2002 SPE ESP Workshop
Summary of Presentations

Prepared by

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I attended the 2002 SPE ESP Workshop in Houston, Texas on May 1 - 3, 2002. The purpose of this paper is to summarize the presentations, break out sessions, and poster sessions that were presented at the workshop, for those who couldn't attend.

If you would like to obtain a copy of the workshop proceedings, visit the workshop web site at www.espworkshop.com, contact the workshop organizers, or contact someone from your organization who attended the workshop.

No.	Title	Author(s)	Comments
1	**Keynote Address - The Formula for Success is so Simple, so Why Don't we Get It?**	**George Lindahl III**, Sandefer Capital	Quotes from the book "Good to Great" by Jim Collins • How "good" companies become "great." • Only 11 of 1400 companies made the list. • They have committed leaders and right people. • They have understandable strategy and stick to it. • They have patience. • They have passion to be the best. "Great" companies grow leaders from within • They learn to say "no." • Technology can't cause transformation. • Mergers do NOT lead to greatness. Why the Petroleum Industry is NOT great • Too much ego, concern with "name," "size." • Won't admit mistakes. • Don't know what we don't know. • Focus on "drilling" our way to success. • Bigger is better. • Fall in love with our own prospects. • Being too optimistic. • Being everything to everybody. • Can't say no. • Focus on "flavor of the month." • Too much red tape, bureaucracy. • Bad advice from "outside." • Try to please "Wall Street."

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<tr><th>No.</th><th>Title</th><th>Author(s)</th><th>Comments</th></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td><u>Moral of stories told by Lindahl</u>
Don't get "hung up" on confidentiality - minimize influence of lawyers.
Your word is your bond.
Have options.
Big fields keep getting bigger.
Think about customers - be company of choice.</td></tr>
<tr><td>2</td><td>ESP's: On and Offshore Problems and Solutions</td><td>Jim Lea, Texas Tech University

John Bearden, Centrilift

Adil al Busaidy and Hamood al Rushaidi, Texas Tech students sponsored by PDO</td><td>Since 1991, Jim Lea and John Bearden have been preparing organized summaries of the various papers and presentations that have been presented at the SPE ESP Workshop.

The references are organized by subject or topic so that it is easy to find references on a particular subject. For example, all of the papers that deal with ESP motors, ESP cables, etc.

So far, this is a "paper" reference, but it could be put "on line" and provided with an electronic search facility.

<table><tr><th>Year</th><th>References</th><th>Cumulative References</th></tr><tr><td>1991</td><td>50</td><td>50</td></tr><tr><td>1992</td><td>10</td><td>60</td></tr><tr><td>1994</td><td>45</td><td>105</td></tr><tr><td>1999</td><td>98</td><td>203</td></tr><tr><td>2002</td><td>89</td><td>292</td></tr></table></td></tr>
<tr><td>3</td><td>Improving ESP Performance in Petroleum Development Oman (PDO)</td><td>Nasser al Rawahy, Iqbal Sipra, and Samuel Armacanqui, PDO</td><td>This is a story about the continuing deployment and expansion of use of ESP's in Petroleum Development Oman, in the Middle East.

