent to reactor well and dryer-separator pool
   e. Credit taken in analysis for the action of impact limiters - none
   f. Thickness of walls or floor slabs impacted - 1 foot
   g. Assumptions regarding drag forces caused by the environment - drag forces neglected
   h. Load combinations considered - vessel head insulation dead load plus impact load
   i. Material properties of steel and concrete - concrete compressive strength, 4,000 psi - reinforcing steel yield strength, 60,000 psi

2. Method of Analysis

   The refueling floor of the reactor building (elevation 855'-0") was analyzed for the postulated drop of the vessel head insulation from the reactor building crane. The effects of the load impact on this floor were evaluated using the conservation of energy and momentum theory described in Reference 1.

3. Conclusion

   Analysis of a postulated drop of the vessel head insulation above the refueling floor concluded that the dropped load would not penetrate or cause spalling of the refueling floor slab. Therefore, damage to equipment which could occur following a drop of this load complies with NUREG 0612, Section 5.1, Criteria IV.

ANALYSIS OF PLANT STRUCTURES

Load Drop Analysis - Stud Tensioner

1. Initial Conditions/Assumptions

   a. Load weight - 12,000 lbs.
   b. Impact area - 1.0 ft^2 (one stud tensioner); 30 ft^2 (complete assembly)
   c. Drop height - 6 feet
   d. Drop location - refueling floor (elevation 855'-0") stud tensioner storage area
   e. Credit taken in analysis for the action of impact limiters - none
   f. Thickness of walls or floor slabs impacted - 1 foot
   g. Assumptions regarding drag forces caused by the environment - drag force neglected
   h. Load combinations considered - stud tensioner dead load plus impact load
   i. Material properties of steel and concrete - concrete compressive strength, 4,000 psi - reinforcing steel yield strength, 60,000 psi

2. Method of Analysis

   The refueling floor slab of the reactor building (elevation 855'-0") was analyzed for the postulated drop of the stud tensioner from the reactor building crane. The effects of the load impact on this floor were evaluated using the conservation of energy and momentum theory described in Reference 1.

3. Conclusion

   Analysis of a postulated drop of the stud tensioner above the refueling floor of the reactor building concluded that the dropped load would not penetrate or cause spalling of the refueling floor slab. Therefore, damage to equipment which could occur following a drop of this load complies with NUREG 0612, Section 5.1, Criteria IV.

ANALYSIS OF PLANT STRUCTURES

Load Drop Analysis - Reactor Feedpump Motor

1. Initial Conditions/Assumptions

   a. Load weight - 36,000 lbs.
   b. Impact area - 7.1 ft^2
   c. Drop height - 50 feet
   d. Drop location - turbine building (west reactor feedpump hatch area)
   e. Credit taken in analysis for the action of impact limiters - none
   f. Thickness of walls or floor slabs impacted - 5 feet
   g. Assumptions regarding drag forces caused by the environment - drag force neglected
   h. Load combinations considered - reactor feedpump motor dead load plus impact load
   i. Material properties of steel and concrete - concrete compressive strength, 5,000 psi - reinforcing steel yield strength, 60,000 psi

2. Method of Analysis

   The turbine building foundation mat was analyzed for the postulated drop of a reactor feedpump motor in the area of the west reactor feedpump hatch. The foundation mat was analyzed for penetration and spalling, using the methods described in Reference 2, to determine if conduit embedded in the mat would be affected.

3. Conclusion

   Analysis of a postulated drop of a reactor feedpump motor over the west reactor feedpump hatch concluded that no damage to safety-related conduits embedded in the turbine building foundation slab near the area of the hatch would occur. Therefore, damage to equipment following a drop of this load complies with NUREG 0612, Section 5.1, Criteria IV.

Load Drop Analysis - Shield Blocks

1. Initial Conditions/Assumptions

   a. Load weight - 36,000 lbs.
   b. Impact area - 1.0 ft^2
   c. Drop height - 16 feet
   d. Drop location - reactor building floor (elevation 757'-6") adjacent to drywell equipment hatch
   e. Credit taken in analysis for the action of impact limiters - none
   f. Thickness of walls or floor slabs impacted - 3 feet
   g. Assumptions regarding drag forces caused by the environment - drag force neglected
   h. Load combinations considered - shield block dead load plus impact load
   i. Material properties of steel and concrete - concrete compressive strength, 5,000 psi - reinforcing steel yield strength, 60,000 psi

2. Method of Analysis

   The reactor building floor slab at elevation 757'-6" was analyzed for the postulated drop of a shield block from the shield block and personnel lock hoist. The effect of the load impact on the concrete slab was evaluated using the conservation of energy and momentum theory described in Reference 1. The slab was also checked for the local effects of perforation, penetration, and spalling using the methods described in Reference 2.

3. Conclusion

   Analysis of a postulated drop of a shield block from the shield block and personnel lock hoist concluded that the load would not penetrate the floor, nor would there be spalling of concrete on the underside of the slab. Therefore, damage to equipment which could occur following a drop of a shield block complies with NUREG 0612, Section 5.1, Criteria IV.

ANALYSIS OF PLANT STRUCTURES

Load Drop Analysis - Gamma Scan Collimator Shield Plug

1. Initial Conditions/Assumptions

   a. Load weight - 900 lbs.
   b. Impact area - 1.0 ft^2
   c. Drop height - 22 ft
   d. Drop location - spent fuel pool skimmer tank area
   e. Credit taken in analysis for the action of impact limiters - none
   f. Thickness of walls or floor slabs impacted - 2 ft
   g. Assumptions regarding drag forces caused by the environment - drag force neglected
   h. Load combinations considered - shield plug dead load plus impact load
   i. Material properties of steel and concrete - concrete compressive strength, 4,000 psi - reinforcing steel yield strength, 60,000 psi

2. Method of Analysis

   The reactor building floor at elevation 812'-0" in the spent fuel pool skimmer tank area was analyzed for the postulated drop of the gamma scan collimator shield plug. The effect of the load impact on the concrete slab was evaluated using the conservation of energy and momentum theory described in Reference 1. The slab was also checked for the local effects of perforation, penetration, and spalling using the methods described in Reference 2.

3. Conclusion

   Analysis of the postulated drop of the shield plug from the gamma scan collimator port hoist concluded that the load would not penetrate or cause spalling of the floor below the hoist. Therefore, damage to equipment which could occur following a drop of this load complies with NUREG 0612, Section 5.1, Criteria IV.

ANALYSIS OF PLANT STRUCTURES

Load Drop Analysis - Fuel Pool Demineralizer Area Shield Plugs

1. Initial Conditions/Assumptions

   a. Load weight - 9,000 - 17,000 lbs.
   b. Impact area - 1.0 ft^2
   c. Drop height - 1 foot
   d. Drop location - reactor building floor elevation 833'-6" directly over demineralizer vessels
   e. Credit taken in analysis for the action of impact limiters - none
   f. Thickness of walls or floor slabs impacted - 1.5 feet (floor slab at 833'-6" with 1.5 to 3.0 feet thick walls below; - 2.5 feet (floor slab at 812'-0')
   g. Assumptions regarding drag forces caused by the environment - drag force neglected
   h. Load combinations considered - dead load plus impact load
   i. Material properties of steel and concrete - concrete compressive strength, 4,000 psi - reinforcing steel yield strength, 60,000 psi

2. Method of Analysis

   The reactor building floor at elevation 833'-6" was analyzed for the postulated drop of a shield plug from the fuel pool demineralizer area hoist. The analysis considered the following:

   a. except for one, two-piece shield plug, each shield plug lifted by the hoist is larger than the opening in its demineralizer vault,
   b. each demineralizer vault is formed by block walls ranging in thickness from 1-1/2 to 3 feet, located below floor elevation 833'-6",
   c. shield blocks are only lifted a short distance (approximately 1 foot) above the floor during removal or replacement
   d. to postulate the maximum damage that could occur, the drop of either half of the two-piece shield plug only considered impact on the concrete slab below, i.e., impact on the demineralizer vessel was ignored.

   The effect of the load impact on the concrete slab was evaluated using the conservation of energy and momentum theory described in Reference 1.

3. Conclusion

   Analysis of a postulated drop of a shield plug from the fuel pool demineralizer area hoist concluded that the dropped load would not pass through its vault or penetrate the floor at elevation 812'-0". Additionally, the analysis concluded that spalling of the underside of the slab at elevation 833'-6" and 812'-0" would not occur. Therefore, damage to equipment following a drop of any of the shield plugs complies with NUREG 0612, Section 5.1, Criteria IV.

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1. BC-TOP-9A, Revision 2 (September 1974), Topical Report, Design of Structures For Missile Impact, Bechtel Power Corporation, San Francisco, California.

2. J.V. Rotz, Evaluation of Tornado Missile Impact Effects on Structures, Symposium on Tornados; Assessment of Knowledge and Implications for Man, Texas Technical University, Lubbrock, Texas (June 22-24, 1976).

TABLE 1

HOISTS AND CRANES AT THE DUANE ARNOLD ENERGY CENTER

Equipment Number	Service	Floor Elevation	Capacity/Type	Figure Number	Location
1H-001	Reactor building crane	855'-0"	100-ton main hoist, 5-ton auxiliary hoist/overhead bridge crane	5	Reactor building
1H-003	Turbine building crane	780'-0"	125-ton main hoist, 25-ton auxiliary hoist/overhead bridge crane	3	Turbine building
1H-005A/B	Recirculation pump motor hoist	--	12-ton manual chain hoist/monorail	2	Reactor building (drywell)
1H-006	Jib crane for refueling facility channel handling	855'-0"	200-pound manual cable hoist/jib crane	5	Reactor building (refueling floor)
1H-008A/B	Radwaste building centrifuge hoist	786'-0"	2-ton manual chain hoist/monorail	3	Radwaste building
1H-009A	Radwaste building sump cover hoist	757'-6"	3-ton manual chain hoist/monorail	2	Radwaste building
1H-010	Radwaste building maintenance hoist	786'-0"	10-ton electric cable hoist/monorail	3	Radwaste building
1H-011	Jib crane for refueling facility floor and service platform	855'-0"	1,000-pound electric cable hoist/jib crane	5	Reactor building (refueling floor)

Tab[illegible] (continued)

Equipment Number	Service	Floor Elevation	Capacity/Type	Figure Number	Location
1H-012	Chlorine building hoist	757'-6"	2-ton electric cable hoist/monorail	7	Pumphouse (chlorine building)
1H-013	Shield blocks and personnel lock hoist	757'-6"	24-ton electric chain hoist/monorail	2	Reactor building
1H-014	Machine shop crane	757'-6"	5-ton electric bridge crane	6	Machine shop
1H-015A	CRD assembly platform hoist	--	1-ton electric chain hoist	2	Reactor building (drywell)
1H-015B	CRD assembly platform hoist	--	1-ton electric chain hoist	2	Reactor building (drywell)
1H-016A/B	Cooling tower discharge screen hoist	755'-0"	2-ton manual chain hoist/jib crane	--	Cooling tower
1H-017	Steam valve area monorails	757'-6"	10-ton monorails (3) (Note 1)	2	Reactor building (steam tunnel)
1H-018	Fuel pool demineralizer area hoist	833'-6"	10-ton manual chain hoist/monorail	4	Reactor building
1H-020	Drywell maintenance hoist	--	5-ton manual chain hoist/monorail (Note 2)	3	Reactor building (drywell)
1H-021	Drywell maintenance hoist	--	3-ton manual chain hoist/monorail (Note 2)	4	Reactor building (drywell)
1H-022	Condensate demineralizer area hoist	780'-0"	5-ton manual chain hoist/5-ton electric chain hoist/monorail	3	Turbine building

Tab[illegible] (continued)

Equipment Number	Service	Floor Elevation	Capacity/Type	Figure Number	Location
1H-023	Spent fuel pool gamma-scan collimator port hoist	812'-0"	1-ton manual chain hoist/monorail	4	Reactor building
1H-024	Machine shop decontamination room hoist	757'-6"	3-ton manual chain hoist/monorail (Note 2)	6	Machine shop
1H-026A/B	Radial and side gate hoist	754'-0"	10-ton electric cable hoist	8	Intake structure (outside of building)
1H-030	Chemical waste filter hoist	716'-9"	1-ton hoist/monorail	1	Reactor building
1H-204	CRD handling equipment	--	1,000-pound electric cable hoist	--	Reactor building (CRD handling platform under reactor vessel)
1H-207	Refueling platform fuel grapple hoist	855'-0"	1-ton electric cable hoist	5	Reactor building (refueling floor)
1H-208	Refueling platform frame-mounted auxiliary hoist	855'-0"	1,000-pound electric cable hoist	5	Reactor building (refueling floor)
1H-209	Refueling platform monorail-mounted auxiliary hoist	855'-0"	1,000-pound electric cable hoist/monorail	5	Reactor building (refueling floor)
--	Torus monorail	716'-9"	3-ton monorail	1	Reactor building (suppression pool)
--	Condensate demineralizer holding pump hoist	780'-0"	2-ton manual chain hoist/monorail	3	Turbine building

Tab[illegible] (continued)

Equipment Number	Service	Floor Elevation	Capacity/Type	Figure Number	Location
--	Offgas prefilter hoist	757'-6"	--/monorail	6 building	Offgas retention
--	Radwaste building empty drum and cap storage area hoist	757'-6"	3-ton manual chain hoist/monorail	2	Radwaste building
--	Radwaste building monorail	786'-0"	2-ton monorail	3	Radwaste building
--	Carbon adsorber vault hoists	739'-6"	--monorails Two	6	Offgas retention building
--	Radwaste building truck loading hoist	757'-6"	1,000-pound electric cable hoist/bridge crane	2	Radwaste building (truck bay)
--	HPCI room monorail	716'-9"	10-ton monorail	1	HPCI/RCIC building
--	Construction hoist	833'-6"	1-ton air winch/ boom crane	4	Reactor building (truck/rail bay)
--	Construction hoist	780'-0"	1-ton air winch/ boom crane	3	Turbine building (truck bay)

Notes:

1. Hoists not installed on monorail(s)
2. Hoist not used, monorail partially removed

TABLE 2

SYSTEMS CONSIDERED IN REVIEW OF POTENTIAL HEAVY LOAD DROPS AT THE DUANE ARNOLD ENERGY CENTER

1. Reactor vessel and internals
2. Reactor recirculation system
3. Main steam system (up to turbine main stop valves)
4. Feedwater system (stop check valves to reactor)
5. Control rod drive system (scram portion only)
6. RHR system
7. RHR service water system
8. Emergency service water system
9. River water supply system
10. Standby gas treatment system
11. Diesel generator room HVAC
12. RHR/CS pump room HVAC
13. Reactor building isolation dampers
14. Offgas stack
15. RHR service water pump room HVAC
16. Intake structure HVAC
17. Reactor vessel instrumentation
18. Emergency diesel generator and fuel systems
19. Primary containment isolation and NSSS shutoff system
20. Standby ac power
21. DC power
22. Reactor protection system
23. Leak detection systems
24. Fuel pool cooling system
25. RCIC system
26. RCIC room HVAC

TABLE 3

OVERHEAD HANDLING SYSTEMS LOCATED IN THE VICINITY OF SAFE SHUTDOWN EQUIPMENT

Equipment Number	Service	Floor Elevation	Capacity/Type	Figure Number	Location
1H-001	Reactor building crane	855'-0"	100-ton main hoist, 5-ton auxiliary hoist/overhead crane	5	Reactor building
1H-003	Turbine building crane	780'-0"	125-ton main hoist, 25-ton auxiliary hoist/overhead crane	3	Turbine building
1H-005A/B	Recirculation pump motor hoist	--	12-ton manual chain hoist/monorail	2	Reactor building (drywell)
1H-013	Shield blocks and personnel lock hoist	757'-6"	24-ton electric chain hoist/monorail	2	Reactor building
1H-017	Steam valve area monorails	757'-6"	10-ton monorails (3)	2	Reactor building (steam tunnel)
1H-018	Fuel pool demineralizer area hoist	833'-6"	10-ton manual chain hoist/monorail	4	Reactor building
1H-020	Drywell maintenance hoist	--	5-ton manual chain hoist/monorail	3	Reactor building (drywell)
1H-021	Drywell maintenance hoist	--	3-ton manual chain hoist/monorail	4	Reactor building (drywell)
1H-023	Spent fuel pool gamma-scan collimator port hoist	812'-0"	1-ton manual chain hoist/monorail	4	Reactor building
--	Torus monorail	716'-9"	3-ton monorail	1	Reactor building (suppression pool)

TABLE 4

OVERHEAD HANDLING SYSTEMS NOT LOCATED IN THE VICINITY OF SAFE SHUTDOWN EQUIPMENT

Equipment Number	Service	Floor Elevation	Capacity/Type	Figure Number	Location
1H-006	Jib crane for refueling facility channel handling	855'-0"	200-pound manual cable hoist/jib crane	5	Reactor building (refueling floor)
1H-008A/B	Radwaste building centrifuge hoist	786'-0"	2-ton manual chain hoist/monorail	3	Radwaste building
1H-009A	Radwaste building sump cover hoist	757'-6"	3-ton manual chain hoist/monorail	2	Radwaste building
1H-010	Radwaste building maintenance hoist	786'-0"	10-ton electric cable hoist/monorail	3	Radwaste building
1H-011	Jib crane for refueling facility floor and service platform	855'-0"	1,000-pound electric cable hoist/jib crane	5	Reactor building (refueling floor)
1H-012	Chlorine building hoist	757'-6"	2-ton electric cable hoist/monorail	7	Pumphouse (chlorine building)
1H-014	Machine shop crane	757'-6"	5-ton electric bridge crane	6	Machine shop
1H-015A/B	CRD assembly platform hoist	--	1-ton electric chain hoist	2	Reactor building (drywell)
1H-016A/B	Cooling tower discharge screen hoist	755'-0"	2-ton manual chain hoist/jib crane	--	Cooling tower

Tab[illegible] (continued)

Equipment Number	Service	Floor Elevation	Capacity/Type	Figure Number	Location
1H-022	Condensate demineralizer area hoist	780'-0"	5-ton manual chain hoist/5-ton electric chain hoist/monorail	3	Turbine building
1H-024	Machine shop decontamination room hoist	757'-6"	3-ton manual chain hoist/monorail (Note 2)	6	Machine shop
1H-026A/B	Radial and side gate hoist	754'-0"	10-ton electric cable hoist	8	Intake structure (outside of building)
1H-030	Chemical waste filter hoist	716'-9"	1-ton hoist/monorail	1	Reactor building
1H-204	CRD handling equipment	--	1,000-pound electric cable hoist	--	Reactor building (CRD handling platform under reactor vessel)
1H-207	Refueling platform fuel grapple hoist	855'-0"	1-ton electric cable hoist	5	Reactor building (refueling floor)
1H-208	Refueling platform frame-mounted auxiliary hoist	855'-0"	1,000-pound electric cable hoist	5	Reactor building (refueling floor)
1H-209	Refueling platform monorail-mounted auxiliary hoist	855'-0"	1,000-pound electric cable hoist/monorail	5	Reactor building (refueling floor)
--	Condensate demineralizer holding pump hoist	780'-0"	2-ton manual chain hoist/monorail	3	Turbine building

Tab[illegible] (continued)

Equipment Number	Service	Floor Elevation	Capacity/Type	Figure Number	Location
--	Offgas prefilter hoist	757'-6"	--/monorail	6	Offgas retention building
--	Radwaste building empty drum and cap storage area hoist	757'-6"	3-ton manual chain hoist/monorail	2	Radwaste building
--	Radwaste building monorail	786'-0"	2-ton monorail	3	Radwaste building
--	Carbon adsorber vault hoists	739'-6"	Two monorails	6	Offgas retention building
--	Radwaste building truck loading hoist	757'-6"	1,000-pound electric cable hoist/bridge crane	2	Radwaste building (truck bay)
--	HPCI room monorail	716'-9"	10-ton monorail	1	HPCI/RCIC building
--	Construction hoist	833'-6"	1-ton air winch/ boom crane	4	Reactor building (truck/rail bay)
--	Construction hoist	780'-0"	1-ton air winch/ boom crane	3	Turbine building (truck bay)

Notes:

1. Hoists not installed on monorail(s)
2. Hoist not used, monorail partially removed

TABLE 5

REACTOR BUILDING CRANE HEAVY LOADS

Loads Handled	Approximate Weight (tons)	Special Lifting Device	Lifting Device	Written Procedures	Notes
Drywell head	46	Head strongback	None	RP59/ie-1,2	Note 1
Reactor vessel head	56	Head strongback	None	RP62/ie-5,6	Note 1
Stud tensioner	6	None	None	RP62/ie-5,6	
Steam dryer	24	Dryer-separator sling	None	RP62/ie-5,6	
Shroud head and steam separator	33.4	Dryer-separator sling	None	RP62/ie-5,6	
Reactor well plugs	3 at 70 1 at 75 2 at 67.5	None	Assigned slings	RP62/ie-11	
Dryer/separator canal plugs	1 at 65 3 at 40	None	Assigned slings	RP62/ie-11	
Spent fuel pool - refueling slot plugs	1 at 7.5 4 at 6.5	None	Assigned slings	RP62/ie-11	
Service platform and support	5	None	Service platform sling	RP81/ie-1	
Jib crane for service platform	$\leq$ 1	None	Chain fall, choker, and sling	RP81/ie-1	
Invessel work platform	1.5	None	Assigned slings	RP81/ie-2	

Tab[illegible] (continued)

Loads Handled	Approximate Weight (tons)	Special Lifting Device	Lifting Device	Written Procedures	Notes
Vessel head insulation	3.5	None	Slings	RP62/ie-7,8	
New fuel crates	1	None	Nylon slings, four-legged sling, with additional cradle slings	FRCHP 9	Special spreader bar with bridal slings is used for fuel movement from crate
Spent fuel pool - refueling slot gates	1 at 6 1 at 3	None	Slings	FRCHP 5	
Spent fuel cask	65	Spent fuel cask lifting device	--	None	Shipment of spent fuel not currently planned
Spent fuel shipping cask pool slot gate	1.05	None	Assigned double-hooked sling	RP62/ie-12	Shipment of spent fuel not currently planned
Cattle chute shield	15.2	None	Two reinforcing spacer bars, two double-hooked slings	FRCHP 5	
LPRM strings and crate	$\leq$ 2.5	None	LPRM spreader beam, slings	FRCHP 16	

Tab[illegible] (continued)

Loads Handled	Approximate Weight (tons)	Special Lifting Device	Lifting Device	Written Procedures	Notes
Head stud rack	2.35	None	Slings	RP62/ie-5,6	Includes weight of studs
Radwaste shipping cask	25	None	Slings	None	May be stored in dryer/separator pool
Hatches and shield plugs	2-4	None	Slings		

Note 1: Weight listed includes weight of head strongback (4 tons).

TABLE 6

TURBINE BUILDING CRANE HEAVY LOADS

Loads Handled	Approximate Weight (tons)	Special Lifting Device	Lifting Device	Written Procedures	Notes
1. TURBINE-GENERATOR					
High-pressure turbine upper shell	68	--	Assigned slings	None	
Exhaust hood A	65	--	Assigned slings	None	
Exhaust hood B	65	--	Assigned slings	None	
Low-pressure upper inner casing A	49	--	Assigned slings	None	
Low-pressure upper inner casing B	49	--	Assigned slings	None	
High-pressure rotor	48	Rotor lifting beam/slings	--	None	Note 1
Low-pressure rotor A	129	Rotor lifting beam/slings	--	None	Note 1
Low-pressure rotor B	133	Rotor lifting beam/slings	--	None	Note 1
High-pressure turbine diaphragms	$\leq$ 1.9	--	Turbine diaphragm lifting device	None	
Low-pressure turbine diaphragms	$\leq$ 2.2	--	Turbine diaphragm lifting device	None	
Control valve parts	$\leq$ 9	--	--	None	

Tab[illegible] (continued)

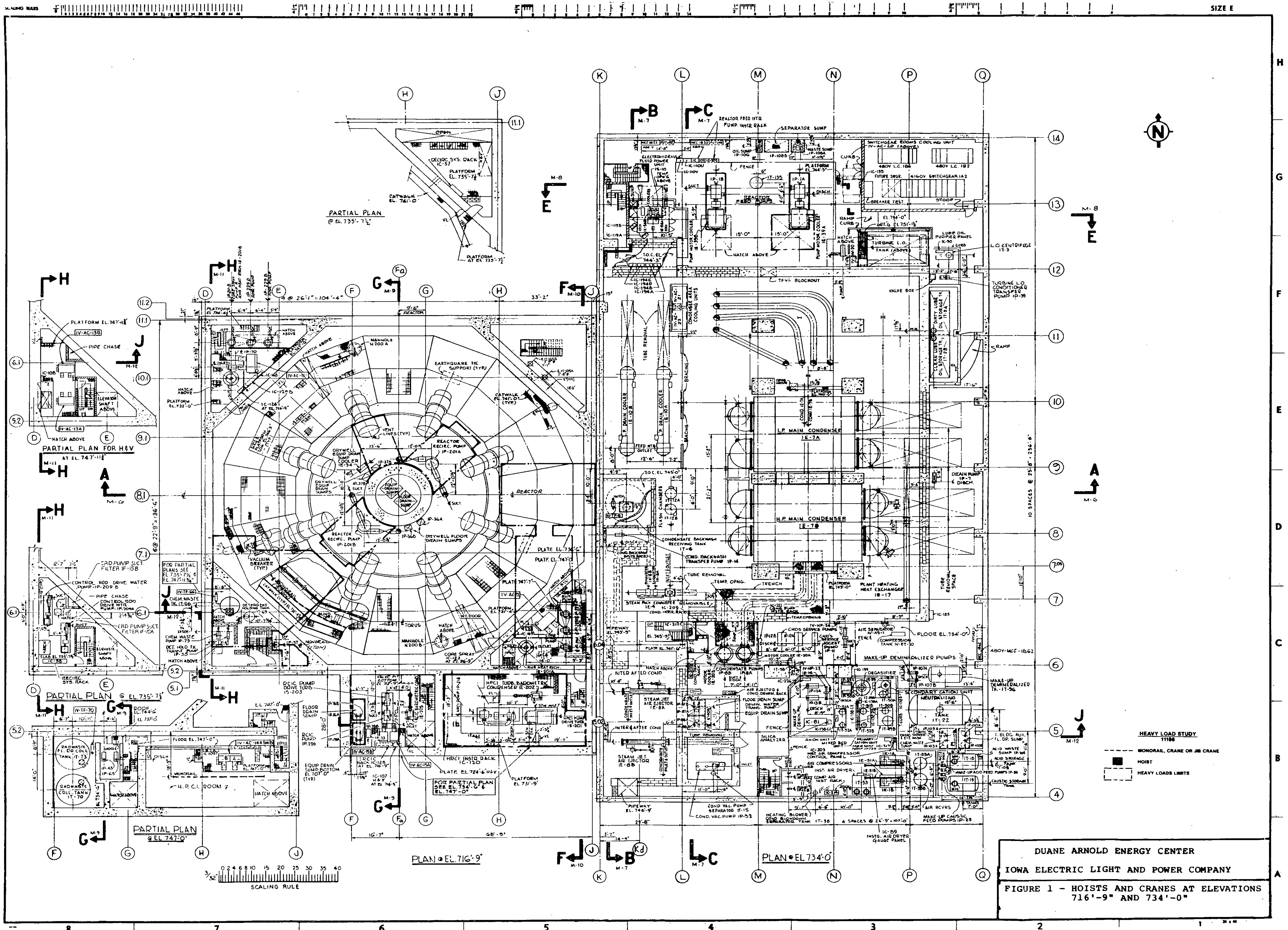
Loads Handled	Approximate Weight (tons)	Special Lifting Device	Lifting Device	Written Procedures	Notes
Main stop valve parts	≤ 20.5	--	--	None	
Combined intermediate valve parts	≤ 21	--	--	None	
Generator outer end shield	5	--	--	None	
Generator inner end shield	1-1/2	--	--	None	
Generator hydrogen cooler	1	--	--	None	
Generator field	141	--	Slings	None	
Alterrex, including base and housing	25	--	Slings	None	
2. REACTOR FEED PUMPS					
Reactor feed pump motor	18	--	--	None	
3. RADWASTE CONTAINERS					
Radwaste liner	9	--	--	None	
Radwaste shipping cask with liner	25	--	--	None	

Note 1: Weight listed includes weight of rotor lifting beam.

