



2003

Engineering Innovation

Judges choose top 14 industry projects

Hart's *E&P* editors and staff proudly present the winners of the prestigious 2003 Special Meritorious Awards for Engineering Innovation.

The pages that follow spotlight the 14 awards the judges picked as best of the 2003 crop of entries. The winners reached across a broad range of disciplines and addressed a number of problems that posed roadblocks to efficient operations. The resulting technologies opened new and better avenues to the complicated process of finding and producing hydrocarbons around the world.

This year, some of the brightest minds in the industry from service and operating companies submitted a record number of entries representing better technology and new techniques for judges to consider.

The award program honors engineering excellence and achievement in every segment of the petroleum industry. It recognizes new products and technologies that offer innovation in concept, design and application. Winning entries represent techniques and technologies that are most likely to solve costly problems and improve exploration, drilling and production efficiency and profitability.

The people and companies that submitted the entries realize the oil- and gas-producing industry depends on new, better and constantly changing technological innovation to continue producing low-cost oil and gas from smaller and deeper

reservoirs to feed an increasingly energy-hungry world.

Contest judges chose the winners, but there were no losers in this contest. The products chosen represented the best of a long list of winners.

The expert panel of judges included engineers and engineering managers from operating and consulting companies worldwide. They applied their expertise in areas in which they were familiar, and judges were excluded from categories in which they or their companies had a business interest.

Hart's E&P would like to thank these distinguished judges for their efforts in selecting the winners in this year's competition.

As in past years, *Hart's E&P* will present the 2003 awards at the Offshore Technology Conference in Houston, Texas, May 5. The magazine would like to break this year's record number of entries in next year's contest. Individuals, companies and organizations are working around the clock on new technology that will improve the industry's efficiency, and those efforts should get the public attention they deserve.

An entry form for the 2004 Special Meritorious Awards for Engineering Innovation contest is available at the magazine Web site at www.eandpnet.com. The deadline for entries is Dec. 1, 2003.



2003

MEA Winners

Si-Flex Accelerometer
Input/Output

Digital Hydraulics
WellDynamics

VectorSeis System Four VR
Input/Output

C-TECH "Precision Strength" Syntactic Foam
Cuming Corp.

GeoTap formation testing service
Halliburton, Sperry-Sun

Fiber Optic In-Well Seismic System
Weatherford Completion Systems

Score 100 Coring
Corpro Systems Ltd.

BJ Python Composite Bridge Plug
BJ Services Co.

Expandable Drill Bit - "XpandaBit"
Weatherford International Inc.

GoFlo
Subsea 7/Halliburton

Accolade drilling fluid system
Halliburton Energy Services Inc.

RamPump
Weatherford Artificial Lift

Trapped Pressure Compensator
Nam/Halliburton

Deepwater Sulfate Removal
Marathon Oil Co.



2003

MEA Judges

David Burnett
Texas A&M University

George King
BP America

Eve Sprunt
ChevronTexaco

Peter Duncan
Society of Exploration Geophysicists

Roger Knight
McMoran

Cheryl Stark
BP America

Donald Duttlinger
Petroleum Technology Transfer Council

Keith Millheim
Anadarko Petroleum Corp.

John Thorogood
BP Amoco Exploration (Faroes)

Bev Edwards
Vanco Energy Co.

David Murphy
Shell Technology E&P

Tim Tipton
Marathon Oil

Richard Ellis
Mullen Energy Corp.

Jerome Schubert
Texas A&M University

Svein Tollefsen
Statoil ASA

Dick Ghiselin
Qittitut Consulting LLC

Lanny Shoeling
Shell Exploration & Production Co.

John Toups
Westport Technology Center International

Bob A. Hardage
Bureau of Economic Geology

Yoram Shoham
Shell International Exploration &
Production Inc.

Doug White
ConocoPhillips

EXPLORATION, INDIVIDUAL EQUIPMENT: SI-FLEX ACCELEROMETER

INPUT/OUTPUT

MEMS reduces seismic acquisition system size

Developed to detect and record seismic reflections, Input/Output's Si-Flex accelerometer provides a low-noise, low-distortion sensor with exceptional bandwidth, dynamic range, stability and robustness.

