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Revision III

I

HRT PROCESS FLOWSHEETS

(Revision III)

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HRT PROCESS FLOWSHEETS

The first four process flowsheets were drawn to show the division between the high and low pressure fuel and blanket systems. This necessitated the repetition of certain equipment which fell at the dividing points, such as the let-down heat exchangers, the feed pumps, etc. They were also designed to make it possible to cut the sheets and join them to make one large flowsheet without repetition of equipment or lines.

In general the flowsheet line numbers on the fuel side are a 100 series and the corresponding lines on the blanket side are in a 200 series; i.e., lines 102 and 202 will have the same function in their respective systems.

The current series of HRT approved flowsheets (excluding Chemical Processing) is as follows:

<u>Title</u>	<u>Dwg. No.</u>
Flowsheet Identification Code	D-18330d
Low Pressure Fuel System	D-18295d
High Pressure Fuel System	D-18296d
High Pressure Blanket System	D-18297d
Low Pressure Blanket System	D-18298d
Cooling Water System	D-18240d
Steam System	D-18267d
Waste and Vent System	D-18309d
Refrigeration and Cold Trap System	D-18333d
Steam and Condensate Service System	D-22579c

An equipment Schedule and a brief functional description of each flowsheet is also included. A new Flowsheet Line Schedule (Dwg. A-18329-Revision III) will be issued in the near future.

Instrumentation references are as follows:

<u>Title</u>	<u>Dwg. No.</u>
HRT Instrument Application Tabulation	A-20954
HRT Multipurpose Instruments	D-18360
Instrument Air-Line Schematic 1	D-21039
Instrument Air-Line Schematic 2	D-21040
Instrument Air-Line Schematic 3	D-21041
Instrument Air-Line Schematic 4	D-21042
Instrument Air-Line Schematic 5	D-20989
Instrument Air-Line Schematic 6	D-20981
Instrument Air-Line Schematic 7	D-20982
Instrument Air-Line Schematic 8	D-22625

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- 203-211. Westinghouse PAR Project

FUNCTIONAL DESCRIPTION OF FLOWSHEETS

High Pressure Systems

(Dwgs. D-18296 and 18297)

The reactor core (Item 1) is a 32-inch I.D. pear-shaped vessel made of 5/16 (spherical section) and 3/8 inch (cone section) Zircaloy-2 plate. Fuel solution (UO_2SO_4 in D_2O) enters the bottom of the core (line 103) at 256°C and, at an operating level of 5 Mw, is heated to 300°C as it proceeds upward to the outlet pipe. A "pressurizer" (Item 2), which is electrically heated to a temperature (335°C) which maintains a pressure of 2000 psia, is attached to the top of the outlet piping to prevent boiling in the high pressure circulating system. The effluent stream flows past the pressurizer to the gas separator (Item 3) where directional vanes centrifuge the fluid, thereby forcing small amounts of fission product and radiolytic gases (D_2 and O_2) toward a central hollow hub. Separated gases and some entrained liquid are bled off to the low pressure system via line 113; its path will be described later. Reactor solution flows from the gas separator to the U-tube primary heat exchanger (Item 4) where it is cooled from 300°C to 256°C by transferring heat to the feed-water surrounding the tube bundle. The 243°C saturated steam produced at this point is bled partially to a 345-KVA turbine-generator set (Item 57) and partially to an air-cooled steam condenser (Item 60). Fuel solution flows next to the intake of the 400-gallon-per-minute, canned motor, water-cooled, circulating pump (Item 5), where its pressure is boosted, and is then returned to the core for reheating.

The blanket proper is the annulus formed by the outside of the core and the inside of the pressure vessel (Item 32), which is a 4.4-inch-thick stainless steel clad carbon steel spherical shell having an I.D. of 60 inches. Effective blanket thickness is approximately 13-11/16 inches. Blanket solution (in this case D_2O) enters the pressure vessel at two points (line 203) through nozzles which impart a swirling action to the fluid, and leaves by way of a single outlet (line 200) designed to promote circulation and prevent accumulation of the blanket material (slurry case) at the top of the core tank. The blanket solution, which flows at a rate of 230 gpm, then follows a path which is identical to that of the high pressure fuel system.

Low Pressure Systems

(Dwgs. D-18295 and D-18298)

Gases and some liquid removed at the gas separator are transferred to the low pressure system through a "let-down" heat exchanger (Item 20) -- (a jacketed, water-cooled pipe-line section) which cools the gas-liquid mixture to $\sim 70^\circ\text{C}$. A valve (LCV-145) downstream of the heat exchanger throttles the two-phase stream to approximately atmospheric pressure, and then discharges it to the dump tanks (Items 7a and 7b), which have sufficient capacity to hold all the reactor solution, via an entrainment separator (Item 7e), which imparts a centrifugal separation action to the stream.

Evaporators, which are essentially inclined pipe legs with steam-heated jackets, are built into the dump tanks to insure continuous mixing and to provide the diluting steam necessary to keep the deuterium and oxygen gas mixture non-explosive. A gas-steam mixture flows upward through the wire mesh inside the entrainment separator (Item 7c), and then to the catalytic recombiner (Item 8a) where a bed of platinized alumina pellets converts deuterium and oxygen into water vapor. A steam coil is utilized to keep the catalyst bed dry.

Heavy water is condensed by a water-cooled shell-and-tube condenser (Item 8) following the recombiner, and normally flows back to the dump tanks via lines 119 and 120; however, the condensate may be diverted to a weighed storage tank (Item 14) if it is desired to change the concentration of the reactor fluid. Valving is also arranged to allow for feeding the condensate directly (via line 119) to the feed pump (Item 21) for quick dilution of the high pressure system. Condensate returned to the dump tanks is mixed with fuel solution (~100 liters) stored there, and then fed (via Lines 107 and 109) to the intake of a sealed, diaphragm type, injection pump (Item 21) which returns the liquid to the high pressure circulating system by way of Line 110; the let-down heat exchanger (Item 20), where heat is recovered from line 113; and line 112 which is connected at the exit neck of the core tank. A fuel feed cooler (Item 17) is used to cool the liquid (to ~50°C) being fed to the pump.

Oxygen is added (Items 26a and b) to the circulating fuel system to prevent reduction of uranyl ions within the solution, and to prevent excessive corrosion of the stainless steel system. This gas can be fed in at the pump intake (low pressure) or introduced downstream of the pump by using a high pressure liquid-gas converter (Item 26b). Condensate (or heavy water) from the condenser (Item 8) is also fed to two purge pumps (Items 23 and 108) via line 123 and the purge pump cooler (Item 68). One pump (Item 23) supplies condensate to the pressurizer in the high pressure system via line 124, the letdown heat exchanger where heat is recovered from line 113, and line 111. Line 111 enters the fuel pressurizer (Item 2) which is designed to prevent mixing of fuel and condensate and to keep fuel solution out of the electrically heated pressurizer legs where it would change to a two-phase state due to the higher temperature. Condensate from the purge pump cooler is also fed to another purge pump (Item 108) via line 797 which provides a purge stream to the back of the motor end of the main circulating pump (Item 5) to keep it free of fuel solution (or slurry on the blanket side).

