

OPERATIONAL MANUAL

FOR

MUD LOGGING ENGINEERS

OIL QUEST INTERNATIONAL LTD

**KM 19 PORT HARCOURT OWERRI ROAD,
IGWURUTA, PORT HARCOURT
RIVERS STATE**

PHONE:

087771460 OR 08067658506, 08023742996

WEBSITE:

WELL LOGGING

Well logging is a technique used in the oil gas industry for recording rock and fluid properties to find hydrocarbon zones in the geological formation below the earth's crust. A logging procedure consists of lowering a logging tool' on the end of a wireline into an oil well (or hole) to measure the rock and fluid properties of the formation. An interpretation of these measurements is then made to locate and quantify potential depth zones containing oil and gas (hydrocarbons). Logging tools developed over the years measure the electrical, acoustic, radioactive, electromagnetic, and other properties of the rocks and their contained fluid. Logging is usually performed as the logging tools are pulled out of the hole. This data is recorded to a printed record called a well Log' and is normally transmitted digitally to office locations. Well logging is performed at various intervals during the drilling of the well and when the total depth is drilled, which could range in depth from 300m to 8000m (1000ft to 25,00ft) or more.

CONTENTS

- Wireline and “while drilling” well logging
- Logging measurement types
- Mud logging
- Use of information

WIRELINE AND “WHILE DRILLING” WELL LOGGING

Well logging usually refers to downhole measurement made via instrumentation tat is lowered into the well at the end of wireline cable, the wireline consists of an outer wire rope and an inner group of wires. The outer rope provides strength for lowering and lifting the heavy instrument and the inner wiring provides for transmission of power to the downhole equipment and for data telemetry upholds to the recording equipment on the surface.

In recent years, a new technique, logging while drilling (LWD), has been introduced which provides similar information about the well instead of sensors being lowered sensors are integrated into the drill string and the measurements are made while the well is being drilled. While wireline well logging occurs after the drill string is removed from the well, LWD measures geological parameters while the well is being drilled. However, because there is no high bandwidth telemetry path available—no wire to the surface—data is either recorded downhole and retrieved when the drill string is removed from the hole, or the measurement data is transmitted to the surface via pressure pulses in the well's mud fluid column. This mud telemetry method provides a bandwidth of much less than 100 bits per second. Fortunately, drilling through rock is a fairly slow process and data compression techniques mean this I an ample bandwidth for real-time delivery of critical performance.

LOGGING MEASUREMENT TYPES

Logging measurement are quite sophisticated. The prime target is the measurement of various geophysical properties of the subsurface rock formations. Of particular between the granules that form the rock. It is this space that contains the oil and gas. Permeability is a measure of the interlinking of the rock pores, a description of the passages between the pores though which the oil and gas may pass. The higher the porosity, the higher the possible oil and gas content of a rock reservoir. The higher the permeability, the easier for the gas to travel from far out in the formation toward the wellborn. While logging tools don't measure these quantities directly, they provide measurement that allows for the mathematical interpretation of these quantities.

Beyond just the porosity and permeability, various logging measurement allow the interpretation of what kinds of fluids are in the pores – oil, gas, brine. In addition, the logging measurement are used to determine mechanical properties if the

formations. These mechanical properties what kind of enhanced recovery methods may be used (tertiary recovery) and what damage to the formation (such erosion) is to be expected during oil and gas production.

The types of instrumentation deployed in well logging are quite broad. Historically, logging measurements consisted of basic electrical logs (resistivity) and spontaneous potential (SP) logs, introduced by the Schlumberger brothers in the 1920's. Tools later became available to estimate porosity via sonic velocity and uncler measurements, tools are now more specialized and better able to resolve fine details in the formation. Radiofrequency transmission coupling techniques are used to determine fluid conductive than oil or gas) sonic transmission characteristics (pressure waves) determine mechanical integrity. Nuclear magnetic resonance can determine the properties of the hydrogen atoms in the pores (surface tension, etc.). Nuclear scattering (radiation scattering), spectrometry and absorption measurement can determine density and elemental analysis or composition. High-resolution electrical or acoustical imaging logs are used to visualize the formation, compute formation dip, and analyze thinly bedded and fractural reservoirs.

In addition to sensor-based measurements above, robotic equipment can sample formation fluid, which may then be bought to the surface for laboratory examination. Also, controlled flow measurement can be used to determine in situ viscosity, water and gas cut (percentage), and other fluid and production parameters.

MUD LOGGING

Another kind of logging techniques used is “mud logging” A wellsite geologist (usually called a Mudlogger” or “Mudlog geologist”) work when drilling is going on. The geologist Analyzes the rock sample coming circulating mud/fluids off ‘flow line’ from the drill sting /pipe. Similar to a well log, a Mud Log is prepared

by the Mud logging company. A mud log displays the gas present in the formation by using gas chromatograph techniques. A mud log also describes the formation geology.

USE OF INFORMATION

The well log and the mud log are usually transferred in ‘real time’ to the operating, which uses these logs to make operational decisions about the well and to make interpretations about the quantity of hydrocarbons present.