<u>Basis for Selecting ESP's</u>
High rates.
Gas-lift facilities not available or shortage of lift gas.
Advancing ESP technology to handle sand, gas.
Have over 700 ESP's now, plan 1465 by 2006.
Now cover 42% of production, plan to cover 70%.
Currently, about 10% of wells use VSD's.
Some wells are sandy.
Some are gassy --- GOR's in range of 100 m^3/m^3.
<u>Run life experience</u>
Average run lift up to 770 days.
Trend is increasing.
Attributed to use of SCADA for monitoring, use of better technology.</td></tr>
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No.	Title	Author(s)	Comments
			Monitoring focus • Use SCADA to monitor wells. • Monitor downhole information with Phoenix gauges. • Focus on quick response to pump trips. Teardowns • Tear down most failures. • If a well runs for longer than average run life, tear down is not used. • Number of premature failures is decreasing. Contractor alignment • Most ESP's are leased. • Longer run life is a win/win for PDO and contractor PDO ESP Life-Cycle Model • Select ESP candidate. • Design ESP. • Procure and plan equipment. • Install and commission. • Operate and optimize. • End life and improvement.
4	**Investigation of a Problematic Well to Restore Production**	**H. Gai**, BP	This is a story about problem solving and the value of careful analysis of a problematic well by BP in the Wytch Farm Field in the UK. Most wells in this field are on ESP. The problem well was equipped with a downhole measurement system. It was producing below the bubble point. The ESP motor was overheating. The investigation focused on eliminating potential problems. It turned out that the downhole instrumentation was wrong. The temperature reading was 30 F too high and the pressure reading was 450 psi too low. The ESP was oversized for the application. Part of the problem was the deposition of asphaltenes in the formation. The pump was replaced with a correct size and the problem was solved. The cause of the incorrect data (temperature and pressure) was not determined.
5	**Reducing Exploitation Time by Using ESP's in Formations with Different Productivity Index**	**Javier Almeida**, Pluspetrol **Victor Villacorta**, Centrilift	This is a story about producing multiple zones, with different productivity indices, at the same time, with an ESP system.

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		Nestor Vilchez, Baker Oil Tools	The "old way" was to produce the different zones one at a time. The "new way" is to commingle two or more zones, thus accelerating overall production from the well by several years. The first option was to use two separate ESP's with two separate tubing strings to produce the separate zones. The second and preferred option was to use two ESP's producing through one common tubing string. A packer is placed between the zones to prevent cross flow. This was designed with Centrilift software. Production from the two zones is "allocated" by knowing the characteristics of the crude from the separate zones.
6	**Successful Method to Restart "A Stuck ESP Pump" in the PEMEX Ek-Balam Offshore Field**	**Antonio Rojas** and **Hermilo Ramos**, PEMEX **David Corona** and **Jose Vidal**, Schlumberger	This is a story about re-starting (unsticking) an ESP pump that is stuck due to sand production. The pumps use abrasion resistant materials. They are operated with VSD's. <u>The approach</u> • 1st try to unstick the pump by injecting diesel down the tubing and through the pump. • If this doesn't work, 2nd try injecting acid down the tubing. The acid is batched with water. • If this doesn't work, 3rd try rocking the pump with rapid "jerks" back and forth. This is done by rapidly (about 20 seconds) running the VSD in the backward and forward directions. <u>Results</u> • One well has been on production now for 20 months, with repeated re-starts. • Another well failed after 17 months. <u>Best approach - prevention</u> • In the future, they plan to add an on-line sand monitor to detect sand production before it becomes severe. • This will be a non-intrusive, ultra-sonic monitor. • They do not have experience yet with this.
7	**Application Considerations for Variable Speed Drives**	**Allan Peats**, Conoco Canada	This is a very interesting paper about the "do's" and "don'ts" of applying VSD's on ESP's. The primary admonition is to "be sure you know why you need a VSD." In many cases, these are "over sold." <u>Good applications for VSD's include</u> • Conducting a well test to determine a well's IPR. • Conducting step-rate well tests to further evaluate a well's productivity. (This has been used very effectively in West Texas.)