Small volumes of intensely radioactive fission gas (principally krypton and xenon), that remain after condensation of the recombined deuterium and oxygen in the condenser, (Item 8) are dried by cold traps (Items 9a and 9b) at -10°F and sent to adsorber beds containing activated carbon (Items 10a, b and c). The cold traps also act to remove any final trace of D₂O which is recovered when the traps are defrosted. One trap is in service while the other is defrosting or in standby. The gases are stored in the beds and radioactively decay until they can be discharged to the atmosphere with 1400 cfm of ventilating air from a 100-foot stack. (Item 13).

A mercury seal pot, vacuum pump (Item 11), and off-gas filter (Item 96) are located in the line from the adsorbers (Item 10) to the stack. The seal pot is installed to prevent water vapor from entering the adsorber beds; and the pump can be used to evacuate the system for filling, increase the flow rate if desired, and facilitate regeneration of the adsorber beds if the need arises. A radiation element (RE 760A) is used to detect the escape of active gases to the atmosphere. A compressor (Item 47) may be installed later if lower system pressure is desirable.

Storage tanks (Items 16a and 16b) are utilized to provide "ever-safe" storage space for the fuel solution when it is necessary to decontaminate or perform work on the rest of the system. These tanks have the same capacity as the dump tanks (Items 7a and b) and also have built-in evaporators. Transfer of solution via line 108 is accomplished by pressurizing either the storage or dump tanks with heat added by the evaporators. Valving is provided to permit sampling or transferring (through line 135) of the solution.

A reflux condenser (Item 15) is provided to remove the heat released by decay of fission products in the storage tanks. Small amounts of gas and entrained D_2O will pass from the condenser to the fuel storage recombiner (Item 117) which utilizes convection circulation induced by heating and cooling coils within the unit. Platinized wire mesh is used as the catalyst; and condensate is drained back to the storage tanks. Valve HCV-731 will normally remain closed and gas will be discharged directly to the adsorber beds when the pressure becomes excessive. In order to prevent high gas activity at the stack exhaust if fuel is transferred by way of the hold-up tank (Item 22), valve HCV-743 in Line 165 in the east valve pit is interlocked to close on high stack activity. Since the possibility exists that gases could collect in the stack if the stack fan were not running, and since subsequent starting of the fan would result in high activity, the valve is interlocked to close if the stack fan is not running. This valve is also interlocked to close on positive shield pressure and thus protects against the possibility of a break in Line 165 in event of an explosion within the cell.

Both the high and low pressure system fluids can be sampled by means of the sample stations (Items 18 and 25). High and low pressure fuel isolation chambers are mounted in one cubicle (a sample cubicle is also provided for the blanket sample stations - Items 38 & 44). Samples are remotely removed from the isolation chambers into shielded containers and transported to an analytical laboratory. A fuel sample cooler (Item 24), which is a length of water-cooled-jacketed pipe, is installed in the lines (128-129) serving the high pressure sample station (Item 25). It is provided to cool the fluid and thereby increase the life of the sampling valve (HCV-136) in line 129.

Fuel solution can be dumped by means of lines 105, 106 and the dump valve (PCV-152). A fuel dump cooler (Item 6) is provided which is similar to the fuel sample cooler (Item 24) in both design and function. The transfer tank (Item 19), associated with the low pressure sample station (Item 18), is used to collect the fluid purged through the sampler to obtain a more representative sample in the chamber, and is also utilized for transferring fluid to the blanket system via lines 164 and 264, or to the hold-up tank (Item 22). A low pressure fluid transfer line (141) and valve (HCV 340) are provided on the fuel side from line 158 (just below the entrainment separator Item 7c) to chemical processing. The return line (162) and valve (HCV 937) runs from chemical processing to line 127 which enters the entrainment separator (Item 7c). Present plans are to fill the system initially with solution from Chemical Processing via line 162 and to remove solution via line 141. High pressure fuel solution is transferred to and returned from the Chemical Processing cells by means of lines 167, 166, and valves HCV 142 and HCV 141. The take-off point is connected to line 101 just before the fuel heat exchanger (Item 4), and the return line is connected to line 102 at the exit from the exchanger.

Line 127 and valves HCV 139 and PdCV 250A are used to bleed down the pressurizer (Item 2) to the low pressure system, as are line 227 and valves HCV 239 and PdCV 250B on the blanket side. These lines are used to bleed down non-condensable gases, and probably will be used to relieve system pressures during the initial phases of dumping. Two valves are utilized in line 127, one for throttling and the other for complete shutoff.

Blanket system dump valve

While it is desirable to keep the fuel and blanket system essentially separate and to prevent mass transfer of fuel and blanket fluids, it is also imperative to avoid any large pressure differentials across the reactor core tank. Both fuel and blanket pressurizers are interconnected by 2" piping; a pressure relief valve (HCV-926) which is set to relieve at a 50 psi differential; and two rupture discs (one for each system) set at 200 psi differential which serve as a safety measure in case of instrument failure.

Line 148 and valve HV-935 are used to transfer the contents of the holdup tank (Item 22) to the chemical process loading pit. Several sampling points are located throughout the low pressure system, such as line 628 just down stream of the cold traps (Items 9a and b); this particular line can be used to take gas samples for measuring the half-life of xenon.

Permanent freezer stations, located at several points in both systems, serve to act as positive means of shutoff, and also as system isolation points for valve and equipment removal if necessary. Provisions will be made for temporary freezing of lines adjacent to flanges and valves at other points in both systems.

The blanket low pressure system is identical to the fuel side except for the size of the dump and storage tanks.

Cooling Water System
(Dwg. D-18240)

There have been several major modifications incorporated in the water system since the last issue of this report. The possibility of chloride-induced stress corrosion in the HRT cooling water system has made it necessary to provide a closed demineralized water loop to cool stainless steel components within the reactor cell.

Water is pumped with an 800 gpm pump (Item 62a) from the 15,000 gallon basin of the cooling tower (Item 61) through lines 390 and 394 which supply cooling water to the demineralized water heat exchanger (Item 125); the turbine condenser (Item 59); the vent condenser on the deaerator and surge tank (Item 64); and the turbine or cooler. Cooling water is also furnished to Chemical Process cell equipment by way of line 386. An additional pump (Item 62b) has been installed as an auxiliary unit. The cooling water from this equipment is returned to the cooling tower via lines 388, 393 and 835.

