Panel Discussion on Selection of Meters for LACT Systems

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INTRODUCTION

Permit me to make the introductions. I am J. C. Spalding of Sun Oil Company, Dallas, Texas. We have been asked to present a panel discussion on the selection of meters for LACT systems. In this panel of experts I think we have men who are eminently qualified to discuss the subject. They are:

MR. A. H. HALL with Shell Pipe Line Corporation of Houston is a native of Oklahoma, holds a BS in Mechanical Engineering from O.U. and an M.S. degree in Industrial Engineering from the University of Houston. He has been with Shell for 17 years and is a member of A.S.M.E. and the API. He is supervisor in the Operating Services Department of Shell Pipe Line Corporation and has been working on LACT equipment since 1956.

MR. J. H. CONINE is with the Basin Engineering Corporation in Midland. He's a native of Midland and holds a B.S. in Petroleum Engineering from Texas Tech. He worked for two years as a Production Engineer for Great Western Production Co. He is a member of the SPE, API, and NACE. He is with Basin Engineering Corporation as a Sales Engineer. As such he has sold and installed some 40 LACT systems. He says he has designed 150 of them but missed the sales on the others.

MR. STEPHEN S. BROWN is supervising Chemical Engineer for the Humble Oil & Refining Company in Houston. He has been in automation and LACT work as long as anybody in the business, I imagine. He is a native of Pennsylvania and holds a B.S. in Chemistry from Princeton. He worked for Shell for one year and then he went to work for Humble about 23 years ago. Steve is a very active member of the API and SPE. He is Mr. Automation for Humble.

MR. HARRY L. JOHNSON, JR. is with BS&B in Oklahoma City. He is a native of Amarillo and holds a B.S. in Mechanical Engineering from O.U. He worked for G.E. for 8 years in turbine engineering and then went to work for BS&B where he has been for 5 years. He has presented several papers on automation and LACT. He has designed and worked with the producers and pipeline companies on several major LACT installations.

I think you can realize that we are fortunate to have these gentlemen here to discuss the selection of the proper type of meter for LACT systems. To begin with, we are going to ask each of these gentlemen to state briefly his views and experiences with LACT systems. We will have Mr. Hall of Shell Pipe Line to tell us something of his views and he will be talking mainly about P.D. type units.

MR. HALL:

From what I know of your personnel and program, a pipeliner here at Texas Tech today is definitely in the minority. Some of my associates in Shell are here from Midland, but even so, our numbers are pretty small. But this should be an excellent time to present some of our ideas and I am appreciative of the opportunity to do this. Although the panel discussion is entitled "Selection of Meters for LACT", I believe that a summary of a generalized pipeline policy with respect to LACT is in order. I consider this approach necessary, since I do not believe it possible to discuss only one part of the LACT facilities without reference to other components in the system.

Pipeline Lease Automatic Custody Transfer Policy

General

When permitted by State and/or Federal law and regulations, the pipeline will receive crude oil on the basis of unattended custody transfer measurement so long as it is satisfied as to the accuracy of the measurement and the ability of the facility to sustain this accuracy. Facilities for unattended custody transfer measurement may consist of positive displacement meters, weir tanks or dump tanks.

Design and Construction

It is the custom in the petroleum industry that the producer furnish required tankage for storage and measurement of crude oil. It is this savings in tankage which allows primary savings in capital investment when automatic custody transfer facilities are installed. In view of this economic factor, the design, construction, and cost of unattended custody transfer facilities will be the responsibility of the producer.

Design of facilities which are to be used for custody transfer must be acceptable to the pipeline from the viewpoint of engineering and measurement standards, as outlined below, and must conform to applicable API codes or standards. Further, operations and measurements must allow conformance with governmental regulations. Where the fluid is started and/or stopped automatically, separate control panels must be provided so that controls affecting quantity and quality measurements to the pipeline can be sealed.

(1) Volume Measurement. All unattended measurement devices must be capable of consistently measuring volume within 1/10 of 1 per cent.

(2) Temperature Measurement. Positive displacement meters or measuring tanks may be temperature-

compensated. When non-temperature-compensated meters or tank measurements are employed, temperature recorders must be installed.

(3) Mechanical sampler. When BS&W and gravity determinations are to be made from composite samples collected by mechanical sampler; the sample collected must be representative of the crude oil stream.

(4) Merchantable Petroleum Liquid. When there is a possibility that crude oil will not meet required specifications for BS&W, a dielectric instrument must be installed which will automatically stop the delivery to the pipeline of any off-specification liquid.

(5) Vapor Pressure and Liquid Stability. In facilities utilizing positive displacement meters, the producer shall supply sufficient head to insure that the liquid being delivered to the positive displacement meters, when the meters are operating at rated capacity, is at a pressure reasonably in excess of the bubble point of the liquid and within the vapor pressure set forth in the applicable tariff. Liquid accepted by meter or dump tank must be stabilized so that subsequent tankage filling losses will be within limits normally accepted by industry.

Pumping Equipment

Accumulator station pumping equipment will usually be installed and operated by the pipeline. Where it is necessary to install auxiliary pumping equipment to furnish sufficient head to unattended custody transfer facilities and to insure flooded accumulator station pumps, such auxiliary pumping equipment will be installed by the facilities' owner and the energy furnished by him.

Calibration and Maintenance

The pipeline will provide and operate a portable, volumetric meter prover tank. If it is impractical to transport this tank to the unattended facilities, or a larger tank is required by API standard or desired by the producer, such calibration tank must be provided at the producer's expense as part of the custody transfer facilities. Similarly, only a low-head pump will be provided to empty the prover, and if a high pressure pump or fixed prover is required, this equipment must be furnished by the producer.

