Robertson Geo regional trainer at work in Gujarat

New customised logging unit to aid coal resource investigations

Additional 1200ft (366m) lock development at the Kentucky Dam

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GLOBAL GEODATA NEWS

ISSUE 10 | WINTER 2020

Training and customised logging vehicles for

INDIA & VIETNAM

On-site Manchester England

Registered trade mark granted

PS LOGGER®

"Wherever we need to go..."

Using a tracked metal access to the rural borehole drilling site, one of the fleet of service logging vehicle on site. Robertson Geo Services teams arrive fully equipped with subsurface tools and surface deployment and data acquisition equipment.

For more see page 8

Windfarms in Europe and USA

BUSY TIMES OFFSHORE

Ground Characterisation Project in

LEEDS, ENGLAND

INSIDE:
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Maintenance and monitoring of boreholes

Probes that provide data to assist with cost and time effective maintenance

EDITORIAL

ROBERTSON GEO

Unlocking Your GeoData

Throughout these challenging times we are Open for Business observing all Safety guidelines to get the job done

Working safely during the Coronavirus pandemic has been challenging for everyone. Here at Robertson Geo Services we would like to take this opportunity to assure our customers that we continue to follow all accepted guidelines and regulations in the ongoing safe conduct of our work.

Travelling regularly to remote sites, it's our responsibility to adhere to the prevailing rules and regulations for each site we visit. In addition, we have our own Coronavirus guidelines and we have adopted social distancing, hand sanitising and the wearing of masks as routine both in and out of the workplace environment. Changes to government guidelines, local lockdowns and overseas travel rules mean that the assessment of risk is a continuous process that we all have to adopt to work as safely as possible.

Our Service teams continue to provide quality geophysical investigation and evaluation projects both in the UK and overseas and we are working hard to provide both local trainers to commission equipment and online training for customers, our global agents and regional managers continue to support the Robertson Geo commitment to get the job done – with Safety being the key.

Graham Comber
Logging Services Manager
RGeo-Services.com

Robertson Geo has for evaluation and investigation, recently supplied two self-contained truck mounted 1000m water well systems to the Gujarat Water Supply & Sewerage Board (GWSSB), India.

Prashant Guar is Robertson Geo's regional trainer at work in Gujarat, India

THE LOCAL VEHICLE installation and training/commissioning was handled by the exclusive representative M/S. AIMIL Ltd - www.robertson-geo.com/aimil/

GWSSB is a statutory body set up by the State Government for Development, Regulation and Control of the drinking water sector in the State. The Robertson Geo systems will be used in the development of the rural water supply systems including installation of hand pumps, mini water supply system, etc. in small habitations and piped water supply system for individual villages including large water supply system covering several villages.

Gujarat has been facing acute drinking water scarcity due to recurrent droughts, low rainfall and skewed distribution pattern. Almost two-thirds of the state had either been facing water availability issues or quality problems. The Government of Gujarat focused attention to provide long term solutions by investing in water supply infrastructure based on sustainable sources to achieve water security.

Training & commissioning was provided by Robertson Geo's regional trainer Mr. Prashant Guar who has over 10 years' experience commissioning and servicing geophysical equipment in India. Over half a dozen GWSSB staff attended the onsite training which included logging a local borehole with a 2,000m winch and Electric Log.

"Borehole logging is proven to be the most cost effective methodology of characterising the construction, performance and sustainability of water wells. Robertson Geo technologies deliver reliable, calibrated quality data for exploration, to locate water tables or perched water bodies, to characterise aquifers and aquitards, to establish potential water yields and for evaluation of new water wells to check the grout integrity behind the casing, to measure borehole depth, dimensions and verticality and to provide permanent records for monitoring studies."

Mr. Prashant Guar

Final testing and commissioning of the fitted out new logging vehicle for Vite.

With the demand for coal to serve the development of national industry increasing, Vietnam National Coal - Mineral Industries Group (Vinacomin) are committed to increasing the investigation and evaluation of coal resources and to develop and increase capacity of more underground mines to meet the needs of the ever growing Vietnam Coal industry.