No.	Title	Author(s)	Comments
			• Producing wells in miscible floods, where production rates of both liquid and gas can change dramatically over short periods of time. It is recommended to use pump intake pressure to control the VSD. • Producing wells with small casing. Sometimes more can be produced by operating at 67 - 68 Hz. • Producing wells that produce abrasives. Sometimes it is better to use a big pump and run it slower. Use a sand probe to detect (and measure) sand production. Consider measuring temperature with a fiber-optic system. • Producing water flood response wells and operating water injection wells where the injection rates must vary over time. • Producing gassy wells where it may be necessary to temporarily slow the pump to overcome gas interference or gas locking. • Operating downhole oil water separation (DOWS) systems. • De-watering gas wells. • Operating ES-PCP systems. • Operating simultaneous ESP/gas-lift systems, where the gas-lift is used to augment the ESP pumping operation. • Operating SAGD (steam augmented gravity drainage) wells Important issues • Systems are expensive. Be aware of capital costs. • Focus on maintenance. • Supply good power. Be aware of harmonics in the electrical system.
8	**Electrical Submersible Pump Power Consumption Optimized with a Variable Speed Drive**	**Rod Kane**, BreitBurn Energy **Tamara Lopez** and **Bell Pelton**, Schlumberger	This is a story about using a VSD to adjust the speed, and thus the electrical current consumption, of an ESP based on the time of day, in California In this case, the cost of electricity varies greatly depending on the time of day - much more expensive during the day than at night. The VSD is used to operate at high speed (e.g. 63 - 65 Hz) at night when power costs are low and at low speed (e.g. 56 Hz) during the day when power costs are high. A timer is used to control the pump speed. Note, the "nominal" speed in the USA is 60 Hz.

No.	Title	Author(s)	Comments
9	**Performance Testing of a Sine Wave ASD on Submersible Pump Applications**	**Kurt LeDoux,** Toshiba **Bill Pelton** and **Richard Bristow,** Schlumberger	This is a story about using a special filter to produce a clean sine wave of both voltage and current with an "adjustable speed drive" (ASD). (An ASD is essential the same as a VSD.) According to the paper, the special filter produces a clean sine wave that reduces electrical stress on the ESP system, with no reduction in ESP system efficiency.
10	**Medium Voltage Drives for Subsea Applications - Evaluation with 23.3 Km Cable Length**	**Alex McIntyre,** TotalFinaElf **Jeremy Andrews, Glen Davis, Peter Hammond,** and **Mukul Rastogi,** Robicon	This is a story about preparations for a TotalFinaElf sub-sea ESP in the northern North Sea. The sub-sea well is 23.3 Km. from the Shell EXPRO Eider Platform to which it produces. It is located in 600 feet of water. The plan is to use a medium voltage system to produce a clean sine wave with an "adjustable speed drive" (ASD) system. The cable and drive were designed and modeled using a computer program. They were tested in the lab before being installed in the field.
11	**ESP Applicability Break-Out Session**	**Jim Lea, Texas Tech University**	This was a "panel" discussion of ESP applicability and tools for choosing the "best" artificial lift approach for a new application. This break-out session was led by Dr. Jim Lea, Chairman of Petroleum Engineering at Texas Tech University. I assisted Jim with the discussion. Jim provided a hand-out entitled, "Artificial Lift Selection," by J. F. Lea, Texas Tech University. A copy can be obtained from Jim Lea at the university. The discussion centered around the following points • The handout gives a good "starting place" to get into the right "ball park." However, it must be supplemented with a good engineering evaluation of each potential artificial lift method. • In addition to the handout, there are some good "expert systems" available. One that I'm aware of is used by PDVSA. Another one from Weatherford was mentioned. • In addition to considering the "technical merits" of the various methods of artificial lift, it is very important to also consider other so-called "soft" issues such as: – The artificial lift "culture" in the area. – The support that is available in the area from artificial lift suppliers, contractors, etc. – Available training.