In most cases, the pipeline will assume responsibility for periodic calibration of unattended custody transfer facilities, including automatic controls and equipment used to determine oil properties, to insure measurement accuracy. If desired by the owner, the pipeline will be responsible for maintenance of these facilities and such expense (direct labor and materials) will be charged at actual cost to the owner. These services are considered conveniences rendered the producer, where qualified personnel are available, and the pipeline reserves the right to determine whether or not these services can be rendered. Where calibrations are made by the producer, these calibrations will be witnessed by a pipeline representative.

Now let us discuss in a little more detail the measurement and engineering standards mentioned above.

The primary interest of a pipeliner in volume measurement for ACT facilities is a measurement at least as accurate as conventional manual tank gauging. At the present time, this is generally considered to be within one-tenth of one per cent of the volume contained in the lease tank. This is, therefore, the reason for the requirement for volume measurement to be within 1/10 of 1 per cent. Any type of weir or dump tank can have fixed levels which will meet this measurement requirement. There are many arrangements which are designed to count the number of times the tank is filled within these fixed levels. Unfortunately, the tank systems have the same limitation of the conventional lease tank in so far as wax encrustation is concerned and "calibrating" the volume. In addition, a system of relatively complicated controls is superimposed on these existent disadvantages.

The word meter has been applied to many types of measuring devices, but in this discussion, I will consider only the positive displacement meter. API's committee on Positive Displacement Metering Measurement has included the following definition of such a meter in the latest draft of API Standard 1101.

"A device installed in a piping system in which flowing liquid is constantly mechanically isolated into segments of known volume. These segments of liquid are counted as they are displaced and their accumulated total continuously and instantaneously indicated in units of liquid quantity by the meter register. These fixed quantity liquid segments are united as they emerge from the measuring element, along with that portion of liquid which "slips" through the clearances between the moving parts of the measuring element. Positive displacement meters are generally differentiated by the type of mechanism employed to isolate the liquid segments, i.e., by the nature of their measuring element. The terms used to describe the most common types of measuring elements are (1) nutating disc, (2) reciprocating piston, (3) oscillating piston, (4) vane type rotary, (5) bucket type rotary, (6) lobed type rotary, (7) helical type rotary, and (8) certain combinations of these."

The 1/10 of 1 per cent requirement eliminates the average domestic type water meter and types of meters which are designed primarily for flow indication with plus or minus 1 to 10 per cent of actual flow being measured.

The positive displacement meter requires more maintenance than the standard lease tank but is lower in cost and can be easily calibrated to insure continued measurement accuracy. Although meter failures have been rare where satisfactory calibration and preventive maintenance procedures were followed, equipment should be installed in conjunction with the meter to prevent mismeasurement in the event of meter or register failure. This is important from a monetary standpoint to both producer and pipeliner and, in many cases, is necessary to prevent violation of Federal and State regulations. Probably the largest concentration of Automatic Custody Transfer installations is in the Four Corners Area. Four Corners Pipe Line and Texas-New Mexico Pipe Line gather oil from approximately 35 such installations. Of these, only one is a tank system while all others utilize positive displacement meters and measure more than seventy-five per cent of the oil.

An additional feature which is considered desirable as part of the volume measurement is automatic temperature compensations so that registration is in net 60° barrels. Placement of the liquid temperature-sensing bulb is important because the flowing stream must continuously pass this element to prevent false indications of temperatures and thereby cause erroneous volume registration. If temperature compensation is not provided, temperature recording must be made so that volumes can be corrected to 60°

The best means for accurately determining gravity and BS&W is by manual methods utilizing hydrometer and centrifuge in accordance with procedures set forth in API Standard 2500 - Measuring, Testing and Sampling Crude Oil. A sampler then which will withdraw a representative sample during all the time oil is flowing is a necessity. In addition, the sample container must not let any of the sample evaporate. Otherwise the determined gravity is not representative of the oil produced.

Present BS&W monitors are proving generally satis-

factory to prevent running of non-merchantable oil to the pipeline but are not yet accurate enough for indication of BS&W content for custody transfer. As an indication of the necessity for the installation of monitors, two to three per cent of full lease tanks in West Texas are turned down by gaugers because the oil does not meet required specifications.

From an overall conservation standpoint, it would be desirable for the producer to deliver oil to the pipeline at vapor pressures higher than atmospheric. Most pipelines operate relatively closed systems or could do so, but deliveries are made into atmospheric storage tanks at terminals so that limitation on vapor pressure must be made.

The general policy sets forth the willingness of the pipeline to perform calibration of positive displacement meters and maintenance of automatic custody transfer installation, although this maintenance is billed to the producer at the pipeline's cost. With such a policy, standardization of installations becomes an important consideration. This is not to infer that each installation should be identical, but the various combinations by which positive displacement meters can be connected into the line is comparatively limited; therefore, positive displacement meter installations offer a minimum opportunity for special and unique design but at the same time provide accurate and dependable measurement.

Much of the development of ACT facilities has been accomplished by engineers and rightfully so; however, since the development stage has, for all intents and purposes, passed and automatic custody transfer is becoming more of a commonplace means of transferring oil from producer to pipeline, regular calibration and maintenance must be performed by operating personnel with a minimum of dependence upon engineers. This presents another case for simplicity of design and operation. This does not infer that operating people cannot handle complicated equipment, but it is obvious that application is limited and payouts are questionable where technicians must spend a disproportionate amount of time with a single ACT installation.

MR. SPALDING:

Thank you, Mr. Hall. Next we will hear from Mr. Steve Brown.

MR. BROWN:

There are four major considerations in choosing meters for LACT installation: (1) first and paramount is accuracy, (2) second is compatability with both production and pipeline operations, (3) third is the amount of attention necessary by trained personnel for proper operation, and (4) fourth is the cost.

The first consideration, accuracy, requires no amplification, but every metering system must be comparable to or must exceed in accuracy the method which it replaces.

