Title: L.A.C.T. Unit Design by Craig A. Francisco

L.A.C.T. UNIT DESIGN

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The Lease Automatic Custody Transfer (L.A.C.T.) unit is designed for the automatic transfer of ownership of crude or condensate between the buyer and seller.

This can be on land or offshore, into pipelines, barges, and tanker loading and off-loading operations.

On land L.A.C.T. units are usually small, single run systems with portable proving connections designed for loading into trucks.

Because of the geographical area, this paper will focus on the offshore L.A.C.T. units. These are dual run with 100% back up and with mechanical displacement meter provers at 150 ANSI working pressures.

The basic components and function of a L.A.C.T. unit are:

1. Charge Pump and Motor - Largely overlooked and undersized, special care should be taken into consideration during sizing to ensure correct NPSH is available to prevent cavitation, and discharge pressure is enough to overcome pressure drop through the L.A.C.T. to allow the required flow and pressure to the pipeline pump inlet.

2. Strainer/Air Eliminator - Strains solids larger than the perforations in the removable basket with liner. They should have differential pressure indicator to show pressure drop caused by debris accumulation and be cleaned periodically. Essential to prevent premature meter wear or breakage. The air eliminator is located on top of the strainer at the highest part of the system to allow air to be discharged and not metered. This should be piped with a soft seated check valve to prevent air from being introduced into the system during shutdown.

3. Sample System - Installed with an upstream static mixer usually flow-proportional, isokinetic, and tubed to a vapor tight storage vessel sized to allow 25 to 30 days storage. The vessel is provided with a recirculation pump, the samples are mixed and then drawn off to be checked for composite API Gravity and BS&W during the delivery period.

4. BS&W Monitor and Probe - Installed downstream of the sampler and upstream of the three-way divert valve, this unit consists of a flanged probe that monitors the flowing stream for basic sediment and water and communicates with the "monitor" unit that is normally installed in the control panel. The "monitor" is usually set at 1.0%, and is wired to the solenoid valves controlling the three-way valves on the bad oil divert line. These will send oil to be treated if a high BS&W signal is received for a given time. When a good oil signal is received for a set time, then the valves will return to normal flow position.

5. Meter - Installed downstream of the three-way valve and downstream of a properly sized thermal relief valve. The meter measures the product stream and

allows totalization either through a local totalizer or electronic pulses to a flow computer. This meter can be a positive displacement or turbine meter.

The meter will provide signals to the flow computer or PLC to allow:
- Ø Sample Pacing
- Ø Totalization
- Ø Meter Proving
- Ø Meter Fail

6. Meter Instrumentation - Downstream of the meter a spool consisting of:

- Ø Temperature transmitter with platinum RTD installed in a S.S. thermowell.
- Ø Pressure transmitter with a pressure gauge mounted with a three-way gauge valve.
- Ø Test S.S. thermowell used to calibrate the temperature transmitter.
- Ø The temperature and pressure transmitters are used to send a live reading to the flow computer for compensation.

7. Check Valves - Downstream of the meter to prevent backflow to the meter in case the downstream block and bleed valve is left open and the opposite meter train is running.

8. Block and Bleed Valves - Located downstream of the check valves at the end of each run and as the main line divert valve separating the to and from lines to the prover four-way divert valve. This is to ensure all fluid is being diverted to the prover during proving, or a false meter factor could be obtained during proving of the meter.

9. Prover Instrumentation - On the outlet of the prover four-way divert valve a spool consisting of:

- Ø Temperature transmitter with platinum RTD installed in a S.S. thermowell.
- Ø Pressure transmitter with a pressure gauge mounted with a three-way gauge valve.
- Ø Test S.S. thermowell used to calibrate the temperature transmitter.
- Ø Thermal relief valve properly sized.

10. Back Pressure Valve - On the skid outlet to maintain pressure above the vapor pressure of the fluid being metered and provide a constant pressure and flow on the meter during proving.

11. L.A.C.T. Control Panel - This can be located on the skid with PLC controls, and local manual proving connections would then be required, for a prover counter, detector switch plug in, power for the counter, and a portable pulse generator for P.D. meters.

An electronic temperature averager could then be used in lieu of temperature transmitters; however, due to their flexibility and relative cost, flow computers are rapidly replacing them.
If located in the MCC room, the panel could then be equipped with a PLC, flow computer, and printer to allow for automatic proving and batch reports by pushing a button, provided the prover's four-way valve is equipped with a remote actuator, and pressure and temperature transmitters were installed.
The control panel will have the following functions:
- Ø Start and Stop Off High and Low Level Switches
- Ø Hand-Off-Automatic Switch
- Ø BS&W Divert Controls

- Ø Meter Fail
- Ø Monitor Failure
- Ø Internal Battery Back-Up for Power Loss

12. Calibrated Bi-Directional Meter Prover - Because of the versatility of configuring a bi-directional prover in tight offshore spaces and its' cost associated with normal offshore flow rates, the bi-directional prover has become the prover of choice versus the uni-directional and small volume prover.
The continuous flow technique of meter proving is accomplished by repeatable displacement of a known volume of liquid in a calibrated section of pipe between two signaling devices (detector switches).

A slightly oversize prover sphere inflated to normally 2% over the pipe inside diameter is used to displace the fluid.
The fluid is run through the meter and the prover. The metered volume is recorded by the electronic meter-proving counter (built into flow computers).
The known volume displaced is checked against the meter's indicated output and a "meter factor" is obtained after correction factors (Ctl)(Cps)(Cts) and (Cpl) are applied.
The use of new workover chemicals now seen offshore suggests internal coatings be exclusively a baked on phenolic versus an air dried epoxy for longer life.

The prover sphere most seen nowadays has gone from the standard 53 Durometer hardness to a 58 Durometer harder material for longer life and durability.
Design Considerations
*Customer's Specifications

First and foremost, if your L.A.C.T. unit does not meet your buyer's or shipper's standard specifications, you may find yourself offshore with a tank full of oil having to shut in your wells because your L.A.C.T. skid has not been approved, or they just were notified that you want to come on-line with a skid they have never seen. Get hold of the specifications and get them involved early in the fabrication of the unit.

*Space

Offshore space is a premium. Units can be built in any number of configurations and footprints, but also consider the serviceability of the unit.

Viscosity

High viscosity can cause several problems.
1. Does the meter (P.D. type) require high viscosity clearances and high temperature trim on units above 150° F?
2. If heat traced and insulated, the instrumentation may require new trim.
3. Check prover sphere operating temperature.
4. Is NACE trim required?

Flow Rates

Is the L.A.C.T. unit only going to see one platform's oil, or is there a chance that a new platform's oil will be shipped over next year when it comes on-line?

Do you need to design the skid for an additional meter run?

Conclusion

The recent acceptance and development of new electronic equipment for crude oil measurement in the past few years has made them more reliable and accurate while requiring less maintenance. However, the technician needs to be more highly trained than ever before.

Many factors go into the design of L.A.C.T. units flow rates, space limitations, temperature, viscosity, corrosion, and customer specifications. As long as these are taken into consideration, one can end up with a quality measurement system.