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12	**Putting Pressure on Production Shut Downs**	**Yasser Bangash** and **Malcolm Rainwater,** Wood Group **Steve Guillot,** Texaco	This is a story about methods to reduce the effects of excessive free gas on ESP performance. Potential negative effects of free gas on ESP's • Pump surging. • Gas locking. • Lost production. • Mechanical / electrical stresses. • Premature failures. Factors to consider to reduce gas problems • Keep pump intake pressure as high as practical, consistent with desired drawdown and production. Free gas comes out of solution below the bubble point pressure. • The gas bubble size is important. A pump can handle small bubbles easier than large bubbles. The smaller the bubble size, the better. • A pump with radial stages can typically handle up to 10% free gas at pump intake. • A pump with mixed flow stages can typically handle up to 28% free gas. • If the amount of free gas is higher than these amounts, it may be possible to separate some of it using either natural gas separation, a rotary gas separator, or both. • If this still isn't sufficient, it maybe possible to use a "homogenizer" such as an Advanced Gas Handler (AGH) or an XGC to produce smaller bubbles. Case study in a CO_2 flood well • The CO_2 flood is a WAG (water alternating with gas). • Production rates of liquid and gas vary considerably over time. • Corrosion is a problem. • Scales and asphaltenes are also a problem. • Initially, an ESP failed after 3 months due to cycling caused by gas interference. Surging was shown on the amp charts. • An XGC (Wood Group "homogenizer") was installed. They didn't use a gas separator, but they did include a tapered pump design. • Now the amp chart shows no surging and the pump is still running OK.
13	**Designing ESP's for Wells with High Gas and Sand: Stag Field, Western Australia**	**Nick Muecke,** Apache **G. H. Kappelhoff** and **A. Watson,**	This is a story about use of ESP's in the offshore Stag Field in Western Australia. This presentation was definitely the funniest one given at the Workshop.

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		Schlumberger	Some of the characteristics • The wells are "extended reach" horizontal completions. • The ESP's are placed in the horizontal sections. • Production is from below a packer. A shroud is used to force fluid to flow past the ESP motor, for cooling purposes. Some results • They have experienced some failures due to gas slugging or surging. (This seems to be a fairly typical problem in horizontal completions.) • They are experiencing sand problems as the rate of water production increases. • They have added more pump stages so they can reduce the pump speed in an attempt to better deal with the gas and sand.
14	**Application of the Electrical Submersible Pump Re-circulation System below Perforations in 5.5" Casing Wells in 25 de Mayo-Medanito S.E. Field, Argentina**	**S. J. Paez** and **Andres Steckinger,** Perez Companc **O. R. Fullana** and **S. A. Pesek,** Centrilift	This is a story about the use of a re-circulation pump to cool the ESP motor in high-rate waterflood response wells in Argentina that are completed in 5.5-inch casing. Some results that were reported • They produce approximately 400 wells in this field. • Most are on beam pump. • 70% of the wells have 5.5-inch casing. • The wells produce with a high water cut. The field is under waterflood. • They use a re-circulation system with a re-circulation pump to cool the ESP motor. They do not use a shroud. • They reported good success in being able to cool the ESP motors with this approach.
15	**Microbilologically Influenced corrosion of ESP Components (Case Histories)**	**D. L. Adams,** Centrilift	This is a very good paper and is "recommended reading" for everyone with ESP (or really any sort of artificial lift) operations. The paper discusses the forms of corrosion that can be caused by anaerobic bacteria. Both sulfide-reducing bacteria (SRB) and acid producing bacteria (APB) are potential problems. The "good news" that the presence of these bacteria can be detected by testing the produced water. And if they are found to be present in the well, they can be treated.

No.	Title	Author(s)	Comments
			<u>The moral of this story is</u> • Have your produced water tested for bacteria. • If they are present, treat for them before they cause major damage (and failures) of your ESP system and/or tubulars.
16	**Asphaltene Alley - Improving ESP Run Life in a CO_2 Flood**	**Matt Cummings,** Schlumberger **Saul Tovar,** Oxy **Heather Gregory,** Hy-Tek Coatings	This is a story about the production of asphaltenes in a CO_2 tertiary recovery field in West Texas. This is in the South Wasson Clearfork Field that was developed by Shell, was operated by Altura, and is now operated by Oxy. <u>Project description</u> • The CO_2 flood is operated as a WAG - water alternating with gas. • The CO_2 "sweeps" the asphaltenes to the wellbore. • They tried chemical treatment without success. • They tried shrouds without success. <u>Current multi-faceted approach</u> • Do "batch" style chemical treating. • Perform routine paraffin cutting in the tubing. • Coat the ESP pump parts with Teflon (made by Dupont). They find that any asphaltenes that accumulate on the pump parts can be wiped away with a finger. • Use mixed-flow impellers on the ESP pumps. The "compression" design helps to minimize the downthrust effects when running on the left side of the ESP pump performance curve. • This combination seems to be controlling the ashphaltene problem.
17	**Use of Dual Capillary Injection Strings in ESP Cable to Improve Operations in a Difficult Well Environment**	**Gary Ohlman,** Questar Operating **Robert Lannom** and **Royce Raddatz,** Wood Group	This is a story about the injection of fresh water to mix with the produced water to prevent scale formation. The field is in the 4-corners are of Colorado (southwest Colorado). <u>The approach is</u> • Use two 0.5-inch capillary tubes that are installed in the ESP cable bundle. • The fresh water is injected down the tubes and mixed with the produced water at the pump intake. • The tubes are made of stainless steel. • They are "in" the cable bundle and are spooled and run with the cable. • Care is used to not damage the tubes by clamping the cable too tightly.

