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MASTER

TECHNICAL DESCRIPTION OF A SODIUM-COMPONENT TEST INSTALLATION

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ATOMICS INTERNATIONAL

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I. INTRODUCTION

This report describes a Sodium-Component Test Installation (SCTI) with capabilities of providing test information similar to those of the test installation described in APDA-134, "Sodium Components Test Facility."

The installation is designed primarily for operational testing of sodium-heated steam generators and intermediate heat exchangers suitable as prototype components for large, sodium-cooled power plants. Secondly, the installation is designed to permit testing of other types of important sodium components.

The site described for this installation is located at the Nuclear Field Test Laboratory of Atomics International, a Division of North American Aviation, Inc., where supporting facilities and a substantial portion of suitable construction already exists.

The component test installation described consists of a 35-Mwt gas-fired sodium heat source, a main primary-sodium system, a main secondary-sodium system, a water-steam cycle system, and a cooling tower for heat rejection to air.

The design and layout indicated in this report are based on use of existing components and structures where possible and where economically feasible.

The following Appendices may be found at the end of this report:

A. Material Lists

B. Schedules

II. DESCRIPTION OF INSTALLATION

A. GENERAL DESCRIPTION

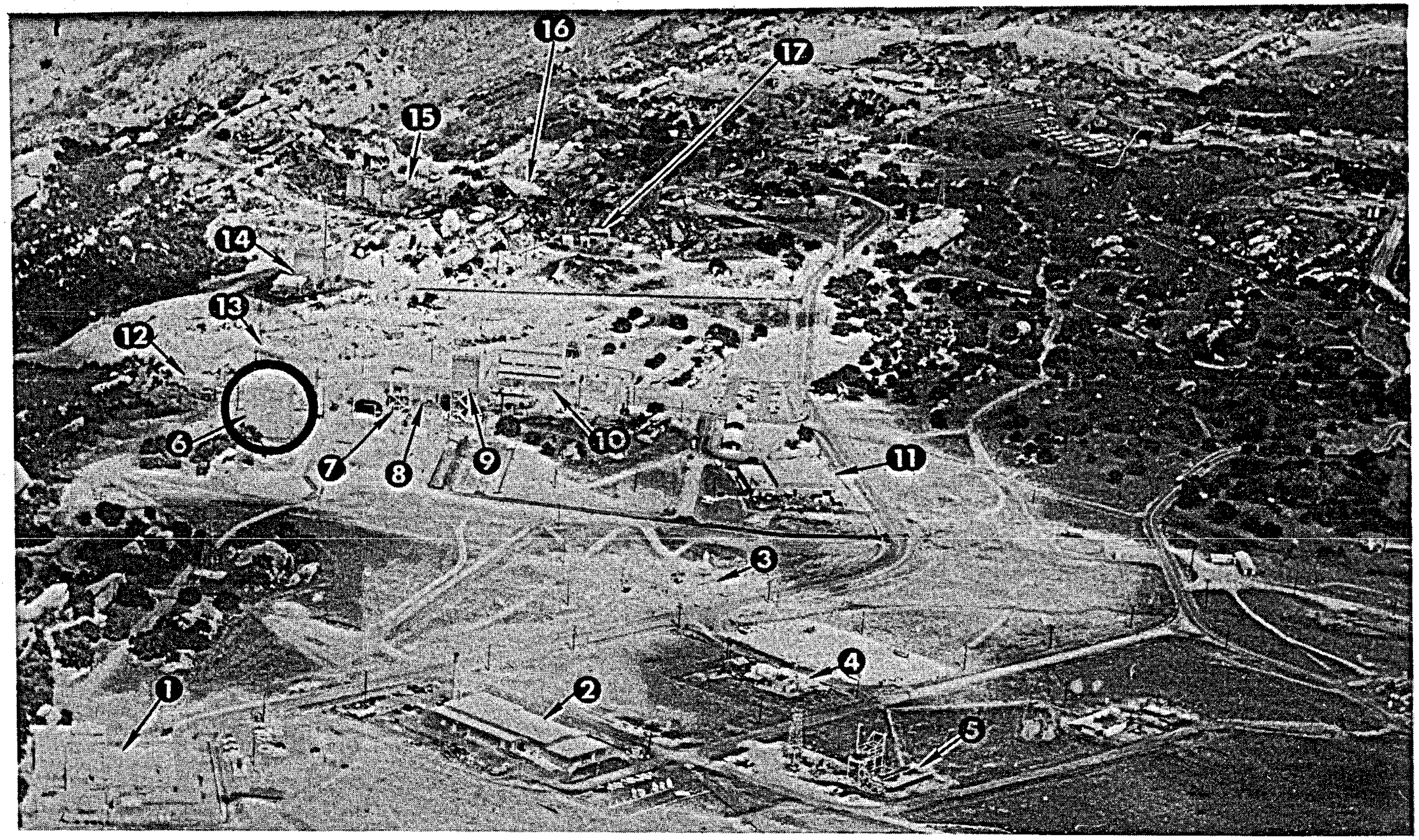
Location for the installation described in this proposal is the Nuclear Field Test Laboratory of Atomics International, located in the Santa Susana mountains (Figure 1). As designed, the complex fully utilizes the HNPF Fuel Handling Test installation, resulting in a minimum of site preparation, cell construction, and additional work area. A graded and paved area available at this installation can accommodate the entire operation except the control room. The plot plan is shown in Figure 2.

The design for a Sodium-Components Test Installation, capable of testing heat exchangers and steam generators under the conditions anticipated for advanced-sodium-reactor systems, is shown in Figures 3 through 15. The existing HNPF fuel-handling test complex includes a large, steel frame, corrugated-metal-sided structure. This installation is 70 ft high, 60 ft square, and open on one side. Inside the structure a reinforced concrete pit 20 by 25 ft extends approximately 50 ft below grade. This pit is used as the steam-generator test cell. It is presently equipped with movable staging to facilitate test and installation work associated with test equipment. Depth of the pit is such that preheater and evaporator portions of the test steam generator may be contained, thus providing maximum blast protection in event of a major heat exchanger failure.

The installation already contains a bridge crane of 20-ton capacity capable of handling all equipment for the new installation except the test heat exchangers. Available mobile crane service will be utilized for installation of the latter.

Equipment to be located within this installation: intermediate heat exchanger, steam generator, sodium piping, both sodium pumps, and a portion of the steam piping. Feedwater heaters, feedwater pump, feedwater storage tank, feedwater-treatment auxiliaries, and startup steam generator are located on a pad on the north side of the existing structure. The sodium heater is located on the south side between the existing structure and the existing roadway. The cooling tower and associated equipment are located in line with the heater and the installation, on the south side of the building.

A 30- by 40-ft control room containing all instrumentation and operating controls is located away from all test apparatus (Figure 2).



1. Critical Experiment Facility
2. Component Development Hot Cell
3. Sodium Instrumentation Tower and Reactor Kinetics Control Building
4. Experimental Development Building
5. Mechanical Component Development Building
6. HNPF Fuel Handling Test Facility
7. Large Component Test Loop and Tower
8. Sodium Laboratory
9. Control Element Test Structure
10. Organic Laboratory
11. Warehouse and Support
12. SNAP 2 Experimental Reactor Test Installation
13. SNAP 2 Experimental Laboratory
14. Radioactive Waste Storage Facility
15. Sodium Reactor Experiment (SRE)
16. Site Service Building
17. Experimental Neutron Physics Reactor

Figure 1. Burro Flats

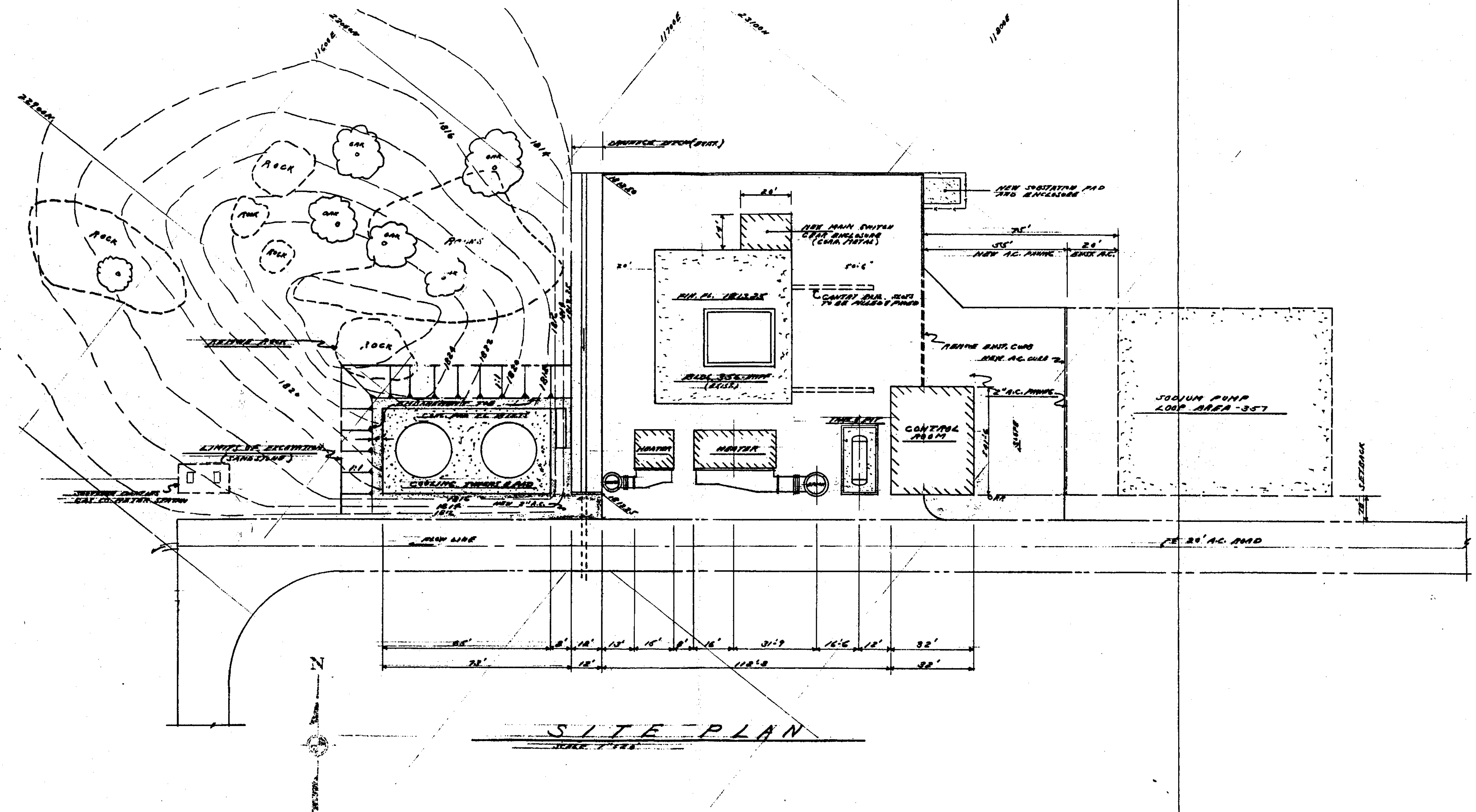


Figure 2. Site Plot Plan

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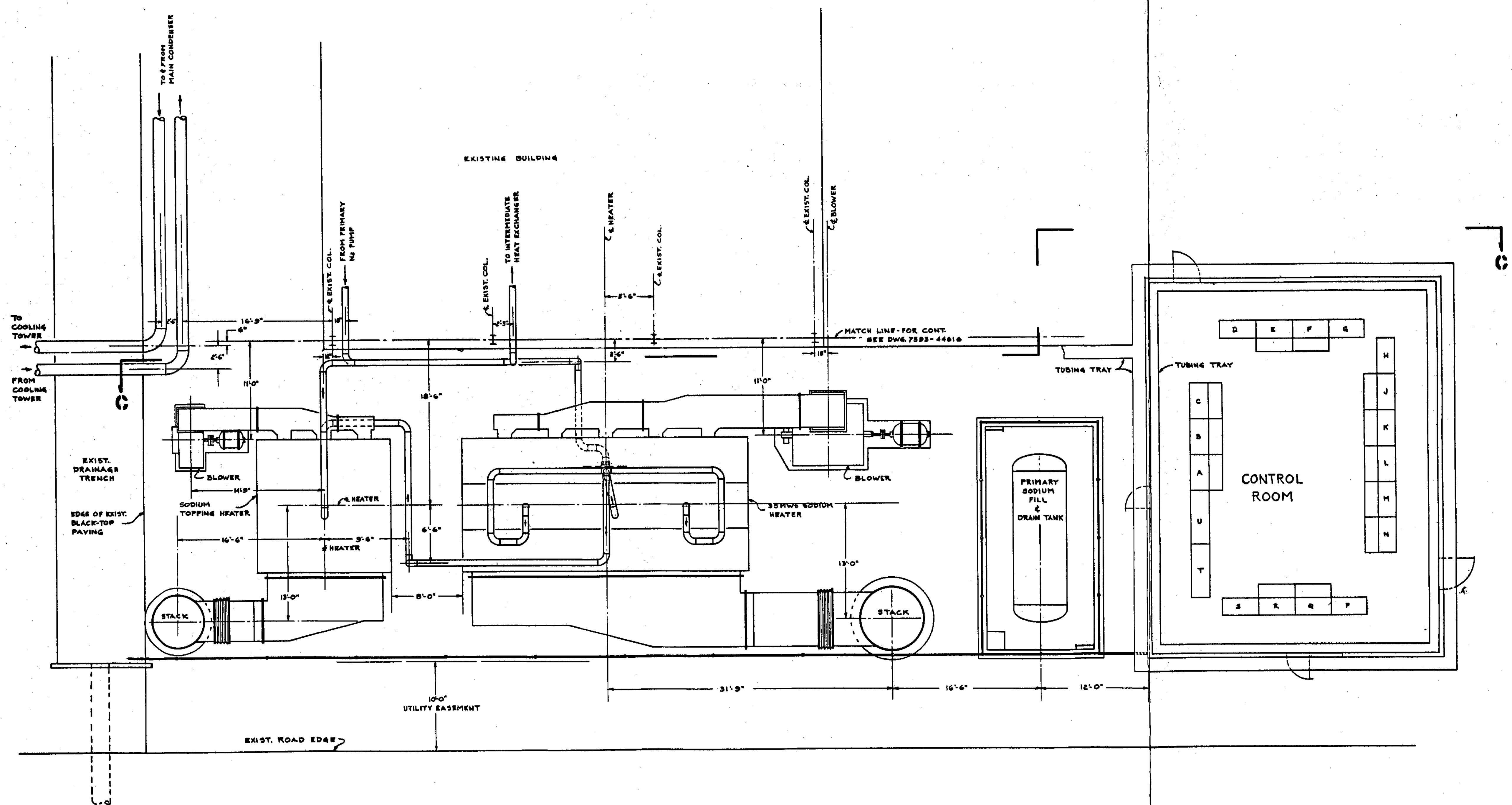