New customised logging unit to aid coal resource investigations in **Vietnam**

FOR OVER 25 years, Robertson Geo has been supplying Vinacomin with its borehole logging technology. In November 2020 it supplied the latest truck mounted borehole logging station to an affiliate company of Vinacomin named "Vinacomin Informatics, Technology, Environment Joint Stock Company (Vite)".

The market leading company within the role of establishing the coal reserves, feasibility studies and exploration reports for many of the Vinacomin coal mines, Vite has an average volume of drilling of around 60,000m per year. This high working volume requires the company to have its own self-contained mobile borehole logging station to fulfil its burgeoning exploration programme. Vite chose Robertson Geo based on the successful and long standing relationship serving the exploration activities of Vinacomin.

The mobile logging unit was installed locally by Robertson Geo regional agent THT International Co., Ltd into a custom built Ford Ranger Wildtrak Vehicle. The logging system comprising of a Micrologger2 surface interface with supporting Winlogger software to provide on-site data capture and a 2,000m wireline surface deployment winch; all to support the application of sidewall density, focussed electric and verticality probes.

The Quang Ninh Coal basin in Northern Vietnam covers an area about 1,000 km^2, within Quang Ninh province and part of Hai Duong province. Coal reserves are nearly 6 billion tons, of which 3.5 billion tons are found up to a depth of 300m. The coal is mainly anthracite of high calorific value with the coal-bearing deposits being shale, sandstone and conglomerate of upper Triassic age.

There are over 52 coal seams of industrial value; many of them have thickness ranging up to 17-64m which includes a number of open pit mines of a capacity of over one million tons per year.

The exploitation of coal in Quang Ninh started as far back as 1888 and today the open pit mines reserve has been reduced considerably. The further exploitation of coal reserves will be driven underground with the objectives of establishing a number of coal mines with capacities of up to 500,000 tons per year.

Highly mobile and completely ready to go - the custom installed interior of the new logging vehicle with full surface deployment and acquisition equipment to deploy its range of Robertson Geo subsurface borehole probes for data acquisition.

On site in Kentucky: the Robertson Geo mini winch is flexible and highly mobile for deployment of wireline subsurface borehole probes for data collection, real time data is viewable through Robertson Geo-CAD® acquisition software.

Additional 1200ft (366m) lock development at the **Kentucky Dam**

THE KENTUCKY LOCK and Dam is located on the Tennessee River near Grand Rivers, Kentucky.

The 184-mile reservoir is the largest in the Eastern United States and spans across parts of Kentucky and Tennessee. Its existing navigation lock is 600ft (183m) long and the addition of a new landward navigation lock of 1,200ft (366m) increases the economic capabilities to commercially use the river for transport and commerce.

The United States Army Corps of Engineers has commissioned Robertson Geo customer Coastal Drilling as the geotechnical subcontractor tasked with acquiring borehole data of subsurface rock consistency and structure for the installation of rock anchors, and the investigation of foundation grouting along the existing lock chamber.

Coastal Drilling has deployed the High Resolution Optical Televiewer (Hi-OPTV) geophysical probe to map out subsurface features. The primary evaluation is the structural integrity for the bonding materials used for over one hundred high capacity rock anchors and a grout curtain to stabilize the rock of the existing lock, essential for the excavation phase for the new lock chamber.

Robertson Geo's High Resolution Optical Televiewer probe was the preferred tool for investigation for its capability to collect 360 degrees of high resolution full colour borehole imagery, oriented to magnetic north. The Hi-OPTV collects real-time data that is viewable during the survey and can be presented and interpreted as a strip log if decisions are needed to be made on site using the data acquisition software - Robertson Geo-CAD®.

Geo-CAD® offers fracture analysis, rose diagrams, and steronets derived from the image in post processing. The user has the ability to populate sinusoids over selected features based on their dip and direction with the image and fractures oriented to magnetic north which aids when determining their dip angle or azimuth.

The deployment and evaluation of the site characterisation data from Robertson Geo's Hi-OPTV is being used in a critical role for the geophysical evaluation for the planning and construction of the new 1,200ft (366m) lock addition at the Kentucky Dam.

Construction work in progress at the Kentucky Dam.

