HW-76928

# DESIGN CRITERIA

# FOR

# HIGH TEMPERATURE LATTICE TEST REACTOR

# PROJECT CAH-100

# CHANGE #3


Prepared by:

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Atomic Energy Commission — Date

## DISCLAIMER

PROJECT CAH-100
HIGH TEMPERATURE LATTICE TEST REACTOR
DESIGN CRITERIA
CHANGE #3

This design criteria document is hereby changed and supplemented as described below. The paragraph reference(s) given for each item is considered to reflect that portion of the document that is most directly affected by the change, other paragraphs may also be affected.

Change No. 3-A Vacuum System & Enclosure Design Pressure

Ref: Para. 2.1E Containment of Reactor. Add the following:

The reactor containment enclosure (gas shell) shall be designed for internal pressures of 20 psia and 0 psia with external atmospheric conditions.

A vacuum system shall be provided to evacuate this enclosure and the associated gas circulation piping and equipment. This system shall be capable of reducing the enclosure internal pressure to 1 psia in a period not to exceed one hour. The system and equipment components shall be designed so as to produce an ultimate pressure suitable for efficiently outgassing of the insulation and other materials used in the system (approximately 1 to 10 torr).

Change No. 3-B Graphite

Ref: Para. 2.3A. Substitute the following for the first paragraph:

The reactor lattice shall be established at 4-3/16 inches by 4-3/16 inches. Alternate small and large front to rear holes shall be arranged as shown on SK-3-10401, Detail 6, and the sizes of these holes shall be 1-3/4 inches and 3 inches respectively. The graphite to be used is excess material from the old "Standard Pile" and Exponential Pile previously assembled in the 326 Building. This material is type CS-GBF as manufactured by National Carbon Co.

Change No. 3-C Purge Stream Features

Ref: Para. 3.2F. Reactor Continuous Gas Purge System. Add the following:

A remote controlled three-way valve shall be provided in the reactor gas purge discharge line to permit, at the operator's discretion, the routing of this stream either into the purge line filters and thence up exhaust stack, or back into the system at a point just upstream of the recirculation blower.

Dual high efficiency filters shall be provided for the purge gas stream. The radiation monitor shall "see" the filter closest to the reactor. The filters shall be fire resistive particulate type.

Change No. 3-D Reactor Heating Elements

Ref: Para. 5.1A In-pile heating elements. The description of a suitable heater system is modified to eliminate the use of insulators for supporting the heater elements within the heated zone of the reactor stack.

Change No. 3-E Fire Alarm System

Ref: Para. 6.2D Fire Detection. Add the following sentence:

An auxiliary annunciator panel shall be provided within the facility to indicate the particular detector and/or sprinkler system which causes an alarm.

Change No. 3-F Basement Ramp

Ref: Para. 7.2 Building Floor Elevation. The requirement for a ramp to the basement is eliminated and an access areaway is substituted therefor.

Change No. 3-G Parking Areas

Ref: Para. 7.4 Roads, Parking Areas and Walks. The requirement for improved parking areas with curbs is eliminated.

Change No. 3-H Painting and Finishing

Ref: Para. 8.5A. Add requirement for a chemical and radiation resistant and decontamination coating on the basement floor under the reactor room.

Ref: Para. 8.5B. Substitute, "exclusive of the basement floor under the reactor room" for "including space under the reactor room".

Change No. 3-I Architectural and Structural

Ref: Para. 9.2 Floor Loading. Substitute the following for Section C:

The floor in the experimental assembly room shall be designed for a live load of 500 #/sq. ft. The design shall also consider additional special loading conditions caused by the core removal dolly when loaded with experimental core. This floor of the reactor room shall be designed for a live load of 250 #/sq. ft. except when additional requirements are needed for supporting the core removal dolly.

Change No. 3-J Crane

Ref: Para. 9.5. The requirement for a continuous variable control system is deleted. The crane hoist shall contain at least two speeds; one speed within range of 2 to 4 feet per minute and one speed within range of 7 to 15 feet per minute. Trolley and bridge movements shall include stepped controls with at least two speeds below 15 feet per minute, a total of 5 steps, and with maximum speeds of 25 feet per minute for both motions. All speeds of all three movements shall have zero to full load capacity.

Change No. 3-K Shielding Doors

Ref: Para. 9.6 Shielding Doors.

Section A. Substitute for first sentence the following: "The first floor shielding door shall provide sufficient shielding to reduce radiation levels to those specified in Para. 2.1.F.

Section B. Delete second sentence which specifies thickness and composition of the basement door, and substitute "sufficient shielding shall be provided to meet requirements of Para. 2.1.F.

Change No. 3-L Furnishings and Equipment

Ref: Para. 10.2 Lunch Room. The requirement for four 3 feet square tables is deleted. Table space for 16 persons shall be provided.

Change No. 3-M Fire Protection

Ref: Para. 10.5 Fire Extinguishers. Water and dry powder types of extinguishers are added.

Ref: Para. 12.2, B.4 Fire Protection Water. The requirement for fire hose racks is eliminated.

Change No. 3-N Exhaust Ventilation

Ref: Para. 11.3C. The requirement that the exhaust air from the basement under the reactor room be discharged through basement floor gratings and underfloor ducts is deleted.

Ref: Para. 11.3 C, E and F System Description - Exhaust System.

The requirement for a by-pass line, containment valve and its associated controls for the reactor room and basement exhaust system is eliminated. The high efficiency filter capacity shall be adequate for full exhaust flow.

Change No. 3-O Building Services

Ref: Para. 12.2B. Add the following:

10. Cooling Tower

A cooling tower shall be provided with sufficient capacity to handle water from the H & V systems. Anti-freeze protection shall be provided.

11. Process Drains

The process drains shall be adequate for acid and caustic wastes. Two pumps shall be provided for each sump. The pumps may be constructed of materials which are not corrosion resistant.

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HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

DOCUMENT NO. HW-76928

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# DESIGN CRITERIA for HIGH TEMPERATURE LATTICE TEST REACTOR PROJECT CAH-100

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AUTHOR
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# HIGH TEMPERATURE LATTICE TEST REACTOR

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PREPARED BY:

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| Physics & Instruments Laboratory - HL | Date 5-17-63 |
| Facilities Engineering - HL | Date 5-21-63 |
| Atomic Energy Commission | Date 5-28-63 |


HANFORD ATOMIC PRODUCTS OPERATION

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## 1.0 INTRODUCTION

This project provides for the design and construction of a High Temperature Lattice Test Reactor (HTLTR) and its supporting facilities as described in this document and the Project Proposal Document No. HW-76408.

This Design Criteria establishes an engineering concept which will provide the basis for the design of a HTLTR to be constructed at Hanford.

The fundamental need for this research facility is to provide nuclear data for high temperature reactor systems. Solid moderators, gas coolants, and any of the known fuels can be tested in this reactor, which will support the technology of advanced high temperature power reactor systems.

This facility consists of the reactor, its safety and control systems, an experimental core and fuel, a gas circulating system, a reactor building and adjoining service building.

The instrumentation for the reactor will include, (1) nuclear safety, (2) temperature measurements at strategic locations throughout the reactor at temperature levels from room temperature to full operating temperature, (3) control of the reactor temperatures at the operating level by controlling the power input to the electrical heating elements within the reactor, (4) rapid and reliable acquisition of nuclear, thermal, and hydraulic data, and (5) control of the gas circulation system.

The reactor will be heated electrically. Approximately 500 kw of electric power will be delivered to graphite heating elements. Eight saturable reactors will regulate the electrical power input. Graphite heating elements will be distributed to provide uniform heat. Reference Drawing, SK-3-10605.

The building facilities consist of: (1) a reactor room with basement, and an attached enclosure for the neutron beam and analyzer, (2) a service building attached to the reactor with basement, main floor, and second floor, (3) an exhaust stack, (4) a liquid nitrogen storage facility.

### 1.1 GENERAL DESCRIPTION OF THE REACTOR

The moderator block of the HTLTR will be a ten-foot cube of graphite enclosed within a thermally-insulated, gas-tight container. The reactor will be designed to operate initially at 1000°C and to be capable of operation at 1200°C with some additional equipment. The insulation and the gas-tight vessel will be equipped with sealed doors that can be removed for access to the reactor.

1.1 GENERAL DESCRIPTION OF THE REACTOR (Continued)

The experimental equipment within and attached to the reactor will permit the removal of the 10' long parallelepiped experimental core section whose maximum cross section is 5' x 5'. This experimental core contains a test cell (about 15" x 15" x 78") which can be moved along its center-line to obtain reactivity coefficients comparing a lattice cell to a void. In addition, a small oscillator is attached to the front face to oscillate fuel or poison samples up to five pounds in weight to determine reactivity coefficients of various materials.

The reactor gas system is a closed nitrogen circulating loop containing equipment to circulate gas for temperature leveling and shutdown cooling. The gas system also contains instrumentation for detection of oxygen, transient radioactivity, and water leaking from the primary heat exchanger. The design life of all reactor process components shall be based on a life span of ten years and reactor operation of 185 days per year (24 hour days). Of this total, reactor operating temperatures shall be assumed as follows: 95 days between room temperature and 600 C, 54 days between 600 C and 900 C, and 36 days at 1000 C.

1.2 PURPOSE OF REACTOR FACILITY

The purpose of this facility is to obtain physical data for high-temperature, solid-moderated reactor lattices. It will support the advancement of power reactors being designed to operate at increasingly higher temperatures. For safe and economical operation of power reactors, comprehensive studies are needed of reactivity transients anticipated in bringing a power reactor up to operating temperature. The required information will be obtained by experimental measurement of the changes in reactivity and neutron energy spectra caused by heating the moderator, the coolant, or the fuel.

The proposed reactor will be designed to study the lattice properties of both gas cooled and liquid cooled fuel elements in a solid crystalline moderator. Coolants to be used initially in the experimental core of HTLTR will be air or other gases. Water, organics and liquid metals are not excluded, but the equipment for these coolants will be provided by the future research program rather than this construction project. The construction project will provide a graphite moderator only. The fuel elements used will be those suitable for high temperature and long exposures.

The facility will not be used to study liquid-moderated systems since facilities for such studies are presently available at other sites.

Problems to receive initial attention may be summarized as follows:

(1) Temperature coefficients of the fuel or prompt power coefficients
(2) Temperature coefficients of k arising from changes in moderator temperature in heterogeneous lattices.
(3) Variations in the strength of control rods with moderator temperature
(4) Investigations of the relative merits of using plutonium or mixed fuels as opposed to uranium isotopes in high temperature reactors, and
(5) Study of the neutron spectrum in lattice cells under reactor operating temperatures.

1.2 PURPOSE OF REACTOR FACILITY (Continued)

The time necessary to change the core loading would be from one to several days, depending upon the complexity of the desired core.

This reactor will provide support for solid-moderated power reactor projects by providing experimental data for normalizing calculated transients which will materially aid the design of any specific high temperature reactor in lieu of the more expensive method of providing separate critical mockup facilities for each type reactor under consideration.

## 2.0 REACTOR AND APPURTENANCES

### 2.1 TECHNICAL SPECIFICATIONS

#### A. Technical Concept

The scientific studies of the properties of reactor lattices to be made using the HTLTR are solidly based upon the technical procedures and experiments developed for use with the existing PCTR (Physical Constants Test Reactor) at Hanford. There are, however, many differences which allow the attainment of the purposes outlined: the reactor stack may be heated to a high temperature, the reactivity comparison of a reactor cell with a void is done remotely, a pulsed neutron source is used for startup and for subcritical experiments, reactivity measurements on small samples may be made with the oscillator technique, the graphite block is larger and is uniformly pierced with channels which can be loaded with fuel, the movable face is absent, and a neutron chopper may be used to measure the differential neutron spectrum. These differences add to the versatility and usefulness with which the HTLTR may be applied to reactor physics and reactor design problems. Yet, the basic operations in the use of the HTLTR remain very close to those of the PCTR.

The design of the facility should provide those features described in this document to do those experiments which are being planned. The design should also provide as much flexibility as is consistent with planned uses and with prudent economic considerations. For example, added space in the reactor room or in the reactor containment enclosure would allow added flexibility for future experimental equipment, but at added cost. Advice will be provided to the Architect-Engineer during design concerning those detailed items which may allow, or prevent, scientific flexibility.

The HTLTR will be operated in either of two ways. A test lattice which is either 5 or 10 feet in length will be inserted in the center of the experimental core section. The flux will be matched with the use of experimental fuel and flattened (in the case of a 5 feet lattice) with the flux leveling rods. The reactor will be heated and reactor physics measurements made as a function of the temperature. The major features of the HTLTR are those which allow measurements of the changes in reactor lattice characteristics with temperature. Such information is needed for future progress in the reactor technology of high temperature reactors.

2.1 TECHNICAL SPECIFICATIONS (Continued)

A. Technical Concept (Continued)

In order to fulfill this concept of advance in reactor technology, the High Temperature Lattice Test Reactor shall have the following technical specifications:

B. Operating Temperatures

The design shall include adequate provisions to attain, measure, and record the following operating temperatures:

| | | |
|---|---|---|
| 1. | Overall reactor | 1000°C |
| 2. | Central Test Fuel Element | 1500°C (Temperature measurement and indication only) |
| 3. | Heater Surfaces | 1600°C Max. |

Permanent materials (insulation, etc.) that cannot be readily removed and replaced shall be designed to operate at 1200°C.

C. Heating and Cooling Rates

The input power required for heating the reactor shall be adequate to heat the entire moderator and thermal shielding to equilibrium, with temperature of 1000°C of the moderator, in five days (120 hours). The heating system shall be capable of elevating the reactor system from 900°C to 1000°C in sixteen hours.

Present estimates indicate that the input and distribution of this heating power can be accomplished with 500 kw of primary power distributed into the moderator by eight secondary saturable reactor heating control circuits.

The equilibrium cooling rate is a measure of the stability of this system and is determined by the size of the system and the quantity and thermal resistance of the insulation used. The reactor with the proposed thermal shielding is calculated to have a 7°C per hour temperature decay characteristic when no power is added to the system; however, the reactor temperature variations can be minimized by use of the heating control circuits. Upon shutdown of the reactor the nitrogen gas circulating and cooling loop system shall have the capacity to reduce the reactor temperature to 260°C in twenty-four hours. At this time, the reactor doors will be opened for observation of the experimental core or changes of fuel or other equipment.

Heat is removed by circulating nitrogen gas. The gas passes through the thermal insulation (a regenerative transfer function) to reduce the temperature gradients in the reactor proper. The performance of this flow pattern within the reactor also reduces the external surface temperatures of the reactor insulation.

2.1 TECHNICAL SPECIFICATIONS (Continued)

D. Thermal Insulation

The proposed insulation for the HTLTR consists of five functional layers of thermal insulation enclosed within a gas-tight metal enclosure.

Each layer of insulation shall be selected for properties related to high temperature capacity, thermal resistance, spalling resistance, and low nuclear absorption cross section.

The preliminary estimate of required thickness of insulation is 36" of the following composition: (Front and rear faces have 2'-3" of higher grade insulation)

| Location | Composition | Thickness |
|---|---|---|
| Layer 1 - adjacent to moderator | Graphite wool | 7-1/2" |
| Layer 2 - gas layer | Nitrogen gas | 3-3/4" |
| Layer 3 | Aluminum Oxide (G32) | 9" |
| Layer 4 | Aluminum Oxide (G26) | 9" |
| Layer 5 | Calcined Diatomaceous Earth | 6-3/4" |

The insulation of the HTLTR shall provide a maximum temperature on the reactor outer surface of 78°C assuming normal ventilation of the surrounding building area. Insulation for front and rear face should be designed with higher thermal resistance properties to meet the space requirements.

E. Containment of Reactor

A containment enclosure shall surround the reactor and shall pass a test limiting maximum leakage to 1/2% of volume per hour at 1 psig. The purpose of this vessel is to contain the reactor atmosphere and prevent any radioactive material escaping into the reactor room.

The detection of radioactive materials in the system is accomplished by continuous scanning of the purge system and reactor gas circulating system.

This means of containment, radioactivity monitoring, automatic shutdown of the reactor, and high efficiency filtration of the ventilation off-gas provides an adequate system for the safe operation of the High Temperature Lattice Test Reactor.

F. Shielding

Shielding shall be provided for the following, (1) the reactor, (2) the reactor building, (3) the counting room, and (4) the beam chopper facility.

2.1 TECHNICAL SPECIFICATIONS (Continued)

F. Shielding (Continued)

In all cases the materials outside the reactor or beam chopper shall not become activated.

The reactor shall have a 1/8" boral sheet attached on the outside of the gas seal layer.

The reactor room walls and roof shall be constructed of ordinary concrete of such thickness as to reduce the radiation fields outside the building up to a height of 6 feet to less than 1.0 m rem/hr at maximum reactor power level of 2000 watts. The radiation level shall not exceed 0.2 m rems/hr at a distance of 20 feet from the building and in the first and second floor levels of the service building. The basement of the service building shall have sufficient shielding wall such that a level of 0.2 m rems/hr is not exceeded at the walls and a level of 1 m rem/hr is not exceeded at the door. Preliminary calculations indicate that these levels require 3 foot thick walls and a 2 foot thick roof for the reactor room.

The counting room shall be shielded with ordinary concrete walls, and a labrynth entrance, of a thickness such that the contribution of the reactor to the counting rate is less than the normal background rate without the reactor operating.

2.2 REACTOR CONTROL & SAFETY ROD EQUIPMENT

A. Horizontal Control Rods

1. General

The HTLTR Horizontal Control Rod system consists of nine horizontal rods, each rod assembly provides neutron absorption by the alternate use of bushings composed of three types, (1) graphite, (2) compounded fuel and, (3) boron poisoned bushings as shown on Drawing SK-3-10402. This arrangement will provide a method of controlling reactor power with only six inches of rod travel.

In this design the Architect-Engineer will be responsible for the overall design of the assembly and the General Electric Company will furnish the Material Specifications for the material compounding to be used in the three types of bushings.

2. Horizontal Control Rods (Primary Control)

Eight of the rods to be installed in the HTLTR will be for use in major control of the reactor and will be composed of a driving mechanism with precision measurement of rod position, a scram mechanism, and the rod assembly and internal cooling arrangements. The rod arrangement is shown on Drawings SK-3-10402 and SK-3-10401, except that the total length may be limited to six feet.

2.2 REACTOR CONTROL & SAFETY ROD EQUIPMENT (Continued)

A. Horizontal Control Rods (Continued)

2. Horizontal Control Rods (Primary Control) (Continued)

The normal control velocity shall not exceed two inches per minute and shall include stepping control with movement of 0.001 inch per step.

The drive motors shall be of the step-motor type, such that they can be positioned to a high degree of accuracy (as stated in paragraph 4.4) by the pulsed output of the Data Logger.

The scram control mechanism, (a holding magnet and internal spring power) shall have the capacity to plunge the horizontal rods into reactor safe position within one second.

The horizontal rods shall be designed to operate at 1000°C and gas cooling shall be provided to permit maximum operating levels of 1200°C. The cooling gas shall be passed through the interior and exterior of the rod in order to cool both the rod and channel elements. Two rod locations shall be provided in the design for each of the eight primary control rods in order to provide reactor control for widely different experimental fuel arrangements.

The specific locations of the alternate rod locations will be provided by the General Electric Company at a later date.

3. Horizontal Control Rod (Secondary Control)

One of the nine horizontal rods shall be of similar design to the primary rod with the following exceptions. The rod driving mechanism does not require the scram mechanism and will be composed of rod elements that have a neutron absorption strength ratio between the secondary (fine) control rod and the primary control rod of 0.05.

The requirements of the normal drive, location indication, electrical motor control, normal speeds, and indexing of movement shall all be standardized with the main horizontal rods. The location of this rod and its spare opening is not shown on Drawing SK-3-10401, however, the data will be supplied to the Architect-Engineer along with the compounding of the graphite spacers, the fuel and poison bushings by the General Electric Company at a later date.

2.2 REACTOR CONTROL & SAFETY ROD EQUIPMENT (Continued)

B. Vertical Safety Rods

The HTLTR shall be equipped with four vertical safety rods. The rod element shall be fabricated of a boron alloyed high temperature steel or a metal sheath containing boron carbide as the reactor poison. The design of the vertical rods is the responsibility of the Architect-Engineer. However, the General Electric Company will furnish the metallurgical requirements for the rods at a later date.

Additional features that are required in the final design of the vertical rod mechanical assembly shall be as follows: (See Drawing SK-3-10401 and SK-3-10402).

1. The vertical rod withdrawal motions shall be designed for maximum rates between one to two feet per minute and shall be operable either on a single rod or group basis. The step control system shall be designed on a decimal increment system. The scram motion of the vertical rods is accomplished by deenergizing the electric holding brake. The insertion time for a vertical rod shall be designed for a period of less than 1.5 seconds.

2. The rod must permit full utilization of the fuel openings adjacent to the rod channel.

3. A safety feature must be incorporated in the rod drive mechanism which prevents a rod from being withdrawn too fast. If the safety rods are withdrawn too rapidly, nuclear activity would increase beyond the pre-set limits within the data logger. Design shall be such that this condition will require the vertical rods to initiate a scram operation.

4. Rod position indicators shall be provided for full-in, full-out, and intermediate position. The nuclear absorption strength data will be furnished to the Architect-Engineer during final design.

C. Flux Leveling Rods

1. General

The flux leveling system is primarily the manual movement of grouped fuel elements in the experimental core section to provide a portion of the experimental adjustments needed for a flattened neutron spectrum.

The Architect-Engineer will not be required to prepare any design or procurement for the flux leveling system. The General Electric Company will perform all development, design and fabrication for the fuel, the spacers, shielding, manipulator rods and grouping bars, at no cost to the project.

2.2 REACTOR CONTROL & SAFETY ROD EQUIPMENT (Continued)

C. Flux Leveling Rods (Continued)

Active fuel for leveling slug assemblies will be pieces about 1-1/2 inch long by about 1-1/2 inch O.D. and radiation shielding pieces will be about 2 inches long.

Leveling slug assemblies shall contain 1, 2, or 3 pieces of active fuel. It shall be possible to rearrange the pieces, choosing from 1 to 3 pieces as required.

Leveling fuel position (end of column closest to vertical center plane of reactor) is to be individually adjustable from 2.5 ft to 3.5 ft from vertical center plane of reactor. Repositioning is to be done manually after removing the reactor access doors. Provision shall be provided for future ganging of the rod assemblies. The outer volume of the leveling assembly hole is to be plugged with a loosely fitting graphite cylinder. The outer plane of a 2 inch long shielding cylinder (possibly depleted $UO_2$) is to be in the plane of the outer graphite surface of the reactor when the leveling slug assembly has been retracted to its outer position. The fuel, inner graphite, shielding, and outer graphite pieces may be placed in a heat resistant, low neutron cross section metal can.

2. Flux Leveling Fuel System

A basic description of the fuel and and graphite loading is made to advise the Architect-Engineer of the elements that will be attached to the adjusting rods.

2.3 GRAPHITE

A. General

Graphite material for the square lattice block used on this project will be supplied from Commission stocks at Hanford. The raw material sizes are 4-5/16" x 4-5/16" x 48" long. This graphite material has been manufactured by the Speer Carbon Company and is designated as SGBF type which is similar to National Carbon Company type TSGBF. The physical properties of these materials are listed in documents HW-63153, HW-27084, and HW-39043 and the book, "Nuclear Graphite" by R. E. Nightingale, Acedemic Press Inc., New York.

The design of the entire moderator with the exception of the test core will be the responsibility of the Architect-Engineer however, assistance will be extended by the General Electric Company when specifications are written for the procurement of components such as lintel blocks and graphite heater elements.

The General Electric Company will fabricate the first experimental core (a 5' x 5' x 10' section) which shall bear no cost to the construction project.

2.3 GRAPHITE (Continued)

B. Graphite Stacking

The graphite stack must provide the maximum possible flexibility for its adaptation to all experiments conceived for graphite moderated reactors. To provide this flexibility, the HTLTR moderator shall incorporate the following features: (1) changeable lattice pattern, (2) high temperature materials may be inserted in any region of the moderator, (3) all reactor core bars shall lay parallel to afford flexibility, (4) the graphite bars shall all be cored and those not in use for circulating gas can be plugged with graphite, (5) both faces of the reactor shall be removable, the front face door shall provide access to the entire moderator, the rear face door shall provide access to the experimental core area of the reactor, (7) adequate access and working space shall be provided on each end of the reactor to provide access for loading the driving fuel, installation of heaters, and all other operations concerned with an experiment. Refer to Drawing No. SK-3-10401 for lattice spacing and hole sizes for graphite blocks. A removable block about 3-3/4 x 3-3/4" shall be provided through the graphite stack side to side on centerline for neutron chopper and side experimental plug.

The moderator spacing bars on the lower support pad shall be dowelled to the base and keys installed in such a manner as to compensate for thermal expansion. Keying arrangement shall be designed to maintain alignment of the graphite to preclude the possibility of adverse alignment after successive temperature cycles.

Special precautions shall be taken to provide the proper alignment of the vertical and horizontal rods or similar penetrating components with respect to their opening in the thermal shield. The problems related to this performance will require certain close tolerances not normally used in standard construction.

Cleanliness procedures normally used for reactor erection shall be implemented for the HTLTR in order to prevent any possibility of foreign contaminants being deposited in the graphite stack.

2.4 REACTOR FUEL

A. General

The Architect-Engineer will not be responsible for design of the fuel for the reactor. These criteria describe the reactor fuel in general terms rather than in detail as the basic information is not needed by the Architect-Engineer.

2.4 REACTOR FUEL (Continued)

B. Reactor Fuel

The driver fuel (including fuel used for flux leveling - see paragraph 2.2-C) will consist mainly of $UO_2$ of about 5 to 10 weight per cent enrichment in either a solid or hollow cylindrical shape and held in containers capable of withstanding high temperatures. Some of these fuel elements will also contain gadolinium oxide mixed in with the fuel in an amount such that the neutron absorbtion in the gadolinium is comparable with that of the $U^{235}$ in the fuel (about 1% of the $U^{235}$ by weight). The purpose of introducing the gadolinium is to reduce the steady state temperature coefficient of reactivity of the reactor.

Some of the fuel elements will be constructed of uranium metal, or of an alloy of uranium, in tubular form. In the event of an uncontrolled power excursion this fuel should melt and collect at the bottom of its container before the $UO_2$ and its cladding reach melting temperatures. The resulting reduction in reactivity will act in addition to the doppler coefficient of the entire driver fuel loading to terminate the excursion.

2.5 REACTOR EXPERIMENTAL EQUIPMENT

A. Neutron Chopper and Related Equipment

The design of an existing Neutron Chopper will be provided to the Architect-Engineer. The A-E shall adopt and modify this design as required for use in the HTLTR. The rotation may be limited to speeds of from 100 to 3600 RPM.

In general, the equipment required for the beam chopper facility is the chopper, time analyzer, detector and shielding.