Figure 3. General Arrangement, Plan; Part 1

803 008

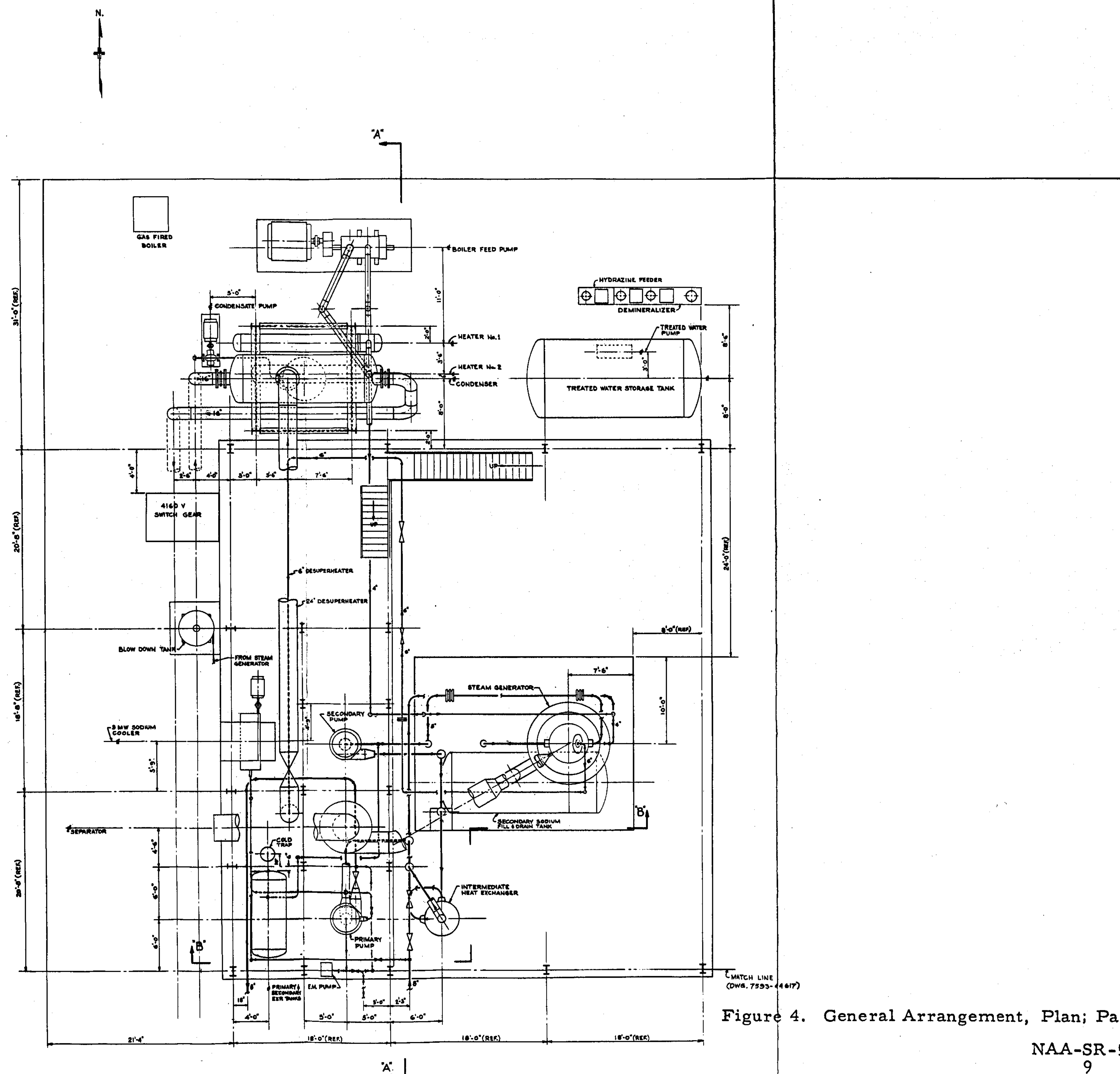
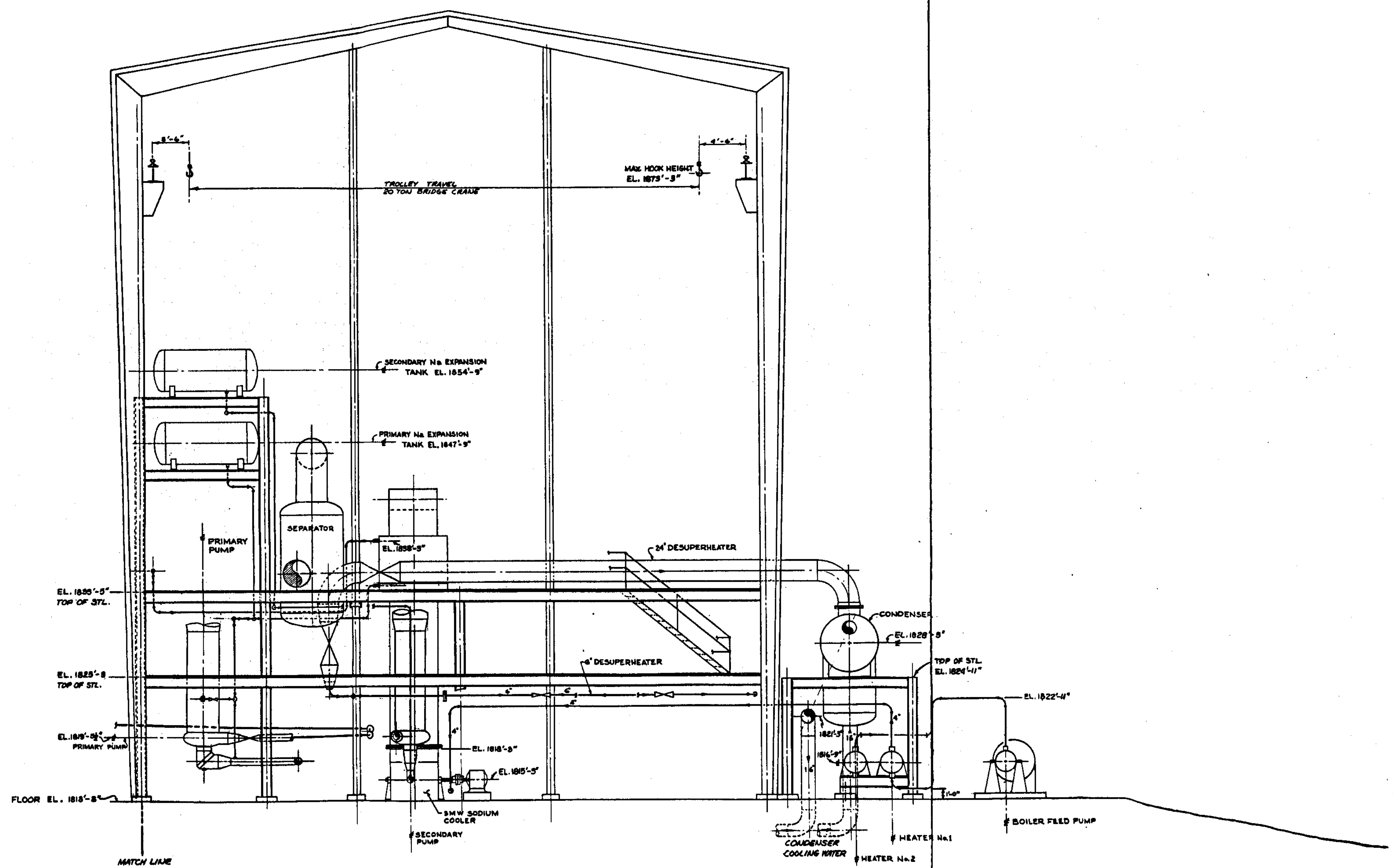


Figure 4. General Arrangement, Plan; Part 2



SECTION "A-A"

Figure 5. General Arrangement, Section A-A

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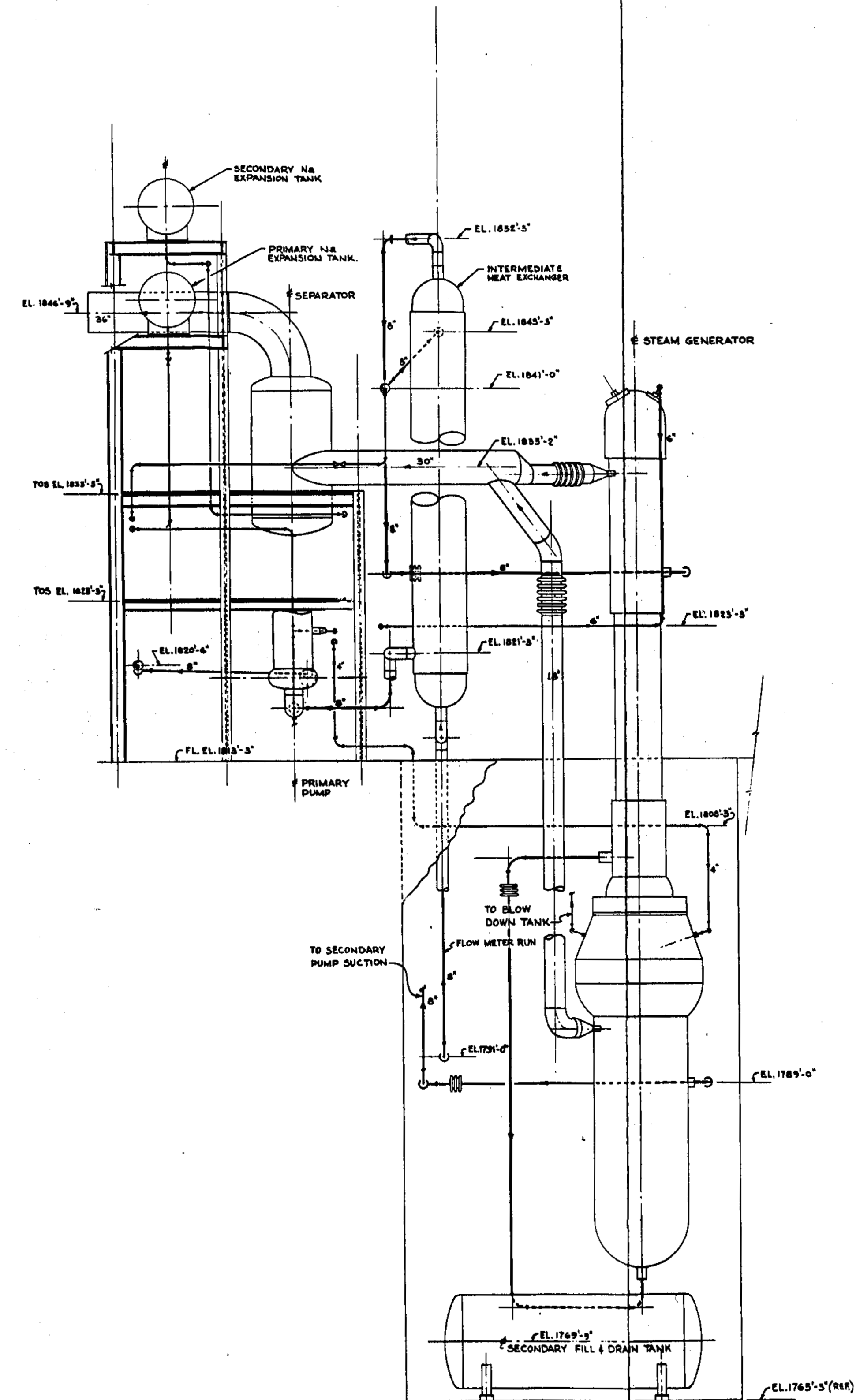

SECTION 'B-B'

Figure 6. General Arrangement, Section B-B

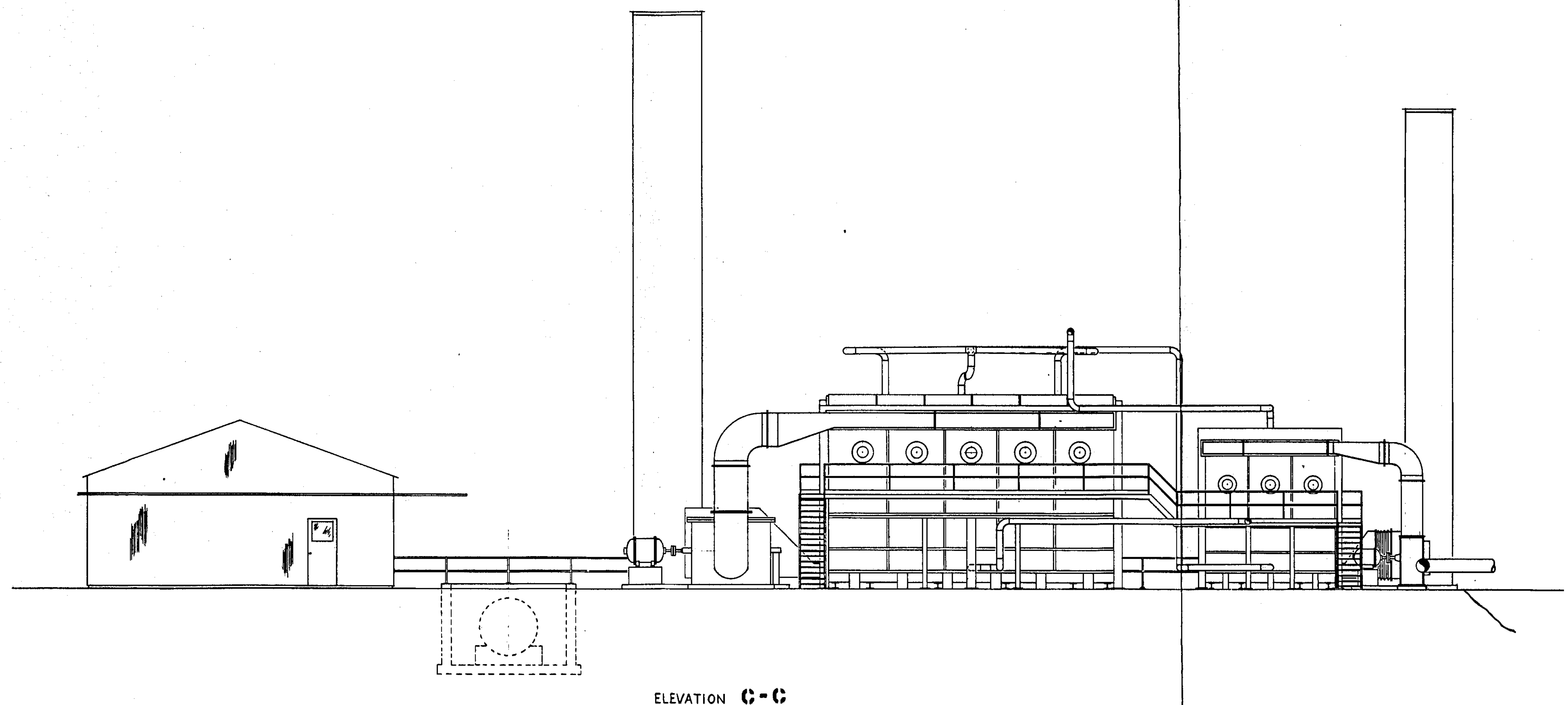

Figure 7. General Arrangement, Elevation C-C

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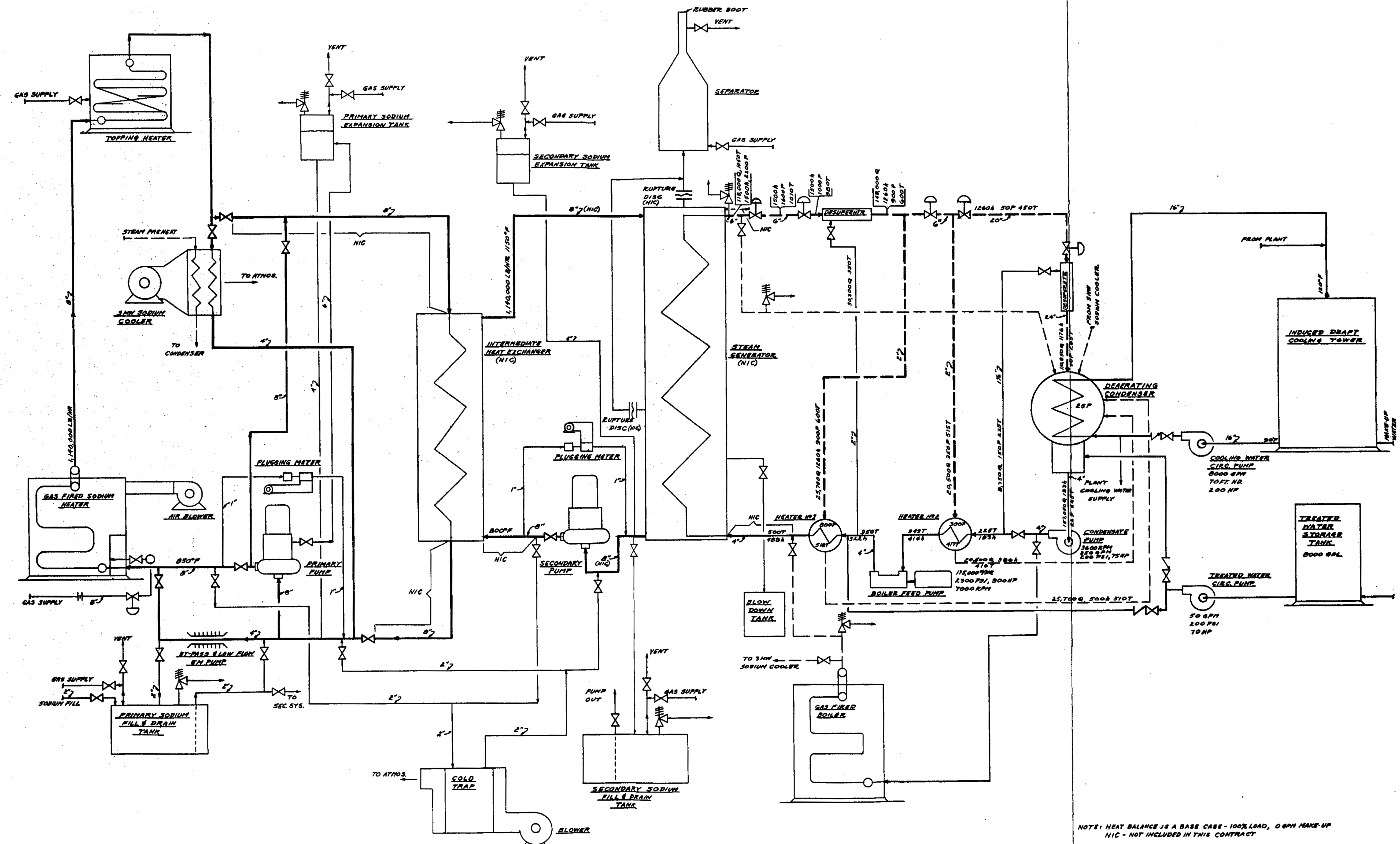