The second consideration, compatability, simply means that a metering system which offers an easy operation to one party involved but seriously interferes with the operations of the other is of no value to the joint operation in the transfer custody of oil. For example, a metering system which requires a minimum throughput rate for accuracy might offer the producer no advantages in its use because he could not operate the lease on a continuous basis with its normal production rate.

The third consideration, the amount of attention necessary by trained personnel, is meant to point out that, while it would be quite feasible to install metering systems which require periodic calibration in areas where installations would be concentrated geographically, it would not be feasible to make such installations where considerable travel is necessary for the people making the periodic calibrations. Also, it would be unwise to install all electrical systems in areas where power failures are frequent.

Similarly, installation of all pneumatic systems where gas supplies are inadequate would not be the best installation.

The cost of equipment installed, of course, must be justified by some attendant savings. However, the first cost is not the sole consideration. The possible savings in manpower, both on the lease and in clerical work, must be considered. The benefits accrued by the installation of automatic custody transfer certainly must offset the costs to the party bearing the greatest part of this expense.

The partnership in the ACT installation must be fully recognized and of necessity must be a complete mutual understanding and agreement between the producer and the pipeline in order to make any such installation an unqualified success. And I would like to emphasize this partnership which is something that in the past we have not always had the highest possible degree in our oil measurement proceedings. The advent of ACT of necessity is going to require that the pipeline and the producer join together in getting the best possible measurement means that they can find. Thank you.

MR. SPALDING:

The next speaker will be Mr. J. H. Conine, Jr.

MR. CONINE:

This afternoon I would like to submit for discussion three basic factors to be considered in the selection of meters for automatic custody transfer. These considerations are accuracy, reliability and cost.

We should expect the accuracy of any automatic custody transfer system to be equal to or better than conventional tank gauging. Practically all of the present systems meet this requirement. Accuracy would logically be the paramount factor to consider.

Of course, reliability is related to accuracy, however, the point I wish to make is that any system that may be designed must have sufficient equipment incorporated in the unit so that various malfunctions may be detected before mismeasurement occurs. Any system that has the task of measuring must be able to perform the same function time after time within certain limits.

An always important factor is cost. On all automatic custody transfer units a payout must be justifiable. The amount of equipment required to perform a certain function is always a limiting factor as to how many applications this equipment will have. As I have previously indicated, you must have sufficient equipment in the system for protection measures. The amount of equipment required for this varies greatly with the type of automatic custody transfer. Some pipeline companies, for instance, require a pressure recorder on a dump tank system to ascertain whether or not the tank filled completely before dumping, and whether or not it dumped completely before filling. Another important cost consideration is one of replacement. How many instruments are included in the design? How many motor valves, controls and recorders are required for accurate, reliable operation? What expenditures can be expected from a maintenance standpoint? In the event an item of equipment should fail to operate satisfactorily, what effect will this have insofar as accuracy is concerned? How much time and money are required for field installation?

These are some of the questions which should be answered in the discussion.

I think most of you gentlemen will agree that simplicity is the key to successful oil field operations. The majority of the field personnel is not trained to do specialized maintenance. The system will realize a longer payout if the company finds it necessary to hire specialized personnel to keep the quipment in operation.

I am sure most of you are familiar with the major components of a positive displacement meter system; however, I think it will benefit us to briefly consider these and to also look closely at some of the lesser but equally important components.

Most positive displacement meter systems have some sort of a charging pump. This pump is not required in all installations, however, a delivery to a pipe line that has varying pressure generally requires a pump in order to move the oil. This pump can serve a dual purpose when used in conjunction with the BS&W monitor. Normally the pump is used as a pipe line pump, however, when the BS&W monitor reads bad oil the pipe line delivery is stopped and a by-pass valve is opened which allows the changing pump to be utilized to circulate bad oil.

Another item of equipment is the BS&W Monitor. It has only one function which is to limit the amount of water that is delivered in the oil. Some pipe lines do not require a BS&W monitor until after the treating system has proven to be unreliable. Personally, I feel that if the producer can deliver oil to the pipeline and meet the requirements of BS&W without the monitor, then the monitor should be left out. The sampler determines how much BS&W was in the crude, the monitor only serves as a policeman to be sure you do not exceed the limits.

It is desirable to protect the meter from rocks, welding slag, etc. A strainer with a 1/4" mesh basket serves this purpose very well.

The air eliminator performs an extremely important function in a positive displacement meter system. In a system where there is no danger of breakout or pumped air, the air-eliminator releases the air or gas to the pump before entering the meter. Please notice I said where there is no danger. In a system moving dead oil with a centrifugal pump and a back pressure valve the air-eliminator probably would never function because there would be no air in the line. These conditions occur frequently and the air-eliminator can be omitted and often is. Where extremely dangerous air conditions prevail, it is recommended to install an auxiliary pilot that will close a valve in front of the meter until all the air or gas has been expelled from the system. These conditions usually arise in trucked oil installations and are not commonplace on the lease.

A back pressure valve is usually included on the unit down stream of the meter to keep the unit packed with oil.

The positive displacement meter is the item of equipment on the unit that all the previously mentioned components compliment. An interesting note about the meter is that while metering positive volumes, the meter is also cleaning itself.

Since paraffin in the oil has the tendency to build up, a self cleaning feature is a must on any automatic custody transfer unit. Automatic temperature compensation is another important feature. By continually correcting the oil to 60 F. the temperature recorders can be eliminated from the system. This eliminates manual correction and allows the field personnel to know exactly how much oil has been run without waiting for conventional "Back-Stock Corrections". There are various temperature compensators available and the method of operation of each should be considered, before deciding what type of unit to install.

The most neglected component on any automatic custody transfer is the sampler. The sampler is just as much of a cash register as is the meter. It is desirable to have a sampler that is proportional to flow and that will store the sample at line pressure.