Demineralized cooling water is pumped (Items 124a & b) from the surge tank (Item 122) through the heat exchanger (Item 125) and to fuel and blanket equipment located within the reactor cell. Return lines from most of the cell equipment go to two headers (Lines 400 and 395) which discharge directly to the surge tank of the demineralized water loop.

The demineralized water loop will be filled by using either service steam condensate or distilled water. Tests of building service steam condensate indicate an average chloride content of 0.3 ppm. Temperature of the demineralized water circulated to the cell will reach a maximum of about 100°F. A temperature of 100°F is considered too high for the purge pump coolers since the flow rate to the pumps is measured by means of differential temperature readings, therefore, two small heat exchangers (Items 128 & 129) are used on the fuel and blanket demineralized water supplies to the pumps to cool the water to about 90°F. The main water return line (509) is monitored and a valve FCV-934 is provided to isolate this system if necessary. A three-second hold-up loop is incorporated in line 509 between the monitor and valve FCV-934. Control valve (FCV-927) is provided in line 402 to allow discharging the returning cooling water directly to the reactor cell; and a relief valve set at 150 psi is installed in parallel to insure venting in case of instrument failure.

The jackets of the recombiner condensers (Items 8 and 35) and reflux condensers (Items 15 and 39) are connected to one return header which also is monitored with radiation detectors which will close valve FCV-933 to prevent the return of contaminated water to the surge tank. A three second hold-up loop is incorporated in Line 434 between the monitor and valve FCV-933. The condensers must have cooling water to remove after-shutdown heat even if the contaminated cooling water cannot be returned to the surge tank, therefore, a valve FCV-932 in line 407 is provided to discharge the water from these coolers to the inside of the reactor shield when activity is detected. A relief valve (set at 150 psig) is installed in parallel (line 404) with this valve to insure venting in case of instrument failure. If a minor leak should occur in these condensers, it is intended that the resultant activity would be detected before the general level of activity in the steam drum pit became sufficiently high to trigger an emergency dump; this would permit an orderly dump without the increased leakage rate that would be incurred by the pressure build-up in the low-pressure reactor system during an emergency dump. On the occasion of this isolated

radiation pick-up, valve FCV933 in line 434 would close and water from that line would discharge to the cell floor. If, however, the general level of activity in the west valve pit should be great enough to trigger an emergency dump of the reactor, the block valves in both the cooling water return lines would close (Lines 434 and 509), and water flow would be diverted to the cell floor. In either of the above conditions emergency cooling water would be supplied from the condensate storage tank (Item 123) and then from the cooling tower basin via Line 840 and valve FCV 635.

Loss of pumping capacity in the closed cooling water system, through either power or pump failure, would also cause the block valves to close and the diversion valves to open.

The original design of the HRT cooling water system planned for all process water to be taken from the cooling tower basin, the basin serving as an air break between the reactor and the potable water supply to prevent back-up of contaminated water into that system. An air break between Bldg. 7500 and the X-10 water supply is not used with the presently installed system. Since water cooler than the cooling tower effluent is required, fresh process water from line 503 (70-85°F) is used to cool the sample station isolation chambers (Items 25, 18, 44, and 38), the space coolers (Items 82a, b, c, and d), the waste evaporator condensers (Item 90a and 90b), the adsorber beds (Item 10), and the refrigerant condenser (Item 75). Process water is also used to fill the hot storage pool in the building and to supply make-up water for the cooling tower.

Although it would be desirable from a water conservation standpoint to use the potable water effluent from the space coolers as cooling tower make-up, it was judged that the cost to extend the required line through the valve pit wall was not justified; the space coolers therefore discharge to drain through Lines 505 and 518.

A valve (FCV-928) is located in line 505, which will close on signal from the radiation monitors. A cooling line rupture in the cell could allow active gases to escape through line 505 if it were not for this valve. The reduction of the adsorption coefficient in the charcoal beds with increasing temperature also made it inadvisable to use the 94°F (Maximum) space cooler effluent for cooling of the beds and therefore, process cooling water from line 493 is now used for this purpose.

A test heat exchanger (Item 126) has been added to the system to evaluate the condition of stainless steel components using the demineralized closed cooling water loop. In order to maintain the integrity of a closed loop the steam jet heater, formerly used to heat the cooling water to the dump and sample coolers and the purge flow heat exchangers, has been replaced with a small heat exchanger (Item 127).

A hand throttling valve, flow indicator, and check valve are installed in the majority of the water feed lines. Lines feeding the recombiner condensers, let-down heat exchanger, and circulating pumps are provided with by passes, as well as flow switches and alarms, since there is a remote possibility of breaking the glass rotameters.

During dumping conditions the recombiner condensers will require several times the normal cooling load, and therefore additional larger valves are installed in parallel with the normal condition one-inch feed valves.

Steam System
(Dwg. D-18267)

The main purpose of the HRT power system is to provide an economical means of controlled heat removal from the reactor. All line information is for operation at a gross power level of 5.22 Mw. Steam is produced on the shell sides of the fuel and blanket U-tube heat exchangers (Items 4 and 31); and the pressure and temperature of the steam depends on the reactor power as well as the reactor solution operating temperatures and flow rates.

Just outside the primary shield (in a secondary shield) are the steam drums (Items 53 and 54) which have sufficient volume to provide a steam flow delay time of 1 to 3 seconds between the heat exchangers and the automatic stop valves (HCV-537 and 538). A radiation monitor (See upper left corner) closes the stop valves in less than 1 second, as well as valves HCV-539 and 540 located in lines 375 and 378, and valves LCV-545 and 546 located in lines 358 and 368, if activity is detected in the system. A tube rupture in the heat exchangers would result in radioactive steam and condensate being released, and the activity can be confined within shielded equipment by closing the six aforementioned valves. Active fluids are thus isolated until they can be removed to the waste system by way of line 382.

After leaving the steam drums (Lines 301 and 303) the steam is throttled either to the air-cooled condenser (Item 60) or to the turbine-generator (Item 57) previously used with the HRE. The condenser has a heat removal capacity of 10 Mw and the turbine ~ 3 Mw. The turbine generator is rated at 345 KVA and can be operated from either plant (Line 338) or reactor steam. The only purpose of the turbine generator is to provide a source of stand-by electrical power, although the electrical energy produced by partial use of the reactor heat has some value.

More than one valve is necessary for throttling steam to the turbine generator or to the air cooled condenser because of the wide variations in flow rates. The steam inlet lines 334 and 328 contain flow measuring orifices, and calorimeter connections. After passing through the turbine the steam is condensed in the turbine condenser (Item 59) and a hotwell condensate pump (Item 63) returns the condensate to the deaerator and surge tank (Item 64). A deaerator is provided to remove gases from the water which would otherwise induce excessive corrosion. Condensate from the air cooled condenser is also discharged directly to the deaerator where flashing steam (Line 349 from building) is condensed and dissolved gases are removed from the condensate which is returned as feedwater. Cooling water is supplied to the vent condenser (lines 396 and 397).