The data from the neutron beam chopper shall be stored in the data logger for read-out. Since the data are not random in time a multi-channel buffer shall be provided as a part of the time analyzer. This buffer shall be a modified, stripped-down, multi-channel pulse height analyzer. The channels shall be 10, 20, 40, or 80 micro-seconds each, switch selectable. The number of channels shall be 200 or 256. The storage mode shall be straight binary. The arithmetic register shall be capable of one micro-second resolution as a counter. The analyzer shall have an oscilloscope to display the contents of the memory in either a linear or logarithmic manner. The memory cycle time shall not exceed ten micro-seconds. The contents of the memory shall be accessible by the data logger. All circuitry shall be solid state. The time base oscillator shall be crystal controlled and counted down from 1 megacycle in order that the time jitter shall be less than 1/10 channel. There shall be no other readout or data handling equipment. The detector shall be an array of $BF_3$ proportional counters. A transistorized linear amplifier and integral discriminator shall provide standard pulses to the time analyzer.

## 2.5 REACTOR EXPERIMENTAL EQUIPMENT (Continued)

### B. Low Temperature Core Removal Equipment

A large share of the experiments carried out in this reactor require that nuclear characteristics be obtainable from different lattice spacing patterns. Therefore, the experimental core section of the reactor must be readily removable. In order to change the lattice of the central core section, which is a ten foot long stack of graphite and has a maximum cross section of 5' x 5', it will be necessary to remove the core, restack it and replace the new core within the remaining moderator shell. The equipment to accomplish this change, shown diagramatically on Drawing No. SK-3-10401, must be capable of withdrawing and replacing the core weighing approximately 12.5 tons. (The fuel will be loaded after the core is placed in the reactor).

### C. Reactor Penetrations for Experimental Equipment

Numerous experimental facilities will be added later and the openings shown on the drawings are specified as to use and size. These penetrations through the reactor shell shall be provided with leak tight gas seals (preferably without cooling water). An approximate list of the openings is as follows:

1. Vertical rods
2. Horizontal rods
3. Gas system inlet, outlet, and purge lines
4. Front and rear face doors and end plugs
5. Side experimental openings (18" diameter)
6. Sleeves for future experimental needs (water cooling of fuel)
7. Neutron chopper
8. Temperature sensing and flux traverse devices

The front and rear face end plugs shall provide an 18" x 18" clear opening. Sleeve penetrations for future experimental uses shall be 6" clear diameter and shall be located as shown on Drawing SK-3-10401, excepting interferences that may exist with the heater terminals.

### D. Heavy Duty Oscillator

The heavy duty oscillator is a mechanism which will oscillate a 15" x 15" x 78" lattice cell located in the center position of the reactor core. The purpose of this equipment is to determine reactivity coefficients of the test lattice compared with a void. The equipment must be capable of oscillating a 1200 lb weight during a time cycle of two to ten minutes and shall have an adjustable horizontal stroke of up to 36".

2.5 REACTOR EXPERIMENTAL EQUIPMENT (Continued)

D. Heavy Duty Oscillator (Continued)

Another use of this oscillator is to perform an oscillating movement of a fuel element train which will provide the experimental comparison of different fuels with a standard reference. The fuel element train could weigh a maximum of 200 lbs and the oscillation would be accomplished in the stroke length of up to 78" and cycle timing as defined above for this equipment. The longer length of stroke will require the use of an extension enclosure which is not a part of this project.

E. Light Duty Oscillator

This equipment is located on the front face shield to manipulate samples located anywhere in the central cell (15" x 15" size max.). The purpose of this oscillator is to move samples into the reactor for short periods of time in order to determine the reactivity coefficients of selected materials, and to insert samples of copper or other neutron detecting foils for short duration tests.

This equipment shall have a capacity to oscillate a five pound sample a distance of five to nine feet in 2-1/2 seconds with a period of oscillation adjustable from two to ten minutes.

Both the heavy duty and light duty oscillators shall be provided with a cooling chamber such that fuel or irradiated foil samples can be removed from the reactor and be replaced by unirradiated samples. This chamber shall have the capability to reduce the temperature of the sample to 100°C within one hour. Port facilities shall be provided to remove and replace the sample manually when the reactor is at operating temperature.

2.6 REACTOR EQUIPMENT DEVELOPMENT

A. Development Testing

It is anticipated that certain items of the High Temperature Lattice Test Reactor auxiliary equipment may need mockup and testing to verify the performance of its function and expected life prior to use in the reactor. This development work will be performed by the G. E. Company and will not be incurred as an expense to the project. The Architect-Engineer shall be responsible for the design of the items listed below and shall proceed on the basis of information supplied in this document. Results of developmental tests will be supplied to the A-E by the Commission and he shall make such design revisions as are indicated.

2.6 REACTOR EQUIPMENT DEVELOPMENT (Continued)

A. Development Testing (Continued)

1. Vertical Rod Assembly
2. Horizontal Rod and Scram Assembly
3. Inconel Sheathed Thermocouple Assembly installed in graphite which is inserted in a furnace with an atmosphere of nitrogen and at a temperature of 1000°C.
4. Thermocouple operating at 1600°C in graphite surrounded with nitrogen gas.

   The following design for the 1600°C thermocouple is recommended: Hot junction tip end, a molybdenum sheath, the rest of thermocouple sheath to be inconel. The thermocouple material to be tungsten - tungsten 26% Rhenium with insulation of magnesium oxide or aluminum oxide. An assembly shown on Aero Research Instruments, Advanced Technology Laboratories Division of American Standards Drawing T-5301-L is an example of this type of design. This couple would be the type needed for measurement of the power electrode temperature in the temperature control circuits when heating the reactor at maximum rate.

5. Prototype rod position transducer for accuracy requirements of 0.001" and check the horizontal rod drive to assure the range of operation and degree of control is adequate. Test transducers for long term stability and temperature coefficient.
6. Neutron chambers for service environment, dependability and saturation characteristics.
7. Run a heating test to assure performance of the graphite heating element and its mullite insulation.

B. Data Logger

Test operate the data logger and safety logic system before installation.

3.0 GAS SYSTEM

3.1 GENERAL

The gas system shall be a closed loop nitrogen circulating system which contains the following principal equipment: (See Drawing No. SK-3-10403)

Filter
Primary Heat Exchanger
Compressor
Horizontal and Vertical Rod Cooling System
A Nitrogen Supply System
A Purge System

Operational requirements of this system are as follows:

3.1 GENERAL (Continued)

The reactor heating cycle will require a low flow of nitrogen through the reactor for temperature leveling. The vertical and horizontal rods will require cooling at the upper temperature levels. The purge system and its complement of radiation detection instrumentation will provide continuous radiation detection during all modes of operation. The cooling cycle requires the maximum flow of nitrogen cooling gas through the reactor, the control rods, the safety rods, and equipment cooling. Therefore, the compressor must provide maximum nitrogen flow during the cooling cycle.

The gas cooling system shall be designed for cooling the reactor from 1000°C to 260°C in twenty-four hours. Preliminary calculations indicate that at maximum capacity the gas system will be required to circulate 150 lbs of nitrogen per minute.

The gas system purge shall be equipped with high efficiency filtration equipment to preclude the possibility of any radioactive particles escaping to the atmosphere. The primary detection of any circulating radioactivity elements will be accomplished by the gas system instrumentation. If there is sufficient radioactive material detected within the gas loop the reactor building ventilating exhaust system containment valve shall be tripped closed and the building ventilation air shall be diverted through an high efficiency filter at reduced flow to prevent the escape of contaminants to the surrounding area.

The control and radiation detection systems are more fully explained in the Instrument Section of this criteria.

The rod cooling system shall contain a heat exchanger to reduce the temperature of the nitrogen gas sufficiently to cool the drive motors (approximately 45°C) and shall circulate a portion of this gas through each rod channel for cooling.

Preliminary calculations indicate that nitrogen gas storage should be provided for the use of 6,300 gallons per month. Present planning indicates a contract will be written between the Commission and a commercial supplier for furnishing liquid nitrogen to this facility. Such a contract would include a storage tank to be provided by the supplier. The A-E shall coordinate the foundation plans for the storage tank, with the nitrogen supplier. Vendor supplied tanks range in size from 5000 to 8000 gallon storage and truck shipments are made in tankers of 5000 gallon capacity. The storage tank shall be equipped with a liquid level indicator with alarm.

The usage is based on a 25 CFM steady purge at a 50% time-temperature reactor operating cycle.

It is presently estimated that 8000 gallon nitrogen storage should be provided to receive ordinary truck shipments with enough overage of liquid nitrogen to protect the HTLT Reactor until another shipment could be dispatched to the site.

3.1 GENERAL (Continued)

The specifications for nitrogen are based on present contract procurement specifications for purity as follows:

| | |
|---|---|
| Minimum Nitrogen | 99.997% |
| Maximum Oxygen, Maximum Argon | .003% |

3.2 CONTROL AND INSTRUMENTATION

A. General

The instrumentation requirements for the cooling gas system are shown on Drawing No. SK-3-10403.

The instrumentation subsystems are as follows:

1. Gas Make-up and Pressure Control
2. Gas Blower Control
3. Safety and Control Rod Cooling
4. Reactor Cooling Gas Circulation
5. Reactor Continuous Gas Purge
6. Gas Analysis
   (a) Gas Moisture Detection
   (b) Alpha Particulate Monitor
   (c) Oxygen Analysis
   (d) Carbon Monoxide Analysis

The instrumentation, unless otherwise shown on the drawing, shall be direct current, two or four wire, miniature instruments with appropriate accessory force balance type transmitters and converters to perform the required functions. Although the readout and control functions are shown as individual instruments for each system, the design shall be directed toward the use of the data logger to the fullest extent possible for these functions. The objective shall be to eliminate individual controllers where economical, in favor of logger control and print-out. In this event recorder or indicator read-out are still required as shown.

The instruments shown to be located in the control room shall be panel mounted on manufacturers standard modular 19" enclosed racks meeting EIA Standards. The instruments, which are visible from the front of the panel shall, in general, be semi-flush or flush panel mounted. All other instrumentation shall be located in the reactor room or in rooms assigned to gas system equipment. In order to prevent the spread of potentially radioactive materials by gas leakage, the direct connection between the gas streams and any instrumentation located within the control room or unlimited access areas shall not be permitted. All instrument racks shall be provided with filtered air flow for instrument cooling.

3.2 CONTROL AND INSTRUMENTATION (Continued)

A. General (Continued)

The system for extracting sample gas from the specified streams shall employ isokinetic type probes and isokinetic sampling techniques. Monitors and Analyzers which are sampling the same streams shall utilize common sampling devices in order to effect the greatest economy of equipment. All sample gas shall be returned to the purge header upstream of the absolute filter but downstream of all sample take-off points.

Oil-free, diaphragm sealed pumps shall be employed in all the sample systems. Special design features shall be incorporated to prevent over-temperature of any of the sampling or monitoring equipment.

The Gas Analysis functions are shown to be accomplished with individual monitors for each component. However, consideration shall be given to combining the functions by use of one or more Gas Chromatographs where lower cost and/or increased sensitivity may be gained.

B. Gas Make-up and Pressure Control System

1. Purpose

The purpose of this system is three-fold:

(a) To maintain a constant volume of inert gas within the reactor system by adding gas at a rate equivalent to bleed-off rate through continuous purge, sample removal, and leakage.

(b) To provide precise regulation of the gas pressure within the reactor during operation in the data taking range.

(c) To precisely measure the absolute pressure within the reactor and present a proportional signal to the data logger for print-out.

2. Required System Performance

a. Make-Up and Pressure Control System controlling pressure to blower inlet shall meet the following performance criteria:

(1) Static pressure at blower inlet: 15 inches of $H_2O$ gage full scale range (1/2 PSIG - Nominal).

(2) Control range (span): 0 to 5 inches of $H_2O$ gage, adjustable to any position within the static pressure range limits. (For example, one might control from 0 to 5 inches of $H_2O$ static, or from 10 to 15 inches of $H_2O$ static, or any span position in between). The span shall also be capable of adjustment to the full static pressure range limits, that is, the span and range would be identical.

3.2 CONTROL AND INSTRUMENTATION (Continued)

B. Gas Make-Up and Pressure Control System (Continued)

2. Required System Performance (Continued)

(3) Measurement Accuracy: $\pm$ 0.5% of span

(4) Measurement Sensitivity: $\pm$ 0.05% of span

(5) Measurement Repeatability: 0.1% of span

(6) Measurement transmitter output shall be temperature compensated or held at constant temperature to hold accuracy and repeatability within specified limits over the expected ambient temperature variations at transmitter location.

b. The system for measurement of absolute pressure within the reactor envelope shall meet the following performance criteria:

(1) Absolute pressure range: 0-840 MM Hg

(2) Measurement Span: 465 to 840 MM Hg

(3) Measurement Accuracy: $\pm$ 0.5% of span

(4) Measurement Sensitivity: $\pm$ 0.05% of span

(5) Repeatability: 0.1% of span

(6) Hysteresis less than 0.1% of span

(7) The measurement transmitters output shall be temperature compensated or the transmitter held at constant temperature to hold the accuracy and repeatability to the specified limits.

C. Gas Blower Control System

1. Purpose

The purpose of the system is to prevent large fluctuations in blower discharge pressure when flow demands on the cooling gas recirculation system changes through the various operating cycles described under Paragraph 3.1 above.

3.2 CONTROL AND INSTRUMENTATION (Continued)

C. Gas Blower Control System (Continued)

2. Required System Performance

The approximately constant discharge pressure shall be maintained by a bypass flow arrangement whereby a portion of cooled gas from the outlet of the rod cooling heat exchanger is bypassed to the inlet side of the blower. The backpressure regulating valve, in the bypass line, shall be sized for the maximum condition when the gas recirculation system is demanding the minimum recirculation flow and be capable of throttling the bypass flow to lower rates as the recirculation demands rise to its maximum rate.

The bypass valve shall be capable of regulating the discharge pressure of the blower at a pre-selected fixed operating point on its characteristic curve plus or minus 20 percent of the preselected pressure. The operating point shall be selected so that the blower will operate on the drooping portion of its characteristic curve.

The discharge pressure and flow rate shown on the drawing are typical for blowers of the type conventionally used for the described service.

The blower differential pressure shall be indicated at the control room panel. The blower start-stop switch shall be located on the control room panel.

D. Safety and Control Rod Cooling System

This system shall be designed to hold the safety and control rod cooling gas flow at a uniform rate. The constant pressure held at the rod cooling heat exchanger outlet by the blower control system becomes the constant upstream pressure for the cooling system. Properly sized restricting orifices in the associated piping to the system with a constant upstream pressure shall act to hold the flow constant. An On-Off, quick opening type remote operated valve (operable from control panel) shall be provided for On-Off control of the rod cooling gas.

The rod cooling gas flow rate and temperature shall be indicated in the control room and loss of flow shall be annunciated.

The temperature of the rod cooling gas shall be controlled below 40°C at rod inlet by means of a controlled flow of cooling water to the heat exchanger. This system shall be fail safe providing full cooling water flow to the exchanger in event of instrument or power and/or air failure. Loss of cooling water flow shall be annunciated in the control room.

3.2 CONTROL AND INSTRUMENTATION (Continued)

E. Reactor Cooling Gas Recirculation System

This system is comprised of the circulation blower, the main gas loop piping, a filter at the reactor outlet, and the primary heat exchanger on the reactor outlet and upstream of the blower.

The control instrumentation for the blower was described above under 3.2, C. The control instrumentation for the primary heat exchanger shall be similar to that for the rod cooling heat exchanger described under 3.2, D. Except, that loss of cooling water flow shall cause reactor scram and be annunciated in the control room.

The differential pressure across the main filter shall be measured by a differential pressure actuated switch which trips an annunciator in the control room at some pre-set increase in differential pressure. Special design features shall be incorporated to protect the differential pressure switch and measuring device from high temperatures.

The recirculation flow rate shall be indicated and automatically controlled by a flow indicator controller on the control room panel. Temperatures shall be indicated in the control room.

F. Reactor Continuous Gas Purge System

The flow through continuous purge system shall be automatically controlled by an indicator controller on the control room panel. Loss of flow shall be annunciated. The purge gas temperature shall be measured immediately downstream of reactor and indicated at the control room panel.

G. Gas Analysis Systems

1. Gas Moisture Detection

Instrumentation shall be provided for automatic and repetitive sequential analysis of the outlet gas streams from the main heat exchanger and the rod cooling system heat exchanger for moisture concentration. A manual switch shall be provided at the control panel to allow selection of either sample for continuous analysis. The moisture concentration shall be indicated at the control room panel.

The analyzer shall trip an annunciator in the control room, scram the reactor, and be interlocked to shut off electric heaters in reactor shut-off gas blower and shut-off cooling water to both heat exchangers, on high moisture analysis. The analyzer shall have a minimum of five selectable full scale ranges of nominally (nearest Sellers standard) 1 to 10 ppm, 1 to 30 ppm, 1 to 100 ppm, 1 to 300 ppm and 1 to 1000 ppm. The accuracy shall be $\pm$ 5% of the full scale range on which instrument is set. The ranges shall be selectable from the control room panel.

3.2 CONTROL AND INSTRUMENTATION (Continued)

G. Gas Analysis Systems (Continued)

2. Alpha Particulate Monitor

Instrumentation shall be provided for continuous monitoring of the purge gas as it leaves the reactor, and the main recirculating gas as it leaves the primary heat exchanger, for entrained alpha-emitting contamination. The monitor shall employ scintillation counter techniques. It shall trip its annunciator contacts within five minutes from installation of a fresh filter paper when the contamination concentration is $10^{-4}$ micro-curies per cubic foot.

3. Carbon Monoxide Concentration Indicator

Instrumentation shall be provided for continuous analysis of the Purge Gas as it leaves the reactor for carbon monoxide concentration. The instrument range shall be 100 to 10,000 parts per million by volume, accuracy ± 200 ppm. The carbon monoxide concentration shall be indicated at the control panel. High concentrations shall be annunciated in control room.

4. Oxygen Concentration Indicator

Instrumentation shall be provided for automatic and repetitive sequential analysis of the nitrogen as it enters the reactor and of the continuous purge gas as it leaves the reactor for oxygen concentration. A manual override switch shall be provided at the control panel to allow selection of either sample for continuous analysis.

The instrument range shall be 100 to 100,000 parts per million by volume, accuracy ± 200 ppm. High oxygen concentration shall be annunciated in control room, cause reactor scram, and be interlocked to shut off electric heaters in reactor.

3.2 CONTROL AND INSTRUMENTATION (Continued)

G. Gas Analysis Systems (Continued)

5. Purge Filter Radiation Monitor

A Halogen quench type Geiger-Mueller tube, gamma sensitive, probe shall be installed at the purge gas exit filter to monitor gamma emitting contamination build-up on the inlet side of the filter. This probe shall be shielded and mounted on the outside of the filter casing and protected from over-temperature limits. Monitor read-out shall be at the control panel. High radiation level shall be annunciated in the control room. Monitor range shall be 0.1 mr to 100 mr/hr.

3.3 MISCELLANEOUS INSTRUMENTATION

A. Miscellaneous Cooling Water Flow

The following cooling water flow systems shall be equipped with flow switches which shall trip annunciators in the control room upon loss of cooling water flow:

1. Concrete cooling coils in floor under the reactor.
2. Door seal cooling water system.
3. Reactor heating element electrode cooling system.
4. Gas blower bearing cool-out flow system.

B. Liquid Nitrogen Storage Liquid Level

A liquid level indicator shall be mounted at the liquid nitrogen storage facility to show tank level in gallons to nearest 50 gallons. The low liquid level shall be annunciated in the control room.

4.0 INSTRUMENTATION AND RADIATION DETECTION

4.1 NUCLEAR MONITORING AND DATA ACQUISITION INSTRUMENTATION

A. Nuclear Detectors

The neutron flux signal shall be generated by uncompensated $BF_3$ ion chambers placed on top of the reactor. These chambers shall cover the entire reactor operating range from source level to full power. This range shall be seven decades of which, six decades shall be used for precision data. The chambers shall be placed inside the boral shielding, but outside the reactor gas seal. The chambers shall be shielded from reactor gamma flux by approximately one-inch of lead or equal shielding. A hydrogeneous reflector shall be placed on top of the chambers. The temperature of the chambers and associated cables shall not exceed 100°F for any reactor operating condition. The chambers shall be divided into two groups, with one group a factor of three to four more sensitive than the other. The two groups shall be positioned to minimize differences in proportionality between the groups as a function of control and vertical

4.1 NUCLEAR MONITORING AND DATA ACQUISITION INSTRUMENTATION (Continued)

A. Nuclear Detectors (Continued)

rod settings. The more sensitive group shall provide a signal of $5 \times 10^{-11}$ amps with all rods in, and neutron source at normal operating current. This current corresponds to a detection of about 2,500 neutrons per second. An additional $BF_3$ proportional counter shall be placed in the same general position as the ionization chambers.

B. Auxiliary Safety Channels

1. Two auxiliary channels shall cover the entire range of reactor operation in a logarithmic fashion. Outputs for both level and period shall be provided from each channel. Trip signals for level, period, and on-scale shall be supplied to the safety circuit These instruments shall be designed with high reliability and fast response in mind. Accuracy is of secondary importance and need not be better than $\pm$ 20% of a decade. However, non-linearities or other inaccuracies shall be such that the indicated period does not vary more than $\pm$ 10% over the range of 10 to 100 seconds. These circuits shall have inherent wide-range nearly logarithmic response and good statistics due to high sensitivity. Level readout shall be by 2 speed chart recorder.

2. An aural monitor shall be provided with loudspeaker in reactor room and control room. This monitor shall use the $BF_3$ proportional counter (4.1-A) and part of the pulse reactivity electronics. An adjustable scaling factor shall be provided.

C. Traveling Wire Flux Monitor

Two manually operated drive units shall be provided for taking axial flux measurements from side to side and front to rear. The through holes for the wire shall be as near to the centerline of the moderator as possible depending on the reactor features. Front to rear passage may be through a fuel channel. Side to side passage shall not penetrate test holes through reactor. The wire shall be manually insertable prior to nuclear startup, with the reactor at high temperature, and removed after reactor nuclear shutdown, with the reactor at high temperature, for counting. Suitable gas seals shall be designed at the points where the wire is inserted into the reactor. The wire shall be manually rolled into a shielded container for safe portability. Flux wire will be supplied by the user and will not exceed 0.150 inch diameter.

4.2 BUILDING RADIATION MONITORS

A. Nuclear Incident Monitor

A nuclear incident monitor will be provided by the user with installation to be designed by the A-E. The monitor detector chamber shall be located on the reactor room roof and arranged to see high radiation limits in any portion of the main floor of the building including the reactor room. The control section and indicator shall be located at the operating console. The device shall provide a high level safety circuit trip. The monitor shall cover the range of 100 mR to 10 R per hour. An interlock shall be added to the monitor design to provide a trip to close the gas system containment valve (see Drawing SK-3-10403). A two speed recorder should be provided with speeds of 1 in/hr and 1 in/min. (Or nearest Seller's standard).

B. Building Radiation Monitor

The building radiation monitor shall monitor gamma radiation level in the control room, the assembly room, and the reactor room. This monitor shall be a halogen quenched Geiger-Mueller tube type monitor with non-saturable count rate meter and built-in check source, and shall have dual range of .1 mR to 100 mR and 100 mR to 1000 R/hour. The monitor shall indicate radiation level at the reactor console. Each point of the monitor shall trip an annunciator in the control room.

4.3 NEUTRON SOURCE

The neutron source used for startup shall be of the accelerator type using the d-t reaction. These neutron generators use acceleration voltages in the range of 100 to 150 kilovolts. The generator for this reactor shall be capable of producing up to $10^{11}$ fast neutrons/second maximum. The normal operating level shall be $10^{10}$ neutrons/second. The neutron production rate shall be adjustable from zero to maximum. Provision shall be made to produce neutron pulses. The pulse length shall be adjustable between one and 100 microseconds. The pulse rate shall be set by the data logger, (4.6), and will be in the range of 10 to 200 pulses per second. It shall be possible to regenerate the tritium target remotely. The primary operation control shall be at the reactor console. The generator shall be mounted vertically in the basement below the center of the reactor. An access hole in the floor shall be provided so that the generator target may be positioned next to the reactor gas seal. Target assembly shall be air cooled as necessary to hold temperature to limits set by equipment manufacturer. The generator shall be mounted on a mechanical elevator to permit routine servicing. A hole shall be provided in boral sheet for neutrons from source to enter reactor. A graphite reflector shall be provided around beam opening to reflect neutrons from source into reactor. A beam current interlock with the reactor basement door shall be provided.

## 4.4 ROD POSITION INDICATION AND CONTROLS

The control rod position indicator shall be based on linear differential transformers. The maximum output shall be in the range of five volts DC, with an impedance level of 100 ohms or less. Linearity shall be .5%. Stability and reproducibility shall be within .02% or .001 inch whichever is greater over the full range of six inches. The rod position shall be read by the data logger, (4.6), and displayed by four numerical digits. Small individual meters shall read the percent of travel, one for each rod. Limit switches and circuitry shall be provided to indicate full-in, intermediate, and full-out positions.

## 4.5 REACTOR TEMPERATURE MONITOR

### A. General

The monitor shall consist of thirty-two inconel sheathed, metallic-oxide insulated, thermocouples, uniformly distributed throughout the graphite in removable stringers. There shall be eight, two-element thermocouple stringers in the driver reflector region inserted through the sides of the reactor, four stringers per side. These stringers shall extend through the gas seal and thermal insulation into the driver reflector region. They shall not extend into the central removable core, nor shall they penetrate a reactor fuel channel or test hole. There shall be four, four-element thermocouple stringers for the central removable core area. These shall be inserted from the rear of the reactor and extend through the gas seal and thermal insulation to various depths within the core.

In addition to the thermocouples in the central core area, there shall be two high-precision, resistance thermometers designed for manually traversing the core from rear to front. These thermometers will be used during low temperature experiments up to 400°C. The detector will be manually removed from the reactor when high temperature experiments are conducted. (Temperature sensors for control of reactor heating are in addition to the above and are described in Section 5.1.2).

All thermocouple and resistance thermometer outputs shall be fed through suitable input devices to the data logger for data acquisition and print-out. The installation and design of the thermocouples shall be such that the AC pickup from the high current density heating elements will be held to a limit that does not produce signal error in excess of accuracy requirements. The repeatable accuracy of the temperature monitors shall be $\pm$ .01°C for the RTD at room temperature and 3/4 of one percent of reading for the T/C at temperatures above 400°C.

## 4.6 DATA LOGGER

### A. Functions Performed

#### 1. Flux Level

The logger shall accept analog signals from the two groups of neutron flux sensors (4.1-A). Both signals shall be digitized and compared. If these signals are not the same within reasonable statistics, an out-of-limit signal shall be given. If the same, one signal shall be corrected for zero errors in the sensor and digitizer, compared with on-scale and high level trip points, and any out-of-limit conditions shall be indicated, if necessary. The signal shall be converted to engineering units, stored in ferrite core memory, and read-out as a power level indication. The overall accuracy shall be .03% exclusive of neutron detection statistics. The logger will periodically test for zero and supply a current to the input in addition to the ion current. If results of either test indicate an error, an out-of-limit signal will be generated. The logger shall perform these functions at the rate of 10 times a second, except that the comparison between the two sensors and the determination of fixed correction factors may be performed at the rate of once in ten seconds.