NOTE: HEAT BALANCE IS A BASE CASE - 100% LOAD, 0 GPM MAKE-UP
NIC - NOT INCLUDED IN THIS CONTRACT

Figure 8. Heat Balance Diagram, 100% Load

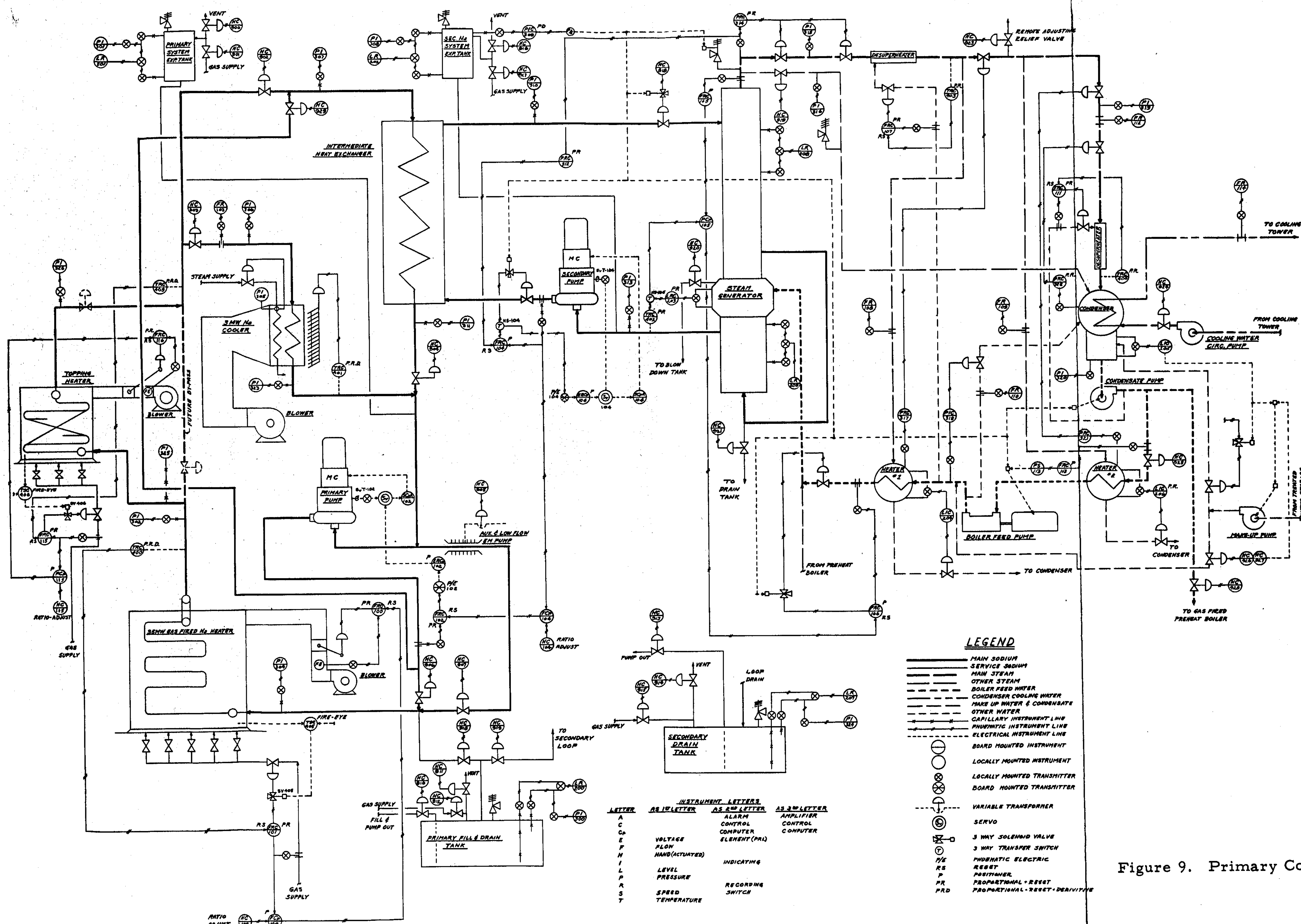

Figure 9. Primary Control Diagram

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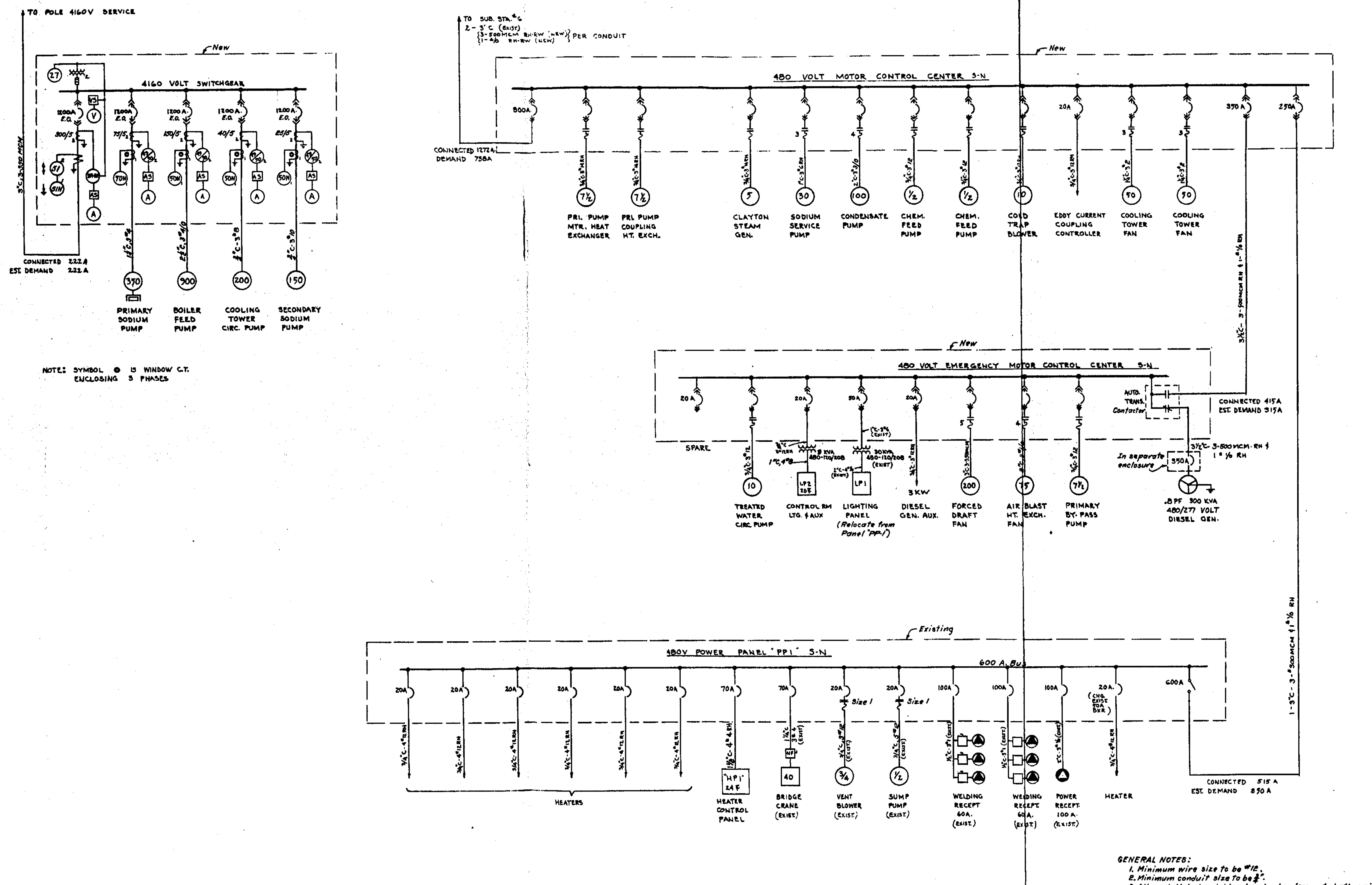

Figure 10. Single-Line Electrical Diagram

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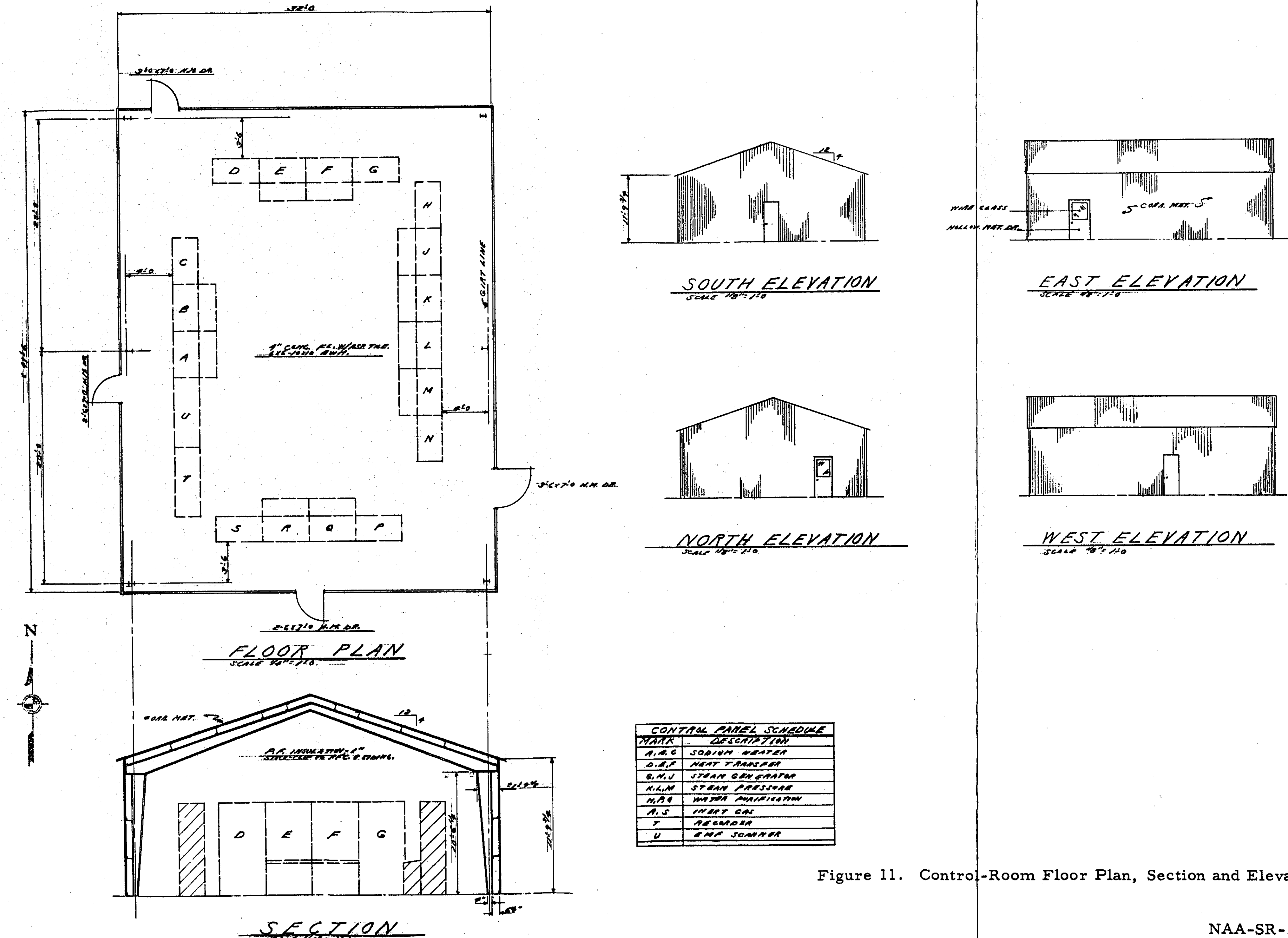

CONTROL PANEL SCHEDULE	
MARK	DESCRIPTION
A, B, C	SODIUM HEATER
D, E, F	HEAT TRANSFER
G, H, J	STEAM GENERATOR
K, L, M	STEAM PRESSURE
N, P, Q	WATER PURIFICATION
R, S	INERT GAS
T	RECORDER
U	EMF SCANNER

Figure 11. Control-Room Floor Plan, Section and Elevation

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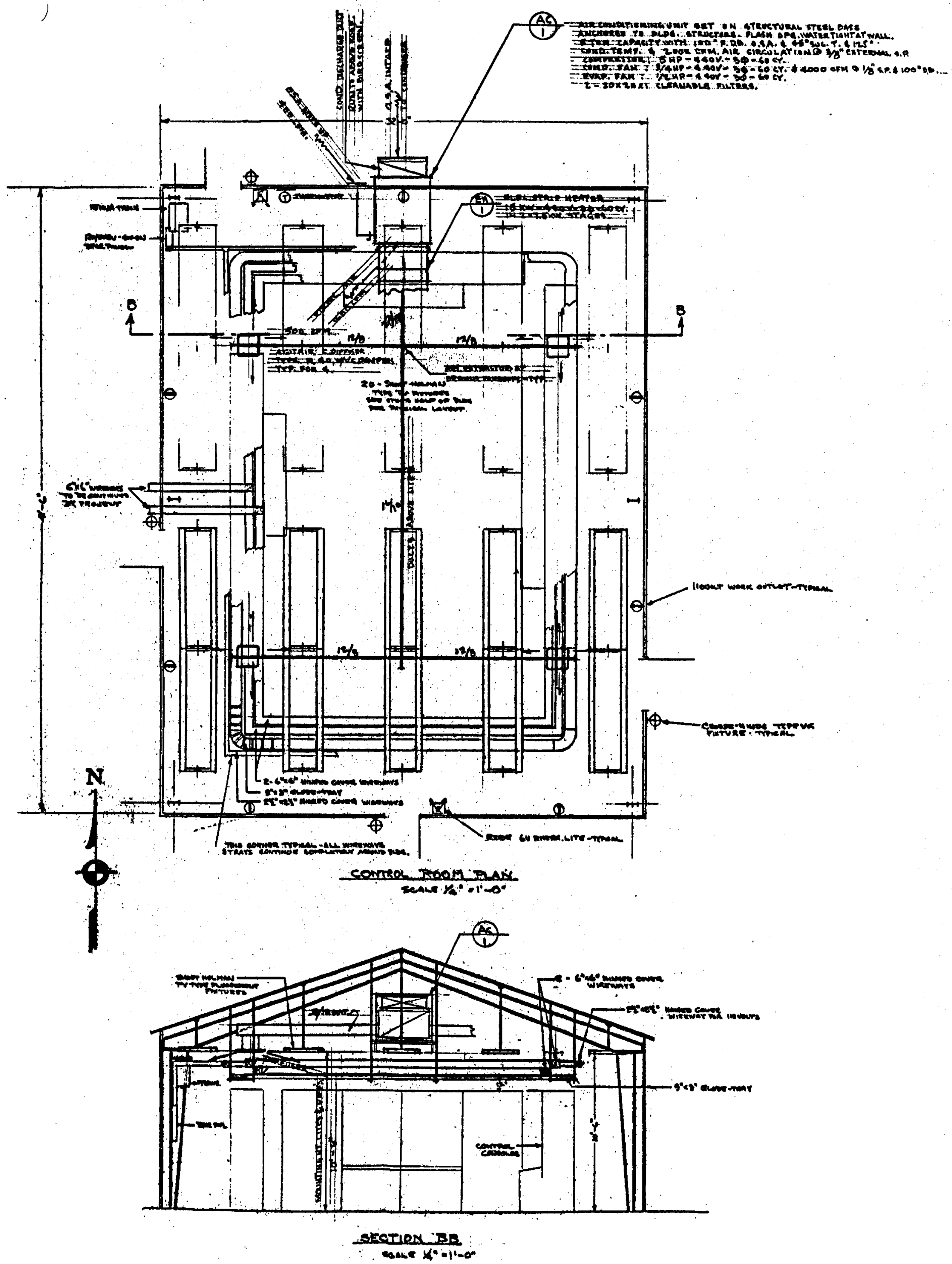

SCOPE OF WORK:

