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C-431 B - SCOPE DOCUMENT

105-C Reactor Plant

GENERAL ELECTRIC COMPANY
HANFORD WORKS

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C-431-B - SCOPE DOCUMENT

INTRODUCTION

This document describes the scope of the C-431-B Reactor Production Facility. In dealing with the broad phases of the project, it includes the Sections "A" (Scope Modifications) of the approved Design Criterion, modified to ensure correctness to date.

Location of the facility has been set as shown on the site map in HDC-2101, designated site number one.

Included in Project C-431-B are the 105-C Building, including within that building facilities previously located in the 1608 Building, a contaminated effluent crib adjacent to 105-C, and gas facilities using the 115-B Building interconnected with 105-C. Also included are an oil shed, a thimble storage cave, a badge house, and an exclusion fence.

Building services and process lines will be considered part of the project to a location nominally five feet outside of 105-C.

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C-431-B - SCOPE DOCUMENTARCHITECTURE - STRUCTURE

1. Concrete block construction used in "H" shall be replaced by Transite siding, Cemesto board, or equivalent, except as noted below. For 105-H building areas now utilizing concrete block, substitutions shall be made as specified below:
 - a. Exterior walls in the vicinity of the lunch room, offices No. 1 and 2, electrical equipment rooms, dummy storage room, metal storage room, compressor room No. 1, etc., are to be poured concrete. All interior walls on the first floor which are concrete block in 105-H are to be replaced with Hauserman metal partitions or equivalent, with the exception of the control room.
 - b. Additional bomb blast protection shall be provided for the control room. Control room walls shall be reinforced concrete two to three feet thick, preferably three feet. The ceiling of the control room shall be substantially reinforced -- at least one foot of concrete.
 - c. The secondary shield walls (three feet) shall be reinforced for bomb blast protection.
 - d. The wall between the top of the pile and the "D" machinery room shall be reinforced concrete six to eight inches thick. Any openings in the wall shall be shielded against radiation to the extent allowed by the wall itself.
 - e. The walls surrounding the sample rooms shall be reinforced concrete.
2. Changes shall be made in 105-C building structure to meet zone 2 earthquake requirements of the Uniform Pacific Coast Building Code.
3. Two rooms for the housing and maintenance of proposed continuous charging and discharging equipment shall be provided. Inside room dimensions shall be 8 feet high by 8 feet deep by 12 feet wide, including an 8 foot clear span when the doors are open. The rooms shall be located one over the other to take advantage of the common services. Steel doors, similar to those for present tool dolly rooms, shall be provided.
4. Minor foundation changes are needed to incorporate the tubes for the Ball 3X System passing from the VSR slots to the -12 Near level (reactor development room in "H"). The slab floor of the reactor development room is to be eliminated and stairs shall permit access to the lowest level from the service tunnel.

In the upper portion of the foundation, forty-five tubes shall be cast integrally with the concrete to carry the 3X balls from the bottom of the reactor to the foundation tunnels.

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Architecture - Structure (continued) - 2 -

5. The present gas wing shall be reduced in size to house ventilation equipment and the equivalent of the 1608-H sewage lift station. The re-designed wing shall have poured concrete walls.
6. The sandwich wall between the inner and outer rod rooms shall be heavy-aggregate concrete instead of steel and concrete as in "H".
7. The process water tunnels shall be enlarged to accommodate three 2 $\frac{1}{4}$ " lines and fittings. Provisions shall be made for replacing check valves.
8. Provisions shall be made for pile effluent sewers of 6 $\frac{1}{4}$ " diameter.
9. The corridor between the work area and the metal and dummy storage rooms shall be eliminated, and a doorway from the work area to the dummy storage room provided.
10. The storage area shall be modified to provide:
 - a. Access to the Viewing Pit from four sides.
 - b. A large viewing pit-weasel pit area.
 - c. A new Special Request Cask Storage Room located adjacent to the transfer area.
11. Provisions shall be made in building foundations and floor loadings to permit removal of 4 ton casks from the front and rear faces to the outside of the pile building.
12. Additional offices shall be provided -- giving a total of ten.