TABLE 7

MISCELLANEOUS HOIST/MONORAIL HEAVY LOADS

Overhead Handling System	Loads Handled	Approximate Weight of Load
Recirculation pump motor hoist	Recirculation pump motor	12 tons
Shield blocks and personnel lock hoist	Shield blocks	
	Four blocks	19 tons
	Three blocks	10 tons
	One block	16 tons
	One block	12 tons
	Personnel air lock	25 tons
Steam valve area monorails (hoist not installed)	MSIV/feedwater valve/miscellaneous valve components	2.33 tons/ 3.8 tons/--
Fuel pool demineralizer area hoist	Shield plugs	4.5 to 8.5 tons
Drywell maintenance hoist (lower)	Not used	N/A
Drywell maintenance hoist (upper)	Not used	N/A
Gamma scan collimator port hoist	Gamma scan collimator port shield	1/2 ton
Torus monorail	Vacuum breakers/miscellaneous maintenance loads	1/2 ton/ $\leq$ 3 tons



DUANE ARNOLD ENERGY CENTER

IOWA ELECTRIC LIGHT AND POWER COMPANY

FIGURE 1 - HOISTS AND CRANES AT ELEVATIONS 716'-9" AND 734'-0"

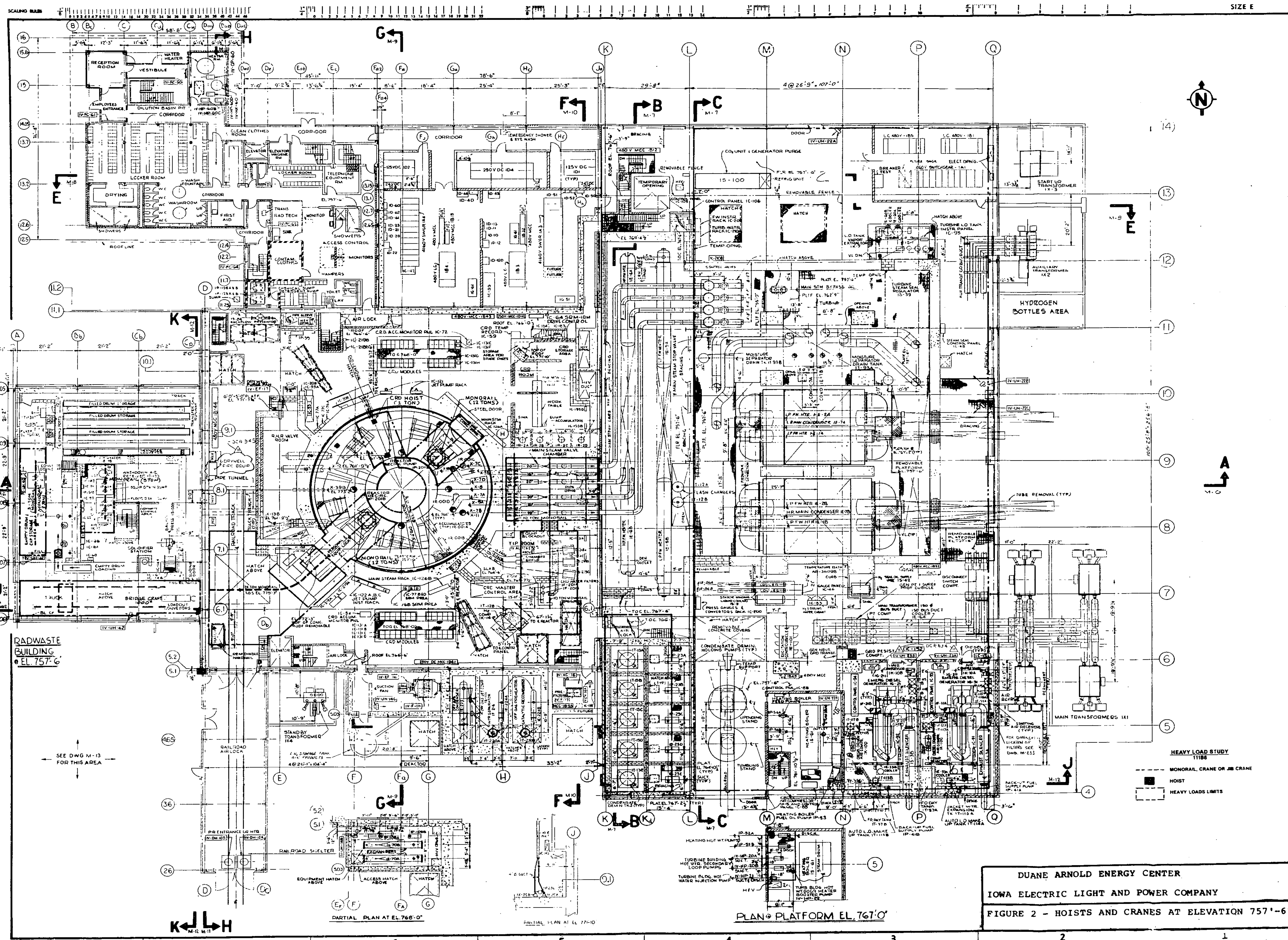


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FIGURE 2 - HOISTS AND CRANES AT ELEVATION 757'-6"

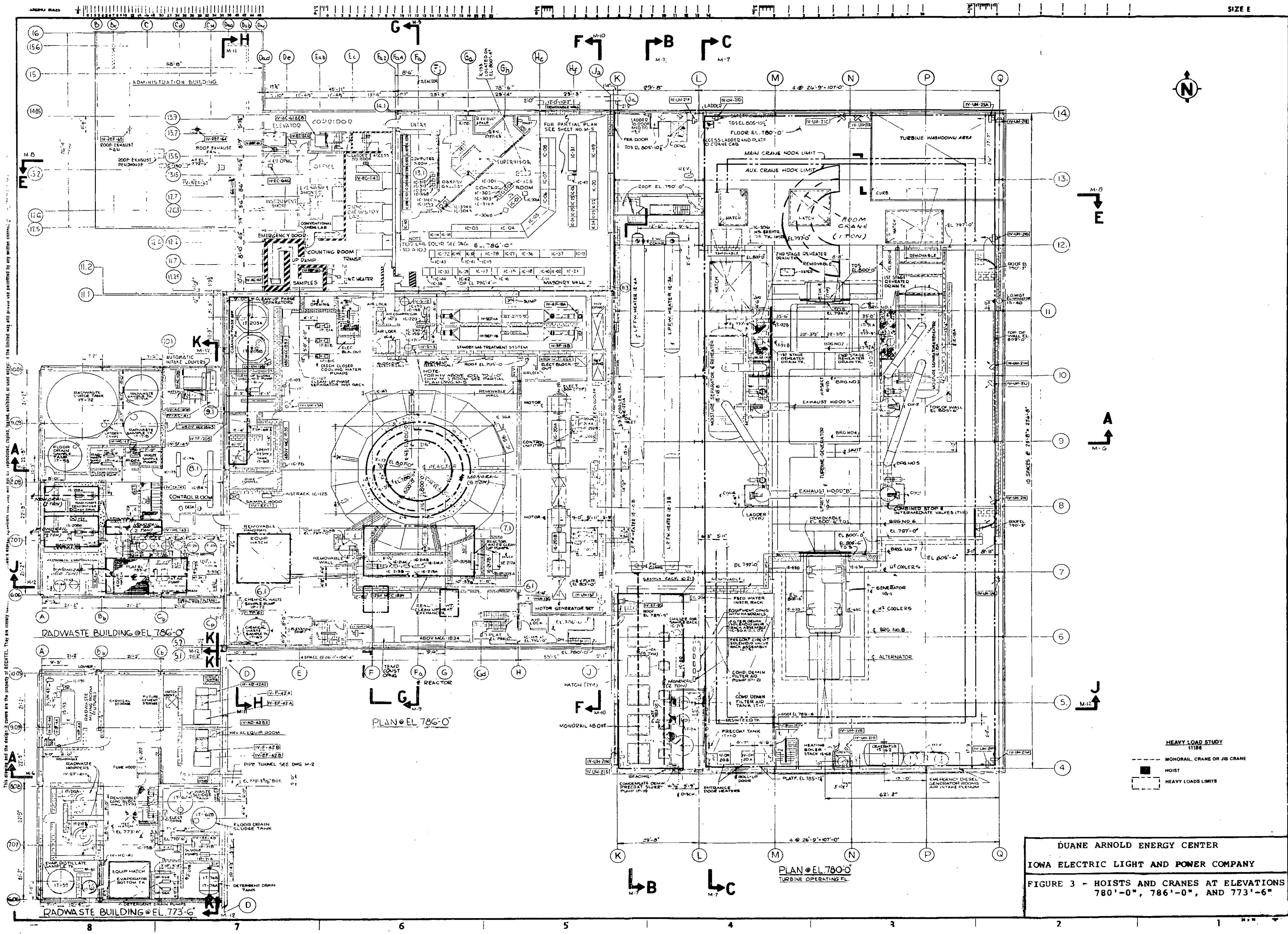

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FIGURE 3 - HOISTS AND CRANES AT ELEVATIONS 780'-0", 786'-0", AND 773'-6"

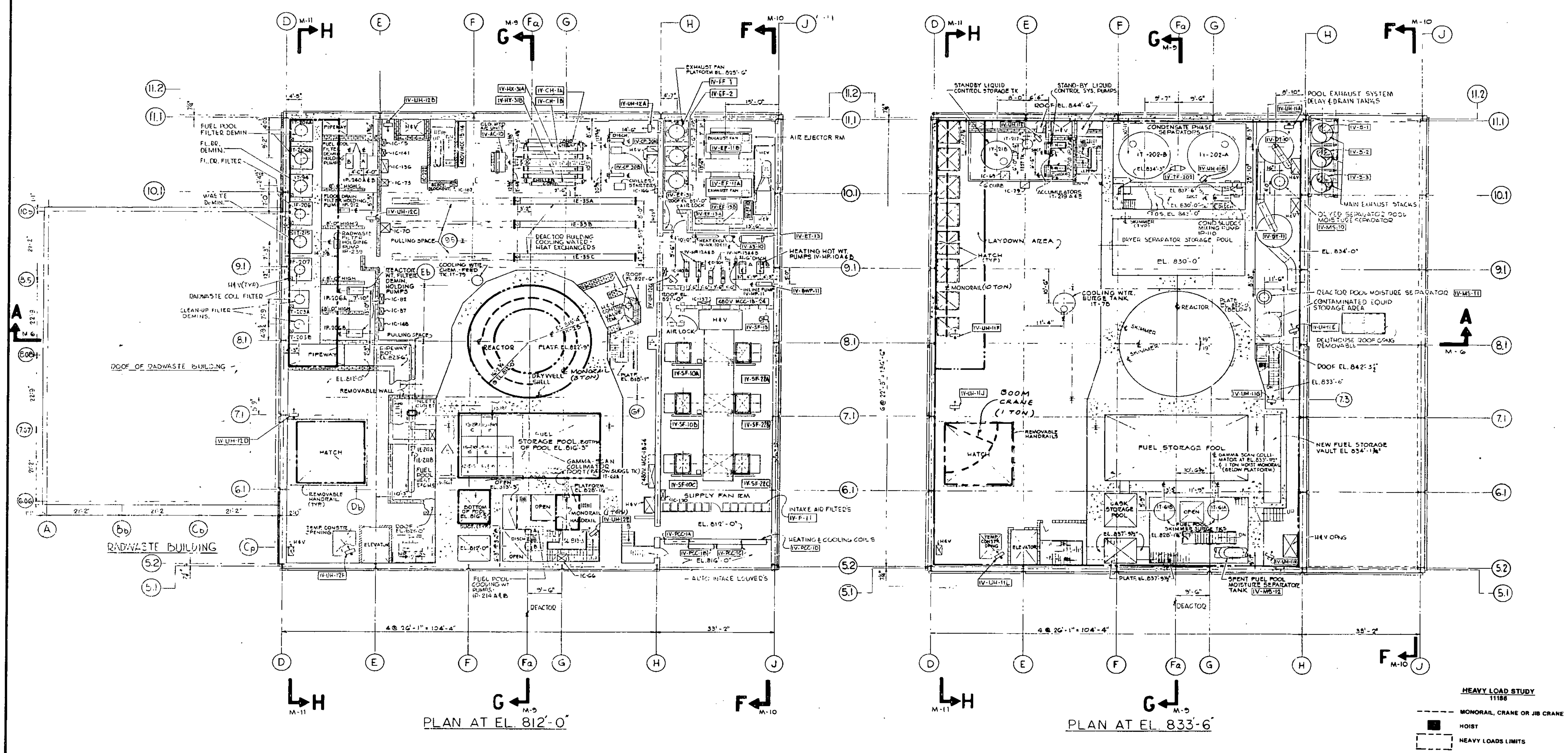

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FIGURE 4 - HOISTS AND CRANES AT ELEVATIONS 812'-0" AND 833'-6"

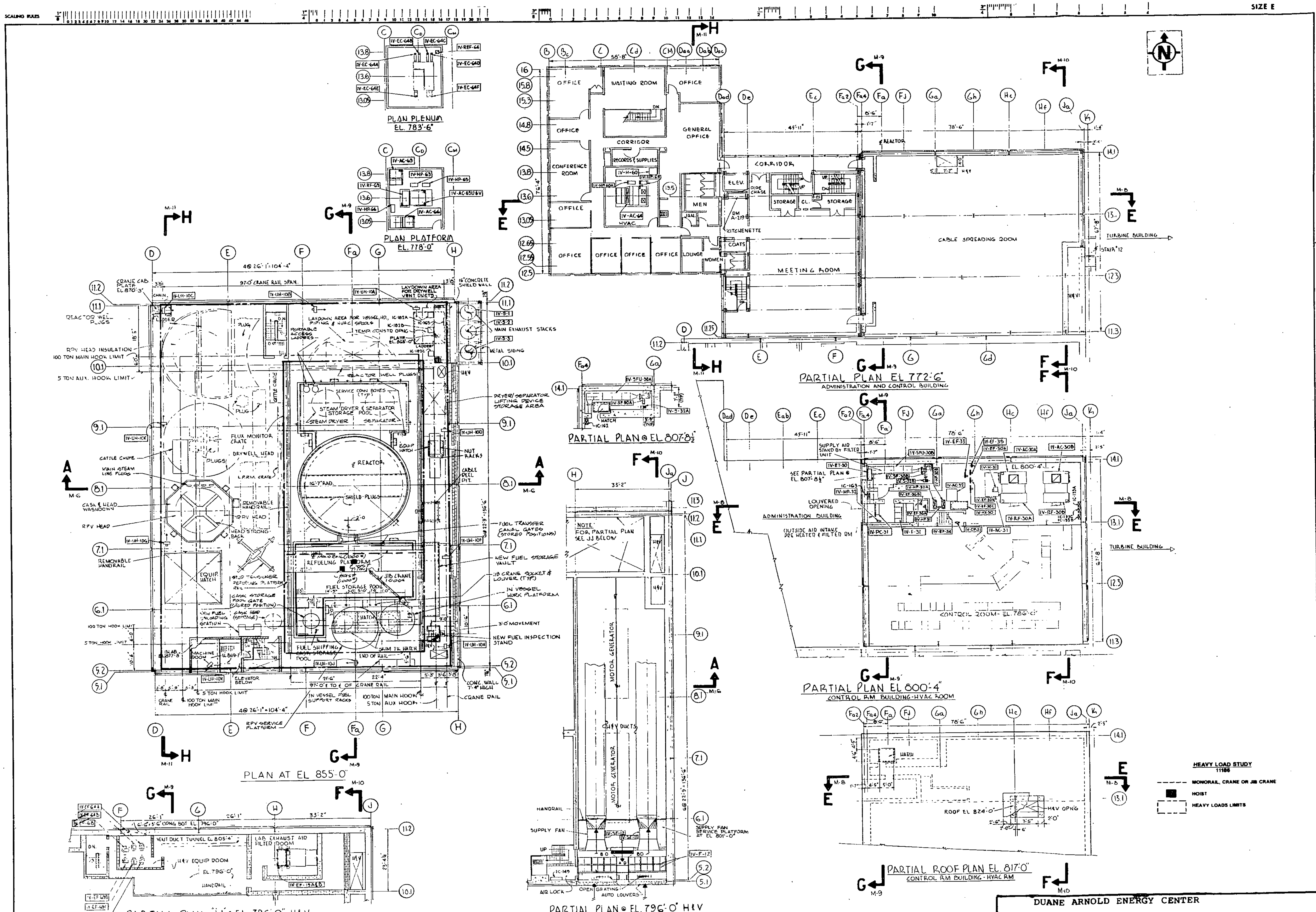

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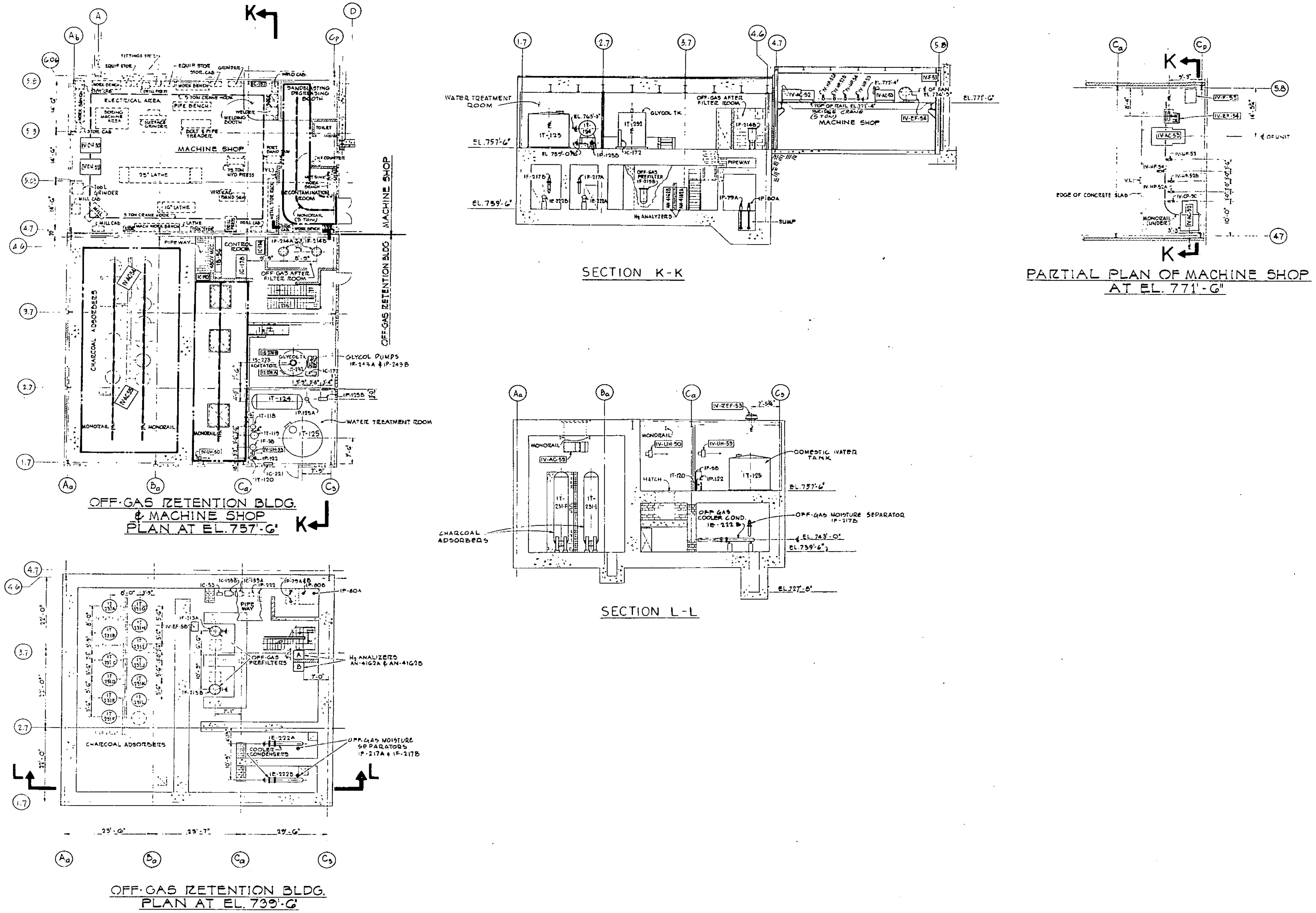
FIGURE 5 - HOISTS AND CRANES AT ELEVATION 855'-6"



HEAVY LOAD STUDY
11186

- MONORAIL, CRANE OR JIB CRANE
- HOIST
- HEAVY LOADS LIMITS

DUANE ARNOLD ENERGY CENTER

IOWA ELECTRIC LIGHT AND POWER COMPANY

FIGURE 6 - HOISTS AND CRANES - OFFGAS RETENTION BUILDING AND MACHINE SHOP

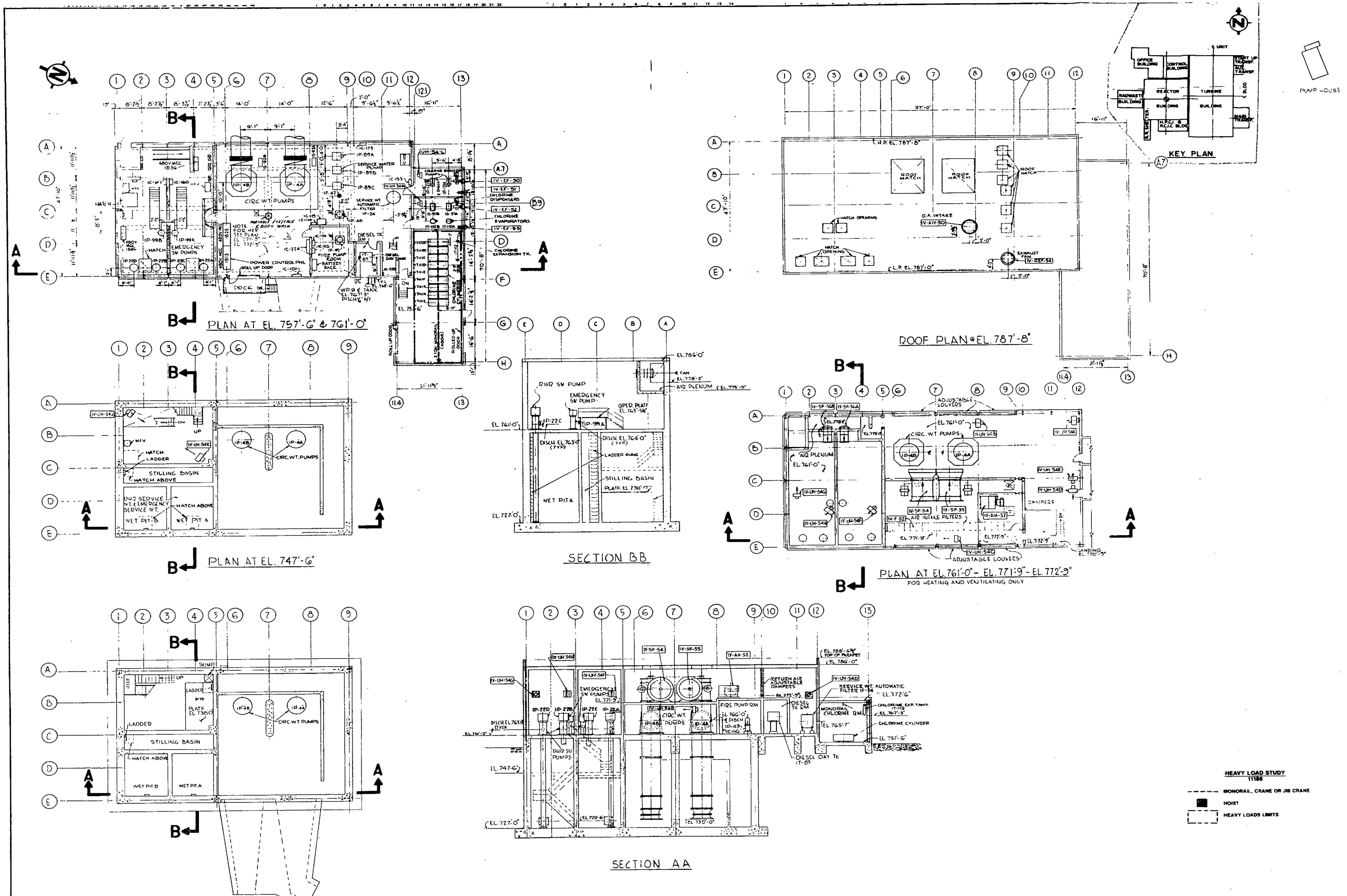


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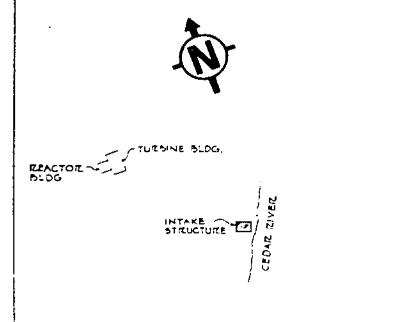
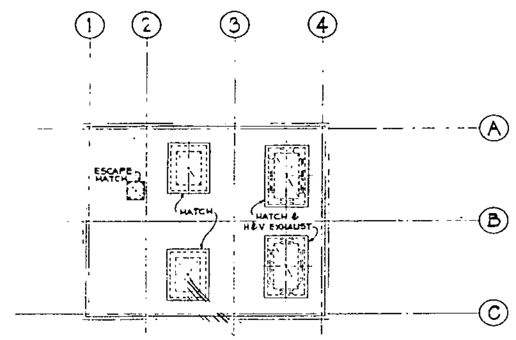
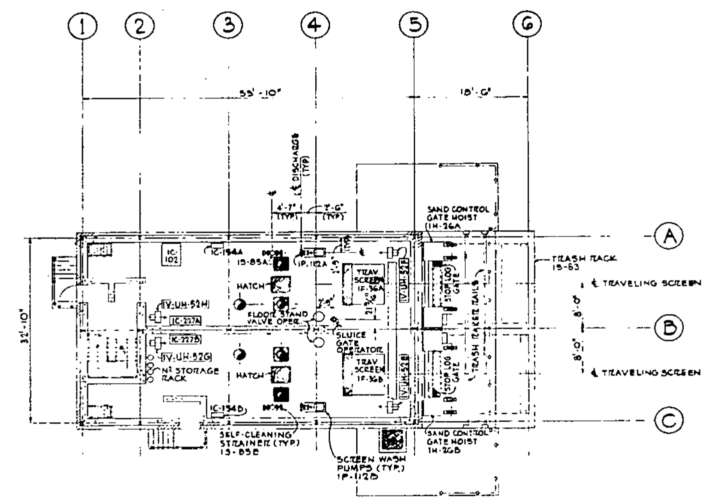
FIGURE 7 - HOISTS AND CRANES - PUMPHOUSE



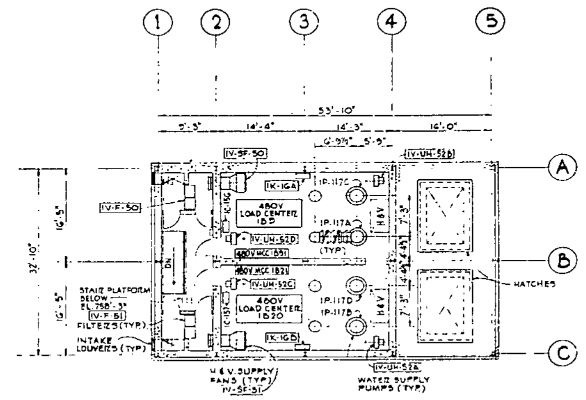
KEY PLAN



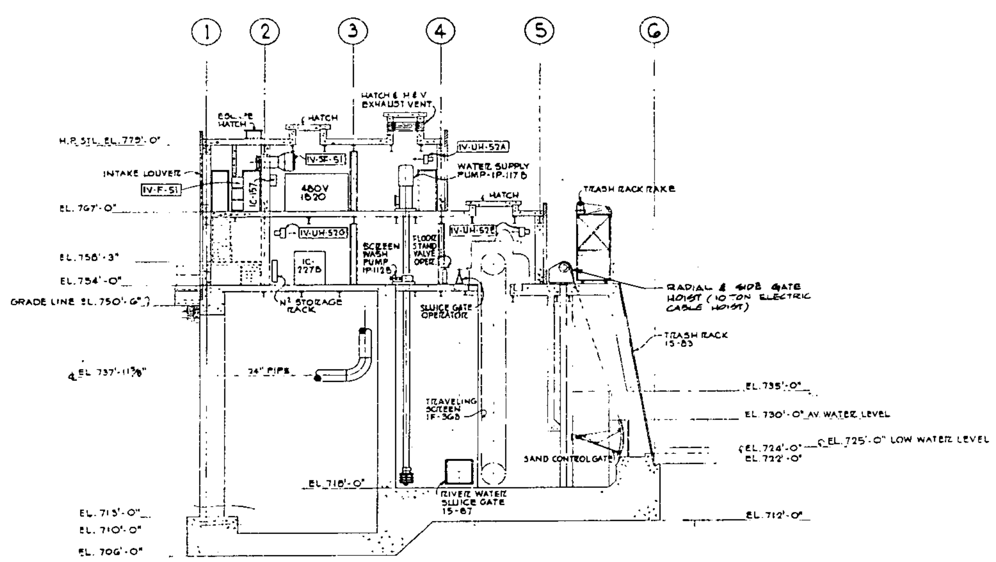
ROOF PLAN



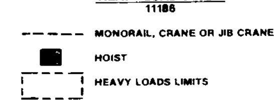
PLAN AT EL. 754'-0"



PLAN AT 767'-0"



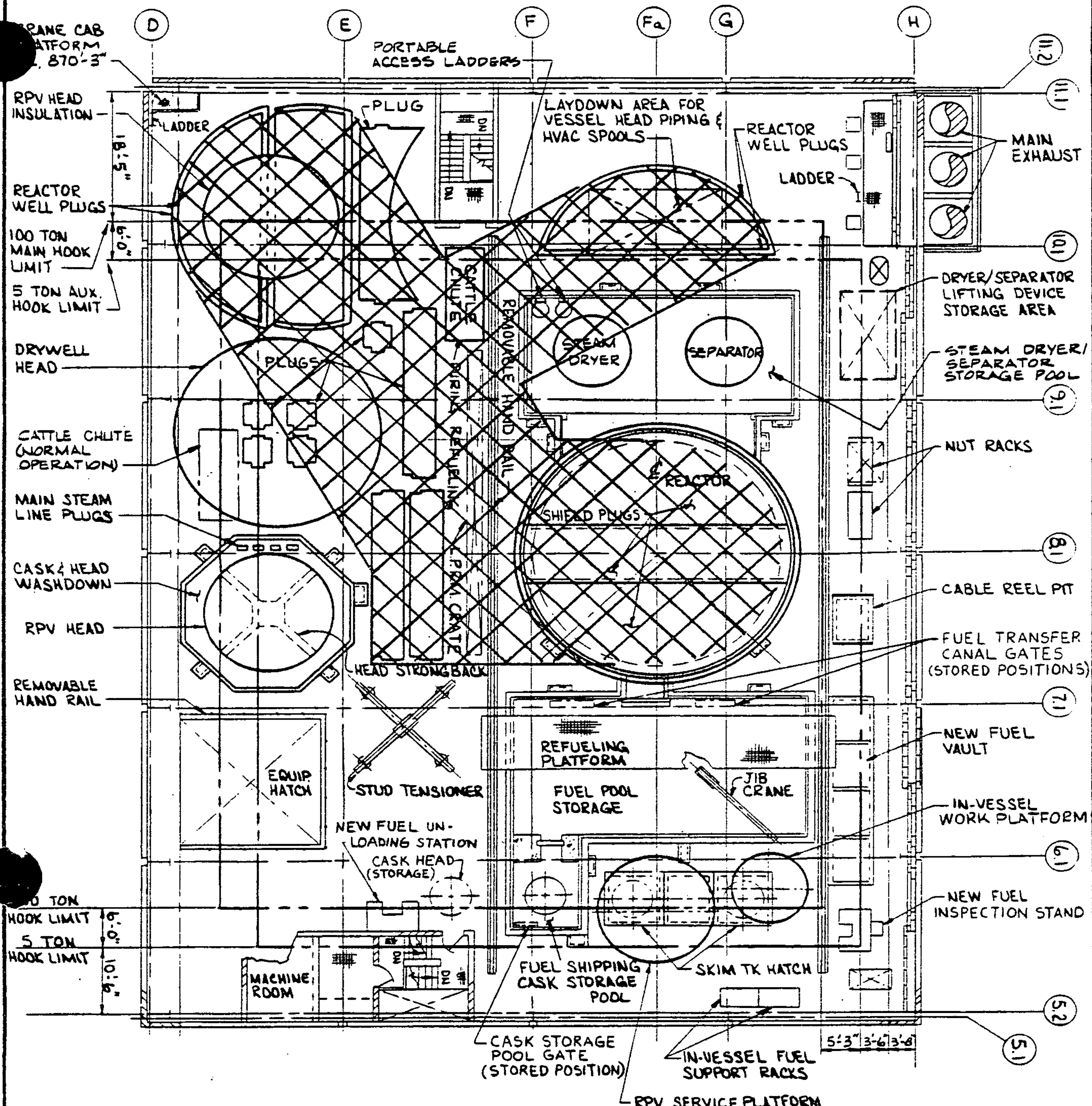
SECTION A-A



DUANE ARNOLD ENERGY CENTER

IOWA ELECTRIC LIGHT AND POWER COMPANY

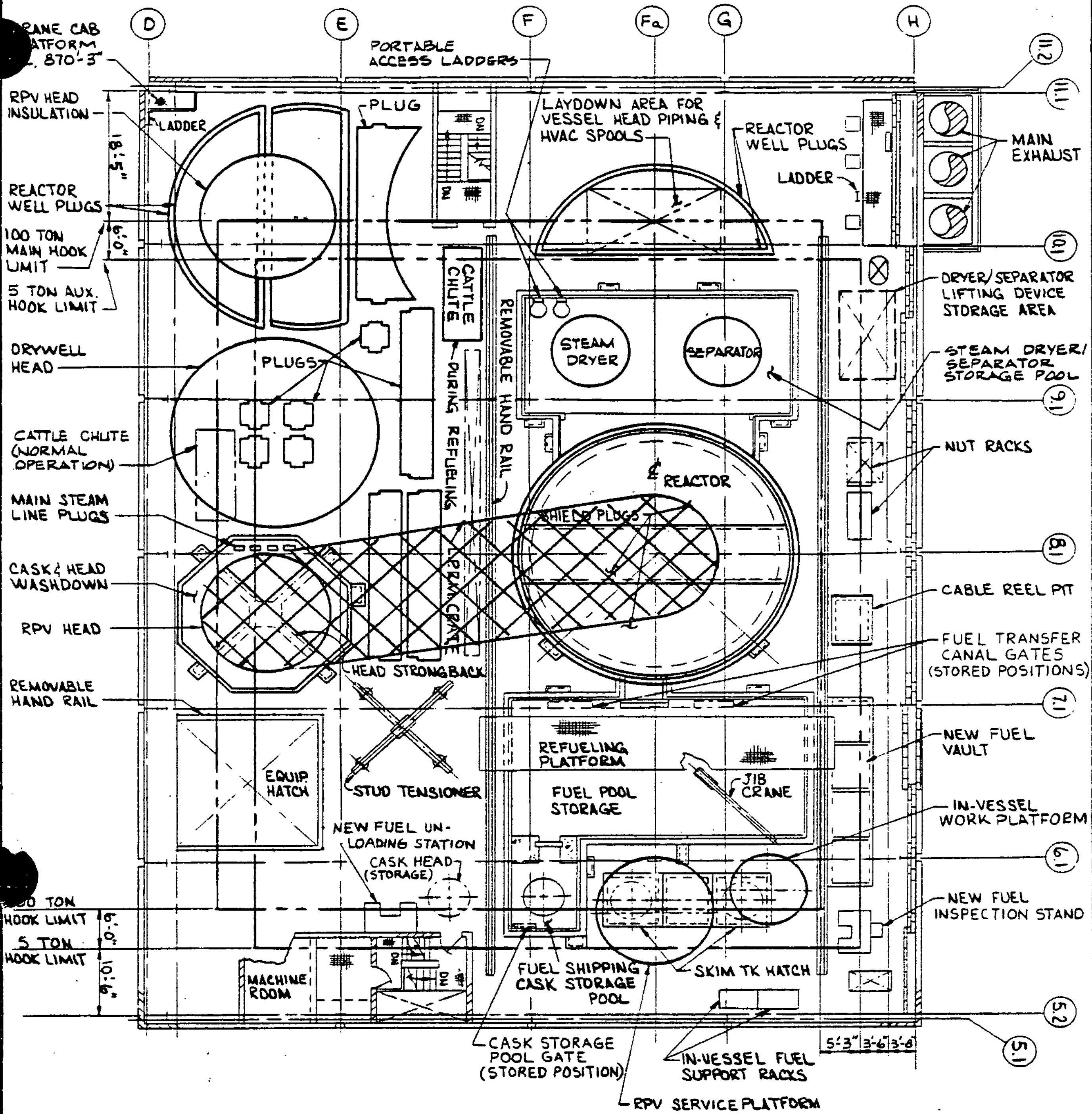
FIGURE 8 - HOISTS AND CRANES - INTAKE STRUCTURE