Feedwater from the deaerator is fed to two high pressure triplex feedwater pumps (Items 65a and 65b) which return the water to the steam generators. Both pumps are driven by manually adjustable variable speed drives.

The valves in the feedwater lines (LCV-545 and LCV-546) are interlocked with the liquid level controllers on the steam generators to prevent rapid introduction of feedwater into the heat exchangers during heat-up, and to maintain a constant liquid level during normal operation. Excess pumpage is returned to the deaerator through a back pressure control valve PCV 559 which can be manually adjusted to keep the pumping power near minimum. Safety valves (366A and 356A) are provided on the pump discharges, and accumulators (Items 88a and 88b) are installed to reduce pulsation. Valving is provided so that

either pump can serve both the fuel and blanket steam generators. When making a system heat balance, it is planned to measure the feedwater flow to the generators by temporarily by-passing condensate from the air-cooled condenser (Item 60) to the roof drain, and reading the differential pressure cell at two water levels. Both steam generators are provided with steam and liquid relief valves.

A 1500 psig oil-fired package boiler (Item 56) is provided in addition to the 2500 lb building steam supply, for pre-heating the system to 280°C at startup, and for use during low-power nuclear experiments. During normal operation condensate produced in the steam drums is returned by gravity to the generators, however, at power levels above 7.6 Mw in the core and 3.5 Mw in the blanket, pressure losses prevent gravity return and it is necessary to flash the condensate through steam traps to the deaerator. This is accomplished by closing valves 375A and 378A, and opening the monitron controlled valves HCV 539 and HCV 540. The last two valves are opened and hand valves 307A and 308A are closed when it is desirable to warm up the system without collecting condensate in the exchangers.

Waste and Vent System (Dwg. D-18309)

The basic requirements of the system as shown on Dwg. D-18309 are as follows:

1. To provide for flooding and dewatering the reactor and chemical processing fuel and blanket cells.
2. To provide for adequate venting and evacuation of the above cells.
3. To provide facilities for handling, concentration, and storing waste solutions.
4. To provide facilities for safely storing and discharging the reactor and chemical process off gases.

Cell flooding is accomplished by pressure feed from the process cooling water supply (Line 386) and a valving header (which also contains an air inlet and drain) is used to direct the flow. Dewatering of the cells to a depth of one foot is done by means of a 1000 gpm centrifugal pump (Item 99); additional dewatering (of possibly more active wastes) is achieved by using steam jets. A scavenging system is also incorporated to recover high activity spills. Air operated drain plug valves are used to discharge the water by gravity from the partitioned storage tank areas (partitions extend 13 feet from bottom of the major reactor cells) to the main reactor cells where it can be removed by steam jets.

The dewatering pump and the steam jets serving the A and D cells discharge directly to a 300,000 gal. waste pond (Item 95) whereas the steam jets serving the reactor and chemical processing cells can discharge to the waste pond or to the 12,000 gal. waste tank (Item 94). Waste from the 12,000 gal. tank can be transferred, by means of a steam jet (Line 550) to the waste evaporator (item 80a) which has a total evaporation capacity of 1-1/2 gal/min. Vapors from the evaporator are condensed in the waste evaporator condensers (Items 90a and b). This condensate flows to a 1000 gal. waste condensate tank (Item 93) from which it can be jetted to the wastepond or to the 12,000 gal. waste tank via line 560, depending on activity level. Overflow from the evaporator flows back to the 12,000 gal. waste tank.

Cell evacuation is accomplished by using 2" lines (543, 544 and 545) and two vacuum pumps (Items 89a and 89b) as shown. Venting during repair operations, etc., is done by two 8" lines (516 and 517) from cells B and C, and one 16" line (532) connected to the stack fan (Item 13a). During normal operation valves in the 8" and 16" lines are closed. Gases are vented via a filter (Item 12), exhaust fan (Item 13a), and then the stack (Item 13). The reactor and chemical processing off-gases are discharged to their respective fission product adsorber beds (Item 10) via lines 117, 247, and 622 before being exhausted to atmosphere.

Blowdown (Line 382) from the reactor steam generators can go directly to the waste pond (Item 95) or to the 12,000 gal. waste tank (Item 94). Steam supply stations are used to direct steam to each of six jets used to dewater the cells.

Flange seals or valves capable of holding the normal cell pressures are to be installed in all lines which penetrate the major reactor and chemical processing cell walls.

Refrigeration and Cold Trap System

The refrigeration and cold trap system is shown on Dwg. D-18333. A liquid coolant system is used to freeze and defrost the cold traps. This system simplifies defrosting; keeps all parts of the primary system in a compact arrangement outside the shield; and permits the use of the same liquid coolant for both temporary and permanent freezer jackets which will be located throughout the system.

Although the liquid coolant as shown on the flowsheet and mentioned in the following description is considered to be Freon-11, actually other coolants are presently being considered due to the fact that Freon-11 is susceptible to radiation damage and contains chlorides. Amsco 125-82, an odorless mineral spirit resembling kerosene in its physical properties, is now being considered as a replacement for the Freon-11 secondary refrigeration system. Freon-12 is still used in the primary circuit since it is only utilized outside the reactor cell.

The liquid coolant (F-11) is chilled to $\sim -30^{\circ}\text{F}$ in the chiller and storage tank (Item 71). This is done by utilizing a refrigeration condensing unit which consists of a four cylinder, single stage compressor (Item 69); a condenser (Item 75) etc. as shown on the flowsheet. The condenser is cooled with water (Line 491 - see cooling water flowsheet). The F-12 primary refrigerant system will be controlled by a thermostatic expansion valve (TV-768) and a cooling water regulator on the condenser. A solenoid valve (FCV-E09) on the liquid line to the F-11 chiller affords positive shut off of refrigerant flow when the F-12 compressor is not in operation. A high-low pressure cut-out switch will be utilized to protect the primary F-12 system and compressor. Chilled F-11 will be circulated by the cold F-11 pump (Item 73) to headers which serve all five cold traps and all the permanent freezer stations. Provision is made to supply F-11 for temporary freezers. Hand and solenoid valves are provided in each feed and return header-line from the cold traps. Only hand valves are used for the freezer stations. Refrigerant will enter the cold traps at about -30°F and leave at $\sim -20^{\circ}\text{F}$ with flow in the trap counter-current to the gas.

Rupture discs have been provided to prevent lines from rupturing if the refrigerant becomes trapped between valves, and the discharges from these discs along with that from the relief valves and vents at the storage tanks (Items 71 and 72) will be vented through a catch tank (having a float operated alarm switch) to a point outside the building.