#### 2. Reactor Period

The flux level that was stored in memory in (4.6-A-1) shall be compared with the previous level. The difference shall be used to determine the approximate reactor period. This shall be compared with a fast period trip point, and an out-of-limit signal initiated if necessary. This period shall be converted to engineering units, stored in memory, and read out as a low accuracy period. This function shall be performed in conjunction with (4.6-A-1) above at ten times a second. An average, or high accuracy period, shall be determined with an averaging interval of 10 seconds. The average of each interval shall be stored in memory and read-out on demand. The accuracy of the low accuracy period shall be 5% for a 30 second period and the high accuracy period shall be .1% between 15 seconds and 100 seconds period values. Initiation of (1) and (2) shall be a signal each 0.1 second from the calendar clock (4.7C). These two functions take precedence over any other function except "scram". If a different function is being performed at the time of the clock signal, that function shall be interrupted, (1)and (2) performed, and the interrupted function resumed. A capability of at least 12 such interruptions should be provided.

4.6 DATA LOGGER (Continued)

A. Functions Performed (Continued)

3. Reactivity

The logger will determine the sub-critical reactivity of the reactor by two different methods, selectable by the operator. In one method the source generator, (4.3) shall be pulsed at the rate of about 100 times per second and the reactivity determined from the decay rate of the neutron flux between source pulses. This method shall be termed the pulse reactivity method. The input for the pulse reactivity shall be A $BF_3$ proportional counter. The chopper timing and storage equipment will be used, (2.5-A). The second method shall determine the reactivity by the inverse multiplication method, as a function of control rod position.

4. Control Rods

The position of all control rods shall be stored in the logger memory. A manual switch on the control console shall select which of the nine rods shall be displayed on the numerical readout.

5. Safety

The logger shall perform nuclear safety functions. As specified in 4.6-A(1) and (2), the logger shall check for reasonable operation of sensors, test itself for proper operation, test for on-scale, high-level, and fast-period trips. However, the logger does not perform the entire nuclear safety function, see (4.1-B-1).

6. Temperature

Thirty-two thermocouples for high temperature use and two RTD's for low temperature use shall be examined by the logger. In either case, the signal shall be digitized, corrected for zero and calibration error, compared with on-scale and high level trip points with an out-of-limit signal, if necessary, linearized, converted to engineering units, stored in memory, and the highest indicated temperature read out. This function shall be performed at the rate of one reading per second. The repeatable accuracy shall be $\leq$ .01$^{\circ}$C for the RTD at room temperature. The repeatable accuracy for thermocouples shall be 3/4% of reading at all temperatures. The capacity of the logger input multiplexer shall be expandable.

4.6 DATA LOGGER (Continued)

A. Functions Performed (Continued)

7. Neutron Chopper

The logger shall accept data from the neutron chopper facility via an auxiliary buffer storage device. Such data shall be corrected for calibration and energy discrimination errors, compensated for back-ground, and stored for read out on demand. (See 2.5-A).

8. Interlocks

The logger shall accept voltage levels representing proper operating conditions of all parts of the safety interlock system. The most recent set of levels shall be held in memory for read out.

9. It shall be possible to extensively modify the foregoing functions or add new functions by the use of an input typewriter. The typewriter shall also be used to change limit points and the value of constants. This typewriter may be the same typewriter specified under 4.6-B-1.

10. The logger and control equipment arrangement shall be such that automatic operation of the reactor may be implimented at a future date without modifying the logger except to add a minimum amount of equipment.

11. Other Functions

The logger shall perform such controlling and logging functions in the gas and electrical systems as may prove economical.

B. Data Logger Outputs

1. A typewriter shall provide the written record of information stored in the logger memory. The logger will read out to the typewriter on operator demand, and automatically if a scram or out-of-limit signal occurs. The normal read out will include the calendar time, the cause of scram or out-of-limit signal, the status of all interlock switches, the flux level and period values, the temperature, barometric pressure within the reactor, and rod position. Capability shall be provided to type out specially selected items. When these items are printed, calendar time shall also be indicated.

4.6 DATA LOGGER (Continued)

B. Data Logger Outputs (Continued)

2. Numerical displays shall be provided on the control console. These displays shall be rear projection type with characters approximately 5/8 inch. The quantities displayed shall be in decimal form and shall include an appropriate title and unit designation and shall be as follows:

   a. Level in watts expressed in four figures with variable decimal point.

   b. Period in seconds expressed in four figures with variable decimal point.

   c. Reactivity shall appear on the same display as period expressed as Keff for the pulse technique, or as predicted rod position in inches at critical.

   d. Deviation from the power level set point shall appear on the same display as reactor period.

   e. Rod position in inches with .001 inches as the least significant digit and a fixed decimal point. This readout shall also show which rod is being displayed.

   f. Temperature in degrees Centigrade expressed in four figures with variable decimal point. Both thermocouples and RTD shall use this display.

3. Two indicating meter readouts shall be provided on the control console. One shall read the power level in a logarithmic fashion covering total range of the logger. Minimum length of scale shall be 4-1/4 inch and meters shall be of the taut band suspension type. The other meter shall show period with infinity at about 20% of full scale.

4. One chart recorder shall read a selected temperature from the logger.

C. Basic Logger Specifications

1. The circuitry shall be all solid state plug-in modules with the exception only of indicator lamps.

2. The speed of the logger may be defined as the time required to extract and replace a word from memory. This time shall not exceed 10 microseconds.

3. The memory shall be ferrite core with the equivalent of 4096 words each 24 bits long. The capability to expand the memory to four times the number of words shall be wired in.

4.6 DATA LOGGER (Continued)

C. <u>Basic Logger Specifications</u> (Continued)

4. The input multiplexer and range switches shall use mercury wetted relays, and shall be under control of the logger. The contact arrangement shall allow differential input to the analog-to-digital converter.

5. In order to reduce noise and statistical variations on the signals, voltage to frequency converters shall be used as the digitizing element. This type of analog-to-digital converter allows the signal to be integrated between logger acquisitions. The input shall be differential with an input impedance of 10 megohms and a sensitivity of 5 millivolts full scale. The full scale frequency shall be 100 kc.

6. Sufficient buffer registers shall be provided such that the logger can read out to indicators and the typewriter without interference with the specified functions.

7. To ensure continuing reliable operation it shall be possible for the operator to rapidly test the logger operations under adverse or marginal conditions. If a malfunction is detected, it shall be possible for the operator or maintenance technician to locate the malfunction with the aid of a diagnostic routine put into the logger. To perform these necessary functions, the logger shall be equipped with a paper tape punch and reader.

8. The performance of all specified functions shall not require more than 30% of the logger operating time.

4.7 REACTOR CONTROL CONSOLE

A. <u>General</u>

1. The control console shall contain all necessary switches and indicators to operate the reactor from the least reactive condition to full power. This shall include all read outs from the logger, control rods and vertical rod drive switches and indicators, safety interlocks and bypass switches, communication equipment, neutron generator control, and basic heating and gas handling controls and indicators.

4.7 REACTOR CONTROL CONSOLE (Continued)

B. Indicators

The control console indicators shall be of three types:

1. Numerical read out shall be rear projection type with numerals approximately 5/8 inch size. There shall be five such read outs from the logger. Flux level, period, reactivity or deviation, temperature, and rod position shall be displayed. In addition, the calendar clock shall be displayed similarly.

2. Analog read out shall be by meters and three charts. The flux level and period shall be displayed as outlined in 4.6-B-3. Each control rod shall be provided with an appropriately sized meter to show percent travel. Two chart recorders shall show the power level of the auxiliary channels. The third chart recorder shall show a selected temperature.

3. Signal lights or annunciator lights shall be two-color rear illuminated type. Each item to be announced shall provide both an acceptable signal and out-of-limits (or not acceptable) signal, such that one or the other color shall be displayed at all times. The only exception shall be the signals for the vertical and horizontal rods. These shall be three-color to indicate in, out, and intermediate positions.

C. Clock

A calendar clock shall provide 0.1 second, 1 second, and 10 seconds pulses to the logger for proper timing of the period function. In addition, a digital word shall be supplied to the logger giving month, day, hour and minute. The calendar clock shall be driven by a tuning fork controlled oscillator with a stability of one part per million per week.

D. Hardware

All wiring and piping into the control room shall come up through the floor into the appropriate equipment. A large number of spare cables shall be provided. The following spare wiring shall be terminated in or near the control room: Fifteen spare coaxial cables, 30 pairs of spare control wires, 20 pairs T/C wires, and 20 pairs power leads (120 V) shall be provided from the reactor room; twenty coaxial cables, and ten pairs of control wires and five pairs of power leads (120 V) from the outside end of the fast chopper facility; five coaxial cables and ten pairs of control wires (120 V) from the reactor basement; and five coaxial cables and five pairs of control wires from the laboratory and counting

4.7 REACTOR CONTROL CONSOLE (Continued)

D. Hardware (Continued)

room each. (Several spare conduits shall be installed through all appropriate walls and floors for future wiring. All infrequently adjusted equipment shall be placed in the basement directly below the control room. Such equipment shall include line voltage regulators, isolation transformers and high voltage and low voltage power supplies. This basement location would be suitable for the termination of spare cables and the terminal box for telephones and intercom. The reactor operation switches shall be best quality, telephone type electric switches. Pushbuttons shall be snap action type. Selector switches shall be precision type such as manufactured by Daven or Shallcross.

E. Instrumentation Wiring

All instrument input AC power shall be furnished through double shielded isolation transformers located in each individual instrument. Primary shields shall be tied to the frame ground at one point. The frame ground shall be tied to the building ground. Secondary shields shall be tied to one instrument system common which shall be ungrounded and floating. In other words, all circuitry shall be floating and referenced to the instrument system common.

The isolation between the instrument system common and the frame ground shall be such that any single input or output lead may be shorted to the frame (or building ground) without affecting the accuracy of any other part of the instrumentation system.

Signal leads shall be shielded and placed such that the instrumentation accuracies stated shall not be exceeded for any normal electrical function in the entire facility.

This requirement shall hold for transient as well as steady state operation of electrical equipment.

In order to implement this requirement, several suggestions are offered below.

All signal cables shall be physically removed from power and control wireways. All low level signal cables shall be double shielding twisted pairs or coax as required, and carried in closed iron trays or conduits. A 00 bonding cable shall connect all sections of the conduits or trays to frame ground. The iron trays or conduits shall be continuous from the transmitters to the appropriate instrument rack.

4.8 PERSONNEL PROTECTION INSTRUMENTATION

The following personnel protection instrumentation shall be provided:

One alpha, beta, gamma sensitive hand and shoe counter.

# 5.0 REACTOR ELECTRICAL SYSTEMS

## 5.1 ELECTRICAL HEATING SYSTEM

### A. In-Pile Heating Elements

Sufficient heating elements shall be provided to heat the reactor as specified in Paragraph 2.1-C. Such a system is described below.

Each element shall be 8 feet long, 1/2 inch diameter and composed of nuclear grade graphite, supported as required by vitreous refractory mullite, ceramic insulation. The element terminals shall be graphite approximately 2 feet long, 2-1/2 inches in diameter, drilled to receive the heating elements. Mullite sleeves applied to the terminals (one on each end of the heating element) complete the assembly. These assemblies shall be placed in the 2-3/4" diameter (approx.) openings in the reactor graphite, in the pattern required to provide uniform heating as shown on Drawing SK-3-10605. Graphite jumpers shall be applied to connect a group of elements in series. Thirty-two elements will be required. Graphite connectors shall be used to penetrate the insulation surrounding the reactor at which point copper connectors are employed for connection to the external circuits.

### B. Power and Control System

Power shall be supplied to the heaters through saturable reactors with one saturable reactor for each series group of heaters. These reactors shall be controlled by amplified DC signals from conventional miniature electronic recorder controllers. A minimum of two recorder controller systems shall be employed to accomplish temperature control in the most economically feasible manner. One system shall be applied to those heating elements within the experimental core (to control two groups of elements) and the other system shall be applied to those elements in the remaining moderator block (to control six groups of elements). If groups of elements are controlled by a recorder controller, the output of the associated reactrol unit shall be amplified and distributed to the saturable reactor control circuits, through an adjustable voltage divider, one for each saturable reactor. The amplifiers and voltage dividers shall be located in and be adjustable from the control room. These recorder controllers shall measure temperature and provide control signals to accomplish the following:

1. Measure and control the heating element temperatures to allow them to approach, but not exceed, 1600°C during the reactor heat-up cycle. The objective is to permit shortest possible heating cycle time consistent with heater element capabilities. (See Paragraph 2.1-C) One spare set of T/C shall be provided for each control system. These spares shall be manually switchable at the controllers.

5.1 ELECTRICAL HEATING SYSTEM (Continued)

B. Power and Control System (Continued)

2. Measure reactor moderator temperatures at strategic points throughout the block and permit these measured temperatures to override the heating element control as the moderator approaches the required experimental temperatures and modulate heat input as required to maintain the desired temperatures within the moderator block.

3. Materials used in the devices for the measurement of temperature of the heating element shall be selected for prolonged life at high temperatures in the presence of graphite and nitrogen. A suggested design would be a tungsten - tungsten 26% rhenium thermocouple and ungrounded hot junction insulated with vitrified aluminum oxide or aluminum oxide and sheathed with molybdenum in the region where the control temperature exceeds 1200°C. After the sheath passes into the region below 1200°C it may be converted to less expensive stainless steel or inconel. The Aero Research Instrument Department of Advanced Technology Laboratory, Chicago, Illinois, offers such a design approach on their Drawing T-5301-L. More information may be obtained on this from Mr. John LaVon of that company.

5.2 CONTROL SYSTEM

A. Safety Circuit

The reactor safety circuit control signals shall come from the data logger logic output described under Section 4.6 - Data Logger and the following. These outputs shall be applied to initiate the tripping of the safety rods and the control rods as described.

Safety circuit logic shall be implemented with Nor-Nand Type diode transistor circuitry. There shall be two separate logic circuits operating in parallel. Each such circuit shall operate one part of the safety magnet amplifier. The two parts shall be effectively in series such that the failure of either in any way will not compromise the safety of the system.

Inputs shall be in the form of SPDT switch contacts or a voltage level corresponding to a logical true.

The nuclear safety circuit may be made up if all of the following items are true:

1. The logger is operating
2. The logger is on scale
3. The logger flux channels are not out-of-limits
4. The temperature is not out-of-limits

5.2 CONTROL SYSTEM (Continued)

A. Safety Circuit (Continued)

5. Two auxiliary channels are on-scale
6. Two auxiliary channels are not out-of-limits
7. Nuclear incident radiation is not out-of-limits
8. The gas circulation system is not out-of-limits
9. The electrical heating system is not out-of-limits
10. Manual scram switches are not operated
11. Shielding doors are closed
12. The keylock switch on the power to the safety magnet amplifiers is on
13. Safety circuit has been reset

In addition to the above trips, a manual trip pushbutton located in the control room and a lockout type scram switch inside the reactor room and basement, at the doors, shall be provided.

B. By-Pass and Permissive Control

The following by-pass logic shall be allowed:

1. The temperature and gas circulation system input may be by-passed if reactor is near room temperature and electrical heating power is shut-off.

2. The electrical heating system may be by-passed if the heating is off.

3. One of the two auxiliary channels may be by-passed.

4. A rod test by-pass shall be provided. This switch shall allow any single horizontal or vertical rod to move if all others are in. In addition, the doors may be open, the logger off, and the auxiliaries not on scale. The building radiation monitor must be on, and the auxiliary channels both on.

5. A by-pass switch shall be provided to permit fuel changing. This switch shall allow two vertical safety rods to be withdrawn, if all other rods are in. The doors may be open. The logger, building monitor, and at least one auxiliary must be unby-passed.

6. It shall not be possible to pull the horizontal rods unless all the verticals are out, except as noted under 4 above.

7. It shall not be possible to pull any vertical rod unless the horizontal rods are in.

8. The manual switches, and the keylock magnet switch shall not be by-passed.

9. A by-pass for the rod gas system.

5.2 CONTROL SYSTEM (Continued)

B. By-Pass and Permissive Control (Continued)

In order to raise vertical safety rods or pull control rods, the nuclear safety circuit must be made up. The by-pass switches shall by key locks separately keyed. These shall be located on the console with indicating lights to announce the status.

C. Interlock Circuits

Control interlock circuits shall be provided as follows:

1. Loss of Heat Exchanger Water

Closing of these sensor contacts shall stop the blower, cut-off the heaters, and scram the reactor.

2. Alpha Particulate Monitor

Closing of these sensor contacts shall stop the blower, cut-off the heaters, and scram the reactor.

3. $O_2$ or CO Monitor

Closing of these sensor contacts shall stop the blower, cut-off the heaters, and scram the reactor.

4. Moisture Monitor

Closing of these sensor contacts shall stop the blower, cut-off the heaters, cut-off the water, and scram the reactor.

5. Nuclear Incident Radiation Monitor

Closing of these sensor contacts shall stop the blower, cut-off the heaters, close the containment valve, and scram the reactor.

5.2 CONTROL SYSTEM (Continued)

D. Annunciator System

All scram signals shall be annunciated. The data logger shall identify the sequence of events and store the information for printout. The annunciator shall also signal the following conditions.

1. Building radiation system (3 points) on high level data logger information.
2. Hi moderator temperature ) Reactor Heating Systems
3. Hi heating element temperature )
4. Loss of flow of cooling water to the rod cooling gas heat exchanger
5. Hi outlet gas temperature (main heat exchanger)
6. Hi differential pressure across the main filter
7. Loss of flow of continuous gas purge system
8. Hi radiation level in the purge gas filter
9. Loss of gas sample analyzer system
10. Reactor or basement access doors open
11. Loss of concrete cooling water flow
12. $N_2$ low supply
13. Door seal loss of cooling water flow
14. Heater element terminal cooling water loss of flow
15. Gas blower bearing cooling water loss of flow

E. Auxiliary Alarm System

An alarm circuit shall be provided with horns in the reactor room and reactor basement. The horn shall sound for a 5 second interval when the safety circuit is made up, or if the safety circuit is tripped when rod test or fuel charge by-pass switches are on.

6.0 BUILDING ELECTRICAL SYSTEMS

6.1 ELECTRICAL SERVICES

A. General

Power to the building shall be supplied from an existing 2400 volt distribution substation located approximately 200 feet southwest of this new facility. Power shall be supplied to the outdoor, pad mounted, building supply transformer banks by underground cable from the substation.

B. Lighting

All building lighting shall be fluorescent except exit lighting and outside lighting. Levels of illumination shall be at least equal to the recommended values of the Illuminating Engineering Society - 1959 Recommendations. Battery powered emergency lights shall be provided for personnel egress in the event of power failure.

6.1 ELECTRICAL SERVICES (Continued)

B. Lighting (Continued)

Lighting voltage shall be 120 VAC and is to be supplied by dry type indoor transformers rated, 480 V to 120/208 V, 3 phase, 25 KVA or less.

Power to the control instrumentation shall be 120 VAC regulated to $\pm$ 1%. The regulation shall be by magnetic amplifiers. The harmonic content shall not exceed 3%. The regulation response time shall be .1 second or less. Service power to the control room, counting room and RMO Laboratory shall be supplied from separate instrument transformers.

C. Power

Power for the building services shall be furnished by a 500 KVA, 2400 V, 480/277 V transformer. Reactor control, instrumentation and power for other than reactor heating will also be furnished from this bank. Power for reactor heating shall be furnished by a transformer of appropriate rating. A more complete description of this system and other reactor services has been given in other parts of this criteria.

6.2 MISCELLANEOUS SYSTEMS

A. Communications

A telephone terminal cabinet of sufficient capacity to provide outlets in each office, the control room, experimental assembly room, reactor room, basement, instrument laboratory, counting room, and lunch room shall be installed. Outlets shall be provided at each of the above listed locations. A tie-in to the 300 Area telephone system shall be provided.

A 12-station master intercommunication system shall be supplied to provide direct communication between any two stations. A quick means of disconnect shall be provided for each intercommunication unit.

B. Audible Alarm Systems

Critical Radiation and Evacuation Alarms shall be provided in accordance with Hanford Engineering Standard HWS-8210-S. Also, a reactor "start-up" warning system shall be provided.

C. Operating Area Access Control

Door from stairwell to first floor shall be equipped with solenoid latches controlled from the control room. Arrangements shall be such as to permit visual identification of visitors from control room (window).

6.2 MISCELLANEOUS SYSTEMS (Continued)

D. Fire Detection

A master fire alarm box shall be provided external to the building and connect-to and be coordinated with the existing 300 Area fire alarm system. A rate of rise of temperature fire detection system shall be applied to the Control Room, the Reactor Room and its basement. A wet pipe fire sprinkler system shall be installed in the rest of the building. The detector system and pressure detector for the wet system should be compatible so an operation of either a detector or sprinkler head will cause an alarm to be registered locally and at the 300 Area Fire Station.

## 7.0 SITE PLANNING

### 7.1 GENERAL

The building site is south of the main 300 Area parking lot. The site is approximately 7 miles from Richland.

### 7.2 BUILDING FLOOR ELEVATION

The Architect-Engineer shall set the building floor elevation giving due consideration to adjacent building floor elevation sewer tie-ins, basement ramp, earthwork, and building aesthetics.

### 7.3 GRADING AND LANDSCAPING

A. The plot plan shall show the topography of the existing and finish grading. The portion of the site to be graded is that area shown bounded by existing new, and future roadways.

B. Top soil is required for that area shown on the plot plan as being planted in ground cover. The ground cover shall be "Vinca Minor". An underground sprinkler system shall be provided for this area. (See Piping, Paragraph 12.2-A-9).

### 7.4 ROADS, PARKING AREAS AND WALKS

A. Walks and curbs shall be constructed of concrete.

B. Roads and parking areas are to be asphaltic concrete as per Hanford Works Standards.

## 8.0 ARCHITECTURE

### 8.1 GENERAL

A. The building shall be designed in accordance with the requirements of the Uniform Building Code for F-2 occupancy, type IV construction. Use of combustible building materials should be avoided.

B. The building consists of three (3) primary areas: 1) reactor room, 2) service area, and 3) Beam chopper structure.

8.1 GENERAL (Continued)

C. The design shall create a building which is aesthetically pleasing and in harmony with existing area structures.

8.2 REACTOR ROOM

A. The reactor room walls, floor, and ceiling serve as personnel biological shielding and shall be constructed of ordinary concrete.

B. Exterior exposed concrete surfaces may be textured finished by textured form lining, etc., if the treatment is not more costly than that of achieving an F-3 concrete finish.

C. The two stepped access plugs in exterior reactor room walls shall be designed to effect an air-tight seal between the inside and outside. The plugs shall be removable only after unbolting or unlocking from the inside.

D. Air tightness of room (doors, penetrations, etc.) shall be such that ventilation system can economically provide the required negative pressure. (Reference Paragraph 11.3.2).

8.3 SERVICE AREA

A. The service area shall be steel frame construction with insulated metal siding. The floor shall be concrete.

B. Partitions may be concrete block, plaster, or gypsum wall board type. Use of wood or other combustibles shall be avoided.

8.4 BEAM CHOPPER BUILDING

The building may be of the pre-engineered pre-fabricated steel type. The structure need not be well insulated, heated, or cooled, but temperatures shall be maintained between limits of 60°F and 95°F. The structure in addition to housing the beam chopper assembly, will serve as a storage area.

8.5 PAINTING AND FINISHING

A. The reactor room floor shall be painted with a chemical and radiation resistant and decontamination coating. Walls and ceiling surfaces shall be painted with enamel.

B. The basement area, including space under the reactor room, shall have walls, floor, and ceiling with enamel. Exception - supply ventilation room need not be painted.

C. All other areas shall be painted for durability and ease of cleaning.

D. Concrete surfaces to be painted shall have F-3 and U-3 finishes except in reactor room, concrete and finish shall be F-4 and U-3.

8.6 FLOOR COVERING

A. Vinyl-asbestos tile shall be used on the floor in the second floor office area and corridor, and on the control room, change room, and laboratory, on the first floor.

B. Ceramic tile may be used around the restroom fixtures, particularly urinals and water closets.

8.7 DOORS AND HARDWARE

A. Pedestrian doors shall be flush hollow metal swinging type. Interior doors, except rest and change room and fire doors, shall have upper panel glazed.

B. Exterior service or vehicle doors in the assembly room and basement shall be electrically powered rolling doors.

C. Lock sets shall be of a design to accommodate a standard (1-1/8" diameter) Corbin cylinder.

D. Lock and keying requirements shall be as follows:

1. The exterior doors shall be noted as Key #1.
2. The following doors shall be keyed alike and noted as Key #2:
   a. Offices
   b. Counting room
   c. Exterior doors, except front and chopper building door.
3. The following doors shall be keyed alike and noted as Key #3:
   a. Control room (2)
   b. Reactor room elevation 0'-0" and elevation (-)13'-6"
   c. Exhaust and filter room
   d. Supply ventilation room
   e. Assembly room front door
4. The following door shall be noted as Key #4:
   a. Instrument and R.M.O. laboratory
5. The following door shall be noted as Key #5:
   a. Chopper building
6. All doors shall be operated by a master key. In addition, Keys #2, #3, and #4 shall operate doors with Key #1.

9.0 <u>STRUCTURAL, CRANE, AND SHIELDING DOORS</u>

9.1 GENERAL

The building shall be designed in accordance with HAPO approved codes as covered in HWS-10006 - Standard Design Criteria.

9.2 FLOOR LOADING

A. The second floor office area and first floor change room shall be designed for a loading of 80#/sq ft or a concentrated load of 3000 lbs upon any space 2-1/2 feet square wherever substitution of this concentrated loading produces stresses greater than the uniform loading.

B. The instrument and R.M.O. laboratory and control room floors shall be designed for a uniform live loading of 200 lbs/sq ft.

9.2 FLOOR LOADING (Continued)

C. The assembly and reactor room floors shall be designed for a live load of 250 lbs/sq ft. The floor area subjected to moving reactor core load - unload conditions shall be investigated for this loading. The load condition producing the greater stress be used as the basis for design.

9.3 FOUNDATION

The minimum depth to the bottom of foundation, except for stack, shall be 2'-6" from finish grade. The stack foundation shall be 4'-0" below finish grade.

9.4 EXHAUST STACK

A. The stack construction may be of mild steel. Design shall be in accordance with best current safe practices.

B. The top of the stack shall be 40 feet above the building first floor elevation.

C. Both interior and exterior surfaces of the stack shall be painted a weather and corrosion resistant coating.

9.5 CRANE

The crane shall be a five ton capacity bridge type and all movements shall be electrified and controlled with pendant type push-button control. A continuous variable control system with speed variation from zero to 15 ft/min shall be provided for all movements. The crane shall be of standard design but the selection shall consider the advantages of obtaining equipment with maximum hook coverage and maximum clearance to floor. The hoisting cable drives shall be reeved for straight vertical movement of the hook.