DUANE ARNOLD ENERGY CENTER-UNIT NO. 1
IOWA ELECTRIC LIGHT AND POWER COMPANY
CEDAR RAPIDS, IOWA

REFUELING EQUIPMENT STORAGE

Figure 9a - Safe Load Paths - Reactor Well Plugs



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CEDAR RAPIDS, IOWA

REFUELING EQUIPMENT STORAGE

Figure 9b - Safe Load Path - Strongback Installation/Removal on Drywell Head

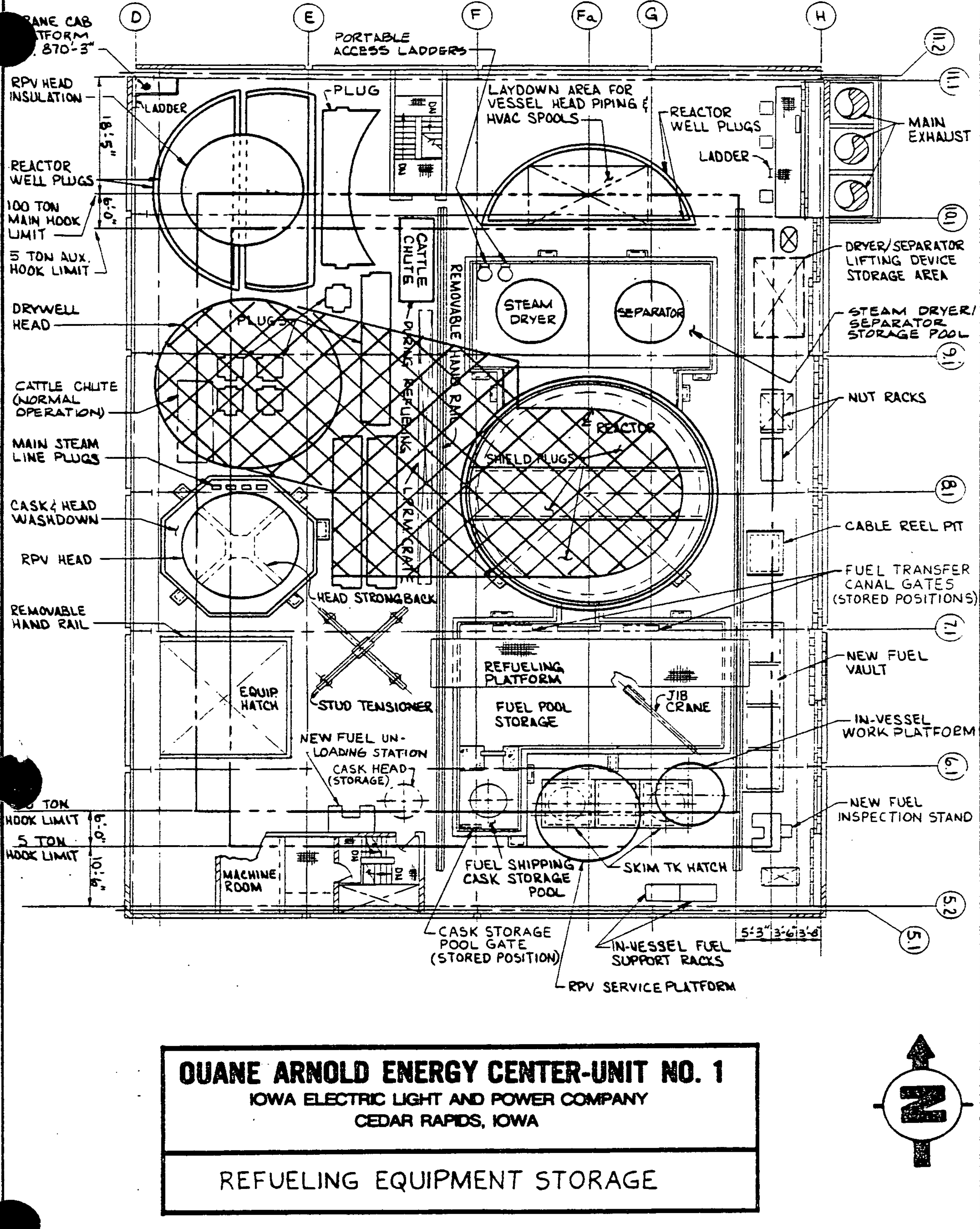
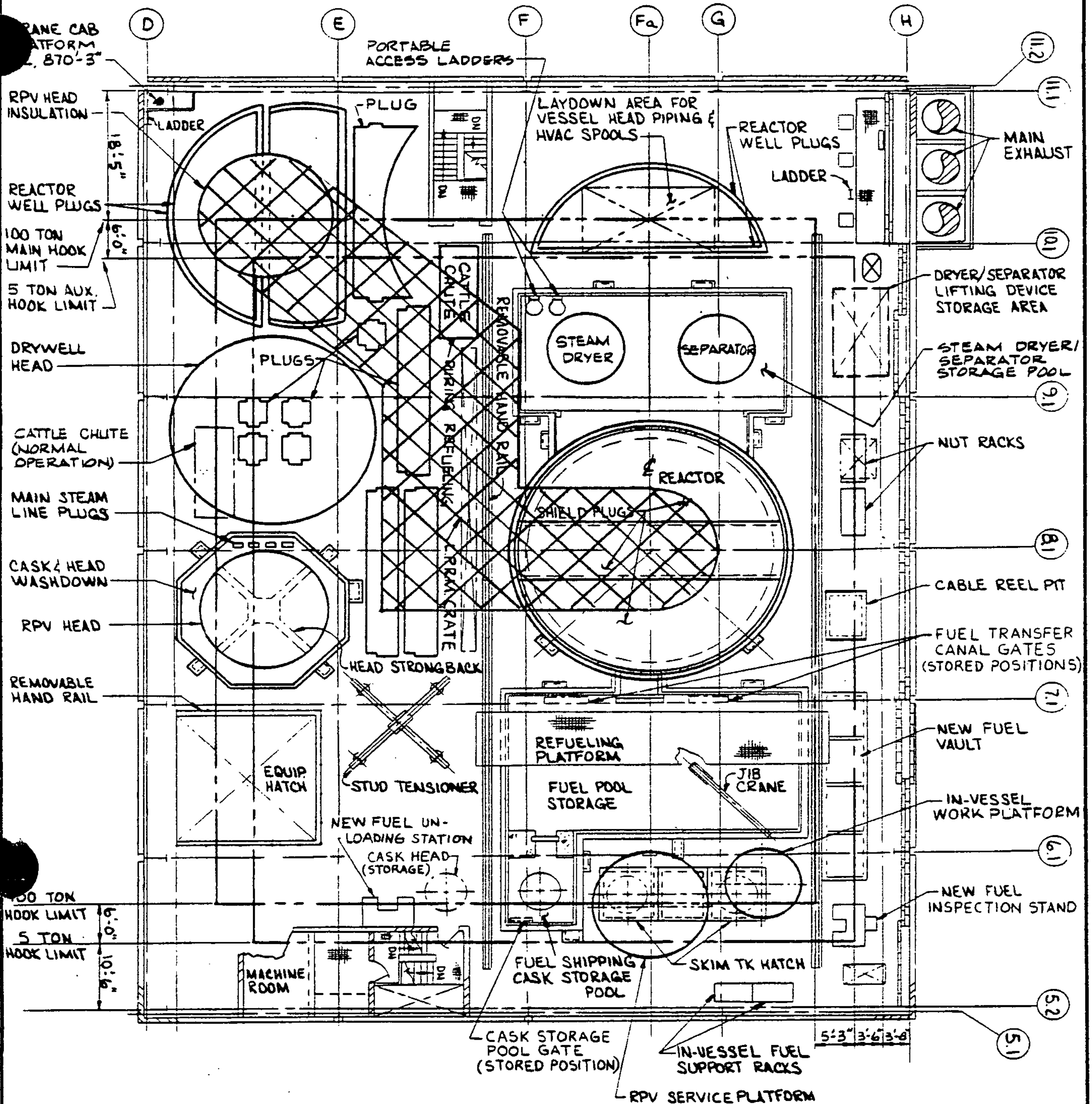


Figure 9c - Safe Load Path - Drywell Head



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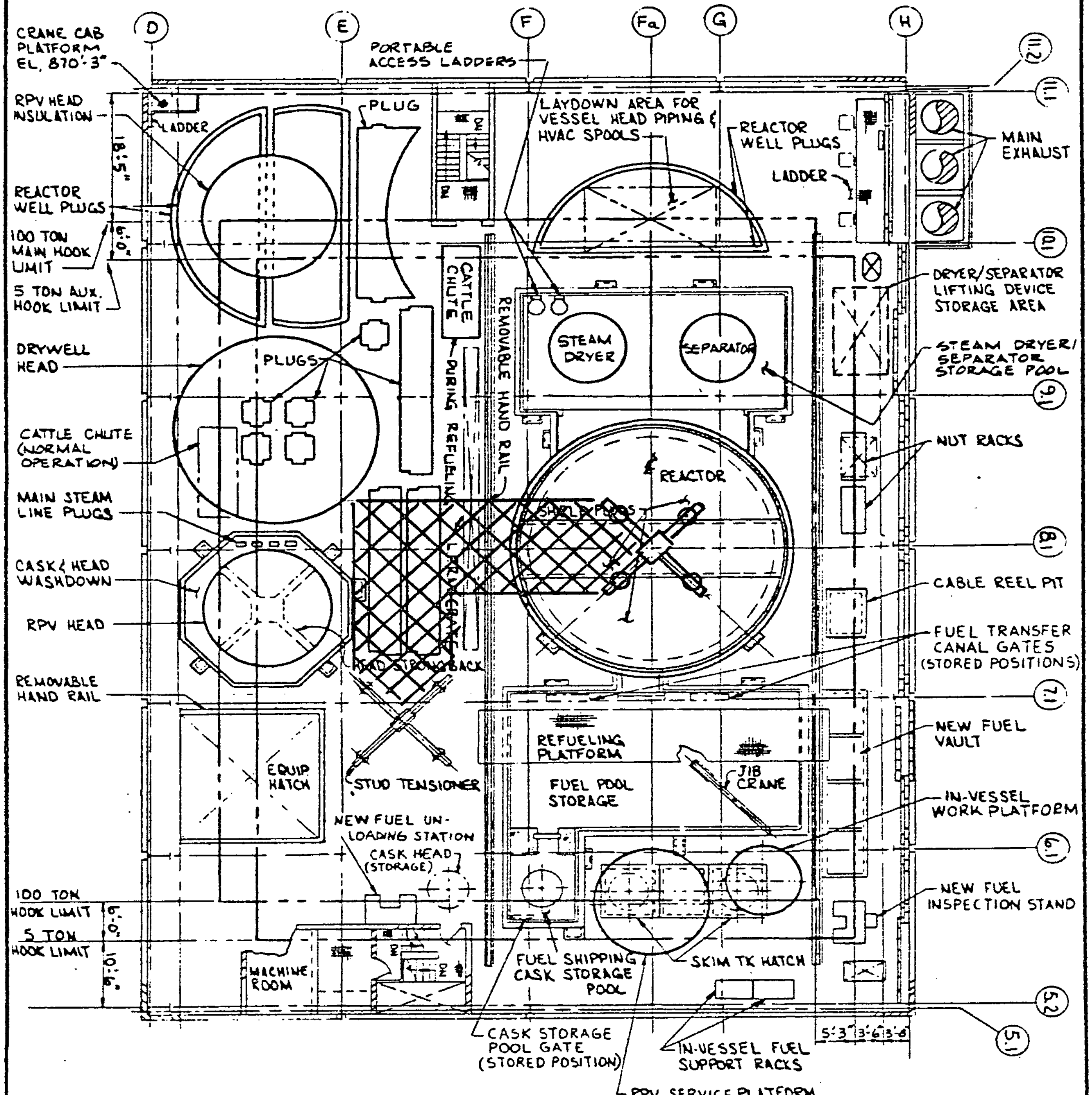
CEDAR RAPIDS, IOWA

REFUELING EQUIPMENT STORAGE

Figure 9d - Safe Load Path - Vessel Head Insulation



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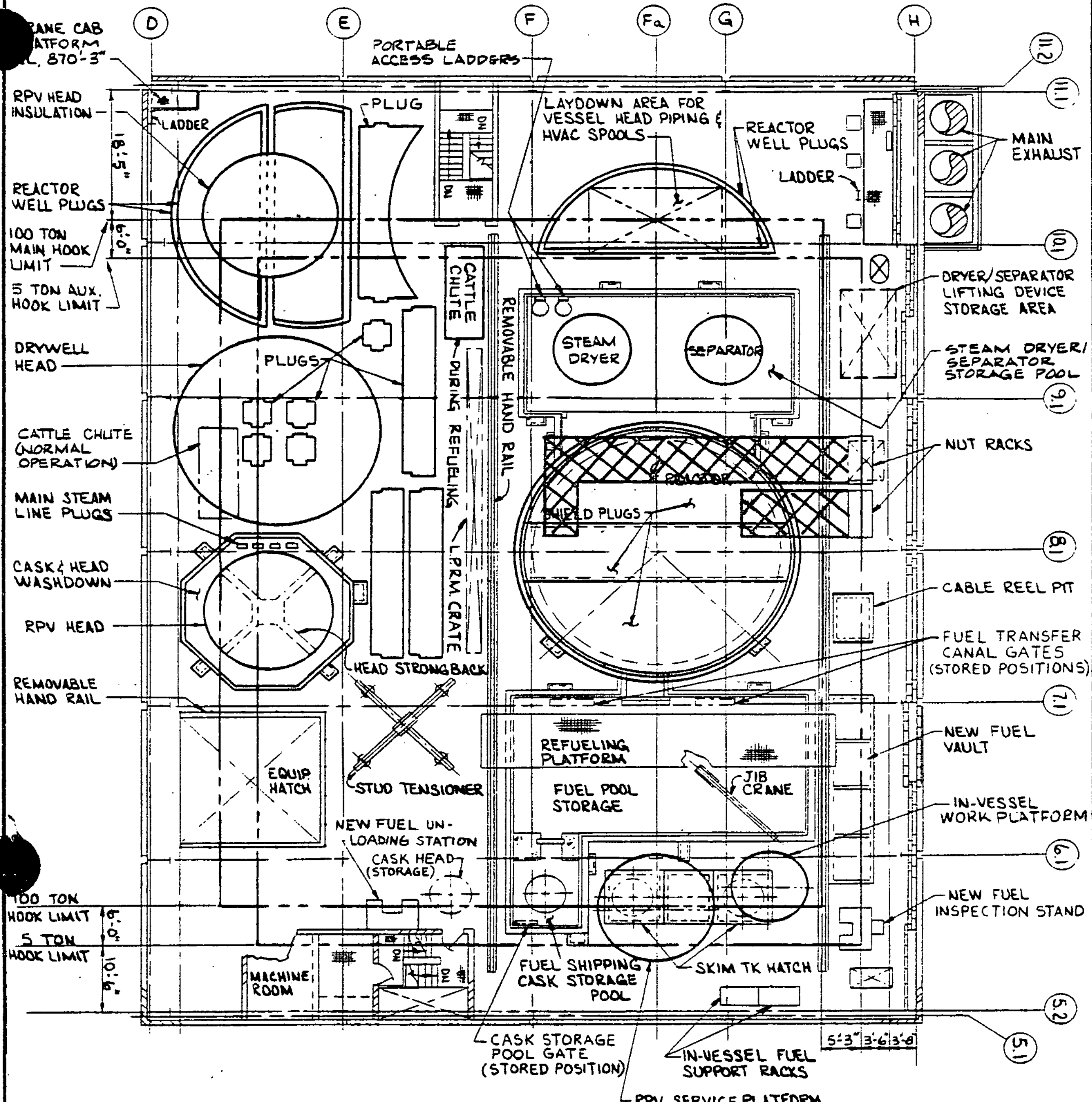
REFUELING EQUIPMENT STORAGE

Figure 9e - Safe Load Path - Stud Tensioner



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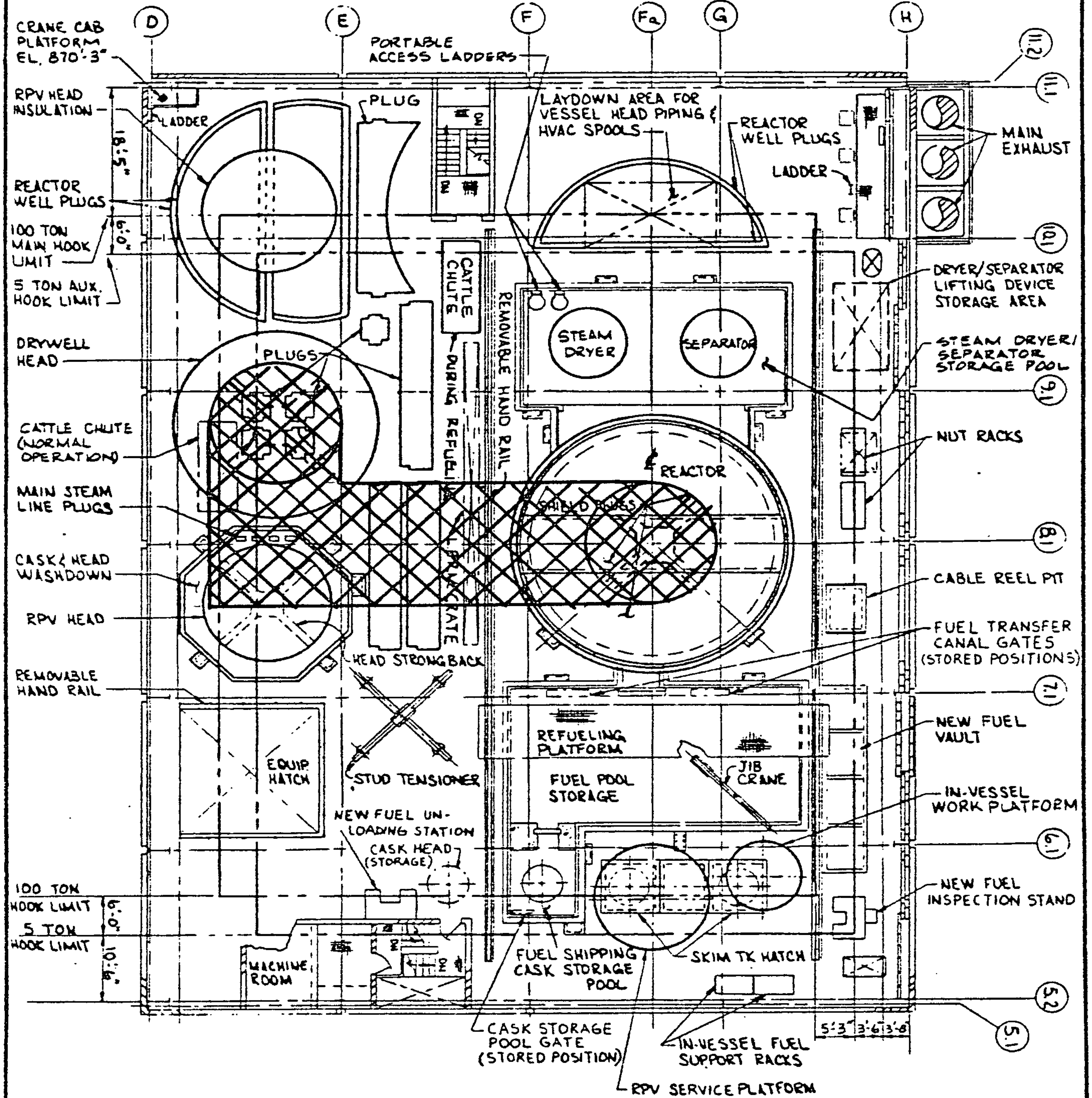
CEDAR RAPIDS, IOWA

REFUELING EQUIPMENT STORAGE

Figure 9f - Safe Load Path - Head Stud Rack/Head Nut and Washer Rack



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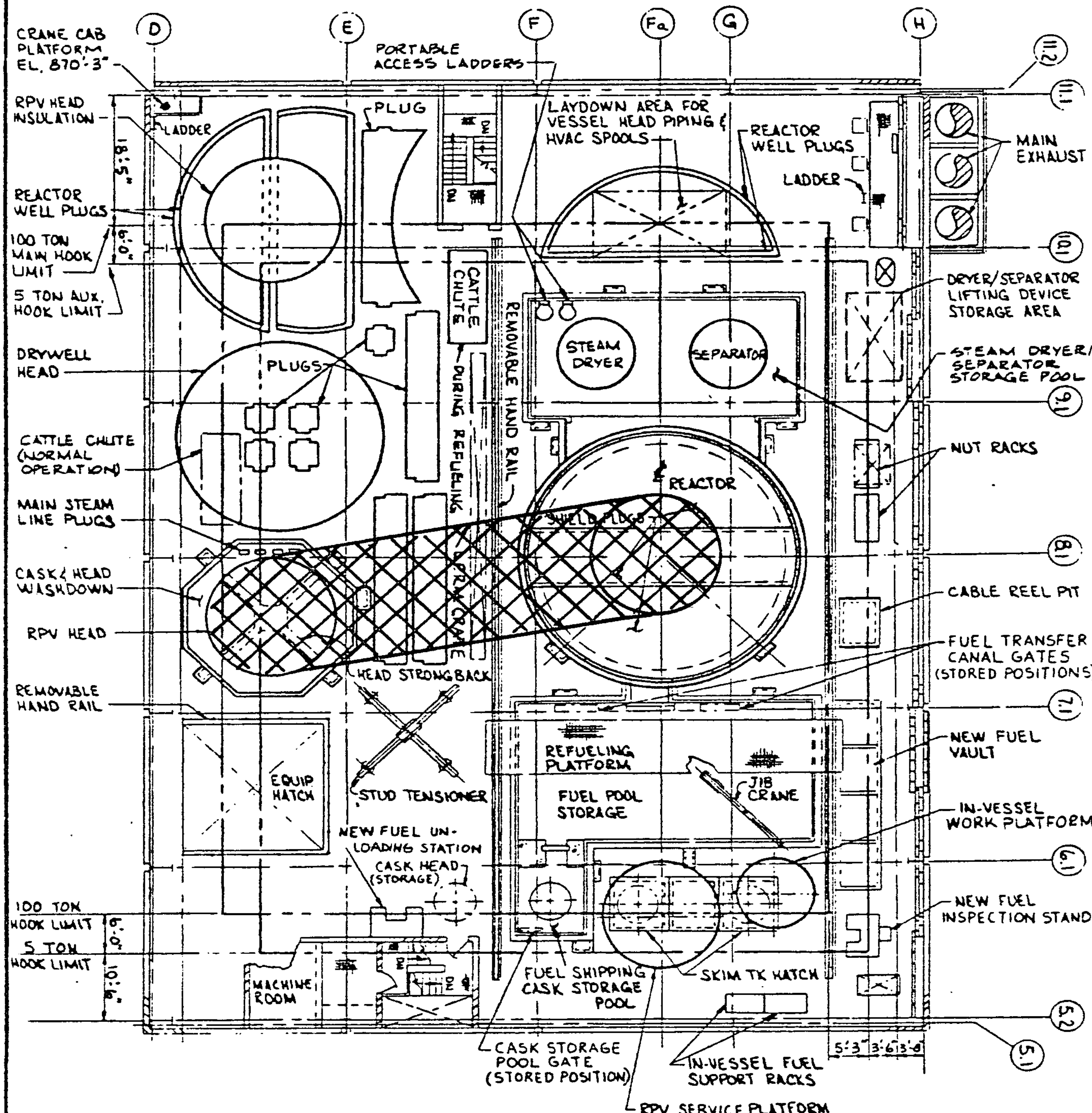
CEDAR RAPIDS, IOWA

REFUELING EQUIPMENT STORAGE

Figure 9g - Safe Load Path - Strongback Installation/Removal on Reactor Vessel Head