Figure 12. Control-Room Air-Conditioning Diagram

800 017

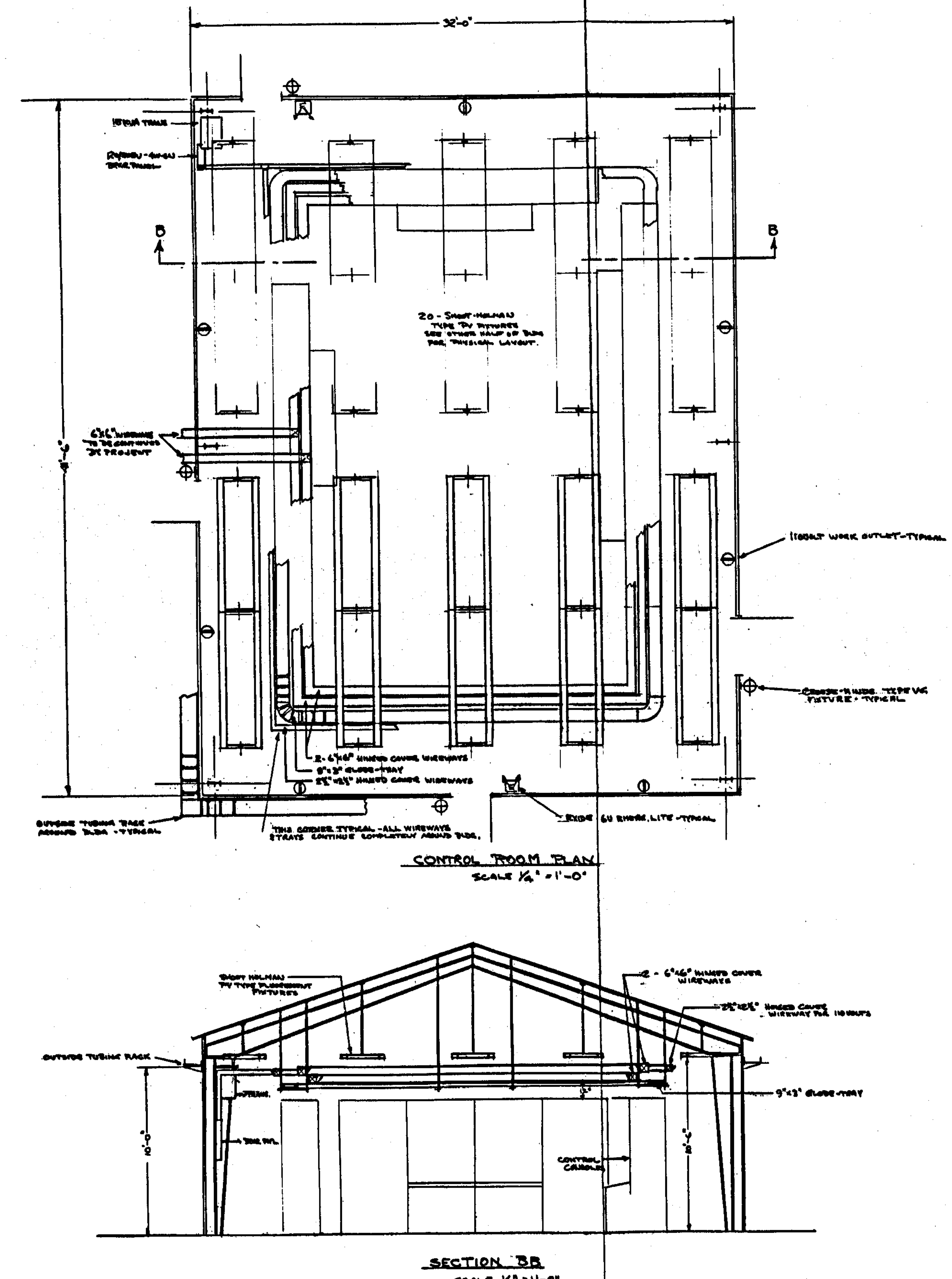

Figure 13. Control-Room Electrical Diagram

800 018

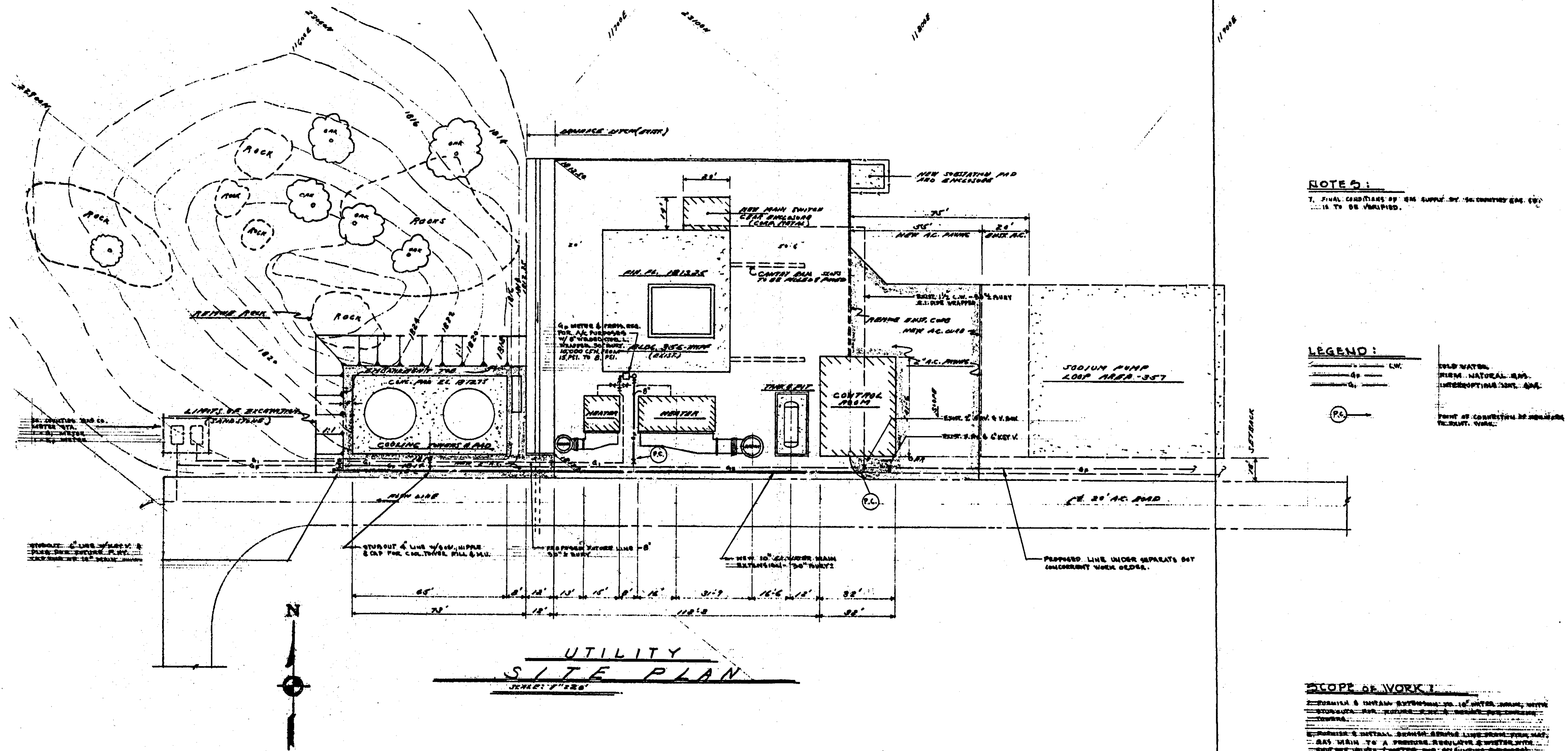

Figure 14. Water and Gas Availability

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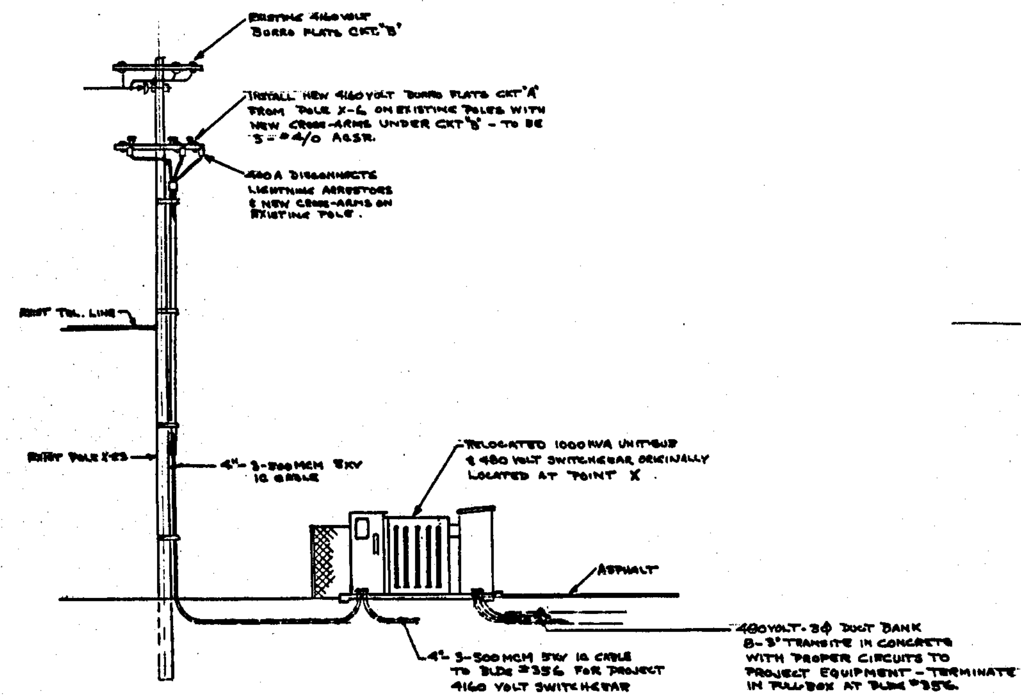
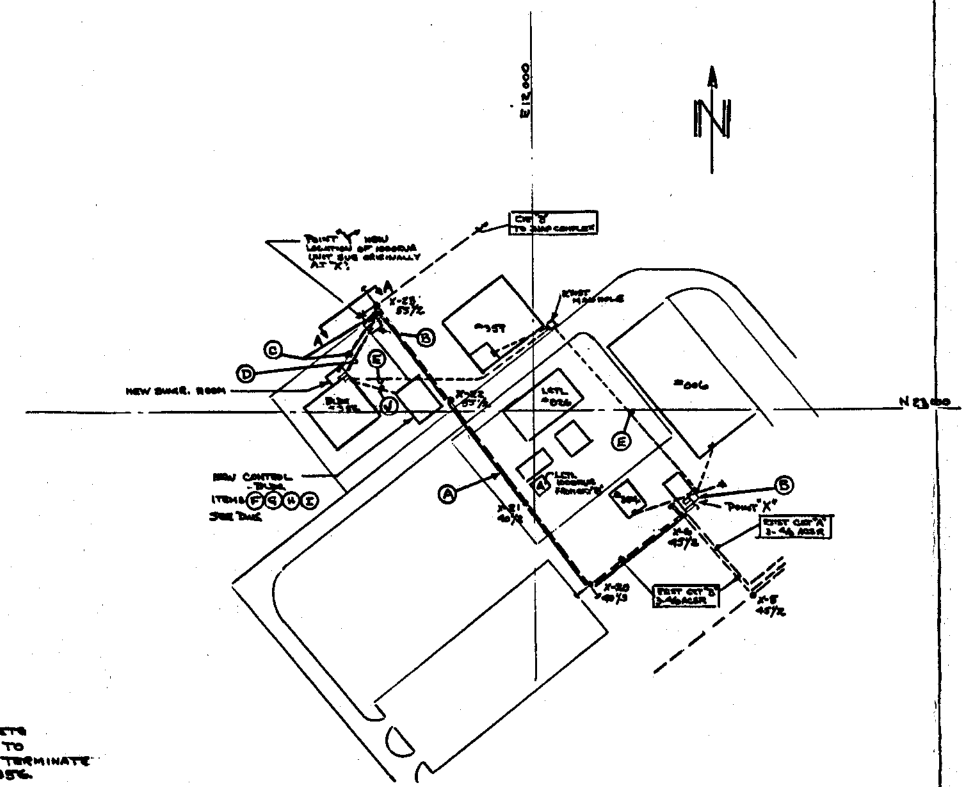
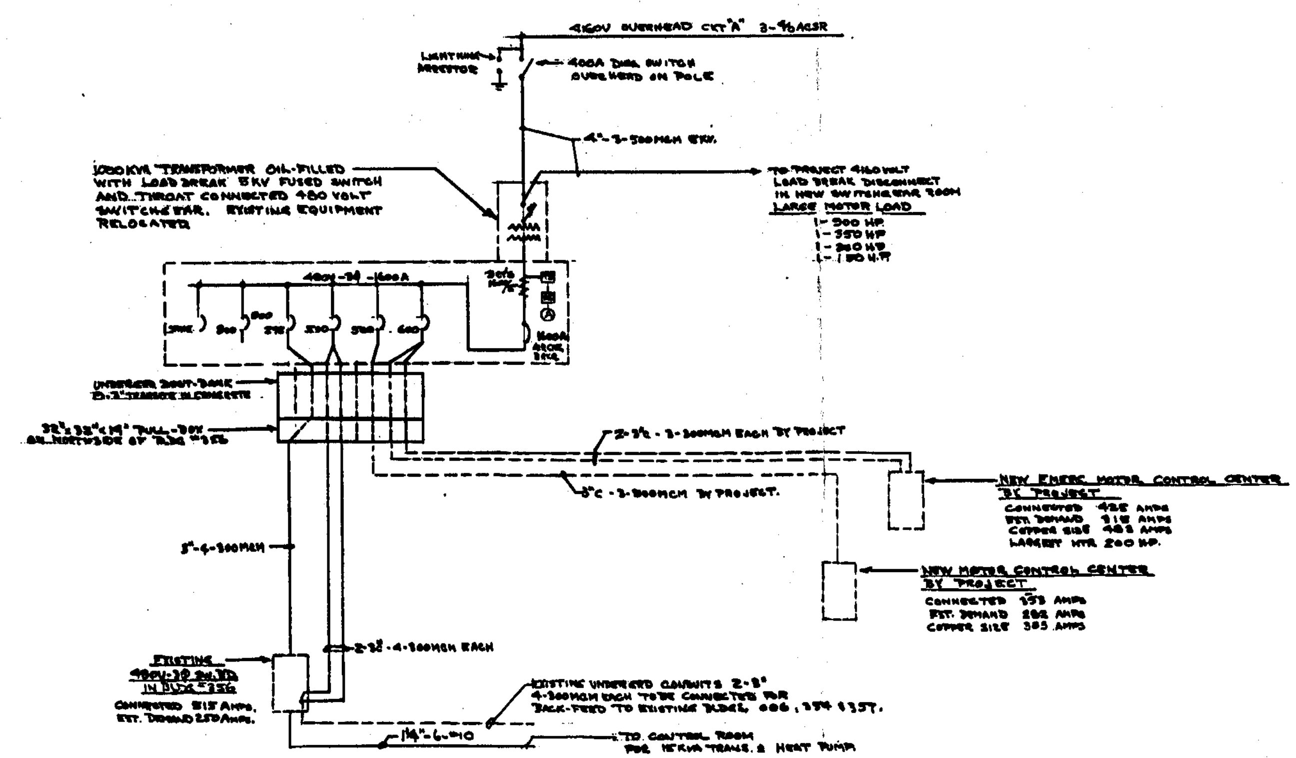


SECTION AA
SCALE 1/8" = 1'-0"



PLOT PLAN
SCALE 1" = 100'



ONE LINE DIAGRAM

S.C.T.I. TITLE I DESIGN ELECTRICAL

SCOPE OF ELECTRICAL WORK

GENERAL

A. Burro Flats 4160 volt 3 phase overhead circuit "A" is to be extended from pole X-6 to X-23. Circuit to be 3 - 4/0 ACSR installed on new crossarms on existing poles and located below the existing circuit "B".

B. Disconnect and remove existing 1000 KVA unit sub and associated switchgear at X. Reinstall this same equipment on new pad at Y.

C. Install new 4160 volt service drop from pole X-23 to unit sub and building 356. Project shall supply load break disconnect switch for 4160 volts in new Switchgear Room - See Section AA.

D. Install new 480 volt underground duct bank and circuits as required by project from 480 volt switchgear at unit sub to pullbox at building 356. See Section AA.

E. Re-establish 500 ampere 480 volt circuit through existing conduit and cables by feeding from building 356. This requires that where 480 volt switchload is removed at point X that new weatherproof pullbox be installed over existing conduit stub-ups and that feeder cables to buildings 357, 354 and 006 be lugged together.

CONTROL ROOM

F. Provide room with 90 foot candles of low brightness indirect illumination by the use of Smoot Holman type FV288L luminaires. See Section BB, Drawing 303-356-X6.

G. Provide room with 15 KVA 480 volt/120/208 volt transformer for lighting and instruments with a 120/208 volt 4w-SN 20 circuit distribution panel.

H. Provide in the rooms for use over control consoles 250 ft. of 6" x 6" hinged cover wireway, 125 ft. of 9" x 3" globe-tray, and 125 ft. of 2½" x 2½" hinged cover wireway. See Section BB, Drawing 303-356-X6.

I. Provide room with miscellaneous outlets and lights.

J. Provide 480 volt 3 phase circuits for lighting transformer and heat pump from building 356 existing switchboard to Control Room.

Figure 15. Electricity Availability

1. Services

A railroad spur to the site is considered unnecessary. A Southern Pacific main line extends through the San Fernando Valley with a spur through Chatsworth, a short distance from the site. North American Aviation maintains an access road suitable for heavy trucking, from Chatsworth to the Field Test Laboratories. Components as large as 60 ft long by 12 ft diameter, and weighing in excess of 55 tons have been transported on this road.

2. Nearby Facilities

A machine shop (Building 011) capable of fabricating sodium-system components is located within a short distance (see Figure 1) of the site. Sodium-system technicians and engineers are presently located in an adjacent sodium laboratory (Building 006). Shops located at Atomics International's central facility, within 10 miles of the proposed site, are adequately equipped to fabricate large sodium-system components. Metallurgical analyses equipment is located at Building 006, and the analytical chemistry laboratory (Building 003) is a short distance away. Computer services are available within the various company's facilities.

3. Existing Equipment

The design shown in this report is based on installation of a gas-fired Babcock & Wilcox sodium heater presently at Lewiston, New York. This heater has a capability of 120,000,000 Btu/hr and a maximum flow capacity of 4000 gpm of sodium at 850°F. All required operating auxiliaries are part of this heater, including a control system.

An additional topping heater capable of continuous operation at 1200°F, and suitable for intermittent operation for transient testing to 1350°F will be installed. The heat duty capability of the topping heater is required to be 31.0 x 10^6 Btu/hr with an approximate heating surface of about 2000 ft^2 with natural gas firing. Both heaters will be fired with natural gas. The existing firing equipment of the B&W heater will be modified for use with natural gas.

A combustion control system will maintain the terminal sodium temperature from each heater constant over the entire range of operation. This outlet temperature setting provides the master control signal for the individual combustion control systems which vary fuel and air supply to the unit over the operating range. In addition, the control system will permit manual division of loads between each heater, or operation of each heater alone, to obtain a desired sodium delta t or outlet temperature.

The 3-Mw sodium-to-air cooler for minimum-load heat rejection in the primary-sodium system is available at the Mine Safety Applicance Research Company in Callery, Pa. This unit has never been used and was originally intended as the replacement coil for the 3-Mw NaK heater being used in the MSA test loop.

The primary-system sodium pump is the HNPF test prototype free-surface unit available at Atomics International. This unit has a capacity of 7000 gpm at 165 ft of sodium head at 1000°F. The unit is complete with Dynamatic coupling for speed control, coupling control panel, and motor control cubicle.