The cold traps can be quickly defrosted by pumping (with Item 74) warm F-11 refrigerant (from the storage tank - Item 72) through them.

A by-pass valve is provided at each storage tank (Items 71 and 72) to maintain circulation within the tank and to regulate F-11 supply pressure. Two lines are provided for transferring refrigerant from one tank to the other.

The valve manifold will be located outside the shield, and the solenoid valves will be controlled by a programming clock.

Steam and Condensate Service System

(Dwg. D-22579)

This flowsheet covers the steam and condensate service to equipment located within the reactor cell.

Building steam (250 lb, line 680) is supplied to two headers which deliver steam to the fuel and blanket catalytic recombiners, and the fuel storage recombiner (items 8a, 35a and 117). Steam from this same header is sent through a pressure regulator station where it is reduced from 250 lbs to 75-100 lbs, and this steam is fed to a header which in turn delivers steam to the evaporator legs on the fuel and blanket dump and storage tanks (Items 7a, b, 16a, b, 34a, b and 49 a and b).

Condensate lines from each piece of equipment are individually trapped and returned to a common condensate receiver tank (Item 103) which is vented to the roof and drains to a sump at the lower level in the control room area. Two radioactive monitors scan the condensate lines from the fuel and blanket equipment and if activity is detected they will close valves FCV-814A and B, thereby isolating the condensate system. The valve header lines are close to the reactor wall and can be temporarily shielded if active condensate should penetrate as far as the steam traps.

NOTE: ALL PROCESS LINE INFORMATION IS FOR OPERATION AT AN
OVERALL GROSS POWER OF 5220 KW.

I. LINE NUMBER NOMENCLATURE

THE LINE SCHEDULE IS DIVIDED INTO FIVE SECTIONS AS FOLLOWS:

1. PROCESS PIPING

A) FUEL SYSTEM - LINES 100-199 INCLUSIVE

INCLUDES ALL LINES NORMALLY CARRYING FUEL SOLUTIONS;
OVERFLOW, VAPOR AND CONDENSATE, TRANSFER AND
SAMPLE LINES.

B) BLANKET SYSTEM - LINES 200-299 INCLUSIVE

INCLUDES ALL LINES NORMALLY CARRYING BLANKET
SOLUTION; OVERFLOW, VAPOR AND CONDENSATE, TRANSFER,
AND SAMPLE LINES.

2. STEAM PIPING

LINES 300-399 INCLUSIVE.

INCLUDES ALL LINES CARRYING STEAM OR CONDENSATE, AND
FEEDWATER SYSTEM.

3. SERVICE PIPING

LINES 400-574; 601-674; 701-949; INCLUSIVE.

INCLUDES ALL STEAM, WATER, VENT, COOLING WATER, AND
REFRIGERANT LINES.

4. PROCESS INSTRUMENT PIPING

LINES 575 - 599 INCLUSIVE
600 - 679 INCLUSIVE
680 - 699 INCLUSIVE
1000 - 1020 INCLUSIVE

SHOWN IN BOX
575

5. LEAK DETECTION SYSTEM

LINES 1 - 96 INCLUSIVE - FUEL SIDE
18 - 96B INCLUSIVE - BLANKET SIDE
950 - 974 INCLUSIVE - FUEL SIDE
975 - 999 INCLUSIVE - BLANKET SIDE

IA. INSTRUMENT NUMBERING CODE

1. INSTRUMENT PROCESS DIVISIONS

100-199 FUEL HIGH PRESSURE
200-299 BLANKET HIGH PRESSURE
300-399 FUEL LOW PRESSURE
400-499 BLANKET LOW PRESSURE
500-699 STEAM POWER
700-799 OFF GAS
800-899 UTILITIES
900-999 MISCELLANEOUS

2. 2nd And 3rd DIGITS	FUNDAMENTAL VARIABLE	MULTIPURPOSE NUMBERS
00-04	ANALYSIS	0000-0400
05-14	ELECTRIC	0500-1400
15-34	FLOW	1500-3400
35-44	HAND	3500-4400
45-49	LEVEL	4500-4900
50-59	PRESSURE	5000-5900
60-64	RADIATION	6000-6400
65-94	TEMPERATURE	6500-9400
95-99	WEIGHT	9500-9900

II. LINE IDENTIFICATION

LINE NUMBERS 183

SHIELD LINE

PRIMARY PROCESS LIQUID LINE

SECONDARY PROCESS LIQUID LINE

PRIMARY PROCESS GAS OR VAPOR LINE

SECONDARY PROCESS GAS OR VAPOR LINE

STEAM LINE

AIR LINE

ELECTRICAL LINE

GAS

NITROGEN

III. PIPE LINE CODE

TYPICAL CODE ON LINE

1-1/2" SCH. 80 CARBON STEEL PIPE 1-1/2 C80

1" SCH. 40 STAINLESS STEEL PIPE 1 S40 OR 1-40

1/2" SCH. 40 WROUGHT IRON PIPE 1/2 W40

1" SCH. 80 GALVANIZED PIPE 1 G80

IV. GENERAL LEGEND

CONDENSATE DRAIN CD

COOLING WATER CW

COOLING WATER DRAIN CWD

(X - BELOW AIR OPERATED VALVE) - FAILS CLOSED - .

(O - BELOW AIR OPERATED VALVE) - FAILS OPEN - .

EXAMPLE:

PC-452

P C - 4 5 2

FUNDAMENTAL VARIABLE ALLOCATION NUMBERS

PROCESS DIVISION NUMBER

INSTRUMENT CLASSIFICATION LETTER(S)

FUNDAMENTAL VARIABLE CLASSIFICATION LETTER

HRT FLOWSHEET IDENTIFICATION CODE

UNCLASSIFIED
DWG. NO. D-18330D

V. VALVE AND FITTING SYMBOLS

SAFETY OR RELIEF VALVE

MANUALLY OPERATED VALVE

CHECK VALVE

AIR OPERATED VALVE (COMMERCIAL DIAPHRAGM)

AIR OPERATED VALVE (REMOTELY OPERATED IN RADIATION FIELD)

AIR OPERATED VALVE WITH POSITIONER

MANUALLY OPERATED EXTENSION HANDLE VALVE

GATE VALVE

GLOBE VALVE

VALVE NORMALLY CLOSED

VALVE NORMALLY OPEN

VALVE THROTTLING

SOLENOID VALVE

MECH. COUPLING

REDUCING COUPLING (SCREWED)

REDUCING COUPLING (WELDED)

FLOW RESTRICTOR

FLANGED JOINT

UNION (THREADED)

LOAD CELL

STRAINER

TRAP

FREEZER STATION

SUBSCRIPT LETTER

A - WELDED SS COIL - PERM. CONN. . . .
 B - SOLDERED Cu COIL - PERM. CONN. . . .
 C - SS OR Cu COIL - TEMP. CONN. . . .
 D - CLAMP-ON JACKET

RUPTURE DISC

CALORIMETER CONNECTION

VALVE (3-WAY) WITH NORMALLY BLOCKED PORT

VALVE (3-WAY) WITH COMMON PORT

PURGE LINE

VI. INSTRUMENTATION AND MISC. SYMBOLS

EQUIPMENT NO.

