

REVISED:

**SECTION W600
SLUDGE CAKE PUMPING SYSTEM**

TABLE OF CONTENTS

A. PURPOSE.....	2
B. SYSTEM DESCRIPTION.....	2
C. CONTROL	3
C.2 Automatic Control.....	5
C.3 Manual Control From FDP-W2	7
C.4 Manual Control From Maintenance Local Control Panels.....	8
D. START-UP	8
E. SHUT DOWN PROCEDURE	10
F. MAINTENANCE.....	10
G. INDIVIDUAL UNITS.....	12

REVISED:

SECTION W600
SLUDGE CAKE PUMPING SYSTEM

A. PURPOSE

The purpose of the Sludge Cake Pumping System is to transfer Sludge Cake (dewatered sludge) from each centrifuge to storage bins in the truck loading bay of the Dewatering Building.

B. SYSTEM DESCRIPTION

Dewatered sludge in the form of sludge cake is expelled from each centrifuge in operation. Sludge cake from each centrifuge falls into a dedicated sludge cake hopper below the centrifuge. Sludge cake is directed to the suction inlet of a dedicated positive displacement sludge cake pump by a cake hopper agitator. The sludge cake discharge from the pump is divided by two discharge valves whereby the thick sludge cake is transferred via the cake supply header to six storage bins in the truck loading bay area (see Section W700) and the thin sludge is returned to holding tanks No. 7 and No. 8 via the thin sludge header.

The following process equipment is used for sludge cake pumping:

- 1) 6 – Sludge Cake Hoppers;
- 2) 6 – Hopper Agitators – W017-CA to W067-CA;
- 3) 6 – Variable Speed Sludge Cake Pumps;
- 4) 6 – Cake Supply Discharge Valves – W015-HV to W065-HV;
- 5) 6 – Thin Sludge Header Discharge Valves – W016-HV to W066-HV.

The Sludge cake pumps consist of the following components:

REVISED:

- 1) Reciprocating positive displacement sludge cake piston pump;
- 2) Positive displacement axial piston hydraulic pump complete with 75 hp motor – W115-CAP to W165-CAP;
- 3) Water reservoir;
- 4) Oil circulating pump complete with 1 ½ hp motor – W118-OCM to W168-OCM;
- 5) Air/oil cooler (radiator) complete with ¾ hp motor – W117-AOC to W167-AOC;
- 6) Swash plate control motor- W116-SWP to W166-SWP.

A schematic of the system is shown in Figure W600. Locations of all the equipment are found in Figures W601 and W602. Figure W603 gives an elevation view of the sludge cake pump system.

C. CONTROL

C.1 Panel Control

Each of the six main drives are controlled by a “COMP/OFF/HAND” switch at FDP-W2. The “OFF/HAND” positions allow for manual control while the “COMP” position surrenders drive control to the Net 90. From here an operator can monitor “RUN” and “LOAD ON” statuses of the drive in addition to the following alarms:

- i) “HI OIL PRESSURE”;
- i) “HI DISCHARGE PRESSURE”;
- ii) “HI OIL TEMPERATURE”;
- iii) “LO OIL LEVEL”;
- iv) “DIRTY FILTER”;
- v) “GENERAL ALARM”.

REVISED:

All of these alarm conditions may be cancelled by pushing the “ALARM REST” pushbutton. All of these devices can be seen in the FDP-W2 layout shown in Figure W604.

The swash plate motors can also be controlled from FDP-W2. An “AUTO/MAN” switch allows an operator to manually control the motor speed using the “INCREASE” and “DECREASE” pushbuttons. The “LOAD/BYPASS” switch allows an operator to bypass normal variable speed control whereby the motor will run at full speed. All of these devices may be seen in the FDP-W2 layout shown in Figure W604.

In addition to the swash plate motors can be controlled from six local control panels. The locations of the panels are shown in Figures W602 and W603 while a sample layout is detailed in Figure W605. From here an operator can select “REMOTE/LOCAL” control, “START” or “STOP” the motor, select “LOAD/BYPASS” speed control, “INCREASE” or “DECREASE” variable motor speed, and also monitor pump speed and elapsed running time.