In closing I would like to say that the positive displacement meter system will fulfill the industry's requirements and that the accuracy and reliability of the positive displacement meter has been proven in numerous installations.

MR. SPALDING:

Thank you, Mr. Conine. And now we will have our other discussion concerning the dump type meter from Mr. Harry Johnson.

MR. JOHNSON:

First, I would like to make this point clear that neither my company, Black, Sivalls & Bryson, Inc. nor myself stand only for the use of positive volume dump type meters for LACT service. In fact, we have sold a considerable number of both this type and the positive displacement meter type for LACT service. For the discussion this afternoon, my side is to primarily stay with the positive volume dump type meters showing their advantages over other types of LACT installations.

Basically, the dump LACT units involve one general principle; the metered volume is controlled by fixed points and not liquid level controllers. These fixed points either include a weir in the top of the meter vessel and a discharge valve or the unit meters between valve seats. The liquid level controllers in both cases are outside of a metered volume. Liquid level controllers, tend to not necessarily repeat themselves, therefore, they would induce an error if they were used for the determination of the metered volumes. On a dump type LACT unit, the only factors that can change this volume are the build-up of foreign material in the vessel walls inside the metered volume or the possibility of the valves leaking. This problem or build-up of foreign materials such as paraffin on the inside of the meter volume can be practically eliminated by the application of a coating on the inside of the vessel which will preclude the majority of any foreign material sticking to its walls. Certainly, the possibility of valve leakage problems is nil due to the fact that the velocity of the fluid flowing through the dump valves on these LACT units is very low and therefore there is very little wear and tear on the valve seat. The dump LACT unit properly designed has many fail-safe features. If an item fails in this type of system, the unit is shut-in; no oil is run to the pipeline that has not been metered. There are several monitoring devices and double checks to insure that all the parts are functioning properly while the unit is on operation. Any failure, be it mechanical or electrical, shuts the unit in.

A properly designed LACT unit actually has four back-ups for registering the amount of oil metered to the pipeline.

1. There is a temperature compensated barrel counter and ticket printer.

2. You have a visual dump counter, which also serves as a lease shut-in device in most cases.

3. There is a record of a pressure head and temperature generally recorded on a strip chart or you can pull the peaks off the pressure head and temperature for counting the number of dumps and calculating your corrected volume back to 60°.

Therefore, failure of any one of these sensing devices will not preclude an operator from checking the amount of oil that has flowed through the LACT unit. As we all know, all these items are mechanical or electrical and they are subject to failure and can do so. Therefore, this

is a very positive type way of metering the crude oil to the pipeline. I will limit this discussion strictly to the LACT measuring device and not its' extraneous controls, as any of these extraneous items can be placed on any type of LACT unit which includes surge tank controls, BS&W monitors, recirculations systems, etc. A positive displacement meter in affect is nothing more than mechanically creating a fixed volume in the rotating or cycling element of the meter. Technically, it is a volumetric means of measuring crude oil, the same as a dump meter. Having moving parts inside the meter, they are subject to wear. Any foreign material such as salt crystals in the crude will tend to create excessive wear. Also, there is a slippage problem in a meter that is inherent. With moving parts you have to maintain certain clearances, therefore due to the viscosity of the fluid and other factors, there will be a certain amount of oil that slips on by the metered volume and is not counted in the ticket printer reading. There is also a possibility of a gas spin in the P.D. meters. According to one P.D. manufacturer the best monitoring device is put in a second meter down-stream of the first meter. There are items such as combinators that you can attach to the two meters in series so that if one gets out of phase more than the other by certain number of unit volumes the unit will shut-in. This is fine as long as both meters have the same meter factor. Next comes the proving of these meters. To the best of my knowledge, most of the meters in the LACT operation are proved periodically on an average of about once a month. This is accomplished by one of two methods either into a prover tank or using a master meter which has been proved in a prover tank. Why not use the prover tank for your metering device in the first place and eliminate the meter. When a master meter is proven by a prover tank, its' meter factor must be checked at the same flow rate of the P.D. meter that is in the LACT unit. Otherwise you would have inconclusive results.

The flow rate through a P.D. meter is critical as far as a meter factor is concerned. Meters can be very accurate as long as the flow rates are maintained at a narrow range of flow. This proving of your meters can run into one sizeable amount of expense in that you are saddled from then on with your periodic proving of the meters. I would briefly like to discuss the flow through the positive volume dump type meter LACT system. If I may, I will call this an average system, granted there are many many ramifications from this. Basically, the meter is filled with a pump. This pump only needs sufficient head to get the oil into the meter vessel. The meter tank discharge valve is closed, the meter tank fills up to through the weir into the over-flow chamber. When the oil reaches the upper liquid level controller, which is above the weir, the fill pump is shut-in. After an adjustable time delay period, the over-flow drain-off valve is opened to allow the excess fluid to drain away from the weir back to the surge tank thus equalizing it, and creating the metered volume. The liquid level controller which is below the weir must clear before a time delay is actuated, which is adjustable, and then it shuts in this over-flow drain valve. The next sequence is that the discharge valve opens. When the discharge valve opens, the crude drains down through it into the pipeline surge section of the meter. We will discuss the pipeline surge section a few moments later. The liquid level controller downstream of the discharge valve signals the controller that the meter tank is empty, a time delay is actuated to hold the discharge valve open to allow any remaining fluid inside the meter vessel to drain out; then the discharge valve closes and the meter fill cycle starts once again. The lower section of a meter tank is a pipeline surge section. This section allows continuous flow to the pipeline. Normally it is some bigger than the metered volume, therefore, that level will surge up and down while the meter is filling and dumping and your rate to the pipeline is constant at whatever the pipeline pump is capable of pumping out. There are normally two controls on this pipeline surge section to start the pipeline pump and shut it in. At one time the dump meter had a very great disadvantage in that it had to cycle to the pipeline. There are a great many dump tank meter LACT units in service now where that is the case. To have continuous flow to the pipeline through a dump meter LACT unit, dual meters or the utilization of this large pipeline surge section have to be used. Using dual meters still can cause some cycling of the pipeline pump. This large pipeline surge section eliminates the necessity of two metering vessels and it allows the pipeline pump to only be sized to handle the capacity of the lease, and still have continuous flow to the pipeline.

