Custody Transfer Using Coriolis Meters in North Dakota

Background:
In 1998, in an effort to improve safety and reduce costs, EOTT (crude oil purchaser) proposed to be allowed to purchase oil via the use of coriolis mass-flow meters. Use of these meters eliminates the need for the purchaser to hand gauge the tank before and after loading the trucks. This eliminates potential safety hazards including those attributable to climbing tanks, particularly during winter weather conditions, and exposure to H_2S. Cost savings are attained through being able to send a lone employee to load a truck. These same benefits are realized by the BLM, as PETs do not need to climb the tanks or have H_2S safety back-up to witness an oil sale.

Testing:
In 1998 and 1999 EOTT, conducted extensive year-long testing of the accuracy of using truck-mounted coriolis meters for custody transfer of crude oil. The testing was designed to test this method of measurement against other established methods under various conditions. At that time there were no API standards for the use of these meters for custody transfer though they had been in use for years for measurement of other fluids in the petrochemical and refining industries.

The reason for the 12 months of testing was to verify the accuracy under the temperature extremes encountered in North Dakota which typically range from -40˚ in winter to 100˚ in summer. It was also tested on various gravities and grades of crude oil to ensure its applicability. Upon successful completion of the testing period, North Dakota Industrial Commission (NDIC) issued orders allowing the use of the specific meters/trucks that had undergone the testing. As additional truck mounted meters were brought into service, they were required to be individually tested to ensure accuracy and a separate order was issued for each meter/truck application.
In 2002, API established standards for the use of coriolis meters for the measurement of oil (MPMS Ch. 5.6 Measurement of Liquid Hydrocarbons by Coriolis Meters) resulting in the issuance of NDIC Order No. 9381.

Approvals:
As coriolis meters are not addressed by Onshore Oil and Gas Order No. 4, their use for custody transfer of oil produced from Federal leases, Communization Agreements (CA), or units require that the operator apply for a variance to the order. Approval is conditioned upon compliance with applicable NDIC orders, API standards, and proving frequency as required by Onshore Order No. 4.

A copy of NDIC order no. 9381 follows:

BEFORE THE INDUSTRIAL COMMISSION

OF THE STATE OF NORTH DAKOTA

CASE NO. 7969
ORDER NO. 9381

IN THE MATTER OF A HEARING CALLED ON A MOTION OF THE COMMISSION TO CONSIDER AMENDING COMMISSION ORDER NOS. 8701, 8781, 9132, 9176, 9256 AND 9366 AUTHORIZING TRUCK-MOUNTED CORIOLIS METERS TO BE UTILIZED IN NORTH DAKOTA FOR CRUDE OIL ALLOCATION OR CUSTODY TRANSFER AND FURTHER TO ESTABLISH PROCEDURES FOR TUCK-MOUNTED CORIOLIS METERS TO BE UTILIZED IN THE FUTURE.

ORDER OF THE COMMISSION

THE COMMISSION FINDS:

(1) This cause came on for hearing at 9:00 a.m. on the 26th day of February, 2003.

(2) Section 43-02-03-48 of the North Dakota Administrative Code (NDAC) requires all meters used for the measurement of crude oil to conform to American Petroleum Institute (API) standards.

(3) The API has recently approved the Coriolis meter for oil measurement and a standard has now been written.

(4) Order Nos. 8701, 8781, 9132, 9176 and 9256 were issued by the Commission allowing the use of truck-mounted Coriolis meters to be utilized in North Dakota for crude oil allocation or custody transfer as an exception to NDAC Section 43-02-03-48. Order No. 9366 was issued by the Commission subsequent to said API standard.

(5) Commission orders issued, prior to the API standard being written, contained a stipulation that the operator of the well and the crude oil purchaser must sign an affidavit authorizing the truck-mounted Coriolis meter to be utilized for purposes of oil allocation and/or custody transfer. Such stipulation is no longer necessary.

(6) Guidelines for the implementation of Coriolis meters have been established by the Oil and Gas Division of the North Dakota Industrial Commission and should be incorporated into this order to provide industry guidance in utilizing the Coriolis meter for oil allocation and/or custody transfer.