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C-431-B - SCOPE DOCUMENTSERVICE PIPING1. Steam Distribution System

- a. Steam will be supplied at 225 psig through the underground water tunnel from the 190 Building.
- b. A complete steam loop shall be provided so that a portion of the loop may be taken out of service while continuing operation on the remainder of the system.
- c. The two supply points will be connected so that the building distribution system can be fed from either supply.
- d. The loop piping will be sized to provide adequate line capacity feeding the steam services within the building.
- e. Each branch line will be provided with an isolation valve.

2. Compressed Air System

- a. The compressed air system will consist of two 150 cfm, 25 HP air compressors. The steam driven compressor will be eliminated.
- b. A separate instrument air compressor connected to the emergency electrical system will be installed. The air piping from this compressor shall be interconnected with the non-instrument air-piping loop ahead of the drier. The estimated capacity of this system is 30 cfm. The source of compressed air delivered to the instrument supply is to be a Nash Hytor, or equal, water sealed air compressor. Air is to be filtered and dried to a maximum of -30° F dew point by use of a semi-automatic silica gel regenerative type drier.
- c. The system designed in "H" to provide compressed air to the liquid third safety device is to be eliminated in the 105-C assign.

3. Contaminated Waste Disposal

- a. A waste crib of the type currently in use in the 200 Areas is to be constructed for the purpose of disposing of highly contaminated process water. Capacity of the crib is to be approximately 50 gpm.
- b. The line leading to the crib shall originate at the rear face of the pile, where branches of the line shall be provided near both rear face risers.

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4. Vacuum System

- a. A permanent vacuum cleaning system will be installed to service the five faces of the reactor and tunnels beneath the reactor where contamination will occur. A Hoffman or similar type unit will be located in the gas and ventilation tunnel pulling through CWS type filters and discharging to the exhaust stack. Provisions shall be made for the safe removal of the filters.
- b. A vacuum cleaner for under-water use shall be provided.

5. Sewage Lift Station (1608 equivalent)

- a. The piping and mechanical equipment arrangement for the sewage lift station is to be essentially the same as in 1408-H. The entire facility, however, shall be located adjacent to the 105-C fan room as a part of the 105-C Building.
- b. There is to be a trap seal provided on all sewer lines which empty into process lift stations and provisions should be made so that vapors from the sump will be discharged into the ventilation stack.

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C-431-B - SCOPE DOCUMENTELECTRICAL - LIGHTING DESIGN1. Motor Control Centers

- a. The process lift station (1608 equivalent) control center will be located in the fan room wing.
- b. The 110 Building control center is to be eliminated.

2. Instrument Supply

- a. The regulated instrument supply for "C" shall be the same as "H" except for the following:
 1. Motor-generator sets and the inverter shall be sized for "C" loads.
 2. Inverter frequency control shall be an independent type.

3. Safety Circuit

- a. The safety circuits for 105-C and the existing 105-B are to be interconnected so that operation of either circuit simultaneously causes operation of the other circuit. Manual by-passes are to be provided to allow for separate operation of either reactor.

4. Ball 3X System

- The primary functions of the Ball 3X Control Circuits are:
 1. Provision for manual scram.
 2. Trip by low flow, low pressure, or earthquake -- the first two provided the VSR does not drop full length into the pile.
 3. Scram by low voltage of the DC circuit, regardless of the VSR position.
 4. Back-up on standard safety circuits in event of their failure or sabotage.

5. Grounding

An adequate grounding system will be provided. Stack ground is to be connected solidly to the building grid at least at two points. A radial type grid is to be provided at the base of the stack to give easy dissipation of lightning discharges. All other details as used in 105-H will be followed.

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C-431-B SCOPE DOCUMENT

ELEVATORS

The "C" and "D" elevators for 105-C will be similar to 105-H with the following modifications:

1. Over-all elevator frames shall be designed to keep "C" and "D" machines correctly aligned whenever in charging position.
2. Guide rails and followers shall be redesigned to give more accurate positioning.
3. Hydraulic hoses shall be installed on both elevators.
4. Structural supports shall be redesigned to accommodate "C" and "D" machines.
5. The "C" elevator platform shall be widened toward the Work Area.