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REFUELING EQUIPMENT STORAGE

Figure 9h - Safe Load Path - Reactor Vessel Head

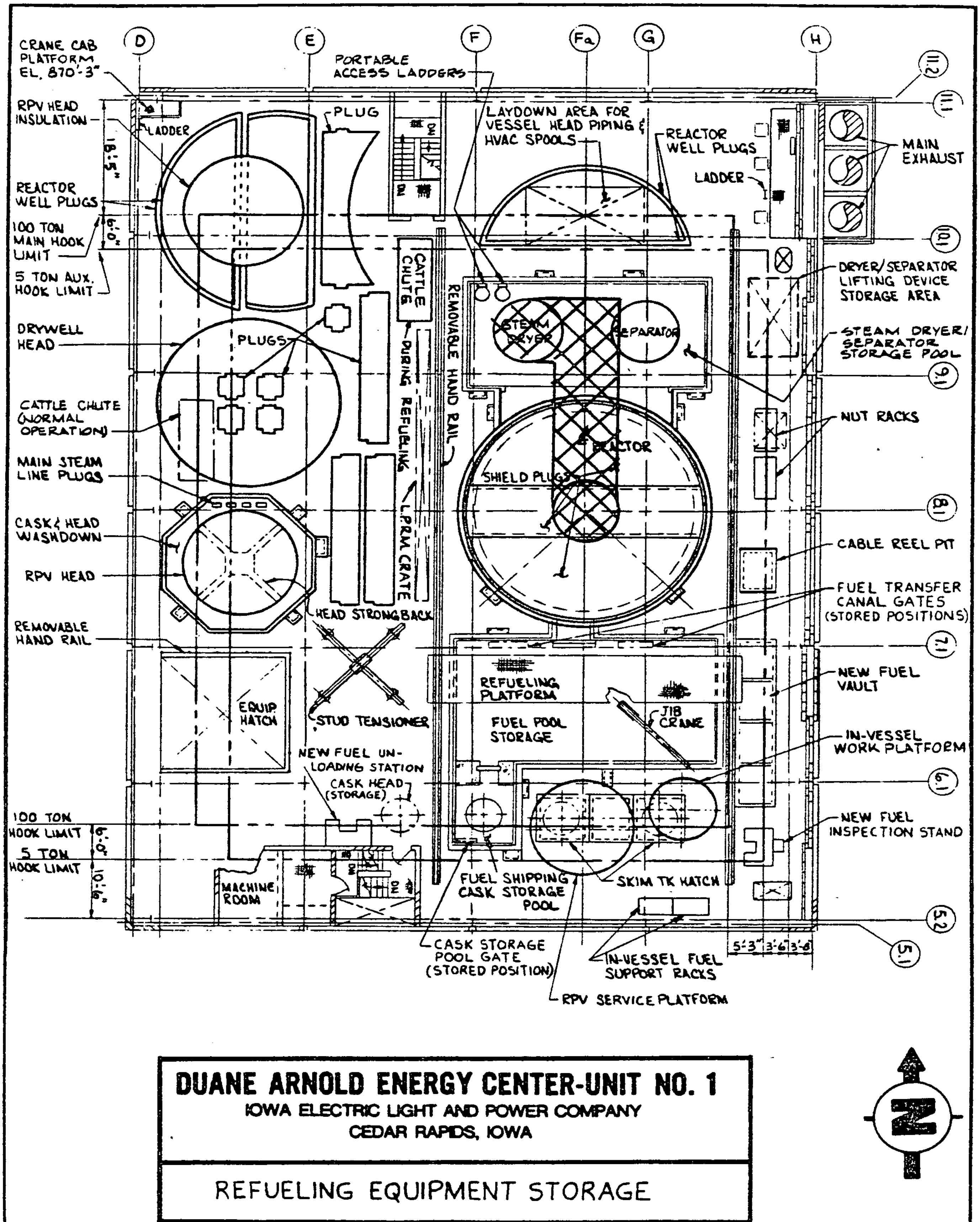
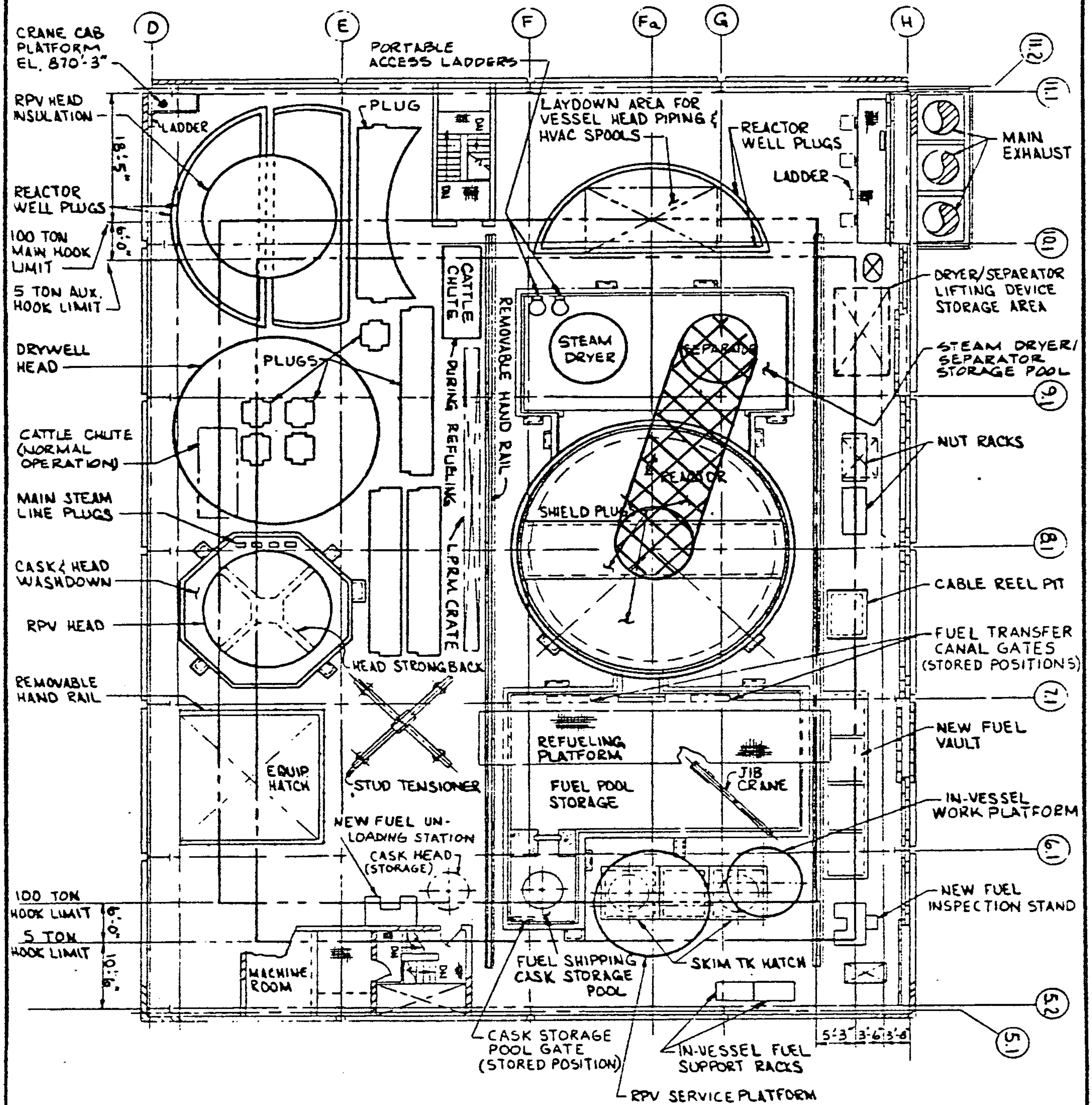


Figure 9i - Safe Load Path - Steam Dryer



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CEDAR RAPIDS, IOWA

REFUELING EQUIPMENT STORAGE

Figure 9j - Safe Load Path - Steam Separator

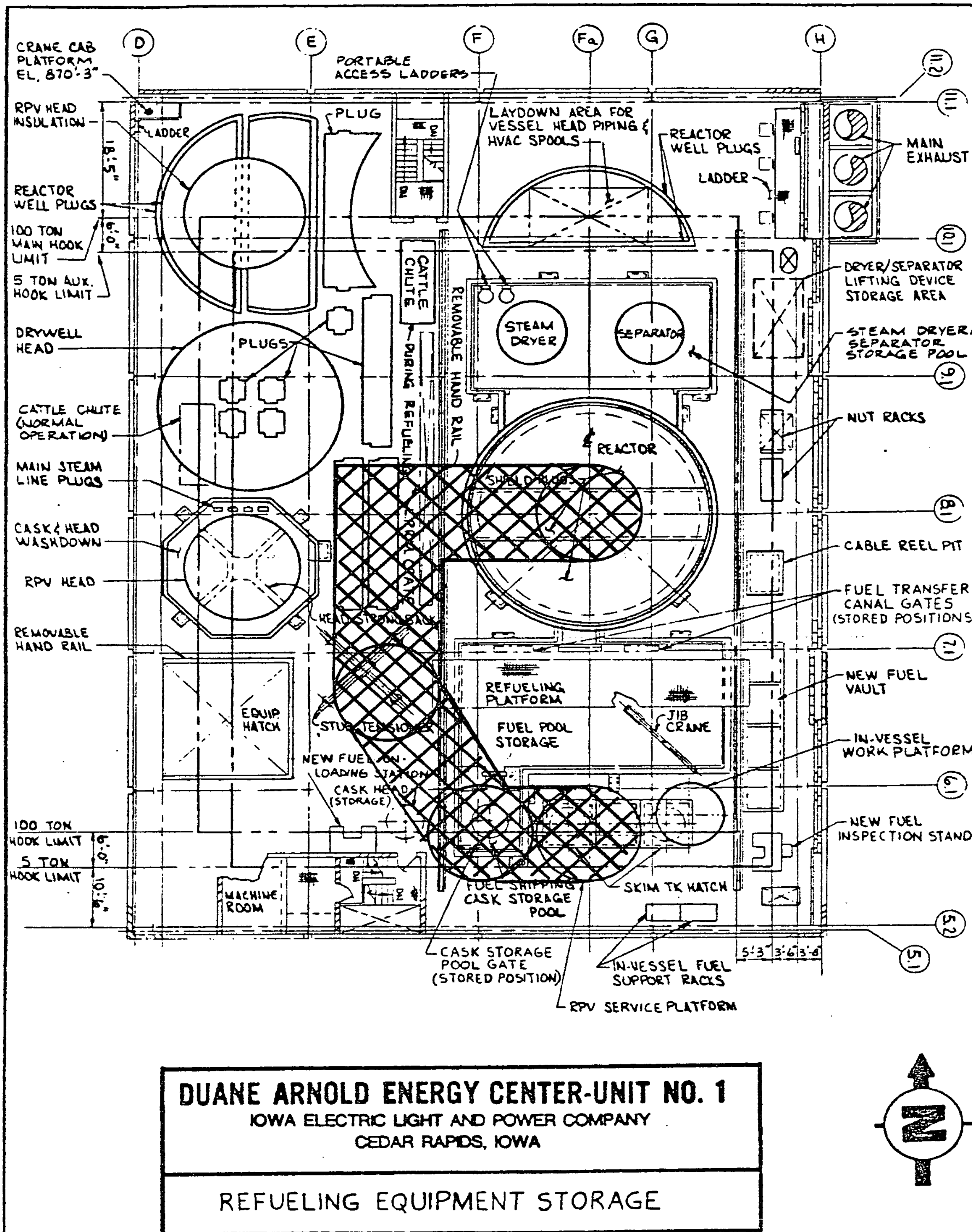
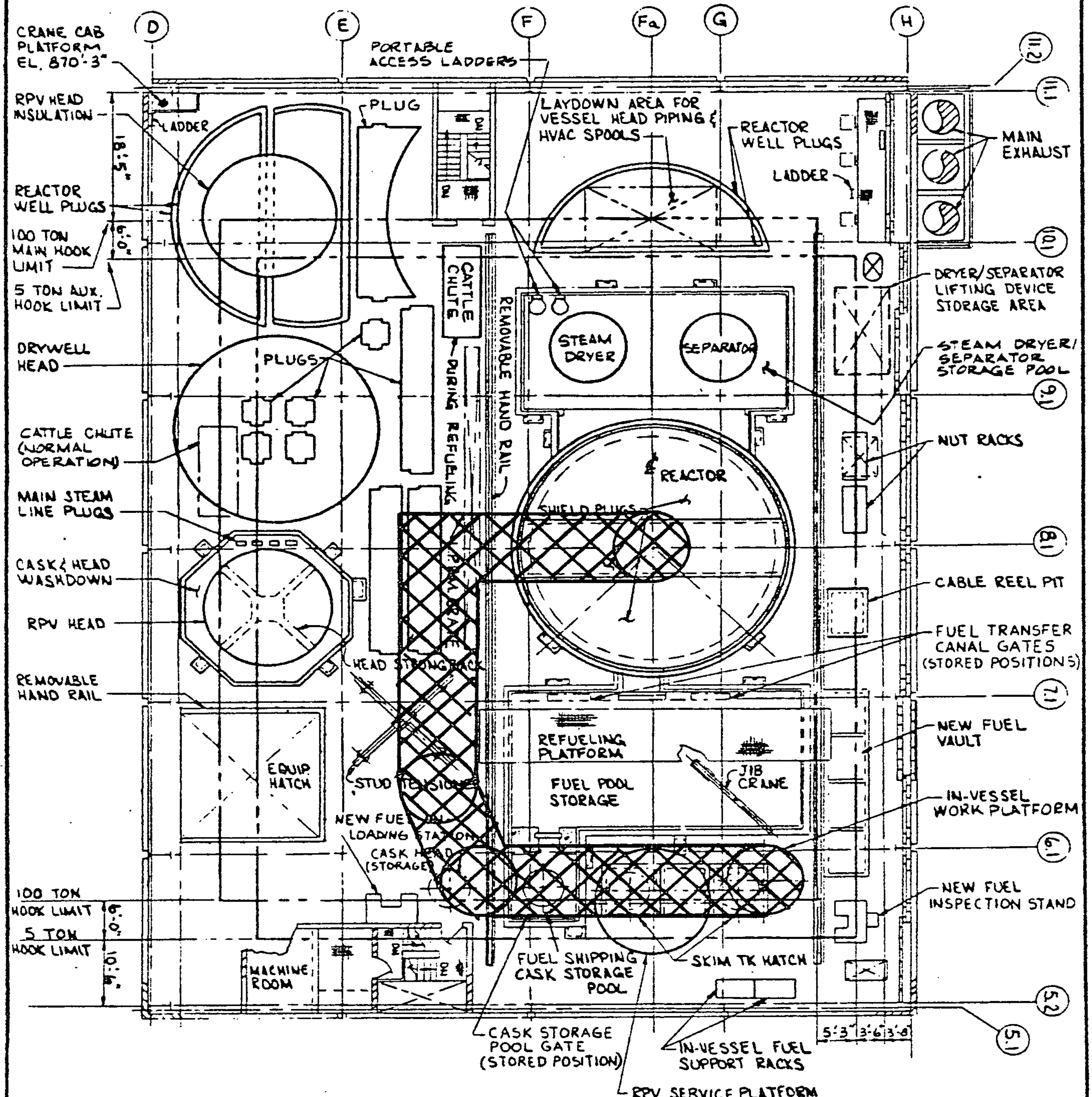


Figure 9k - Safe Load Path - Reactor Vessel Service Platform



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CEDAR RAPIDS, IOWA

REFUELING EQUIPMENT STORAGE

Figure 91 - Safe Load Path - In-Vessel Work Platform

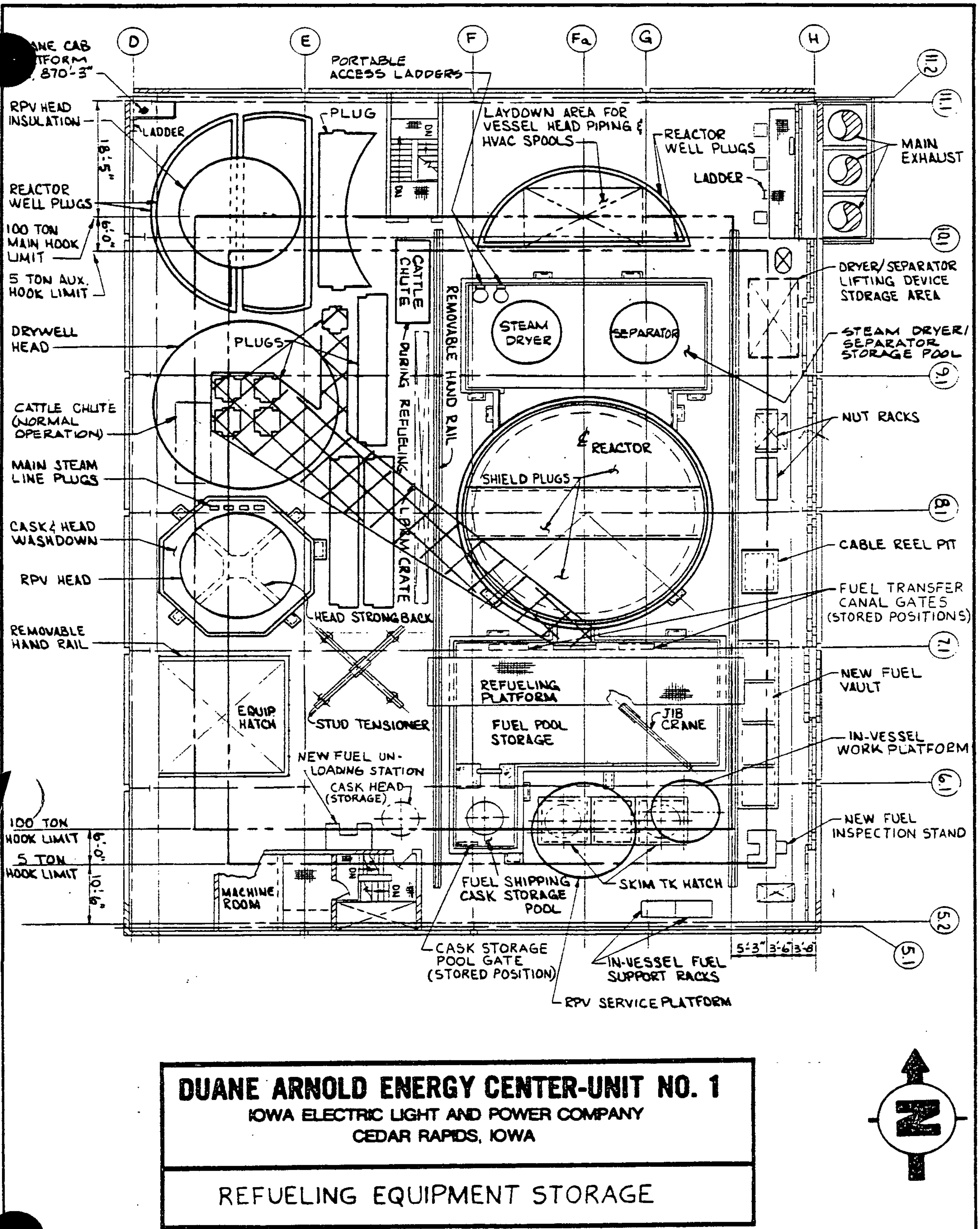

Figure 9m - Safe Load Path - Spent Fuel Pool Refueling Slot Plugs

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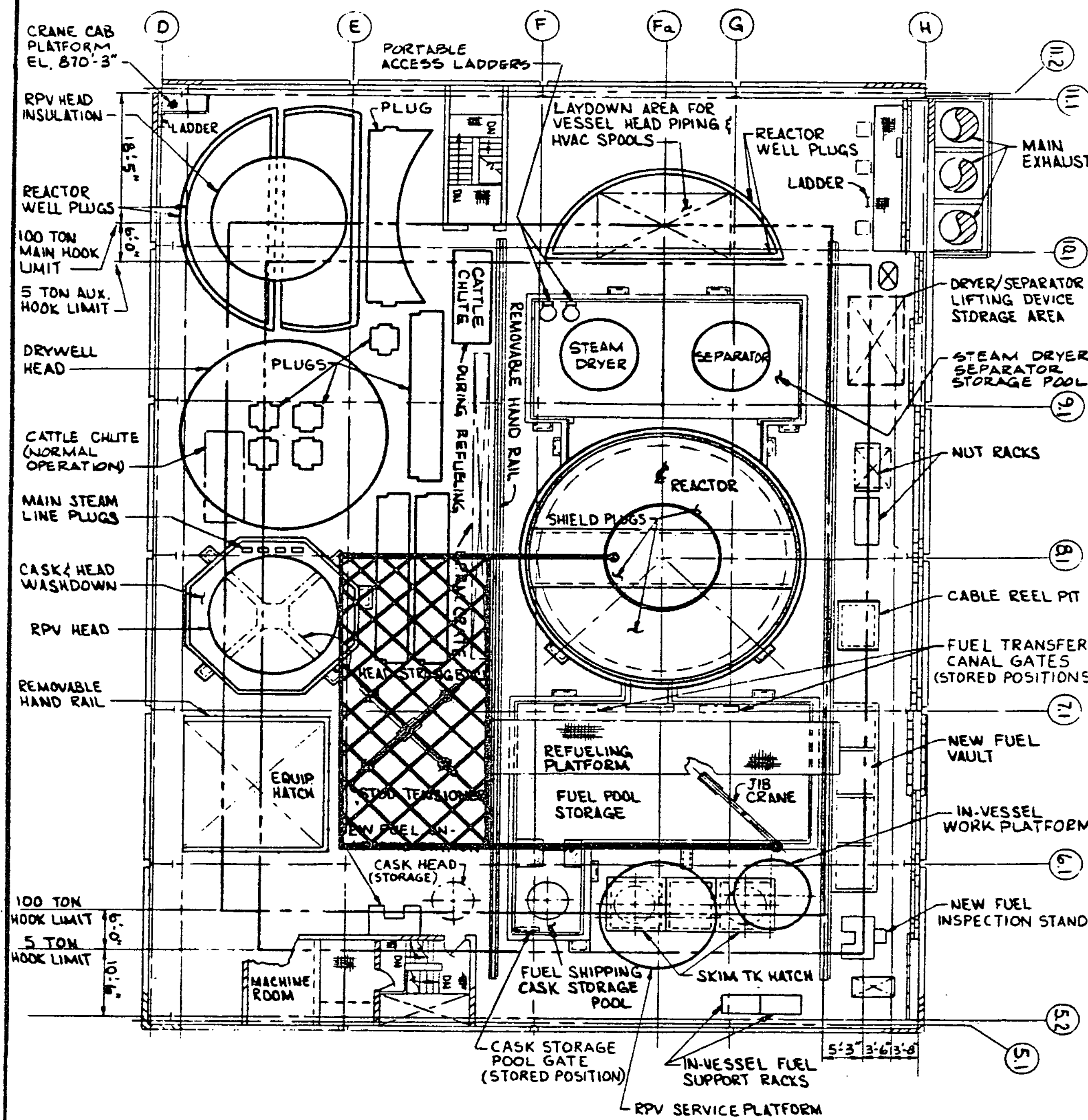

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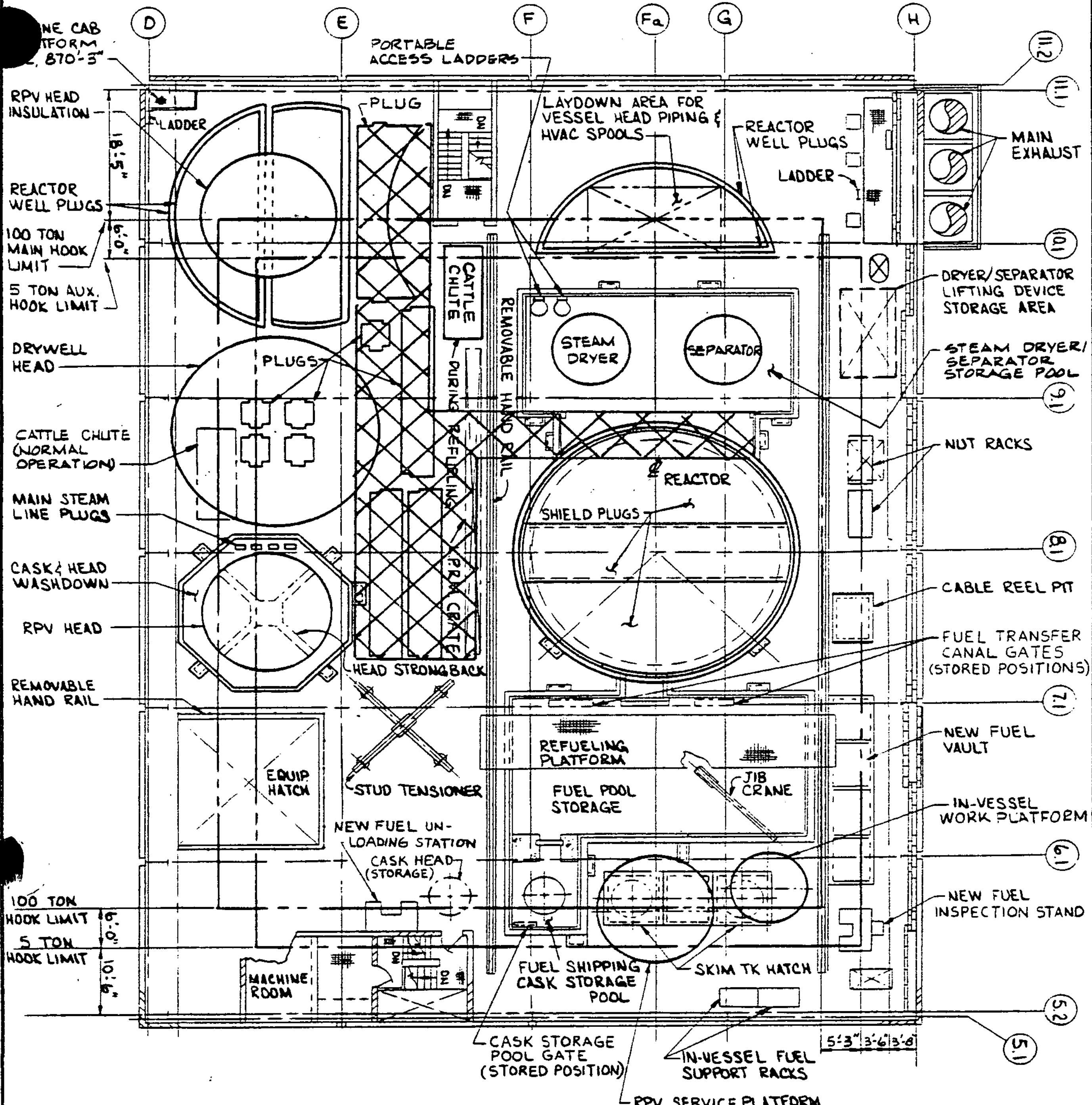
IOWA ELECTRIC LIGHT AND POWER COMPANY

CEDAR RAPIDS, IOWA

REFUELING EQUIPMENT STORAGE

Figure 9n - Safe Load Path - Jib Crane Installation/Removal on Reactor Vessel Service Platform



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REFUELING EQUIPMENT STORAGE

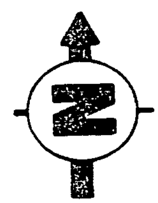
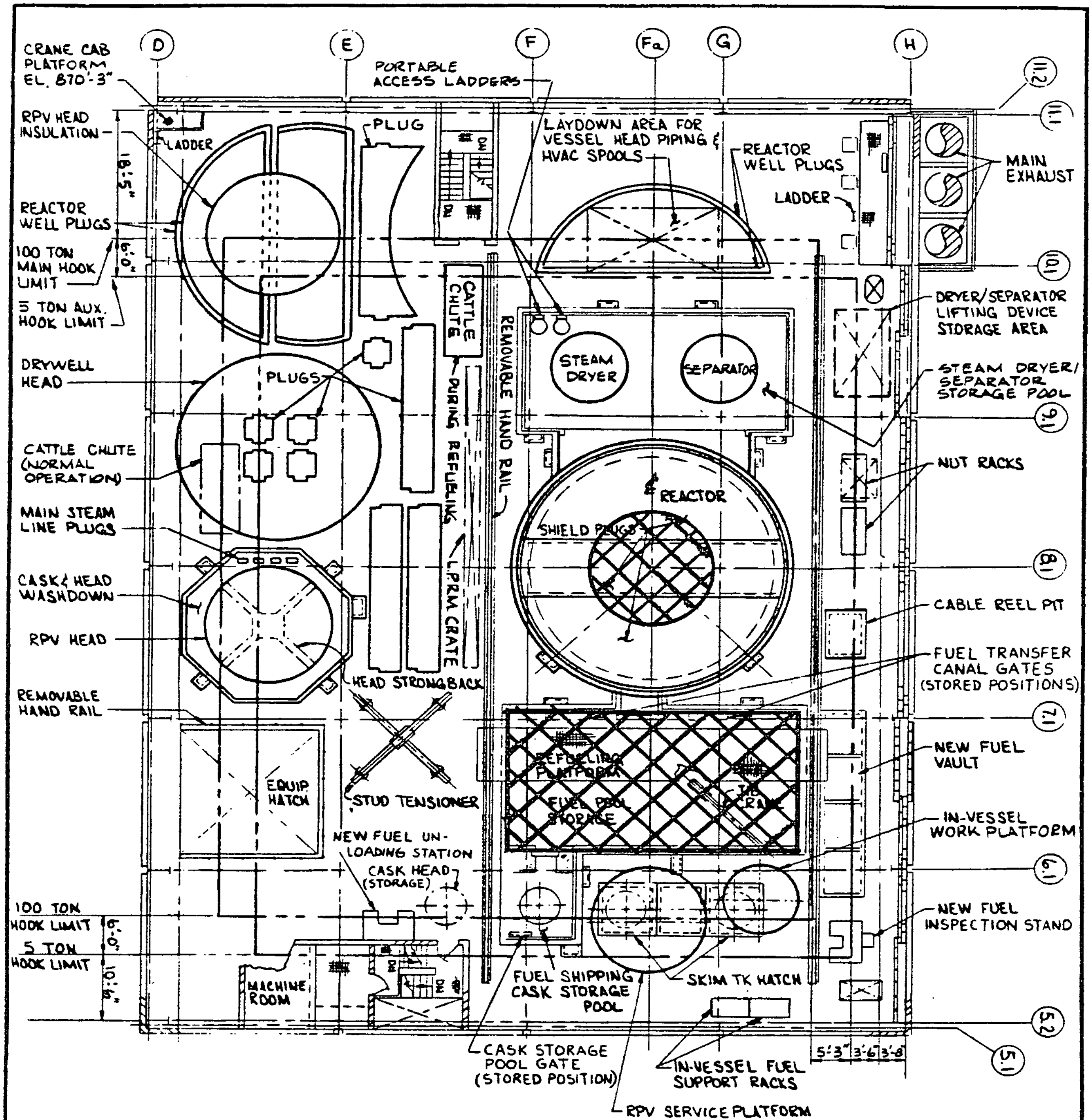


Figure 9o - Safe Load Path - Dryer Separator Canal Plugs



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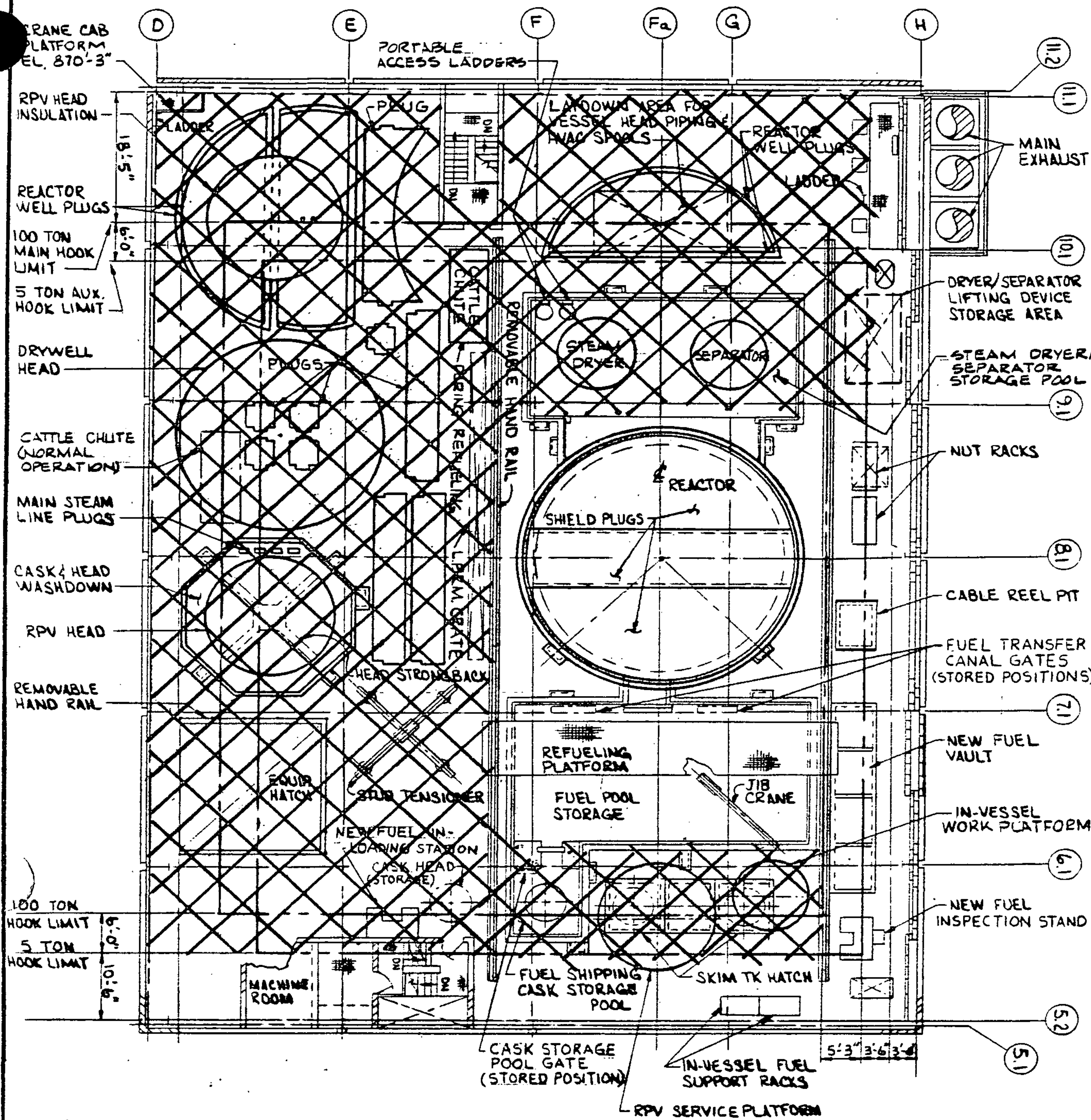
REFUELING EQUIPMENT STORAGE