No.	Title	Author(s)	Comments
			They report that this approach is helping to prevent deposition of scale on the ESP pump and the tubing.
18	**Two-Phase Flow Performance of Electrical Submersible Pump Stages - Experimental Investigation and Literature Review of Predictive Methods**	**Rui Pessoa,** PDVSA **Raghaven Beltur** and **Mauricio Prado,** University of Tulsa	This is a story about research conducted under TUALP (Tulsa University Artificial Lift Project) at the University of Tulsa. It is a continuation of on-going research at TUALP on the effects of gas on ESP gas separators, gas conditioners, and pumps. Test objectives • Map the full effects of gas surging on ESP performance. • Conduct a comprehensive literature review. • Run stage-by-stage tests. In this test • The pumping system was positioned in the horizontal position. • Pressure measurements were taken at each stage of a 22-stage ESP. • The flow rate was 6000 b/d. • The pump intake pressure was 100 psig. • The tests were run with air and water. • The pump was operated at 55 Hz. Conclusions reached • Performance improves with each stage, as the gas is compressed through the pump. • Current ESP prediction programs are not adequate to predict the effects of gas on ESP pump performance. • More research is needed, possibly with oil and gas, possibly in a vertical ESP.
19	**ESP Complete Characteristics**	**Lyle Wilson,** Centrilift	Normally, we are concerned about the portion of the ESP performance curve that lies in the upper right quadrant, in the area of positive head and positive production rate. There are two other quadrants that hold some interest: Other quadrants of interest • Upper left quadrant (positive head, negative flow) experienced when injecting down through the pump. • Lower right quadrant (negative head, positive flow) experienced when flowing up through a non-operating pump. • Lower left quadrant (no interest). Upper left quadrant • This will be experienced during injection back down through the ESP pump.

No.	Title	Author(s)	Comments
			• There should be no problem if the injection rate down through the pump is less than 25% of BEP (best efficient production rate). • Need to avoid the flow range of from 25 - 30% of the BEP if injecting back down through the pump. • Also need to avoid the condition of injecting down through the pump at 2 - 3 times the BEP rate. <u>Lower right quadrant:</u> • This will be experienced if a well is being produced up through a non-operating ESP pump (e.g. if the well is flowing or on gas-lift). • There should be no problem if the flow rate up through the pump is less than 25% of BEP. • Need to avoid the flow range of 30 - 80% of the BEP if producing up through the pump.
20	**Modeling and Testing Electrical Submersible Pump Motor Leads and Potheads - A Short Story**	**Robert Krush** and **Jeff Arnaud,** Schlumberger	It is interesting that this is the only paper at this workshop on ESP cable. Years ago there were several papers on cable problems. This is testimony to the fact that most cable problems have been solved. This is a story about developing a higher rated cable to convey 560 Kw of power (750 Horse Power) to drive a high power ESP motor. The approach used to model the cable was "finite element analysis" (FEA). Both the FEA analysis and an analysis based on the "capacitance" methods provided good agreement. FEA analysis is supported by modern three-dimensional software and is an effective method for evaluating electrical components of ESP systems.
21	**Emulsion Viscosity Testing with ESP's**	**John Patterson,** Phillips **Joe Henry** and **Walter Dinkins,** Centrilift	This is a story about the importance of knowing the emulsion tendencies of the crude oil being produced, and the effects that this has on ESP performance. In this study, three actual crude oil/water samples were tested. This is a sobering story. It is essential to obtain actual data on the crude/water mixture being produced. <u>Some results of the evaluation</u> • Emulsion effects can increase with oil viscosity, pump size, and pump power. • Emulsion effects can be increased by presence of alphaltenes and paraffin. • Knowing the API gravity of the crude is not enough. • Emulsion predictions based on studies with mineral oil and water do not agree with results based on testing with actual crude samples. • Tests are required to determine when an oil/water