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C-431-B - SCOPE DOCUMENT

Process Water Requirements

1. Installed capacity shall be 62,000 gpm at 525 psig measured at the top of the riser. "Bottleneck" components are to be sized for 80,000 gpm to accommodate later expansion. Estimated flow vs. pressure is shown in HDC-2043.
2. Transient pressure requirements following electrical power outage are as shown on the curve forming part of HDC-2049. Shutdown flow is 5,000 gpm.
3. Clearwell capacity shall be 21 million gallons (5½ hours at full flow) for the installed plant.
4. The retention basins shall have a total capacity of 18 million gallons (9 million gallons in each of two basins). The nominal retention time is 2½ hours for 62,000 gpm.
5. High tanks similar to 187-H shall be provided having a capacity of 300,000 gallons each (600,000 gallons total). The elevation shall be sufficient to provide a static pressure of 55 psig measured at the top of the riser with tanks full.
6. The hot water recirculation system shall be eliminated.

105 Building Services

1. Electrical Power

- (a) Normal maximum 750 KVA
- (b) Emergency maximum 300 KVA

2. Filtered Water (Normal Usages)

(a) Rod cooling	200 gpm
(b) Cooling loop	400 gpm
(c) Test facilities	50 gpm
(d) Miscellaneous	50 gpm
(e) Storage basin	200 gpm {2000 gpm for filling)
(f) High tank	- - - (6000 gpm emergency)

3. Steam (225 psig)

	<u>Normal</u>	<u>Emergency</u> (Electrical Power Outage)	
		<u>5 seconds</u>	<u>60 seconds</u>
a. Heating (-10°F. day)	19,300 lb/hr	19,300 lb/hr	19,300 lb/hr
b. Emergency Ventilation	- - -	- - -	16,000 lb/hr
c. Steam Siphons (Pumps)	19,760 lb/hr max.	- - -	- - -
d. Other	3,805 lb/hr	3,805 lb/hr	3,805 lb/hr
e. Contingency -10%	4,300 lb/hr	2,300 lb/hr	3,900 lb/hr
 Total	 47,165 lb/hr	 25,405 lb/hr	 43,005 lb/hr

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C-431-B - SCOPE DOCUMENTPROCESS WATER PIPING

1. The design shall provide for a pressure of 525 psig measured at the top of the front face riser and a flow of 80,000 gpm.
2. Process water will be supplied from the 190-C Building through 6-24" pipes. Flange connections will be 600 lb. A.S.A. standard.
3. The hot water recirculating system is to be eliminated.
4. Four inch cross headers on the front and back faces will be spaced every row of process tubes instead of every other row. Provisions will be made for thermal expansion of the cross headers due to temperature fluctuations on front and rear faces. Drop-tight valves or blanking flanges shall be provided so that any one horizontal row of process tubes can be isolated for a hydrostatic pressure test.
5. Provisions shall be made near the ends of each of the rear face cross headers so that removable orifices may be inserted.
6. The concrete enclosure for the downcomers shall be the same as "H". The downcomers shall permit a flow of 80,000 gpm each with water velocities not exceeding those experienced in "H". The emergency bypasses on the crossover line connecting the two rear face risers shall be sized for an emergency flow of 80,000 gpm. The downcomers shall be vented to the stack.
7. The entire downcomer shall be stainless steel, with 5 baffles per downcomer.
8. The effluent line shall be 60" diameter from the pile building to an outside transition box where the diameter shall increase to 66".
9. Earthquake protection for the piping shall be adequate for Zone 2 of the Uniform Building Code of the P.C.B.O.C., dated 1950.
10. Two stainless steel risers similar to the one on the DR pile shall be provided to permit discharge either to the Sewage Lift Station or the contaminated crib. This, plus an oil drain through, shall replace the oil drain system used in "H".

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C-431-B SCOPE DOCUMENTPROCESS ASSEMBLIES

The process assemblies shall include in scope the features shown below:

1. Front face nozzles shall be similar to 100-H.
2. Rear face nozzles shall be two piece nozzles, similar otherwise to 100-H design, to fit Hansen couplings.
3. Front face pigtails shall be similar to 100-H.
4. Flexible connectors shall be of size to provide flow area at least equal to a 1" O.D. tube. These connectors are referred to as "enlarged pigtails."
5. Gun barrels shall be a flexible type, with wall thickness 0.020" less than in 100-H.
6. Process tubes shall be designed for an enlarged annulus, 0.040" greater diameter than in 100-H.
7. Centering flanges shall be similar to 100-H.
8. Bellows shall be modified to enable their removal with a 4" crossheader in each row.
9. Donuts shall be similar to 100-H.