MUD LOGGING

- Overview
- Solids
- Liquids
- Gasses

Overview:

Mud logging is the process of collecting, analyzing and recording the meaningful solids, fluids, and gasses brought to the surface by the drilling fluid (mud). The mud logger keys all of his data to the geolograph on the rig floor.

Solids:

The mud logger collects sample of the cutting from the downhole strata on a regular basis, usually every ten feet. Collections are usually made at the shaker table for the mud system. The logger then washes and dries the cutting, keeping them properly labeled as to depth that they represent. In order to know what depth the samples actually come from it takes the samples to reach the surface from the time they were cut. The greater the depth, the greater the time for the samples to reach the surface after they were cut. In order to help with the lag calculations, the logger tracks hole size, pump strokes and occasionally sends distinctive sample down the pipe to measure the actual lag.

The logger examines the dried sample under a binocular microscope and records the predominant rock types on a depth strip chart that has drill times and chromatograph reading also recorded on it. Rock types are often correlated with the drill time for a particular rock type e.g. fast drill time for porous sandstone obviously properly recording what rock type is being drilled at what depth is not an exact science. Some factors that affect the accuracy are longer experience in an area, improper lag times, interbedded thin layers of multiple rock types, finely-ground rock fragments sloughing of uphole rock material, and diligence of the logger.

Liquids:

The logger analyzes for liquids primarily in two ways: chloride content and fluorescence. Chloride content of the mud is constantly monitored. An increase in chloride from a certain depth can indicate a strong salt water flow from a permeable formation. Samples are also viewed under ultraviolet light to check for fluorescence because most oils fluoresce. In the event that fluorescence is detected. The sample is subjected to cleaning fluid to determine whether it is hydrocarbon or mineral fluorescence.

Gasses

A key component of a mudlogging unit is a gas chromatograph. This unit continuously samples the gases coming out the mud and analyzes them for methane and the heavier hydrocarbons. The presence of 'show' of hydrocarbons on the chromatograph alerts the logger to be more alert for other evidences of hydrocarbons. Sometimes a separate "lag" must be determined for gasses as they may rise faster to the surface than the samples. A bag of carbide dropped down the drill pipe is usually used for this purpose.

MUD LOGGING

What is Mud Logging?

Mud logging provides subsurface geological information while drilling a well.

Mud logging examines and analyzes geological information contained in formation cutting and drilling mud, to determine if oil and gas are encountered during well drilling. Mud logging also provides critical safety function such as determine pore pressure, kick control and ambient gas monitoring. Mud logging is used whole drilling most exploratory and much development wells, both on and off shore.

Mud logging service range from basic unmanned gas detection to sophisticated full serviced, manned operations. Services have evolved to become the inform the well and include electronic monitoring of drilling parameters. These parameters include torque, penetration rate, mud levels, pump speed and third party service provider data.

Basic unmanned services use cost effective mud logging unit that provides simple gas de potentially productive pay zones and enhances drilling safety. The system is configurable for sulphide H₂S monitoring. The units are equipped with alarms to alerts the user if gas increase problems occur and works in conjunction with data logging and drilling penetration rates.

Mud logging services provides:

- Advance drilling monitoring systems capable of gas detection, electronic monitoring and database recording for a full range of drilling parameters on manned or unmanned operations.
- Experience crews and additional tools to monitor and analyzes both the geology of the subsurface information and the drilling parameters.
- Various combinations of services and crew sizes depending on customer requirement and well complexity.

- A portable laboratory (mud logging unit) that houses the hardware and software (mud logging system)
- Analysis conducted at wellsite during the drilling process and samples are returned to the operator after analysis.

BENEFIT OF MUD LOGGING

Mud logging lowers costs and improves the success rates.

Manned mud logging uses sophisticated system and experience crews, which range from people. Mud Loggers analyzed geological data as well as drilling parameters to identify and or productive hydrocarbon reserves, subsurface formation porosity and formation fractures. The used to make recommendation that optimize drilling paths (geosteering) for maximum reset production. Mud Loggers also look at the filling parameters in conjunction with formation and provide recommendations to improve drilling rates reduce costs and enhance safety.

Advanced Mud Logging Equipment and Services:

Equipment /service	Description
Formation evaluation	Analysis of the physical and chemical properties of formation or determine the classification of the subsurface rock formation, the
Geosteering	Assisting operators in determining the optimum path of drilling a in order to maximize hydrocarbon reserves and well productivity
Drilling Optimization	Analysis of drilling parameters to optimize drilling rates and redu
Fracture Identification	Identifying existing fracture in the rock surrounding a well that r and gas.
Thin Zones	Identifying thin zones in the well, which contain

	producible hydro zones often are overlooked and require sophisticated Mud Logg help identify them.
Oil/Water/Gas CONTACT Uss	Determining CONTACT US points of oil, water and gas in order quantifying the location of hydrocarbon reservoirs.
Gas Chromatograph	Tool that analyzes gas entrained in the drilling mud for its precis composition, which is used to perform complex analyses such a oil/water/gas CONTACT USs, identify thin zones, identify fracture geosteer horizontal wells. High speed units can analyze the gas every 30 seconds.
Calcmeter	Tool that determines the amount of limestone and dolomite press formation in order to assist formation evaluation.