The secondary-system sodium pump is presently installed in the LCTL and is a freeze-seal type. To obtain head and capacity required for this equipment, a new drive motor is needed. A single-speed open-frame ac motor of 150 hp is considered appropriate. A replacement pump of adequate capacity is available for installation in the LCTL.

Three 12-in. sodium valves are available at Atomics International for incorporation into this equipment. Two of these are disigned for precise flow control. In additon, a 10-in. flow-control valve built by Ohio Injector Co. may be available.

A 2-bbl sodium melt station complete with holdup tank, sodium filters, valving, and electrical control panels is available in the LCTL. This unit is portable and plugs into a power cable to become operable at any desired location.

The start-up steam generator is a flash boiler of 15 boiler horsepower currently installed as a part of the HNPF fuel-handling test installation. This is a self-contained unit requiring only a water and electrical connection to make the unit operable.

B. MAIN PIPING SYSTEMS

1. Primary Heat Transfer System

The primary-sodium system is a single loop which transfers heat from a gas-fired sodium heater to the intermediate heat exchanger to be tested. Sodium leaves the heater at 1200°F, passes through the intermediate heat exchanger, and is pumped back to the heater at 850°F. Installed as system parts are necessary filling, draining, and sodium-storage equipment, as well as purification equipment. Piping is of Type 304 stainless steel. At the rated 350°F delta t, 1,140,000 lb/hr of sodium at 1200°F passes through the gas-fired sodium heater and enters the intermediate heat exchanger, where heat is transferred to the secondary sodium loop. The free-surface pump, rated at 7000 gpm and 165 ft of sodium head, returns sodium to the fired heater. Installed as part of the primary system, 3-Mw sodium-to-air cooler rejects heat to the atmosphere. For this bypass-flow, an electromagnetic pump having 100-gpm capacity is used. This bypass loop provides minimum flow for the gas-fired sodium heater at all ratings. It is also used for startup of the plant in order to establish the desired sodium temperatures. A sodium fill-and-drain tank permits rapid sodium dumping from the system and is used to fill the primary system.

2. Secondary Heat Transfer System

The secondary-sodium system transfers heat from the intermediate heat exchanger to the steam generator under test. Major components of the loop are: intermediate heat exchanger, test steam generator, and secondary-sodium pump. Also included are necessary fill, drain, storage, cover-gas, and sodium purification equipment. Piping is Type 304 stainless steel. The steam generator and the intermediate heat exchanger indicated on the layouts are the present designs being considered as part of the Sodium Components Committee program. Loop design is flexible enough so that a wide variety of other test units may be readily installed.

The steam generator is located in the existing reinforced concrete pit along with the secondary-sodium-system drain tank. Pit depth is such that the evaporator and preheater section of the steam generator are below grade. As an added precaution against a possible violent sodium-water reaction due to equipment failure, rupture discs discharging into an emergency separator are provided. This is further described under Safety Aspects (Section V).

Sodium flow rate for the secondary system is 1,140,000 lb/hr. Sodium enters the steam generator at 1150°F and returns to the intermediate heat exchanger at 800°F.

3. Steam System

The steam system is the heat dump and load simulator for the entire plant. The system is a closed loop which receives steam from the steam generator at desired pressure. Steam flow is controlled by the throttle simulator. The steam pressure is reduced, desuperheated, and eventually is condensed in the steam-to-water surface condenser where heat of the system is rejected to atmosphere via a cooling tower.

The system is designed at 100% base load to permit generation of 118,000 lb/hr of steam at 2200 psig and 1050°F total temperature when supplied with feed-water of 500°F to the steam generator. In addition, two feed-water heaters form a regenerative type of cycle. This regenerative, condensing-cycle system is similar to a basic power-plant cycle with the throttle valve simulating steam expansion through the turbine. Steam can be generated in the test unit between 2200 and 2400 psig at a temperature of 1050°F. Steam first passes through the throttle simulating station, then through the high-pressure reducing station, and then exits at 1000 psi and 980°F to the high-pressure desuperheater. The steam is further reduced in pressure to 50 psi, desuperheated, and passed to the condenser.

A cooling tower supplies sufficient water to the condenser to cool the condensate to 250°F. Maximum cooling-water flow rate is 8000 gpm; it enters the tower at 120°F and leaves at 90°F.

C. AUXILIARY SYSTEMS

1. Sodium Purification

Low oxide level required for operation of the sodium systems is maintained by use of a circulating cold trap. This unit is based on HNPF design. It is an air-cooled unit with an internal economizer of over 200 lb oxide capacity. Rapid system cleanup is achieved with the 10-gpm sodium flow rate through the unit.

With the large sodium oxide capacity of the unit and the rapid cleanup rate, a single unit is adequate to maintain the desired oxide level in both sodium loops. With the high degree of piping system tightness, only intermittent operation of the cold trap is required after initial system cleanup has been achieved.

Oxide plugging meters in each loop monitor the oxide levels in the system sodium. These meters are self-contained units with a solenoid-operated plug, sodium flowmeter, and cooling blower. Plugging-temperature determinations can be made approximately every 20 min.

Oxide monitoring of the secondary sodium is most important as most steam generator failures result from slow leaks rather than from major breakdown. An unusual oxide rise rate is usually the first indication of possible failure. This permits an orderly shutdown before any gross damage occurs. A hydrogen detector, now under development, may also be installed.

2. Inert Gas System

The inert gas system serves as a protective atmosphere to prevent excessive contamination of sodium. In addition it serves as a pressurization medium to provide required NPSH for sodium circulating pumps and to effect transfer of sodium from storage tanks into operating loops.

Gas required is supplied from bottles attached to appropriate pressure regulating systems and manifolds. No gas purification (NaK bubbler) or recovery system is included in the installation. It is more economical and convenient to remove, by cold trapping, the small quantities of oxide contributed by the cover-gas system to the sodium. During normal operation, only a small amount of inert gas is added to the loop, so that a minimal amount of oxide is contributed to the sodium metal from this source.

For general use in the test equipment, nitrogen cover gas is utilized because of availability and economy. For critical areas of the system (Such as those operating at temperatures of 1200°F and higher) helium or argon cover gas is utilized to eliminate the possibility of nitride formation. Although such formation has not been conclusively demonstrated in all cases, the conservative approach of using helium or argon is followed to eliminate any such possibilities.

To minimize carryover of sodium vapor and attendant vent-pipe plugging, vent lines are heated to the point where they terminate in sodium vapor traps. These traps are of the disposable type, thus permitting continuous loop operation.

3. Preheating

Sodium piping in the primary and secondary loops is heated by tubular resistance heaters. The heating units are placed adjacent to the pipe and backed by a stainless reflector sheet. The reflector is covered by thermal insulation which is in turn covered by a protective metal jacket. Very satisfactory heating and reliability has been achieved by using this method on existing sodium piping systems at Atomics International.

For sodium tanks where heating problems are not so critical, the use of strip heaters is adequate. Continuous operation of the heaters at low operating temperatures permits this approach.

The steam generator under test will be heated by the gas-fired auxiliary steam boiler to the sodium melt temperature.

4. Sodium Loading

Appropriate filling connections are provided for each sodium system. Sodium is added to each system through the LCTL drum melt station. Use of drum sodium, together with the melt-station filtering system, assures that initial sodium is of comparatively high purity.

5. Feedwater System

The steam plant is furnished with demineralized water from a storage tank of 8000-gal capacity. This tank is of aluminum-clad steel construction to prevent any contamination during storage.

Purity of the steam-system water is maintained by a side-stream polishing unit. The latter continuously processes 5% of the condensate. This system contains regeneration equipment, chemical mixing tanks, conductivity meters, and necessary controls.

A small hydrazine injection pump serves as a backup to the deaerating hotwell for oxygen removal from the condensate.

6. Cooling Water

Water supplied at the site requires only intermittent chemical treatment. A combination acid and phosphate feed system controls pH, and algicide is periodically added. The blowdown rate is somewhat higher than would result with lower mineral-content supply water.

7. <u>Instrument and Control System</u>

The installation control system is similar in design and operation to an actual nuclear power facility. All necessary instrumentation and control equipment is provided for automatic or manual control during steady-state or transient conditions required by the testing program. The control room contains instrumentation, control sub-panels, electrical starters, valve actuator controllers, and alarm annunciators. Data-logging equipment is capable of indicating and recording any variable desired from equipment test or operation. The control system is a load-following, self-stabilizing system with a steam-pressure controller which operates as a master controller for the plant. A detailed control diagram is given in Figure 9.

8. <u>Electrical</u>

A one-line diagram of the facility electrical system is shown in Figure 10. The system consists of a high-voltage (4160) system to supply power to large power equipment and a 480-volt system. The latter is further divided into a motor control center, an emergency motor control center, and a power panel. The emergency motor control center can be fed from either the normal electrical power source or a 300-kva automatic-starting diesel-generator set. The system is provided with automatic switching in case of power outage on the electrical feeder; the emergency system will permit operation of critical auxiliaries so that orderly plant shutdown can be carried out and damage to equipment prevented.

Electrical resistance heaters similar to those on the sodium storage tanks will be installed on each intermediate-heat-exchanger unit received for test.

The steam generator is partially preheated by the 15-boiler-horsepower auxiliary steam generator. Steam at 150 psig is circulated through the unit until a temperature of 300°F is reached. Portions of the outer shell of this unit have electrical resistance heaters to speed up the heating process.

III. SYSTEM OPERATION

A. PRIMARY AND SECONDARY SODIUM SYSTEMS

Primary sodium is transferred through the intermediate heat exchanger and gas-fired heaters by a motor-driven, free-surface pump. A side stream of approximately 10% flow is continually bypassed through the air-blast heat exchanger. This air-blast heat exchanger, which is in parallel flow with the main system, provides a minimum flow to protect the sodium heater during emergency and transient operation. The basic heat-transfer system as designed, is capable of operation with a delta t as low as 300°F across the primary system at 100% load. At this delta t, the sodium flow rate is 1,326,000 lb/hr. The loops are capable of full-load operation with a delta t as high as 550°F and a corresponding flow rate of 724,000 lb/hr, or approximately 1800 gal/min. The heat balance (Figure 8) is a base case of 350°F delta t and 1,140,000 lb/hr sodium flow.

There are two gas-fired sodium heaters provided with all necessary firing controls. The main sodium heater is a 35 Mw and a second topping heater is connected in series. Both sodium heater outlet temperatures are maintained by three-mode temperature controllers installed at the heater outlets. These temperature controllers remote-set the fuel gas flow controllers set points which in turn establish the correct fuel gas flow for each heater. Heater fuel gas flow establishes proper combustion air flows by remote-setting the combustion air flow controllers. An adjustable fuel gas and combustion air flow ratio is provided for maximum controllability. The combustion air flow final control elements are located in the blower discharge ducts.

Sodium flow in the primary loop can be varied either by the variable-speed coupling on the sodium pump or by operating the flow control valves in the main and auxiliary piping loops. This arrangement permits a maximum of flexibility especially desirable during the transient testing described under System Capability (Section IV).

The heat-exchanger bypass system contains a 3-Mw sodium-to-air heat exchanger, a 100-gpm electromagnetic sodium pump and a sodium-flow control valve. This bypass heat-rejection system protects the sodium heater against damage in the event of test-loop outage. To accomplish this protection, the loop is designed to handle 10% of full flow and to reject 5% of the system heat capacity.

This system is also utilized during thermal transient tests to bypass the main sodium heater during thermal-shock testing of the heat exchangers.

B. STEAM SYSTEM

The steam section of the test installation is the heat dump for rejecting 35 Mw of heat. This system receives steam at 2200 psi or 2400 psi and 1050°F and through a series of pressure-reducing and de-superheating stations, rejects its heat to a water-cooled condenser, which in turn rejects heat to a forced-draft cooling tower located on the west side of the facility. The heat rejection system duplicates that of a typical power-plant cycle. There are two regenerative feedwater heaters in series, a boiler feed pump, a booster pump, and a deaerating condenser.

Steam leaving the generator passes through a throttle valve which controls plant load. It then passes through a pressure-reducing and desuperheating station for which steam exit conditions are 900 psia and 600°F. The steam is further throttled and reduced to 50 psia at 450°F and is then passed through a desuperheater to the condenser. Steam enters the condenser at 30 psia and 265°F. The entire system is maintained under a positive back pressure of not less than 25 psia to prevent in-leakage of air to the system. In this way minimum deaeration requirements are imposed. Deaeration is accomplished within the condenser. On leaving the condenser, condensate enters the booster pump which provides a pressure of 200 psia to the suction of the boiler feed pump. The boiler feed pump is rated at a top discharge pressure of 2500 psi absolute and discharges via a high-pressure feedwater heater to the steam generator. The feed pump is a 7000-rpm unit driven by an electric motor and is of constant-speed design. Feedwater is returned to the steam generator at 500°F.

As studies of current power cycles indicate that feedwater temperatures do not normally exceed 550°F, feedwater temperature of 500°F was selected. This selection significantly decreases the cost of feedwater heating equipment. The two feedwater heaters are closed shell-and-tube types. The heaters take steam from the high-pressure steam lines and are drained to the condenser.

Cooling water for the condenser is provided by a tower which supplies a sufficient quantity to cool condensate in the hot well to 250°F. Cooling water requirement is 8000 gpm; water enters the tower at 120°F and leaves at 90°F. Tower make-up rate, including blow-down, is 100 gpm.

The steam condenser is of once-through design, and cooling capability is controlled by regulating flow of cooling water through the condenser. Feedwater flow is controlled by use of either a three-element flow-regulating valve which senses steam flow, feedwater flow, and drum level for the drum (recirculating) type generators or a temperature element in the return sodium flow in a non-recirculating type steam generator replacing the level unit. In addition to the three-element feedwater control valve, there is a feedwater recirculation system which, at minimum flow for the boiler feed pump, opens a valve and returns part flow of the boiler feed pump to the condenser. This valve operates only at low flow through the boiler feed pump. In this way a constant-speed boiler feed pump can be utilized with significant cost savings. The boiler feed pump has been sized to permit generation of steam at 2400 psia and 1050°F, in accordance with current power-plant practice.

C. WATER TREATMENT SYSTEM

Once-through steam generators require solid-free water with a conductivity between 1.0 and 0.1 micromhos, total dissolved solids not over 0.5 ppm, and a silica content not over 0.2 ppm. In addition, make-up must be oxygen free, and equipment must be supplied which will maintain the system at the above purity. In order to obtain make-up water of this purity, demineralized water is necessary. System make-up requirements are estimated at 2% of flow from the steam generator. This requirement takes into consideration emergency blow-down required during cleanup of the system. Therefore, this make-up rate is adequate for system leakage, flushing, and normal blow-down from both drum-type and once-through steam-generator units where the steam generator to be tested is a steam-drum type and is suitable for a continuous blow-down system. Blow-down from this plant will be sent to the blow-down tank outside the plant building. Demineralized water for the test equipment is contained in an aluminum-lined, carbon-steel storage tank of about 8000-gal capacity.

A transfer pump provides system make-up. The transfer pump takes demineralized water on demand and supplies it to the hot well of the steam condenser. Sufficient storage for a 24-hour supply of make-up at the 2% rate is provided. The pump is sized to provide 2 hours of emergency operation of the test steam generator at 20% of capacity. This protects the steam generator in event of power outage or failure of the boiler feed pump. The transfer pump may be operated from the emergency power supply, and can supply water at 200 psi through the high-pressure feed-water heater into the steam generator. This prevents undue thermal shocking of the cold end of the steam generator, as well as providing sufficient water during the time necessary either for recovery of the main power supply or for an orderly shutdown of the system.

D. CONTROL SYSTEM

The control system is load following and self-stabilizing. The master controller is the steam pressure valve, which simulates a turbine throttle valve. A control diagram is presented in Figure 9. Feedwater flow is regulated by a throttle valve. Secondary-sodium flow may be controlled by either a throttle valve or by pump speed, through a magnetic coupling to the pump drive motor. Primary-sodium flow is regulated by pump speed.

Changes in steam pressure will adjust the sodium flow. Feedwater flow from the boiler feed pump is adjusted by signals from the water-level sensing element in the steam generator, from the steam flow controller, and, for improved stability, from feedwater flow. The boiler feed pump is of constant-speed design with a minimum permissible flow. When the flow requirement is below this minimum, a part of the pump output is automatically returned to the steam condenser.

Secondary-sodium flow is held proportional to steam flow and varies directly with the throttle (master controller) setting. A reset signal from the sodium temperature at the outlet of the steam generator trims the sodium flow to maintain a constant outlet temperature.

The control system permits variation in the ratio of primary-to-secondary flow. A flow meter in the secondary-sodium loop provides the signal to maintain the required flow in the primary loop. The outlet temperature from the sodium heaters is held constant by controls on the gas burners and forced-draft fan dampers

Output of the plant is indicated by the product of primary-sodium flow and delta t across the heater.

In order to protect the heaters from the possibility of gas explosion, a flame-failure system for trip-out is provided. The forced-draft fan remains in operation. Sodium outlet temperature above the setpoint trips an alarm. Sodium flow rate lower than minimum first alarms, and then trips the unit if uncorrected. Fan failure equipment indicates the air flow across the fan; in event of loss of flow the entire unit is shutdown. A time delay system for startup of the unit causes a number of air changes to take place in the heater prior to automatic light-off of the unit. Automatic restart is not available in event of trip-out of the unit; it must be manually restarted.