MAINTENANCE AND MONITORING OF BOREHOLES

As a specialised wireline logging company **Robertson Geo** offers a variety of probes which are routinely deployed to provide data to assist owners with cost and time effective maintenance of boreholes.

Robertson Geo has a fleet of service logging vehicles fully customised and comprehensively equipped with subsurface data acquisition and surface winch deployment equipment; ready to go whatever the location or application.

MAINTENANCE AND MONITORING OF BOREHOLES

Boreholes are drilled for many reasons, for the purposes of this discussion they can be divided into either temporary or permanent, the latter meaning they have a working life.

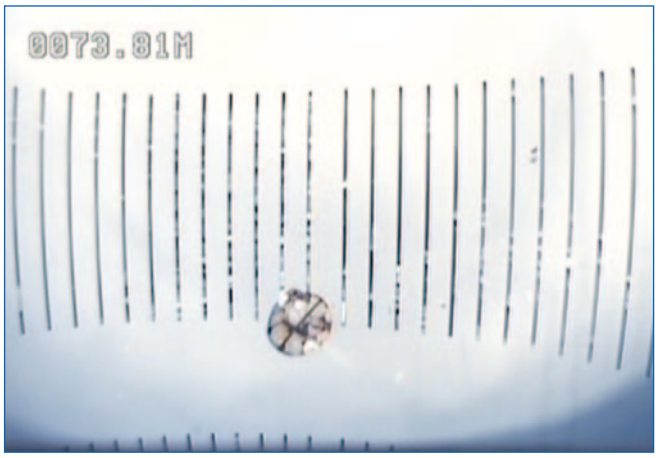
Temporary boreholes, for geotechnical or mineral exploration are drilled to extract specific information, after which they are often filled in and abandoned, although in some cases they may be cased and have instrumentation installed for continuous measures of water level as an example. Oil and natural gas boreholes with their sophisticated designs and techniques are a specialist area; it is the permanent groundwater filled boreholes, which have a working life and by necessity are monitored and maintained, that will be discussed here.

The starting point for the borehole inspections is invariably a visual image. Downhole cameras provide indisputable evidence of borehole condition. Downward and side-facing cameras and more recently fish-eye cameras such as Robertson's RGeo-Eye® provide depth referenced video images of the borehole/casing condition. For boreholes up to 12" diameter optical and acoustic televiewers offer an alternative high resolution unwrapped oriented image of the borehole wall. Where the water is cloudy or opaque only the acoustic televiewer will work as it provides a pseudo-colour image based on high frequency sound rather than light. Images obtained by these means form an integral part of the historical record of the borehole which cannot be achieved by any other means.

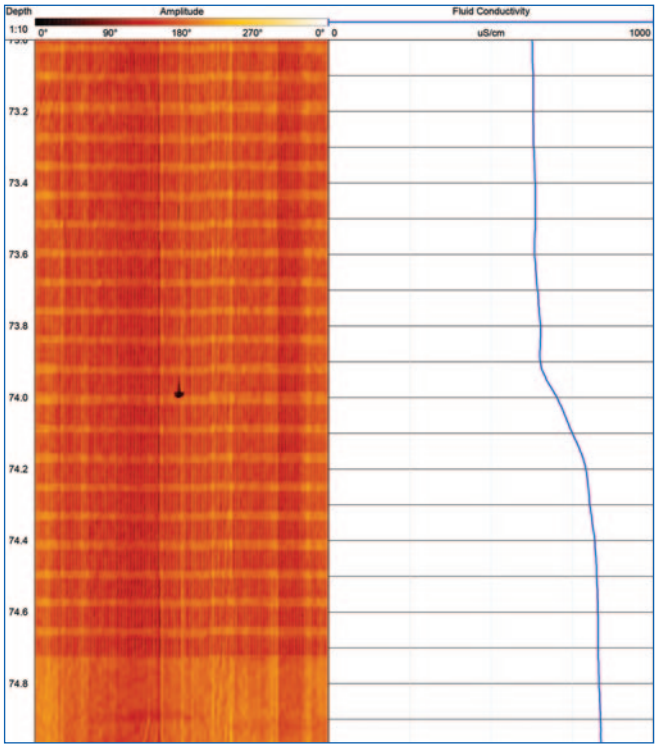
In conjunction with a visual image, caliper logs are also routinely employed to provide millimetrically accurate diameter measurement to quantify borehole breakout and casing anomalies. The Robertson Geo 3-Arm Caliper gives a single diameter and the Borehole Geometry probe uses two pairs of arms which can provide additional information on any ovalisation present.