EXPERIENCED CREW

ILI's experience crews are specialist in manned Mud Logging Services.

ILI has developed its experience workforce primarily through internal training and promotion hires junior personnel as sample catchers and trains them in accordance with our document program. Sample Catchers are promoted to Mud Logger, Data Engineers and pressure Eng meet specific training and experience criteria required for advancement. Ill's requirements include internal and external training classes with centrally examinations. Also, they have minimum number of wells logged with excellent safety records and job performance.

Mud logging crew functions

Pressure Engineer	Predicts and interprets pore pressure, which is used for drilling safely and casir seat selection. Usually has at least one year experience as a data engineer. The individual also must have completed the abnormal formation pressure training class and has shown
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	competence in pressure evaluation.
Data engineer	Analyzes drilling and logging data to make recommendations on drilling Parma documents probable hydrocarbon rich pay zones. Usually has at least two tear as mud logger. This position requires a completed advanced mud logging, evaluation, drilling engineering and well controls training classes. The person proven competence in the analysis of drilling operations.
Mud Logger	Prepares an cutting samples used for drilling and geological interpret with monitoring drilling parameters. Usually the mud logger has 6 to 12 months a sample catcher, worked as a trainee and has passed the basic two part mud course.
Sample catcher	Typically an entry level training position for mud loggers. Retrieve sample for system for analysis and assists mud loggers, data engineers and pressure Eng

OUR SERVICES

MUD LOGGING

LOGGING UNIT & EQUIPMENT

To meet your operational and budgetary, Oil Quest offers:

Two types of logging unit design: Wheeled and Skid mounted units

Two types of Services: Standard and Online computerized

A wheeled mounted logging trailer designed and constructed with high quality materials in accordance with international oil industry requirements. The trailer has enough room to accommodate equipment to perform formation evaluation services and withstand al normally encountered working conditions for drilling operations. Ample office space is provided for the operator's representative.

The Oil Quest skid mounted mud logging unit represents a significant advance in surface unit design. It offers a spacious and safe working environment. The modular design of the instrument results in low maintenance operation. The

equipment is functionally grouped and configured for optimum use. Thus, the basic lab instruments could be expanded in accordance with the client's project needs.

The Oil Quest sensing systems are designed and installed to satisfy the requirements of national and international agencies. Advances in sensor technology in conjunction with Virtual Instrumentation concept, interfacing, while ensuring that measurements are accurate and reliable.

MAIN FEATURES (Skid Mounted Units)

- Dimension: Height: 8' – 5" – width: 8' – 5" Length: 32' – Weight: 6.8 tons
- Skid mounted construction.
- Power and environmental support system area
- UPS system
- Emergency lights
- Smoke and H₂S gas detection and alarms
- Dual Air conditioning equipment

EQUIPMENT BASIC INSTRUMENTS

- Power distribution panel
- Voltage regulator – UPS System
- Gas Circulating Sytem (GCS) include air de-gassing unit)
- Multipoint Chart Recorders
- Intercom System]
- Inkjet Printers

POWER AND ENVIRONMENTAL

- 1) Support System Area (back Room)
- 2) Main Instrument Panel
- 3) Logging Geologist Work Area
- 4) Formation Evaluation Work Area
- 5) Client Work Area
- 6) Sample Preparation Area

2 Main Systems

Gas Detection and Analysis System (GDAS)

Dual Catalytic and Thermal Conductivity Total Gas Detector

Chromatographs. SPT Units are equipped with two (2) independence chromatographs operating in parallel. “Standard” and high speed resolution

“Micro –GC” chromatograph

Quantitative H₂S Detector

Quantitative CO₂ Detector

Cuttings Gas Detector with blender (optional)

Depth Controller and Drill rate Monitor System (DC/DRMS)

Mud Control System (MS)

The standard MCS includes the following equipment:

- Mud Weight In/Out Indicator
- Pump Strokes Counter System with Recorder
- Pit Level System
- Mud Resistivity In and Out (optional)
- Mud Temperature In and Out (optional)
- Accessories (Marsh Funnel, Mud Balance, Salinity kit)

Drilling Parameters Measurements Systems (DPMS)

- Rotary Rate Monitor
- Weight On Bit/Hook Load Monitor
- Pump Pressure Monitor
- Casing Pressure Monitor
- Rotary Torque Monitor
- Return Flow

FORMATION EVALAUTION EQUIPMENT

Binocular Microscope (10 x 30)

Ultraviolet and White Lights (fluoroscope). Adapted for core frag inspection

Sample drying oven

Chemicals for analysis and evaluation of geological samples

Additional equipment for geological examination of drill cuttings

Shale density kit

Calcimeter (quantitative carbonate analysis)

LOGGING UNIT

Design to accommodate equipment and personnel in a suitable working environment, regardless of the onshore or offshore location or the external climatic conditions.

