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SUBJECT: Operating Procedure for the HRT Chemical Plant

TO: S. E. Beall

FROM: R. B. Lindauer

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To: S. E. Beall
From: R. B. Lindauer
Subject: Operating Procedure for the HRT Chemical Plant
Date: March 5, 1956

The detailed procedure for operating the core processing plant for the HRT is described below. The schematic flow diagram of the plant is included to aid in following the operations. The procedure is broken down as follows:

- I. Charging Fuel to the Hydroclone System
- II. Startup of the Hydroclone System
- III. Operation of the Hydroclone System
- IV. Shutdown of the Hydroclone System and Transfer to a Carrier
- V. Refluxing of the Carrier
- VI. Boildown of the Carrier
- VII. Removal of the Carrier from the Cell

I. Charging Fuel to the Hydroclone System

1. Fill T-11 with the calculated amount of concentrated fuel and T-16 with the calculated amount of D₂O. Mount in the fuel system rack with all valves closed.
2. Close valves HCV-141 and HCV-142 to and from the reactor. Check that freeze plug temperatures at these valves are < -30°C.
3. Set cell C valves as follows:

HCV T-1-2	Open
HCV T-1-4	Open
HEV P-1-4	Open
HCV H-5-2	Closed
HCV P-1-2	Closed
HCV 1112-2	Closed
HCV T-2-2	Closed
HEV T-11-2	Closed

4. Freeze plug temperatures should be:

FP-3	HCV T-1-2	Ambient temperature
FP-4	HCV T-1-4	Ambient temperature
FP-5	HCV H-5-2	< -30°C

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FP-6	T-1 Drain	Ambient temperature
FP-7	T-2 to T-5	Ambient temperature
FP-8	HCV P-1-2	< -30°C
FP-9	F-1 to S-1	Ambient temperature
FP-10	HCV P-1-4	Ambient temperature
FP-11	P-1 drain	Ambient temperature
FP-12	T-1 to P-1	Ambient temperature

5. Check pressures in high and low pressure systems.

6. Charge fuel:

- Open HCV T-11-2
- Open 2 valves between T-11 and cell C
- Open valve between T-11 and oxygen cylinder
- Slowly apply oxygen pressure until bullseye indicates fuel has been added.
- Close valve between T-11 and oxygen cylinder

7. Charge D₂O rinse:

- Open 2 valves between T-16 and T-11
- Open valve between T-16 and oxygen cylinder
- Slowly apply oxygen pressure until bullseye indicates fuel has been added.
- Close valve between T-16 and oxygen cylinder
- Close 2 valves between T-16 and T-11
- Close 2 valves between T-11 and cell C
- Close HCV T-11-2

8. Charge remainder of D₂O from T-2:

- Check that HCV T-2-2 is closed
- Fill D₂O gauge tank T-5 from D₂O receiver T-2 by thawing FP-7
- After T-2 level stops falling, freeze FP-7
- When FP-7 temperature is < -30°C, open HCV T-2-2
- Allow D₂O to drain for 15 minutes, then close HCV T-2-2.

II. Startup of the Hydroclone System

1. Set valves as follows:

HCV T-1-2	Closed
HCV T-1-4	Closed
HCV P-1-4	Closed
HCV H-5-2	Closed
HCV P-1-2	Closed
HCV 141	Closed
HCV 142	Closed

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2. Freeze plug temperatures should be:

FP-3	HCV T-1-2	< -30°C
FP-4	HCV T-1-4	Ambient temperature
FP-5	HCV H-5-2	< -30°C
FP-6	T-1 drain	Ambient temperature
FP-7	T-2 to T-5	Ambient temperature
FP-8	HCV P-1-2	< -30°C
FP-9	F-1 to S-1	Ambient temperature
FP-10	HCV P-1-4	< -30°C
FP-11	P-1 drain	Ambient temperature
FP-12	T-1 to P-1	Ambient temperature

3. Set T-1 TC at 300°C, turn current on manual heater H-11-2, and start P-12 blower.
4. Start P-1 with PdC S-1 on manual and output air equivalent to a frequency of 60 cps. Check cooling water, current, sound and pump temperatures.
5. When T-1 reaches 250°C turn off manual heater H-11-2. When T-1 reaches 300°C stop P-1 and freeze FP-6, FP-11 and FP-12.
6. Thaw plugs in lines 166 and 167 and open valves HCV-141 and HCV-142.
7. Freeze FP-4 as soon as the temperature of the plugs in lines 166 and 167 reaches 0°C. This plug was left unfrozen until the lines to the reactor were open to permit use of the vent valve HCV T-1-4 as a pressure relief valve. In case an excessive quantity of solution was charged to the high pressure system, the pressure could become excessive on heating.
8. Start P-1 with PdC S-1 on automatic. Obtain set point from S-1 ΔP vs flow curve.
9. Adjust temperature controller on H-3 if heater is to be used.