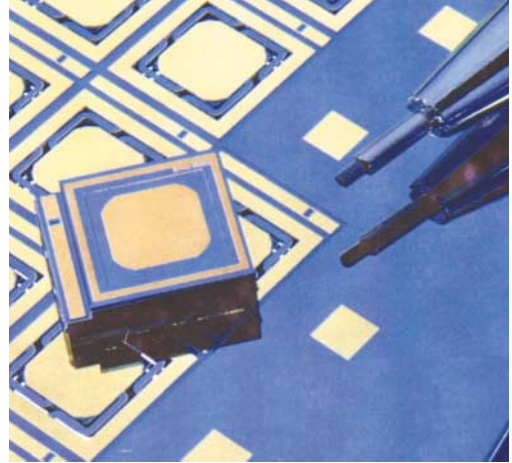
Ultimately, designers hoped to replace analog geophones with a technology for improved frequency response, performance and reliability along with reduced sensor size and weight. Along the way, they identified additional applications: vehicle control systems, platform leveling, earthquake protection systems, intrusion detection, equipment vibration control and protection, construction equipment and structure modal studies.

This electrostatic force rebalanced microelectromechanical system (MEMS) accelerometer enables accurate seismic measurements over a wide dynamic range. It incorporates a bulk micromachined capacitive accelerometer die and a closed-loop, force-feedback application-specific integrated circuit to produce a digital output.

Use of the Si-Flex accelerometer in land,

in-well and ocean-bottom seismic imaging systems significantly reduces acquisition system and sensor size and weight. In ocean-bottom seismic acquisition systems, the accelerometer allows sensors to operate at any inclination angle and measure sensor deployment angles directly, eliminating the need for expensive gimbal receiver units that create data artifacts. High vector fidelity, along with improved linearity and bandwidth at all tilt angles, makes these sensors ideally suited for recording the full seismic vector wave field much better than with existing omnidirectional geophones.

Operators have enjoyed improved and cost-effective imaging of direct hydrocarbon indicators, low-impedance reservoirs, complex thrust-faulted terrain and direct access to quantitative rock and fluid properties. When seismic data acquired with Input/Output's VectorSeis ocean-bottom trials were



The Si-Flex accelerometer enables significant reductions in acquisition system and sensor size and weight.

compared to legacy datasets acquired with gimballed sensors in the same area, VectorSeis data demonstrated measurable and significant improvements in vector fidelity.

EXPLORATION, SYSTEMS: VECTORSEIS SYSTEM FOUR VR

INPUT/OUTPUT

Multicomponent seismic recording improves imaging

Designed for multicomponent (full-vector) seismic recording in land and transition zone environments, the VectorSeis System Four VR is the first commercial seismic system to use microelectromechanical system (MEMS) accelerometers.

Full-vector seismic recording enables improved P-wave imaging, converted wave imaging and full, nine-component imaging. Seismic surveys then can image stratigraphic and structural detail and provide improved visibility in such difficult areas as gas clouds and gas chimneys.

The accelerometer operates in the full range of gravity, from right side up to horizontal to upside down, with 40-nano-G sensitivity and 100 dB of dynamic range. This reduces time spent manually orienting transducers.

The multicomponent VectorSeis sensor module is autonomous and intelligent, interfaced via a cable with a digital telemetry and power delivery system. Simpler logistics and improved operational efficiency result from a single sensor

module instead of a multi-element string of geophones.

The system reduces equipment weight 35% over conventional systems and 60% over conventional multicomponent operations. Manpower requirements and health, safety and environment exposure also are reduced. Conventional acquisition and processing cycle time is cut by up to 10%, and multicomponent recording by up to 25%.

In northern Alberta the VectorSeis System Four VR has improved structural and stratigraphic imaging in heavy oil sands. Special techniques dependent on accurate horizontal drilling enable exploitation of these enormous reserves, but poor structural imaging with conventional seismic surveying techniques has hampered economic success. VectorSeis multicomponent technology provides



The VectorSeis System Four VR incorporates TrueDigital microelectromechanical systems accelerometers to image structural and stratigraphic detail in land and transition zone environments.

superior structural imaging in such areas. Shear data are being studied as an indicator of lithology, redirecting client resources from high-density exploratory drilling to production.

SUBSURFACE ANALYSIS, INDIVIDUAL EQUIPMENT: GEOTAP FORMATION TESTER HALLIBURTON, SPERRY-SUN

While-drilling service estimates pressure near the bit

Unlike conventional designs that use hydraulic or inflated packers and cannot take measurements with pumps on, Halliburton Sperry-Sun's GeoTap formation tester provides subsurface pressure measurements using downhole hydraulics and a single pad/probe design.

With this service, estimates of formation pressure can be made near the bit, which provides critical information during the drilling process.