Each of the hopper agitators are also controlled by “COMP/OFF/HAND” switches at the FDP-W2. From here an operator can monitor “HOPPER HI LEVEL” and hopper “RUN/REV” status. These devices may be seen in the FDP-W2 layout shown in Figure W604. The agitators also have some local control from two switches mounted near the unit (see location Figure W602). The devices allow an operator to locally select “COMP/HAND” and “FWD/OFF/REV” operation.

The twelve discharge valves are controlled by “COMP/HAND” switches also found at FDP-W2. From here an operator can “OPEN” and “CLOSE” any of the valves and monitor their status as such. The “COMP” position surrenders valve control to the Net 90. All of these devices can be seen in the FDP-W2 layout shown in Figure W604.

REVISED:

The six cooling fans and six oil-circulating pumps are controlled by “HAND/OFF/AUTO” switches at FDP-W6. The “HAND/OFF” positions allow for manual control while the “AUTO” position ties in fan and pump control to the corresponding main drive. From here an operator can monitor fan or pump “RUN” status. All of these devices may be seen in the FDP-W6 layout shown in Figure W606.

C.2 Automatic Control

Automatic control of the sludge cake pumping is provided by the Net 90 and the Programmable Logic Control (PLC) in FDP-W2. FDP-W2 contains one PLC with redundant processors which control all six sludge cake pump assemblies.

In automatic mode, the Net 90 will issue a permissive start to the PLC when the following conditions have been met:

- i) One of the following two valves and the pump discharge must be open: the thin sludge valve on the line running to holding tanks 5, 6, & 8 or the sludge cake valve on the manifold line running from the pump to the sludge cake bins #1, 2, 3;
- i) One valve on the sludge cake manifold discharge to the sludge cake storage bin must be open;
- ii) The centrifuge dedicated to the pump must be started and running over 2400 rpm.

The Net 90 will issue a stop if:

- i) The pump discharge valves (thin sludge cake) are closed;
- i) All valves on the manifold from the pump are closed.

The sludge feed to the centrifuge will be stopped.

REVISED:

After permissive from the Net 90 has been given to the PLC, the PLC will:

1. Start the main drive motor, hopper agitator, oil circulating pump and cool fan;
2. Load/bypass valve will remain in bypass until sludge cake in hopper reaches a level of 40%;
3. Above 40% hopper level, the sludge cake pump accelerates to 1 stroke per minute (S.P.M) and remains at 1 S.P.M. until the 55% level;
4. Above the 55% hopper level, the sludge cake pump accelerates to 2 S.P.M. At 60% the pump speed is increased to 3 S.P.M. Above this level the pump accelerates until maximum speed is achieved;
5. When hopper level is reduced below 20%, the pump has been reduced to minimum output and the load/bypass valve goes into bypass;
6. When the hopper level is over 90%, the upstream feed shuts down until the hopper level has been reduced to 70%.

A graph depicting the relationship between % hopper level and pump speed is shown in Table W600.

The PLC will perform the following logic and control:

1. Pump will operate at low speed at starting level and stopping level;
2. The pump speed will be adjusted to control sludge cake level in the hopper. The cake pump will be stopped if the hopper level is below a pre-set minimum (20%);
3. Shutdown of the hydraulic power drive on the following alarms:
 - i) High oil pressure – indicates that the maximum hydraulic pressure has been achieved during the pump operation;

REVISED:

- ii) High discharge pressure – indicates discharge pressure in the discharge lines has exceeded the maximum;
- iii) High oil temperature – indicates the hydraulic oil temperature has exceeded 74 C;
- iv) Low oil level – indicates the hydraulic oil level in the tank has fallen below the minimum operating level.

A general fail signal will be issued to the Net 90 for the above.