Resume' of the advantages of a Positive Volume Dump Meter:

- Positive metered volume
- No necessity for constant recalibration
- No worry with gas breakout or slippage
- Failure of any of the equipment shuts unit in and will not mismeasure the crude
- Records give visual picture of operation and any failure
- Continuous flow to pipeline
- Flow rate to pipeline does not affect the meters repeatability
- Aside from the controller, the equipment is standard oilfield products
- Very simple electrical controller with plug-in components

MR. SPALDING:

Generally speaking thus far, I think, there is not exactly what you might call unity of opinion on this subject. Mr. Hall, do you have any questions to ask any of the other panel members?

MR. HALL:

I do not believe I have any questions but I would like to confirm a point that Steve brought up. No matter what system is utilized, the pipeliner and the producer certainly have to work together.

MR. SPALDING:

Mr. Brown, do you have a question?

MR. BROWN:

On capacity control and monitors, I would like to ask Mr. Hall why the producer buys those instruments? Who is being protected? We put a treating system in on our lease and we say to the pipeline "We are going to guarantee not to give you any oil having more than 1% BS&W. Now you take our personal guarantee". Then he will say "But we do not think your guarantee is enough. We want to check it". Then we will say "Go ahead and check it — put something in there if you want to". Why should we pay for that?

MR. HALL:

Well, I do not know. I have never heard this personal guarantee. I quoted a figure here of 2 to 3% of the tanks in the West Texas Area which are full and ready for the pipeline but which our gauger finds are not of

merchantable quality. If you will insure that each and every barrel of oil which is delivered to the pipeline has been appropriately treated and is merchantable, then obviously BS&W monitors are not needed. Our pipeline policy has been that monitors should go in. The reason for the monitor is to provide insurance against failure of the treating equipment.

MR. BROWN:

My point is that we are paying for your protection and we think maybe you ought to pay for part of that cost because it is affecting you. You are the one who disbelieves — not us.

MR. HALL:

Yes, but on the other hand, if we disbelieve and have the proof of our disbelief, then we feel that we are justified in asking the producer to install monitors. If someone proves me wrong, I think I'd admit it.

MR. BROWN:

The same point comes up about the sampler only in a little different way. This is one of the points that I have been real bull headed about. The pipeline people are interested in that percent BS&W and they ought to at least put in the sampler. When you go to a whole LACT system, the sampler is a drop in the bucket of the cost. Actually the main reason why I am bull headed and wanted the pipeline to do it is just to keep the pipeline people involved in the whole picture.

MR. HALL:

Well, I think you probably have a point there. The reason this was set up as it is, at least from our standpoint, was that a single isolated automatic custody transfer facility offers essentially no saving as far as the pipeline is concerned. Field gaugers in West Texas probably average working somewhere around 10 to 13 tanks a day. One automatic custody transfer facility or even two does not offer us any savings in man power. There are no savings in installation costs as far as the pipeline is concerned. We run a line to, and make a similar connection in either case. At the present time, until we have an opportunity to study some of these costs and perhaps get a large enough concentration of automatic custody transfer facilities, it would seem that the cost should be taken care of by those that can best afford to pay. I think you have a good point there, Steve, and our company is reviewing it. Recognizing the point of pipeliner-producer cooperation, our policy is such that we stand ready to do the calibration. Also, by charging back some of the maintenance at our cost not including overhead, we are carrying a portion of this maintenance cost. And while we are on that subject, let us discuss a point that was brought through Mr. Johnson here — lease tanks have not been recalibrated or cleaned for long periods. This last part may be true. There is an indication that maybe the build up is not too great. The claimed advantage for dump tanks is this — that, since we have not recalibrated lease tanks, we assume that you do not have to recalibrate dump tanks. That is not correct. P.D. meters are easily recalibrated in a few minutes, and there is no question in the minds of producer or pipeliner. In other words if you or I or anyone else questions the measurement volume you can answer that question very simply. For a dump tank calibration it could be more difficult. As I told Steve earlier, if I wanted to find the volume of his dump tank, I would connect a meter and find out how much oil is run through the dump tank.

MR. BROWN:

But you know we're maintaining to our pipeline that if they want to prove their meters put one of our dump tanks on it — It is more accurate than their prover tanks. Mr. Hall hit on one point there that I think should be elaborated on just a little. He said that in an area where a gauger puts on 10 or 13 tanks per day, one installation is not going to help the pipeline. This is a real hard point to sell, in getting ACT units in. It does not help the producer either, but you cannot pay out a single one by logical reasoning. It is much easier to pay out a whole field. Do it all at once. In considering ACT we have to look not at just one installation but at the whole field or an entire area. There is where the payout comes. I would like to ask a couple of other questions — just real short ones. The internal audit feature, on the P.D. meter is something I am not sure that we have and I would like to get a little amplification on it. It might interest you to know that before this all started Mr. Spalding asked me "How many times, to your knowledge, have you mismeasured any oil through a dump tank system". We never have. We have had them fail and we have had them shutdown, but in not a single case have we not had a complete record of how much oil went through the dump tank and was delivered to the pipeline. With this internal audit that is built into the dump tank with the temperature recorder and the dump count, you can stand there and look at it and tell in five minutes if the thing is reasonably accurate. Of course, it takes a longer run than that to get down to the fine points, but I do not see how you can stand at a P.D. meter and watch that register turning over and be sure that every time it says a barrel, a barrel of oil goes through. I do not know how you can be sure that you did not get any gas. In other words I do not see the internal audit part of it.