- Fully furnished for geological analysis and data processing
- Pressurized for safety in explosive atmosphere
- Skid-mounted
- Air-conditioned

Description

The Oil Quest Logging Unit has been specially designed and built to house our logging instruments and ALS computer equipment at the wellsite. The Logging Unit is the gathering centre for processing drilling parameters and geological data while drilling; it can also be used for processing production data while testing. The processed data are relayed from here to other computer stations on location or via a communications link to distant offices.

Construction

Different types of construction are available to suit different locations, including sites only accessible to helicopter. The units are usually built of steel and are always well insulated with high density rockwool against extreme external temperatures. All units are fitted with an air lock, are skid mounted and equipped with four lifting eyes to facilitate mobilization and loading.

Equipment

The unit is fully equipped to serve as office, laboratory and data processing center to the Oil Quest crew and rig supervisors. It is pressurized for hazardous explosive atmospheres and is furnished with the following equipment:

- Safe-wired electric circuit
- Built-in worktops and cupboard

- Sink
- Water heater
- Instrument rack
- Printer carrier
- Heater
- Office chairs
- Lab equipment
- Sample processing equipment
- Drying oven
- Air conditioner
- Safe chemical storage

Technical Specification

Length	Overall (including skids) Interior	8.30m (27' 3") 7.86m (25' 9")
Width	Overall Interior	2.45m (8' 0") 2.30m (7' 6")
Height	Overall Interior	2.66m (8' 8") 2.30m (7' 6")
Weight	Furnished Equipped	6.8 tons 8.5 tons approx.
Power Supply		220V output from 220V, 380V, 440V or 480V three phase input, 50 or 60 Hz
Power Consumption		Maximum 12 kVA
Water Supply		Maximum pressure 6 kg/cm ² (85 psi)

LOGGING UNIT

The mud logging unit is a proven design development as the result of more than 40 years experience with unit engineering, manufacturing and maintenance. Very feature from the rugged corrugated shell to the ergonomic interior is well thought out provided a rugged, safe and comfortable working environment.

Each unit Features:

- Rugged skid mounted construction
- Intrinsically safe electrical system
- Choice of main power voltage and frequencies
- UPS backup
- Pressurized and explosion proof with automatic power shutdown
- Interior combustible gas alarm
- Interior emergency lighting system
- Escape hatch
- Dual air conditions units
- SEISBIT work area with convenient spacious interior including engineer workstation, geologist work area, sample preparation area, and work area for company geologist
- Ample storage space.

	Standard	Standard Onshore	Standard Offshore	Hel
Length	27 feet	24 feet	24 feet	20
Width	8 feet	8 feet	9 feet	8 feet
Height	8.5 feet	9 feet	8.7	8.5
Weight (fully loaded)	10 metric tons	13 metric tons	13.78 metric tons	5.3

The mud logging unit interior is designed with close attention to detail several advance features to ensure an optimal working environment. Standard inside than its true physical dimensions. Counter and storage space is plentiful and supplies are always easily accessible.

The sample preparation area is large enough to perform all sample related procedures from washing and drying the sample to autocalcimetry analysis. Chemicals, trays, glassware and other sample related items are stored in this area. The geologist work area is to the left of the sample preparation area and includes a computer station for updating the log and running offline programs.

This area is reserved for the company geologist and SEISBT operator. It includes counter and wall space, ample leg room, storage drawers, electrical outlets and network connection ports. A data display monitor is placed in this area.

High Speed Chromatograph

Hydrocarbon shows are often missed or poorly evaluated due to sampling and analysis speed limitations of most conventional chromatographs. ILI's high Speed chromatograph is configured to analyze C1 to C5 in 30 seconds. This chromatograph samples gases such as H₂S, CO₂ and a variety of inert gases without additional equipment.

Standard Speed Chromatograph

ILI standard speed chromatograph is configured to analyze C1 to C5 in 90 seconds. This chromatograph utilizes FID technology.

Contingency Plan

ILI's ANAX 500 system has redundancy built in with two independent hard drives. The primary hard drive runs the system and the secondary mirrors the primary for the continual back up of all data. The offshore ANAX 500 system also provides a second CPU unit for redundancy and added protection.

SPECIFICATIONS (CPU Unit)

- Rack mounted
- 8 Channel serial
- Dual hard drive RAID, ATX

COMPONENTS (DAU Unit)

- Wall mounted (rack mount option)
- Clear plexi cover fitted

WALL MOUNTED UNIT

32 ANA and 8 DIG channels

MUD LOGGING DRILL LOGIC SYSTEM

The Drill Logic system Server (DLS) is an extremely reliable and fast software application responsible for all real-time Mud logging and drilling data services.

DLS is used primarily by the data engineer to calibrate sensors, set parameters, configure screens and set data archival options. Once running, DLS scans all the sensors once per second and displays the calculated and drilling logic results.