A steam-generator isolation system isolates the steam generator in event of a major sodium-to-water leak. This is detected by a rise in pressure in the secondary expansion tank (or, if violent, by failure of the rupture discs). This closes the steam throttle valve and the feedwater regulating valve, and opens the Electromatic relief valve. Sodium valves on the inlet and outlet of the steam generator close, thereby isolating the unit, which then exhausts through rupture discs or through the Electromatic relief valve. The boiler feed pump is stopped, and the fired heater continues to operate at low power through its own bypass heat-rejection system.

In addition, a hydrogen-detector installation in the sodium system at the steam-generator outlet provide an alarm in the steam-generation system; the operator can then manually shut down the unit.

IV. SYSTEM OBJECTIVES

The following discussion presents the design objectives of the test installation described in this report and may be modified during final design of the actual equipment.

A. GENERAL SYSTEM PARAMETERS

Both sodium systems are designed for continuous operation at 1200°F with capability up to 1400°F for short intervals. The primary-sodium pump system has a flow capability of 7000 gpm at 165 ft of sodium head. This extra flow capacity permits evaluating the intermediate-heat-exchanger heat transfer coefficients over a wide range of sodium flow. Flow variability becomes especially useful when determining shell-side film coefficients. System design is based on a flow rate of 3240 gpm at a heater delta t of 300°F or a flow of 1760 gpm at a delta t of 550°F.

The steam system is designed for a operating pressure of 2400 psia at a temperature of 1050°F. Thermal capacity of the entire complex is about 35 Mw.

B. TRANSIENT CONDITIONS

APDA-134 lists expected transients for sodium-cooled reactors. These transient conditions may be simulated in the proposed test equipment as described below. In all transients, the sodium heater and other permanent components of the test installation are protected against thermal shock to the maximum possible extent. The transients can be imposed on the test pieces repeatedly and as rapidly as the system valves, piping, and controls other than the permanent units can be brought to the required operating temperature.

1. Reactor Scram Simulation

Severity of temperature and flow transients imposed upon heat exchangers by load rejection depends to some extent upon the quantity of sodium in the system. The rate at which heat decay occurs depends upon the quantity of sodium stored at the reactor outlet temperature. It is desirable in this facility to simulate different decay heat rates for various reactor designs. Scram conditions may be simulated in this plant design by a reduction in temperature at a predetermined rate. Desired reduction in temperature, of 35°F/sec for 10 sec, in the primary system may be obtained by returning primary sodium from the pump directly to the intermediate heat exchange, bypassing the heater. The heater is protected from thermal shock by dropping the fire in the heater and maintaining flow through the 3-Mw airblast heat exchanger.

2. Loss of Sodium Pumping

Temperature decay following loss of pumping depends, in general, upon sodium velocity in the lines at the time of the scram, the flow resistance, and the inertia of the pump rotating assembly. In the primary and secondary system of the design shown, electrically driven, centrifugal pumps are utilized. The effect on the heat exchangers of loss of pumping may be observed directly by interrupting the power supply to the pumps. Sodium control valves on both the primary and secondary loops may be positioned in order to vary rate of flow decay.

3. Rapid Load Swings

The basic control concept in sodium-reactor power plants is that a constant steam outlet pressure from the generators be maintained. Changes in steam demand affect steam pressure, which in turn affects the steam-generator cold-leg temperature. This change in cold-leg temperature sets flow rates of primary- and secondary-sodium pumps. In the installation described, similar to reactor plants, steam pressure is the master-control variable. Changes in steam flow may be made by varying the throttle simulator valve, which in turn sets the flow rate of primary and secondary pumps. A change in the primary flow tends to change the heater outlet temperature, and adjustments of the fuel gas valve and the dampers controlling the flow of air in the fired heater result automatically. Therefore, rapid load swings, whether they be ramp changes or step changes, may be made by changes in adjustment of the throttle valve.

4. Loss of Feedwater Flow

Failure of the boiler feed pump in a power plant results in loss of feedwater to the steam generator. The steam generator boils dry and temperature transients are introduced into all components in the plant. This type of transient may be simulated on this test system by closing the feedwater valve and opening the pump bypass line to the condenser. In this way, the boiler feed pump is completely protected, and a fast transient may be imposed upon the heat exchangers without damage to the test equipment. In addition, any feedwater flow transient may be simulated by proportioning of the bypass valve as well as the boiler feedwater valve.

A reactor outlet sodium temperature rise of 11°F/sec may also be simulated by raising the sodium temperature from the heater and cooling a portion of it in the bypass loop. The cooled sodium would then be mixed with the flow to the intermediate heat exchanger. By shutting down the bypass cooler, a ramp increase in the temperature of the inlet sodium to the intermediate heat exchanger may be accomplished.

V. SAFETY ASPECTS

A. GENERAL FEATURES

Experience at Atomics International has indicated that, with proper design and inspection, leaks in sodium systems can be kept to a minimum. About 95% of sodium-system leaks which occurred were of a size that the sodium did not penetrate the thermal insulation. The characteristic dense white smoke of burning sodium serves as a reliable leak indicator and locator for nonradioactive systems. Because of the very limited usefulness and doubtful reliability of leak-detection systems as applied to sodium piping, none has been included in this design.

All critical inert gas vent lines and sodium drain lines are equipped with quick-acting valves with pneumatic operators. An adequate compressed-air tank permits valve operation even in the case of an electrical power failure.

The test pit which contains the steam generator is designed with a carbon steel liner to a height sufficient to contain the entire secondary-system sodium charge.

B. STEAM-GENERATOR EMERGENCY VENT SYSTEM

This system is designed to prevent damage to the sodium systems and feedwater systems in the unlikely event of a rapid tube rupture within the steam generator. Tube failures usually begin as minor leaks. In the event of small leaks, an oxide buildup occurs on the sodium side of the system, as pressure in the steam system is higher, and leakage occurs toward the secondary-sodium system. These small leaks may be detected through sodium oxide monitoring. The operator may then shutdown and make necessary adjustments or repairs to the system. In event of a large leak, a buildup of pressure occurs in the expansion tank and sounds an alarm.

In the test steam generator under consideration, which has a gas space over the sodium in the unit, the buildup of gas pressure occurs within the unit and in the secondary-system expansion tank. A signal alerts the operator in event of this pressure rise. Should the pressure rise be normal (slow), the operator may manually shutdown the system. Should pressure rise continue and the operator not take action, or should pressure rise be rapid, the automatic rejection system begins its operation in the following sequence: the feedwater regulating valve begins to close, and the electrically driven feedwater pump stops, the steam throttle valve on the discharge side of the superheater begins to close, and the Electromatic relief valve begins to open and discharge its pressure to atmosphere; sodium valves on the inlet and outlet of the steam generator and in the secondary system begin to close, and the secondary-sodium pump stops. This effectively shuts down the sodium system. The sodium dump valve opens and dumps the contents of the secondary-sodium system to the drain tank within the steam-generator pit. If the pressure still rises rapidly in the steam generator, the rupture discs located on the superheater and evaporator sections fail and discharge the sodium-water reaction products to the separator provided, which in turn discharges steam and water to atmosphere and contains the solids and liquids within the separator tank.

The gas-fired heater is protected. On failure in the secondary system (that is, the steam generator), the alarm signals are delivered to the fuel gas valve on the heater, and immediately drop the heater to the minimum fire (5% heat load and 10% flow rate). The primary pump is de-energized, and the auxiliary pump continues its operation, passing sodium through the airblast low-level-heat rejection system, which is always in operation. This minimum fire maintains temperatures in the primary-sodium system, and the operators may prepare an orderly shutdown of the gas-fired heater.

APPENDIX A: MATERIAL LISTS

I CRITICAL - SYSTEM MATERIALS

Item	System	Temperature (°F)	Material	Notes
main (all) 8-in. Na piping	sodium	1200 (maximum operating fluid temperature)	304 SS (seamless)	all joints welded
main (all) 8-in. Na valves	sodium	1200	304 SS	piston operated
main gas-fired sodium heater	primary sodium circuit	1200	316 SS	existing-test-facility heat source
Na - to-air, low-level heat rejector	primary sodium circuit	1200	347 SS	tube sections, Cu fins, stainless clad
main Na circulating pump	primary sodium circuit	850 (operating fluid temperature)	304 SS	existing free-surface pump
main Na fill-and-drain tank	primary sodium circuit	850	carbon steel	
2-in. fill-and-drain piping and valves	primary sodium circuit	850	carbon steel	connecting nipples of SS as necessary
main Na expansion tank	primary sodium	1200	304 SS	
cold-trap assembly	sodium	800	carbon steel	
main Na circulating pump	secondary sodium circuit	800	304 SS	existing freeze-seal pump
main Na fill-and-drain tank	secondary sodium circuit	800	carbon steel	
2-in. fill-and-drain piping and valves	secondary sodium circuit	800	carbon steel	connecting nipples of SS as necessary

I CRITICAL - SYSTEM MATERIALS (Continued)

Item	System	Temperature (°F)	Material	Notes
main Na expansion tank	secondary sodium circuit	1150	304 SS	
high-pressure, spray-type desuperheater	steam circuit	1000	2-1/4 Cr - 1 Mo	
low-pressure, spray-type desuperheater	steam circuit	500	carbon steel	
high-pressure, feed-water heater	steam circuit	600	carbon steel	
low-pressure, feed-water heater	steam circuit	500	carbon steel	
main-steam condenser	steam circuit	300	carbon steel	
main-steam pipe	steam circuit	100	2-1/4 Cr 1-Mo	to high-pressure, spray-type desuperheater
main-steam pipe	steam circuit	750	carbon steel	after high-pressure spray-type desuperheater

800 038

II EQUIPMENT LIST

Item	Quantity	Description	Remarks
		<u>Primary Sodium Circuit</u>	
1	1	Test Installation heat source. Full Load, Test Installation, base operating conditions: Heat load: 120,000,000 Btu/hr Sodium temp, in: 850°F Sodium temp, out: 1200°F Flow: 1,142,000 lb/hr	Consisting of existing oil-fired sodium heater, now located at Lewiston, N.Y. Requires conversion for natural-gas firing and a new topping
1	1		heater with a duty of 31.0 x 10^6 Btu/hr with outlet temp. capability of 1300°F.
2	1	Main F.D. Fan and Motor - for Heat Source Fan-53,400 cfm with inlet boxes and Dampers 200-hp drive	Existing equipment, now located at Lewiston, N.Y.
3	1	Sodium-to-air, low-level, heat rejector. Test Facility base, operating conditions: Service: startup and low-load testing Heat Load (max): 10,000,000 Btu/hr Sodium temp in (max): 1200°F Sodium temp out (max): 850°F Flow: 100,000 lb/hr	Existing sodium heating sections now located at Callery, Pa.
4	1	Forced-draft fan for low-level Heat rejector with motor and duct work Fan: 30,000 cfm, 75-hp motor	
5	1	Main sodium circulating pump with motor. Capacity of available equipment: Flow: 7000 gpm Head: 170 ft	Existing free-surface sodium pump located at AI test site near Chatsworth, Calif. (possible use of ex-SIR EM pump of 3300-gpm capacity)
6	1	Low-flow sodium circulating EM pump and motor Service: Startup and low load testing Flow: 300 gpm Head: 50 ft	

800 039

II EQUIPMENT LIST (Continued)

Item	Quantity	Description	Remarks
		<u>Primary Sodium Circuit</u>	
7	1	Primary Sodium Expansion tank 1,000 gal	
8	1	Primary-sodium fill and drain tank 5,000 gal	
9	1	Sodium cold trap, Air Cooled (for primary and secondary sodium) with Blower and Motor	
10	1	Plugging-meter assembly	
		<u>Secondary Sodium Circuit</u>	
100	1	Main sodium circulating pump capacity of available equipment Flow 3000 gpm Head 120 ft	Existing freeze-seal sodium pump located at AI test site near Chatsworth, Calif.
101	1	Secondary-sodium expansion tank 1,000 gal	(possible use of ex-SIR EM pump of 3300-gpm capacity)
102	1	Secondary-sodium fill- and -drain tank, 3,000 gal	Possible use of 5000 gal ex-SIR tank now at ANL
103	1	Plugging-meter assembly	
		<u>Water-Steam Circuit</u>	
200	1	High-pressure spray-type desuperheater Full load base, operating conditions: operating pressure: 1,000 psia inlet temperature: 980°F outlet temperature: 600°F main steam flow, in: 118,000 lb/hr spray-water flow: 30,300 lb/hr	

II EQUIPMENT LIST (Continued)

Item	Quantity	Description	Remarks
		Water-Steam Circuit	
201	1	Low-pressure spray-type desuper-heater Full load base, operating conditions: operating pressure: 50 psia inlet temperature: 450°F outlet temperature: 265°F main-steam flow-in: 102,100 lb/hr spray-water flow: 8750 lb/hr	
202	1	High-pressure feed-water heater Full load base, operating conditions: duty: 19,600,000 Btu/hr flow main condensate: 118,000 lb/hr temp in condensate: 350°F temp out condensate: 500°F design pressure: 2500 psig flow steam: 25,700 lb/hr condensing pressure: 800 psia	
203	1	Low-pressure feed-water heater Full load base, operating conditions: duty: 18,000,000 Btu/hr flow main condensate: 148,300 lb/hr temp in condensate: 225°F temp out condensate: 343°F design pressure: 300 psig flow steam: 20,500 lb/hr condensing pressure: 300 psia	
204	1	Main-steam condenser equipped for deaeration duty: 120,000,000 Btu/hr condensing pressure: 25 psia steam flow: 110,850 lb/hr cooling water temp in: 90°F cooling water temp, out: 120°F cooling-water flow: 8000 gpm	
205	1	Cooling tower with induced draft fan and motor duty: 120,000,000 Btu/hr flow: 8,000 gpm temp water, in: 120°F temp water, out: 90°F	

II EQUIPMENT LIST (Continued)

Item	Quantity	Description	Remarks
		<u>Water-Steam Circuit</u>	
206	1	Condenser cooling-water pump flow: 8000 gpm head: 70 ft	
207	1	Condenser cooling-water-pump motor, 200 hp	
208	1	Main-condensate circulation pump 350 gpm, 250°F water head: 500 ft	
209	1	Main-condensate circulative-pump motor, 100 hp	
210	1	Boiler feed pump flow: 400 gpm discharge temp: 350°F head: 6,000 ft	
211	1	Boiler-feed-pump motor and gear 900 hp	
212	1	Gas-fired startup boiler 15 hp, 160 psi	Existing equipment located at AI test site near Chatsworth, Calif.
213	1	Treated-water storage tank, 8,000 gal	
214	1	Treated water circulation pump 50 gpm; head: 50 ft with 10-hp motor	
215	1	Steam generator blowdown tank 1,000 gal	
216	1	Demineralizer unit flow: 7 gpm	
217	1	Subcooler for demineralizer unit 10 gpm cool condensate from 250°F to 100°F 50-psig nominal design	

800 042

III. MATERIAL LIST, ELECTRICAL SINGLE LINE

Amount	Description	Remarks
1	4160-volt switch gear Gen. Electric class M20 outdoor 5 breakers rated 1200 A Protective devices: 1) On incoming line (1 only) 3 CT 1 51 1 27 on bus 2 PT 4200-120 3 CT W.H. meter Ammeter and switch Voltmeter and switch 2) On each branch circuit (4 only) 1 Window CT 1 50N 2 CT 1 49 1 50	
1	480-volt motor control center consists of four 20-in.-wide sections and contains 1 800-amp incoming breaker 1 350-amp branch circuit breaker 1 250-amp branch circuit breaker 1 20-amp branch circuit breaker 6 size 1 CBS 3 size 3 CBS 1 size 4 CBS All CBS to have individual 120-volt transformer for control	
1	280-volt motor control center consists of three 20-in.-wide sections. Contains 1 Auto transfer switch 3Ø 400 amp 1 50-amp branch circuit breaker 3 20-amp branch circuit breaker 2 size 1 CBS 1 size 4 CBS 1 size 5 CBS All CBS to have individual 120-volt transformers for control	
1	480-volt power panel	Existing, but replace one existing breaker with 3Ø 20-amp breaker

800 043

Amount	Description	Remarks
1	480-volt 3Ø emergency diesel, generator .8PF 300-kva with 350-amp circuit breaker. Aux to include pneumatic start unit	
1	lighting panel 120/208 3Ø 4W with 20 1Ø cts.	
1	10-kva 480-120/208 indor transformer	
1	lighting panel "LPI"	Existing
3300 ft	500-MCM RH-RW 600-volt conductor	
150 ft	350-MCM conductor	
180 ft	No. 2/0 conductor	
150 ft	No. 1/0 conductor	
150 ft	No. 2 conductor	
1000 ft	No. 4 conductor	
250 ft	No. 6 conductor	
2000 ft	No. 12 conductor	
600 ft	No. 4 conductor	
1000 ft	No. 4/0 conductor	
450 ft	No. 4/0 4160-volt conductor Okonite No. OK10519	
120 ft	No. 6 4160-volt conductor Okonite No. OK10505	
120 ft	No. 1 4160-volt conductor Okonite No. OK10511	
600 ft	No. 8 4160-volt conductor Okonite No. OK10503	
800 ft	3/4-in. conduit	
50 ft	1-in. conduit	

III MATERIAL LIST, ELECTRICAL SINGLE LINE (Continued)

Amount	Description	Remarks
400 ft	1-1/4-in. conduit	
300 ft	2-in. conduit	
50 ft	2-1/2-in. conduit	
260 ft	3-in. conduit	
1	riser on 4160-volt service pole	
3	nonfused cutouts on 4160-volt pole	
1	new 40-ft 4160-volt service pole with cross-arm dead-end construction (next to existing pole)	
1	heating control panel 3∅ 4W S-N with 24 1-pole 15-amp "EH" breakers	

800 045

IV. INSTRUMENT INDEX

Measuring-systems and control-loop instrumentation are separated into process-variable group numbers. All components in the same instrument-circuit use the same suffix number.