III. Operation of the Hydroclone System

1. Check P-1 frequency hourly.
 - a) Frequency rise indicates:
 - 1) Clone erosion or corrosion
 - 2) Screen, heater or line plugging
 - 3) FP-6, FP-11 or FP-12 leaking
 - b) Frequency fall indicates plugging of the hydroclone
2. Check L.P. system static pressure hourly.
 - a) Pressure rise indicates:
 - 1) Leak from hydroclone system to L. P. system
 - 2) Increase in cell ambient temperature.

- b) Pressure fall indicates lack of over-pressure
- 3. Record freeze plug temperatures hourly.
- 4. Check high pressure system temperatures hourly.
- 5. Check P-1 current and sound every 30 minutes.
- 6. Check P-12 hourly.
- 7. Record reading on gamma-eye hourly.
- 8. Sample overflow once per shift:
 - a) Thaw FP-5 and open block valves
 - b) Check water flow and temperature (120 - 140°F) to H-5 and isolation chamber.
 - c) Open valve HCV H-5-2 for 30 seconds. Check air pressure to valve-pressure regulator is set to limit flow to 0.5 gpm.
 - d) Close HCV H-5-2, freeze FP-5
 - e) Close block valves
 - f) Open vent valve
 - g) Raise sample flask holder with air cylinder
 - h) Open isolation chamber for 20 seconds, then close
 - i) Remove sample flask holder to carrier
 - j) Close vent valve and turn off water to H-5 and isolation chamber

IV. Shutdown of the Hydroclone System and Transfer to a Carrier

- 1. Stop P-1
- 2. Close HCV-141 and freeze associated freeze plug
- 3. Set T-1 TC at 90°C. As soon as T-1 temperature reaches 110°C, close HCV-142 and freeze associated plug.
- 4. Thaw FP-4, FP-6, FP-11 and FP-12.
- 5. Start P-1 with PdC S-1 on manual at 60 C.P.S.
- 6. Check that low pressure system pressure is > 13 psia. Adjust if necessary.
- 7. When T-1 temperature reaches 100°C, open HCV T-1-4, stop P-1, freeze FP-11 and thaw FP-3 and FP-8.
- 8. When FP-11 temperature is < -30°C, start circulation through under-flow sampler:
 - a) Open HCV P-1-2
 - b) Open HCV T-1-2
 - c) Open underflow sampler block valve
 - d) Check that HCV 1112-2, HCV T-11-2 and HCV T-2-2 are closed.
 - e) Start P-1 with PdC S-1 on manual at 80 C.P.S.

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9. After circulating through sampler for 30 minutes, take underflow sample.
 - a) Stop P-1 and turn freon off FP-11
 - b) Close block valve, HCV P-1-2 and HCV T-1-2.
 - c) Open sampler vent valve
 - d) Raise sample flask holder with air cylinder
 - e) Open isolation chamber for 20 seconds, then close
 - f) Remove sample flask holder to carrier
 - g) Close vent valve
10. Prepare desired carrier to receive batch - this can be done while circulating through sampler:
 - a) Open HCV T-3-2 (or T-4-2)
 - b) Turn cooling water on H-1 (or H-2) at 4 gpm
 - c) Turn cooling water on H-14 and H-16 (or H-15 and H-17) at 1 gpm
 - d) Turn 250 lb steam on superheater H-7 (or H-8)
 - e) Turn cooling water on C-1 (or C-2) at 2 gpm
 - f) Turn chilled water (33-38°F) on cold trap H-4 at 2 gpm
 - g) If carrier contains a previous batch, boil off 1.5 gal of D₂O (2.0 gal if more than one batch had been added to carrier):
 - a) Close HCV T-3-2 (or T-4-2)
 - b) When T-2 level has risen 1.5 (or 2.0) gal, immediately open HCV T-3-2 (or T-4-2)
11. Drop batch to carrier if FP-11 is $> 30^{\circ}\text{C}$
 - a) Open HCV C-1-2 (or C-2-2)
 - b) Open HCV 1112-2
 - c) Open HCV T-1-2
12. Allow batch to drain for 20 minutes (gamma-eye readings should stop falling), then add D₂O rinse to high pressure system:
 - a) Close HCV C-1-2 (or C-2-2)
 - b) Close HCV 1112-2
 - c) Check that HCV T-2-2 is closed and thaw FP-7
 - d) When T-2 liquid level stops falling, freeze FP-7
 - e) When FP-7 temperature is $< -30^{\circ}\text{C}$, open HCV T-2-2
 - f) Allow to drain 15 minutes, then close HCV T-2-2 and HCV T-1-2
13. Circulate rinse through H-3, F-1, T-1 and P-1:
 - a) Check that FP-4, FP-6, FP-11 and FP-12 are $> 30^{\circ}\text{C}$.
 - b) Start P-1 with PdC S-1 on manual at 60 C.P.S.
14. During step 13, provide room in carrier for rinse by boiling off 1.5 gal of D₂O:
 - a) Close HCV T-3-2 (or T-4-2)
 - b) When T-2 liquid level has risen 1.5 gal, immediately open HCV T-3-2 or T-4-2).