Figure 9p - Reactor Core and Spent Fuel Pool



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REFUELING EQUIPMENT STORAGE

Figure 9q Refueling Floor Load Impact Areas Located Above Safe Shutdown Equipment

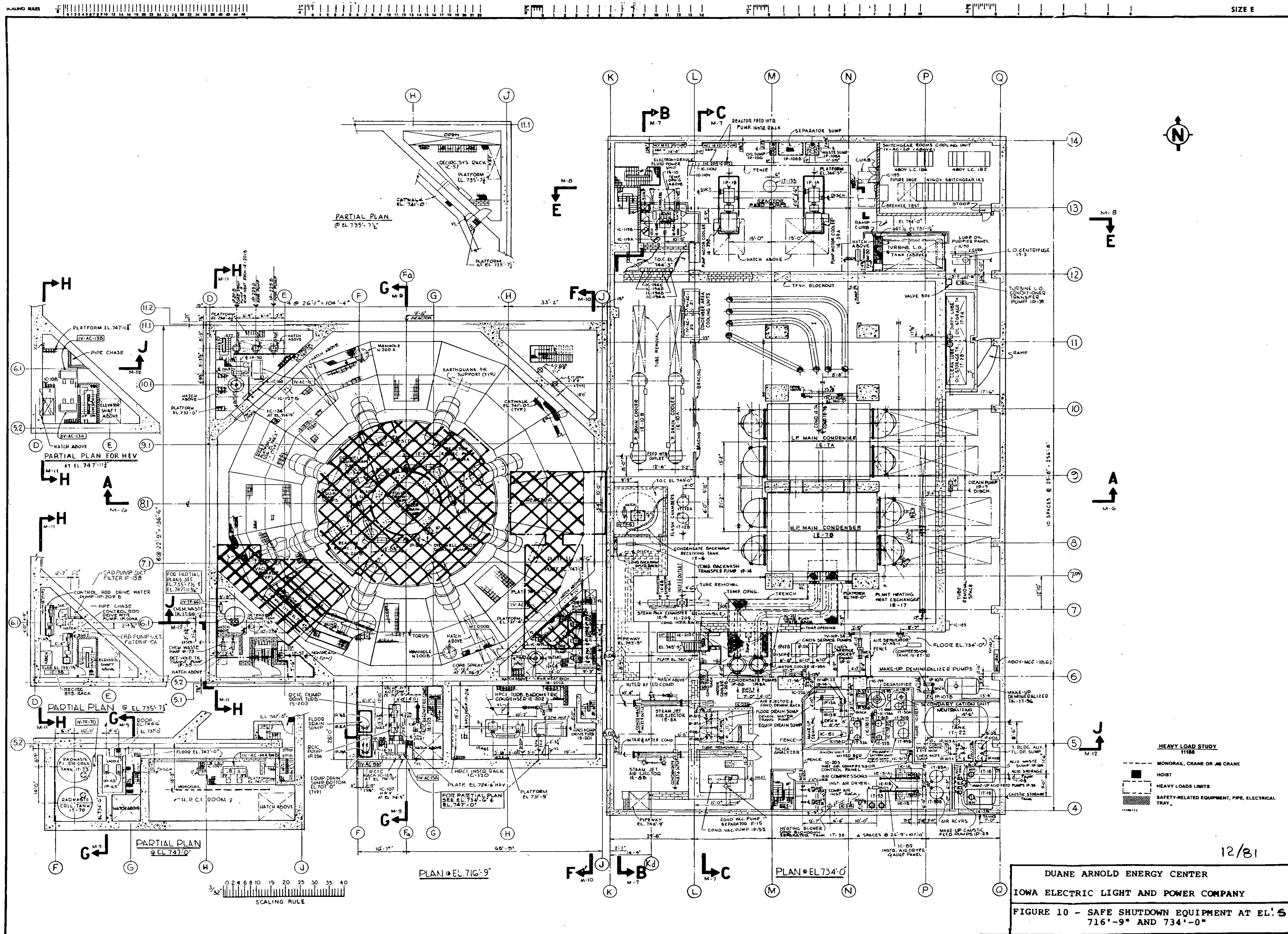

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FIGURE 10 - SAFE SHUTDOWN EQUIPMENT AT EL'S 716'-9" AND 734'-0"

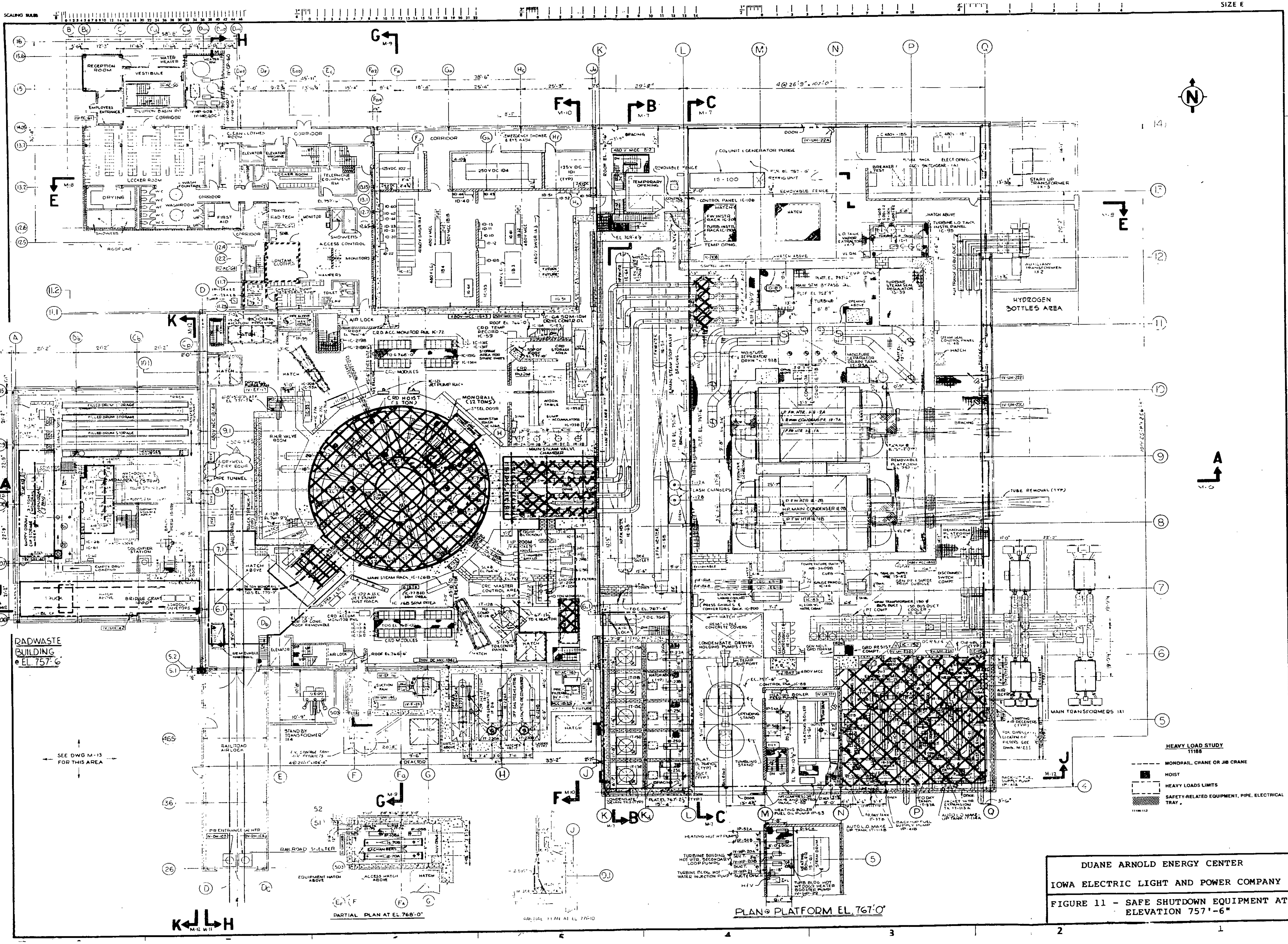

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FIGURE 11 - SAFE SHUTDOWN EQUIPMENT AT ELEVATION 757'-6"

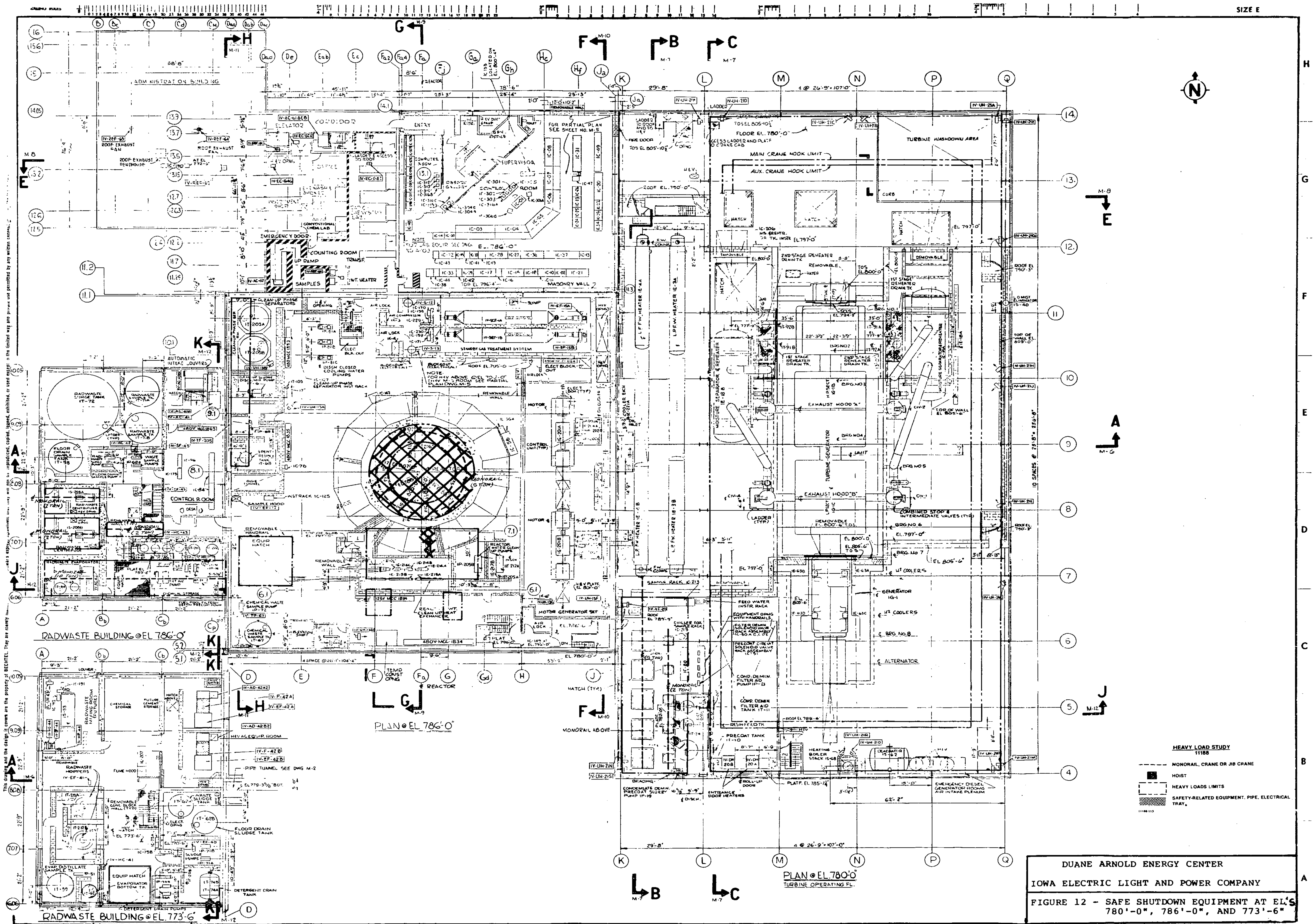

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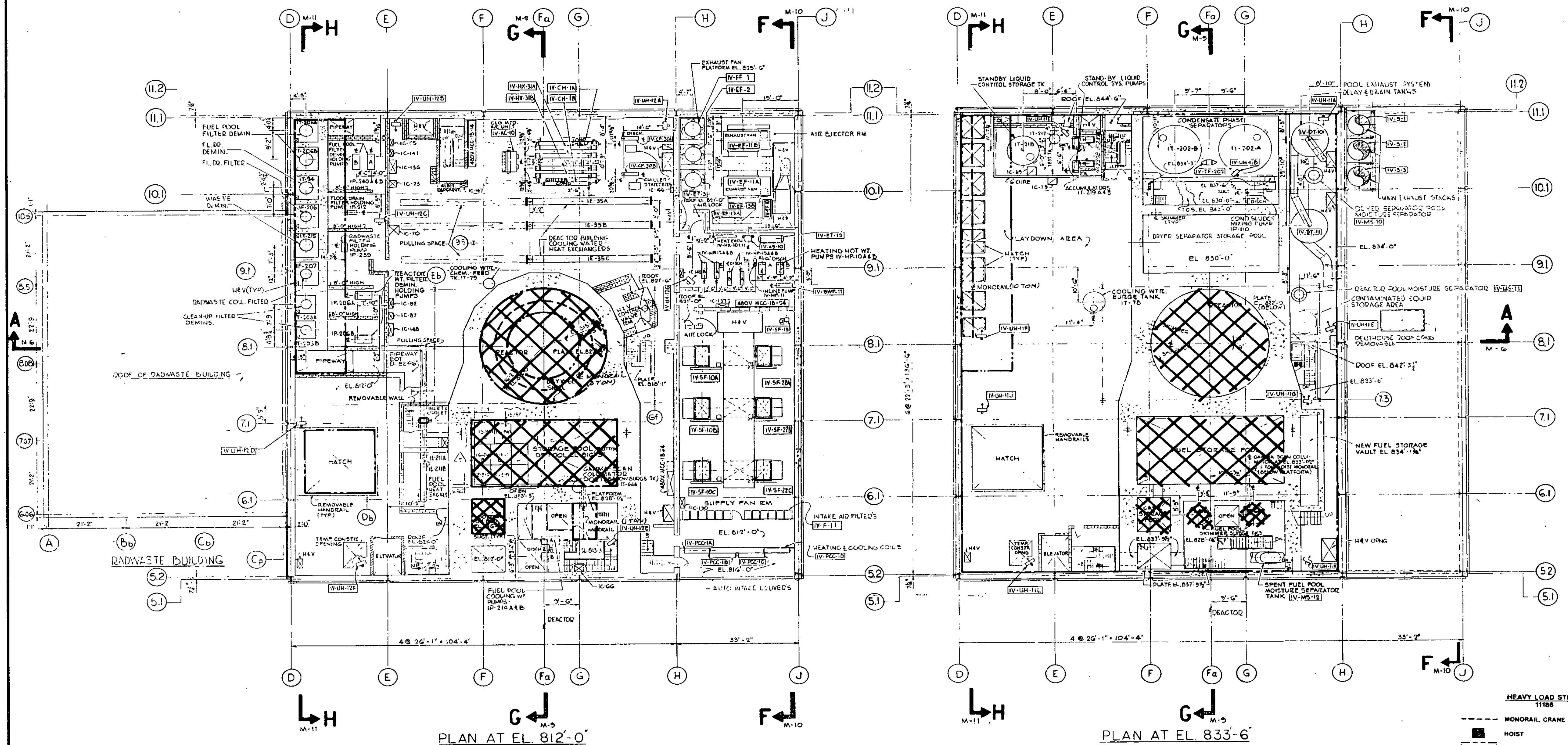
FIGURE 12 - SAFE SHUTDOWN EQUIPMENT AT EL'S 780'-0", 786'-0", AND 773'-6"



HEAVY LOAD STUDY
11186

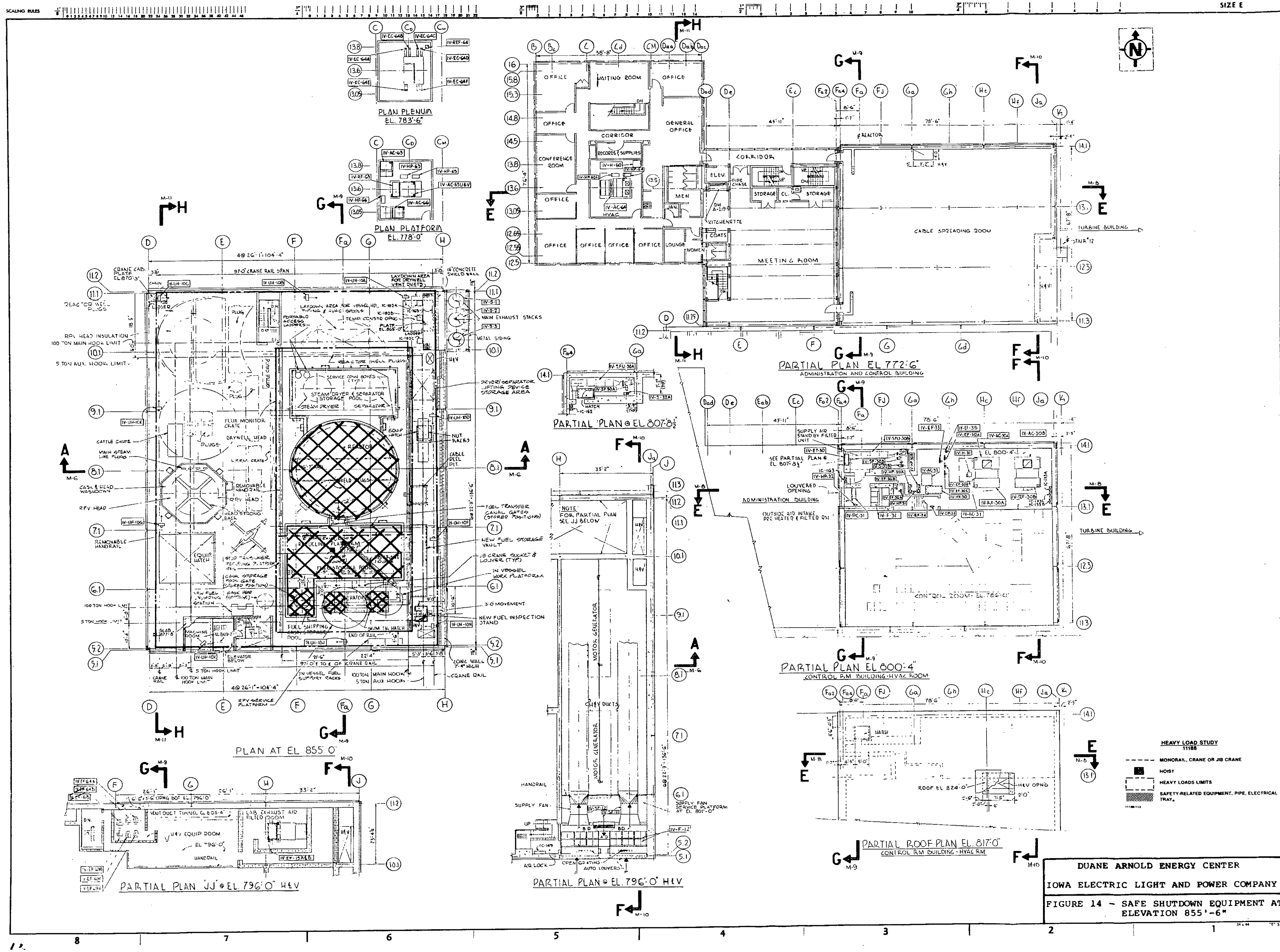
- MONORAIL, CRANE OR JIB CRANE
- HOIST
- HEAVY LOADS LIMITS
- SAFETY-RELATED EQUIPMENT, PIPE, ELECTRICAL TRAY.

11186-113

DUANE ARNOLD ENERGY CENTER

IOWA ELECTRIC LIGHT AND POWER COMPANY

FIGURE 13 - SAFE SHUTDOWN EQUIPMENT AT ELEVATIONS 812'-0" AND 833'-6"



DUANE ARNOLD ENERGY CENTER

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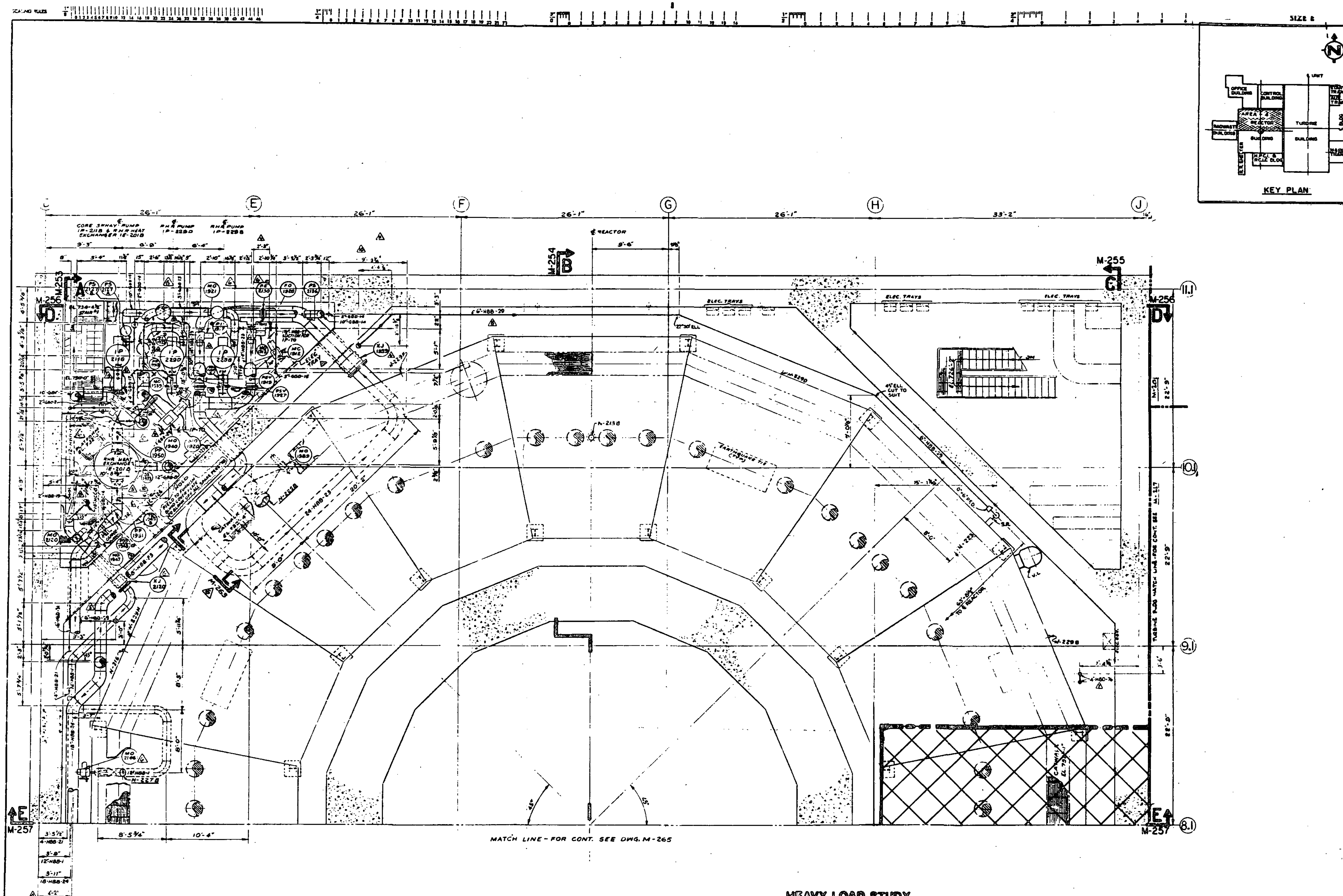
FIGURE 14 - SAFE SHUTDOWN EQUIPMENT AT ELEVATION 855'-6"



HEAVY LOAD STUDY
11188

MONORAIL, CRANE OR JIB CRANE

HOIST

HEAVY LOADS LIMITS

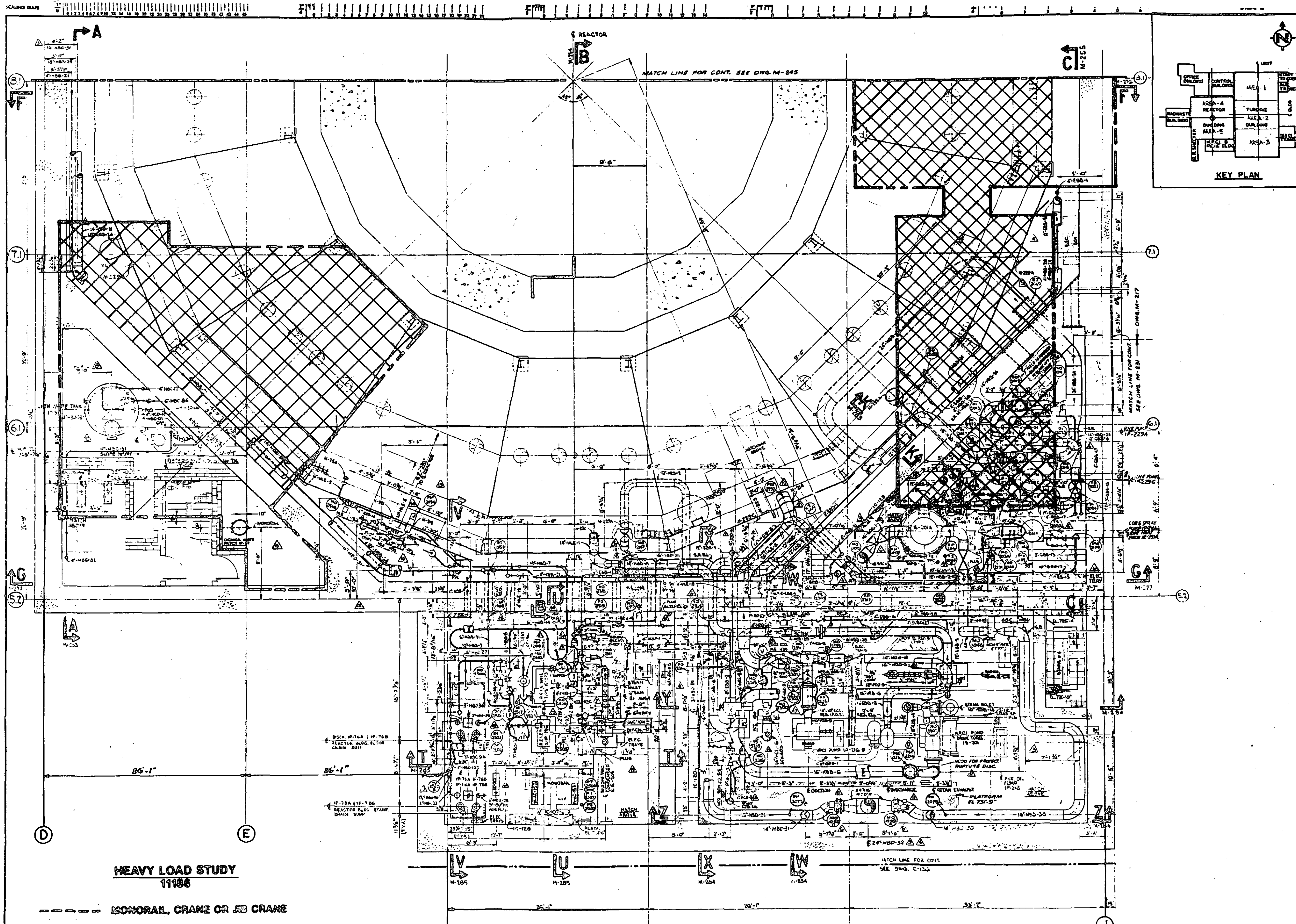
SAFETY-RELATED EQUIPMENT, PIPE, ELECTRICAL TRAY.

11188-113

DUANE ARNOLD ENERGY CENTER

IOWA ELECTRIC LIGHT AND POWER COMPANY

FIGURE 15 - REACTOR BUILDING NORTH - SAFE SHUTDOWN PIPING BELOW ELEVATION 734'-6"



HEAVY LOAD STUDY
11156

- MONORAIL, CRANE OR JIB CRANE
- HOIST
- HEAVY LOADS LIMITS
- SAFETY-RELATED EQUIPMENT, PIPE, ELECTRICAL TRAY.