9.6 SHIELDING DOORS

A. The first floor cell shielding door shall be sliding type constructed of 3-foot thick ordinary concrete. The surfacing material may be carbon steel. The door shall be electrically power operated with provision for manual emergency operation. The door need not be provided with gas tight seals, but should be designed and constructed to limit cracks and openings.

B. The shielding doors leading into the basement space beneath the reactor shall be a pair of swinging doors constructed of press wood lamination and steel. The door overall thickness shall be 8", 6" of press wood and 2" of carbon steel. Press wood shall be the high density tempered type with specific gravity of not less than 1.42. Reduction of pinch-point hazards should be considered in selection of door operation method.

10.0 FURNISHINGS AND EQUIPMENT

10.1 GENERAL

The furnishings required are those necessary for the lunch room, rest rooms, lounge and change room.

10.2 LUNCH ROOM

Lunch room equipment may consist of a sink, base and wall cabinets, range, food warmer, refrigerator-freezer, blackboard (4' x 8'), exhaust hood, can opener, paper towel dispenser, and waste cans. Tables shall be 3 feet square with pedestal base. There shall be 16 metal framed chairs and four tables to serve 16 people. Tables shall have burn resistant plastic tops.

10.3 CHANGE AND REST ROOMS

A. Rest room fixtures should be wall hung type to facilitate cleaning. Toilet compartments shall be metal prefabricated type equipped with self-closing doors, rolled paper holder, and coat hook on back of door. Metal edged mirrors and 6" deep metal shelf shall be specified for over each lavatory. Sanitary napkin dispenser and disposal receptacle are required for the women's rest room. Rest rooms should contain soap dishes, paper towel dispensers and waste cans. Shower stalls shall be provided in the men's rest room.

B. Change room facilities include a minimum of 12 single tier lockers and pedestal base maple or birch benches. Clean clothes cabinets and shelving units approximately 18" deep by 3'-0" wide by 7' high with expanded metal screening across two shelves forming shoe cover bins. A soiled clothes hamper shall be provided.

10.4 JANITOR CLOSET

Provide service sink, steel shelving for supplies, and hooks to hang up brooms and mops.

10.5 FIRE EXTINGUISHERS

Carbon dioxide fire extinguishers shall be installed at locations and size to be determined by General Electric Company at a later date.

11.0 HEATING, VENTILATING AND AIR CONDITIONING

11.1 GENERAL

A. Scope

These criteria shall be used as a basis of design of the heating, ventilating and air conditioning for the HTLTR. The design shall provide a system capable of heat removal during the different modes of reactor operation. This system shall also be capable of preventing the spread of any radioactive contamination within the building or to the surrounding area.

These criteria will include specific recommendations for both the supply and exhaust systems, since it is difficult to explain a system. The recommendations contained herein represent proven techniques deserving special merit for this application. Alternate methods must be analyzed fully and established as superior to the recommendations presented in these criteria.

## 11.2 DESIGN TEMPERATURE

### A. Outside Design Temperature

The outside design temperatures for summer and winter conditions shall be as recommended in Hanford Design Guide DG-105-M, Weather Data for Heating and Cooling Load Estimation.

### B. Inside Design Temperatures

The inside design temperatures which have been selected from the effective temperature chart "ASHRAE Comfort Chart for Still Air" shall be as specified below:

1. Summer Inside - Evaporative Cooling

For personnel comfort in continuously occupied space, design conditions shall be as follows:

Effective Temperature: 75°ET
Corresponding equivalent design temperatures:
Dry Bulb Temperature: 80°F
Relative Humidity: 60% (random)

2. Winter Inside Temperature

The winter inside design temperature for personnel comfort shall produce an equivalent temperature of 67-68°F with a suggested dry bulb temperature of 75°F.

3. Chilled Glycol Cooling

Chilled glycol cooling shall be used for equipment cooling and for air conditioning the Control Room, Instrument and RMO Laboratory, the Counting Room and Experimental Assembly Room. The design conditions shall be as follows:

| | |
|---|---|
| Dry Bulb Temperature | 75° F ± 2° |
| Relative Humidity | 45% ± 5% |

The emergency glycol cooling coils included in the reactor room supply system shall be capable of cooling 7000 CFM of emergency air to 50°F and shall be equipped to automatically start operating on a reactor emergency shutdown. It will be necessary to shut down the washer pumps during a reactor emergency in order to gain full effectiveness of the cooling from the glycol coils.

11.2 DESIGN TEMPERATURE (Continued)

C. Calculations

For the above design loads calculations shall be made in accordance with ASHRAE cooling loads using temperature data from Hanford Design Guide No. DG-105-M, where applicable.

In calculating the requirements of the evaporative cooling system for the normal supply to the reactor room, use 103°F dry bulb and 67°F wet bulb from DG-105-M and 95% adiabatic efficiency for central station air washers for selection of the equipment.

For the chilled glycol system, the maximum proportion (10% to 25% make-up air) shall be calculated at the 103°F dry bulb temperature inlet.

The particular rooms requiring cooling will have extensive heat generating instruments and equipment which shall be included along with the maximum occupancy for determining the total cooling load.

11.3 SYSTEM DESCRIPTION

A. General

The High Temperature Lattice Test Reactor needs ventilation and air conditioning on a year-around basis. The design must satisfy the combination of unusual problems and system demands, therefore, the system must be capable of providing ventilation air for the various modes of reactor operation, provide a suitable atmosphere and reasonably correct temperature to guarantee a long life and low maintenance for the control and instrumentation complex needed for the reactor and its service systems. The aspects of personnel comfort will integrate with the above requirements to provide satisfactory occupancy for this facility.

The primary criteria for this facility is to provide a system with the integral versatility to meet all operating modes as follows:

1. Reactor Room and Basement

a. Ventilation for normal personnel occupation for setting up moderator and fueling for a specific experiment. Personnel occupancy would be a maximum of twenty (20).

b. Ventilation during reactor operation when high heat removal will be required, and high efficiency filtration is not required.

c. Ventilation for personnel protection and equipment cooling when changes are made to an open reactor at 300°C.

d. Radioactive contamination filtration during containment and protection of this facility and the surrounding laboratory areas.

11.3 SYSTEM DESCRIPTION (Continued)

A. General (Continued)

2. Service Building Area

The principal function of the system for this section of the facility would be to provide air conditioning, cooling and heating the facility as follows:

a. Provide air cooling for the reactor room during an emergency operating condition.

b. Provide air conditioning requirements for the protection and stable operation of the control and instrumentation systems.

c. Provide adequate ventilation for the personnel occupying the service building office and work spaces.

B. Supply System

1. Reactor Room and Basement

Air conditioning in this section of the facility can best be accomplished by adiabatic evaporative cooling during normal reactor operation. However, during a possible radiation incident operating condition, it will be necessary to maintain a low flow of make-up air (7000 CFM) that has been cooled through chilled glycol coils installed in the evaporative system. In the case of an emergency of this type, the washer pumps shall be shut down automatically and the chilled glycol circulated through the coils to cool the minimum amount of air during this time. During an emergency the exhaust air requires high efficiency filtration before passing out the stack, and supply flow shall be restricted to 7000 CFM maximum. (Control is as defined under 11.3 D).

The equipment required to perform this ventilation function includes the following items:

a. Inlet louvers
b. Preheater
c. Filter
d. Air washer and eliminator
e. Supply fan
f. Reheater and cooling coils
g. Control damper

11.3 SYSTEM DESCRIPTION (Continued)

B. Supply System (Continued)

2. Service Building

The ventilation requirements for this section of the building are to be designed around a system which will protect the delicate instruments and control devices located in the control room, the counting room, the RMO laboratory, instrument and experimental assembly room. The instrumentation systems of the HTLTR use semiconductor elements and their reliability function is dependent upon correct temperature and humidity control. Therefore, the ambient control room temperature shall not exceed 77°F and the relative humidity shall not exceed 50% under any foreseeable weather conditions.

The system used to provide air conditioning for areas described in above paragraph shall be capable of controlling the temperature at 75°F ± 2°F maintaining relative humidity at a low of 40% RH. Some type of air conditioning will be required for all other areas of the service building to provide reasonable personnel comfort. It may be economical to provide a chilled glycol system for the entire service building since there will be some reactor emergency cooling capacity available during normal reactor operation that could be diverted for use in the office area.

The determination of the overall air conditioning system for the service building will be made when final design is underway and the various possible alternates can be evaluated in more detail with respect to their capital cost and operating integration.

C. Exhaust System

The main exhaust system serves the reactor section of the building and shall be designed to provide a slightly negative pressure within the reactor room and basement to preclude the possibility of uncontrolled out-leakage from the reactor facility.

The supply air shall be introduced into the reactor room near the ceiling and exhausted through floor gratings into the basement and thence through additional basement floor gratings into the exhaust ducts located under the basement floor slab.

The ventilation off-gas then passes through the fan and direct to the exhaust stack under normal operating conditions. In an emergency situation where radioactive particulate matter may have escaped in the reactor, reactor room, or basement, the containment valve on the exhaust duct shall automatically close thereby by-passing a 7000 CFM flow of ventilation air through the high efficiency filter.

11.3 SYSTEM DESCRIPTION (Continued)

C. Exhaust System (Continued)

The exhaust system shall be designed to provide the protections listed above in order to provide adequate safeguards for personnel protection in the surrounding area as well as within the building.

The equipment required to perform all the above functions would be a duct system, fan, containment valve, by-pass filter and a stack 40 feet in height.

D. Motorized Inlet Damper

The reactor room will require a motorized damper in the supply ducts to control the air flow through the reactor building during normal operations. A negative pressure in the reactor room shall be controlled at 1/8" column of water based on an atmospheric reference of outside barometric pressure. This damper shall also be capable of controlling the negative building pressure during an incident emergency.

E. Containment Valve

The containment valve shown on Drawing SK-3-10403 is a standard butterfly valve equipped with a normally energized latching solenoid for holding the valve open and fitted with a weight arm for closing the valve upon an electrical failure signal from the radiation detection instrumentation. When the emergency condition has been corrected the containment valve will be reset manually.

F. Exhaust System Filter

When a radiation incident detection is determined in the gas circulating system the exhaust system containment valve automatically closes and passes the minimum amount (7000 CFM) of ventilation off-gas through an high efficiency filter to the stack.

This filter shall be designed for the total by-pass flow and for removal of micron size particles at 98% efficiency. The maintenance of this filter can be accomplished by contact work and needs no remotely removable elements.

G. Office Heating

The heating system for the office section of the service building shall be designed to be accomplished with low pressure steam supplied from the building steam mains, with sufficient zone control to maintain temperatures within specified limits.

## 12.0 PIPING SERVICES

### 12.1 GENERAL

These criteria shall be used as the basis for the design of the various piping systems required for services to the HTLTR. The services provided shall include those listed below.

1. Sanitary water (includes process water)
2. Fire protection water
3. Steam and condensate
4. Compressed air
5. Nitrogen gas
6. Sanitary sewer
7. Process sewer
8. Underground sprinkler

The plot plan (Drawing No. SK-3-10443) shows the proposed layout and point of service supply.

### 12.2 SERVICES DESCRIPTION

#### A. Underground Piping Services

1. General

The underground piping services shall connect to the 300 Area utility system except for those systems which will be provided as a part of the facility equipment, for example: nitrogen gas. All other systems will be connected to the utility system at locations shown on Drawing No. SK-3-10443.

2. Sanitary Water

The sanitary water piping shall be supplied from the 300 Area water system and shall be piped to the building in cast iron pipe with bell and spigot or mechanical joints.

The incoming sanitary water system shall be sized for distribution of all hot and cold sanitary water, and all process water services within the facility. This system shall include a post indicating valve near the utility connection.

3. Fire Protection Water

The fire protection water underground service shall be supplied by a separate and exclusive connection to the 300 Area underground sanitary water utility system. The line shall be cast iron with bell and spigot or mechanical joints. This system shall be sized to supply the hydrants, the automatic sprinkler system and fire hose racks in the building. This underground system shall contain a post indicator valve near the utility system take-off point.

12.2 SERVICES DESCRIPTION (Continued)

A. Underground Piping Services

4. Steam and Condensate

Underground steam and condensate line shall be provided for connection to the 300 Area underground steam and condensate utility extensions. The steam lines shall be insulated in sealed conduit jackets or with impervious unjacketed material. The condensate lines shall only be insulated against freezing when necessary.

Adequate supports and provisions for thermal expansion shall be designed into the underground system. The steam piping shall be steel with welded connections except where flanges are needed for servicing the system or installation of valves. The steam lines shall be trap drained at entry into the building. These systems shall contain adequate valving within access boxes for adequate control and access for maintaining the system.

The condensate system may require a pump to return the condensate to the 300 Area system. The condensate system shall be piped with Schedule 80 wrought iron pipe.

5. Compressed Air

An underground supply line for compressed air shall connect to the existing 300 Area system shown on SK-3-10443 and shall be fabricated of steel pipe with outside treatment for corrosion prevention. A box and service valve shall be located near the take-off point.

6. Nitrogen Gas

Nitrogen gas piping shall be rated for the operating pressure and underground portions shall be protected as specified for the compressed air system.

7. Sanitary Sewer

An underground sanitary building sewer shall be provided for connection to the 300 Area sanitary sewer extension. The sanitary sewer shall be of concrete pipe not less than 6" in diameter.

8. Process Sewer

An underground process sewer shall be provided for connection to the 300 Area process sewer extension. Due to the invert elevation of the 300 Area process sewer, a lift station may be required to elevate the process wastes from the basement to the sewer extensions. If a lift pump is used, a installed spare pump shall be provided. The process sewer shall be vitrified clay pipe with acid and base resistant joints. Process sewer lift pumps shall be constructed of corrosion resistant materials.

12.2 SERVICES DESCRIPTION (Continued)

A. Underground Piping Services (Continued)

9. Underground Sprinkler System

An underground sprinkler system shall be installed to provide sectionalized means of irrigating the planted areas surrounding the HTLTR facility. The water service is to be taken from service water mains. The system shall be designed of corrosion resistant plastic pipe of adequate capacity and pressure rating to serve the purposes intended for the system. The individual spray distributing heads may be selected from standard manufactured products.

10. Encasements

The underground service piping shall be fully encased at roadway crossings or other locations of significant surface loadings. Encasements shall be structurally adequate to essentially free the cased pipe or surface induced loadings.

B. Building Services

1. General

The building service piping shall be distributed from neatly run mains. In general, these mains will be located near the ceiling of the basement with risers or laterals serving the point of utilization. The laterals for potable water shall be run in galvanized pipe.

2. Sanitary Hot and Cold Water

The sanitary water for building service shall be supplied from the underground sanitary service main. If necessary, a pressure reduction station shall be included to reduce the service pressure to 50 psig. The sanitary water system shall be limited for use in restrooms, drinking fountains, laboratory service and air washer supply. Hot sanitary water for the restrooms and lunchroom shall be heated in an electric heater storage tank (ASME Codes, if applicable). No unprotected cross connections shall exist between the sanitary water system and any other piping service. The hot water storage tank shall be equipped with a liquid relief valve set at 55 psig in addition to the code-required pressure-temperature relief valve.

12.2 SERVICES DESCRIPTION (Continued)

B. Building Services (Continued)

3. Process Cold Water

Process water for this facility shall be supplied from the underground sanitary main through a double check valve and a vacuum breaker. The process water system shall supply all water for the process operation and shall provide protection from contamination for the sanitary water system.

Conventional air-gap practices will be observed between process water and waste connections; however, process water may be connected directly (without air-gap or vacuum breaker protection) to equipment inlet points; provided that outlet points are connected with an air-gap at the waste connection. This case only applies to services that cannot possibly contaminate the potable water supply. Protected process water shall be provided for all areas containing radioactive products or gases. This system shall contain a vented supply tank or concrete vault, air-gap, float valve and distribution pump.

4. Fire Protection Water

Fire protection water in the building shall be supplied from the underground fire water service without intermediate valves. The fire protection water will be supplied to the fire hose racks and the fire alarm valve for the automatic interior sprinkler system. Each fire hose shall be limited to 50 feet in length.

5. Sanitary Waste and Vent

Interior building service for waste and vent of restroom fixtures, drinking fountain and air conditioning system washer shall be provided. Sanitary waste shall be discharged to the underground sanitary sewer. Basement fixtures not having solids discharge, such as drinking fountains, may be discharged into the process sewer provided they are equipped with an air-gap to drain.

6. Steam Building Service

The 125 psig building service steam will connect the underground steam system to a primary steam pressure reduction station from which all other building steam supply system will originate.

The primary reduction station should reduce the steam pressure from 125 psig to 30 psig. The secondary system shall be equipped with safety relief valves set at 40 psig. This system piping shall comply with ASA Standard Piping Code requirements.

12.2 SERVICES DESCRIPTION (Continued)

B. Building Services (Continued)

6. Steam Building Service (Continued)

The 30 psig building service steam should be distributed to the control system for the preheat and reheat coils for the reactor room ventilation system, also to the heat exchangers for other systems in the service building area.

The various systems of the HTLTR require a reducing station for generating a service pressure of 15 psig. In this case the system should be designed for a minimum pressure of 40 psig and in accordance with ASA Code requirements.

7. Steam Condensate

Condensate drains in the building should discharge into a vented gravity condensate system. A condensate collection tank and pump may be required to return the condensate to the 300 Area underground condensate return system.

The piping for the condensate system shall be Schedule 80 wrought iron pipe.

8. Compressed Air System

General purpose compressed air at 90 psig will be distributed to serve the various process and laboratory requirements and the instrument air supply.

The instrument air system shall consist of a storage receiver (ASME Coded) connected to the supply system, a regenerative pressure air dryer, filters (ASME Coded) and shall be capable of reducing the free air dew point to minus 45°F, a dual stage pressure reducing station set at the pressure required for servicing the instrumentation systems.

The piping distribution system for the compressed air shall meet the requirements of ASA Code.

9. Nitrogen Gas System

The nitrogen gas system is principally regulated in size and design by the temperature of the process operation. The materials, pressure and temperature rating will be made at the time of detail design to assure a safe and operable facility.

# 13.0 INSTRUCTIONS TO ARCHITECT-ENGINEER

## 13.1 CODES, STANDARDS AND GUIDES

### A. General

Hanford Standards take precedence over all other codes and standards and shall be used where applicable in all design. They are prepared for direct and specific reference in the design drawings and specifications and those referenced will be reproduced and become an integral part of the construction contract drawings and specifications. The Hanford Standards shall not be referenced as a total package.

### B. Hanford Standards

1. HWS-10000 - Architect Civil Standards
2. HWS-10001 - Safety - Mechanical Standards
3. HWS-10002 - Electrical Standards
4. HWS-10003 - Guides, Vol. 1 and Vol. 2
5. HWS-10004 - Welding Standards
6. HWS-10005 - Instrument Standards
7. HWS-10006 - Standard Design Criteria

### C. Industrial Codes and Standards

1. Codes as Sources of Specifications for Materials

   a. American Society for Testing Materials, ASTM Standards including Tentatives.
   b. American Standards Association (ASA), American Standards.
   c. Federal Specifications

2. Safety and Fire Protection Codes

   a. National Fire Protection Association (NFPA), National Fire Codes.

   The following is a partial listing of the American Standards Association's American Safety Standards. Listing of these Standards does not preclude the use of other American Safety Standards where applicable:

   b. American Standard Safety Code for Building Construction, ASA A10.2.
   c. American Standard Safety Coee for Floor and Wall Openings, Railings, and Toe Boards, ASA A12.
   d. American Standard Safety Code for Mechanical Refrigeration, ASA B9.1.
   e. American Standard Safety Code for Mechanical Power - Transmission Apparatus, ASA B15.1.
   f. American Standard Safety Code for Compressed Air Machinery and Equipment, ASA B19.

13.1 CODES, STANDARDS AND GUIDES (Continued)

C. Industrial Codes and Standards (Continued)

2. Safety and Fire Protection Codes (Continued)

g. American Standard Safety Code for Cranes, Derricks, and Hoists, ASA B30.2.
h. The Electrical Overhead Crane Institute, Inc. Specification #49 for standard industrial service - Electrical Overhead Traveling Cranes, 1949 Edition.
i. American Standard Safety Color Code for Marking Physical Hazards and Identification of Certain Equipment, ASA A53.1.

3. Electrical Codes

a. National Bureau of Standards, National Electrical Safety Code, Handbook II 30.
b. National Bureau of Standards, Installation and Maintenance of Electric Supply and Communication Lines - Safety Rules and Discussion, Handbook II 43.
c. National Fire Protection Association (NFPA) Publications:
   (1) No. 70, National Electrical Code
   (2) No. 72 and 73, Fire Alarm Systems
   (3) No. 77, Static Electricity
   (4) No. 78, Code for Protection Against Lightning
d. American Institute of Electrical Engineers (AIEE) Standards and Recommended Practices.
e. Electrónic Industries Association (EIA) Standards
f. Illuminating Engineering Society (IES) Standards and Lighting Handbook
g. Insulated Power Cable Engineers Association (IPCEA) Standards.
h. National Electrical Manufacturers Association (NEMA) Standards.

4. Mechanical Codes

a. American Society of Mechanical Engineers, ASME Boiler and Pressure Vessel Code.
b. American Standards Association, American Standard Code for Pressure Piping, ASA B31.1.
c. American Standards Association, American Standard National Plumbing Code, ASA A40.8.
d. Air-Conditioning and Refrigeration Institute (ARI) Standards.
e. Air Moving and Conditioning Association (AMCA) Standards and Test Codes.
f. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Standard Codes.

13.1 CODES, STANDARDS AND GUIDES (Continued)

C. Industrial Codes and Standards (Continued)

5. Building Codes

a. The Pacific Coast Building Officials Conference, "Uniform Building Code," Volume I and III.
b. American Concrete Institute (ACI) Standards.
c. American Institute of Steel Construction (AISC), "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," ASA A57.1.
d. American Iron and Steel Institute (AISI) "Light Gage Steel Design Manual".
e. American Standards Association (ASA) American Standard Building Code Requirements for Masonry, ASA A41.1.
f. American Welding Society (AWS) Code for Arc and Gas Welding in Building Construction.
g. Steel Joist Institute, Standard Specifications for Open Web Steel Joist Construction, ASA A87.1.

6. Other Codes

a. American Water Works Association (AWWA) Standard Specifications.
b. Instrument Society of America (ISA) Recommended Practices.

D. Code Certification

1. Pressure Vessels

ASME Code regulations for vessels require that formal code documentation shall be available for each vessel and submitted to the responsible Project Engineer, General Electric Company.

2. Piping Systems

Piping systems falling within the ASA Code shall comply with its regulations. Documentation of each completed system shall be prepared and submitted to the responsible Project Engineer, General Electric Company.

The documentation forms in use at Hanford are the "Pressure Piping Completion Record" (Sample included in Appendix). This record certifies that the materials, fabrication techniques and tests used comply with the applicable code. The major elements of the documentation content are as follows:

a. Code approved weld procedures for field fabrication.
b. Welder qualification tests and the identification of the welds on the fabricated piping.
c. Identification of the materials used in the respective piping systems.
d. Inspection of the fabrication, testing and joint x-ray of the systems requiring a code installation.

13.1 CODES, STANDARDS AND GUIDES (Continued)

D. Code Certification (Continued)

2. Piping Systems (Continued)

The above documents must be prepared and submitted to the General Electric Company for use in the Third Party Inspection of the process facility prior to the operation of code piping systems. Further, the design of Code systems shall be submitted to the General Electric Company for approval by the Third Party Inspection prior to the start of construction.

E. Hanford Design Guides, HWS-10003, Vol. I and II

Hanford Design Guides are not mandatory for compliance but are intended to indicate a preferred and acceptable design basis.

13.2 MATERIALS AND EQUIPMENT

A. Specifications

Materials and equipment shall be specified, when practical, by means of a functional type description or nationally recognized standard specification such as Federal Specifications, ASTM, ASA, NEMA, etc., to obtain maximum free competition. If a national recognized standard specification is not available or preparation of a functional specification is impractical, two or more brand names may be used, followed by the term "or approved equal."

B. Identification of Equipment

The Architect-Engineer shall include in the specifications the following as the contractor's responsibility:

> "Each piece of equipment, mechanical or otherwise, which is identified in the construction or equipment specification by an Equipment Piece Number (EPN) shall be plainly marked by the manufacturer with that number. Wherever possible, the number shall be stenciled on the item in numerals not less than 1" high using oil base paint. Where stenciling is impracticable, the number shall be stamped on a metal tag securely fastened to the item (not cemented or glued). In all cases the letters EPN shall precede numerals."

A block of Equipment Piece Numbers will be assigned to the Architect-Engineer by the Commission.

## 13.3 SHOP DRAWINGS, MAINTENANCE INSTRUCTIONS, ETC.

A. The Architect-Engineer shall state in the specifications what shop drawings and other information is required to be furnished by the contractor, in accordance with the following:

1. Approval Data

When necessary to the engineering of acceptable facilities the contractor shall submit for approval by the Commission five (5) copies or one set of reproducibles of fabrication and shop drawings, circuit diagrams, performance data, installation instructions and similar data necessary to prove the acceptability of the proposed materials or equipment and for integration into the design of the total facility. All data must be approved by the Commission before material or equipment is shipped or fabrication is started.

2. Certified Data

The designer shall require that the construction contractor submit certified data for operating equipment and for all items for which approval data was requested and deemed necessary. The material shall include operating and maintenance instructions, parts lists, circuit diagrams, performance data, dimensional drawings and similar information necessary for the operation and maintenance of the equipment. Five (5) sets or one (1) reproducible set of the required information shall be furnished for each equipment item or structure. Each set of bulletins and data sheets shall be furnished in individual paper envelopes approximately 9 x 12 inches. The following information shall be prominently displayed on each envelope:

Project Number
Project Title
Contract Number
Equipment Piece Number
Name of Equipment
Purchaser's Name
Order Number
Certified Vendor's Information (CVI No. _____)

## 13.4 PREPARATION OF DRAWINGS

A. General

1. Drawing symbols and their use shall be in accordance with the American Standards Association Standards for Graphical Symbols (Y32 and Z32 series) supplemented by specific Hanford Drafting Symbols furnished by the Commission in the Booklet of Drafting Practices.

13.4 PREPARATION OF DRAWINGS (Continued)

A. General (Continued)

2. Generally, Hanford Standard drawings can be most economically used by direct reference. They are intended to be used in this manner.

3. All drawings shall be prepared so that they are clearly legible when reduced 50% photographically. The drawing requirements for 50% reduction are:

   a. All drawings shall be based on a minimum scale of 1/4" per foot.
   b. All lettering shall be a minimum of 1/8" high. Figures and letters shall be full, approximately as wide as they are high. Narrow or compressed letters will "fill in" and become illegible.
   c. Notes typed with elite or pica style typewriters shall not be used on drawings. Typewritten notes shall be used only if all letters are open and 1/8" high, minimum.
   d. Parallel lines shall be spaced at least 3/64" apart so that fill-in will not occur during reduction.
   e. All lettering, lines, dimension lines, etc., should be uniformly dark. Lines or lettering which are grayish or light will disappear or be only partially reproduced.