MR. CONINE:

I am not going to agree with your statement that a dump tank has never mis-metered any oil.

MR. BROWN:

I beg your pardon, but Mr. Spalding asked me our experience.

MR. CONINE:

The point I was fixing to bring out was that you have no audit against wax build up in a dump tank. How does the temperature compensator on a dump tank help you spot inaccuracies?

MR. BROWN:

You can tell by standing there and looking at it. If the compensator says it has delivered 92 barrels and the dump count says it has delivered 100 barrels, and the temperature recorder says 60 degrees, you know that the compensator is wrong.

MR. CONINE:

Are you going by there every day to read all this equipment or are you going to make daily temperature corrections?

MR. BROWN:

No, at the end of a month's time you're going to write a ticket and if you think there is a discrepancy you've the written record to go back to. If you want to go back and calculate it, you can go back and check it without recalibration.

MR. CONINE:

Of course, we are going on the assumption that the temperature recorder is always accurate?

MR. BROWN:

The temperature recorder is not always accurate and there is the battle that I am in right now. I discussed this with the temperature recorder people and when they learned what I was doing — reading a temperature off of their instrument and correcting the dump count to see how it compared with our temperature compensator, they said "You are doing it the wrong way. The temperature compensator can be used to check our recorder." You are absolutely right. When you calibrate with master meters do you use a recording instrument?

MR. CONINE:

Generally, we do not.

MR. BROWN:

Well, some do.

MR. CONINE:

We have a mercury type thermometer that we read periodically during calibration.

MR. BROWN:

You take a number of temperature readings and average them and assume that this gives you a satisfactory correction

MR. CONINE:

If we were in Alaska or some place we might not be able to do it, but here in West Texas where we have a heater treater operating at 120 and it is 80 in the tank, the oil goes through that meter with the sun shining down and there is a very small variation — you have got to consider what a degree difference in change does to the volume. A degree on the average is .05 of a per cent. If your temperature changes, how are you going to get your meter to calibrate within .05 of 1% if you are not reading the correct temperature. You said a meter factor the first of one month and a meter factor the first of next month are never the same.

MR. BROWN:

Within a certain limit.

MR. CONINE:

What limit?

MR. BROWN:

Well, I think that the code sets out .25 of 1 per cent. But let us do not take once a month. Let us say barrel to barrel. In other words meter factors on the basis of time and through put is what determines the meter accuracy.

MR. CONINE:

You do not get meter factors by calibrating them?

MR. BROWN:

It does not mean much to pipeline people now cost wise because comparatively there are few meter installations, but what is going to happen when we have 10,000 meters or even 2,000 meters, and the policy is to calibrate every month. Will they calibrate on through put? Do you think that is a sound way? What about the lease that will not make the watever mark you set — will not make it for six months. Will that meter sit there and hold that factor for six months?

MR. CONINE:

It had better! I know exactly the point you are trying to make, but can you put a dump tank out in West Texas crude in a sand storm for six months and get an exact volume?

MR. BROWN:

Yes, Sir. How could you change the volume?

MR. CONINE:

By build-up. Paraffin build-up is something that has to be considered in the dump tank. All of the dump tank systems that I know anything about have inspection holes so that they can be periodically inspected. You can have paraffin build-up on any dump tank in West Texas. Of course, I cannot speak for the Gulf Coast Area or anything like that. I do not know of but a few dump tank installations out here, but I know that paraffin is a very critical thing. One producer is going into his dump tank once a month and washing it out. The pipeline is talking about calculating the rate of build-up of paraffin on that dump tank in resisting that volume.

MR. SPALDING:

I think that this can be revolved to a basic question and in order to do so we must put it into two parts. First, we must say that if there is a paraffin build-up, the dump tank has a serious question. Therefore, we must decide whether or not a paraffin build-up is a real thing in dump meter installations. Mr. Brown has pointed out that in his experience it is not a real thing, but I am quite sure there are other places where it is a real thing. In order to not argue or labor this point any further, I think it would behoove us to say this — that where paraffin is a problem the dump meter has a serious disadvantage. Each of you then would have to decide for yourselves whether you are embarking in an area where paraffin is a problem. With that out of the way, I think we are a little bit freer to discuss this matter of accuracy and calibration of the dump tank meter as compared to the P.D. meter. The basic question that started this was one of checks. Mr. Brown specifically asking if there is any method by which you can check whether or not any oil had gone through a P.D. meter without being measured. He made the statement that in his experience no oil had ever gone through a

dump tank meter without being recorded. He did not mean to infer, I think when we first started this, to the accuracy. He meant to infer that gross barrels that went through were recorded some place. Now I believe that is where we got off — this first question — I believe that is right is it not?

MR. BROWN:

That is right.

MR. SPALDING:

Now, with that in mind I think we can go back to the question of an audit control or check method for a P.D. meter system.

MR. CONINE:

I am not going to be foolish enough to step up here and say that a counter on a meter has never stopped and the meter kept running. Is that what you had in mind?

MR. BROWN:

That is the sort of thing, but where you have got gas breaking out in it you are going to meter some barrels of oil that were not there. Also, if the flow rate drops very much below the optimum flow rate for the meter, the meter looses its accuracy.

MR. CONINE:

Yes, but it is a simple matter to take an impulse off the top portion of the ticket printer or counter and carry it to a control circuit that will shut-down the operation in the event the meter drops below any established rate.