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			mixture will invert from an oil to a water base. This has a very large effect on viscosity and emulsion formation. • It is essential to de-rate the ESP head/flow curve for emulsion viscosity, but this can only really be known if the characteristics of the actual crude are known. It is not sufficient to use standard viscosity factors.
22	**Downhole Oil Water Separation Systems**	**Yasser Bangash** and **Sarfarez Jokhio,** Wood Group **Marcello Reyna,** Intevep PDVSA	There has been much discussion of downhole oil/water separation (DOWS) systems. Interestingly, only about 50 DOWS units have ever been installed in the world. At this time, only about 10 systems are in operation. Why? The idea of a DOWS system is to separate oil and water downhole, re-inject the water into an injection zone downhole, and produce only the oil to the surface. The potential advantages are significant in terms of less fluid handling and cost on the surface. <u>Problems with this approach include</u> • It has sometimes been mis-applied. For example, there must be an excellent injection zone for this to work well. • The downhole hardware design is often too complicated. • This has led to short run life. • There is often plugging of the injection zone. • There has been inadequate training of users. This paper describes a new system called an "encapsulated" DOWS system. The paper should be read if there is interest in this approach.
23	**Determining Load Ratings for a Horizontal Pump Thrust Chamber**	**Steve Sakamoto,** Wood Group	This was an alternative paper. It was not presented, but it is included in the ESP Workshop transactions, so it may be read if desired.
24	**Gas Separation Break-Out Session**	**Shauna Noonan,** Chevron/Texaco	This was a "panel" discussion of gas separation and gas handling by ESP systems. This break-out session was led by Shauna Noonan of Chevron/Texaco. Members of the panel included Pat Kallas of Schlumberger/Reda, Lyle Wilson of Baker/Centrilift, and Yasser Bangash from Wood Group. <u>Several points of interest were raised</u> • If a well produces with a consistent gas rate, it can probably be successfully operated with a combination of natural gas separation, use of a rotary gas separator, use of a gas conditioner, use of a tapered pump, and/or use of mixed-flow

No.	Title	Author(s)	Comments
			stages or a compression pump. • Words of wisdom - separate if possible; if separation is not possible, consider a gas conditioner. In other words, keep the gas out of the pump if possible. • Some typical guidelines are: – Radial pumps can handle up to 10% free gas. – Compression pumps up to 25% free gas. – Natural separation efficiency depends greatly on the design. – Rotary separation also depends on the design, but may handle up to 25 - 30% free gas. Even more is claimed in a few instances. – Gas conditioners may handle up to 50 - 60% free gas. – A new gas conditioner (the poseidon from Schlumberger) was mentioned, but no performance data was given. • One of the important issues in dealing with gassy wells with horizontal completions is gas slugging. The slugs develop in the horizontal section. – Chevron/Texaco is using the program Olga 2000 to predict these slugs. – Pat Kallas said that, to deal with slugs, it may be necessary to temporarily slow down or speed up the pump. It may be necessary to use trial and error to determine the best approach. – If a pump must be temporarily showed down, we need to worry about downthrust and motor cooling. Use of a compression pump may minimize the detrimental effects of downthrust. But we need to be careful not to move too far to the left on the head/rate curve, and we need to be careful to avoid moving to far to the right into the upthrust region. – Manufacturers should be able to tell us how far we can safely operate either below the downthrust limit or above the upthrust limit. – An automation system designed to deal with these gas slugs will need to be very clever.
25	**Thru-Tubing Conveyed ESP - First Installed Units at West Sak**	**Walter Dinkins,** Centrilift **John Patterson,** Phillips Petroleum **J. Ryan Dunn, Mavriky Kalugin,** and **Jordan Wiess,**	This is a companion paper with #26. This is a story about thru-tubing conveyed ESP's in the West Sak field on the Alaskan North Slope. <u>They are using</u> • Horizontal completions. • Multi-lateral completions. • This gives them much improved productivity indices and allows them to produce more oil.