4. The scope of information on individual drawings should be restricted as reasonably practical to separate general subjects to minimize the need for multiple use of Numerical Index Numbers on any one drawing.

B. Final Design Drawings

The Architect-Engineer shall approve his final drawings and forward seven (7) sets of prints, together with the tracings or approved reproducibles, for Commission approval. Each print furnished by the Architect-Engineer shall bear a Professional Engineer's license stamp.

Final drawings shall be prepared on white tracing film furnished by the Commission, size 28" x 40". The title block on each sheet shall bear the project title, drawing index, and building and project numbers. The drawing number space shall be used for the assigned Commission drawing number. Each sheet shall have a separate number; page numbers shall not be used. Blanks for "Sheet No." should not be used.

All drawings shall be penciled using plastic lead.

13.4 PREPARATION OF DRAWINGS (Continued)

B. Final Design Drawing (Continued)

A drawing schedule shall be prepared listing all drawings and specifications by number and title. The drawing schedule is usually on the sheet with the first of the assigned drawing numbers or combined with the Project Title Drawing.

All drawings shall carry complete reference, both on the drawing proper and in the space provided near the title block for reference drawings, to all immediately related drawings, the "Next Used On" drawing number, and the drawing index. The detail and section number system shall cross reference the effected drawings.

The Architect-Engineer shall furnish with the final drawings a list of all HW Standard drawings and specifications used (by reference) in the design drawings and specifications.

13.5 PREPARATION OF SPECIFICATIONS

A. Purchase Specifications - Engineered Equipment

In the early stages of design the Architect-Engineer shall prepare purchase specifications and drawings related to the procurement of engineered equipment or long-delivery items which will be needed to maintain continuity of project construction scheduling. These items will be purchased by the Commission and will not be included in the Construction Contract for the facility.

A survey should be initiated during the early stages of design to seek all items of this nature and schedule the design and procurement to meet the overall project schedule.

A partial list of items representing examples in various categories of the HTLTR is as follows:

1. Data logger and associated equipment
2. Nuclear Instrumentation
3. Gas System instrumentation
4. High temperature metals and ceramics
5. Heat Exchangers
6. Hot gas filter
7. Control Valves
8. Graphite Machining details
9. Control and Safety Rods
10. Electrical heaters and control system
11. Gas Blower

13.5 PREPARATION OF SPECIFICATIONS (Continued)

B. Construction Specifications

Construction specifications shall be prepared covering the work, materials, and equipment. The specifications shall also include the requirements for workmanship, and functional testing for construction contracts.

The purpose of construction specifications is to define the facility requirements and performance, and indicate the quality of materials and workmanship required. These are technical specifications for the purpose of construction, and contractual matters shall be excluded. However, it shall be the responsibility of the Architect-Engineer to inform those concerned of any unusual items which should be included in the Special Conditions of the contract.

C. Specification Acceptance Test Procedures

The specifications or ATP's (paragraph 13.7) shall require functional testing of facilities installed under a contract. The specifications shall describe, briefly and specifically, the tests required to demonstrate that a new installation functions correctly as shown on the drawings and specifications.

Functional testing includes, but is not limited to, such items as:

1. Hydrostatic and leak testing of pipe lines, basins, and tanks.
2. Simple operating tests of valves, instruments, electrical motors, automatic equipment, system continuity, system integrity, etc., to demonstrate that all components will work freely, water flows, lights turn on, motors turn in the proper direction, automatic equipment operates properly in response to the appropriate signal, etc.
3. Line continuity testing.
4. Heat runs on motors, and motor driven equipment.
5. Proper balancing of ventilating systems and operational testing as prescribed by the design capacity.

D. Preparation of Specifications

Specifications shall be prepared on masters suitable for multilith type reproduction on medium or long run masters.

E. Reproduction of Specifications

Specifications shall be prepared for reproduction on 8-1/2" x 11" size sheets. Each specification shall have a combination title and approval sheet, and a table of contents sheet. The specification number will be provided to the A-E and shall appear on the approval sheet, the table of contents sheet, and on the upper right hand corner of each other page of the specifications.

13.5 PREPARATION OF SPECIFICATIONS (Continued)

F. Approval Sheet

An example of approval sheet and a typical specification page showing the preferred paragraph numbering system are shown in the Appendix.

13.6 ASSIGNMENT OF SPECIFICATION AND DRAWING NUMBERS, EQUIPMENT PIECE NUMBERS, ETC.

A. A block of numbers for drawings, specifications, and ATP's will be furnished to the Architect-Engineer by the Commission.

B. The list of Drawing Index Numbers will be furnished to the Architect-Engineer by the Commission.

C. The Certified Vendor's Information Numbers (CVI No's.) will be assigned to the data by the Blue Print File after the Architect-Engineer's approval of information to be filed.

13.7 ACCEPTANCE TEST PROCEDURES

A. Definition

An Acceptance Test Procedure differs from construction specification statements for functional testing in that it is prepared as a separate document which includes tests explained in the construction specification. Similar in form to a specification, an ATP outlines the steps to be followed by the Construction Contractor in demonstrating the acceptability of a new installation. The Acceptance Test Procedure form describes in detail the test to be performed and provides blank spaces for the insertion of the actual test results, and signature sheets for witnessing and approving the tests. The ATP must clearly establish who will conduct and record the tests and what special services, if any, will be offered by others.

Acceptance Test Procedures are required for the complete heating and ventilating system, all control and instrumentation systems, reactor heating and cooling system, fire alarm and sprinkler system, process equipment and systems as required by the Architect-Engineer.

B. Special Services

Where facilities to be given an acceptance test require the use of test equipment, the equipment shall be furnished by the contractor. The Commission reserves the right to check the calibration and accuracy of test equipment.

13.7 ACCEPTANCE TEST PROCEDURES (Continued)

C. Preparation

ATP's may be combined with the construction specifications or issued as separately numbered documents. Final ATP's shall be prepared on masters for reproduction using the multilith process (medium or long run masters) and submitted for approval. Each ATP shall have a combination title and approval sheet with blank spaces for approval of the procedures, witnessing of the test, and approval and acceptance of the system being tested. Final ATP's shall bear signatures of the Architect-Engineer where appropriate. An example of an Acceptance Test Procedure Approval Sheet is included in the Appendix.

13.8 SPECIAL BUILDING CLEANLINESS REQUIREMENTS

The construction specifications shall relate the requirements of the contractor to perform special building and reactor cleanliness requirements to assure the completed reactor and control systems shall be free of any contaminants or hindrances to a safe and dependable operation of the facility.

During construction the reactor room, its basement and the control room shall become areas requiring cleanliness procedures to prevent foreign material from being deposited in the reactor process.

The timing of the institution of the procedure for cleanliness requirements shall also be defined in the specifications and shall be at a time when the reactor shell is essentially completed and the reactor is ready for cleanup and stacking of graphite. The control room may require earlier initiation of the cleanliness procedure.

The cleanliness procedure must be defined in a manner of measurable terms which shall be on the basis of commercial practices for reactor construction.

# APPENDIX

## SECTION I

Sample of Specifications

## SECTION II

Sample of Acceptance Test Procedure

## SECTION III

Sample Purchase Specification Attachments

## SECTION IV

Sample Piping Completion Record - Heat Exchanger Data Sheet

APPENDIX - SECTION I

SAMPLE SPECIFICATION APPROVAL SHEET

*(Supplement, if such is the case) No. _____ to

HWS-____

SPECIFICATIONS

FOR

(Title, include Bldg. No. where applicable) ______________________

Project No. ______________________

Original Issue Date ______________________

(Rev. No. and date or supplement date, if such is the case) __________

THIS SAMPLE SPECIFICATION APPROVAL SHEET IS A GUIDE ONLY AND SHOULD BE MODIFIED AS REQUIRED TO FIT CONDITIONS.

Architect-Engineer

______________________ Prepared by | ______________________ Checked by

______________________ Approved by | ______________________ Date

General Electric Company

______________________ Approved | ______________________ Date

Atomic Energy Commission

______________________ Approved | ______________________ Date

General Electric

Hanford Atomic Products Operation

*Use only for revisions or supplements. For revised issues or supplements, include original issue date.

# SAMPLE SPECIFICATION SHEET

## DIVISION I

## EARTHWORK AND FENCING

### GENERAL

1. WORK INCLUDED

The work to be done under this division of the specification consists of all excavating, backfilling, grading and fencing in connection with the Critical Mass Laboratory, Building 209-E.

### MATERIALS

2. CHAIN LINK FENCE

a. All fence materials shall conform to the requirements of Hanford Standard Specification HW-4680-S, Chain Link Security Fence.

b. Line posts shall be Type I as specified in HW-4680-S.

c. Chain link fence fabric shall be 8 feet in height.

### WORKMANSHIP

3. EXCAVATING

3.1 FOOTINGS AND FOUNDATIONS

Sample Specification page showing preferred numbering system and location of page and specification numbers.

a. Excavations will be made in with rocks varying in size from 1 foot in diameter.

b. All excavations for footings and foundations shall be made to proper depth and width with adequate allowances made for forms and bracing. Bottoms of such excavations shall be level and true and free of loose materials. Where excavations are made below the elevations of the bottoms of footings shown on the approved drawings, the concrete of the footings or foundation shall extend to undisturbed earth.

c. Machine excavation for structures to bear on undisturbed earth shall be stopped 2-inches or more above the elevation of the bottom of the footing or structure as shown on the drawings. Remaining excavation to the required elevation shall be done by manual means.

3.2 PIPE TRENCHES

All excavations for piping shall be true to line and grade as shown on the drawings. They shall be of adequate width to permit handling of pipe and accessories and making necessary connections. They shall be of sufficient depth to permit the placement of a sand cushion (4-inches minimum

OFFICIAL USE ONLY

ACCEPTANCE TEST PROCEDURE NO.______________________________ Rev.______

SUBJECT______________________________

PROJECT______________________________

BUILDING______________________________

DATE PREPARED______________________________

PROCEDURE PREPARED BY______________________________

TEST PROCEDURE APPROVED BY:

Architect Engineer______________________________ Date______

General Electric Co.______________________________ Date______

______________________________ Date______

Atomic Energy Commission______________________________ Date______

TEST PERFORMED BY:

Construction Contractor______________________________ Date______

TEST WITNESSED BY:

General Electric Co.______________________________ Date______

______________________________ Date______

FINAL APPROVAL AND ACCEPTANCE:

General Electric Co.______________________________ Date______

______________________________ Date______

Atomic Energy Commission______________________________ Date______

1.0 PURPOSE

1.1 The purpose of this test is to demonstrate that the heating and ventilation system and the chilled water cut-off will perform satisfactorily as designed with respect to functional requirements.

2.0 REFERENCES

2.1 Drawings

H-2-44340 - Service Bldg. Ventilation Supply & Exhaust

H-2-44341 - Reactor Room Supply Ventilation

H-2-44366 - Equipment Hook-Ups

H-2-44375 - Control Bldg. Ventilation Supply & Exhaust

3.0 TEST PROCEDURE

3.1 Run the following motor operated units for a minimum of 6 hours. During this time the units shall be checked for proper operation. Note voltage and current through each motor, listing three readings for each 3 phase motors.

| E.P. No. | | Volts | Amperes |
|---|---|---|---|
| 209E-911 | Reactor Room H & V Unit | ____ | ____ |
| 209E-901 | Equipment Room H & V Unit | ____ | ____ |
| 209E-901 | Equipment Room H & V Circulating Pump | ____ | ____ |
| 209E-903 | Change Room Wall Exhauster | ____ | ____ |
| 209E-902 | Water Chiller | ____ | ____ |
| 209E-608 | Chilled Water Pump | ____ | ____ |
| 209E-904 | Mens Room Wall Exhauster | ____ | ____ |
| 209E-904 | Womens Room Wall Exhauster | ____ | ____ |
| 209E-908 | Control Room Wall Exhauster | ____ | ____ |
| 209E-909 | Counting Room Wall Exhauster | ____ | ____ |
| 209E-905 | Hood Exhaust Blower | ____ | ____ |

3.2 Air Balance

Check all supply outlets to verify that the air flow quantities are as specified on the drawings. Record the following air flow quantities in CFM.

| SPACE | ROOM NO. | SPECIFIED FLOW | ACTUAL FLOW |
|---|---|---|---|
| Reactor Room | - | 4500 | |
| Mixing Room | 2 | 1320 | |
| Change Room | 3 | 1260 | |
| Equipment Room | 4 | 1400 | |
| Office | 9 | 320 | |
| Office | 10 | 410 | |
| Office | 11 | 240 | |
| Office | 12 | 340 | |
| Lunch Room | 13 | 900 | |
| Office | 14 | 340 | |
| Lab | 15 | 840 | |
| Office | 16 | 340 | |
| Counting Room | 18 | 460 | |
| Control Room | 21 | 1230 | |
| Men's Room | 22 | 240 | |
| Women's Room | 24 | 340 | |

3.3 Heating Coils

With steam control valve wide open, verify that the air temperature rise across each coil equals or exceeds that specified.

| Coil | Entering Temp. | Leaving Temp. | Actual Rise | Basic Ent. Temp. | Corrected Rise | Specified Rise |
|---|---|---|---|---|---|---|
| Reactor Room H & V Coil | | | | 40°F | | 55°F |
| Equip. Rm. H&V Preheat | | | | -20°F | | 80°F |
| Equip. Rm. H&V Reheat | | | | 40°F | | 55°F |

3.4 Cooling Coils

Testing of cooling coils and water chiller shall be done before the addition of ethylene glycol to the system. With water chiller operating and chilled water pump running, verify that the temperature decrease across each coil equals or is better than that specified. Test shall be run only if air at 85°F or warmer is available.

Reactor Room H & V Cooling Coil

| | | |
|---|---|---|
| Entering Water Temperature | ____________ | °F |
| Leaving Water Temperature | ____________ | °F |
| Water flow through coil | ____________ | GPM |
| Entering air temperature | ____________ | °F |
| Leaving air temperature | ____________ | °F |
| Actual Temperature decrease | ____________ | °F |
| Air flow through coil | ____________ | CFM |

Specified decrease with 45°F ent. water, 24 gpm, 4500 CFM, and 85°F entering air is 25°F.

| | | |
|---|---|---|
| Corrected decrease under test conditions | ____________ | °F |
| Entering Water Temperature | ____________ | °F |
| Leaving Water Temperature | ____________ | °F |
| Water flow through coil | ____________ | °F |
| Entering air temperature | ____________ | °F |
| Leaving air temperature | ____________ | °F |
| Actual temperature decrease | ____________ | °F |
| Air flow through coil | ____________ | CFM |

Specified decrease with 45°F ent. water 12 GPM, 10,000 CFM and 90°F entering air is 6°F.

| | | |
|---|---|---|
| Corrected decrease under test condition | ____________ | °F |

3.5 Heating and Ventilating Controls

Verify that the heating and ventilating controls operate as specified.

SAMPLE ACCEPTANCE TEST PROCEDURE



Reactor Room (with room closed up)

Heating Cycle (with room air less than 70°F). Turn thermostat up to 80°F. Verify that cooling coil control valve turns off and heating coil control valve opens and stays open until temperature is attained and then throttles. Note time required __________ minutes.

Remarks: ____________________________________________________________

Cooling Cycle. With room at 80°F turn thermostat to 60°F and verify that heating coil control valve turns off and cooling control valve opens and stays open until temperature is attained and then throttles. Note time required __________ minutes.

Equipment Room H & V Unit (Set reactor room in heating cycle.) For heating cycle perform in early morning with outside temperature 50°F or less. For cooling cycle perform in afternoon when outside temperature is 75°F or more.

Heating Cycle - with room air less than 70°F. Turn thermostat in change room to 80°F. Verify that cooling coil control valve turns off and control valves to preheat and reheat coils open and that reheat coil control valve throttles when temperature is attained.

Cooling Cycle - With room air 80°F or more. Turn thermostat in change rooms to 90°F. Verify that control valves to reheat and preheat coils are closed and that the cooling coil control valve opens. Verify that cooling coil control valve throttles when temperature is attained.

3.6 Chilled Water Shut-Off

The chilled water shut-off is a regulating valve in the chilled water line to the Equipment Room cooling coil. Its purpose is to shut off all chilled water to that coil when the cooling load in the Reactor Room requires all the chilled water. Verify that this capillary actuated valve is wide open when its capillary bulb is 50°F and that valve is completely closed when the bulb in the chilled water return goes up to 54°F.

Bulb Temperature to open valve __________°F

Bulb temperature to close valve __________°F

3.7 Water Chiller

Verify that chiller will cool 24 gpm of water from 54°F to 44°F.
Ent. Temperature __________°F. Outlet Temperature __________°F.
Flow __________gpm.

SAMPLE OF ACCEPTANCE TEST PROCEDURE

EXCEPTIONS TO ACCEPTANCE TEST

| | | EXCEPTIONS | CORRECTION APPROVAL | | |
|---|---|---|---|---|---|
| NO. | DATE | DESCRIPTION | DIV. | INITIALS | DATE |
| | | | | | |

TEST APPROVED WITH EXCEPTIONS

General Electric Co.____________________________Date____________

____________________________Date____________

Atomic Energy Commission____________________________Date____________

## SAMPLE PURCHASE SPECIFICATION ATTACHMENTS FOR PROCURED MATERIAL

Engineer or author is requested to check applicable items where required. These clauses will then be included as a part of the purchase requisition.

_____1. INSPECTION

Inspection by a General Electric Company or Atomic Energy Commission representative is required:

_____During Fabrication
_____During Testing
_____Prior to Shipment

_____2. MATERIAL TO BE FURNISHED WITH QUOTATION:

Each bidder shall furnish with his quotation five (5) copies of bulletins, drawings, or data sheets to include the following information:

_____Dimensional Drawings, illustrative cuts, etc.
_____Performance curves and/or data
_____Specifications
_____
_____

_____3. APPROVAL DATA:

Within Thirty (30) days after receipt of the purchase order, and prior to start of fabrication, the Seller shall furnish for approval six (6) sets of drawings.

_____4. CERTIFIED DATA:

A. _____Within fifteen (15) days after receipt of the purchase order, certified bulletins, drawings, or data sheets shall be furnished by the Seller, and shall include the following required information:

B. _____Within fifteen (15) days after the return of the approval data to the Seller, certified bulletins, drawings, or data sheets shall be furnished by the Seller, and shall include the following required information:

_____One (1) reproducible set of dimensional drawings on Standard ASA white linen.
_____Copies of Specifications
_____Copies Spare Parts List
_____Copies Performance Data
_____Copies Circuit Diagrams
_____Copies Operation, Maintenance, and Lubrication Instructions
_____Copies Installation Instructions
_____Copies Quotation, without price
_____
_____
_____

5. CHEMICAL AND MECHANICAL PROPERTIES CLAUSE:

Three (3) copies of a notarized certification of chemical and mechanical properties are required in accordance with the specification used for the purchase.

6. CHEMICAL AND PHYSICAL PROPERTIES CLAUSE:

The vendor shall be required to furnish three (3) copies of Certified chemical and physical analysis, prior to shipment of any material.

7. SAFE SHIPMENT CLAUSE:

The Seller shall crate material for safe shipment.

8. BID REVIEW:

Review of bids by the author is required prior to purchase.

9. ALTERATION BID REVIEW:

Review of vendor's charges, or extras, quoted as a result of this alteration is required by the author prior to issuance of formal alteration.

10. ESTIMATED COST: $__________.

11. SUGGESTED VENDORS:

Company Address

Company Address

Company Address

Company Address

Company Address

Company Address

COMPRESSED AIR RECEIVER DATA SHEET

1. Capacity: ______________ cubic feet, minimum

2. Preferred dimensions: Diameter __________inches

   Length __________feet

3. Mounting arrangement:

   a. Vertical, floor __________

   b. Horizontal, floor __________

   c. Other ____________________

4. Construction material: ________________________________________________________

________________________________________________________________________________

5. Design pressure: __________psig

6. Design temperature: __________ °F

7. Design, fabricate, inspect, test and stamp in accordance with __________ edition of ASME Unfired Pressure Vessel Code, Section VIII.

8. Drain connection (include valve) pipe size: __________ inch

9. Inlet pipe connection: __________ inch (flanged) (screwed)

10. Outlet pipe connection: __________ inch (flanged) (screwed)

11. Gauge connection: __________ inch

12. Gauge dial size and range: __________ inch; _____to _____ psig

13. Relief valve connection size: __________ inch

14. Relief valve size and setting: __________ inch; __________ psig

15. Painting: ________________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

16. Special requirements: ________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

## SPECIFICATION SHEET
## BELLOWS EXPANSION JOINT

1. Pipe Size: ________

2. End Connection: ________ Vanstone Flange ________ lb ASA

   ________ Fixed Flange ________ lb ASA

   ________ Weld End, Schedule ________ Pipe

3. Pressure: Internal ________ psi max.

   Vacuum ________ in. mercury or ________ in. water

   External ________ psi max.

   Pulsating or Shock (give details) ____________________

   ________________________________________

4. Temperature: Max. Operating ________ °F

   Min. Ambient ________ °F

   Installation ________ °F

5. Media Conveyed (liquid, gas, solids contained) ____________________

6. Motion: Axial traverse (entire range) ________ inches

   Lateral movement (from c/L) ________ inches

   Angular Motion ________ degrees

   Frequency of thermal cycle ________ cy/yr

   Vibration: Amplitude ________ in.

   Frequency ________ cy/min.

   Direction ________

7. Materials: Element ________

   End Connection ________

   Liner (if required) ________

   Cover (if required) ________

8. Life Expectancy of Expansion Joint anticipated ________ Yrs.

9. Distance between Pipe Anchors ________ Ft.

10. Unit to be Self-Restrained? Yes ____ - No ____

11. Test Requirement ____________________

   ________________________________________

# SPECIFICATION SHEET
# HOT WATER HEATERS

This specification applies to steam or electric water heaters for hot water service.

1. Tank Capacity: _________ gallons nominal
2. Tank Dimensions (Approx.): _____Dia. x _____ Long
3. Tank Position: Vertical _________ Horizontal _________
4. Heating Method: Electric _____ Steam _____
5. Max. Working Pressure: _____ PSIG - ASME Stamp _____
6. Hydrostatic Test Pressure: _________ PSIG
7. Materials of Construction: Manufacturer's Standard
8. Interior Wall Coating (If required): _________
9. Safety Relief Valve(s) Required: _________ Pressure Actuated

   _________ Temperature Actuated
10. Insulation Required on Tank: Yes _____ - No _____
11. For Electric:
    a. Voltage - _________ V
    b. Wattage - _________ W Min.
    c. Single Unit Heater _____ - Two-Unit Heater _____
    d. Immersion _____ or strap-on _____ Heaters
    e. Thermostat Control Range _________
12. For Steam:
    a. Steam Pressure Avail.: _________ PSIG
    b. Coils to be Copper (or Mfgr's Std.) and easily removable through flanged connection.
    c. Thermostat control Range: _________
13. Immersion thermostat for electric or steam hot water heaters shall be located no higher than the center of the tank.
14. Tank supports shall be suitable for floor mounting.
15. Inlet Water Temperature Range: _________ to _________ F
16. Water pH: _________
17. Room Temperature Range: _________ to _________ F
18. Tanks shall meet applicable requirements of National Plumbing Code, ASA A40.8, Chapter 10.

# CENTRIFUGAL PUMP DATA SHEET

This specification applies to close coupled, single suction, centrifugal pumps.

## Rating Data

1. Capacity: _________ GPM

2. Total Head: _________ Ft.

3. Suction Head: _________ Ft.

## Liquid Characteristics

4. Liquid Pumped: _________

5. Specific Gravity of Liquid: _________

6. Normal Temperature of Liquid: _____ °F, Max. _____ °F, Min. _____ °F

7. Viscosity of Liquid: _________ CPS

8. Nature of Solids Present: _________ Gritty, _________ Hard, _________ Soft

9. Percentage of Solids by Weight: _________ %

   Particle Mesh Size: _________ % by Weight

## Construction Details

10. Materials of Construction: _________

11. Connection Size: _________ Inlet (flgd.) (Scrd.), _________ Outlet (Flgd.)(Scrd.)

12. Type of Seal: _________

13. Type of Bearings: _________

14. Type of Impeller: _________ Statically Balanced _________ Dynamic Balanced _________

15. Type of Impeller Case: _________

16. Type of Flexible Coupling: _________

17. Provide Coupling Guard: Yes _____ No _____

18. Vibration Isolation Base Required: Yes _____ No _____

19. Type of Gaskets: _________

## Driver Data

20. *Motor HP _________ 440** Volts, Three Phase, 60 Cycle

21. Enclosure: Drip proof: _________
    Explosion proof: _________
    Splash proof: _________
    Totally Enclosed: _________
    Open: _________

Driver Data (Continued)

22. Motor Insulation Class: B ________

C ________

H ________

23. Motor Rating Continuous Duty for 40°C Rise: Yes _____ No _____

24. Motor Starter: a) Magnetic ________

b) Manual ________

25. Magnetic Control Location at motor ________

at motor control center ________

26. Motor Bearings: a) Sleeve ________ Lubrication ________

b) Ball ________ Lubrication ________

27. Steam Turbine: Type: ________

Steam Conditions: ________

28. Other: V-Belt Drive ________

Gasoline Engine ________

Diesel Engine ________

29. Special Requirements: ____________________________________________

____________________________________________________________

____________________________________________________________

*Reference HWS-8015-S - Electric Motor Specifications and Instructions for use of HWS-8015-S.

**Motors 1/3 HP and less may be 115 single phase.

## AIR WASHER PUMP SPECIFICATION DATA SHEET

This specification applies to a close coupled single suction centrifugal pump for continuous air washer duty.

### Rating Data

1. Capacity: _________ gallons per minute
2. Total Head: _________ Ft.
3. Suction Head: _________ Ft.
4. Pumped Fluid: water at 70$^{\circ}$F
5. Pump Efficiency: _________ minimum.

### Construction Data

6. Pump shall be single inlet, single impeller, solid casing, vertical discharge, close coupled centrifugal type.
7. Casing Material: cast iron
8. Impeller Material: bronze
9. Wear Rings: bronze, replaceable
10. Seal: mechanical type
11. Shaft: corrosion resistant replaceable sleeve

### Application Data

12. Impeller Rotation: counterclockwise facing inlet.
13. Inlet: single end suction, _________ 125 lb. flanged ASA B16a.
14. Discharge: vertical _________ 125 lb. flanged ASA B16a.
15. Motor shall be grease lubricated ball bearing normal starting torque induction type. Motor shall be drip proof. Motor full load speed shall be _________ RPM.
16. Power Requirements: _________ HP, 440 V, 3-phase, 60 cycle
17. Pump shall be furnished with vibration isolation base.
18. Pump shall be equipped with drain and test connections.

## SUMP PUMP DATA SHEET

This specification applies to vertical Sump Pumps.