Besides making hundreds of engineering calculations in just a few milliseconds, DLS is also responsible for maintaining an online MS Access database, providing real-time data to DSL Clients, servicing historical data requests from DLS Clients and setting internal and external alarms. All these features and its proven field record make Drill Logic system the premier Mud logging on-line system.

Real-time alpha-numeric and graphical displays of mudlog and drilling data on networked PC workstations. This allows networked users to view real-time data site or across the world! DSL Client displays are created by the user and alpha-numeric windows may be types of displays that may. Everything on the screen is configurable so there is no limit to the types of displays that may. This DSL Client workstation installed on the rig-floor is used for stand alone operation and command the DSL software remotely.

The explosion proof enclosure contains a powerful Pentium computer and high resolution LC specifically designed for harsh industrial environments.

With stand alone operations the full power of DSL and DLS Client is available through optimize menus but a built in mouse is available if the user prefers. DLS Clients is so powerful it could command DLS even over a corporate WAN or the internet if the appropriate permissions are.

There is a limit to the number of DLS Client workstation that may be connected to the net international Logging inc. Uses sophisticated client-server techniques that places most of the interface processing on the client computer. This not only allows for a far greater number for the service but also saves valuable network bandwidth and allows data to be transmitted into two second transfer intervals are not uncommon even over a WAN! Of course like everything Client even the transfer interval may be selected by the user and separate workstations can intervals.

If you have access to your corporate intranet you can view real-time data and playback data DLS Clients is a standard MS Windows program so you can multitask it with the rest of your service. There is no need to have it running 24 hours a day just connect when you want data. Historical retrieved from the on-line data in the logging unit and you download only the data that you require won't be frustrated by long downloads.

If you already have a network connection to the rig-site you can install DLS on one of the computers with no additional hardware. If you have a spare communication line we can use small WAN to your office. At the rig-site we extend our logging unit network to the client work.

DLS Client trouble free setup and operational reliability has been proven time and again in sight demanding network environments.

DLS CLIENT HIGHLIGHT

Fully configurable displays including:

- a) Depth curves
- b) Time curves
- c) Bar Charts
- d) Alpha-numeric
- e) Drilling Status

- Multi-tasking MS Windows 2000/XP operating system
- Client server technology uses low network bandwidth
- User configurable smart alarms both visual and audio
- Playback time and depth data over entire well interval
- View data from multiple rigs on one computer

MUD LOGGINGS DLS VibrA

The Drill Logic System Vibration Analysis (DLS VibrA) package is a tool designed drill sting provides immediate feedback about the results of remedial actions. The system allows the immediate practical guidelines designed to suppress torsional vibrations common drilling conditions.

The DLS VibrA system is designed to detect and quantify the severity of torsional drill string provides immediate feedback about the results of remedial action. The system allows the impractical guidelines designed to suppress torsional vibration before it results in BHA failure.

By smoothing out downhole drilling conditions BHA components can expect to yield a longer failure thus bringing drilling operations closer to optimum.

The DLS VibrA Server

The VibrA Server acquires sensor data at the necessary rate to insure sufficient data quantity supplied to the DLS VibrA Clients Digital Signal Processing functions.

The DLS VibrA Server performs the following services:

- Sensor calibration
- Modify data acquisition parameters
- Acquire sensor data and convert to engineering units
- Manage connections for multiple network users

Typically, sensor signals are acquired at a rate of 10Hz which is sufficient for analyzing torsic vibrations (typically observed in range of 5 to 2 Hz).

The Vibra Server sends full data packets, at the frequency specified by the operator, to all connected DLS VibrA clients connect to the DLS VibrA server via a local permitting; wide area network Windows 2000/XP workstation may connect using the TCP/IF protocol.

DLS VibrA Client

The DLS VibrA Client software provides real-time display of rotary torque, rotary RPM, hook pipe pressure at the frequent the DLS VibrA Server is acquiring data (usually 10Hz). The result display allows the driller or other VibrA Client users on

the network, to observe drill-stirring vile results of corrective actions as they occur.

Sophisticated digital signal processing routines perform complex Fast Fourier Transform (FF analysis of the torque signal in real-time. The FFT result, implemented as a Power Spectrum sinusoidal variations of the torque signal and analyses those variations for frequency and man display results, represented by the Power Spectrum graph and RMS (root mean squared, magnitude of the variation) gauge provide a measure for the torsional vibration.

Detailed post-drilling analysis is provided by easy playback of the raw data. Since data is saved at its acquisition rate (not displayed exactly as they were while drilling thus the torque signals power spectrum may be analyzed for the presence and magnitude of the torsional vibration. The DLS VibrA Client software will allow historical data playback while the real-time signals are saved to a database to ensure no data is lost.

Alarms will alert the user to adverse drilling conditions based on the standard deviations of signals, paired signal standard deviation, or high torsional vibration.

Alarms will alert the user to adverse drilling conditions based on the standard deviations of signals, paired signal standard deviation, or high torsional vibration.