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		Phillips Alaska	• They install the ESP motor and other "permanent" kit with a rig. • This includes a downhole measurement system (Phoenix) and a rotary gas separator. • It also includes the ESP cable and a downhole heat trace. They have 2000 feet of perma-frost. • They install the ESP pump with wireline. <u>Operation</u> • They use a very slow ramp up (bean up) time on the order of 50 psi / day, using a VSD. This is to minimize effects of gas and sand. • They closely monitor downhole vibration and use this to help control the ramp up process. • They are able to handle up to 66% free gas. • They feel that they are obtaining 70% natural gas separation with their design. This is based on actual measurement of the casing-head gas being produced. • They allocate production to the different multi-lateral zones by using a geo-chemical analysis of the crude and by knowing the composition of the crude from each zone.
26	**Thru-Tubing Conveyed Progressive Cavity ESP Operating Issues - A Short Story**	**Walter Dinkins,** Centrilift **John Patterson,** Phillips Petroleum **J. Ryan Dunn, Mavriky Kalugin,** and **Jordan Wiess,** Phillips Alaska	This is a companion paper with #25. This is a story about thru-tubing conveyed ES-PCP's in the West Sak field on the Alaskan North Slope. <u>Some characteristics are</u> • This is MUCH less expensive than using a rig to pull and re-deploy the pumps. • It also greatly reduces downtime when a pump must be changed. • As with the ESP's, they install the motor and related kit with the rig and the PCP with wireline. • They are able to produce 800 b/d with 3.5-inch tubing, and 1200 b/d with 4.5-inch tubing. • They have sand problems with some of these wells. They use resin-coated proppant in the sand control system.
27	**Tandem Upper Tandem ESP Motor System Increases Pump Capacity by 67% in Field Test**	**Dana Pettigrew,** Nexen Petroleum **Bob Kipp,** Nexen Petroleum Yemen	This is a story about using two tandem ESP motors to provide 1000 HP to operate a large ESP pump in Yemen. They need 1000 HP to produce the desired amount of fluid. The lead time to obtain the two tandem pumping systems (four motors in tandem) was much less than would have been required to obtain on 1000 HP motor. In this field in Yemen, they have 184 wells, all on ESP. They produce 230,000 b/d.

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<tr><td></td><td></td><td></td><td>To obtain the required 1000 HP, they use two 500 HP tandem ESP motors that drive one ESP. Each tandem 500 HP motor has its own VSD and cable.

They use a MicroMotion coriolis meter to measure the produced oil and water. There is no free gas.

The system is working fine and is now installed on seven wells.</td></tr>
<tr><td>28</td><td>Summary of Break-Out Sessions

Severe Conditions

Gas Separation

ESP Applicability

Heavy Crude

Unconventional Installations and Applications</td><td>Mike Parker, Anadarko

Shauna Noonan, Chevron/Texaco

Jim Lea, University of Tulsa

Gabriel Diaz, Chevron/Texaco

John Patterson, Phillips</td><td>In this final session, the persons who coordinated the break-out sessions reported back to the full workshop about the key points discussed.