IT IS THEREFORE ORDERED:

(1) Commission Order Nos. 8701, 8781, 9132, 9176, 9256 and 9366 are hereby amended to allow the use of truck-mounted Coriolis meters for crude oil allocation and/or custody transfer without filing an affidavit signed by the operator of the well and the crude oil purchaser authorizing its use.

(2) All Coriolis meters utilized in the State of North Dakota shall comply with North Dakota Administrative Code Section 43-02-03-48 and the API standards as outlined in the API Manual of Petroleum Measurement Standards.

(3) The following equipment must be incorporated into any metering system utilizing a Coriolis meter:

(a) Pump.
(b) Divert valve.
(c) Automatic sampler.
(d) Temperature probe and temperature well.
(e) Automatic air eliminator (vented into the truck tank) with provisions to prevent liquid from passing.
(f) Block valves (for zeroing meter as to manufacturer's recommended procedures and API standards).
(g) Back pressure control valve (if deemed necessary by the Director).
(h) Prover loop.
(i) Heat tracing (if conditions require).
(j) Security sealing equipment.
(k) Any additional equipment requirements deemed necessary by the Director.

(4) The following requirements must be incorporated into any metering system utilizing a Coriolis meter:

(a) The meter must be mounted and operated according to API standards and meter manufacturer's recommendations.
(b) The meter shall register volume in barrels.
(c) Effects from vibration, pulsation, vaporization, cavitation, liquid swirl, or electrical interference must be eliminated or be minimized as to not effect meter performance.
(d) All equipment utilized must be installed according to API standards and manufacturer's recommendations.
(e) The automatic air elimination system must be installed with the air vented into the truck tank to eliminate possible safety hazards or spills.

(f) Valves shall be installed upstream and downstream of the meter to stop flow through the Coriolis meter to allow zeroing.
(g) No meter bypass shall be allowed.
(h) A divert system shall be installed to circulate crude oil in order to eliminate air in the metering system. When meter indicates system is ready, the divert valve shall open to the truck tank. The meter shall not record any volume while divert valve is in the closed position. The divert system shall be automatic so that the driver has no capability to override divert valve until meter shows it is ready for custody transfer.
(i) Effects of ambient temperature shall be eliminated or minimized to insure meter accuracy and performance.
(j) A thermowell must be installed in close proximity to metering device for verifying meter temperature readings.
(k) Seals shall be placed on the meter inlet flange, divert valve, meter outlet flange, meter module and on all other primary and secondary equipment where changes can be made that have an affect on the meter factor or meter registration. A seal record shall be maintained throughout the life of the metering system, including the test period. The record shall identify each seal removed, the reason for the seal removal, and identify the new seal installed.
(l) The Coriolis meter shall be protected from pressure surges as well as excessive pressures caused by thermal expansion of the fluid when the system is not operating.

(5) The test period for a new or modified truck-mounted Coriolis metering system must be approved by the Director. Approval for such test period must be requested on a Sundry Notice and contain the following:

(a) Manufacturer's meter specification data and equipment operations manual, which shall include mounting instructions, testing procedures, a list of software parameters, software options and security information.
(b) Associated equipment list and information.
(c) Truck number and truck style (i.e.: Semi, Double bottom).
(d) Tank tables for all wells tested shall be on file with the Commission.
(e) Proposed operating procedures for measuring and transporting crude oil from location.
(f) Schematic(s) of truck-mounted Coriolis meter system installation.
(g) Any additional information deemed necessary by the Director.

(6) All test period procedures for truck-mounted Coriolis meter systems shall incorporate the following:

(a) Prior to the test period the transporter shall make sure that the truck-mounted Coriolis metering system is functional and accurate.
(b) A Zero test (with truck engine running) shall be performed at the beginning of the meter test period and the Zero shall be checked at the end of the meter test period. Such Zero test and check shall be witnessed by the Oil and Gas Division.

