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PREPARING A PROVER FOR A WATER DRAW CALIBRATION
Class # 4190

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Introduction

The key to a successful calibration of a prover by the water draw method is thorough planning and organization followed by good execution of the plan. The primary goal is to get the prover as clean as possible and perform any replacements and maintenance needed prior to the arrival of the Calibration Company. This paper is intended to assist you attain an accurate calibration by presenting some things to consider for the planning, organization and execution phases.

A more detailed Procedure for prover preparation is provided in API Manual of Petroleum Measurement Standards, Chapter 4-Proving Systems, Section 9, Part 2.

Planning for Personnel

The organizing and coordination phase should be assigned to one individual. The number of employees, contract service groups and contract personnel need to be identified. Usually mechanical technicians are needed to remove replace or install four way valves, bolts, gaskets, spheres and any pipe sections to be removed. Proper cleaning of the prover is critical to an accurate calibration. An electrical technician may be utilized to isolate power from the prover and associated motor operated valves for safety purposes. The electrical technician may also remove the detector switches, inspect, clean and install rebuild kits and electronic elements if your switches are of this type. After a rebuild the switches need to be tested prior to installing them. You may require the cathodic protection to be temporarily removed and initiated after the work is finished. Any confined space entry should be considered for safety reasons also. If confined space is involved certified professionals may be required. If the facility has been declared a Foreign Trade Zone (FTZ), an approved, certified U.S. Customs Inspector will need to be on site the day of the calibration. Consideration should be given to any other special skills that require qualified persons such as crane/hoist operators or internal pipe inspectors.

Planning for Product and Water Acquisition and Disposal

Planning should include locating and securing a supply of clean fresh water close to the facility. Determine if the supply is from a hydrant which may need flushing or pond water. The water must be clean so the source may require filtration equipment if from a pond or lake. A decision should be reached on where to dispose of any product from the prover. Any newly instituted safety procedures for drain up into a sump or vacuuming out a sump need to be considered. A disposal plan for the contact water should be developed and truck carriers labeled properly for the content carried.

Planning for Equipment

Develop a plan for the equipment you will need to perform the tasks. If there is no fresh clean water available on the work site a tanker truck(s) may be needed to transport the supply to the prover. The tanker should have a pump off capability or a pump installed in line from the tanker to the prover. Determine the capacity needs for the fresh water supply truck(s) and the Vacuum truck(s).Determine if you could use two vacuum and fresh water trucks to minimize any turnaround time hauling water in or contact water off the work site. If the disposal facility is too far from the work site consideration in a Frac Tank should be given. The bulk from the tank can be removed a more leisurely pace and time. A hot oil truck or a hot water hydro-jet (high pressure washer unit) with sufficient hose length to run through the prover will greatly minimize the amount of contact water generated. This will reduce disposal cost of the contact water. If previous calibrations have been difficult to obtain within the API guidelines and you suspect the internal coating is bad you may want to consider running a sewer

camera through the prover with video or DVD capabilities for proof of coating failure. I do this if the last calibration was or exceeded +4% of the I.D. A crane or hoist may be needed with adequate lift and reach to safely remove a four way valve for inspection and slip replacement. It is also useful to lift the old and new sphere to the closure door on provers. Adequate lengths of hose need to be determined to reach a fresh water source, Frac tank or vacuum truck. Review the need for any special adaptor fittings such as Cam-Locks, hydrant threads to pipe threads or other required fittings. Visqueen, metal drip pans and grounding cables should be considered for environmental and safety reasons.

Plan for Materials Needed.

A list of materials needed for and readily available for a Small Volume Prover (SVP) may include a differential pressure gauge kit to perform a seal fail test, a poppet assembly seal kit, upstream and downstream shaft seal kits, spare photo optic cells, and a command/logic card.

Conventional Bi-directional and Uni-directional Pipe Provers should have the following readily available. New slips (bi-directional) Seal cups (uni-directional) prover loops for the appropriate size and ANSI rating. Both types should have new detector switches, or switch rebuild kits and new electronic elements for those manufacturers that make these available. When ordering any associated detector switch part, the manufacturer of the base needs to be provided with the order. If a new switch is ordered the distance from the inside of the pipe to the top of the switch base needs to be provided for the proper probe length. Long switch lead wires need to also be specified if required. If you want to bring buried detector switches above ground you need to order extensions. This eliminates excavations to replace switches. The size of the new sphere, composition, standard weight, weighted, and low friction should be determined prior to ordering. The new sphere needs to be sized at +2 or +3 % away from heat, sunshine or cold too minimize potential expansion or contraction of the sphere. If internal coating is losing the bonding to the pipe wall you will probably need to increase the sphere oversize to attain a proper seal with the pipe wall.

As a special note, drain lines need to be isolated with skillets or blind flanges. Vents and thermal relief systems need to capped or plugged to prevent any external leakage from the prover during the water draw calibration. Do not rely on valves to prevent bleed through.