In many boreholes solid casing is grouted in to isolate sections of the borehole column to ensure not only stability but to avoid intrusion by surface water contaminants. Cement bond logs from a Full Waveform Sonic probe are traditionally used to investigate the condition of grouting around steel casing, the interpretation of which is well established from the oil industry. However, where solid PVC casing is grouted in, the cement bond log will still give results which can give indications of loss of casing integrity.

For boreholes that are open or with perforated casing it is often important to investigate the characteristics of

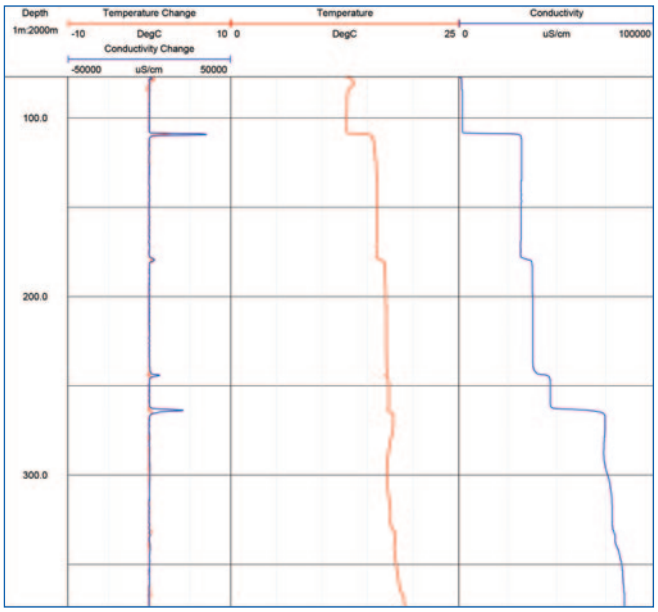


Downhole camera image showing break in perforated PVC casing.



Acoustic televiewer image of same break in perforated PVC casing.

the water column. For pumped boreholes, advantage can be taken when the pump and filters are removed for routine maintenance whereby the water column can settle allowing measurements of the static conditions. A Temperature/Conductivity probe gives highly sensitive logs which can exhibit step changes in temperature or fluid conductivity indicating potential inflow and outflow regions. As boreholes can effectively connect different



Temperature conductivity log showing step changes with depth.