Specific instrument identification numbers have been assigned in accordance with the following table;

First Letter Designations	Type	Group Numbers
F	Flow	100 through 199
L	Level	200 through 299
P	Pressure	300 through 399
T	Temperature	400 through 499
X	Misc.	900 through 999

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TAG NO. Series		APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA	
100	Flow	Record	Section A		Page 1	
100	Flow	Record & Control	Section A		Page 2	
100	Flow	Computer	Section A		Page 3	
200	Level	Record	Section B		Page 1	
200	Level	Indicate Control	Section B		Page 2	
200	Level	Record Control	Section B		Page 3	
300	Press.	Indicate	Section C		Page 1	
300	Press.	Indicate	Section C		Page 2	
300	Press.	Indicate Control	Section C		Page 3	
300	Press.	Record Control	Section C		Page 4	
1	EMF	Scanner	Section D		Page 1	
400	Temp.	Record Control	Section E		Page 1	
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300	Press.	Trans.	Section F		Page 4	

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TAG NO. Series		APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
300	Press.	Trans.	Section F		Page 5
100	Flow	Control Valves	Section G		Page 1
200	Level	Control Valves	Section G		Page 2
300	Press.	Control Valves	Section G		Page 3
400	Temp.	Control Valves	Section G		Page 4
900	Misc.	Control Valves	Section G		Page 5
900	Misc.	Control Valves	Section G		Page 6
100	Flow	Solenoid Valves	Section J		Page 1
200	Level	Solenoid Valves	Section J		Page 2
400	Temp.	Solenoid Valves	Section J		Page 3
900	Misc.	Solenoid Valves	Section J		Page 4
100	Flow	Hand Control	Section K		Page 1
900	Misc.	Hand Control	Section K		Page 2
900	Misc.	Hand Control	Section K		Page 3
100	Flow	Misc.	Section L		Page 1

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INSTRUMENT INDEX	CATEGORY: Recorder	ATOMICS INTERNATIONAL	7593 NO. 446110	Sec A
			PROJECT SCTI	PAGE 62

TAG NO.	Flow 100	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
FR-103	bd.	3-Mw cooler Na inlet			3-to 15-lb receiver recorder and 4" meter run
FR-108	bd.	steam to feedwater heater 1			3-to 15-lb receiver and meter run using 2" flow nozzle
FR-109	bd.	steam to feedwater heater 2			3 - to 15-lb receiver and meter run using 2" orifice plate
FR-110	bd.	feedwater heater 1 by-pass to cond.			3- to 15-lb receiver and meter run using 2" flow nozzle
FR-112	bd.	main L.P. steam header			3- to 15- lb receiver and meter run using 20" flow nozzle

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INSTRUMENT INDEX		CATEGORY Record Control	ATOMICS INTERNATIONAL		7593 NO. 446110	Sec.A
					PROJECT SCTI	PAGE 63

TAG NO.	Flow 100	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
FRC-100	bd.	air to main Na heater			2-mode, 3-to 15-lb pneumatic with remote set, and pitot tube
FRC-101	bd.	fuel gas to main Na heater			2-mode, 3-to 15-lb pneumatic with remote set and 8" meter run
FRC-102	bd.	main heater Na inlet			2-mode, 3-to 15-lb pneumatic with remote set and 8" meter run
FRC-104	bd.	sec. pump Na outlet			3-to 15-lb receiver recorder controller single mode remote set and 8" meter run
FRC-105	bd.	steam-gen. steam outlet			3-to 15-lb receiver controller single mode and 6" meter run using flow nozzle
FRC-106	bd.	steam-gen feedwater inlet			3-to 15-lb receiver controller, single mode and meter run using 4" flow nozzle; remote set
FRC-107	bd.	atemperation H_2O to H.P. desuperheater			3-to 15-lb receiver controller, 2-mode and meter run using 2" flow nozzle remote set.
FRC-111	bd.	atemperation H_2O to L.P. desuperheater			3-to 15-lb receiver controller, 2-mode with remote set and meter run using 1-½" orifice plate.
FRC-113	bd.	feedwater to heater 1			3-to 15-lb receiver controller, single mode and meter run using 4" orifice plate
FRC-114	bd.	cooling-tower water			3-to 15-lb receiver and meter run using 16" line and orifice plate
FRC-115	bd.	Gas to Na Topping Heater			2-mode, 3-15 lb, receiver with remote set and 8" meter run
FRC-116	bd.	Air to Na topping heater			2-mode, 3-15 lb receiver with remote set and pitot tube

REMARKS:

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DATE	11-1?-60

INSTRUMENT INDEX	CATEGORY: Computer	ATOMICS INTERNATIONAL	7593 NO. 446110	Sec.A
			PROJECT SCTI	PAGE 64

TAG NO.	Flow 100	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
FC_p-100	bd. rear	heater air-to gas ratio control			3-to-15-lb proportional ratio relay
FC_p-104	bd. rear	sec-to-pri. Na ratio control			3-to 15-lb proportional ratio relay
FCp-115	bd. rear	topping Htr. air-gas ratio adjust			3-to 15-lb proportional ratio relay
FCp-105		Main steam flow			Proportional ratio relay pneumatic

REMARKS:

800 051

ENGR	M.B. Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX	CATEGORY: Recorder	ATOMICS INTERNATIONAL	7593 NO. 446110	Sec.B
			PROJECT SCTI	PAGE 65

TAG NO.	Level 200	APPLICATION	REFERENCE DWGS	INST SPEC NO.	
LR-200	bd.	Pri. drain tank			3- to 15 - lb receiver
LR-201	bd.	Pri. exp. tank			↓
LR-202	bd.	Sec. exp. tank			↓
LR-207	bd.	Sec. Na drain tank			3- to 15- lb receiver
LR-208	bd.	Steam-gen upper Na level			3 - to 15- lb receiver
LR-209	bd.	Steam-gen lower Na level			3- to 15- lb receiver

REMARKS:

800 052

ENGR	M. B. Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX		CATEGORY Indicator Control	ATOMICS INTERNATIONAL		7593 NO. 446110	Sec. B
					PROJECT SCTI	PAGE 66

TAG NO.	Level 200	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
LIC-204	bd.	Heater 1 H_2O level		570	3-to-15 lb receiver controller, two mode
LIC-205	bd.	Condenser Level		300	3-15-lb receiver controller, electric on-off control action
LIC-206	bd	Heater 2 H_2O level		570	3-to-15-lb receiver controller, two mode

REMARKS:

800 053

ENGR	M.B.Bagley
CHK	
APPD	[signature]
DATE	Nov. 15, 1960

INSTRUMENT INDEX		CATEGORY Recorder Control	ATOMICS INTERNATIONAL		7593 NO. 446110	Sec. B
					PROJECT SCTI	PAGE 67
TAG NO.	Level 200	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA	
LRC-203	bd.	Steam-gen H_2O level			3-to 15- lb receiver controller, two mode	

REMARKS:

800 054

ENGR	M. B. Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX	CATEGORY Indicator		ATOMICS INTERNATIONAL		7593 NO. 446110 PROJECT SCTI	Sec. C PAGE 68
TAG NO.	Press 300	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA	
PI-300	bd.	Pri. Na drain tank			3-to-15- lb 6" receiver	
PI-301	bd.	Pri. Na Expansion Tank			3-to 15- lb 6" receiver	
PI-302	bd.	Heater Na Outlet			3- to 15- lb 6" receiver	
PI-304	bd.	Heater Na Inlet			3- to 15- lb 6" receiver	
PI-305	local	Steam to Na cooler			6" gauge with pig-tail and 3/4" block valve	
PI-306	bd.	Na cooler Inlet			3- to 15- lb 6" receiver.	
PI-307	bd.	I.H.X. Na inlet			3-to 15- lb 6" receiver	
PI-308	bd.	Sec. Na exp. tank			3-to 15- lb 6" receiver	
PI-310	bd.	I. H. E. sec. Na outlet			3- to 15- lb receiver 6"	
PI-311	bd.	I. H. E. pri. Na inlet			3- to 15- lb 6" receiver	
PI-313	bd	Sec. Na pump suction			3-to 15- lb receiver 6"	
PI-315	bd.	Steam header 1st stage			3-to 15- lb 6" indicator	
PI-316	bd.	Main steam by-pass to condenser			3- to 15- lb 6" indicator	
PI-319	bd.	Condenser pressure			3- to 15-lb receiver, 6" indicator	
PI-320	bd.	Hot-well pressure			↓	
PI-323	bd.	Na cooler outlet			3- to 15-lb receiver, 6" indicator	
PI-324	bd.	Sec. Na drain tank			3- to 15-lb receiver, 6" indicator	

REMARKS:

800 055

ENGR	M. B. Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX	CATEGORY: Indicator	ATOMICS INTERNATIONAL	7593 NO. 446110	Sec. C
			PROJECT SCTI	PAGE 69

TAG NO.	Press 300	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
PI-325	local	topping heat-er Na inlet			3- to 15-lb, 6" receiver
PI-326	bd.	topping heat-er Na outlet			3- to 15-lb, 6" receiver

REMARKS:

800 056

ENGR	M. B. Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX		CATEGORY Indicator control	ATOMICS INTERNATIONAL		7593 NO. 446110	Sec. C
					PROJECT SCTI	PAGE 70
TAG NO.	Press 300	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA	
PIC-309	bd.	Sec. Na exp. tank			3½ to 15-lb receiver controller P&D control functions and pressure switch in output	
PIC-318	bd	Feedwater by-pass to condenser			3-to 15-lb receiver controller 1-mode	

REMARKS:

ENGR	M. B. Bagley
CHK	
APPD	[signature]
DATE	11-15-60

809 057

INSTRUMENT INDEX	CATEGORY Record Control	ATOMICS INTERNATIONAL	7593 NO. 446110 PROJECT SCTI	Sec. C PAGE 71

TAG NO.	Press 300	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
PRC-312	bd.	Steam-gen steam outlet			3- to 15- lb receiver controller, 2 mode
PRC-314	bd.	Steam-gen steam outlet			3-to 15- lb receiver controller, 2 mode
PRC-317	bd.	Main steam 2nd stage			3- to 15-lb receiver controller, single mode
PRC-321	bd.	Main-steam third-stage pressure			3- to 15-lb receiver controller, 1- mode
PRC-322	bd	Main-steam first-stage pressure			3- to 15-lb receiver controller, 2-mode

REMARKS:

800 058

ENGR	M. B. Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX	CATEGORY E. M. F. Scanner	ATOMICS INTERNATIONAL	7593 NO. 446110	Sec. D
			PROJECT SCTI	PAGE 72

TAG NO.		APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
TS_c-1		Process and pre-heat temp			C. A. type thermocouples

Alarm scanner for 300 points with TAH and TAL functions for all points. Other features to include:

a) Automatic or manual scanning.
b) Any input may be manually switched to a recorder or indicator.
c) Visible and audible alarm.
d) Variable scan rate.
e) Repeatability of alarm setting ± 0.05 mv.
f) Automatic alarm reset after acknowledgment.
g) Alarm test.
h) Elimination of groups of points from scan sequence.
i) Lock-up circuit for momemtary alarms.
j) Circuitry provided for alarm printer.
k) Precision temperature indicator.

Additional instrumentation:

Six 12-point Null-balance C. A. recorder controllers for recording of selected scanner points, and control of pre-heat. Recorders to include TAH and TAL functions.

Scanner accessories include:

a) 25 ea 4" SS thermometer wells.
b) 275 thermocouples welded to pipe
c) 300 thermocouple runs of 75' ea (extension wire)
d) 50 20-amp contactors for control elements for preheat control.

REMARKS:

59

ENGR	M. B. Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX		CATEGORY: Recorder Control	ATOMICS INTERNATIONAL		7593 NO. 446110	Sec. E
					PROJECT SCTI	PAGE 73

TAG NO.	Temp 400	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
TRC-400	bd	35-Mw heater Na outlet			C. A., T. C., well & ext. wire 3-mode pneumatic control, elec null bal. measuring circuit.
TRC-401	bd	Sodium cooler outlet			↓
TRC-402	bd	Steam-gen Na outlet			C. A., T. C., well & ext. wire 2-mode pneumatic control, elec. null bal. measuring circuit.
TRC-403	bd	Main-steam attemperator			↓
TRC-404	bd	Main-steam attemperator			↓
TRC-409	bd	Topping heat-er Na outlet			C. A., T. C., well & ext. wire 3-mode pheumatic control, elec. null-bal measuring circuit.

REMARKS:

800 060

ENGR	M. B. Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX		CATEGORY: Ssfety Control	ATOMICS INTERNATIONAL		7593 NO. 446110 / PROJECT SCTI	Sec. E / PAGE 74
TAG NO.	Temp 400	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA	
TSC-405	local	Gas-fired heater		Exist.	Fire-eye control unit, power supply, gas solenoid valve and start-stop stations.	
TSC-406	local	Topping heater			Fire-eye control unit, power supply, gas solenoid valve and start-stop stations.	
TSC-407	local	Gas-fired heater			Purple peeper system (Brown Inst. Co.)	
TSC-408		Topping Heater			Purple Peeper System (Brown Inst. Co.)	

REMARKS:

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ENGR	M. B. Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX		CATEGORY: Transmitter	ATOMICS INTERNATIONAL		7593 NO. 446110	Sec. F
					PROJECT SCTI	PAGE 75

TAG NO.	Flow 100	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
FT-100	Local	Air to 35-Mw heater			0-100" water D/P cell 3- to 15-lb output & 24" Pitot Tube Inside Length.
FT-101		Gas to 35-Mw heater			0 - 100" H_2O D/P cell 3- to 15-lb output
FT-102		Pri. Na pump discharge			3- to 15-lb output, NaK filled D/P system, 0 - 100" H_2O range
FT-103		Sodium cooler Sodium inlet			3- to 15-lb output, NaK filled D/P system o - 100" H_2O range
FT-104		Sec. Na pump discharge			3- to 15-lb output, NaK filled D/P system, 0 - 100" H_2O range
FT-105		Steam-gen outlet			3- to 15-lb output, 0 - 200" H_2O range, condensate chamber & block valves for 3000 lb service
FT-106		Feedwater to steam gen.			3- to 15-lb output,0 - 200" H_2O range, and block valves for 3000 lb service
FT-107		F. W. to de-superheater No. 1			3- to 15-lb output, 0 - 100" H_2O range, block valves for 3000 lb service
FT-108		Steam to heater No. 1 shell			3- to 15-lb output, 0 - 100" H_2O range, condensate chambers & block valves for 2000 lb ser.
FT-109		Steam to heater No. 2 shell			3- to 15-lb output, 0- 100" H_2O range, condensate chambers & block valves for 3000 lb ser.
FT-110		Heater No. 1 By-pass to condenser			3- to 15-lb output, o - 100" H_2O range, and block valves for 3000 lb service
FT-111		F. W. to de-superheater No. 2			3- to 15-lb output, 0 - 100" H_2O range, block valves for 300 lb service
FT-112		Main steam final stage			3- to 15-lb output, 0 - 100" H_2O range, condensate chambers & block valves for 300 lb ser.
FT-113		Condensate to heater No. 1, T. S.			3 - 15-lb output, 0 - 100" H_2O range, block valves for 300 lb service
FT-114		Cooling tower water			3- to 15-lb output, 0 - 100" H_2O range, and block valves for 300 lb service
FT-115		Gas to Na Topping Heater			0-100" H_2O D/P Cell 3-15 psig output
FT-116		Air to Na Topping heater			0-100" H_2O D/P Cell 3-15 psig output

REMARKS:

800 062

ENGR	M. B. Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX		CATEGORY: Transmitter	ATOMICS INTERNATIONAL		7593 NO. 446110	Sec. F
					PROJECT SCTI	PAGE 76

TAG NO.	Misc.	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
SvT-102		Pri. Na pump		Exist	Tach. generator unit with electric output signal
P/ET-102		Pri. Na flow		Exist	3 - to 15-lb input, and 10-50 M.V. output, pneumatic - electric trans.
SvT-104		Secondary Na pump			Tach. generator unit with electrical output signal
P/ET-104		Secondary Na flow			3- to 15-lb input and 10-50 M.V. output, pneumatic-electric trans.