### Rating Data

1. Capacity: __________ GPM

2. Discharge Head: __________ Ft.

3. Depth of Sump: __________ Ft. Diameter: __________ inches

   Max. in Flow Rate of Sump: __________ GPM

### Liquid Characteristics

4. Liquid Pumped: __________

5. Specific Gravity: __________

6. Normal Temperature: __________ Max., __________ Min.

7. Viscosity: __________ CPS

8. Vapor Pressure: __________

9. Percentage of Solids by Weight: __________ %

10. Character of Solids: Gritty __________, Hard __________, Soft __________

11. Particle Mesh Sizes: __________ % by Weight

    __________ % by Weight

    __________ % by Weight

### Float Switch

12. Enclosed: Yes _____ No _____

13. Location of Switch: __________

14. Float Required: Yes _____ No _____

### Construction Details

15. Materials of Construction
    a) Motor Support: __________
    b) Pump Shaft: __________ stainless steel, heat treated, ground and polished
    c) Pump Shell: __________
    d) Pump Strainer: __________
    e) Supporting Pipe: __________ approximate length: __________
    f) Pit Cover Base Plate: __________ Size __________ Square or Round __________
       Are vent connections required: Flanged or Screwed: __________ Size __________
    g) Float: __________

Construction Details (Continued)

15. Materials of Construction (Continued)
    h) Impeller: __________ Impeller shall be statically balanced. Dynamically __________
    i) Discharge: __________ Size __________, Flanged or Screwed __________
    j) Gasket Material: __________

16. Type of Seal: __________ Slinger ring required: Yes _____ No _____

17. Type of Bearings: __________ Lubrication

18. Type of Coupling: __________

19. Provide Coupling Guard: Yes _____ No _____

20. Vibration Isolation Base Required: Yes _____ No _____

21. Check Valve: __________ Location: __________

Driver Data

22. *Motor HP __________, 440** Volts, three phase, 60 cycle

23. Enclosure: Drip proof: __________

    Explosion proof: __________

    Splash proof: __________

    Totally enclosed: __________

    Open: __________

24. Motor Insulation Class: B __________

    C __________

    H __________

25. Motor Rating continuous duty for 40°C Rise: Yes _____ No _____

26. Motor Starter: a) Magnetic __________

    b) Manual __________

27. Magnetic control location at motor __________

    at motor control center __________

28. Motor Bearings: a) Sleeve __________ Lubrication __________

    b) Ball __________ Lubrication __________

29. Steam Turbine: Type __________

    Steam Condition __________

Driver Data (Continued)

30. Other: V-Belt Drive ________

Gasoline Engine ________

Diesel Engine ________

31. Special Requirements: ________________________________________________

________________________________________________________________

________________________________________________________________

32. Site Installation

Exposed to weather ________, or housed ________.

If housed, is the building temperature controlled in the winter? Yes _____ No _____

If controlled, what is the maximum temperature range? From _____ to _____ °F.

*Reference HWS-8015-S - Electric Motor Specifications and Instructions for use of HWS-8015-S.

**Motors 1/3 HP and less may be 115 single phase.

# SPECIFICATION SHEET
# MECHANICAL VACUUM PUMP

1. Capacity: __________ CFM min.

2. Ultimate Vacuum: __________ Microns Hg or less

3. Type of Pump: Single Stage __________ Compound __________

4. Cooling: Air Cooled __________

   Water Cooled __________

5. Pipe Connections: Inlet __________ Std. Flg. __________ Scrd.

   Discharge __________ Std. Flg. __________ Scrd.

6. Motor: _____ Hp, _____ V, 3 phase, 60 cycle

   Enclosure __________________________

   Motor Insulation Class: B _____ C _____ H _____

   Continuous Duty Rating For 40°C Rise: Yes _____ No _____

7. Gas Ballast Feature: Yes _____ - No _____

8. Belt guard is required

9. Pump shall be dynamically balanced to reduce vibration

10. Automatic Lubrication System: Yes _____ - No _____

11. Floor Space Requirements (if any): ______________________________________________

    ______________________________________________________________________________

    ______________________________________________________________________________

12. Special Requirements: ___________________________________________________________

    ______________________________________________________________________________

    ______________________________________________________________________________

# CAPILLARY AIR WASHER
# SPECIFICATION DATA SHEET

This specification applies to a capillary wet cell type industrial air washer but does not include the pumps. A separate data sheet is provided for the pump which should have a minimum capacity of 3 gpm per cell and 35 foot minimum head.

Rating Data:

1. Capacity _________ CFM @ 70°F based upon a maximum of 1100 CFM per capillary cell.

2. Face velocity _________ feet per minute maximum.

3. Washer shall be concurrent flow type with (right) (left) hand connections.

4. Pressure drop shall not exceed 0.45 inches water gauge when supplied with 3 gpm spray water per cell.

5. Unit shall have a saturation efficiency of (95%) or better with 3 gpm spray water per cell.

Construction Data:

6. The air washer shall have _________ (number) cells total arranged _________ (number) cells wide by _________ (number) cells high with overall dimensions approximately _________ high by _________ wide by _________ long.

7. Piping connections shall be on the (right) (left) side when viewed facing in the direction of airflow. Internal piping shall be galvanized steel furnished complete with a low head, spray nozzle (3 psi) for each cell and an eliminator section flooding system. Piping (connections) shall be provided as follows:

   a) Make-up connection with float valve (3/4" minimum).
   b) Quick-fill (1" minimum).
   c) Dilution (1/2" minimum).
   d) Overflow, drain and spray header(s) (manufacturer's standard).
   e) Pump suction with removable bronze mesh strainer sized for minimum capacity of 3 gpm per cell.

8. Cells shall be approximately 20 x 20 x 8 inches and shall be designed to prevent sagging of the glass media by orientation of the fibers in the direction of airflow. Cell frames shall be galvanized steel equipped with lifting handles and galvanized wire mesh faces. Each cell shall have an effective contact area of 125 square feet minimum.

9. Washer tank shall be 3/16 inch minimum thickness welded construction furnished with the required piping connections. External and internal tank surfaces shall have one coat of primer and two coats of manufacturer's standard corrosion resistant paint.

10. Casing shall be 18 gauge minimum galvanized steel watertight construction reinforced externally with galvanized steel angles. Casings shall have flanged and drilled end connections.

11. Eliminators shall be 24 gauge minimum galvanized steel and shall have a minimum of three surfaces and two hooks. Eliminators shall be removable with a recommended 2-1/2 inch spacing.

## CENTRIFUGAL FAN DATA SHEET

The attached specification covers centrifugal fans for industrial applications. For light dirty air conditioning applications, some items do not apply.

### RATING DATA

1. Capacity: __________ SCFM (CFM @ 70$^{O}$F and 29.92" Hg.)

2. Static Pressure: __________ inches of water.

3. Gas handled: (Air at _____F*
Fan shall be rated in accordance with the Standard Test Codes of the Air Moving and Conditioning Association (AMCA) Standards.

### SIZE AND ARRANGEMENT

4. Fan wheel size __________ inches (approximate).

5. Fan wheel type __________ (backward curved non-overloading)(forward curved)

6. Fan width __________ (single) (double)

7. Fan discharge size __________ inches by __________ inches (approximate)

8. Rotation __________ (CW, CCW, etc.)

9. Discharge __________ (upblast) (top horizontal), (etc.)

10. Arrangement __________ (1, 2, 3, etc.)

11. Drive shall be (direct) (vee-belt). If vee-belt drive is specified, drive should be selected for 130% of drive motor rating.

12. Motor position __________ (W, X, Y, Z for vee-belt drive)

13. RPM __________ max. (specify where noise or other limiting factors are important.

### CONSTRUCTION

14. Materials: a. Fan casing __________ b. Rotor __________ c. Shaft __________

15. Fan shall be Class (I, II, III or IV) construction as defined by AMCA.

16. Inlet shall be (flanged) (unflanged)

17. Outlet shall be (flanged) (unflanged)

18. Bearings shall be (anti-friction ball type) (sleeve type) (etc.). For applications where continuity of service is required, the bearing life should be specified. A suggested specification is that the bearings shall have a B-10 life of 10,000 hours with a service factor of two for Class II and heavier fans as defined by Anti-Friction Bearing Mfgs. Association (AFBMA).

19. Belt guard (is) (is not) required. Guard shall comply with Hanford Standard M-4-6.

20. Fan shall be dynamically balanced. (The amount of unbalance permitted should be specified for critical applications or for fan wheels larger than 24" diameter. For these applications a dynamic balance to within 2 inch ounces is usually acceptable.

21. Fan and motor assembly shall be furnished with a vibration isolation base. The type of isolators shall be manufacturer's standard for intended service. (Where transmission of vibration to the associated structure is important, isolator dampening efficiency should be specified).

FINISH

22. Fan shall be finished with light gray machinery enamel. Color shall be approximately the same as 16473 of FEDERAL STANDARD NO 595.

MOTOR

23. Motor shall be __________ Hp* for (indoor) (outdoor) application in accordance with Hanford Standard Specification HWS-8015-S. (Motor size should be determined by designer to assure uniformity of bids but can be left to vendor if desired. Other considerations such as voltage, ambient temperature, motor enclosure, etc. specified in HWS-8015-S should be reviewed prior to issuance of specification).

*Motor size shall be adequate for cold air (gas) conditions with the system in the minimum resistance (wide open) condition.

SPECIAL CONSIDERATIONS

24. Flanged and bolted casing construction is usually required for removal of large fans. Access to space will determine this but generally fans with 49" wheels and larger should be made in sections.

25. Access plates (bolted) should generally be required on fans where cleaning may be required or where access to the fan wheel is limited.

26. Airtight casings and external bearings should be considered where contaminated air is handled. Welded construction and witnessed inspection tests may be required. Shaft seals should also be considered for these applications.

27. Special fan characteristic curve requirements for parallel operation with other fans and pertinent system considerations should be evaluated. A continuously drooping characteristic curve is required in parallel fan operation.

28. For discharge damper specifications see separate data sheet. If radial inlet damper is to be purchased with the fan consult manufacturer's data.

29. Fan shall be furnished with a one-inch female NPT drain connection in bottom of casing.

# HEATING COIL SPECIFICATION DATA SHEET

This specification applies to an extended surface air heating coil utilizing steam as a heating medium. Except for item 12, items 1 through 18 are required for purchase of coil. All items are required to be furnished by the bidder.

RATING DATA:

1. Air flow _________ SCFM (CFM @ 70$^{o}$F)

2. Entering Air Temperature: _________ F drybulb

3. Leaving Air Temperature: _________ F drybulb

4. Face Velocity _________ feet per minute max.

5. Air friction _________ inches of water (specify when limiting).

6. Position of tubes: (horizontal) (vertical)

7. Airflow direction: (horizontal) (vertical up) (vertical down)

DIMENSIONAL DATA:

8. Coil width _________ inches

9. Coil length _________ inches (may be expressed in terms of tube length)

10. Face area _________ square feet

11. Number of tube rows _________. Coil depth _________ inches.

12. Number of fins per inch _________.

13. Size of tubes _________ inches O.D.

14. Tube wall thickness _________ inches (optional)

15. Steam distributing tubes are (are not) required.

CONSTRUCTION DATA:

16. Materials
    a. Tubes _________ b. Fins _________ c. Tube header _________
    d. Casing Material _________

17. Tubes shall (shall not) be pitches in casing to drain.

18. Casing shall be flanged and drilled for duct connection. Coil shall be designed to allow support of coil from casing ends only.

19. Steam connection and condensate outlet on same (opposite) ends.

20. Steam connection size _________ inches I.P.S. (male) (Female)

21. Condensate connection size _________ inches I.P.S. (male) (female)

TEST

22. Steam test at (100) psig followed by pneumatic test at (400) psig.

# DAMPER SPECIFICATION SHEET

This specification applies to multileaf (parallel) (opposed) blade damper for installation inside ductwork. Operator or manual control not covered.

## RATING DATA:

Air Flow _________ CFM @ 70°F

Velocity through damper _________ FPM maximum

Air Temperature _________ F.

Static pressure differential across damper in open position _________ inches water gauge.

Maximum pressure differential across damper in closed position _________ inches water gauge.

## CONSTRUCTION DATA:

Blade Material: Galvanized 16 gauge steel with interlocking edges.

Blade Width: Maximum 10 inches.

Blade Length: Maximum 48 inches.

Frame: Manufacturer's standard painted flat bar or channel construction of black steel. Provide corner braces on dampers over 18 inches in any dimension.

Stops: All damper sections shall be provided with angle or flat bar stops all around. Stops shall be continuous along blade length.

Damper Action: (Opposed) (Parallel)

Bearings: Ball bearings on operator shaft(s). Oilite sleeve bearings on all others.

Blade Shaft: 1/2 inch diameter by 6 inch minimum length. Shaft extensions shall be provided for (manual) (operator) operation.

Damper Tightness: Damper shall not leak more than (5%) rated airflow under maximum static pressure differential conditions.

Sections: Dampers with blades over 48 inches long or 96 inches wide and a maximum of 25 square feet shall be made in two or more sections. Damper sections shall be furnished complete with fastenings for assembly as a unit.

## APPLICATION DATA:

Overall size Overframe: _________ inches long (blade length) by _________ inches high.

Damper Orientation: Blade axis (horizontal) (vertical) damper plane (horizontal) (vertical).

Damper Operator: (Required) (Not Required)

HWS-________

Page ______

PROJECT NO.________

CONTROL VALVE DATA

| E.P. NO. | QTY. |
|---|---|
| | |
| | |
| | |
| | |

SYSTEM: ________

DWG. REF: ________

VALVE USE: ________

Valve Type: ________

Line Fluid: ________ Temp. Max.: ______ Min.: ______

Sp. Gr. @ 60 F ________ Sp. Gr. @ Service Conditions______

Inlet Pressure - Max.: ________ Min.: ________

Flow Rate - Normal: ________ Max.: ______ Min.: ______

Pressure Drop - Normal Flow: ______ Max. Flow: ______ Min. Flow: ______

OV - Required: ________ Shut Off Required: ______

OV - Available: ________ Body Size: ______

Line Size: ________ Port Size: ______

Action: ________ Plug Char.: ______

Connections: ________

Spring Range: ________ Air Supply: ______

Material: Body: ________ Plug: ______

Seat: ________ Trim: ______

Packing: ________

Valve Positioner: ________

Additional Specifications:

HWS-______

PAGE ______

PROJECT NO.______

INSTRUMENT DATA

| E.P. NO. | QTY. |
|---|---|
| ______ | ____ |
| ______ | ____ |
| ______ | ____ |
| ______ | ____ |

SYSTEM: ______

DWG. REF.: ______

Instrument Type: ______

Range: ______ Chart: ______

Scale: ______

Service Conditions: Fluid: ______ Static Pressure: ______

Temp.: ______ Sp. Gr.: ______

Line Size: ______ Air Supply: ______

No. of Points: ______ Sensitivity: ______

Accuracy: ______ Ambient Temp.: ______

Output: ______ Input: ______

Control: On-Off: ______ Prop. Band: ______ Rate: ______ Reset: ______

Auto.-Manual Switch: ______

Chart Speed: ______ Pen Speed: ______

Connections: Process: ______ Air: ______

Alarm Contacts: Action: ______ Rating: ______

Power Supply: ______ Mounting: ______

Material: ______ Finish: ______

Additional Specifications:

## SPECIFICATION SHEET
## PACKAGED ROOM AIR CONDITIONERS

This specification applies to self-contained room air conditioners for window or through-the-wall mounting.

1. BTU Ratings*, ARI, NEMA, ASRE: _________ BTU Total Min.

   _________ BTU Sensible Min.

2. Total Wattage, ASRE: _________ Watts Max.

3. Voltage: (115) (230) Volts, single phase, 60 cycle

4. Fan: Centrifugal type, dual speed with minimum capacity of _________ CFM. Provide rubber mountings to minimize vibration and noise.

5. Compressor: High capacity, heavy duty, hermetically sealed compressor floated on spring mountings.

6. Fresh Air Intake: Adjustable from zero to approximately 10% of fan capacity.

7. Filter: Hygienic-clean type. Replaceable

8. Cabinet: Steel construction with baked-on finish coating for weather resistance.

9. Air Grille: Adjustable type.

10. Temperature Control: Variable range or multiple position thermostat switch.

11. Cabinet Dimensions: _________ In. Height Max.

    _________ In. Width Max.

12. Coil Freeze Protection Required: Yes _____ - No _____

13. Electric Heating Coil Required: Yes _____ - No _____

    If Yes, size of coil: _________ Watts.

*These ratings are based on inside conditions of 80°F DB, 67°F WB and outside conditions of 95°F DB, 75°F WB.

# SPECIFICATION SHEET
# HIGH VACUUM VALVE

1. Size: __________ Std. (150# ASA) Flange with Flat Face and O-Ring Groove

   __________ Female Pipe Tap

   __________ Solder Connection

2. Type: Slide Gate __________

   Globe, In-Line __________ Right Angle __________

   Ball __________

3. Material: Aluminum __________

   Stainless Steel __________

   Carbon Steel __________

   Bronze __________

   Plastic __________

4. Valve shall be tested with mass spectrometer-type leak detector to guarantee vacuum tightness.

5. Special Features: Top entry __________

   Handwheel __________

   Quick-Acting Lever __________

   Pneumatic Operator __________

   Electric Operator __________

   Bellows Stem Seal __________

   O-Ring Stem Seal __________

6. Other Special Requirements: ______________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

## SPECIFICATION SHEET
## MECHANICAL BOOSTER VACUUM PUMPS

1. Displacement: 1st Stage Blower __________ CFM min.
   2nd Stage Pump __________ CFM min.

2. Ultimate Blank-Off Vacuum: __________

3. Minimum Pumping Speed: __________

4. Motor: 1st Stage __________ Hp, __________ V, 3 phase, 60 cycle

   2nd Stage __________ Hp, __________ V, 3 phase, 60 cycle

5. Inlet Connection: __________ Std. (150# ASA) Flat Face Flange With O-Ring Groove

6. Outlet Connection: __________ 1. P.S.

   Other ________________________________________

7. Belt drive and coupling guards are required.

8. Automatic operation from atmospheric to ultimate vacuum shall be provided.

9. Pumping unit shall be pre-assembled on steel base and shall be complete with interstage connections, starters, pressure switch and drive.

10. Special Requirements: ________________________________________

________________________________________

________________________________________

________________________________________

# SPECIFICATION SHEET
# HIGH VACUUM DIFFUSION PUMP

1. Minimum Pumping Speed: __________ CFM between range of .1 and 1 microns Hg absolute.

2. Ultimate Blank-Off Vacuum: __________ microns Hg. or _____ x _____ min. Hg.

3. Inlet Connection: __________ Std. (150# ASA) Flat Face Flange with O-Ring Groove.

   __________ O-Ring Coupling

   Other ______________________________________________________

4. Outlet Connection: __________ Std. (150# ASA) Flat Face Flange with O-Ring Groove.

   __________ O-Ring Coupling

   Other ______________________________________________________

5. Cooling: Air Cooled with Blower __________

   Water Cooled __________

6. Detachable Boiler: Yes _____ - No _____

7. Oil Drain and Filler Connections: Yes _____ - No _____

8. Heater Voltage: 230 V _____ - 460 V _____

9. Heater Wattage: _____ Watts (Approx.)

10. Limiting Forepressure: __________ microns (min.) (Full Load)

11. Pump Casing Material: Carbon Steel __________

    Stainless Steel __________

12. Special Requirements: ______________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

# VERTICAL TURBINE PUMP DATA SHEET

This specification applies to direct drive vertical turbine pumps.

## Rating Data

1. Capacity: __________ GPM

2. Discharge Head: __________ Ft.

3. Suction Head: __________ Ft.

## Liquid Characteristics

4. Liquid Pumped: __________

5. Specific Gravity: __________

6. Normal Temperature: __________ Max. __________ Min. __________

7. Viscosity: __________

8. Vapor Pressure: __________

9. Nature of Solids Present: __________

10. Percentage of Solids by Weight: __________ %

    Character of Solids: Gritty __________, Hard __________, Soft __________

    Particle Mesh Sizes: __________ %

    __________ %

## Construction Details

11. Materials of Construction

    a) Axial Adjustment: __________

    b) Shaft: __________ stainless steel, heat treated, ground and polished

    c) Shaft Enclosing Tube: __________ Max. Dia. __________

    d) Column Bearing-Spiders: __________ Lubrication: __________

    e) Impellers: __________ dynamically balanced

    f) Guide Fins: __________

    g) Pump Bearings: __________

    h) Suction Case: __________

    i) Suction Strainer: __________

    j) Shaft Seal Type: __________

    k) Discharge Connection: __________ Flanged or Screwed: __________ Type of Gaskets: __________

Construction Details (Continued)

12. Pump Length: __________ from __________

13. Vibration Isolation Base Required: Yes _____ No _____

14. Type of Coupling: __________

15. Liquid Level Indicator: __________ Altitude Gauge Reading in Feet: __________

16. Reverse Rotation Preventer: __________ Yes _____ or No _____

Driver Data

17. *Motor HP __________ 440** Volts, three phase, 60 cycle

18. Enclosure: Drip proof: __________

    Explosion proof: __________

    Splash proof: __________

    totally enclosed: __________

    Open: __________

19. Motor Insulation Class: B __________

    C __________

    H __________

20. Motor Rating Continuous duty for $40^{\circ}C$ Rise: Yes _____ No _____

21. Motor Starter: a) Magnetic __________

    b) Manual __________

22. Magnetic control location at motor __________

    at motor control center __________

23. Motor Bearings: a) Sleeve __________ Lubrication __________

    b) Ball __________ Lubrication __________

24. Steam Turbine: Type __________

    Steam Conditions __________

25. Other: V-Belt Drive: __________

    Gasoline Engine: __________

    Diesel Engine: __________

26. Special Requirements: ______________________________________________

________________________________________________________________

________________________________________________________________

27. Exposed to Weather: __________ or Housed: __________

If housed, is the building temperature controlled in the winter? Yes _____ No _____

If controlled, what is the maximum temperature range? From _____ to _____ °F.

*Reference HWS-8015-S - Electric Motor Specifications and Instructions for use of HWS-8015-S.

**Motors 1/3 HP and less may be 115 single phase.

# SPECIFICATION SHEET
# COMPRESSOR-TANK UNIT

This specification applies to self-contained compressed air system complete with tank, motor-compressor, gauges, controls and valves.

1. Compressor Displacement: _________ CFM Min.

2. Discharge Pressure: _________ PSIG

3. Receiver Tank: Size _________ Gal. Min.
   Vertical _________ Horizontal _________
   Mounting: Floor _________ Wall _________
   ASME Code Stamp: Yes _____ - No _____

4. Compressor Drive: _________ Direct _________ V-Belt with guard

5. Compressor Cooling: _________ Air _________ Water

6. Compressor Mounting: _________ Top of tank

   Other ______________________________________________

7. Oil-free air Delivery required: Yes _____ - No _____

8. Receiver Accessories Required: _________ Safety Valve, _________ Drain Valve,

   _________ Outlet Valve, _________ Pressure Gauge

9. Controls: _________ Manual, _________ Dual, _________ Automatic

10. Receiver shall be ASME Code stamped for design pressure of _________ PSIG

11. Compressor Intake Pressure: _________ PSIG

12. Compressor Delivery: _________ CFM Min.

13. Motor shall be _________*Hp in accordance with Specification HWS-8015-S.

14. Pressure switch to cut in at _________ PSIG and out at _________ PSIG.

15. Magnetic push button starter required: Yes _____ - No _____

16. Unit to be completely assembled and ready for installation.

*Size may be optional if not specified.

# SPECIFICATION SHEET
# AFTERCOOLER FOR AIR COMPRESSOR

1. Capacity: ________ SCFM (Min.)
2. Design pressure: ________ psig
3. Design temperature: ________ $^{o}$F
4. Air outlet temperature: ________ $^{o}$F Max.
5. Cooling water temperature: ________ $^{o}$F Max.
6. Cooling water pressure: ________ psig Max.
7. Mounting arrangement:
   a. Vertical, floor mounted ________
   b. Horizontal, wall mounted ________
8. Tube nest: (Removable) (Fixed)
9. Accessories required:
   a. Moisture separator: ________
   b. Drain valve: ________
   c. Discharge temperature thermometer: ________
10. Materials of construction: Manufacturer's standard
11. Maximum space limitations for aftercooler:
    a. Length ________ Ft.
    b. Width ________ Ft.
    c. Height ________ Ft.
12. Design, fabricate, inspect, test and stamp in accordance with ________ edition of ASME Unfired Pressure Vessel Code, Section VIII.
13. Painting: ________________________________________
14. Special Requirements: ________________________________________

# SPECIFICATION SHEET
# OIL FREE AIR COMPRESSOR

1. Capacity: ________SCFM (min.) of oil free air

2. Discharge pressure: ________psig, continuous service

3. Compressor type: Single stage, double acting, straight line, water cooled, heavy duty, non-lubricated cylinder construction and arranged to operate in (vertical) (horizontal) position.

4. Operating conditions:

   a. Fluid handled: ____________

   b. Ave. Mol. Wt.: ____________

   c. Ave. Rel. Humidity: ________

   d. Inlet air temperature: ____________

   e. Altitude: ____________Ft.

   f. Cooling water temperature: ____________$^{o}$F Max.

5. Materials of construction: ____________

6. Electric motor requirements:

   a. ________Hp (min.), ________V, 60 cycle, 3 phase

   b. Continuous duty rating for ________$^{o}$C rise and shall meet NEMA Standards.

   c. Other: ______________________________________________

7. Accessories Required:

   a. V-belt drive

   b. Belt guard per HAPO Std. M-4-6

   c. Inlet air filter

   d. Discharge line check valve

8. Compressor regulation and controls required:

   a. Continuous regulation ________

   b. Automatic stop and start control ________

   c. Dual control ________

9. Maximum space limitations for compressor:

   a. Length: ________Ft.
   b. Width: ________Ft.
   c. Height: ________Ft.

10. Special Requirements: ______________________________________________

HWS- __________

PAGE __________

| E.P. NO. | QTY. |
|---|---|
| | |
| | |
| | |

DATA SHEET

PROJECT - NO.

Additional Specifications:

Prepared by: __________ Approved: __________ Date: __________

# PRESSURE PIPING COMPLETION RECORD

| AREA NO. | BUILDING OR FACILITY NO. | LOCATION | DATE |
|---|---|---|---|
| | | | |

DESCRIPTION OF PIPING (IF NECESSARY USE ADDITIONAL SHEETS)

MAX. ALLOWABLE WORKING PRESSURE ______ PSI TEMPERATURE ______ F

TEMPERATURE CORRECTION ______ % AND ______ PSI

APPLICABLE DRAWINGS OR SPECIFICATIONS

PIPE MATERIAL SPECIFICATIONS (ASTM, ETC.)

| ORIGINAL CONSTRUCTION | MODIFICATION | REPAIR | JOB ORDER (PROJECT NO., CONTRACT NO., OR W.O.NO.) |
|---|---|---|---|
| | | | |

FABRICATOR (NAME OF PLANT FORCE FACILITY, COST PLUS FF CONTRACTOR, LUMP SUM CONTRACTOR)

WELDING DONE IN ACCORDANCE WITH QUALIFIED WELDING PROCEDURE NOS.