The DLS VibrA software is a fully integrated client of Drill Logic System thus allowing real-time transfer of other parameters such as Depth and Rate of

Penetration: The DLS VibrA software will run on Windows 2000/XP workstation that can establish a netv to the DLS VibrA Sever.

The Oil Quest Log Drafting Software is a feature rich Integrated Log Development Environment (ILDE) used for creating and editing an endless variety of well logs.

Oil Quest utilizes the power and reliability of 2000/XP to produce logs many times faster than previous log drafting packages while keeping the exported file sizes to a minimum to facilitate distributing exported log files over a shared network environment.

Designing logs is accomplished by dragging and dropping graphical objects and text onto a preview screen that displays the log exactly as it will appear on the printer. Oil Quest automatically retrieves the latest data from the DLS online database while plotting the log to the screen.

To the right is a screenshot of the Oil Quest software displaying the toolbars, top design pane and bottom preview pane.

Log Features:

Data

- Log data linked to DLS database
- Line objects to database records, files or even Internet URL's
- Insert pictures or graphs in the header or log body
- Fill between any two curves
- Unlimited number of tracks
- Select database files or calculated files for track data
- Choose curve type, pint to point or stair step
- Linear and logarithmic scales
- Versatile curve wrapping

- Custom line styles and fill patterns
- Data types include lines, histograms, symbols, lithology, static text, dynamic text and picture
- Import and plot data from 3rd party sources such as Wireline or MWD services
- Plot data from multiple wells on a single log
- Create distinct log formats with common data associated with tracks. No need to duplicate such as text or symbols that are common in two or more logs.

Format

- Versatile log design, virtually any type of log may be created
- Print preview while editing and viewing logs
- Automatically generate TVD logs
- Select any log scale and depth units
- Automatically adjusts data objects such as symbol position and text size so log prints perfect
- Create an unlimited variety of custom lithology patterns and symbols including background

Export

- GeoView log viewer software for viewing and printing logs
- Export to optimized log file format (mdr) or common graphics formats (wmf, emf, I
- View and print logs on windows 2000/XP computers printing
- Print logs to all printers that support window

ENHANCED SERVICES

The Cutting Flow Meter (CFM)

“Taking the guesswork out of hole cleaning”

We have developed a service where direct measurement and analysis of the cuttings flow provides valuable information for drilling optimisation. The cuttings falling off the shakers are continuously measured and a volume calculation is made. This service allows drillers to:

Maximize ROP while still ensuring correct hole cleaning

Minimize off-bottom time while still ensuring correct hole cleaning

OTHER APPLICATIONS AND ADVANTAGES INCLUDE:

- Finding optimal string rotation for good cleaning and minimal string fatigue
- Evaluating the relation between torque and drag and % cuttings left in hole
- Assessing risk situations (annulus packing off)
- Monitoring the recovered Volume of dry or wet cuttings
- Monitor the volume of mud lost with cuttings (Coating effect)
- Knowing when at least 90% of what has been drilled has been recovered on surface
- Real-time control of volume/weight of cuttings for environmental treatment
- Monitoring the volume or weight of cuttings left in hole
- Determining the critical angle of accumulation
- Evaluating optimal hook movement for efficient cleaning
- Quantifying returns due to Lovis/Hivis pills

PREVIEW PORE PRESSURE PREDICTION SERVICE

Preview is a new service, which makes use of the extensive mud logging and drilling experience of our engineers to give our clients the critical pore pressure information, which will enable them to:

- Optimize their casing programs
- Avoid costly stuck pipe incidents
- Prevent formation damage
- Minimize their drilling risks

THE ESSENTIAL COMPONENTS OF THE PREVIEW SERVICE ARE:

- Very Experienced pore pressure Engineers with a strong mud logging background
- Reliable data and high quality control of all data being used in the evaluation
- Specialized software from **Petrospec Technologies** which allows full integration of mud logging & LWD data; and the real-time display of calculated pore pressure, Overburden Gradient, Mud Weight, and Fracture Gradient
- Excellent Communication with Rig Crew, Drilling Supervisors and Onshore Support Staff
- Close Cooperation between the Oil Quest engineers and LWD and Mud Contractor

THE KEY TO OIL QUEST' SUCCESS IS THE QUALITY OF OUR PORE PRESSURE ENGINEERS

Oil Quest extensive experience on HPHT drilling projects has confirmed that correct use of specialized software and the consideration and analysis of all information during drilling requires the full attention of a specialized engineer.

Our Engineers:

- Are highly experience(10+ years in HPHT drilling environments)

- Have extensive training in geopressure and well control
- Work closely with the client project team in pre-drill planning,
- Have in depth knowledge of gas and fluid behavior in overpressure formations
- Effectively communicate across all drilling disciplines

PRECISION HYDROCARBON EVALUATION

There is often a clear connection between hydrocarbon shows, surface gas composition and pore pressure. As a result Oil Quest strongly recommended to use the highest possible level of gas measurement in situations where pressure problems are anticipated. **The ReservalTM service** will give you the Reliability, Repeatability and Quality Gas Analysis you require.