MR. BROWN:

When my company makes P.D. meter installations, we still gauge for the tax. We do nothing with that record but the record is maintained because there is a law that says you have to. Our legal department has never let us get around this. In our fields where we had P.D. unit installations there was no indication that anything had gone wrong with the meters on three leases but the leases turned up over. We went back and checked the tax gauges to see if we could find what had happened. Obviously something had failed in the system. I do not know what it was, but all three of those meters at different times had pulled amounts of gas or air through amounting to 100 to 300 barrels. I have forgotten what that field runs a month, but it was a lot of oil. Percentage wise it was around 2 or 3 tenth per cent. My point is that there is a possibility of failure in a P.D. system that does not exist in a dump tank system. If anything goes wrong with dump tanks, they shut-down right where they are. They shut the lease in. The other thing that can affect the accuracy of a dump tank system is leaky valves. You can pass fluid through a leaky valve but you can do that on your stock tanks. Some way you have got to trust some equipment.

MR. BROWN:

Well, I would like to ask about vapor pressure requirements of the pipelines.

MR. HALL:

You are getting into whether or not gas in the meter is a design problem. I do not believe that has anything to do with the meter. If gas reached the meter in that installation, I would say that that design was incorrect — not that there was any fault with the meter. Jim did not mention that if you have a power failure or meter failure there are modes of shutting a P.D.installation in. You made a point of testing in a P.D. meter installation. If desired, you can use a service tank or heater treater or some other vessel. It would be quite simple to install a level gauge in them if you wanted to test. I think some advocate putting meters in series. I think that is profitable to the meter manufacturers only. So, I think the point that we made is excellent — that some place you have to trust something. If foreign particles will affect displacement meters, foreign particles will also hold your valves open so that is a standoff there. It seems to me that we are always going to have some tipe of malfunction as long as we have remote operated unattended equipment. You know the old gasoline stations that used to have these glass bowls where you measured out from one indicator to the next — I always wanted to get the dump tank boys to show me the gasoline station that still has that type of bowl where they buy their gasoline! I do not know that that proves anything, but I have not seen one of those lately, have you Mr. Spalding? The P.D. people always get around to the fact that all the stuff Steve and I buy from the refiners are measured by one of these things we say are no good. That is hitting below the belt because it is true.

MR. JOHNSON:

I have heard this statement made about this old gasoline pump. It is true that they quit using those things, but when they converted over to using P.D. meters in gasoline pumps, nobody raised a stink or rumpus over it because the ultimate consumer — the old boy out there in that car — got the benefit of the doubt of the meter?

MR. HALL:

Well, No — the Railroad Commission insures that there is accurate measurement at the lease and I believe the Department of Weights and Measures makes the same type of determination at all filling stations.

MR. JOHNSON:

I want to make one point here — I am not saying that P.D. meters are not good and are not accurate because I know they are. I simply do not want P.D. meter advocates to say the dump tanks are not good and are not accurate. That is the whole point.

MR. HALL:

Let me in on that point, too. I think Steve has a statement here, too, that this transition from manual gauging to the type dump tank that is getting more near to the size of a P.D. meter. So I think this transition from the manual gauging to the P.D. meter or the smaller tanks that Steve is talking about — our own people (give Shell Oil a pat on the back) over ten years ago were working on that and some of the Shell Oil people here — specifically Bob Jasper, and some of those people set up a system which exactly duplicated a hand gauge but did it automatically. They served an extremely useful purpose, actually, to the use of P.D. meters — in other words they demonstrated the fact that the oil could be measured automatically without having a gauger there. So — and I also agree with

Steve, you cannot get any discussion if all of us are going to agree up here. So the point is — he has a good point there and so let us understand the part that dump tanks have played in this whole development because we could not have gotten where we are without the work of those people who are working primarily with automatic lease tanks.

QUESTION:

He requests information concerning the maintenance cost of a system that has 5,000 barrels per day over a period of 15 years. For the P.D. part of that, we'll ask a user that I am quite sure has had some experience along that. Mr. Hall, could you give him some sort of a number as to maintenance cost yer year.

MR. HALL:

I am sorry but I cannot do that at the moment. Shell Pipeline is operator of Corners pipeline and with the concentration of installations out there, we hope within the next year or so to make some information of that type available. But at the moment, I do not believe we can say we have had sufficient experience to quote any figures.

MR. SPALDING:

Steve, do you have anything on the dump type system that would allow a figure being presented?

MR. BROWN:

Dump tank systems are too new at this stage to have developed any history of maintenance. I can say that on the system we have in operation, the replacement of parts was high for the first four or five months of operation, but we were learning then. Since that time we have had just very minor expense, but they are all too new to have developed any histories.

MR. SPALDING:

The question was whether or not Mr. hall or Shell Pipeline will accept a P.D. meter installation without a test period in which the P.D. meter readings are checked against the tank gauges.

MR. HALL:

Yes! If there is any comparison with tankage, it would be simply to iron out the system. The idea of checking to see if they are as accurate as tank gauges is a thing of the past. That was necessary initially all right but now it is not necessary. We check the design of the system and if we think that it is good and that it can be calibrated, we do not need to compare it with a tank gauge.

QUESTION:

Can we have a comparison of costs for systems that will handle 2000 barrels per day of non-troublesome crude?

MR. CONINE:

Well, of course the best way a fellow can answer a question like that is "I do not know". It is going to be hard to tie down a definite cost because some of the people like to buy a cadillac and some of them buy strip down chevrolets. Let me briefly bring up the items of equipment just to make sure we know what costs we are talking about — a centrifugal pump, monitor, a divering valve to by-pass the bad oil, an air eliminator, strainer, temperature compensated meter with a monthly allowable shut-in, the sampler, the safety shut-down device, the plug valve for the prover loop, a back pressure valve plus three level control switches. The cost is roughly $4,500 f.o.b. the location. And then you have got around $1,200 to tie up in a prover tank.

QUESTION:

This equipment is delivered to the lease and must be installed?

MR. CONINE:

Right.

QUESTION:

In other words this is not a something that you can just walk out and start operating like a heater-treater. You have got to put it together?