FILLER MATERIAL (ASTM AND TYPE)

WELDERS OR WELDING OPERATORS WELD IDENTIFICATION NO. AND DATE LAST QUALIFIED

TEST PERFORMED:

SECTION X-RAY *** FLUID PENETRANT OTHER **

HYDROSTATIC TEST PRESSURE ______ PSI AND TEMPERATURE ______ F MET TEST REQS. ______

PIPE MATERIAL, FITTINGS, SIZES, SCHEDULES AND RATINGS CONFORMS TO DRAWINGS AND SPECIFICATIONS ? ☐ YES ☐ NO

PRESSURE RELIEF VALVES AND DEVICES INSTALLED IN ACCORDANCE WITH CODES ☐ YES ☐ NO

PRESSURE RELIEF VALVES -(CROSS OUT INAPPLICABLE) – (BURSTING DISC) – (TESTED) (TAGGED) AT ______ PSI

INSTALLATION, WELDING AND TESTING DONE ACCORDING TO ASA B31.1 PLUS ADDITIONAL REQUIREMENTS IMPOSED BY APPLICABLE SPECS OR DWGS. ☐ YES ☐ NO *

REMARKS:

* IF "NO" GIVE DETAILS IN "REMARKS"
** DESCRIBE IN "REMARKS"
*** SPOT ______ % 100%

(CODE PIPING SYSTEMS ARE SUBJECT TO THIRD-PARTY INSPECTION: DATA BELOW IS REQUIRED FOR SUCH SURVEILLANCE.)

INFORMATION REQUIRED FOR THIRD-PARTY INSPECTION

1. FULL SET OF DRAWINGS AND SPECIFICATIONS.
2. ALL APPLICABLE WELDING PROCEDURE QUALIFICATION SHEETS.
3. ALL OPERATOR PERFORMANCE QUALIFICATION SHEETS.
4. NON – DESTRUCTIVE TEST RESULTS SHEETS, INCLUDING RADIOGRAPHS.
5. CERTIFIED MILL TEST REPORTS ON ALL MATERIAL AND COMPONENTS USED.
6. WELDER STAMPED JOINTS LEFT UNCOVERED BY PIPE COVERERS SO THAT JOINTS MAY BE INSPECTED.

CERTIFIED CORRECT:

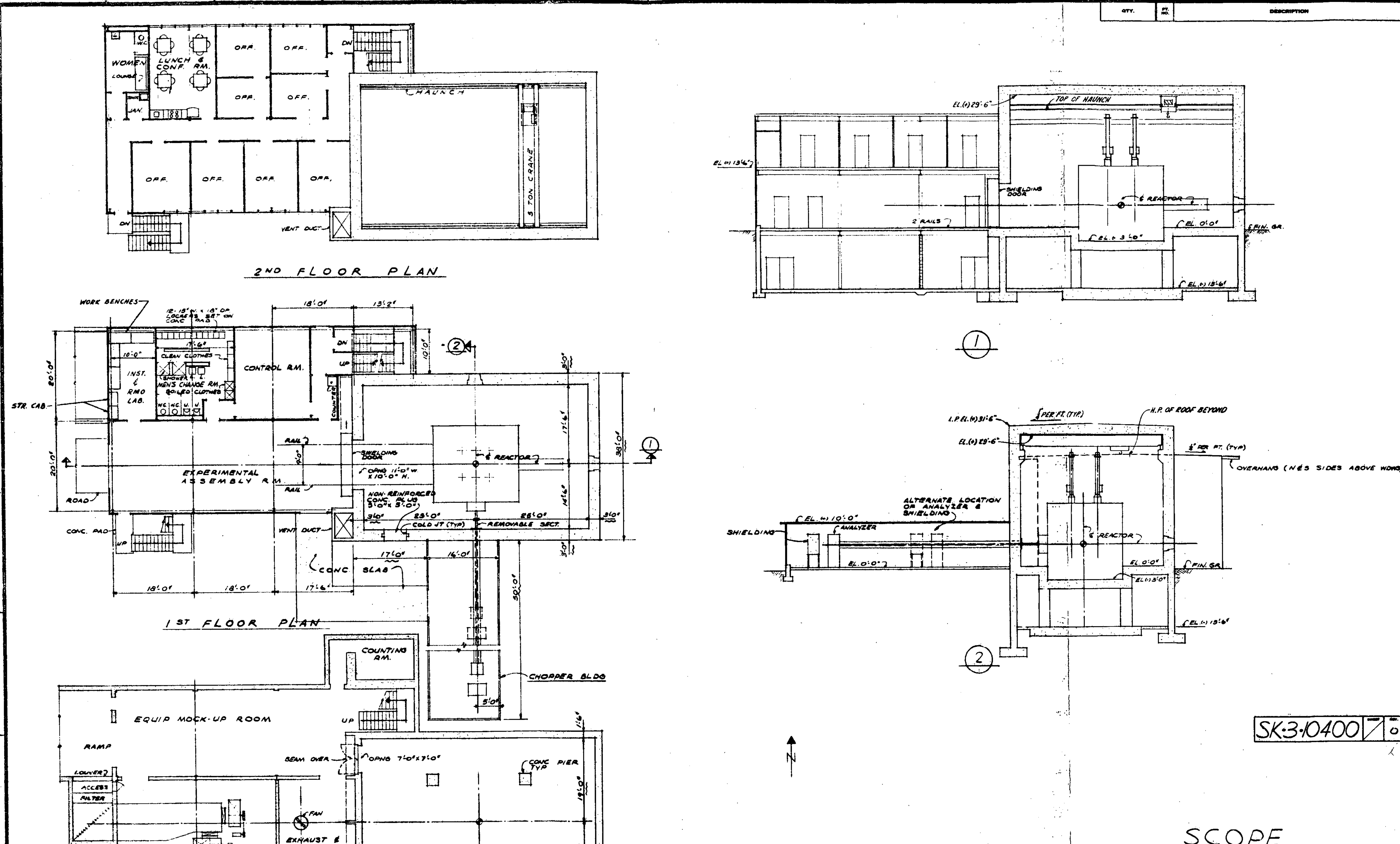
FABRICATOR ______

TESTS WITNESSED BY:

INSPECTOR ______

REVIEWED AND APPROVED BY:

ENGINEER ______




SCOPE

SK-3-10400 0

| REF. NO. | DWG. NO. | DRAWING TITLE |
| --- | --- | --- |
| | SK-3-10403 | COOLING GAS FLOW DIAGRAM |
| | SK-3-10402 | LIFTING MECH ARRGT |
| | SK-3-10401 | REACTOR SECTS & DETS |
| | SK-3-10449 | PLOT PLAN |

REFERENCE DRAWINGS

NEXT USED ON

REVISIONS

CHECK PRINT | COMMENT PRINT

ISSUE NO. 5

SCALE 0 — 8 FT

DRAWN L.R. LADOLCEUR

PROJECT CAH-100 | INST. NO. W-11992

DATE 1/25/63

APPROVED FOR CONST.

APPROVED FOR PURCHASE

APPROVED FOR DESIGN

CLASSIFICATION NONE

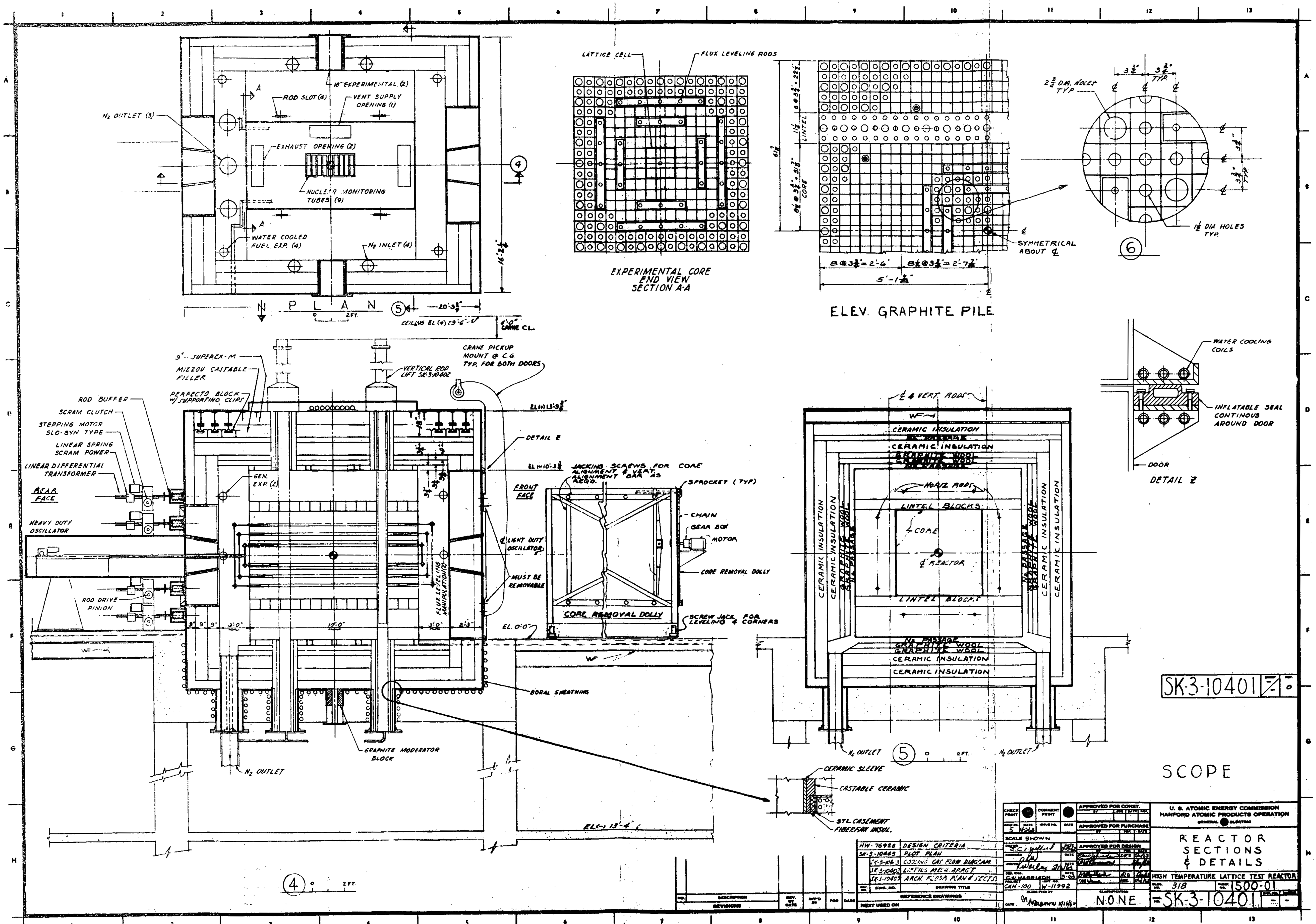
U. S. ATOMIC ENERGY COMMISSION
HANFORD ATOMIC PRODUCTS OPERATION
GENERAL ELECTRIC

ARCHITECTURAL FLOOR PLANS & SECTIONS

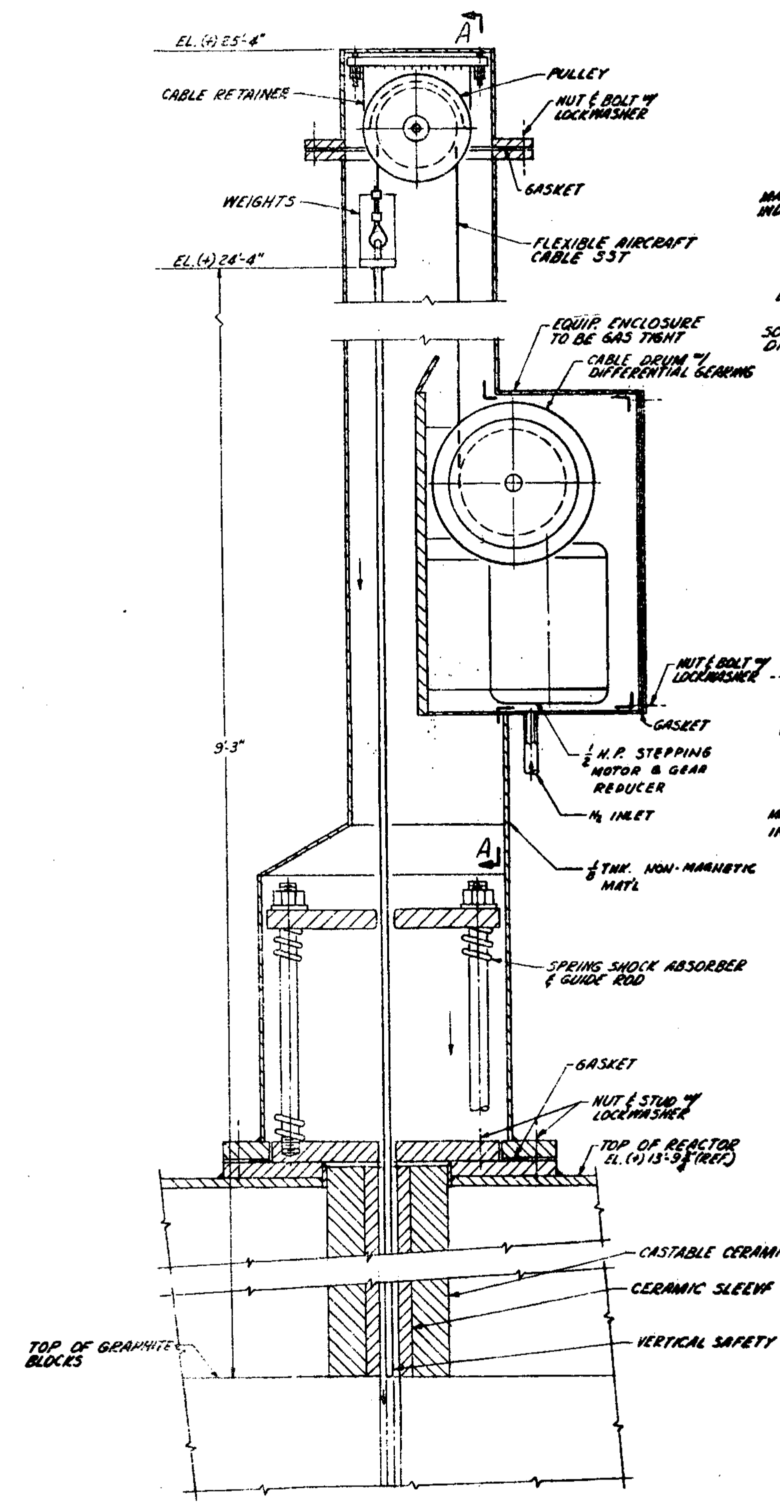
HIGH TEMPERATURE LATTICE TEST REACTOR

BLDG. NO. 318 | INDEX NO. 0800.01

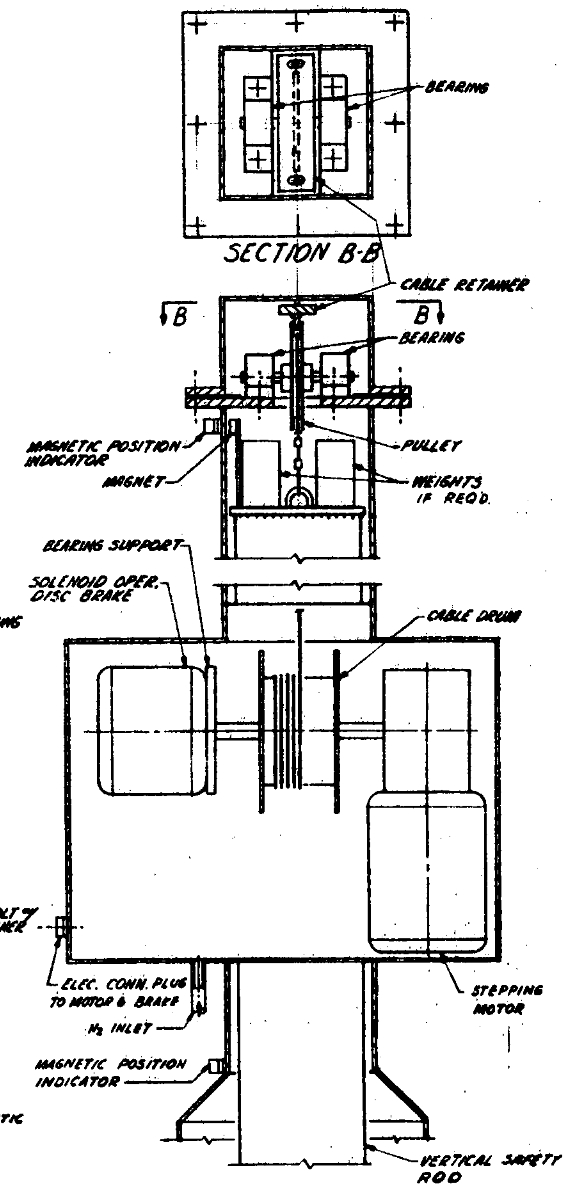
DWG. NO. SK-3-10400



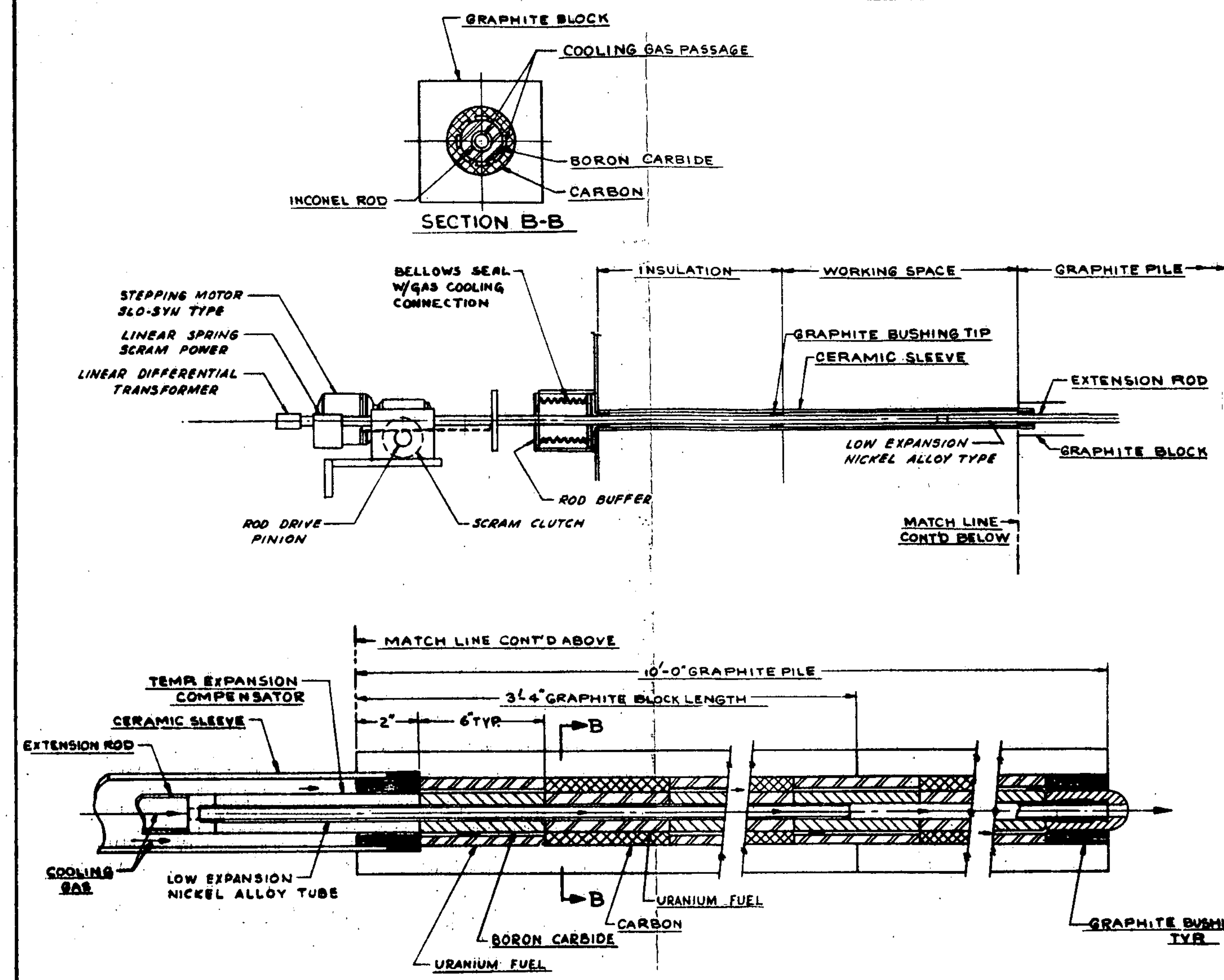
PLAN
18" EXPERIMENTAL (2)
ROD SLOT (4)
VENT SUPPLY OPENING (1)
N2 OUTLET (3)
EXHAUST OPENING (2)
NUCLEAR MONITORING TUBES (9)
WATER COOLED FUEL EXP. (4)
N2 INLET (4)
16'-2¼"
20'-3¾"
CEILING EL (+) 29'-6"
4'-0" CRANE CL.
LATTICE CELL
FLUX LEVELING RODS
EXPERIMENTAL CORE END VIEW SECTION A-A
LINTEL
CORE
8@3⅜"=2'-6"
8½@3⅜"=2'-7⅞"
5'-1⅞"
SYMMETRICAL ABOUT ℄
ELEV. GRAPHITE PILE
2⅝ DIA. HOLES TYP.
1½ DIA HOLES TYP.
9" JUPEREX-M
MIZZOU CASTABLE FILLER
PERFECTO BLOCK W/ SUPPORTING CLIPS
VERTICAL ROD LIFT SK-3-10402
CRANE PICKUP MOUNT @ C.G. TYP. FOR BOTH DOORS
EL(+)13'-9¾"
DETAIL E
EL(+)10'-3¾"
ROD BUFFER
SCRAM CLUTCH
STEPPING MOTOR SLO-SYN TYPE
LINEAR SPRING SCRAM POWER
LINEAR DIFFERENTIAL TRANSFORMER
REAR FACE
HEAVY DUTY OSCILLATOR
GEN. EXP. (2)
FRONT FACE
LIGHT DUTY OSCILLATOR
FLUX LEVELING MANIPULATOR(2)
MUST BE REMOVABLE
ROD DRIVE PINION
10'-0"
EL. 0'-0"
BORAL SHEATHING
GRAPHITE MODERATOR BLOCK
N2 OUTLET
EL(-) 13'-4"
JACKING SCREWS FOR CORE ALIGNMENT & VERT. ALIGNMENT BAR AS REQD.
SPROCKET (TYP)
CHAIN
GEAR BOX
MOTOR
CORE REMOVAL DOLLY
SCREW JACK FOR LEVELING & CORNERS
℄ & VERT. RODS
CERAMIC INSULATION
GRAPHITE WOOL
N2 PASSAGE
HORIZ. RODS
LINTEL BLOCKS
CORE
℄ REACTOR
WATER COOLING COILS
INFLATABLE SEAL CONTINOUS AROUND DOOR
DOOR
DETAIL Z
CERAMIC SLEEVE
CASTABLE CERAMIC
STL. CASEMENT
FIBERFAX INSUL.
SK-3-10401
SCOPE
HW-76928 DESIGN CRITERIA
SK-3-10403 PLOT PLAN
COOLING GAS FLOW DIAGRAM
SK-3-10403 LIFTING MECH. ARRGT.
SK-3-10405 ARCH. FLOOR PLAN & SECTS.
REFERENCE DRAWINGS
REVISIONS
NEXT USED ON
U. S. ATOMIC ENERGY COMMISSION
HANFORD ATOMIC PRODUCTS OPERATION
GENERAL ELECTRIC
REACTOR SECTIONS & DETAILS
HIGH TEMPERATURE LATTICE TEST REACTOR
SCALE SHOWN
C.W. HARRISON
CAH-100
W-11992
318
500-01
NONE
SK-3-10401




VERTICAL ROD & LIFTING EQUIP. ARR'G'T.




SECTION A-A




HORIZONTAL CONTROL ROD ARRGT.