Sever Applications Break-Out Session - Mike Parker, Anadarko
Power quality - this is always a very important issue.
Cable technology - this is less of an issue these days.
Pumps - focus on proper coatings, and bearing design to deal with sand, asphaltenes, corrosion, etc.
Scale - high temperature and low pump intake pressure both promote scale deposition.
Protectors - consider compression pumps, use of more seal sections.
Motors - monitor motor winding temperature and don't allow motor to become overheated.
Corrosion - be aware of corrosion tendencies, be careful to avoid high flow rates past the ESP motor housing.
Key issues - consider alternative deployment methods, focus on teamwork between Operators and Suppliers.
Gas Separation Break-Out Session - Shauna Noonan, Chevron/Texaco
I attended this one. See item #24 above.
Unconventional ESP's Break-Out Session - John Patterson, Phillips
Coal bed methane
Use cheap (throw away) water well ESP's.
Consider use of a re-circulation system to cool the ESP motor.
Surface applications
Place ESP in a vertical "can" (very short well).
Use a PIMP system (pump in metal pipe).
Coiled tubing deployed ESP's
Can use in 7-inch or 9 5/8-inch casing.</td></tr>
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			– For example, spend $250,000 vs. $1.2 MM for a pump replacement. – Plus have much less downtime. – Run upside down with motor on top. ▪ Seal section did have to withstand from 0 psi to the pump intake pressure. ▪ Now it has to withstand from 0 psi to the pump discharge pressure. But most manufacturers can support this. – Or, consider Phillips' approach of running motor on tubing and pump with wireline or coiled tubing. **Heavy Crude** Break-Out Session - Gabriel Diaz, Chevron/Texaco • Some approaches being pursued. – Don't worry too much about downthrust (??) – Work is being done on new ESP designs for heavy oil. – Use a tapered pump with a larger pump on bottom. **ESP Applicability** Break-Out Session - Jim Lea, Texas Tech University • I attended this one. See item #11 above. **ESP Analysis** Break-Out Session • This session was not held.
29	**Summary of the 2002 SPE ESP Workshop**	**Mike Parker,** Anadarko	Total workshop attendance = 413 • 140 from Operating Companies • 159 from Manufacturing Companies • 111 from Service Companies & Consultants • 3 from Universities • 24 Different Countries were represented Workshop proceedings are available from the workshop organizers by: • Hardcopy book • CD Other contents of the proceedings include: • A list of the members of the Permanent ESP Workshop Committee and the 2002-2003 Rotating Committee. • A comprehensive list of all attendees, with names, addresses, telephone numbers, and e-mail addresses. Handouts at the workshop included: • A list of all of the companies that had exhibits at

No.	Title	Author(s)	Comments
			the workshop. • A summary of the break-out sessions.
30	**Poster Presentation: Remote, Automatic, Intelligent ESP Operation**	**Steven Bernard,** Worcester Controls **Ken Booth,** CAC **Julian Cudmore,** Phoenix **Cleon Dunham,** OAC **Klaus Mueller,** PDO **Norman Ritchie, Centrilift** **Petter Schmedling,** CorrOcean	This was a poster presentation of the "intelligent ESP" (iESP) project that is being developed by Petroleum Development Oman (PDO). It included: • The iESP objectives • System components • System concepts (bean-up, normal operation, optimization, and shut-down management), • Expected benefits • Current status. In addition to the panel presentation, a paper of the same title is included in the ESP Workshop proceedings. Cleon Dunham of OAC and Abdullah al Harthy of PDO made the panel presentation. In addition, CAC posted a paper that they have prepared on the remote terminal unit (RTU) portion of the project. This is the same paper that CAC (now part of eProduction Solutions) presented at the 2002 Southwestern Petroleum Short Course in Lubbock, Texas on April 24 and 25, 2002. This paper is not included in the proceedings, but an abstract of it is included.
31	**Demonstrations, Displays, and Exhibits**	**Numerous Companies,** see list of exhibitors in Workshop proceedings	There were several excellent demonstrations, displays, and exhibits. As usual, there were numerous opportunities to hold individual and small group discussions with the various ESP workshop attendees and exhibitors.