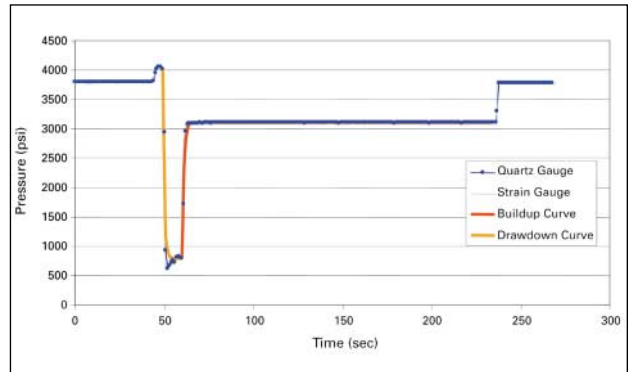
Pressure tests, with pumps on or off, are achieved in 5 to 10 minutes, dependent on formation permeability. The tester replaces wireline or pipe-conveyed logging services, which are time-intensive and represent higher operational risk.

Using a closed hydraulic system, battery power and quartz and strain gauges, the sensor extends a probe on command to establish a seal at the borehole wall. It then performs a drawdown and build-up sequence to define formation pressure. This information is stored to memory and sent

to a surface data unit for analysis and use in real time.

The tester has reached total well depth determining measurement before borehole degradation as well as hydrocarbon typing and fluid contact determination via pressure gradients.

A North Sea operator used GeoTap to measure reservoir pressure while drilling from a semisubmersible rig. The reservoir fluids gradient obtained was identical to that obtained by a wireline-type formation tester run in an adjacent well at 0.28 psi/ft. GeoTap eliminated the risk and cost of pipe-conveyed wireline testing, saving the operator more than US \$350,000.



The GeoTap formation tester provides subsurface pressure measurements in real time using downhole hydraulics and a single pad/probe design.

A Gulf of Mexico operator deployed GeoTap in deep water after unsuccessfully attempting to obtain reservoir pressures with a wireline-type formation tester. The service delivered the required data at a savings of more than \$500,000 compared to drillpipe-conveyed logging.

SUBSURFACE CHARACTERIZATION AND ANALYSIS, SYSTEMS: SCORE 100 CORING CORPRO SYSTEMS LTD.

System restricts sampling to proven targets

Seeking to reduce the "dead time" involved in drillstring tripping in and out of a wellbore to retrieve core samples, Corpro Systems Ltd. developed the Score 100 system.

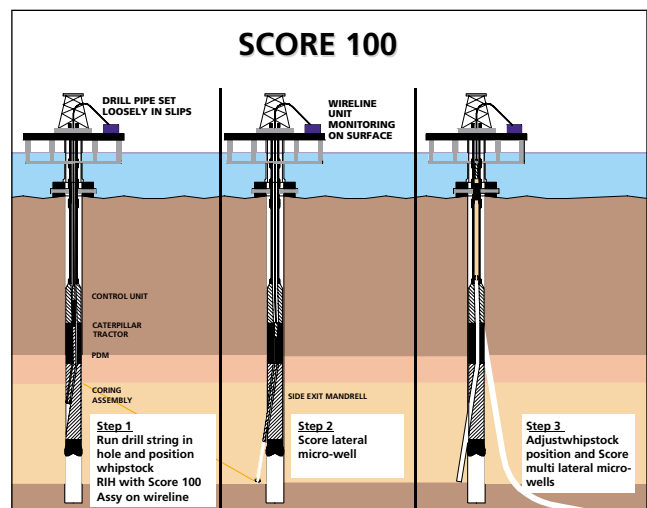
Lack of available data at the time of selecting the coring point can easily compromise coring operations, resulting in the missing of a target sample. Using electric logs to select specific zones of interest, Score 100 can cost-effectively restrict coring to proven targets. And using the exploration well for more complete formation evaluation data acquisition negates the need for an additional appraisal well – a direct savings for the operator and the environment.

This wireline-operated coring system obtains representative fresh state formation samples from existing wellbores (open or cased) without length restriction. Modules enable configuration for various applications, such as coring to evaluate residual fluids distribution in mature field wells and identify reasons for production decline.

caterpillar tractor unit, the system uses a dormant whipstock integrated with a conventional drillstring to exit from the primary wellbore at an angle of 4 degrees. A 1½-in. diameter core is cut and retrieved in a 2.4-in. diameter hole using the lower coring assembly. The tractor unit applies weight on bit or pulling power of up to 6,000 lb. A series of pressure transducers and a hydraulic system controlled from the surface through the wireline interface enable system monitoring.

The tool can withstand temperatures to 247°F (120°C) and pressures to 10,000 psi. Production testing

included retrieval of downhole samples at the Aberdeen Drilling School test rig site. Additional tools are being constructed for commercial use.



The Score 100 system enables low-invasion coring of multiple objectives from existing open cased holes.

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