(WHEN SHOWN ON AIR OPERATED VALVES)

FIGURE TO LEFT INDICATES LOWER AIR OPER. PRESSURE

FIGURE TO RIGHT INDICATES UPPER AIR OPER. PRESSURE

INSTRUMENTS WITH SINGLE FUNCTION:

LOCALLY MOUNTED

TURBINE PANEL MOUNTED

INTERMEDIATE MOUNTED

CONTROL PANEL MOUNTED

AUXILIARY MOUNTED

TRANSMITTER

INSTRUMENTS WITH DUAL FUNCTIONS OR

INSTRUMENTS WITH CLOSE MECH. COUPLING

INSTRUMENT NOT COVERED IN CODE

LEADS TO ELECTRICAL CONTROL CIRCUIT ECC

LEADS TO ANNUNCIATOR ANN

LEADS TO VALVE POSITION INDICATOR VPI

INLINE INSTRUMENT

VII. INSTRUMENT CLASSIFICATION CODE

(MEANING OF LETTERS APPEARING IN INST. BALLOONS)

FIRST LETTER	ANNUNCIATOR	PRIMARY ELEMENT	CONTROLLER	INDICATOR	AMPLIFIER, BOOSTER, RELAY - MODIFIER	RECORDER	TRANSMITTER - TRANSDUCER	SWITCH	REORDER - CONTROLLER	INDICATOR - CONTROLLER	REMOTE OPERATED VALVE	SELF OR MANUAL OPERATED VALVE	SAFETY VALVE
2ND-3RD LETTER	A	E	C	I	M	R	T	X	RC	IC	CV	V	SV
ANALYSIS	A	AA	AE	AC	AI	AM	AR	AT	AX	ARC	AIC	ACV	ASV
ELECTRIC	E	EA	EE	EC	EI	EM	ER	ET	EX	ERC	EIC	ECV	ESV
FLOW	F	FA	FE	FC	FI	FM	FR	FT	FX	FRC	FIC	FCV	FSV
HAND	H	HA		HC	HI	HM		HX		HIC	HCV	HV	
LEVEL	L	LA	LE	LC	LI	LM	LR	LT	LX	LRC	LIC	LCV	LSV
PRESSURE	P	PA	PE	PC	PI	PM	PR	PT	PX	PRC	PIC	PCV	PSV
RADIATION	R	RA	RE	RC	RI	RM	RR	RT	RX	RRC	RIC	RCV	
SPEED	S	SA	SE	SC	SI	SM	SR	ST	SX	SRC	SIC	SCV	
TEMPERATURE	T	TA	TE	TC	TI	TM	TR	TT	TX	TRC	TIC	TCV	TSV
WEIGHT	W	WA	WE	WC	WI	WM	WR	WT	WX	WRC	WIC	WCV	
SPECIAL	X	XA	XE	XC	XI	XM	XR	XT	XX	XRC	XIC	XCV	XSV

THE FOLLOWING SUBSCRIPTS MAY BE APPLIED TO THE FIRST LETTER.

o - AVERAGE i - CURRENT v - VOLTS

c - CONDUCTIVITY m - MOISTURE w - WATTS

d - DIFFERENTIAL pf - POWER FACTOR

f - FREQUENCY pH - CONCENTRATION

g - SPECIFIC GRAVITY t - TIME

MATERIALS LIST

ITEM NO.	DWG. NO.	QTY.	NAME	SIZE	MATERIAL
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ALL LINES SHOWN TERMINATING WILL CONTINUE ON DWG. D-18295

d	General	1-1457 F.C.E.	W.H.B.		
c	General	3-7-56 F.C.E.	W.H.B.		
b	General	7-19-55 F.C.E.	W.H.B.		
a	General	4-30-55 F.C.E.	W.H.B.		
NO.	REVISIONS		DATE	APPR.	APPR.
DRAWING NO. D-					
DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
C.W. DAY				W.P. WALKER	3-2-1955
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
		F.C. ZAPP	2-22-55	W. P. WALKER	3-2-1955
HEALTH PHYSICS		MEDICAL	OPERATIONS	SAFETY	
PIPE PROTECTION		RESEARCH SHOP	MAINTENANCE		
HRT Cooling Water Flowsheet D-18240					
HRT Multipurpose Instruments D-18360					
HRT Instrumentation Application Tabulation A20954a					
HRT Flowsheet Identification Code D-18330					
HRT Flowsheet Line Schedule A-18329					
Low Press. Blanket System Flowsheet D-18298					
High Press. Blanket System Flowsheet D-18297					
High Press. Fuel System Flowsheet D-18296					
Steam System Flowsheet D-18267					
REFERENCE DWGS. DWG. NO.					

H.R.T. BLDG. 7500

FLWSHEET

LOW PRESSURE FUEL SYSTEM

OAK RIDGE NATIONAL LABORATORY

OPERATED BY

CARBIDE AND CARBON CHEMICALS COMPANY

A DIVISION OF UNION CARBIDE AND CARBON CORPORATION

OAK RIDGE, TENNESSEE

SUBMITTED

ACCEPTED

APPROVED

PER. E.C. APP

SCALE:

D-18295 d

ALL LINES SHOWN TERMINATING WILL CONTINUE ON DWG. D-18297

d General		F-16-57 F.C.E. 1/10/64	
c General		3-7-56 F.C.E. 1/10/64	
b General		7-12-55 F.C.E. 1/10/64	
a General		4-30-55 F.C.E. 1/10/64	
NO.	REVISIONS	DATE	APPR. APPR.
DRAWING NO. D-			
DRAWN	DATE	CHECKED	DATE
C.W. DAY	10-1-64	10-1-64	10-1-64
DESIGNED	DATE	SUBMITTED	DATE
	2-22-55	4-1-64	10-1-64
HEALTH PHYSICS	MEDICAL	OPERATIONS	SAFETY
FIRE PROTECTION	RESEARCH SHOP	MAINTENANCE	
REFERENCE DWGS		DWG. NO.	
HET Cooling Water Flowchart		D-18240	
HET Multipurpose Instruments		D-18360	
HET Instr. Application Tabulation		A-209549	
HET Flowchart Identification Code		D-18330	
HET Flowchart Line Schedule		A-18329	
Low Press. Blanket System Flowchart		D-18298	
High Press. Blanket System Flowchart		D-18297	
Low Press. Fuel System Flowchart		D-18295	
Steam System Flowchart		D-18267	