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15. After at least 30 minutes of circulation, drop rinse to carrier as in Step 11.

Note: If necessary due to plugged line, or to provide a more positive indication of complete transfer, carriers can be charged by pressuring high pressure system:

- a) Close vent valve HCV T-1-4
- b) Raise pressure in high pressure system to 25 psig by heating T-1
- c) Open drain valve HCV T-1-2
- d) Complete transfer will be indicated by a decrease in pressure to 0 psig.

V. Refluxing of the Carrier

After rinse from high pressure system has been added to the carrier, the carrier is kept on total reflux until time to boil down the carrier either for adding another batch or removing from the cell. During total reflux the following procedure is followed:

1. Maintain CW to H-1 (or H-2) at 4 gpm
2. Maintain CW to H-14 and H-16 (or H-15 and H-17) at 1 gpm
3. Maintain 250 lb steam on superheater
4. Regulate steam pressure to carrier to provide a boil-up rate of 3 - 5 lbs of D_2O per hour. This rate will be obtained by checking the steam flow integrator for a reasonable length of time.
5. Check carrier temperatures and pressure hourly.
6. If pressure in carrier vapor line increases during refluxing, this is an indication of plugging in the entrainment separator. Cooling water should then be turned on the S-2 (or S-3) reflux coil until the pressure returns to normal.

VI. Boildown of the Carrier

After the last batch has been added to the carrier, the carrier is refluxed (operation V) until there has been sufficient decay to permit removal of the carrier to the dissolving facility. Prior to removal of the carrier the D_2O is boiled off for recovery of the D_2O and to prevent pressure buildup during transit due to D_2O decomposition.

1. Increase steam pressure to carrier to provide a boil up rate of 8-12 lbs/hour.
2. Close HCV T-3-2 (or T-4-2).
3. Turn 20 lb steam on H-14 and H-16 (or H-15 and H-17)
4. When T-2 level stops rising and steam flow indicator reads zero, continue heating the carrier for one hour.

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5. Turn off steam to carrier, H-14 and H-16 (or H-15 and H-17) and superheaters. Turn CW off condenser.

VII. Removal of the Carrier from the Cell

1. Check that all cell C valves are closed except reflux valve if other carrier is refluxing.
2. Check that FP-3, 4, 5, 7, 8 and 10 are $< -30^{\circ}\text{C}$
3. Check that valves from and to reactor are closed and freeze plugs $< -30^{\circ}\text{C}$.
4. Check cell air monitor
5. Check cell sump liquid level. Sample via scavenging line if level exceeds 3".
6. Open 1" valve at dewatering pump to bring cell to atmospheric pressure.
7. Open 8" cell ventilation valve to stack.
8. Add shielding water to cell until pressure gauge indicates a water level of 18 feet.
9. Remove 5 roof plugs from top layer above desired area. Check radiation level with a cutie pie.
10. Remove a 6 x 12 foot section of membrane and 2 bottom plugs.
11. Check radiation level. If necessary, raise shielding water level to 1 inch below bottom of plugs. Lower carrier shield into cell.
12. If carrier temperatures are $< 100^{\circ}\text{C}$, prepare carrier for removal:
 - a) Cut thermocouple leads
 - b) Close 4 manual valves
 - c) Disconnect service connections.
 - d) Disconnect flanges
13. Place carrier in shield, place top on carrier and remove from cell.
14. Install empty carrier:
 - a) Evacuate empty carrier and fill with oxygen
 - b) Install thermocouples
 - c) Blow water from 2 process lines below shut-off valves by inserting small air line into flange and slowly displacing water with air.
 - d) Lower carrier into position in cell and connect flanges and service connections.
 - e) Connect thermocouple leads in junction box at top of cell
 - f) Open 4 manual valves

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15. Prepare cell for operation:

- a) Replace 2 lower roof plugs
- b) Replace and weld membrane
- c) Replace 5 top roof plugs
- d) Pump shielding water to waste retention pond to a level of 11' in the cell
- e) Close the 8" vent valve to the cell
- f) Pump the remainder of the water to the pond. The last foot will have to be jetted out. This should reduce the cell pressure to about 1/2 atmosphere.

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