SK-3-10402 / 0

SCOPE

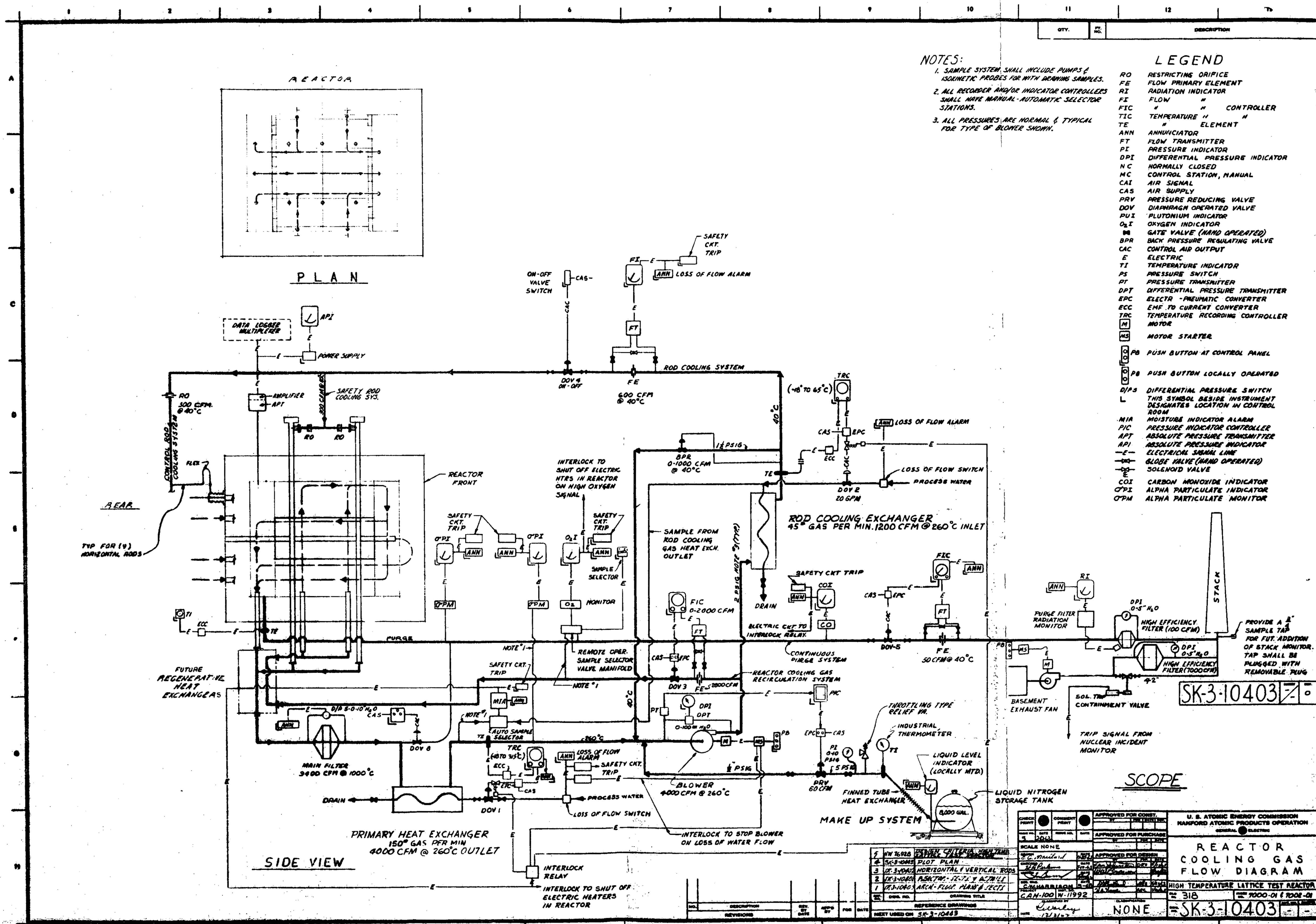
| Dwg. No. | Drawing Title |
| --- | --- |
| HW-76928 | DESIGN CRITERIA |
| SK-3-10463 | PLOT PLAN |
| SK-3-10400 | COOLING GAS FLOW DIA. |
| SK-3-10401 | REACTOR SECTIONS & DETAILS |
| SK-3-10403 | MAIN FLOOR PLAN & SECT'S |

REFERENCE DRAWINGS

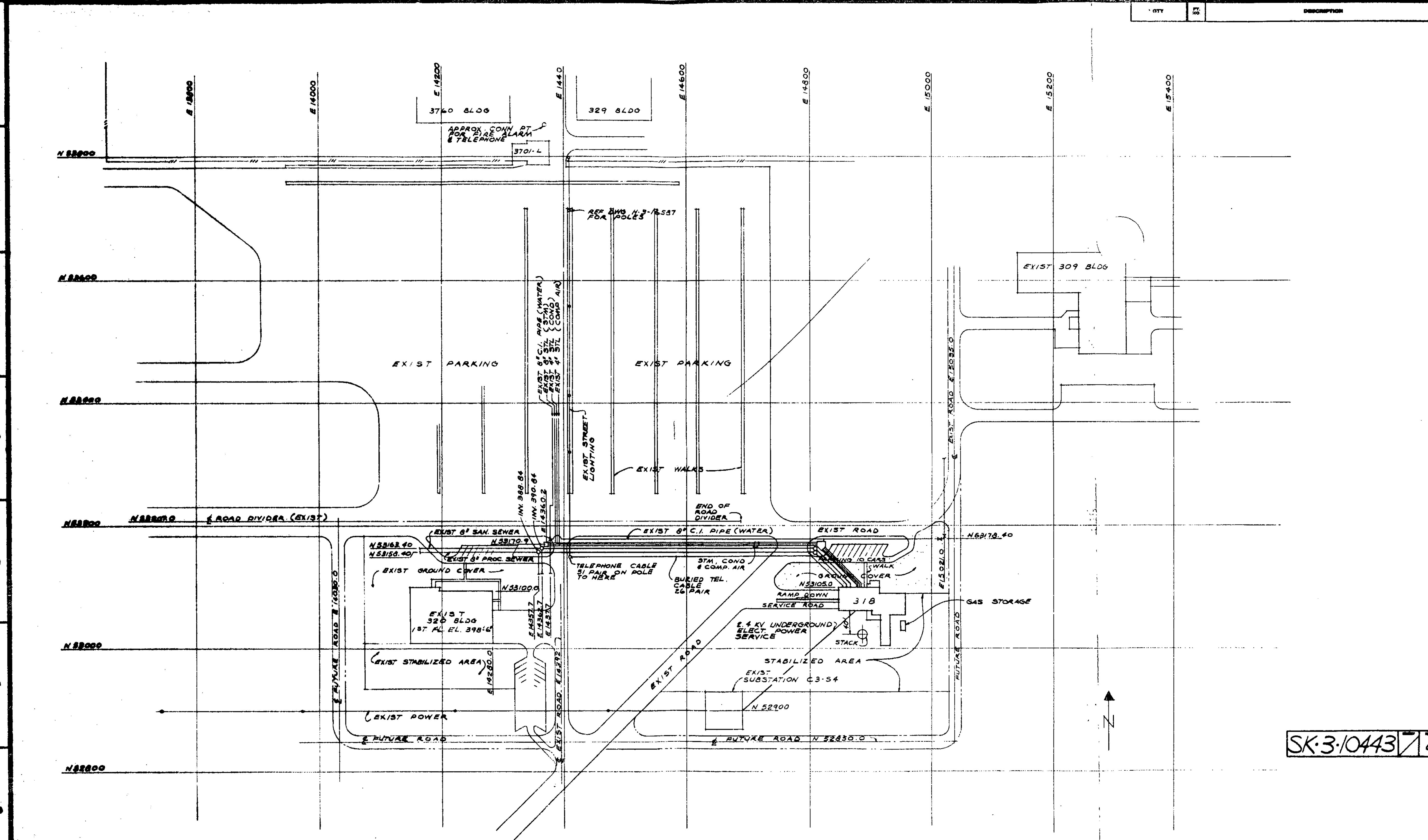
U. S. ATOMIC ENERGY COMMISSION
HANFORD ATOMIC PRODUCTS OPERATION
GENERAL ELECTRIC

HORIZONTAL AND VERTICAL ROD ARRANGEMENTS

SCALE NONE
R. DAHL
C.H. HARRISON
CAH-100 W-11992
318 1900
NONE
SK-3-10402



NOTES:
1. SAMPLE SYSTEM SHALL INCLUDE PUMPS & ISOKINETIC PROBES FOR WITH DRAWING SAMPLES.
2. ALL RECORDER AND/OR INDICATOR CONTROLLERS SHALL HAVE MANUAL-AUTOMATIC SELECTOR STATIONS.
3. ALL PRESSURES ARE NORMAL & TYPICAL FOR TYPE OF BLOWER SHOWN.
LEGEND
RO RESTRICTING ORIFICE
FE FLOW PRIMARY ELEMENT
RI RADIATION INDICATOR
FI FLOW " "
FIC " " CONTROLLER
TIC TEMPERATURE " "
TE " ELEMENT
ANN ANNUNCIATOR
FT FLOW TRANSMITTER
PI PRESSURE INDICATOR
DPI DIFFERENTIAL PRESSURE INDICATOR
NC NORMALLY CLOSED
MC CONTROL STATION, MANUAL
CAI AIR SIGNAL
CAS AIR SUPPLY
PRV PRESSURE REDUCING VALVE
DOV DIAPHRAGM OPERATED VALVE
PUI PLUTONIUM INDICATOR
O2I OXYGEN INDICATOR
GATE VALVE (HAND OPERATED)
BPR BACK PRESSURE REGULATING VALVE
CAC CONTROL AIR OUTPUT
E ELECTRIC
TI TEMPERATURE INDICATOR
PS PRESSURE SWITCH
PT PRESSURE TRANSMITTER
DPT DIFFERENTIAL PRESSURE TRANSMITTER
EPC ELECTR.-PNEUMATIC CONVERTER
ECC EMF TO CURRENT CONVERTER
TRC TEMPERATURE RECORDING CONTROLLER
M MOTOR
MS MOTOR STARTER
PB PUSH BUTTON AT CONTROL PANEL
PB PUSH BUTTON LOCALLY OPERATED
D/PS DIFFERENTIAL PRESSURE SWITCH
THIS SYMBOL BESIDE INSTRUMENT DESIGNATES LOCATION IN CONTROL ROOM
MIA MOISTURE INDICATOR ALARM
PIC PRESSURE INDICATOR CONTROLLER
APT ABSOLUTE PRESSURE TRANSMITTER
API ABSOLUTE PRESSURE INDICATOR
—E— ELECTRICAL SIGNAL LINE
GLOBE VALVE (HAND OPERATED)
SOLENOID VALVE
COI CARBON MONOXIDE INDICATOR
αPI ALPHA PARTICULATE INDICATOR
αPM ALPHA PARTICULATE MONITOR
REACTOR
PLAN
SIDE VIEW
REAR
REACTOR FRONT
TYP FOR (4) HORIZONTAL RODS
DATA LOGGER MULTIPLEXER
POWER SUPPLY
AMPLIFIER
APT
SAFETY ROD COOLING SYS.
RO 300 CFM @ 40°C
CONTROL ROD COOLING SYSTEM
ROD COOLING SYSTEM
DOV 4 ON-OFF
FE 600 CFM @ 40°C
ON-OFF VALVE SWITCH
SAFETY CKT. TRIP
LOSS OF FLOW ALARM
(-18° TO 65°C)
TRC
EPC
ECC
DOV 2 20 GPM
LOSS OF FLOW SWITCH
PROCESS WATER
BPR 0-1000 CFM @ 40°C
ROD COOLING EXCHANGER 45# GAS PER MIN. 1200 CFM @ 260°C INLET
SAMPLE FROM ROD COOLING GAS HEAT EXCH. OUTLET
INTERLOCK TO SHUT OFF ELECTRIC HTRS IN REACTOR ON HIGH OXYGEN SIGNAL
SAMPLE SELECTOR
MONITOR
REMOTE OPER. SAMPLE SELECTOR VALVE MANIFOLD
SAFETY CKT TRIP
CONTINUOUS PURGE SYSTEM
ELECTRIC CKT TO INTERLOCK RELAY
FIC 0-2000 CFM
REACTOR COOLING GAS RECIRCULATION SYSTEM
DOV 3
DRAIN
FIC
FE 50 CFM @ 40°C
DOV-5
PURGE FILTER RADIATION MONITOR
HIGH EFFICIENCY FILTER (100 CFM)
DPI 0-5" H2O
HIGH EFFICIENCY FILTER (7000 CFM)
STACK
PROVIDE A 3/4" SAMPLE TAP FOR FUT. ADDITION OF STACK MONITOR. TAP SHALL BE PLUGGED WITH REMOVABLE PLUG
BASEMENT EXHAUST FAN
SOL. TRIP CONTAINMENT VALVE
TRIP SIGNAL FROM NUCLEAR INCIDENT MONITOR
SCOPE
FUTURE REGENERATIVE HEAT EXCHANGERS
PURGE
MAIN FILTER 3400 CFM @ 1000°C
D/P S-0-10" H2O
DOV 6
AUTO SAMPLE SELECTOR
TRC (46 TO 45°C)
LOSS OF FLOW ALARM
BLOWER 4000 CFM @ 260°C
THROTTLING TYPE RELIEF VA.
INDUSTRIAL THERMOMETER
LIQUID LEVEL INDICATOR (LOCALLY MTD.)
PRV 60 CFM
FINNED TUBE HEAT EXCHANGER
LIQUID NITROGEN STORAGE TANK
3,000 GAL.
MAKE UP SYSTEM
DRAIN
DOV 1
LOSS OF FLOW SWITCH
PRIMARY HEAT EXCHANGER 150# GAS PER MIN 4000 CFM @ 260°C OUTLET
INTERLOCK TO STOP BLOWER ON LOSS OF WATER FLOW
INTERLOCK RELAY
INTERLOCK TO SHUT OFF ELECTRIC HEATERS IN REACTOR
SK-3-10403
U. S. ATOMIC ENERGY COMMISSION
HANFORD ATOMIC PRODUCTS OPERATION
GENERAL ELECTRIC
REACTOR COOLING GAS FLOW DIAGRAM
HIGH TEMPERATURE LATTICE TEST REACTOR
CAH-100
W-11992
NONE
NEXT USED ON SK-3-10403
REFERENCE DRAWINGS
PLOT PLAN
HORIZONTAL & VERTICAL RODS




SCOPE

| REF. NO. | DWG. NO. | DRAWING TITLE |
|---|---|---|
| | SK-3-10380 | PLOT PLAN |
| | SK-3-1064 | HTLTR TOPOGRAPHIC MAP |
| | H-3-16587 | 300 AREA PARKING LOT |
| | SK-3-10400 | ARCH PL. PLANS & SECTS |

REFERENCE DRAWINGS

NEXT USED ON

| NO. | DESCRIPTION | REV. BY DATE | APP'D BY | FOR | DATE |
|---|---|---|---|---|---|

REVISIONS

SCALE 1" = 60 FT

PROJECT CAH-100 INST. NO. W-11992

DATE 3-28-63

CLASSIFICATION NONE

U. S. ATOMIC ENERGY COMMISSION
HANFORD ATOMIC PRODUCTS OPERATION
GENERAL ELECTRIC

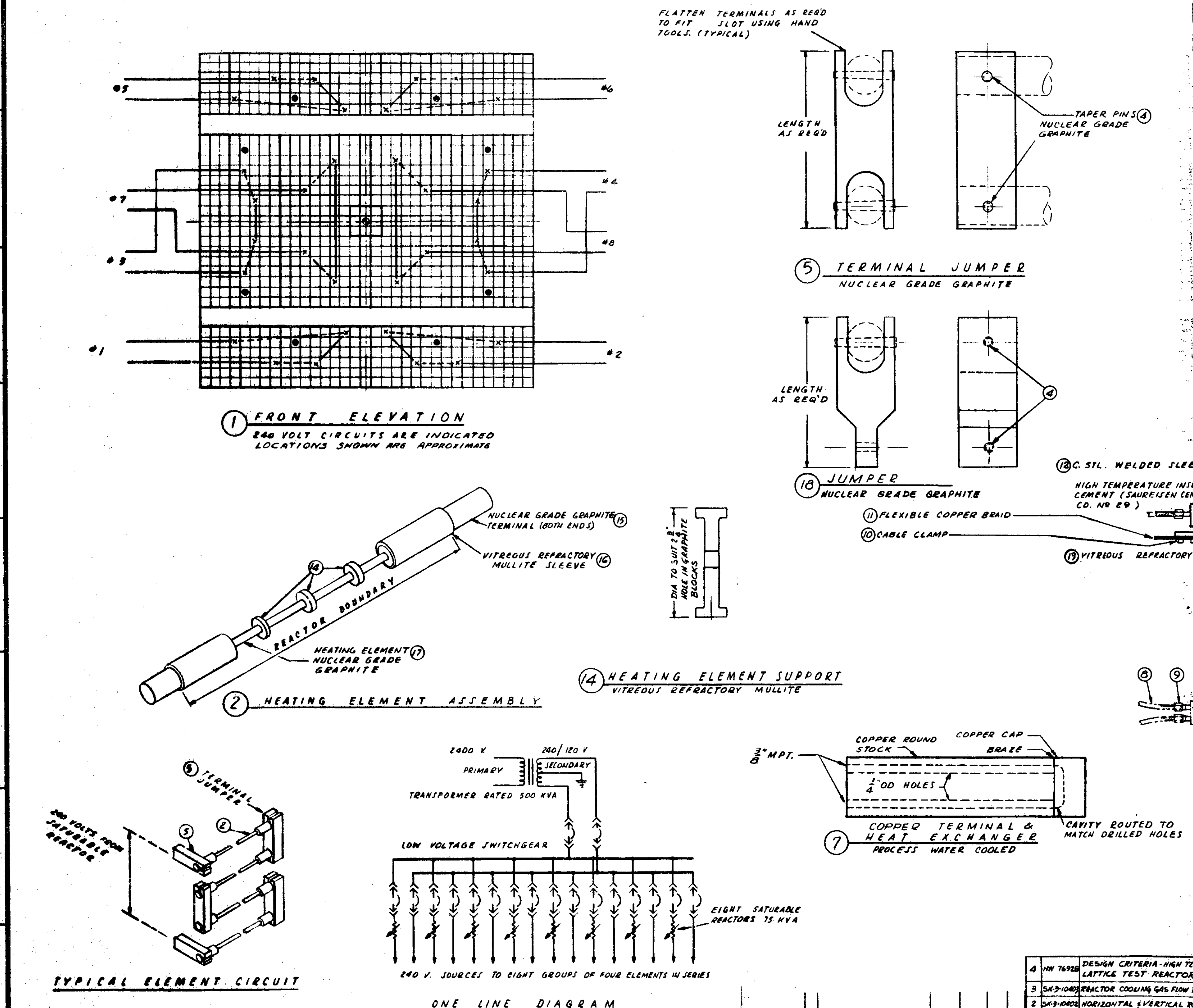
# PLOT PLAN

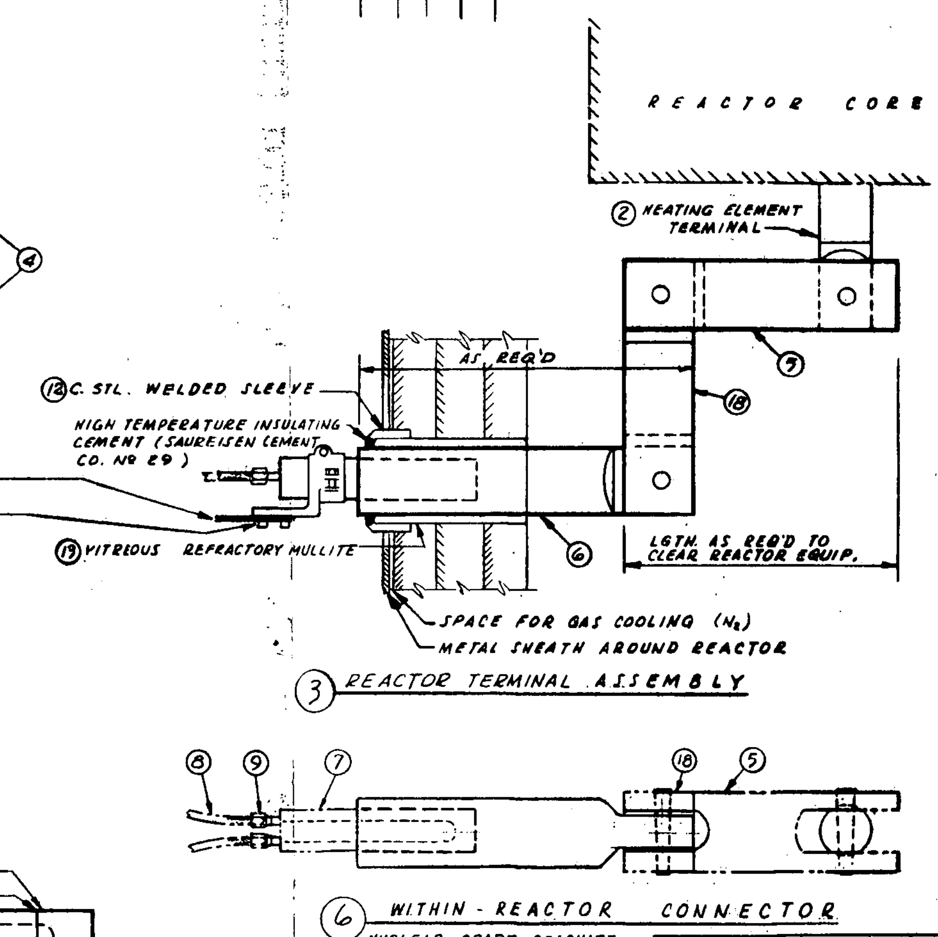
HIGH TEMPERATURE LATTICE TEST REACTOR

BLDG. NO. 318 INDEX NO. 0110.01

DWG. NO. SK-3-10443

SK-3-10443 / 0




| QTY. | | | PT. NO. | DESCRIPTION |
|---|---|---|---|---|
| | | X | 1 | ELECTRICAL HEATING ARRANGEMENT |
| | X | 8 | 2 | HEATING ELEMENT ASSEMBLY |
| X | | 16 | 3 | REACTOR TERMINAL ASSEMBLY |
| A.R | | | 4 | TAPER PIN |
| 1 | | | 5 | TERMINAL JUMPER |
| 1 | | | 6 | WITHIN-REACTOR CONNECTOR |
| 1 | | | 7 | COPPER TERMINAL & HEAT EXCHANGER |
| 2 | | | 8 | NON METALLIC FLEXIBLE HOSE 36" LGTH |
| A R | | | 9 | HOSE FITTINGS |
| 1 | | | 10 | CABLE CLAMP |
| A R | | | 11 | COPPER BRAID |
| 1 | | | 12 | SLEEVE |
| 1 | | | 13 | SLEEVE |
| | 3 | | 14 | HEATING ELEMENT SUPPORT |
| | 2 | | 15 | TERMINAL |
| | 2 | | 16 | SLEEVE |
| | 1 | | 17 | HEATING ELEMENT |
| 1 | | | 18 | JUMPER |

SK-3-10605 / 0

NOTES

1. VITREOUS REFRACTORY MULLITE SPECIFIED HEREIN SHALL BE MCDANEL CERAMICS NO. MV33 OR EQUAL
2. FLAT SURFACES SHALL BE MILLED TO A DRIVE FIT IN ORDER TO PROVIDE SUFFICIENT ELECTRICAL CONDUCTION ACROSS EACH CONNECTION POINT.

SCOPE

| REF. NO. | DWG. NO. | DRAWING TITLE |
|---|---|---|
| 4 | HW 76928 | DESIGN CRITERIA - HIGH TEMP LATTICE TEST REACTOR |
| 3 | SK-3-10403 | REACTOR COOLING GAS FLOW DIAG |
| 2 | SK-3-10402 | HORIZONTAL & VERTICAL RODS |
| 1 | SK-3-10401 | REACTOR SECTIONS & DETAILS |

REFERENCE DRAWINGS

NEXT USED ON

NO. | DESCRIPTION | REV. BY DATE | APP'D BY | FOR | DATE

REVISIONS

CHECK PRINT | COMMENT PRINT

ISSUE NO. 1 DATE 9-15-...

SCALE NONE

DRAWN D.E. Taylor

PROJECT CAH-100 | W 11992

CLASSIFIED BY Jim Burns

DATE 4-11-63

APPROVED FOR CONST.

APPROVED FOR PURCHASE

APPROVED FOR DESIGN

CLASSIFICATION NONE

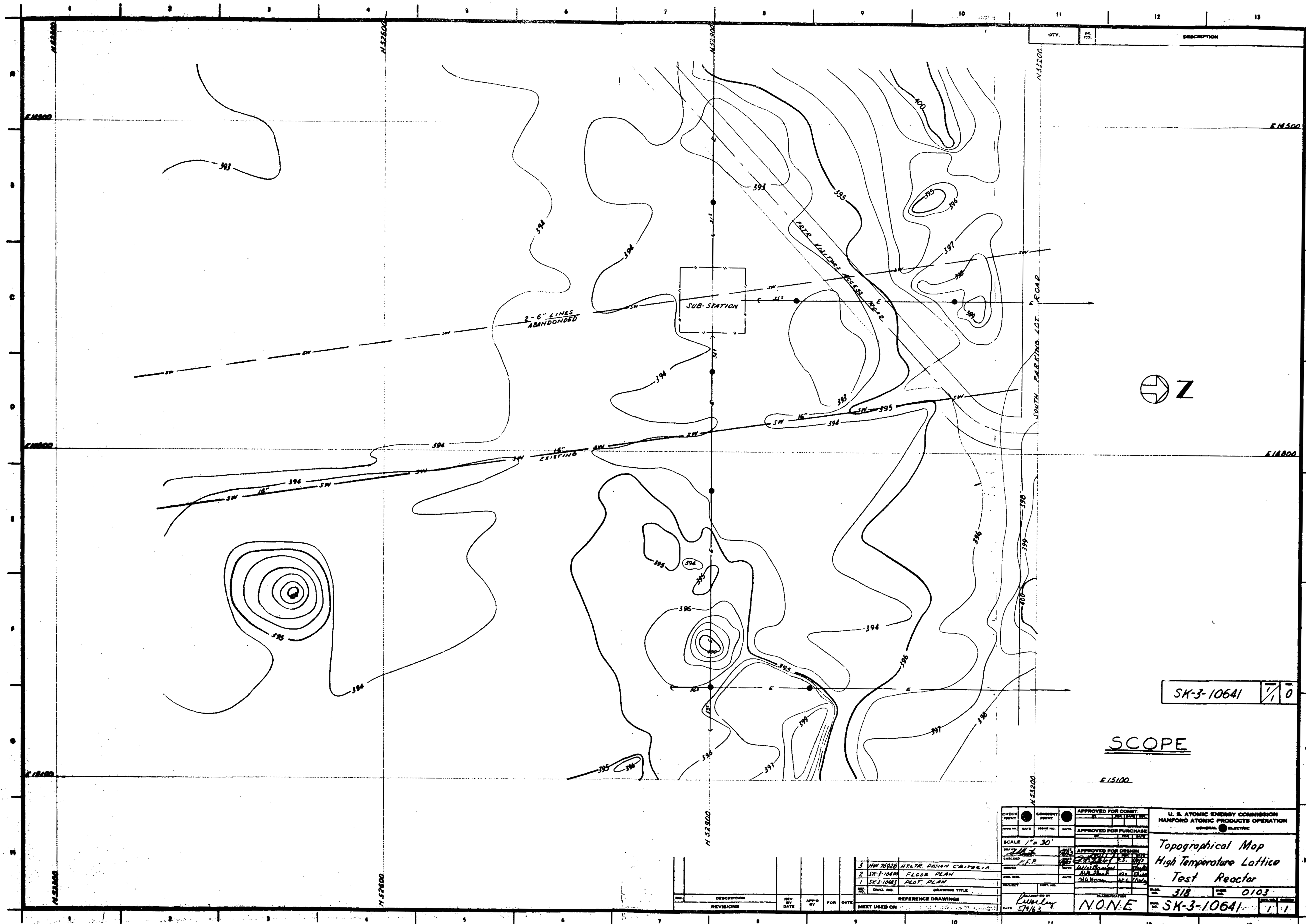
U. S. ATOMIC ENERGY COMMISSION
HANFORD ATOMIC PRODUCTS OPERATION
GENERAL ELECTRIC

ELECTRICAL
HEATING ARRANGEMENT
ELEVATION AND DETAILS

HIGH TEMPERATURE LATTICE TEST REACTOR

BLDG. NO. 318 | INDEX NO. 730101

DWG. NO. SK-3-10605



SK-3-10641 1/1 0
SCOPE
Z
SUB-STATION
2-6" LINES ABANDONDED
16" EXISTING
16"
PATR. VISITORS ACCESS ROAD
SOUTH PARKING LOT ROAD
E15100
E14500
E14800
N52900
N53200
N52600
393
394
395
396
397
398
399
400
SW
U. S. ATOMIC ENERGY COMMISSION
HANFORD ATOMIC PRODUCTS OPERATION
GENERAL ELECTRIC
Topographical Map
High Temperature Lattice
Test Reactor
SCALE 1" = 30'
CHECKED P.F.P.
3 HW 76928 HTLTR DESIGN CRITERIA
2 SK-3-10400 FLOOR PLAN
1 SK-3-10443 PLOT PLAN
REF. NO. DWG. NO. DRAWING TITLE
REFERENCE DRAWINGS
NEXT USED ON
NO. DESCRIPTION REV. BY DATE APP'D BY FOR DATE
REVISIONS
CHECK PRINT
COMMENT PRINT
APPROVED FOR CONST.
APPROVED FOR PURCHASE
APPROVED FOR DESIGN
CLASSIFIED BY
DATE 5/9/63
CLASSIFICATION
NONE
318
0103
SK-3-10641
1 1