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C-431-B SCOPE DOCUMENTModerator

Design of the moderator involves significant changes from 100-H design:

1. "Coring"

- a. Coring, defined as the overboring of process tube blocks, to increase fringe temperatures and reduce growth, shall be a part of moderator design. A "10-60" pattern shall be overbored from 10 mils in the center to a maximum of 60 mils at the fringe, with 2 intermediate steps.
- b. Centered trunion blocks shall be used for the two outer coring steps; straight trunion blocks shall be used for the two inner coring steps.

2. Undercutting

Straight undercutting shall be used as in 100-H design; however, the dimension of undercut will be reduced from 122 mils to 108 mils.

3. Color Pattern

A three-zone color pattern of graphite grades shall be used:

- a. 1000 tons of "red" graphite in the fringe zone (reflector).
- b. 900 tons of "blue" graphite in the active zone.
- c. 900 tons of "green" graphite in the active zone.

4. Keying

The blocks shall be keyed and/or interlocked to withstand zone two earthquake conditions.

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Shielding

Shielding of the process unit shall be similar to 100-H except as follows:

1. The top row of "E" blocks shall be eliminated from front and rear vertical "B" shields. Side shields shall be shortened correspondingly, in order to support the top shield evenly.
2. The bottom row of "B" blocks shall be eliminated from the rear face "F" shield.
3. To increase the resistance of the front and rear faces to earthquakes, clips shall be provided at the corners of the unit to restrain each horizontal row of "B" blocks.
4. The top shield shall be a seven-foot thick composite steel and heavy-aggregate concrete slab. The concrete shall consist of Portland cement, gradations of limonite ore, and steel punchings.

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TEST OPENINGS AND IRRADIATION FACILITIES

(To be written at a later date).

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VERTICAL SAFETY RODS

Principal features of the vertical rod system which are deviations from 100-H design are:

1. All winches will be on one level, at 80' - 4" elevation, instead of on two levels as at 100-H.
2. The cable will be a flat wire rope, instead of round stranded wire rope.
3. Either an inverted steel thimble or a gland seal shall be substituted for the internal thimble. Design will proceed on a dual basis for these items.
4. The rods shall be 3" diameter cast boron stainless tubing; their penetration into the pile shall be 33" less than in 100-H.
5. In case of cable breakage or power failure, the rod will be decelerated by two hydraulic oil shock struts.
6. Approximately 2500 inhours of controls will accrue from the rods.

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C-431-B - SCOPE DOCUMENTHORIZONTAL CONTROL RODS

The main design features of the horizontal rod system are:

1. Control

About 700 inhours of control will accrue.

2. Rod Structure

- a. Rod tip shall be composed of a round outer aluminum shell with a concentric inner boron-filled can. Actual outer diameter will be 3"; nuclear diameter, 2-3/4".
- b. The rod will be about 3 feet longer than in 100-H, resulting in a correspondingly increased insertion distance into the pile.

3. Rod Drive

The rod drive shall be similar to 100-H.

4. Step Plug

- a. Step plugs filled with heavy aggregate concrete will be used.
- b. Dimensionally, the step plug will be the same as in 100-H except for the bore which shall be circular.

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C-131-B - SCOPE DOCUMENT

Ball BX System

The Ball BX Safety Device replaces the liquid borax solutions and shall include the following features:

1. Control

About 4000 inhours of control (HDC-1863) shall result.

2. Ball Storage

- a. The balls shall be stored in 45 hoppers of approximately 5 cubic feet capacity each, located in the top shield.
- b. The hoppers shall have release gates held closed by a normally energized solenoid.
- c. The plug and release mechanism will be removable.

3. Ball Return

- a. At the base of the vertical rod slots, stainless-steel pipes lead to a gas-tight chain conveyor which will remove the balls to a storage bin at -12'-0" level, near side.
- b. The conveyor shall have a graphite dust scrubber.
- c. At the base of the storage bin shall be a measuring bin of volume equal to one hopper charge.
- d. The measuring bin shall feed a bucket elevator which will lift the balls to winch-level height.
- e. A pipe-and-gravity flow system will convey the balls from the elevator to the hoppers.