C.3 Manual Control From FDP-W2

In the manual hand mode, the operator can control the pump from FDP-W2 by the following:

1. Permissives from the Net 90 are not required for start-up; therefore, all permissives must be checked manually before start-up. The following statuses must be satisfied:
 - i) Thin sludge or sludge cake valve on line from started pump is open;
 - ii) One valve on manifold leading from started pump to sludge cake storage bins is open;
 - ii) Cake hopper agitator motor is started;
 - iii) Dedicated centrifuge is started and running at 2400 rpm.
2. Start-up takes place when the “COMP/HAND” switches are turned to the “HAND” position;
3. The “LOAD/BYPASS” switch and pump speed are operated manually by the operator in this mode. Equilibrium of speed vs. level occurs at approximately 52% hopper level and 2 S.P.M.

REVISED:

C.4 Manual Control From Maintenance Local Control Panels

1. The “COMPUTER-OFF-HAND” selector switch at FDP-W2 for the pump must be turned to the “OFF” position;
2. The “REMOTE/LOCAL” switch is in “LOCAL”;
3. Control motor operation using “START” and “STOP” pushbuttons. Control motor speed by placing “LOAD/BYPASS” switch in “LOAD” position and adjusting potentiometer. “BYPASS” position allows motor to run at full speed.
4. Caution – there is no fault protection when the unit is operated from the maintenance panel.

NOTE: Operation of the sludge cake pump from the maintenance local control panel is not recommended. The maintenance panel is the convenience of the maintenance personnel during servicing. These controls are for maintenance only.

Cross references between the equipment described herein and the Net 90 can be found in Bridging Table W106. Observe that the six oil circulating pumps and six cooling fan motors have no tie in to the Net 90 at all; consequently, they will not be found in any Bridging Table. Equipment/Instrument Summary Tables W601 to W606 provide a detailed summary of all control, monitoring, and alarm devices associated with this system. A listing of these alarms may be found in Dewatering Building Process Alarms Summary Table W106. Further control information is provided in the Process and Instrumentation Diagram shown in Figure W607.

D. START-UP

The following lists the checks and adjustments to be made for start-up;

Pre-Start-Up

REVISED:

- 1) Review safety instructions;
- 2) Place main control valve level(s) in neutral;
- 3) Check all hydraulic fittings for tightness;
- 4) Fill water box with fresh clean water;
- 5) If, at first start-up or after replacing material cylinders or material piston heads (rams), there is a squeaky noise from friction between the cylinder and ram, it is recommended to mix the water box water 1:1 with bore oil (water soluble oil) or release agent (Detergent, ½ gal.);
- 6) If the unit is tested without pumping material, the material side of the material piston head (ram) should be submersed in water or sprayed regularly to keep it wet;

NOTE: Testing for more than 20 minutes at the maximum pump speed of 20 strokes per minute will cause damage to the material piston head (ram) and cylinder. Testing by pumping in reverse is recommended.

- 7) Open Bail Valves on hydraulic lines;
- 8) Check that all Material Pipeline valves are OPEN.

Start-up

At start-up observe the following safety precautions:

- 1) Keep area clear of unauthorized personnel;
- 2) Be observant for leaks and unusual noises;

NOTE: Double check that all hand valves are in neutral position and/or bypass switch is in “BYPASS” (note indicator light) before starting.

REVISED:

- 3) Review the “Sequence of Operating” that is included on the Electrical Schematic to understand what happens at start-up of system.

Keep hands and feet out of the water box, screw conveyor and/or agitator hopper, and discharge valve housing.

- 4) All covers, guards, and safety decals must be in place before start-up.

After starting the Sludge Pump and related equipment, the system must be checked for proper operation. This includes monitoring of gauges and lights, and adjusting the output if necessary.