REMARKS:

800 063

ENGR	M.B. Bagley
CHK	
APPD	[signature]
DATE	11-15-60

730-L-19 REV 12-58

INSTRUMENT INDEX	CATEGORY: Transmitter	ATOMICS INTERNATIONAL	7593 NO. 446110	Sec. F
			PROJECT SCTI	PAGE 77

TAG NO.	Level 200	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
LT-200	Local	Pri. Drain tank			3 - to 15-lb output, 0-100" H_2O D/P system NaK filled
LT-201	↓	↓			3 - to 15-lb output, 0-100" H_2O D/P system NaK filled
LT-202		Sec. Exp. tank			3 - to 15-lb output, 0-100" H_2O D/P system NaK filled
LT-203		Steam Gen.			3 - to 15-lb output, 0-20" H_2O range, condensate chamber & block valves for 3000 lb ser.
LT-204		Heater No. 1 Shell Side			3 - to 15-lb output, 0-20" H_2O range, and block valves for 3000 lb service
LT-205		Hot Well			3 - to 15-lb output, 0-20" H_2O range, and block valves for 300 lb service
LT-206		Heater No. 2 Shell Side			3 - to 15-lb output, 0-20" H_2O range, and block valves for 300 lb service
LT-207		Sec. Na Drain Tank			3 - 15-lb output, 0-100" H_2O D/P system NaK filled
LT-208		Steam Gen. Upper Na Level			↓
LT-209	↓	Steam Gen. Lower Level			↓

REMARKS:

800 064

ENGR	M.B.Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX	CATEGORY: Transmitter	ATOMICS INTERNATIONAL	7593 NO. 446110	Sec. F
			PROJECT SCTI	PAGE 78

TAG NO.	Press 300	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
PT-300	Local	Pri. drain tank			3- to 15-lb output, 0 to 100-lb trans with helical pressure element
PT-301	Local	Pri. exp. tank			3- to 15-lb output, 0 to 100-lb trans with helical pressure element
PT-302	Local	Na heater Na outlet			3- to 15-lb output, 0 to 100-lb trans. and NaK filled helical element
PT-304	Local	Na heater, Na inlet			
PT-306	Local	Na to Na cooler			
PT-307	Local	IHX Na pri. inlet			
PT-308	Local	Pri. exp. tank			3- to 15-lb output, 0 to 100-lb trans and helical press ele
PT-309	Local	Pri. exp. tank			3- to 15-lb transmitter, o to 100-lb with NaK filled sensor element
PT-310	Local	IHX Na sec. outlet			
PT-311	Local	IHX Na pri. outlet			
PT-313	Local	Sec. Na pump suction			
PT-314	Local	Main-steam gen-outlet			3- to 15-lb output, 0 to 2500-lb range with condensate chamber and block valve
PT-315	Local	Main-steam 1st stage reduction			3- to 15-lb output, 0 to 2000-lb range with condensate chamber and block valve
PT-316	Local	Main steam condenser by-pass			3- to 15-lb output, 0 to 50-lb range, condensate chamber and block valve
PT-317	Local	Heater No. 1 shell			3- to 15-lb output, 0 to 1000-lb range, condensate chamber and block valve
PT-318	Local	Feedwater pump discharge			3- to 15-lb output, 0 to 3000-lb range and block valve
PT-319	Local	Condenser			3 to 15-lb output, 30" vac to + 45-lb range, condensate chamber and block valve

REMARKS:

800 065

ENGR	M. B. Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX		CATEGORY: Transmitter	ATOMICS INTERNATIONAL		7593 NO. 446110	Sec. F
					PROJECT SGTI	PAGE 79
TAG NO.	Press 300	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA	
PT-320		Hotwell			3- to 15-lb output, 0 to 50-lb range and block valve	
PT-321		Heater No.2 shell			3- to 15-lb output, 0 to 400-lb range, condensate chamber and block valve	
PT-322		Main steam final stage			3- to 15-lb output, 0 to 100-lb range, condensate chambers and block valve	
PT-323		Na outlet, Na cooler			3 to 15-lb trans., 0-100 lb with NaK filled sensor element	
PT-324		Sec. Na drain tank			3- to 15-lb output, 0- to 100-lb helical element	
PT-326		Topping heater Na outlet			3-15 lb output, NaK fitted D/P system, 0-100° H_2O range	

REMARKS:

800 066

ENGR	M. B. Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX	CATEGORY Control Valve	ATOMICS INTERNATIONAL	7593 NO. 446110	Sec. G
			PROJECT SCTI	PAGE 80

TAG NO.	Flow 100	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
FCV 100		35-Mw Na heater combustion air			louver actuator and positioner, cylinder - type unit, pneumatic
FCV 101		35-Mw heater fuel gas			4" pneumatic and positioner 125-lb cast iron, bronze trim
FCV 104		sec. Na pump discharge			8" vane-type valve, freeze seal, positioner, 3-to 15-lb pneumatic
FCV 106		feedwater to steam gen			4", 2500-lb, RTJ Flange
FCV 111		desuperheater H_2O			2",3000-lb carbon-steel body
FCV 115		Topping heater fuel gas			4" pneumatic & positioner 125-lb cast iron,bronze trim
FCV 116		Topping heater combustion air			louver actuator & positioner, cylinder type, pneumatic

REMARKS: Provide valve positioners for all valves

ENGR	M.B.Bagley
CHK	
APPD	[signature]
DATE	11-15-60

800 067

INSTRUMENT INDEX	CATEGORY Control Valve	ATOMICS INTERNATIONAL	7593 NO. 446110	Sec. G
			PROJECT SCTI	PAGE 81

TAG NO.	Level 200	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
204		Heater No.1 level			2", 1500-lb RTJ, carbon-steel body
205		make-up H_2O			2", 300-lb carbon-steel body
206		Heater No. 2 level			2", 300-lb carbon-steel body with ss trim

REMARKS: Provide valve positioners for all valves

800 068

ENGR	M.B.Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX		CATEGORY Control Valve	ATOMICS INTERNATIONAL		7593 NO. 446110	Sec.G
					PROJECT SCTI	PAGE 82

TAG NO.	Press. 300	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
305		steam to Na cooler			2", 300-lb, raised face flange
314a		main-steam steam-gen. out			4" double-pt. high-pressure body and valve construction
314b		main-steam second stage			6", 1500-lb raised-face carbon-steel body and stellated seats and guides
317		2nd-stage-steam main hdr.			6", 600-lb raised-face carbon stell body, ss trim
318		heater No. 1 feedwater by-pass			2", 600-lb, raised face flange control valve
321		3rd Stage Steam Main Header			6",600-lb raised-face carbon-steel body, ss trim
322		4th-stage steam main hdr.			↓

REMARKS: Provide positioners for all above

ENGR	M.B.Bagley
CHK	
APPD	[signature]
DATE	11-15-60

800 069

INSTRUMENT INDEX		CATEGORY: Control Valve	ATOMICS INTERNATIONAL	7593 NO. 446110	Sec. G
				PROJECT SCTI	PAGE 83

TAG NO.	Temp 400	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
CV 401		Na cooler louver operator			4" stroke, air cylinder, and pneumatic positioner

REMARKS: Provide positioners for size over 3"

800 070

ENGR	M.B.Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX		CATEGORY Control Valve	ATOMICS INTERNATIONAL		7593 NO. 446110	Sec.G
					PROJECT SCTI	PAGE 84

TAG NO.	Misc.	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
900		Gas			¾" air-operated, single-port S.S. trim and lubricator
901		Gas			↓
HCV 902		pri. Na to IHX			8" Vane-type valve, freeze seal, positioner, 3-15-lb pneumatic
HCV 903		Na to pri. Na cooler			3" vane-type, freeze seal, positioner, 3- to 15-lb pneumatic
HCV 904		pri Na IHX out			8" Na gate valve, pneumatic cyl.-operated, and freeze seal
905		aux. pri. EM pump			variable auto-transformer
HCV 906		pri. pump disch.			8" vane-type valve, freeze seal pneumatic
CV 907		aux. pri.Na pump disch.			3" gate and freeze seal with pneumatic positioner
908 & 909	*	Na			2" bellows seal, single-port, welded nipples with S.S. trim
910		Na			2" bellows seal, single port, welded nipples with SS trim
911		Gas			¾" air-operated, single-port S.S. trim and lubricator
912		Gas			↓
913		Na			2" bellows seal, single-port, welded nipples with S.S. trim
914		Gas			¾" air-operated, single-port S.S. trim and lubricator
915		Gas			↓
916		Gas			¾" air-operated, single-port S.S. trim and lubricator

REMARKS:
Provide positioners on above over 3"

* 2 valves

800 071

ENGR	M.B.Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX	CATEGORY: Control Valve	ATOMICS INTERNATIONAL	7593 NO. 446110	Sec.G
			PROJECT SCTI	PAGE 85

TAG NO.	Misc. 900	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
917		Gas			¾", air-operated, single port S.S. trim and lubricator.
HGV 918		Na to steam gen.			8" Na gate valve, pneumatic cyl.-operated, and freeze seal
919	*	Hi-pressure desuperheater water			2", 3000-lb carbon-steel body
919	*	startup by-pass to con denser			2", 2500-lb body
920		steam-gen.			2" 304 S.S. 1200°F, 100-lb operating pressure, 2500-lb design bellows seal, & pneumatic pos.
921		steam-gen Na drain			
923		steam-header relief adj.			2", 600-lb raised-face carbon-steel body
924		cooling H_2O from tower			16", butterfly and piston
925		condenser condensate pump disch.			4", 600-lb, raised ball flange gate
926		Make-Up Water			2", 300-lb carbon-steel body
928		H_2O to gas fired preheater			2", 300-lb carbon-steel body with S.S. trim
929		Na Heater By pass			8" vane-type, freeze seal & pneumatic positioner.

REMARKS: Provide positioners for 2" and larger

800 072

ENGR	M.B.Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX	CATEGORY Solenoid Valve	ATOMICS INTERNATIONAL	7593 NO. 446110	Sec.J
			PROJECT SCTI	PAGE 86

TAG NO.	Flow 100	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
SV-104		Air			¼", 3-Way solenoid, 110 VAC operations
SV-106		Air			¼", 3-way solenoid, 110 VAC operation
SV-115		Air			¼", 3-way solenoid, 110 VAC operation

REMARKS:

800 073

ENGR	M.B.Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX		CATEGORY: Solenoid Valve	ATOMICS INTERNATIONAL		7593 NO. 446110	Sec.J
					PROJECT SCTI	PAGE 87

TAG NO.	Level 200	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
SV 205		Air			¼", 3-way solenoid, 110 VAC operations

REMARKS:

800 074

ENGR	M.B.Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX		CATEGORY Solenoid Valve	ATOMICS INTERNATIONAL		7593 NO. 446110	Sec.J
					PROJECT SCTI	PAGE 88
TAG NO.	Temp. 400	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA	
SV 405		Air			¼", 3-way solenoid, 110 VAC operation	

REMARKS:

800 075

ENGR	MB.Bagley
CHK	
APPD	[signature]
DATE	11-19-60

INSTRUMENT INDEX		CATEGORY Solenoid Valve	ATOMICS INTERNATIONAL		7593 NO. 446110	Sec. J
					PROJECT SCTI	PAGE 89
TAG NO.	Misc. 900	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA	
SV 918		Air			¼", 3-way solenoid, 110 VAC operation	

REMARKS:

800 076

ENGR	M.B.Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX		CATEGORY Hand Control	ATOMICS INTERNATIONAL		7593 NO. 446110	Sec. K
					PROJECT SCTI	PAGE 90

TAG NO.	Flow 100	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
HC-100		heater air-to gas flow ratio adjust			3-to 15-lb remote loading station 3-gauge unit and precision regulator
HC-104		sec. to pri. Na flow patio adjust			↓
HC-115		Topping HTR Air-gas flow ratio-adjust			↓

REMARKS:

800 077

ENGR	M.B.Bagley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX		CATEGORY Hand Control	ATOMICS INTERNATIONAL		7593 NO. 446110	Sec.K
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TAG NO.	Misc. 900	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
HC-900	bd	CV-900			3-to 15-lb remote loading station, control and position gauge and precision regulator
HC-901	bd	CV-901			↓
HC-902	bd	CV-902			
HC-903	bd	CV-903			
HC-904	bd	CV-904			
HC-905	↓	CE-905			
HC-906		CV-906			
HC-907		CV-907			
HC-908		CV-908			
HC-909		CV-909			
HC-910		CV-910			
HC-911		CV-911			
HC-912		CV-912			
HC-913		CV-913			
HC-914		CV-914			
HC-915		CV-915			
HC-916		CV-916			

REMARKS:

800 078

ENGR	M.B.Bageley
CHK	
APPD	[signature]
DATE	11-15-60

INSTRUMENT INDEX

CATEGORY: Hand Control

ATOMICS INTERNATIONAL

7593 NO. 446110 Sec. K

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TAG NO.	Misc. 900	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
HC-917		CV-917			3-to 15-lb remote loading station, control and position gauge and precision regulator
HC-918		CV-918			↓
HC-919		CV-919			↓
HC-920		CV-920			↓
HC-921		CV-921			↓
HC-922		CV-922			↓
HC-923		CV-923			↓
HC-924		CV-924			↓
HC-925		CV-925			↓
HC-926		CV-926			↓
HC-927		makeup pump			2-position electric switch, auto-on operates relay circuit makeup pump magnetic starter
HC-928		CV-928			3-15 lb remote loading station, control & position gauge and precision regulated
HC-929		Na Heater By-pass			↓

REMARKS:

809 079

ENGR	M.B.Bagley
CHK	[signature]
APPD	[signature]
DATE	11-15-60

720-L-19 REV 12-60

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TAG NO.	Flow 100	APPLICATION	REFERENCE DWGS	INST SPEC NO.	ADDITIONAL DATA
Sv-102		Pri.Na Flow	Existing		220-v, 3-phase regulation control system & servo, d.c. output to M.C.
ERCp-102		Pri.Na Flow	Existing		10-50-Mv, input & d.c. output, 1-mode null bal. controller
SCpA-102		Pri.Na Flow	Existing		0-90-v.d.c. amplifier
Sv-104		Sec.Na Flow			220-v, 3-phase regulation control system & servo,d.c. output to M.C.
ERCp-104		Sec.Na Flow			10-50-Mv.input & d.c. output 1-mode null-bal controller
SCpA-104		Sec.Na Flow			0-90 - v.d.c. amplifier
HS-104		CV-104 and P/E-104 Selector			3-way double-angle pneumatic transfer switch located behind panel
HS-105		LRC-203 and TRC-402 Selector			3-way double-angle pneumatic transfer switch located behind panel
PS-113		Feedwater Flow & pump Cut-out			3-15 lb pressure switch with electric contacts

REMARKS:

800 080

ENGR	M.B.Bagley
CHK	
APPD	[signature]
DATE	11-15-60

APPENDIX B: SCHEDULE

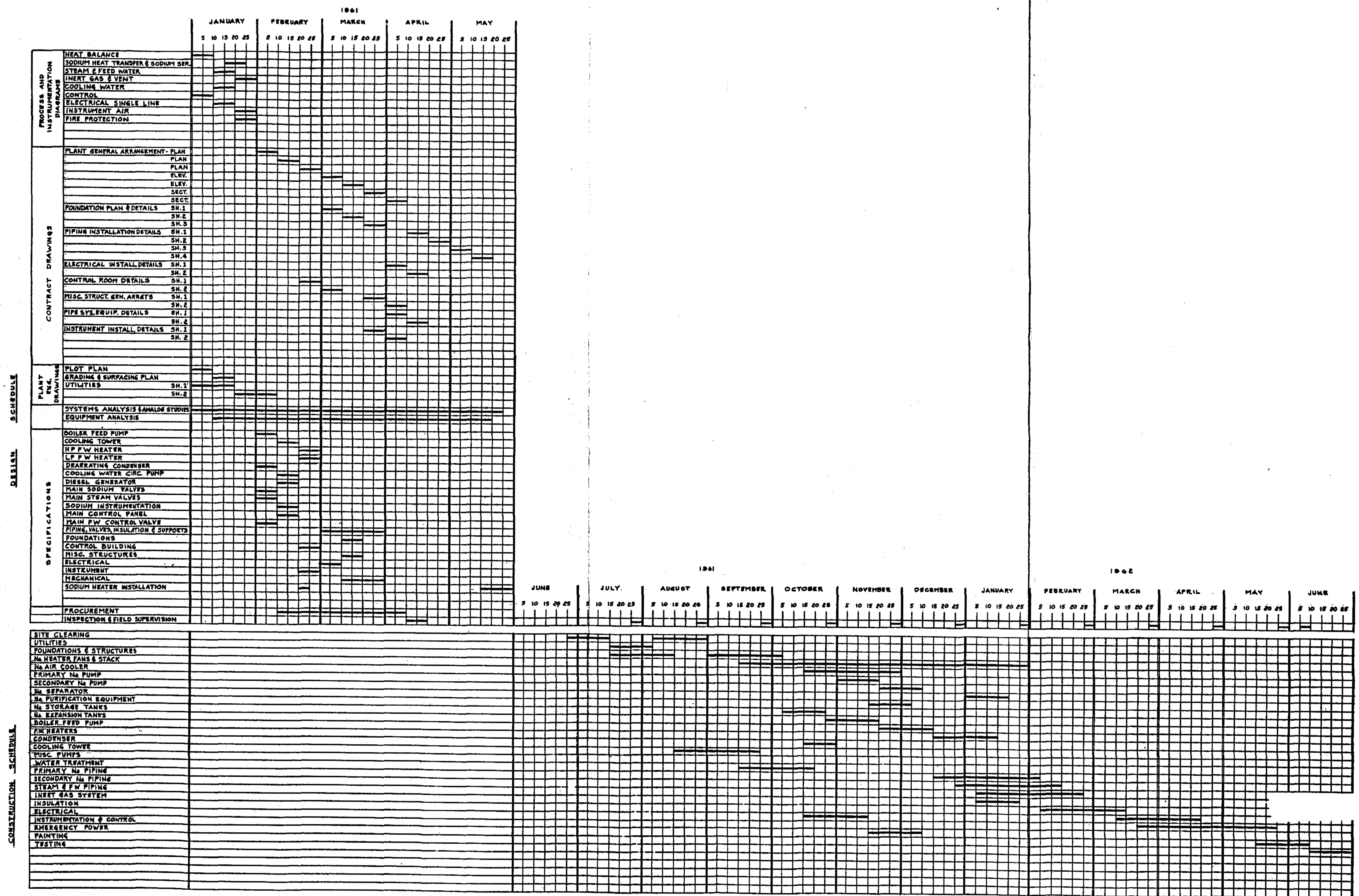

Figure 16. Design and Construction Schedule