4. System Capacity

Two full charges of balls will be accommodated -- one in the storage bin, and one in the hoppers.

5. Balls

The balls will be 3/8" diameter nickel-plated boron steel; 45,000 pounds will be required for one charge.

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C-431-B SCOPE DOCUMENTGAS SYSTEM1. Pile Gas System

The present gas wing is to be reduced to a ventilation fan room wing. Gas system design shall be similar to the "D-DR" arrangement. Design from the expansion joints to the pile shall be the same as "H".

2. Vertical Thimble Gas Purge System

A separate gas handling system shall be provided to purge the vertical safety rod thimbles. The nominal rate of flow into each thimble shall be 0.5 cfm. Gas will be taken from the inlet circulating loop and compressed to 750 psi for storage. A storage capacity of 12,500 standard cubic feet should be provided and should consist of a series flow system of approximately ten tanks. The compressor is to be located in one of the exhaust fan cells and the storage vessels should be located in the far side tunnel. The tank location should be in a part of the tunnel which will provide 3' of concrete for shielding.

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C-431-B - SCOPE DOCUMENTINSTRUMENTATION

The instrumentation of C-431-B project is divided into several systems, for convenience in discussion:

Pile Motion Measurement

1. Rear face measurements shall be made by an optical system replacing the taut wire system used in "H".
2. The top cover measurements shall be as in "H", with the addition of 3 units, giving a total of 9 push-rod and dial systems.
3. Vertical measurements shall be made at the far and near front corners by a vertical telescope, replacing the plumb bob system.
4. At the side shields, several of the existing experimental hole plugs shall be modified to take push rods and dials.
5. Remaining pile motion measurements shall be same as "H".

Power-Level Calculator

The power-level calculator shall be equivalent to "H".

Earthquake Measurement

At a suitable location there shall be 3 seismoscopes for earthquake detection. An alarm light shall be located in the control room; the Ball 3X System will have a trip circuit tied to the seismoscopes.

IBM Accounting

The IBM accounting system shall be equivalent to "DR" design.

Pressure Monitoring

Pressure monitoring shall be the same as "H" with the addition of a row of pressure gauges, one gauge for each crossheader.

Temperature Monitoring

Temperature Monitoring shall be similar to "H", except for improved thermo-couple design and use of selen tubing.

Rapid Temperature Scanner

An addition to the temperature-monitoring system shall be the rapid temperature scanner, described by Working Committee Minutes No. 15 and references therein, to scan 200₄ tubes in 5 seconds.

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Instrumentation (continued)

- 2 -

Water Monitoring

The proposed scope of the water monitoring instrumentation will include a sampling chamber on both ends of each crossheader.

EGST Monitoring

There shall be approximately 319 thermocouples in the moderator. The number of thermocouples in the shield shall be unchanged from "H".

Gas Analysis

Gas analysis equipment shall measure helium, CO₂, oxygen, and CO in any amounts within the range 0% He--100% CO₂ to 60% He--35% CO₂. Moisture determination shall be essentially as in "H".

Gas System

Gas system instrumentation (gas makeup, blowers, etc.) shall be the same as "H".

H. I. Panels

Health Instrument Division panels and locations shall be the same as "H".

Ball 3X Control

Instrumentation aspects of Ball 3X control shall provide for tripping the system in the event of:

1. Extremely low water pressure and failure of the VSR's.
2. Extremely low water flow and failure of the VSR's.
3. Earthquake in excess of Class 6.

An operations control center shall be located at the -12 near level for testing and for replacing balls into their hoppers.

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C-431-B SCOPE DOCUMENTMISCELLANEOUS EQUIPMENTTool Dolly.

The tool dolly shall be identical to "H" except for changes necessitated by the flexible connector and nozzle design on the rear face.

Storage Area.

The pick-up gates and metal manipulator shall be left essentially unchanged from "H" design.

Process Equipment.

The tube cutter, nozzle-attached hand charger, Van Stone flanging tools, hydraulic stuck-slug pushing equipment, expanding mandrels, and pneumatic charger all shall be altered from "H" only to accommodate new nozzle, process tube, and gun barrel design. New equipment shall be designed to remove stuck slugs from front or rear faces.

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Unassigned drawing numbers will be provided at a later date.

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