(c) All truck-mounted Coriolis metering systems used to transport oil within North Dakota shall be tested and proved in North Dakota.
(d) The daily dispatch shall be provided to the Oil and Gas Division prior to the comparison test.
(e) The test period shall include at least 20 loads with hand-gauge-to-meter comparison tests recorded on each load. The test period shall include at least two provings against a conventional pipe prover, which shall include an initial proving and a final proving conducted at the end of the test period. The test period may be extended to include additional loads and/or provings if deemed necessary by the Director. All data gathered shall be submitted to the Commission and the transportation company must perform a comparison test on all loads taken during the test period.
(f) Prior to the removal of any seal during the test period, the Commission must be verbally notified of the reason therefor.
(g) Alterations to meter performance, registration, or meter factors shall only be possible by breaking meter seals.
(h) All problems with, adjustments made in, or changes made to the metering system shall be noted and immediately submitted to the Commission to determine if the test period accuracy has been compromised. If the Commission determines the test period accuracy has been compromised, the test period shall begin again on the date changes were made.
(i) Hand gauge run tickets and meter run tickets shall be used as a comparison of volumes for the test period.
(j) Hand gauge run tickets must show date, producer name, lease name and number, tank number, open gauge, open temperature, close gauge, close temperature, observed gravity, observed temperature, corrected gravity, BS&W, gross barrels, net barrels, and driver's name.
(k) Meter run tickets must show date, producer name, lease name and number, tank number, average observed gravity, average observed temperature, corrected gravity, gross barrels, BS&W (derived from composite sampling), meter factor, API volume correction factors, net barrels, and driver's name.
(l) Any additional information deemed necessary by the Director.

(7) Truck-mounted Coriolis meter systems must be proved using the following:

(a) A prover loop or other valve configuration shall be installed downstream of meter and as close to the meter as possible to allow meter to be proved.
(b) The proving shall consist of a minimum of 6 runs (round trips) with a conventional pipe prover.
(c) Proving repeatability shall be based on meter factor repeatability (not pulse repeatability) and 5 out of 6 consecutive runs must be within tolerance.
(d) Oil utilized during the proving must be at a temperature between 50°F and 125°F.
(e) Provings must be performed as an on-loading procedure at any location approved for testing or custody transfer.
(f) Monthly provings are required once the truck-mounted Coriolis meter has been approved for custody transfer. The transporter must notify the Commission at

least ten days prior to proving date of the approximate time and location of proving. The transporter must also notify the Commission if the proving date, time or location has been changed.

(8) Application to utilize a truck-mounted Coriolis metering system for custody transfer may be approved by the Director only after completion of the test period. Approval for custody transfer must be requested on a Sundry Notice and contain the following:

(a) Truck number and truck style (i.e.: Semi, Double bottom)
(b) A copy of all test results during the test period. Such results shall include, but not be limited to the following:

1. Chronological history of events from setting up the truck-mounted Coriolis meter to the end of the test period.
2. Volume comparison (hand-gauged vs metered) including the following:

a. Date
b. Operator
c. Lease
d. Tank number
e. Hand measured oil tank temperature
f. Hand measured oil gravity corrected to 60°F
g. Hand measured net sales volume
h. Metered oil temperature
i. Metered oil gravity corrected to 60°F
j. Metered gross sales volume
k. Meter factor
l. Metered net sales volume
m. Net sales oil volume difference (hand measured vs metered)
n. Graph comparing hand-measured oil tank temp vs meter oil temp
o. Graph comparing hand-measured oil gravity vs metered oil gravity
p. Graph comparing hand-measured net sales volume vs meter net sales volume

3. Coriolis meter proving data including the following:

a. Date
b. Location
c. Oil temperature
d. Observed oil gravity
e. Corrected oil gravity
f. Pump rate
g. Meter factor
h. Graph comparing meter factors vs date
i. Graph comparing pump rate vs meter factor
j. Graph comparing corrected oil gravity vs meter factor

k. Graph comparing oil temperature vs meter factor

4. Any additional information deemed necessary by the Director.

(9) This order shall remain in full force and effect until further order of the Commission.

Dated this 26th day of March, 2003.

INDUSTRIAL COMMISSION
STATE OF NORTH DAKOTA

/s/ John Hoeven, Governor

/s/ Wayne Stenehjem, Attorney General

/s/ Roger Johnson, Agriculture Commissioner