

Company, LACT Control

Revised 11/06/2006

This narrative discusses the changes that have been made to the LACT shipping system when control was shifted from a hard-wired electrical system to a PLC-driven system.

Pump Operation

All motor operations for the NGL pump, the LACT charge pumps, and the shipping pumps are ultimately controlled through the PLC. So A PLC failure (or even an I/O card failure) will cause all motor operation to stop until the problem can be fixed or an electrician can temporarily install bypass jumpers. Critical spares of all PLC parts are kept on site.

You can still run each pump in the **HAND** or **AUTO** mode, but because a PLC has been added, selecting that mode will be more complicated than in the past. We want to avoid a situation where the field switch is calling for Hand operation but Wonderware is trying to start the pump automatically. Or the reverse situation, where the operator has all the field switches in Auto, but shipping does not start because Wonderware is waiting for a manual start signal. To resolve this, the field switch will now be used to select the source of control — either **FIELD** or **PLC**. Once a source of control has been selected, an operating mode will need to be selected — either **HAND** or **AUTO**.

The 3-position switch at each pump selects a source of control... **FIELD**, **OFF**, or **PLC**.

FIELD: Placing the Field-Off-PLC switch in the **FIELD** position means that pump operation is controlled in the field. Placing the switch in the field position forces the pump into the Hand mode.

HAND: The pump will run if there are no critical safeties which are keeping the pump locked out. The pump will continue to run until the operator turns the field switch to **OFF**, or until a safety shuts down the pump.

OFF: The pump will not run.

PLC: Placing the Field-Off-PLC switch in the **PLC** position means that pump operation must be controlled through Wonderware. The operator can place the pump in either Hand or Auto mode through Wonderware.

HAND: The pump will run if there are no critical safeties that are keeping the pump locked out. The pump will continue to run until the operator turns the pump off in Wonderware, places the field switch in the OFF position, or until a safety shuts down the pump.

AUTO: The pump is waiting for a start signal from the Automatic Shipping Sequence before it will start.

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LACT Charge Pump Safeties

- | | | | |
|----|----------------------------------|------------|--|
| 1) | Charge Pump Low Suction Pressure | < 0.5 psig | |
| 2) | Crude Oil Tank Alarm Low Low | < 15% | |

Shipping Pump Safeties

- | | | | |
|----|---------------------------------------|------------|-----------------------|
| 1) | Shipping Pump Low Suction Pressure | < 15 psig | 5 sec TD on P3 start |
| 2) | Shipping Pump Low Discharge Pressure | < 40 psig | 30 sec TD on P5 start |
| 3) | Shipping Pump High Discharge Pressure | > 570 psig | 60 sec TD on P5 start |

(When in Auto, a Charge Pump must be running)

(The Shipping Pump Low Discharge Pressure shutdown has an operator-enabled bypass for 5 minutes to compensate for changing pipeline conditions)

NGL Pump Safeties

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|----|-----------------------------|-----------|-----------|
| 1) | NGL Vessel Level Safety Low | < 5% | |
| 2) | NGL Low Flow (alarm only) | < 2.0 bph | 15 sec TD |

(When in Auto, a Shipping Pump must be running)

Shipping Sequence

The oil shipping sequence can be initiated automatically or manually.

Automatic Shipping

For automatic operation of crude oil shipping, at least one shipping pump and one charge pump need to be placed in the **Auto** mode by selecting PLC at the Field-Off-PLC switch mounted in the field and setting the "Shipping Sequence" controller in Wonderware to Auto. The NGL pump needs to be placed in the Auto mode also, if automatic operation is desired.

Run Permissives

The following run permissives must be met before the automatic shipping sequence can be initiated:

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|----|---------------------------------------|----------|---------------------|
| 1) | Charge Pump Low Suction Pressure | > 1 psig | |
| 2) | Crude Oil Level > Automatic Stop | > 20-29% | Operator Adjustable |
| 3) | At least 1 shipping pump in Auto mode | | |
| 4) | At Least 1 charge pump in Auto mode | | |

When these conditions are met, the light labeled **Ready to Ship** on the Wonderware LACT screen will turn from red to green.

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Initiate Shipping

If the above run permissives are met, then shipping is automatically initiated when the level in the Crude Oil Tank reaches the Automatic Start level. The operators may adjust this level to anywhere between 30% and 80%.