H.P.T. BLDG 7500

FLWSHEET

HIGH PRESSURE FUEL SYSTEM

OAK RIDGE NATIONAL LABORATORY

OPERATED BY

CARBIDE AND CARBON CHEMICALS COMPANY

A DIVISION OF UNION CARBIDE AND CARBON CORPORATION

OAK RIDGE, TENNESSEE

SUBMITTED

ACCEPTED

APPROVED

THIS DRAWING

CLASSIFIED

AS UNCLASSIFIED

PER 10/2/88

SCALE:

D-18296

d

MATERIALS LIST

ITEM NO.	DWG. NO.	QTY.	NAME	SIZE	MATERIAL
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NOTE:
WATER PIPING:
Inside Reactor Shield To Be Galvanized
Screwed Piping-ASTM A53-54T-Grade B (except
Outside Reactor Shield To Be Screwed or
Welded Piping-ASTM A53-54T-Grade B

HRT Instrumentation Application Tabulation	A289546
HRT Flowsheet Identification Code	D-18330
HRT Flowsheet Line Schedule	D-18320

REFERENCE DRAWINGS	DWG. NO.
--------------------	----------

HRT BLDG. 7500
COOLING WATER SYSTEM FLOWSHEET

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
CARBIDE AND CARBON CHEMICALS COMPANY
A DIVISION OF UNION CARBIDE AND CARBON CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED	ACCEPTED	APPROVED
3-7-55	3-7-55	3-7-55
D-18240		

THIS DRAWING
CLASSIFIED
AS UNCLASSIFIED
PER EC ZAPP
SCALE:

NOTE:
Water Flow Rates Shown Are Maximum Expected.

NO.	REVISIONS	DATE	APPR.	APPR.
d	General	1-16-57	ECZ	WTR
c	General	5-6-54	ECZ	WTR
b	General	7-24-55	ECZ	WTR
a	General	1-29-55	ECZ	WTR
DRAWING NO. D-18240				
Drawn	DATE	CHECKED	DATE	APPROVED
C.M. DAY	1-15-55	WTR	1-15-55	3-7-55
Reviewed	DATE	SUBMITTED	DATE	APPROVED
ECZ	2-10-55	W.R. Walker	3-7-55	
PHYSICS	MEDICAL	OPERATIONS	SAFETY	
RESEARCH SHOP	MAINTENANCE

MATERIALS LIST

ITEM NO.	DWG. NO.	QTY.	NAME	SIZE	MATERIAL
----------	----------	------	------	------	----------

- NOTES:
1. Recombiners operate with steam @ 250 PSI. & Evaporators with steam @ 75 PSI.
 2. The traps (8) serving the Evaporator legs are to be Armstrong No. 882 with built in strainer and a 3/8" orifice (3/4" connections) or equal & the traps (4) serving the recombination coils are to be Armstrong No. 881 with built in strainers and a #38 orifice (1/2" connections) or equal.
 3. Valves in line with the traps are to be gate valves. By-Pass valves & feed valves are the globe type.
 4. The pressure regulator is to be a Mason #11-1"scr. Reduced Pressure 5 to 130# inlet - 250#.
 5. All steam and condensate lines are to be insulated per specifications JS-HRT-1202-4.
 6. This Flowsheet covers service to equip. in Reactor cell only.
 7. Piping to be in accordance with specifications - JS-1202-1 & JS-1202-2.

C	General	1-6-57	F.C.Z.	W.R.
b	General	3-6-56	F.C.Z.	W.R.
a	General	7-23-55	F.C.Z.	W.R.

DRAWING NO. D-

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
W.D.D.	6-9-55	R. J. Kennedy	6-10-55	W. J. W. L.	6-29-55
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
F.C.Z.	6-9-55	F.C.Z.	6-9-55	F.C.Z.	6-9-55
HEALTH PHYSICS	MEDICAL	OPERATIONS	SAFETY		
FIRE PROTECTION	RESEARCH SHOP	MAINTENANCE			

Cond. Service Piping in Control Area - Plan	D-22624
Cond. Service Piping in Control Area - Section	D-22623
REFERENCE DRAWINGS	DWG. NO.

HRT BLDG. 7500

STEAM & CONDENSATE SERVICE - FLOWSHEET

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
CARBIDE AND CARBON CHEMICALS COMPANY
A DIVISION OF UNION CARBIDE AND CARBON CORPORATION
OAK RIDGE, TENNESSEE

THIS DRAWING
AS UNCLASSIFIED
PER F.C.Z.

SUBMITTED	ACCEPTED	APPROVED
		R.B. Hagg 6-29-55
		REV
		D-22579
		C

SCALE:

32

HRT EQUIPMENT SCHEDULE

<u>No.</u>	<u>Name</u>	<u>Code</u>	<u>Flowsheet*</u>
1	Core	K-39	V
2	Fuel Pressurizer	G-38	V
3	Fuel Gas Separator	H-35	V
4	Fuel Heat Exchanger	H-30	V
5	Fuel Circulating Pump	J-34	V
6	Fuel Dump Cooler	M-30	V
7a	Fuel Dump Tank and Evaporator	K-14	V
7b	Fuel Dump Tank and Evaporator	K-14	V
7c	Entrainment Separator	J-15	V
8	Fuel Recombiner Condenser	D-14	V
8a	Fuel Recombiner	D-15	V
9a	Fuel Cold Trap	C-6	V
9b	Fuel Cold Trap	B-6	V
10a	Fission Product Adsorber	A-2	V
10b	Fission Product Adsorber	B-2	V
10c	Fission Product Adsorber	B-2	V
11	Off-Gas Vacuum Pump	E-1	V
12	Stack Filter	L-1	V
13	Stack	K-1	V
13a	Stack Fan	K-1	V
14	Fuel Condensate Tank	E-11	V
15	Reflux Condenser	H-6	V
16a	Fuel Storage Tank and Evaporator	L-7	V
16b	Fuel Storage Tank and Evaporator	L-7	V
17	Fuel Feed Cooler	M-18	V
18	Fuel Sample Station	E-9	V
19	Fuel Transfer Tank	F-8	V
20	Fuel Letdown Heat Exchanger	E-21	V
21	Fuel Feed Pump	L-21	V
22	Holdup Tank	C-39	V
23	Fuel Purge Pump	H-20	V
24	Fuel Sample Cooler	L-30	V
25	H.P. Fuel Sample Station	H-21	V
26a	Fuel Gas Supply (Cylinders)	M-9	V
26b	H.P. Gas Converter	M-9	V
28	Blanket Circulating Pump	H-45	V
29	Blanket Pressurizer	G-41	V
30	Blanket Gas Separator	H-43	V
31	Blanket Heat Exchanger	H-49	V
32	Pressure Vessel	K-39	V
33	Blanket Dump Cooler	M-49	V
34a	Blanket Dump Tank and Evaporator	K-65	V
34b	Blanket Dump Tank and Evaporator	K-65	V
34c	Entrainment Separator	J-63	V
35	Blanket Recombiner Condenser	D-65	V
35a	Blanket Recombiner	D-63	V
36a	Blanket Cold Trap	C-73	V
36b	Blanket Cold Trap	B-73	V