EARLY KICK DETECTION

For high risk wells Oil Quest also offers an Early Kick Detection system ALS-K (see next section below). This system has been validate at the Shell test facility in Holland and proven itself operationally in the North Sea, Latin America and South East Asia.

A DRILLER-FRIENDLY KICK DETECTION SYSTEM WHICH RESPONDS TO SMALL VOLUME INFLUXES (ALS-K)

Responding to a need

In recent year a need has developed for a kick detection system with increased sensitively. The basic system widely used in the industry relies primarily on a simple mudflow paddle- type measurement of relative flow rate, in combination with changes in surface mud volume.

The practical lower limit of detection for the above systems is about 1.5 m³ (10 bbl) of gain during drilling; some-what less during tripping, and several minutes are usually required to identify a well control event and initial shut-in procedures.

Minimizing kick volume is critical, requiring rapid detection through accurate measurement of differential flow rates (flow IN vs. flow OUT). With a detection threshold of 1001/min (less than 1bbl/min), and minimal response time.

When Oil Quest first decided to design this new kind of kick detector it determined that four criteria were fundamental to meeting the foregoing needs:

- The detector must be sensitive to small flow increase (less than 1001/min).
- It must decide automatically and virtually instantly whether the flow increase signals a kick, or result from normal events such as mud displacement during tripping, disconnecting pipe and pump shutdown / startup.
- The hardware must be compact, rugged, and easy to install and configure for operation
- Signals must be quickly and easily interpretable on the rig floor to allowing the operator to take immediate action.

The result that we came up with fulfils the criteria and can be installed as part of an existing suite of mud logging sensors. Using sensitive flow meters and software based on the electronic fingerprints of normal flow rate changes, ALS-K senses small changes in mud flow volume, identifies those that signal a kick, and then alerts the driller. In general electromagnetic flow meters are used with water-based mud system, while coriolis-type meters are used with oil-based systems.

EARLY VIBRATION EVALUATION (ALS-EVE) WARNS OF POTENTIAL VIBRATION-RELATED DRILLING PROBLEMS

Oil Quest developed a new approach for the detection of vibration generated down hole. It consists of estimating the drill bit behavior through the exclusive use of surface measurements, with the use of a model which simulates the drill string

vibrations. To avoid any divergence between the results from the model and what can be measured on the rig floor, the model is continuously fine-tuned.

This is achieved through the comparison of some of its outputs with the corresponding surface measurements. This process leads to an estimation of the drill bit instantaneous rotation speed or the weight on bit in order to assess any vibrations occurring down hole. By estimating the bit behavior, it is possible to design alarms which will react as soon as abnormal vibration of the bit begins. In this way the driller receive early warning and can take the corrective action necessary to halt the vibrations before they reach tool high a level.

The system is based on a standard PC equipped with a fast acquisition board. Four channels are acquired at high speed: weight on Hook (WHO), Torque (TRQ), RPM and injection pressure (SPP). Each channel can be scanned and stored at 100 Hz.

Before starting the ALS-EVE the operator has to run a pre-processor to initialize the real time model. The data needed to run the pre-processor are the drill string description (length, internal and external diameter of the main components) and the mean WOB and RPM. A comprehensive window helps to enter these data, then the model is computed before starting the estimator.

TECHNICAL DATA SHEET

The Autocalcimeter measures the amount of calcium carbonate and/or magnesium carbonate in rock samples.

- Portable, rapidly installed and easy to use
- Data management system stores over 800measurements
- Stand-alone or connectable to a data acquisition system
- Rechargeable internal power supply for up to 40 hours of operation

- Automatic or manual sample weight entry

DESCRIPTION

The autocalcimeter measures and records the amount of carbonates contained in rock samples and can quantify:

- Calcite CaCO_3
- Dolomite $\text{CaMg}(\text{CO}_3)_2$

The system consists of the Autocalcimeter, an electronic balance (accuracy 0.01 gram) and a printer. The printer can be a shared ALS printer or any other printer in common use.

Weighing the rock sample can be carried out directly by the Autocalcimeter when the specific balance is connected.

A built in sensor (0 – 5 bar) records the pressure increase resulting from the production of carbon dioxide (CO_2).

The microprocessor-controlled programme calculates the percentage of carbonates contained in rock samples according to the pressure, corrected for the sample weigh.

Calcimetry measurements can be stored in memory and output by a printer. The Autocalcimeter can also be connected to the ALS system using an RS 232 cable to transfer calcimeter data into the main database for automatic update of the Masterlog.

OPERATING PRINCIPLE

The carbonate content of a rock sample is determined from the carbon dioxide (CO₂) liberated during a chemical reaction between a known quantity of the sample and hydrochloric acid.

Reaction occurs in a constant volume cell, where any CO₂ pressure rise versus time is recorded (automatically up to 15 minutes per analysis), allowing identification of the carbonate percentage. The monitoring process is not dependent on variations in atmospheric pressure and is temperature compensated. This technique is far more precise than measurement of CO₂ volume, as performed with conventional equipment.