E. SHUT DOWN PROCEDURE

For maintenance that requires equipment shut down follow these steps, making sure that the equipment is locked out and cannot be accidentally restarted while it is being worked on:

- 1) Put the Hand Valve lever for the Hopper Agitator into “OFF” position;
- 2) Put the Hand Valve lever for the Sludge Pump into “OFF and/or place the “BYPASS” switch on the electrical control enclosure in “BYPASS” position;
- 3) Turn off the main power supply to the hydraulic Power Pack;
- 4) Secure all controls from accidental operation by unauthorized personnel.

F. MAINTENANCE

- 5) Daily:
 - i) Check hydraulic oil level and temperature;
 - ii) Check water level in water box;

REVISED:

- iii) Change water in water box. Drain box at the end of each day's shift;
 - iv) Check for contamination in water box, reporting any contamination to maintenance department. Contamination will appear as oil or sludge;
 - v) Check for leaks and unusual noises.
- 6) Weekly:
- i) Empty water box immediately after shutting down pump at end of process shift;
 - ii) Fill water box at beginning of process shift.
- 7) Monthly:
- i) Lubricate all levers and linkage;
 - ii) Check bolts of material piston head;
 - iii) Drain condensed water from hydraulic oil tank. Allow enough shut down time for water to settle.
- 8) Tri-Monthly:
- i) Check poppet valves;
 - ii) Check nuts and bolts for tightness.
- 9) Bi-Annual:
- i) Change hydraulic oil;
 - ii) Check setting of throttle valves;
 - iii) Check pressure setting of safety valve;
 - iv) Check pressure setting of pressure switch.
- 10) Annual:
- i) Change hydraulic oil.

REVISED:

G. INDIVIDUAL UNITS

- 1) Sludge Pump Main Drives - W115-CAP, W125-CAP, W135-CAP, W145-CAP, W155-CAP, W165-CAP
- Manufacturer: Pump - Schwing Model #KSP 25, 115 USGPM
 Motor - Siemens
 75 hp, 575 V, 3 ph, 60 Hz
 1775 rpm, 67.2 FLA
- 2) Sludge Cake Pumps - W116-SWP, W126-SWP, W136-SWP, W146-SWP, W156-SWP, W166-SWP
- Manufacturer: Lafert
 0.35 hp, 575 V, 3 ph, 60 Hz, 3360 rpm, 0.65 FLA
- 3) Air/Oil Cooler Fan Motors - W117-AOC, W127-AOC, W137-AOC, W147-AOC, W157-AOC, W167-AOC
- Manufacturer: Radiator - Modine
 Motor - U.S. Electrical Motors
 $\frac{3}{4}$ hp, 575 V, 3 ph, 60 Hz, 1725 rpm, 1.2 FLA
- 4) Oil Circulating Pumps - W118-OCM, W128-OCM, W138-OCM, W148-OCM, W158-OCM, W168-OCM
- Manufacturer: Pump - Rexroth
 18 USGPM
 Motor - Baldor
 2 hp, 575 V, 3 ph, 60 Hz, 1725 rpm, 2.7 FLA

SECTION W600: PAGE 13 of 13

REVISED:

- 5) Hopper Agitators - W017-CA, W027-CA, W037-CA, W047-CA,
W057-CA, W067-CA
Manufacturer: U.S. Electrical Motors
15 hp, 575 V, 3 ph, 60 Hz, 880 rpm, 19.0 FLA
- 6) Thick Sludge Discharge Valves - W015-HV, W025-HV, W035-HV, W045-HV,
W056-HV, W065-HV
Manufacturer: Valve - Kitz 8-600 WCB Steel Body
8 " diameter
Actuator - Rotork Model #250-082DA
- 7) Thin Sludge Discharge Valves - W016-HV, W026-HV, W036-HV, W046-HV,
W056-HV, W066-HV
Manufacturer: Valve - Kitz 6-600 WCB Steel Body
6" diameter
Actuator - Rotork Model #250-082DA
- 8) Level Sensors - W018-LE/LIT, W028-LE/LIT, W038-LE/LIT,
W048-LE/LIT, W058-LE/LIT, W068-LE/LIT
Manufacturer: Miltronics Multiranger Plus