* See Page 26

33

HRT EQUIPMENT SCHEDULE

<u>No.</u>	<u>Name</u>	<u>Code</u>	<u>Flowsheet*</u>
37	Blanket Condensate Tank	E-67	V
38	H.P. Blanket Sample Station	H-58	V
39	Blanket Reflux Condenser	H-73	V
40	Blanket Feed Cooler	M-61	V
41	Blanket Feed Pump	L-57	V
42	Blanket Transfer Tank	E-71	V
43	Blanket Sample Cooler	L-49	V
44	Blanket Sample Station	E-69	V
45	Blanket Letdown Heat Exchanger	E-57	V
46	Turbine Oil Filter	L-18	X
47	Future Compressor	B-3	V
48	Blanket Purge Pump Cooler	F-64	V
49a	Blanket Storage Tank and Evaporator	L-72	V
49b	Blanket Storage Tank and Evaporator	L-72	V
50	Storage Cold Trap	B-35	V
51	Building Steam Cond. Tank (Existing)	O-14	X
52	Condensate Pit Sump Pump (Existing)	O-17	X
53	Fuel Steam Drum	C-4	X
54	Blanket Steam Drum	C-6	X
55	Steam Calorimeter		
56	Steam Separator	F-15	X
57	Steam Turbine	F-16	X
58	Generator	F-18	X
59	Steam Condenser	H-17	X
60	Auxiliary Steam Condenser	H-21	X
61	Cooling Tower	C-5	W
62	Cooling Tower Pump	D-7	W
63	Hotwell Pump	K-16	X
64	Deaerator and Feedwater Storage Tank	L-12	X
65a	Feedwater Pump	M-10	X
65b	Feedwater Pump	N-10	X
66	Packaged Boiler System	G-11	X
67a	Gas Accumulator	L-10	V
67b	Gas Accumulator	L-11	V
68	Fuel Purge Pump Cooler	F-15	V
69	Refrigerant Compressor	N-18	Z
70	Oil Separator	M-14	Z
71	Chiller and Storage Tank	M-9	Z
72	Heater and Storage Tank	L-3	Z
73	Cold F-11 Pump	O-8	Z
74	Warm F-11 Pump	N-3	Z
75	Refrigerant Condenser	M-12	Z
76	H.P. Fuel Loop Piping		
77	H.P. Blanket Loop Piping		
78	H.P. Valves and Fittings		
79	L.P. Piping, Valves and Fittings		
80a	Waste Evaporator	B-21	Y
80b	Waste Evaporator Ent. Separator	B-22	Y
81	Decontamination System		
82a	Space Cooler	G-11	W

* See Page 26

<u>No.</u>	<u>Name</u>	<u>Code</u>	<u>Flowsheet*</u>
82b	Space Cooler	H-11	W
82c	Space Cooler	G-13	W
82d	Space Cooler	H-13	W
83	Freezer		
84	Corrosion Sample Retainers and Corrosion Study Facilities		
85	Source Tube and Thimble		
86	Handling Tools		
87	Leak Detector System		
88a	Feedwater Accumulator	M-9	X
88b	Feedwater Accumulator	N-9	X
89a	Chemical Vent Vacuum Pump	F-15	Y
89b	Reactor Vent Vacuum Pump	G-15	Y
90a	Waste Evaporator Condenser	D-20	Y
90b	Waste Evaporator Condenser	F-20	Y
91	Reactor Vessel Cooler	K-12	W
92	Thermal Shield Cooler	K-12	W
93	1000 Gal. Waste Condensate Tank	G-20	Y
94	12,000 Gal. Waste Tank	L-20	Y
95	Waste Pond	P-14	Y
96	Off Gas Filter	H-1	V
97	Thermal Insulation (in Cell)		
98	Reactor Blast Shield		
99	Dewatering Pump	M-8	Y
100	Dump Tank Weighbeam Assembly		
101	Condensate Weighbeam Assembly		
102	Cell Air Monitor Blower	B-3	Y
103	Condensate Receiver Tank	B-7	U
104	Blanket Purge Pump	D-61	V
105	Heat Exchanger Blast Shield		
106	F-11 Drier	L-2	Z
107	F-11 Drier	M-7	Z
108	Fuel Purge Pump	G-22	V
109	Blanket Purge Pump	D-59	V
110	F-12 Drier	O-13	Z
111	F-12 Receiver	N-12	Z
112	Thermal Shield Cooler Fill Tank	J-11	W
113			
114	Replacement Core Vessel		
115	Replacement Pressure Vessel		
116	Replacement Pressure Vessel Blast Shield		
117	Fuel Storage Recombiner	F-5	V
118	Fuel Purge Flow Heat Exchanger	F-27	V
119	Blanket Purge Flow Heat Exchanger	G-53	V
120	Rupture Disc Assembly	F-40	V
121	Catch Tank	J-17	Z
122	Demineralized Water Surge Tank	C-7	W
123	Demineralized Water Storage Tank	A-8	W
124a	Demineralized Water Circulating Pump	C-9	W
124b	Demineralized Water Circulating Pump	C-9	W
125	Demineralized Water Heat Exchanger	D-11	W
126	Water Test Heat Exchanger	K-5	W

* See Page 26

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<u>No.</u>	<u>Name</u>	<u>Code</u>	<u>Flowsheet*</u>
127	Demineralized Water Heater	M-3	W
128	Fuel Purge Pump Coolant Heat Exchanger	N-6	W
129	Blanket Purge Pump Coolant Heat Exchanger	N-18	W

* Flowsheet Code References

(Code gives location of equipment on following flowsheets)

		<u>Abscissa Range</u>
V	= Low Pressure Fuel System Flowsheet - D-18295d	(1 thru 19)
V	= High Pressure Fuel System Flowsheet - D-18296d	(20 thru 39)
V	= High Pressure Blanket System Flowsheet - D-18297d	(40 thru 56)
V	= Low Pressure Blanket System Flowsheet - D-18298d	(57 thru 78)
W	= Cooling Water System Flowsheet - D-18240d	
Y	= Waste and Vent System Flowsheet - D-18309d	
Z	= Refrigeration and Cold Trap System Flowsheet - D-18333d	
U	= Steam and Condensate Service Flowsheet - D-22579c	
X	= Steam System Process Flowsheet - D-18267d	