The Autocalcimeter can store more than 800 individual measurements, with the additional possibility of output to another data acquisition system (such as Oil Quest ALS logging systems) via a standard RS-232 serial port.

INSTALLATION AND OPERATION

The Autocalcimeter installs easily in a few second and requires only removal of the protective cove, positioning of the arm containing the sample chamber and connection to the power supply.

The system can be set up in any reasonably clean, dry location that is not subject to severe vibration.

Three configurations are possible:

- Autonomous and portable (battery + charger included);
- In a laboratory, with printer + mains power supply;
- Integrated with an ALS system.

DISPLAY AND OUTPUT

The operator can follow the progress of each measurement via the built-in monochrome screen. The measurements can also be output via a dedicated printer, or routed to the mud logging data acquisition system for inclusion on the Masterlog.

SPECIFICATIONS

Memory capacity	More than 800 calcimetry measurements
Sample weight compensation	Between 0.90 and 1.10g
Accuracy	1 %
Working temperature range	0.1 %
Maximum sensor pressure	0 – 50 ⁰ C
Languages	English, French, Spanish, Italian, German

TECHNICAL DATA

Power supply	220 VAC
Battery back-up life	40 hours
Battery recharging	10 hours
Internal memory	EEPOM 256 kBits
H x W x D	240 x 270 x 300mm (9.4”x 10.6” x 11.8”)
Weight	11 kg (24 lbs)
Pressure sensor (with temp. compensation)	0 – 5 bar (relative)
Front panel protection	Water resistant
Display pixels)	Graphic monochrome LCD (240x320
Materials	Frame: Stainless steel
	Display: Lexan
	Reaction chamber: Altuglas

WHY USE MUD.LOG?

Easy to Learn and to Use

- Whether you are an experienced computer user or not, you can master using MUD.LOG in under half an hour.
- If you are familiar with other Windows programs, you will be off and running in minutes.

Saves Drafting Time

Draft 100s of feet or more per hour, including ROP and Gas data, lithology and other symbols, engineering and geological description, porosities, and grain sizes.

High-Quality Output

- Clear, precise, professional quality printed strip logs.
- Complete header information for the well, the operator, the geologist, cores, DSTs.
- Easy to reprint or make corrections.

Affordable

Whether you are an independent field geologist or a major exploration company, you will quickly recover your investment in MUD.LOG. See current pricing.

EASY USER INTERFACE

- WYSIWYG (what you see is what you get) – you work directly on the strip log as it appears when printed.
- Change the dept range or log scale at anytime.
- Scroll to any depth or go directly to a specific depth.
- Zoom in or out to see more detail or more of your log.
- Color or monochrome monitors are supported.

LOG TYPES

- Use either feet or meter for depth.
- Several drafting scales for both well logs and core logs.

ROP, GAS, GAMMA, AND OTHER DATA

- Two data curve tracks can display up to seven data curves each.
- Each curve's name and unit can be customized. For example, you could have ROP (min/ft), Gas (%), and Gamma (API).
- Each curve can be logged at its own data step. For example, OP and Gas could be logged at 1 M steps, and Gamma could be logged at fifths of meters.
- Enter curve data quickly using a spreadsheet dialog. The data values are plotted and you enter them.
- Alternatively, import curve data instantly from gas loggers or other sources in Logged ASCII Standard (LAS) or plain ASCII files.
- Customize each curve's appearance: color, line style, etc.
- Change data scales as needed at any depth.

LITHOLOGY, ACCESSORY AND OTHER SYMBOLS

- Add and move symbols with a click of the mouse.
- Supports a complete set of industry standard symbols, including: major rock type, fossils, minerals, stringers, textures, porosity types, sorting, rounding, and oil shelve.
- Where the standard symbols provided do not met your requirements, you can change and add new symbols.

GEOLOGICAL DESCRIPTIONS AND ENGINEERING DATA

- Import or export all geological descriptions in one step – abbreviating or expanding terms automatically.

- Geological descriptions and engineering data can be added and moved to any depth, just double-click where you want the text and start typing.
- Assisted description mode allows you to enter descriptions quickly and flexibly on lithology intervals.
- Use cut, copy, and paste to quickly copy text to or from your word processor.
- Choose from three font sizes.

POROSITY AND GRAIN SIZE

- Set the porosity or grain sizes for one depth or a range of depths with one click and drag of the mouse.
- Set individual grain sizes independently.

QUICK INFORMATION BAR

- Continuously displays the depth and the name of the track under the mouse cursor.
- Displays the current font size or symbol type for that track
- Prompts remind you how to use each track.

PRINTING

- All Windows raster printers are supported – color or monochrome.
- Print any depth range of the log, and, optionally, the log header, the symbol legend and/or track headings.
- Logs can be printed at various standard scales.
 - Well logs: 1:240, 1:480, 1:600, 1:200, 1:500.
 - Core logs: 1:480, 1:50.