- 1) The light labeled **Initiate Shipping** on the Wonderware LACT screen turns from red to green. The green pilot light at the LACT, labeled Initiate Shipping, will turn on.
- 2) The LACT charge pump starts pumping.
- 3) A 90-second Reject Timer starts counting down.
- 4) The BS&W content of the oil is monitored.
- 5) When the BS&W content drops below 3% (the Alarm High High point), a 30-second Good Oil Timer begins counting down. If the BS&W content rises above 3%, then this timer resets and won't start counting down until the BS&W content again falls below 3%. The light on the Wonderware LACT screen will be green (**Good Oil** $\leq 2.5\%$), yellow (**Wet Oil** $>2.5\%$) or red (Wet Oil $>3\%$).
- 6) When both the Reject Timer and the Good Oil Timer time out, the Reject Valve (FCV-1) energizes, packing the line through the gross oil meter with oil. The light labeled **Rejecting** on the Wonderware LACT screen turns from red to green, and the text changes from Rejecting to **To Sales**.
- 7) A 15-second Shipping Pump Timer starts counting down. When the Shipping Pump Timer times out, the shipping pump starts. The light labeled **Shipping** on the Wonderware LACT screen turns from red to green.
- 8) A 15-second NGL Timer starts counting down.
- 9) The NGL Timer times out.
- 10) If the NGL level is above the NGL Vessel Automatic Stop, then P19-SDV opens and the NGL pump starts pumping. The NGL pump is controlled by a variable speed drive which ramps up the frequency of the motor until the desired speed is reached. The speed will be determined by desired the NGL rate, selected in Wonderware. This rate is currently set to 14.4 bph. If a flow rate is not detected within 15 seconds of P19-SDV opening, then a Flow Alarm Low is generated. (The flow meter is currently not working, so operations has been running the VSD in Manual at about 48.5Hz.)
- 11) Shipping will continue until the level in the Crude Oil Tank reaches the Automatic Stop level. The Operators may adjust this level to anywhere between 20% and 29%.

Reject

If, at any time during the shipping cycle, the BS&W content rises above 3%, a 30-second Wet Oil Timer begins counting down. When the timer times out, the Reject Valve is de-energized, the shipping pump stops, the NGL pump stops, P19-SDV shuts, and oil is sent back to the Crude Oil Tank. When the oil is good for 30 seconds, the reject valve is re-energized sending the oil back through the meter, and the shipping sequence continues from step #5 above.

- BS&W High High Alarm > 3% 30 sec TD

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Alarms

The following conditions generate alarms in Wonderware, but do not affect shipping.

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| 1) | Deaerator Low Level | | 30 sec TD on P5 start |
| 2) | BS&W High | > 2.5% | |
| 3) | NGL Low Flow Rate | < 2.0 bph | 15 sec TD |

Shutdowns

The following conditions will cause the shipping sequence to stop. The first-in shutdown condition will latch and prevent shipping until the operator has pressed the Reset button. Automatic shipping will then restart when the Crude Oil Tank reaches the Start Shipping level. The latched alarm will flash on/off on the Wonderware LACT screen until the reset button is pressed.

- | | | | |
|-----|--|------------|-----------------------|
| 1) | Charge Pump motor fail | | |
| 2) | Shipping Pump motor fail | | |
| 3) | Charge Pump Low Suction Pressure | < 0.5 psig | 5 sec TD on P3 start |
| 4) | Shipping Pump Low Suction Pressure | < 15 psig | 30 sec TD on P5 start |
| 5) | Shipping Pump Low Discharge Pressure | < 40 psig | 60 sec TD on P5 start |
| 6) | Shipping Pump High Discharge Pressure | > 570 psig | |
| 7) | Crude Oil Tank Low Low Level | < 15% | |
| 8) | BS&W transmitter failure | | |
| 9) | Meter Fail—East (50% normal shipping rate) | | 60 sec |
| 10) | Sample Fail—East (10:1 sample pulse ratio) | | 600 sec |
| 11) | Meter Fail—West (50% normal shipping rate) | | 120 sec |
| 12) | Sample Fail—West (10:1 sample pulse ratio) | | 1200 sec |

Reset

If any of the above shutdown conditions stops the LACT shipping sequence before a normal stop can be initiated (Crude Oil Tank Automatic Stop or Manual Stop) the alarm will flash in Wonderware and the LACT will be locked out until the **RESET** button is pressed (either at the LACT skid or through Wonderware).

Manual Shipping

The Manual mode of operation is identical to the automatic in terms of alarms, run permissives and shutdowns. The only difference is that the sequence can be started by pressing the **START** button (either at the LACT skid or through Wonderware) any time the Ready to Ship light is green.

Shipping will then continue until the Automatic Stop level is reached, the Stop button is pressed (either at the LACT skid or through Wonderware), or a shutdown (safety) condition stops the shipping sequence.