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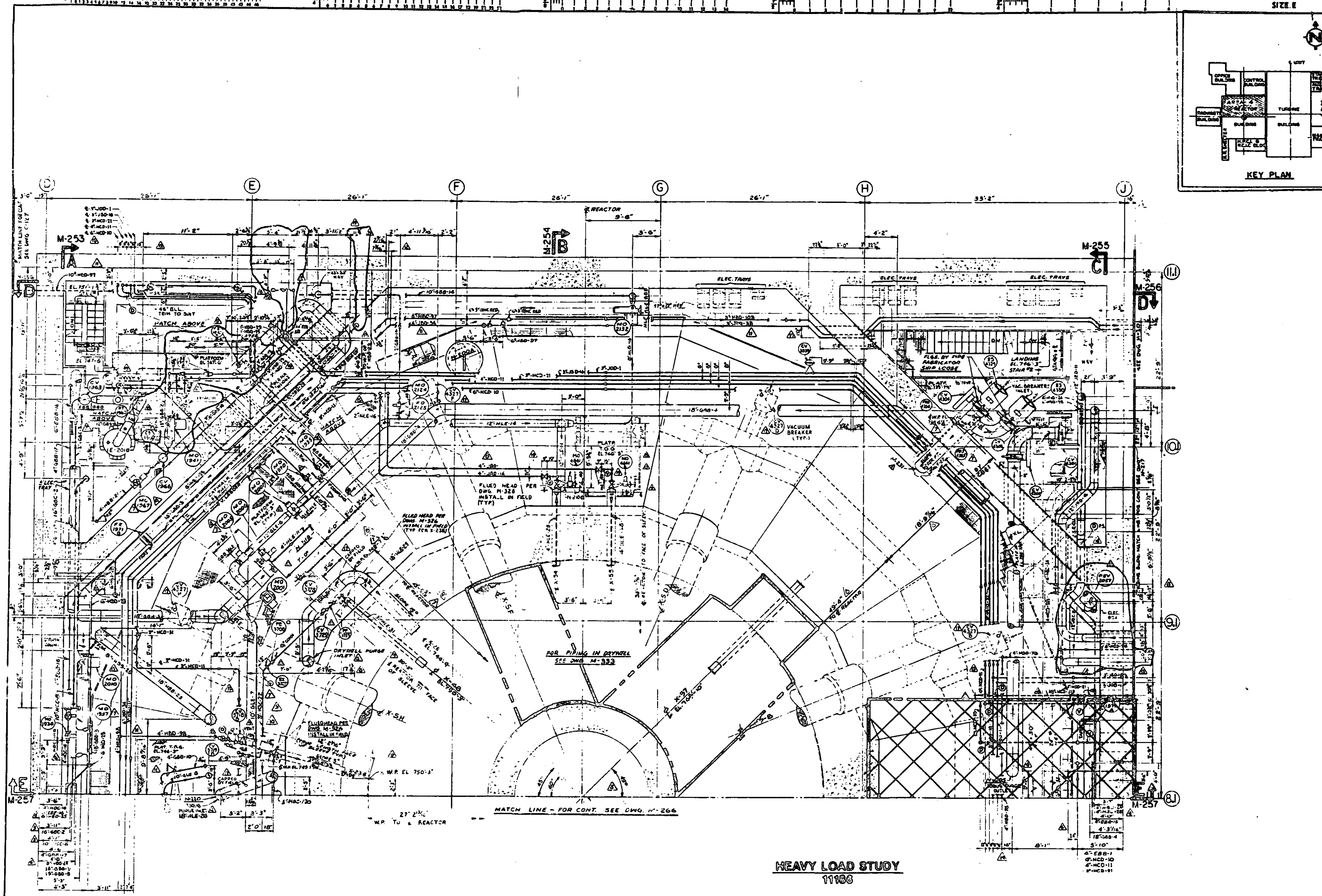
IOWA ELECTRIC LIGHT AND POWER COMPANY

FIGURE 16 - REACTOR BUILDING SOUTH - SAFE SHUTDOWN PIPING BELOW ELEVATION 734'-6"



HEAVY LOAD STUDY
11186

MONORAIL, CRANE OR JIB CRANE

HOIST

HEAVY LOADS LIMITS

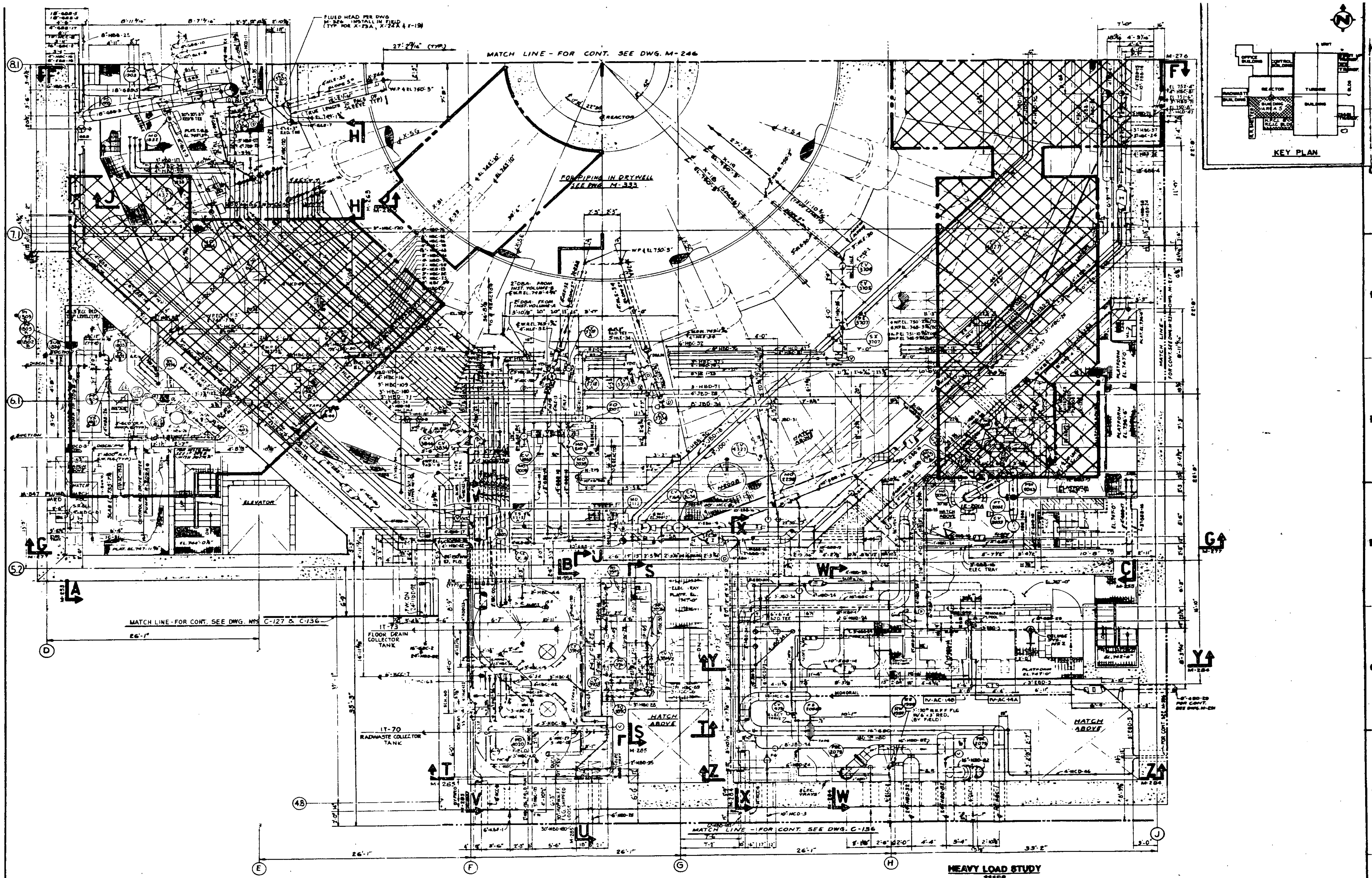
SAFETY-RELATED EQUIPMENT, PIPE, ELECTRICAL TRAY.

11186-113

DUANE ARNOLD ENERGY CENTER

IOWA ELECTRIC LIGHT AND POWER COMPANY

FIGURE 17 - REACTOR BUILDING NORTH - SAFE SHUTDOWN PIPING BELOW ELEVATION 757'-6"



HEAVY LOAD STUDY
11186

MONORAIL, CRANE OR JIB CRANE

HOIST

HEAVY LOADS LIMITS

SAFETY-RELATED EQUIPMENT, PIPE, ELECTRICAL TRAY.

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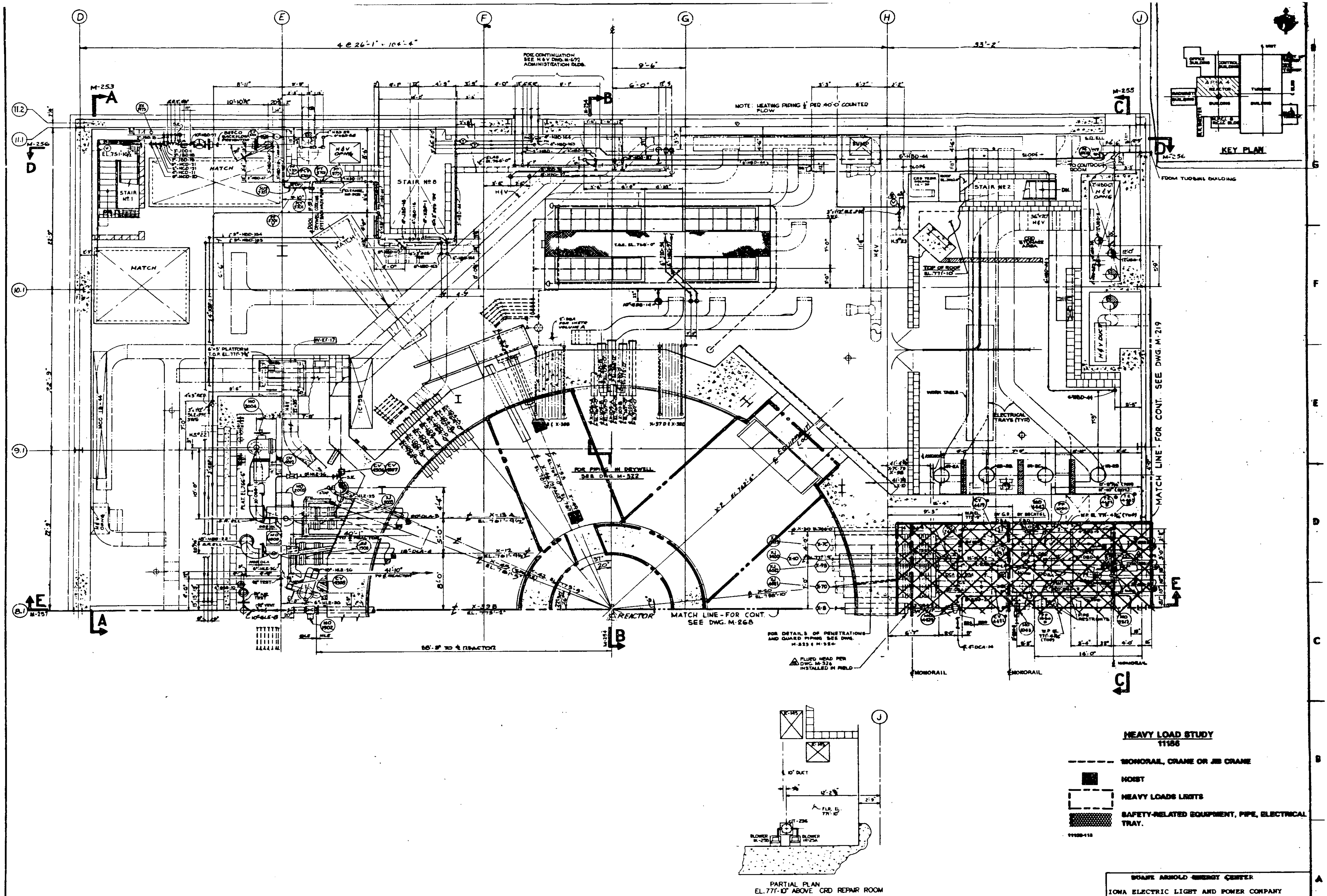
FIGURE 18 - REACTOR BUILDING SOUTH - SAFE SHUTDOWN PIPING BELOW ELEVATION 757'-6"



HEAVY LOAD STUDY
11186

- MONORAIL, CRANE OR JIB CRANE
- HOIST
- HEAVY LOADS LIMITS
- SAFETY-RELATED EQUIPMENT, PIPE, ELECTRICAL TRAY.

11186-113

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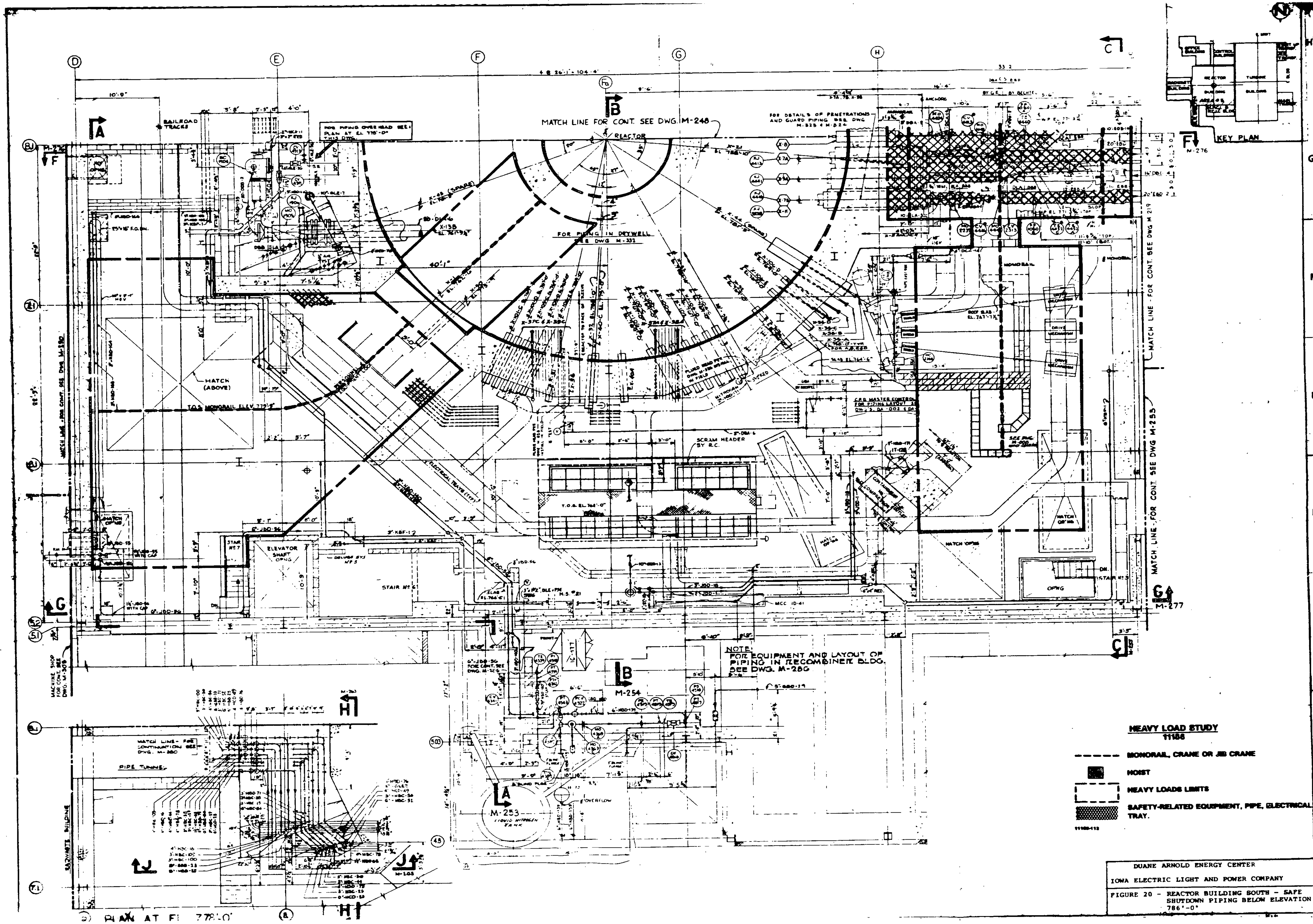
FIGURE 19 - REACTOR BUILDING NORTH - SAFE SHUTDOWN PIPING BELOW ELEVATION 786'-0"



HEAVY LOAD STUDY
11186

MONORAIL, CRANE OR JIB CRANE

HOIST

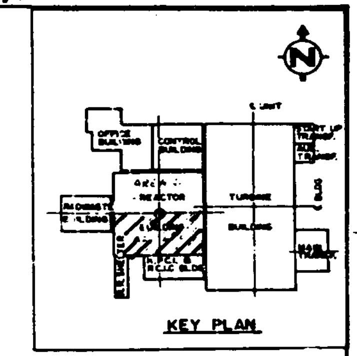
HEAVY LOADS LIMITS

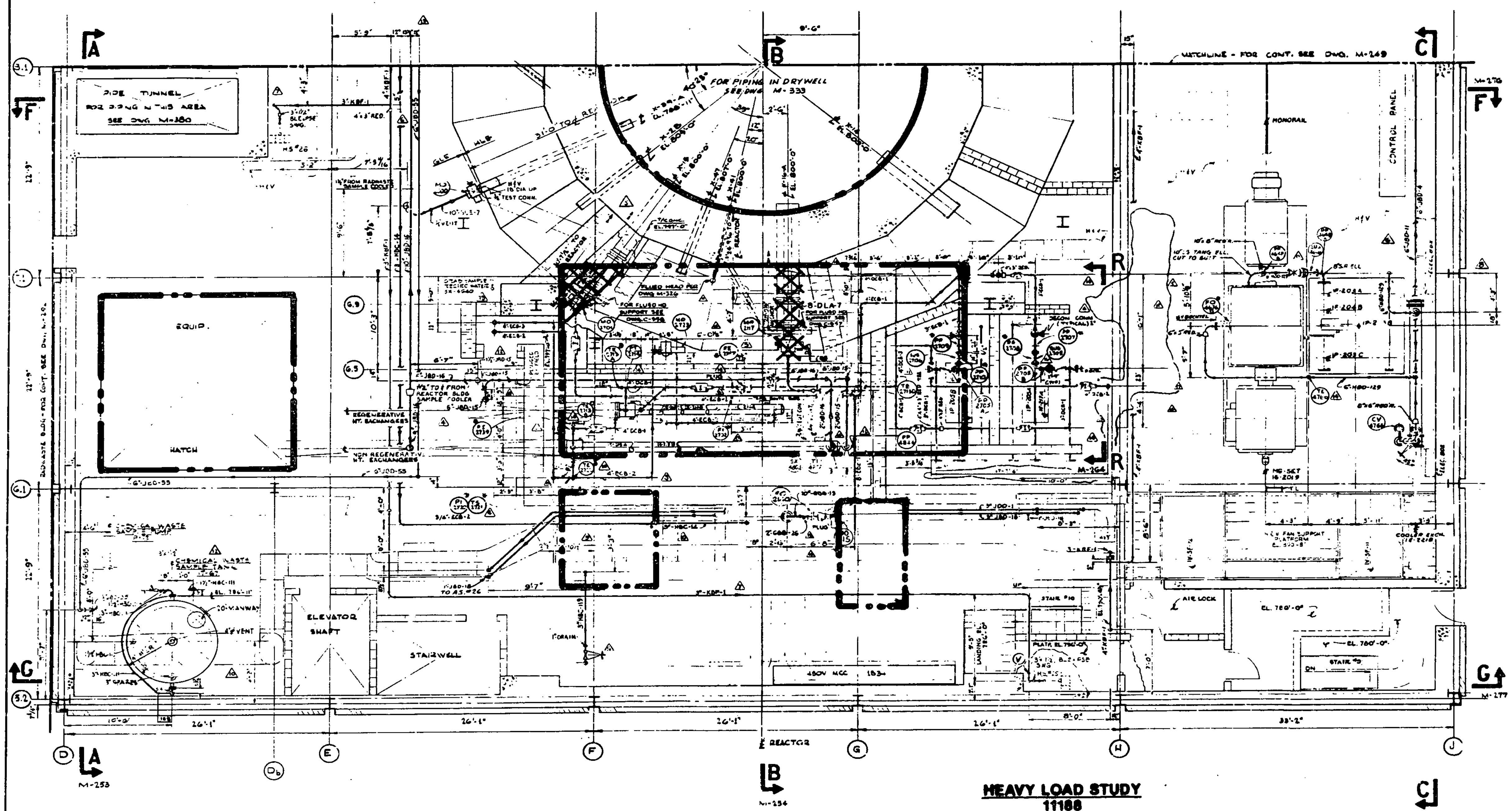
SAFETY-RELATED EQUIPMENT, PIPE, ELECTRICAL TRAY.

DUANE ARNOLD ENERGY CENTER

IOWA ELECTRIC LIGHT AND POWER COMPANY

FIGURE 20 - REACTOR BUILDING SOUTH - SAFE SHUTDOWN PIPING BELOW ELEVATION 786'-0"





HEAVY LOAD STUDY
11188

- MONORAIL, CRANE OR JIB CRANE
- HOIST
- HEAVY LOADS LIMITS
- SAFETY-RELATED EQUIPMENT, PIPE, ELECTRICAL TRAY.

11188-113

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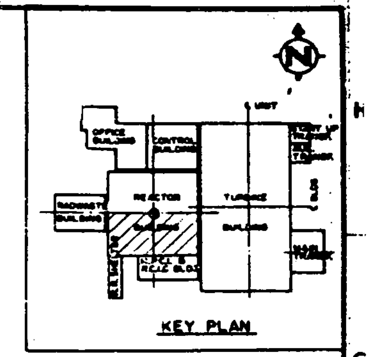
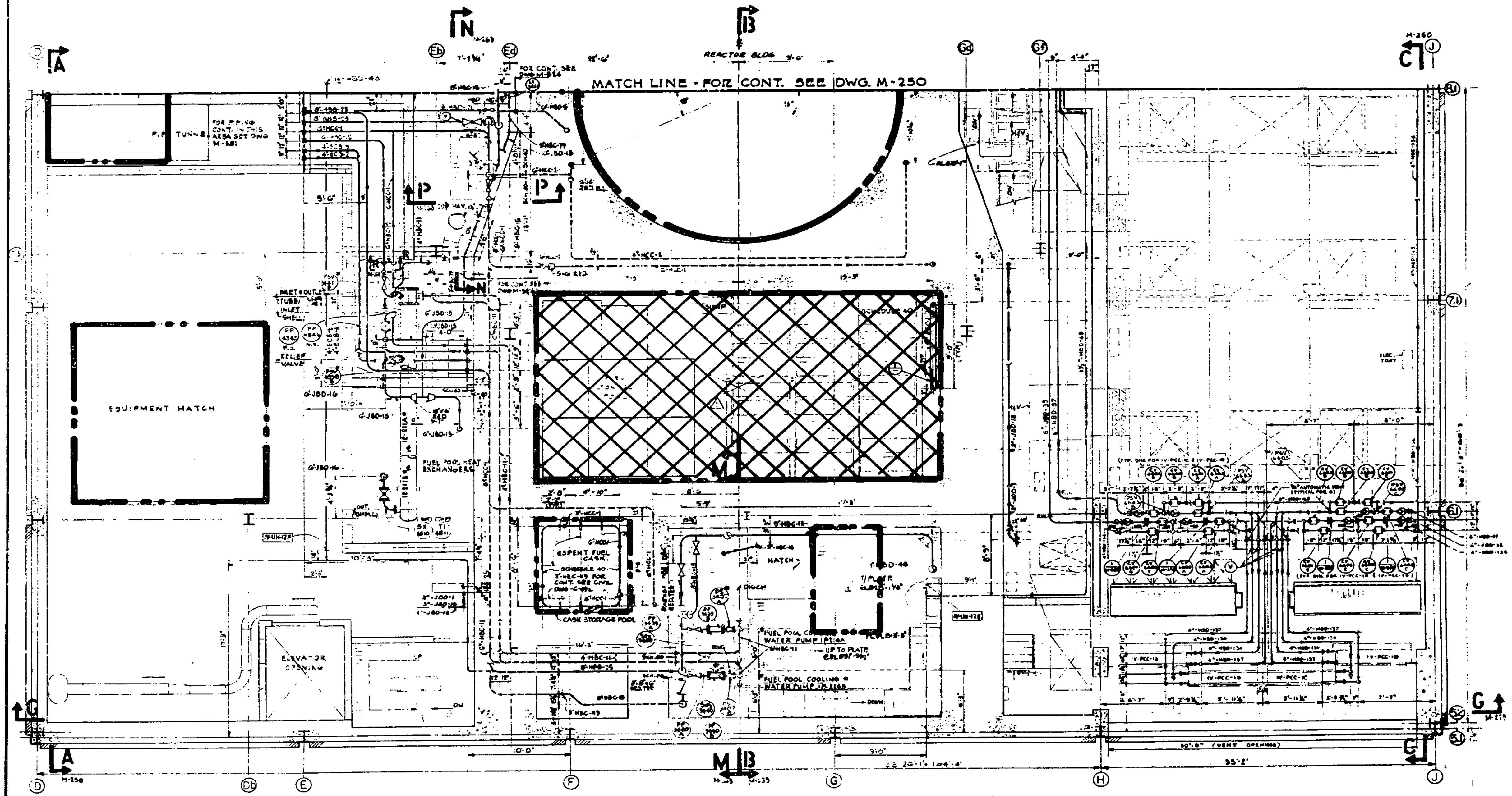
DUANE ARNOLD ENERGY CENTER
IOWA ELECTRIC LIGHT AND POWER COMPANY
FIGURE 21 - REACTOR BUILDING SOUTH - SAFE SHUTDOWN PIPING BELOW ELEVATION 812'-0"





HEAVY LOAD STUDY
11186

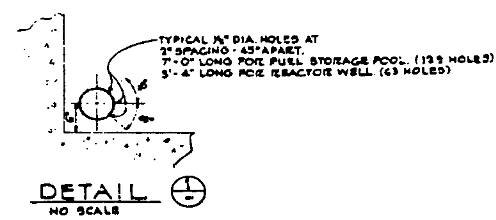
- - - - - MONORAIL, CRANE OR JIB CRANE

HOIST

HEAVY LOADS LIMITS

SAFETY-RELATED EQUIPMENT, PIPE, ELECTRICAL TRAY.

11186-113



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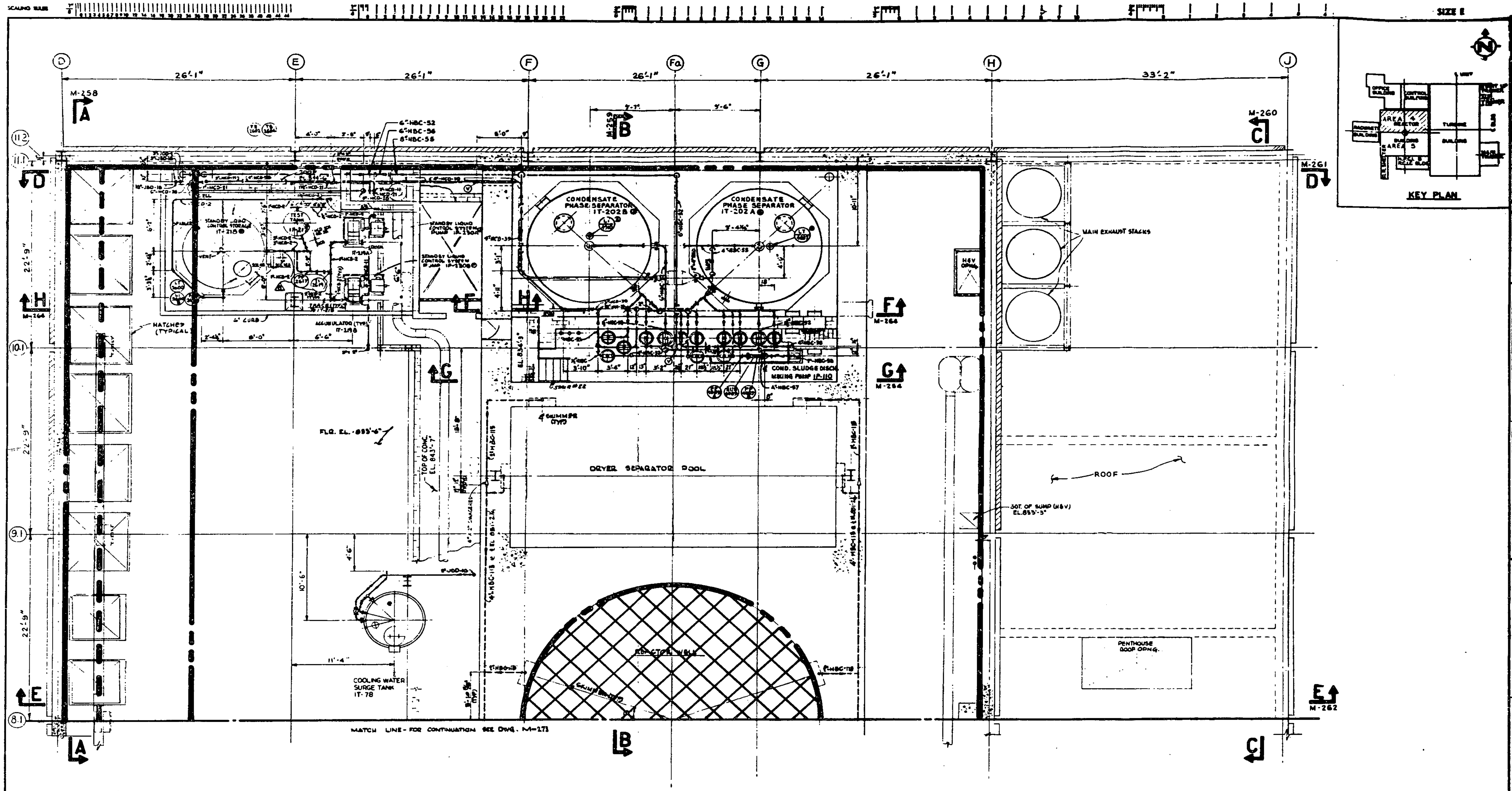
IOWA ELECTRIC LIGHT AND POWER COMPANY

FIGURE 22 - REACTOR BUILDING SOUTH - SAFE SHUTDOWN PIPING BELOW ELEVATION 833'-6"



HEAVY LOAD STUDY 11186

- MONORAIL, CRANE OR JIB CRANE
- HOIST
- HEAVY LOADS LIMITS
- SAFETY-RELATED EQUIPMENT, PIPE, ELECTRICAL TRAY.