MR. CONINE:

When we send a skid out, you hook up the level controls, you bring in 440 volts and you make your pipe line tie-in, tie your prover tank up and you are on automatic custody transfer.

MR. SPALDING:

Harry, can you answer that with a similar dump tank?

MR. JOHNSON:

Well, I will answer the question very broadly the same as Jim did there. That cost can vary depending again on how much equipment you put in there — from around $6,000 to $13,000.

QUESTION:

The equipment that he listed you can buy from BS&B for around $6,000?

MR. JOHNSON:

That is right — and it just depends upon which type of system — now I am talking about dump system — it could vary from $6,000 to $13,000.

QUESTION:

Would Mr. Hall clarify his company's policy in the matter of vapor pressure?

MR. HALL:

This is in all the applicable tariffs. In West Texas it is 13 pounds. In Four Corners Area it is 11 pounds because of the elevation. They vary somewhat — that is the reason I said applicable tariffs. Cities Service in Oklahoma is moving butane and natural gasoline to Chicago in a closed system and I understand there is a initial stripping unit of some sort at the refinery in which they strip out all the butane and gasoline and store only stabalized crude. So obviously in their tariff, there is a higher value than 13 pounds. But the usual tariff specifies about 13 pounds for this area. Specialized movements are subject to negotiations between the shipper and the pipeliner depending upon what facilities are available.

MR. BROWN:

I would like to make a comment here on vapor pres-

sure. This is something that we are starting to look at very seriously and are doing something about. We restrict our crude products to the pipelines at say 13 pounds and it comes to us in the separator at 75 or 80 pounds. That represents a loss that we take in the stock tanks. We are taking a closer look now at operating our own closed gathering system. We cannot put a little vapor recovery system on every battery. Maybe we can gather the oil at an elevated pressure and take it to a central point where one vapor recovery system can recover that vapor which is a merchantable product and then give them their 13 pound product and the gains from the vapor will more than pay for the installation.

MR. SPALDING:

This is one field where the animosity between the pipelines and the producers has blinded both of them to the chance of making more money than either one of them ever thought about before. The idea of saving these lighter ends does not represent just peanuts in the production of oil. Every drop of stock tank vapors that is vented to atmosphere is worth anywhere from 10 to 40 times as much as the same volume of gas that you protect so preciously out of a gas well. The sooner we get together and figure out some way of trapping all of the vapors and hydrocarbons that come out of the ground, the better off everybody is going to be.

QUESTION:

What determines or is there a determined optimum rate of dumping and filling a dump tank so that one might decide whether or not a ten barrel tank dumping very often or a 25 barrel tank dumping less often is more desirable?

MR. BROWN:

Generally most of the people involved in dump tank business are now aiming at a rate of one cycle every two minutes. A one barrel capacity tank will handle up to 700 barrels a day. A ten barrel system will handle 7,000 barrels a day. There is really no restriction on how fast the thing can work if you can get the oil into it and out of it fast enough. But the slower you work your valves, the less wear you have and the longer they last. Obviously if you are in a 100 barrel system like we had once, we cannot run that thing once every two minutes. It takes 30 minutes to fill it because of the size pump we had.

QUESTION:

In the proving of the P.D. meter, could you use a master meter as well as you could use a prover tank?

MR. JOHNSON:

The API recommends that if you are using a master meter for proving a LACT unit that you use the same or a similar fluid for proving the master meter that you are measuring on the lease. Because of the differences in the various crude and because the meter would have to be checked at many different flow rates, it would be very difficult to get proper meter factors for all the LACT installations in an area.

QUESTION:

Mr. Brown, how do you get by without calibrating a dump tank during its life since there are at least three ways it can leak or can be wrong. One was paraffin build-up, one was leaky valves, and one was temperature compensation?

MR. BROWN:

I can show you any number of installations where there is paraffin in the crude but the producers and the pipeline feel that it is not problem and have agreed that only the periodic opening up of a man-hole on the meter vessel will suffice. That includes units in the area from Canada to West Texas. Now, this business of the valves leaking. Granted that they are mechanical, they move, they have wear, foreign material can distort the seat and cause them to leak. However, I do not know of but one case where that happened. It happened when the operator was actually calibrating a meter and he had received a defective valve. A man does not need to be a trained technician to go out and inspect your valve. Most of the people in the oil patch today are familiar with diaphragm operated valves. Secondly, the flow rate across the valves in most cases is low. I grant that the temperature compensator is subject to error, but as we were talking about with the meters, you have got to believe something somewhere. You do have two means of checking your temperature. In turn you know the calibrated volume of the meter vessel so you have a check on the actual temperature corrected volume of oil.

QUESTION:

How do you prove a meter that is used in condensate service?

MR. HALL:

We have not actually done it but I do not see why the standard pressure system as used in proving butane or natural gas meters would not be entirely satisfactory.

QUESTION:

Has anyone experimented with insulating these tanks to help hold a constant temperature either in the P.D. prover tanks or in the dump tanks? Could you people with P.D. prover tanks comment on that?

MR. HALL:

Our pipeline insulates their prover tanks as a matter of policy. As far as I know, no one has insulated any dump tanks in this area.

MR. SPALDING:

If I might summarize what these experts have told us today — they said there are two ways of metering oil in an LACT system. One using a P.D. meter and the other using a dump meter. Both of them are relatively new compared to gauging tanks. Both ways have been proven in applications to be accurate within the limits of hand gauging and therefore both of them should be just as acceptable as hand gauging. The P.D. meter system has the advantage of a lower initial cost, and it is self cleaning. Its disadvantage is its inability to check against itself in case oil goes through without being measured. Now, on the other side, the dump meter is claimed by its proponants to be positive in its volume every time and it has an additional check built in to allow you to be sure that no oil passes without being measured. They are relatively higher in cost than the P.D. meter system.