Commission-Decommission-Recommission Plan (CDR)

A very useful tool is to gather all the data, list of personnel, materials and equipment needed to perform the water draw and develop a CDR Plan. This plan will organize who, what, when, where and at times why to isolate, drain, clean, repair or replace parts, or install rebuild kits to get an accurate calibration. The CDR style Marathon Pipe Line uses includes a communication list with personnel, office and cell phone numbers. The list includes Contract service company representatives. Emergency telephone numbers may be requires for areas that do not have 911 capabilities. For safety during removal of four way valves and any pipe open to the atmosphere, an Energy Isolation plan should be included. If good double block and bleed type valves are not in the piping, skillets or blinds should be used to protect personnel and the environment from a release. Coordinating with the scheduling department should be considered to alert them for a possible unexpected down time reducing throughput and profit for the month. The plan outlines in detail specific tasks as goals to achieve for each day. To keep all parties in the loop each should receive a draft of the CDR. A telephone conference should follow reviewing the CDR. Any additions, deletions, or revisions should be made following the CDR teleconference. Revisions should be distributed to all parties for a final approval. All parties will now be familiar with the tasks at hand, who is to perform them and the desired time frame to complete the job.

Cleaning The Prover

The SVP type prover uses less fresh water and generates less contact water than the pipe prover designs. Isolate the prover from the meter run using double block and bleed valves showing no leakage. Inspect the upstream and downstream shaft seals. If there are no signs of leaks, perform a seal fail test using a pressure differential kit. This will determine if the poppet assembly piston seals are holding. If no seal fail is determined, drain the prover of product. Introduce a suds less solvent like Purple Power and water into the prover cylinder and cycle the poppet assembly piston. Continually flush with only water until the unit is producing clean water from the vents on the cylinder. If the seals show any signs of leaking the power supply needs to be locked out and the prover needs to be disassembled, seals replaced and reassembled. Restore power and perform a second seal fail test proving the new seals are not leaking. At this point the prover is ready for calibration. When calibrating the prover the photo cell optical switches should be covered so a change in light does not affect the point the cell initiates contact with the flag. These provers are light sensitive which will cause calibration problems and errors in the readings.

A Bi-directional and Uni-directional pipe prover preparation includes isolating the prover from the meter run and lock out the power supply to the prover. Drain the prover of product. Remove the old sphere and inspect for any damage which will give you an indication of an internal problem. Remove the four way valve and inspect the slips for any wear or damage. The Uni-directional seal cups should also be inspected. If damage appears on these they should be replaced. NOTE: If you have seal fail alarms on the prover, they may or may NOT be working properly. Check this by block and bleed tests on the four way or interchange seals. If these alarms have been received during a proving you should check the limits on these assemblies. If the limits are set correctly you can rest assured the seal devices are NOT holding and warrant replacement. The detector switches may now be removed, cleaned, inspected, for wear, and replaced with new switches or rebuilt with rebuild kits and electronic elements if you use this design switch. The switches should be tested before being installed. I prefer to run a hydro-jet through the prover for faster cleaning and generating less contact water. The new sphere may now be sized to +2 to 3 % over pipe I.D. and installed in the prover. If the coating is disbanding from the pipe wall you should consider increasing the oversize percent of the sphere to 4 or 4.5 %. Another consideration is to use a sphere of a lower durometer (softer material) such as neoprene. This could help the sphere conform to the irregular pipe walls better. Fill the prover slowly with water while venting air from the prover. Let the water set in the prover for a short while and then apply a slight amount of water pressure, open the vents and skim off any residual product. The sphere may now be cycled through the prover while the four way valve is still removed from the prover. Under this scenario the receiver chambers have blinds with 2" female threaded openings for nipples, Cam-Locks and hoses to be attached the prover. Each hose has two 2" ball valves with Cam-Locks separating the valves. This allows for total isolation of any water so the inlet and out let hoses can be switched from one side to the other minimizing water lose. If you know the slips are not leaking you may use the four way valve to cycle the sphere through the prover. Continually monitor the water quality while cycling the sphere from the vents. When there is clean clear water with no signs of product or sheen the prover is considered clean. Any product residue left in the prover will transfer into the calibration cans leaving a film which will alter the calibrated volume. Any film or debris transferred from your prover into the calibration equipment may require steam cleaning. This expense may come back to you. Good cleaning procedures may cost more initially, but will save your company money in the long run due to increased accuracy. Remember, CLEAN provers enhance accuracy of the calibration.

Conclusion

In conclusion, a teleconference to review the CDR Plan will reinforce all parties' knowledge, scope of the daily tasks at hand, and who is to perform them and the desired time frame to complete the job successfully. The number of flush cycles using a sphere or hydro-jet will determine how clean you get the prover. Removing and inspecting Bi-directional four way valve slips, inspecting or replacing Uni-directional seals, and a seal fail test on Small volume provers is essential in obtaining an accurate calibration.

These all play an important role in preventing any internal leakage through these seals thereby preventing a good calibration. Water should be CLEAN, no SHEEN nor product residue in the prover. Detector switches MUST be in good clean working condition. Their action or lack of it determines the success of the calibration and accurate volume of the prover.