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FIGURE 23 - REACTOR BUILDING NORTH - SAFE SHUTDOWN PIPING BELOW ELEVATION 855'-0"

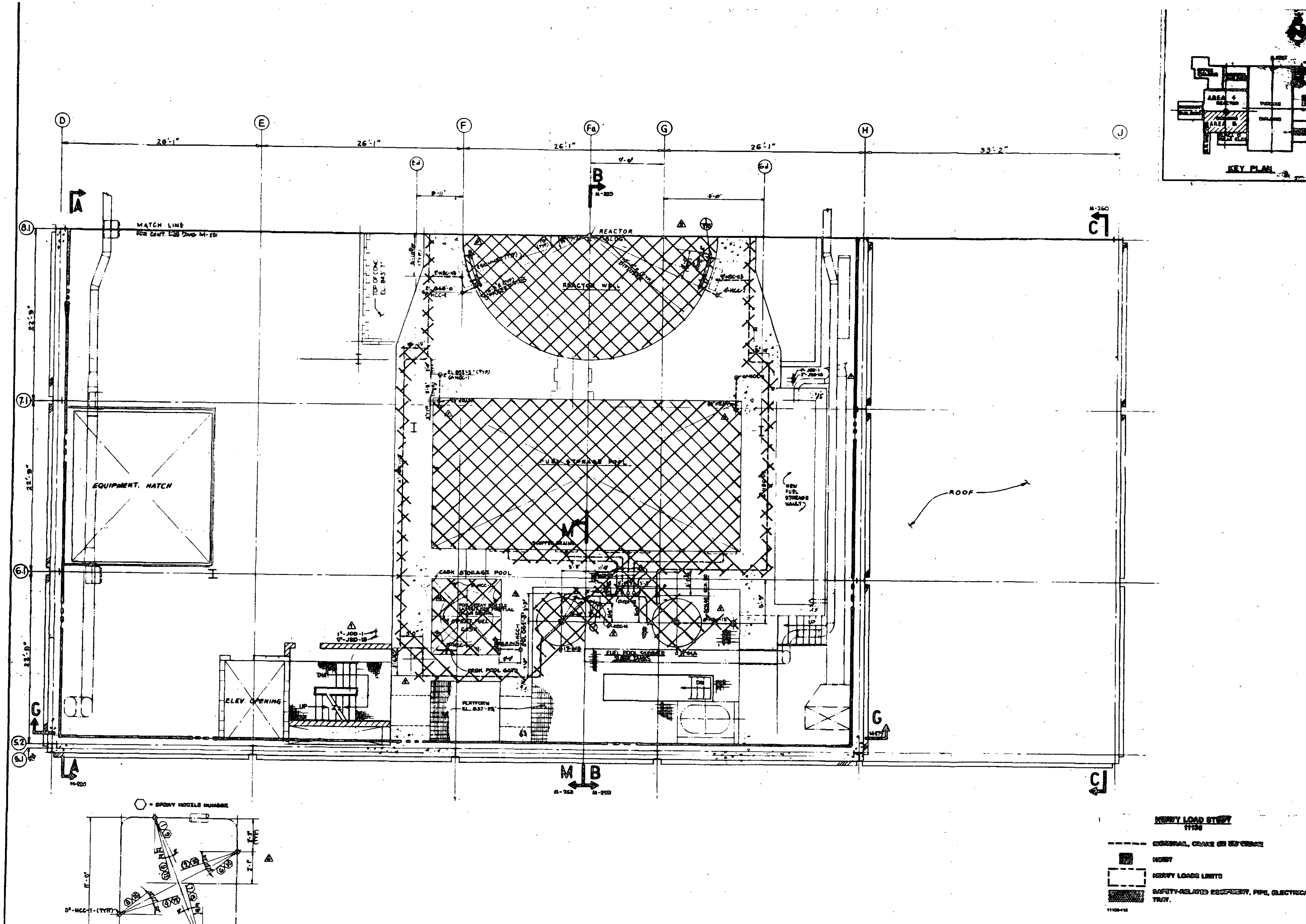

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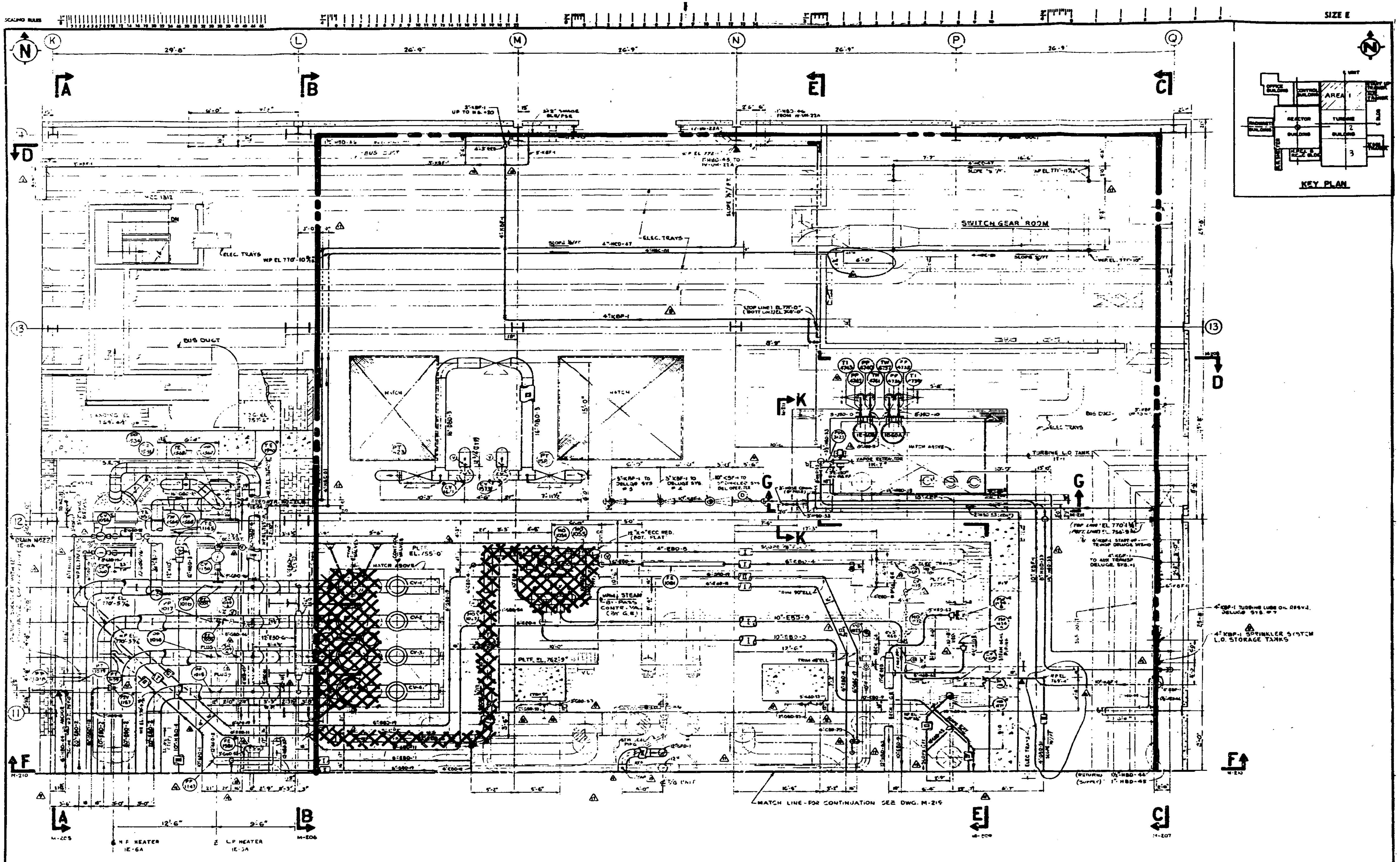
FIGURE 24 - REACTOR BUILDING SOUTH - SAFE SHUTDOWN PIPING BELOW ELEVATION 855'-0"



HEAVY LOAD STUDY
11186

NOTES:
1. SEE DWG M-234 FOR PLANT HEATING SYS. GEN NOTES.

- - - - MONORAIL, CRANE OR JIB CRANE

HOIST

HEAVY LOADS LIMITS

SAFETY-RELATED EQUIPMENT, PIPE, ELECTRICAL TRAY.

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FIGURE 25 - TURBINE BUILDING AREA 1 - SAFE SHUTDOWN PIPING BELOW ELEVATION 780'-0"

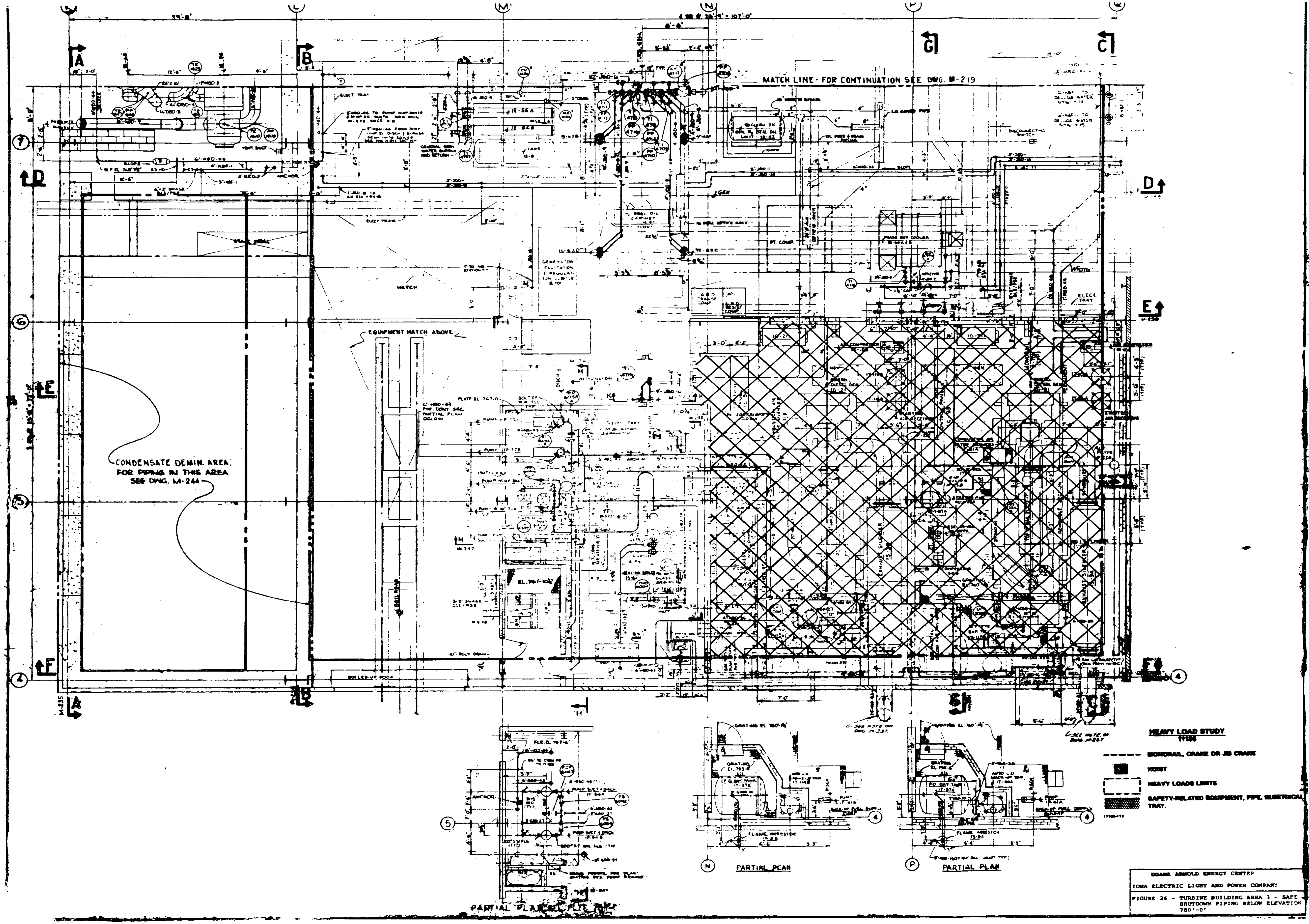

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FIGURE 26 - TURBINE BUILDING AREA 3 - SAFE SHUTDOWN PIPING BELOW ELEVATION 780'-0"

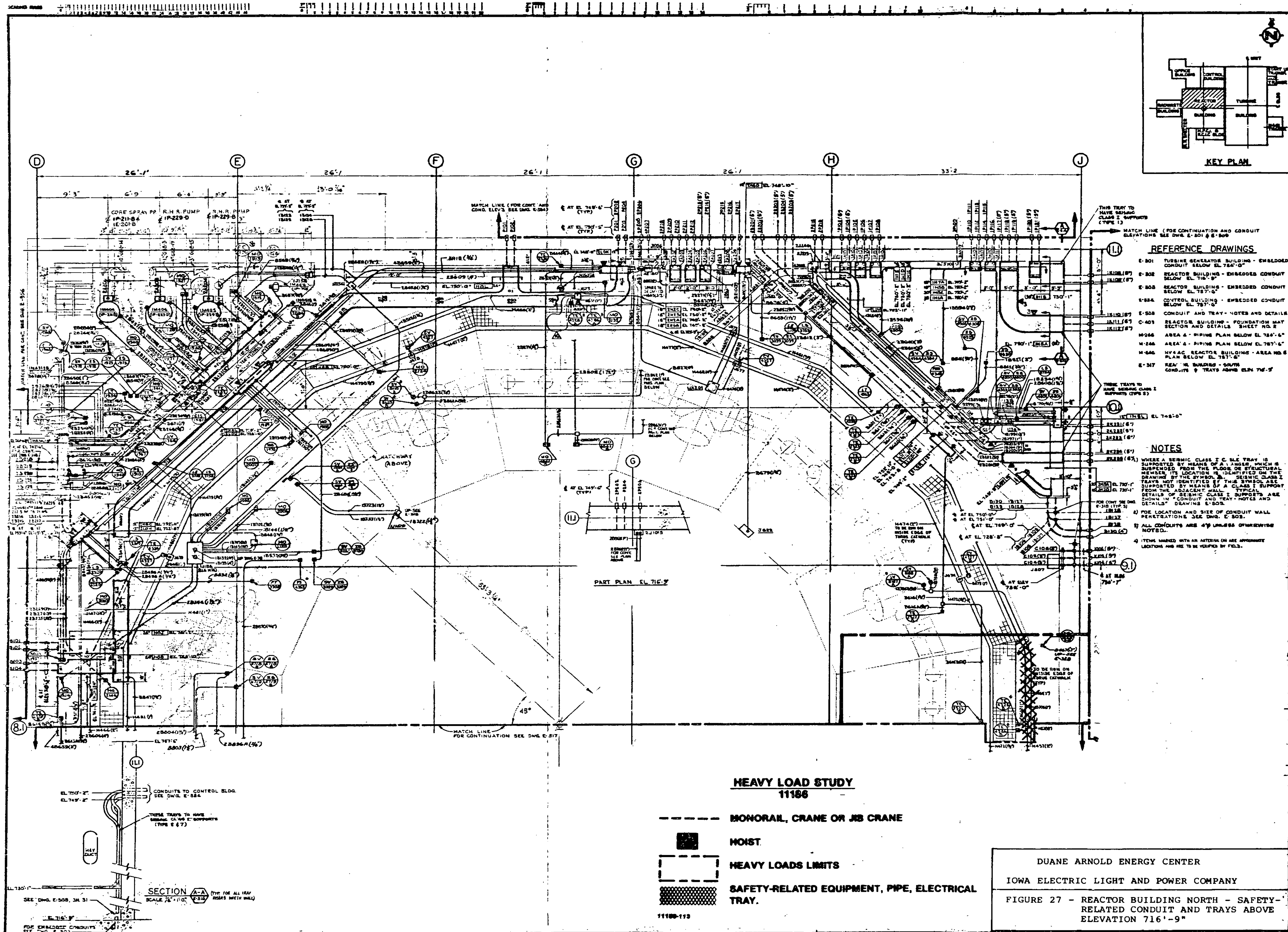

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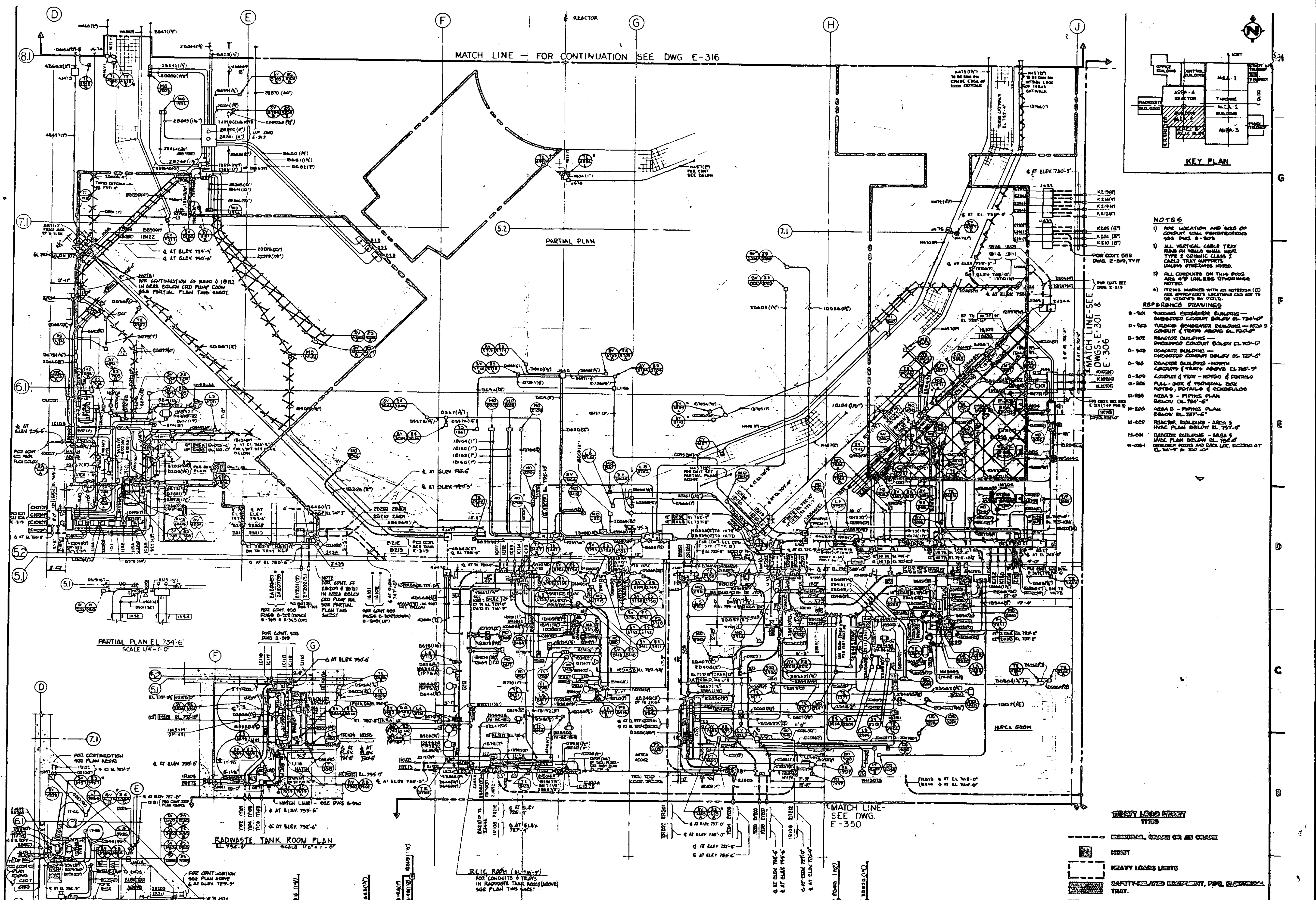
FIGURE 27 - REACTOR BUILDING NORTH - SAFETY-RELATED CONDUIT AND TRAYS ABOVE ELEVATION 716'-9"



DUANE ARNOLD ENERGY CENTER

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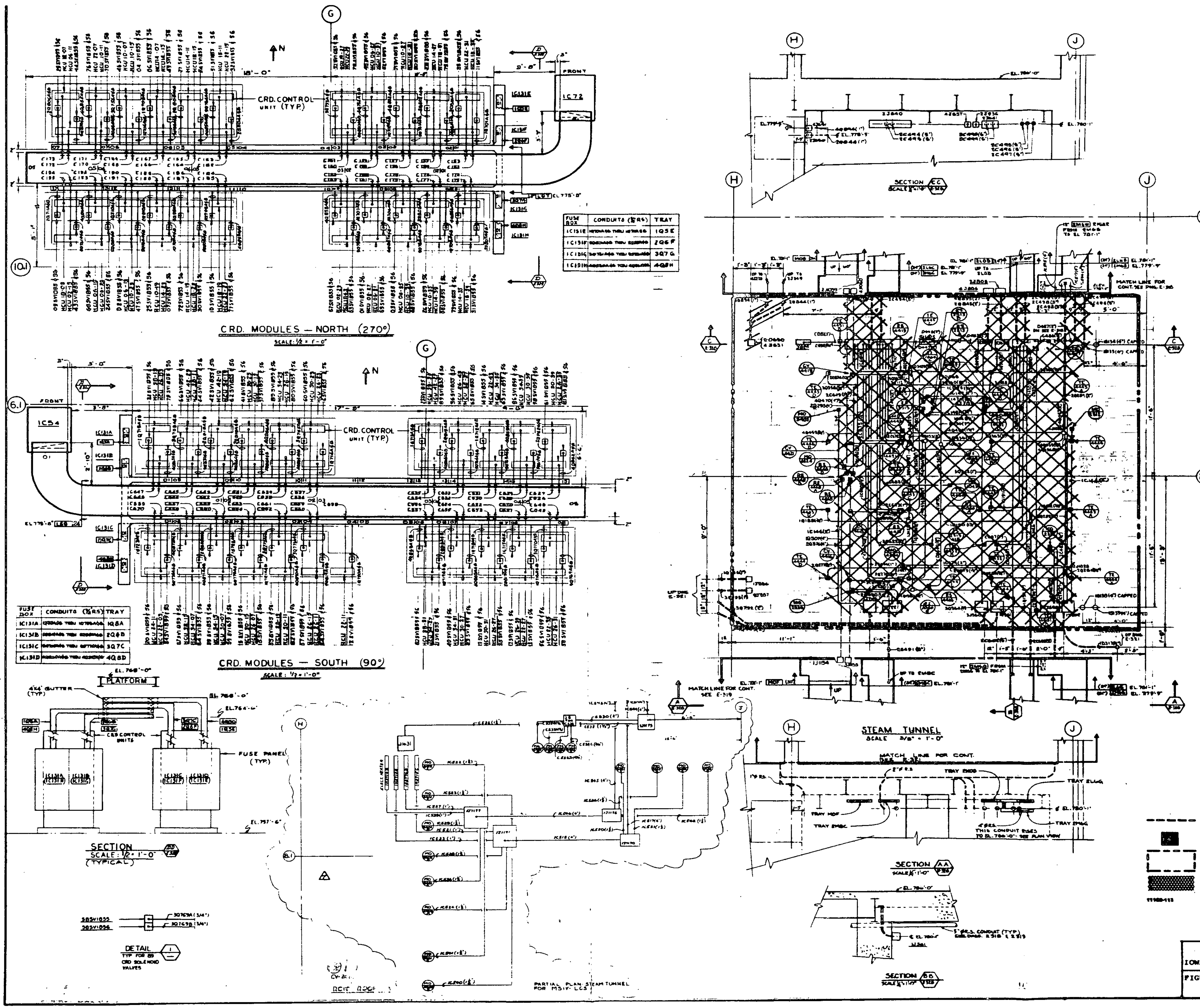
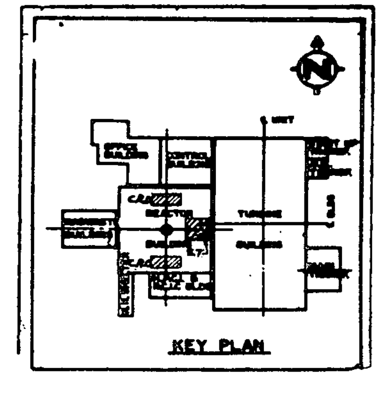
FIGURE 28 - REACTOR BUILDING SOUTH - SAFETY-RELATED CONDUIT AND TRAYS ABOVE ELEVATION 716'-9"



FUSE BOX	CONDUITS (1/2" RS)	TRAY
1C131E	[illegible]	1Q5E
1C131F	[illegible]	2Q6F
1C131G	[illegible]	3Q7G
1C131H	[illegible]	4Q8H

FUSE BOX	CONDUITS (1/2" RS)	TRAY
1C131A	[illegible]	1Q8A
1C131B	[illegible]	2Q6B
1C131C	[illegible]	3Q7C
1C131D	[illegible]	4Q8D



NOTES:

1. THIS DWG. SUPERSEDES INFORMATION SHOWN ON DWG. SK-E-45
2. CONDUITS C152 THRU C196 AND C686 THRU C670 SHALL BE 1 1/2".
3. GUTTERS ON THIS DWG. ARE IDENTIFIED WITH TRAY NUMBERS 1Q5A & E, 2Q6B & F, 3Q7C & G & 4Q8D & H WHICH IS AN EXCEPTION TO THAT SHOWN ON DWG. E-503 SECTION II ITEM 3 & 5, SHEET #12, AND ON DWG. E-500 SECTION I ITEM 6
4. ALL ELECTRICAL CONDUITS IN THE STEAM TUNNEL SHALL BE RIGID STEEL.
5. SEE SK-E-61 FOR SEISMIC SUPPORT.

HEAVY LOAD STUDY
11186

- - - - - MONORAIL, CRANE OR JIB CRANE

HOIST

HEAVY LOADS LIMITS

SAFETY-RELATED EQUIPMENT, PIPE, ELECTRICAL TRAY.

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DUANE ARNOLD ENERGY CENTER

IOWA ELECTRIC LIGHT AND POWER COMPANY

FIGURE 29 - REACTOR BUILDING - SAFETY-RELATED CONDUIT AND TRAYS - STEAM TUNNEL

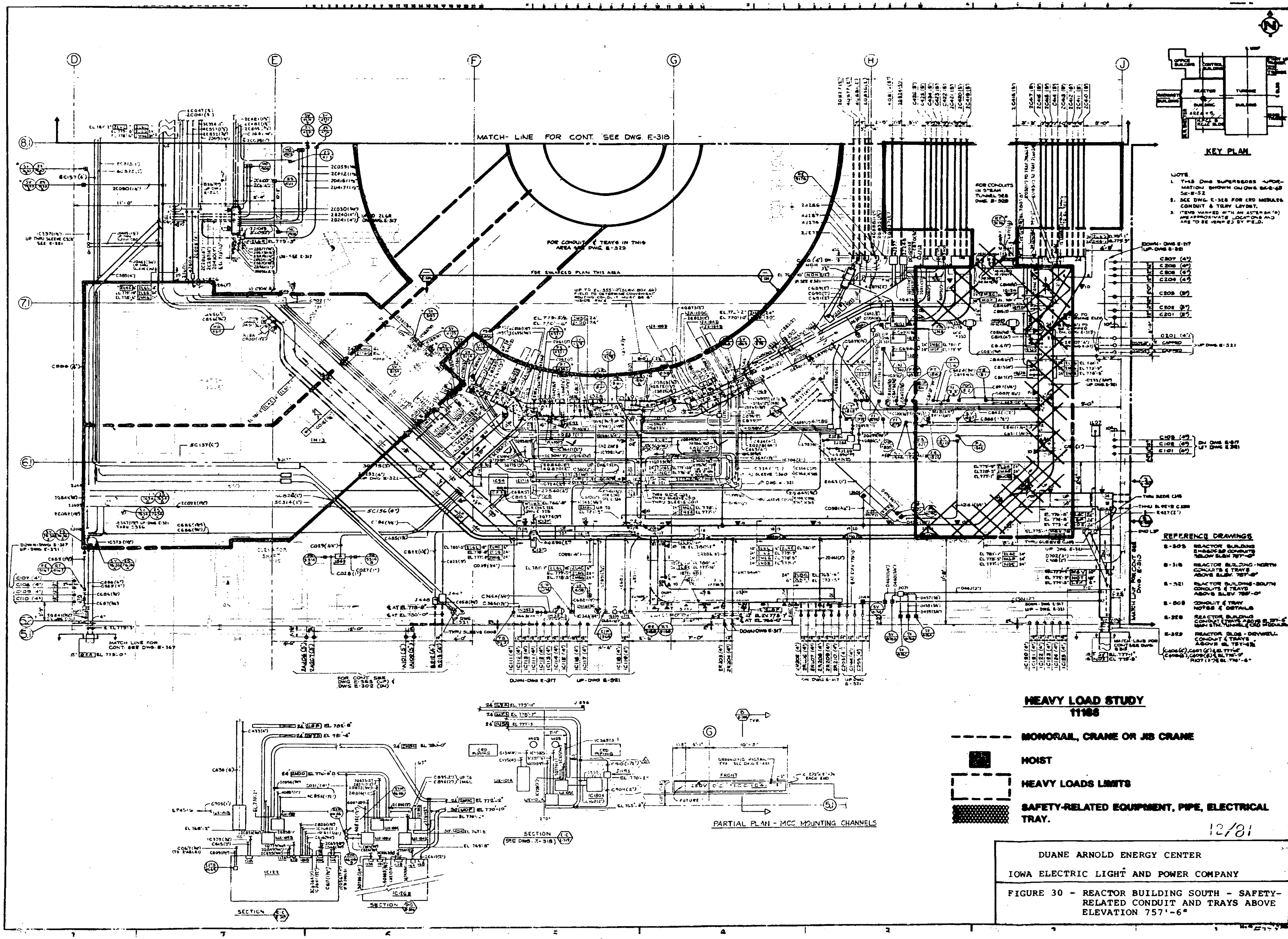

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FIGURE 30 - REACTOR BUILDING SOUTH - SAFETY-RELATED CONDUIT AND TRAYS ABOVE ELEVATION 757'-6"

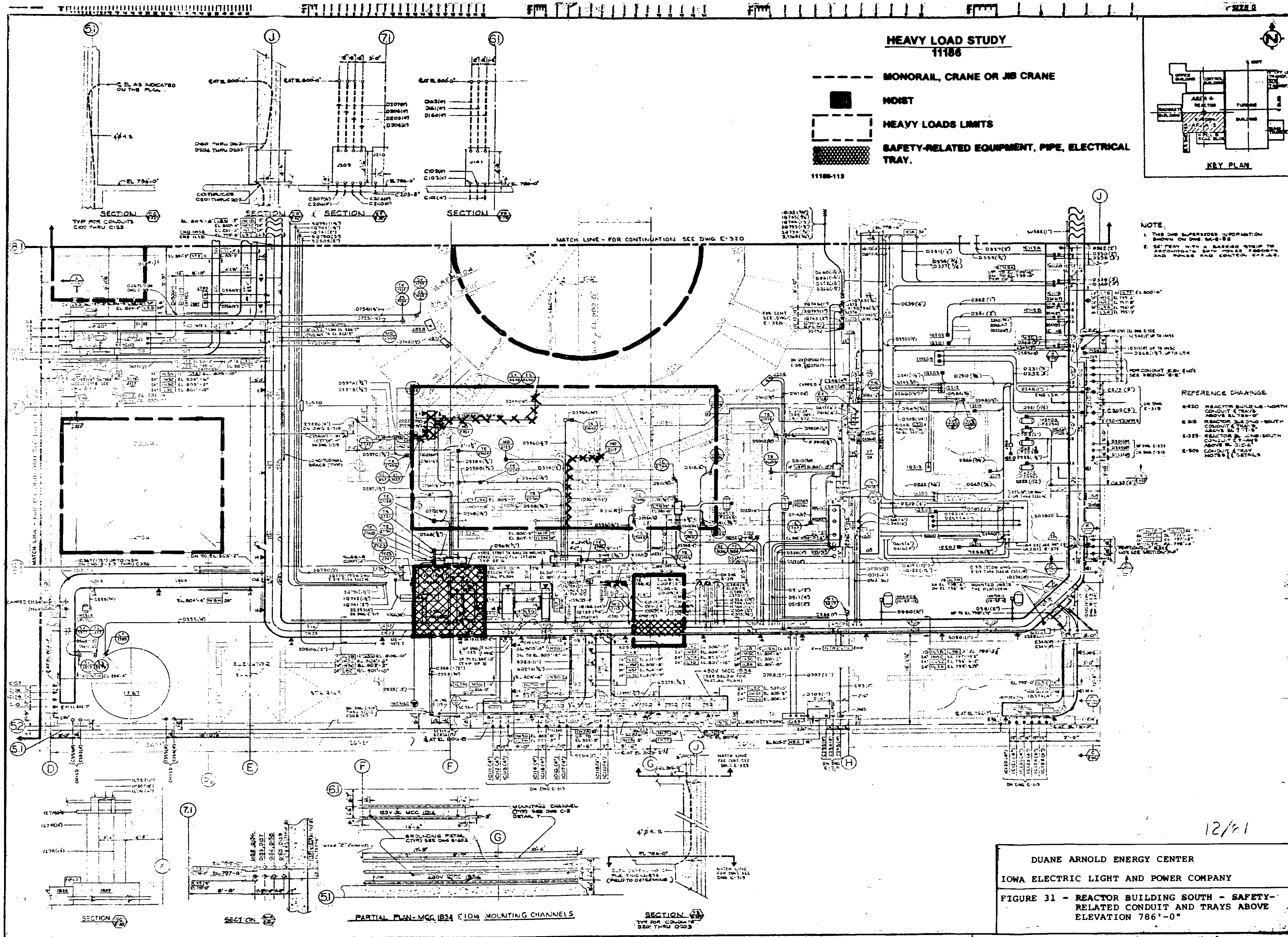

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FIGURE 31 - REACTOR BUILDING SOUTH - SAFETY-RELATED CONDUIT AND TRAYS ABOVE ELEVATION 786'-0"

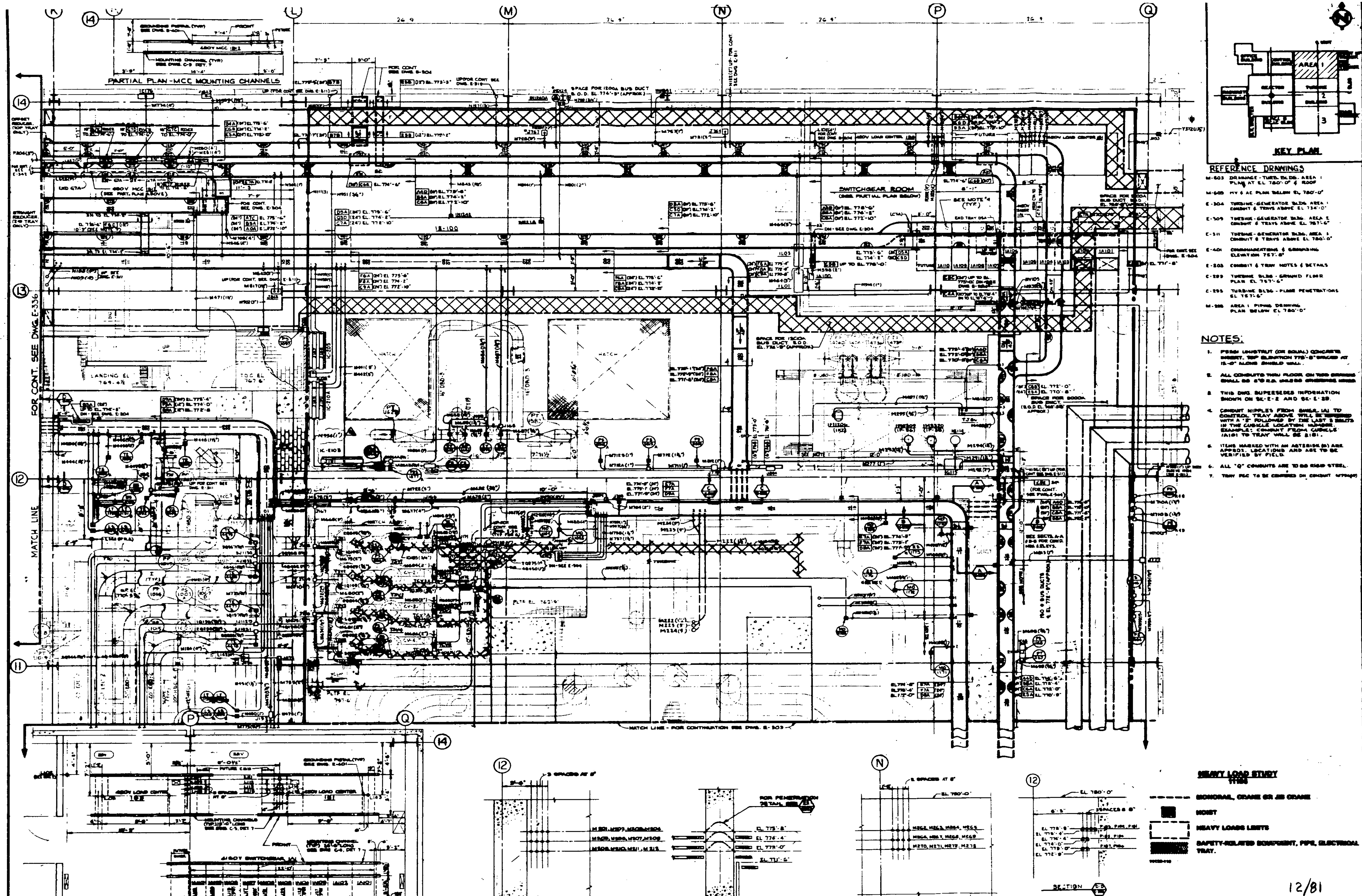

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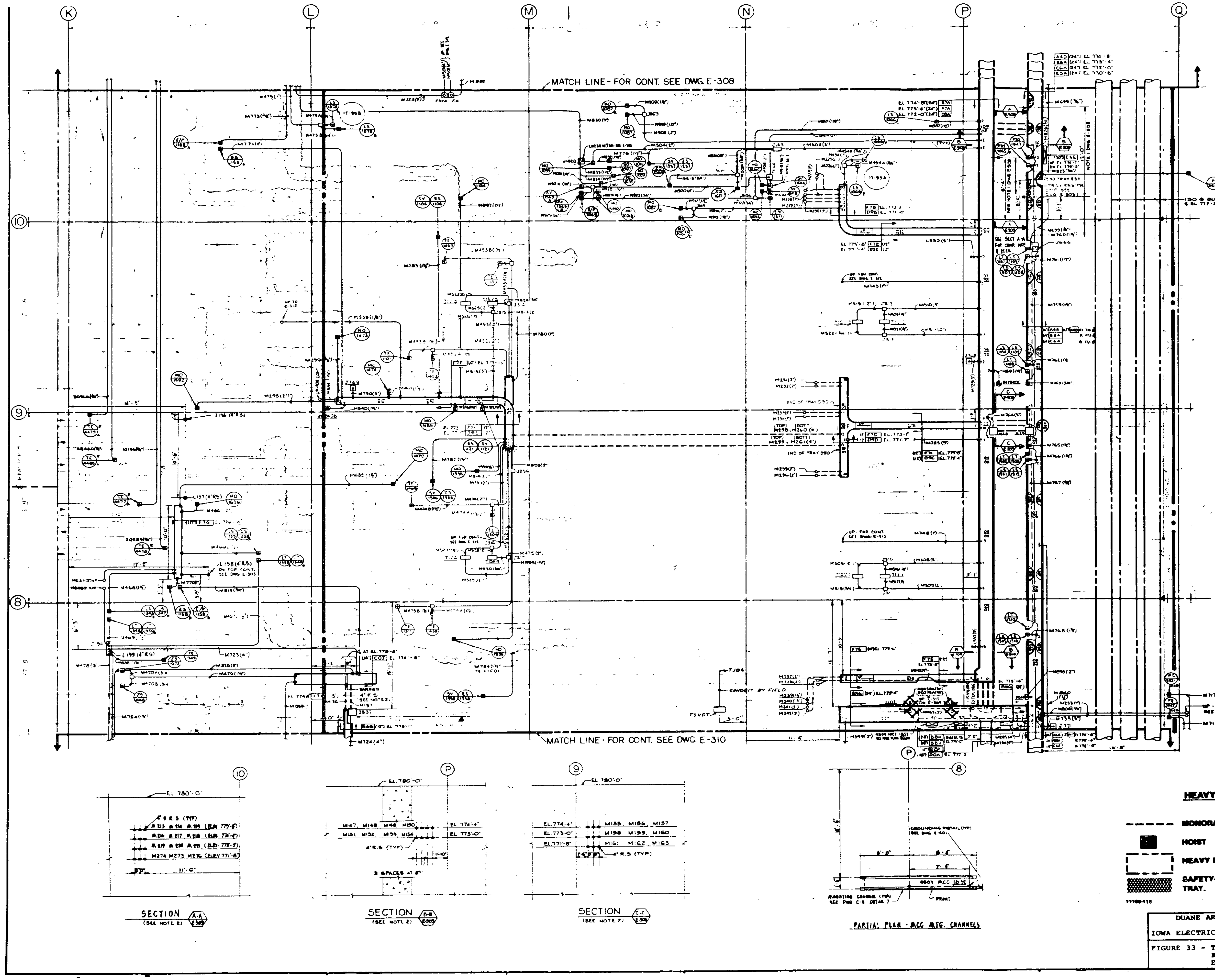
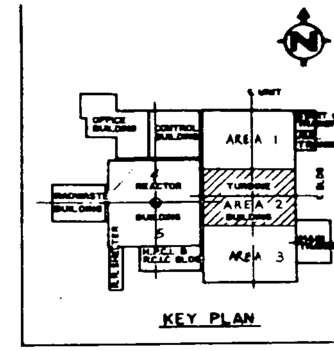
FIGURE 32 - TURBINE BUILDING AREA 1 - SAFETY-RELATED CONDUIT AND TRAYS ABOVE ELEVATION 757'-6"





150 @ BUS DUCTS
℄ EL. 777'-9" (APPROX.)

NOTES

1. THIS DWG SUPERSEDES INFORMATION SHOWN ON SK-E-2 AND SK-E-50
2. FOR PENETRATION DETAIL SEE 22/E-305
3. ITEMS MARKED WITH AN ASTERISK (*) ARE APPROX. LOCATIONS AND ARE TO BE VERIFIED BY FIELD.

REFERENCE DRAWINGS

E-309	TURBINE-GENERATOR BLDG. AREA 2 CONDUIT & TRAYS ABOVE ELEV. 754'-6"
E-308	TURBINE-GENERATOR BLDG. AREA 1 CONDUIT & TRAYS ABOVE ELEV. 757'-6"
E-310	TURBINE-GENERATOR BLDG. AREA 3 CONDUIT & TRAYS ABOVE ELEV. 757'-6"
E-305	CONDUIT & TRAYS NOTES & DETAILS
M-219	AREA 2 - PIPING PLAN BELOW ELEV. 780'-0"
M-507	DRAINAGE - TURBINE BLDG. AREA 2 PLAN AT ELEV. 780'-0" & ROOF
M-614	HV & AC TURBINE BLDG. - AREA 2 PLAN BELOW ELEV. 780'-0"

HEAVY LOAD STUDY
11186

MONORAIL, CRANE OR JIB CRANE

HOIST

HEAVY LOADS LIMITS

SAFETY-RELATED EQUIPMENT, PIPE, ELECTRICAL TRAY.

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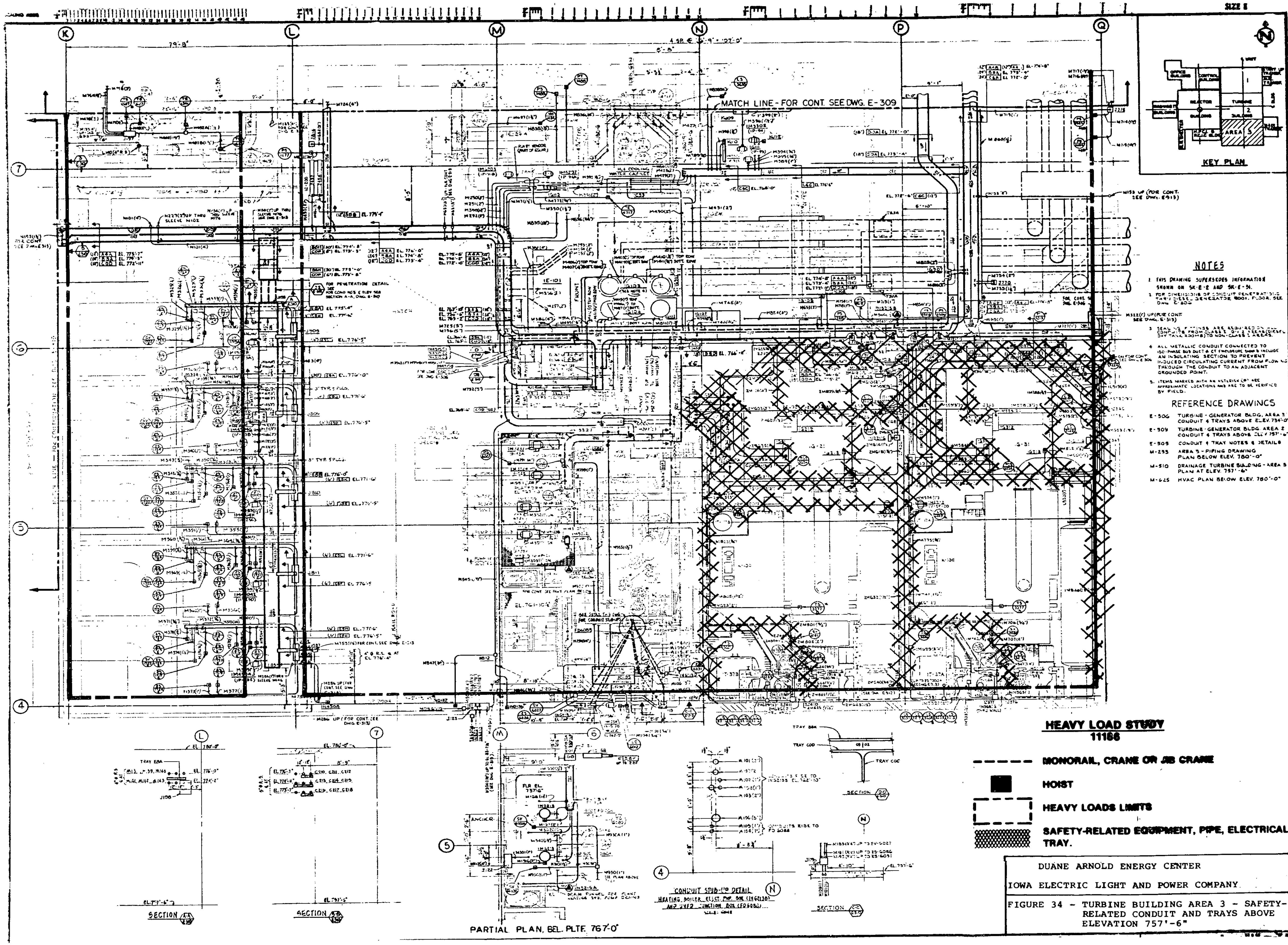
DUANE ARNOLD ENERGY CENTER

IOWA ELECTRIC LIGHT AND POWER COMPANY

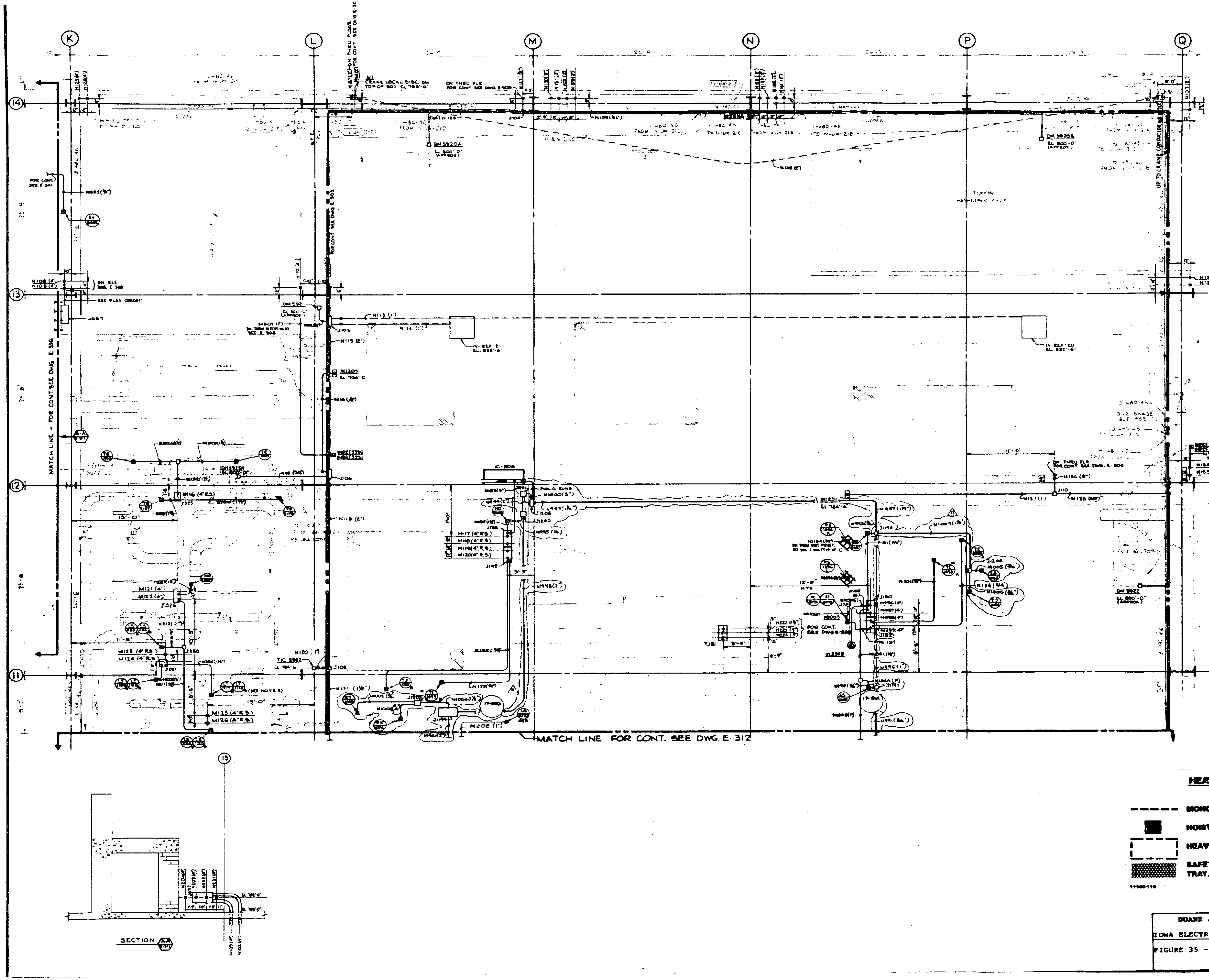
FIGURE 33 - TURBINE BUILDING AREA 2 - SAFETY-RELATED CONDUIT AND TRAYS ABOVE ELEVATION 757'-6"

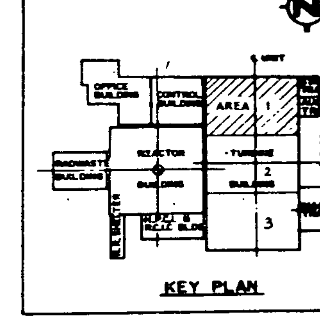


DUANE ARNOLD ENERGY CENTER

IOWA ELECTRIC LIGHT AND POWER COMPANY

FIGURE 34 - TURBINE BUILDING AREA 3 - SAFETY-RELATED CONDUIT AND TRAYS ABOVE ELEVATION 757'-6"





NOTES:

1. ALL CONDUITS THRU FLOOR & WALLS ON THIS DWG SHALL BE 4" R.S. UNLESS OTHERWISE NOTED.
2. THIS DRAWING SUPERSEDES BK-E-55.
3. ITEMS MARKED WITH AN ASTERISK (*) ARE APPRO[X] LOCATIONS AND ARE TO BE VERIFIED BY FIELD

REFERENCE DRAWINGS:

E-306	TURBINE-GENERATOR BLDG. AREA CONDUIT & TRAYS ABOVE ELEV. 757-
E-312	TURBINE-GENERATOR BLDG. AREA CONDUIT & TRAYS ABOVE ELEV. 780'-
E-336	CONTROL BUILDING - CONDUIT & T ABOVE EL. 772'-6"
M-204	AREA I - PIPING DRAWING PLA BELOW EL. 800'-0"
M-405-3	INSTRUMENT POINTS & RACK LOCATIONS DIAGRAM EL. 780'-0"
M-602	HV&AC TURB. BLDG. AREA I OPER ATING FLOOR PLAN EL. 780'-0
E-503	CONDUIT & TRAY NOTES AND DETAILS
FSL-308	TURB. BLDG. LTG. AND FAN CONDUIT ON ROOF
E-506	PULLBOX & TERMINAL BOX NOTE DETAILS & SCHEDULES

HEAVY LOAD STUDY
11186

MONORAIL, CRANE OR JIB CRANE

HOIST

HEAVY LOADS LIMITS

SAFETY-RELATED EQUIPMENT, PIPE, ELECTRI[C] TRAY.

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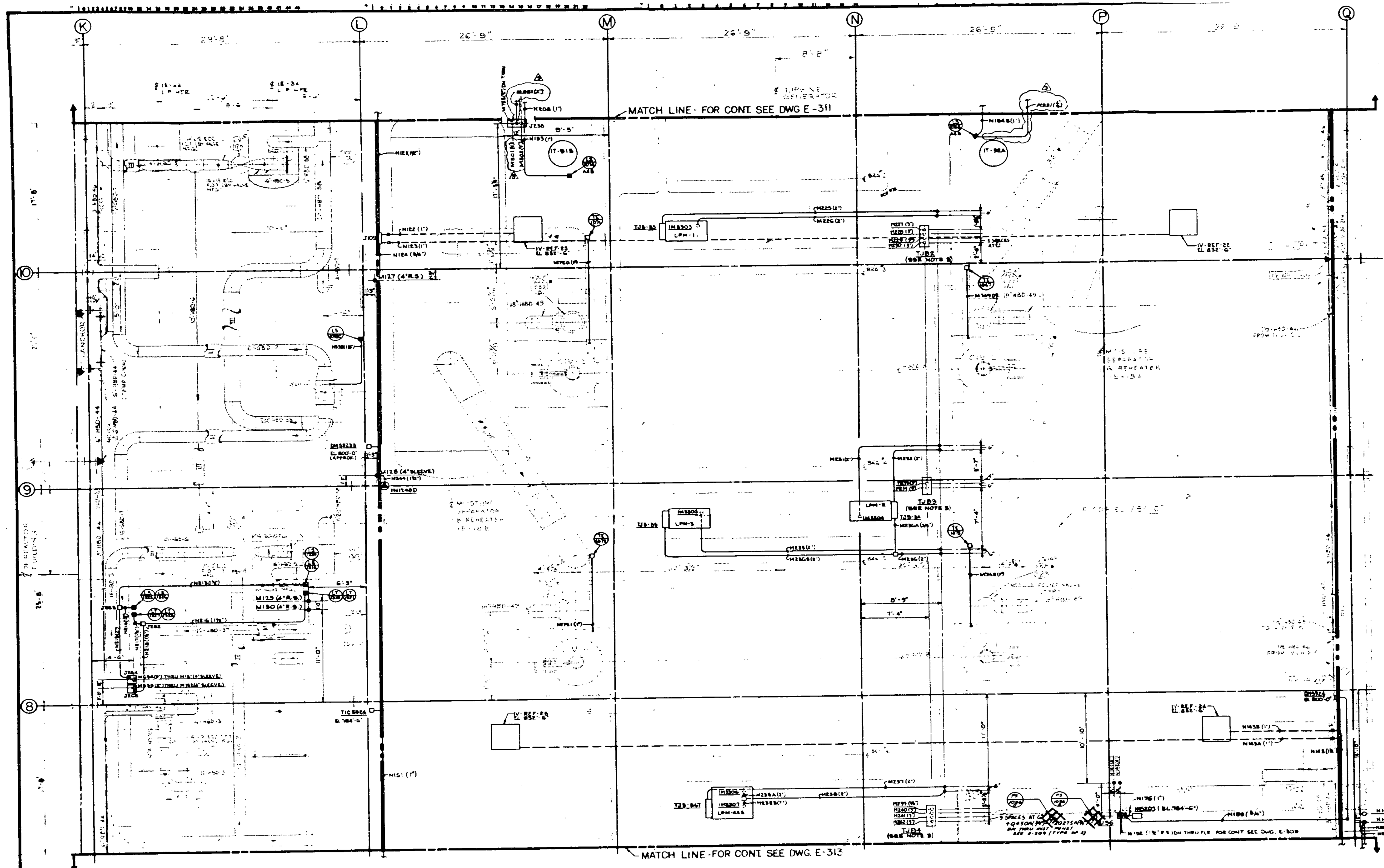
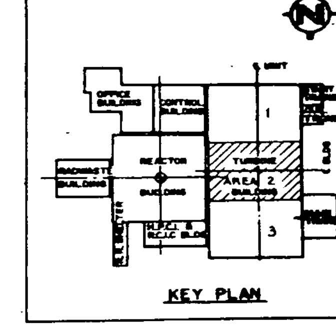
FIGURE 35 - TURBINE BUILDING AREA 1 - SAFET[Y] RELATED CONDUIT AND TRAYS ABOVE ELEVATION 780'-0"





NOTES

1. ALL CONDUITS THRU FLOOR ON THIS DWG. SHALL BE 4" R.S. UNLESS OTHERWISE NOTED
2. THIS DWG. SUPERSEDES SK-E-85.
3. FOR CONTINUATION OF CONDUITS M225 THRU M242 SEE DWG. E-503.

REFERENCE DRAWINGS

E-305	TURBINE GENERATOR BLDG. AREA 2 CONDUIT & TRAYS ABOVE ELEV. 757'
E-311	TURBINE GENERATOR BLDG. AREA 1 CONDUIT & TRAYS ABOVE ELEV. 780'
E-313	TURBINE GENERATOR BLDG. AREA 3 CONDUIT & TRAYS ABOVE ELEV. 780'
E-503	CONDUIT & TRAY NOTES & DETAILS
M-220	AREA 2 PIPING DWG. PLAN BELOW EL. 800'-0"
M-405-5	INSTRUMENT POINTS & RACK LOCATIONS DIAGRAM AT EL'S 7[illegible] AND 786'-0"
M-615	HV & AC TURB. BLDG. AREA 2 OPERATING FLOOR PLAN EL. 780'-
FSK-506	TURBINE BLDG - LTG. & FAN CONDU[illegible] ON ROOF
FSK-379	CONDUIT FEEDERS FOR ROOF FA[illegible] ON SOUTH END OF TURB. BLDG
E-506	PULL BOX & TERMINAL BOX NOTES DETAILS & SCHEDULES

HEAVY LOAD STUDY
11186

MONORAIL, CRANE OR JIB CRANE

HOIST

HEAVY LOADS LIMITS

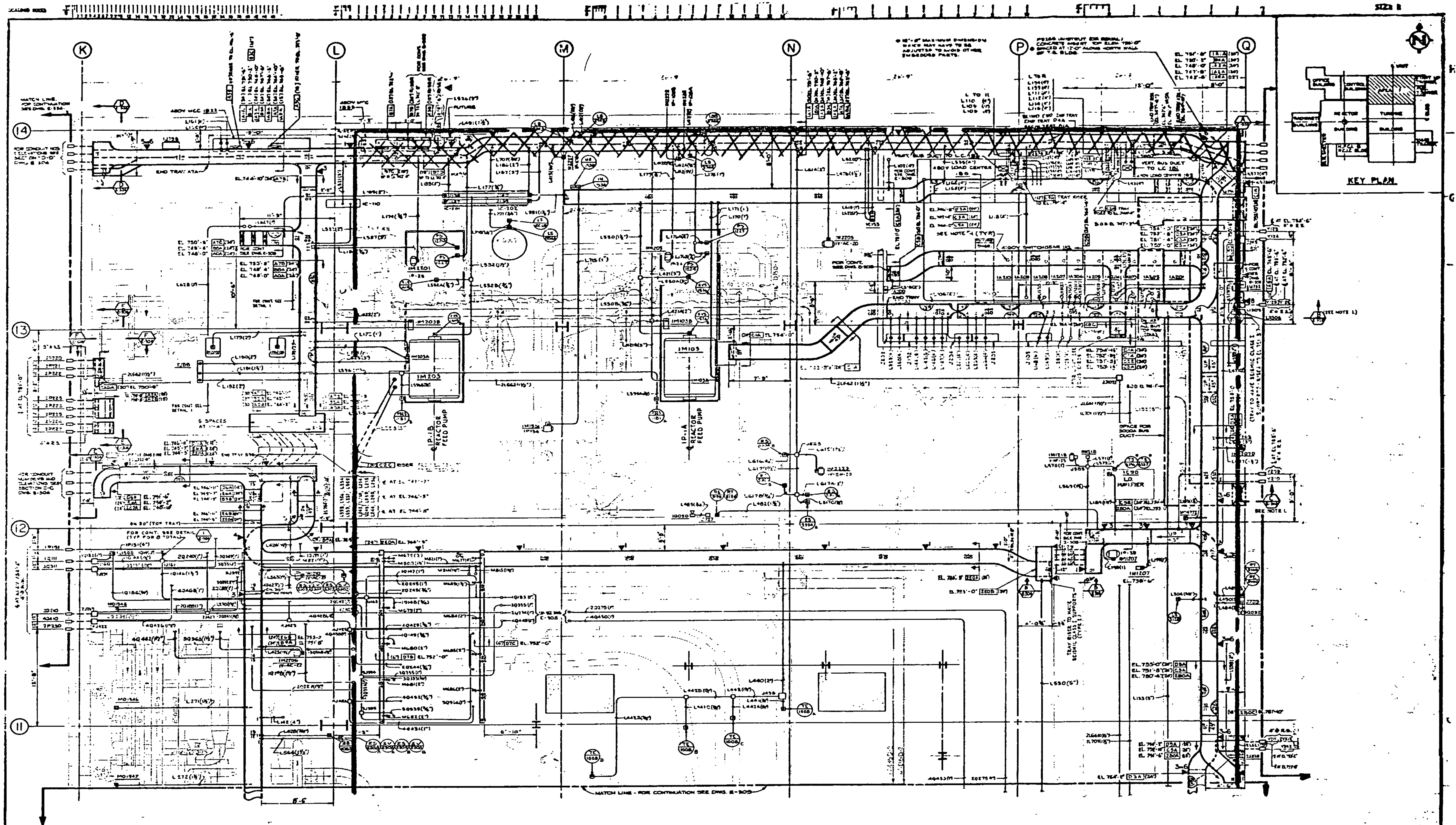
SAFETY-RELATED EQUIPMENT, PIPE, ELECTRI[illegible] TRAY.

11186-113

DUANE ARNOLD ENERGY CENTER

IOWA ELECTRIC LIGHT AND POWER COMPANY

FIGURE 36 - TURBINE BUILDING AREA 2 - SAFE[illegible] RELATED CONDUIT AND TRAYS ABOV[illegible] ELEVATION 780'-0"



HEAVY LOAD STUDY
11186

- MONORAIL, CRANE OR JIB CRANE
- HOIST
- HEAVY LOADS LIMITS
- SAFETY-RELATED EQUIPMENT, PIPE, ELECTRICAL TRAY.

FIGURE 37 - TURBINE BUILDING AREA 1 - SAFETY-RELATED CONDUIT AND TRAYS ABOVE ELEVATION 734'- 0"