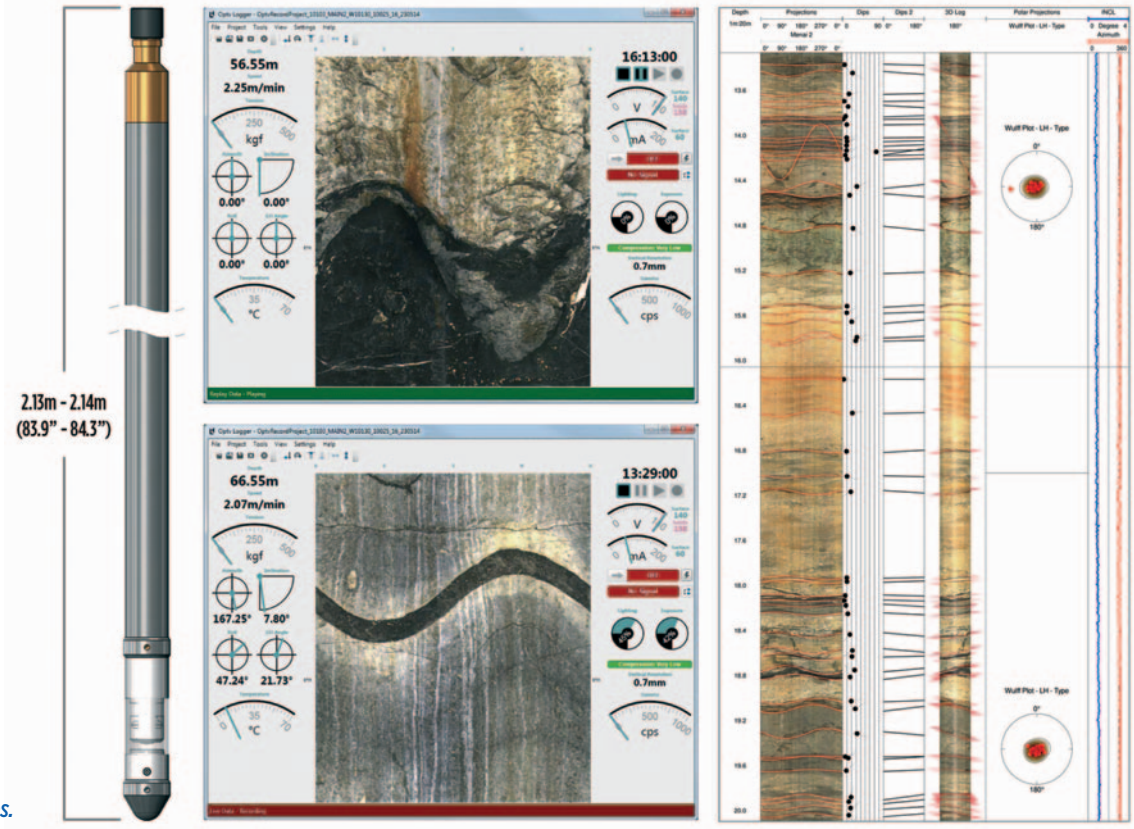
strata vertically where previously there was no connection there may be flows between layers. To quantify these flows, probes can be deployed to measure flow rates. For significant flows an Impeller Flowmeter such as the Robertson High Resolution Flowmeter can be used. For smaller flows a Heat Pulse Flowmeter, which collects data statically, can be used, targeted around areas identified by the Temperature/Conductivity logs. Where the water column is stratified, sealed samples for laboratory analysis can be extracted at specific depths using a Water Sampler probe.

Although not strictly maintenance, information for casing design and pump deployment can be obtained

> *"The starting point for the borehole inspections is invariably a visual image. Downhole cameras provide indisputable evidence of borehole condition... Images obtained by these means form an integral part of the historical record of the borehole which cannot be achieved by any other means."*

by measuring the hydrogeological characteristics of the surrounding strata. Electric and Focussed Electric logs measure formation resistivity and conductivity while the Dual Neutron probe measures porosity. Most recently Robertson Geo have partnered with Vista Clara to deploy the Javelin Nuclear Magnetic Resonance probe which provides detailed information on porosity, water content distribution and permeability, using multiple depths of investigation.

The industry sector that most commonly requires regular monitoring is the water industry. Water service companies that abstract potable water for public consumption are responsible for the water quality and the continuance of supply. In addition to the extensive continuous monitoring of water quality, when the well is offline it presents a good opportunity to conduct a detailed investigation. This invariably means that a visual image is taken and casing integrity checked and can also include water level checks, characterisation of the static water column for pump placement, measurement of static flow rates, collection of samples from specific depths and identification of any biological build up. Apart from routine maintenance these investigations



High Resolution Optical Televiewer (Hi-OPTV) probe with data examples.

Table showing probes commonly used for borehole monitoring with outputs and typical data benefits:

Probe	Outputs	Benefit
CCTV Camera	Down and side facing video	Video image record
RGeo-Eye® camera	Fish eye view video	Small diameter
High Resolution Optical Televiewer	Unwrapped borehole image	Highest resolution
High Resolution Acoustic Televiewer	Unwrapped borehole image	Works in cloudy water
3-Arm Caliper	Diameter	Highlights anomalies
Borehole Geometry	X and Y diameters	Shows ovalisation
Temperature/Conductivity	Temperature/Conductivity	Shows ingress/egress
Hi-Res Impeller Flowmeter	Flowrate	For large flowrates
Heat Pulse Flowmeter	Flowrate	For small flowrates
Water Sampler	Samples	For laboratory analysis
Cement Bond Log	Amplitude	Grouting integrity
Electric Log	Formation resistivity	Resistivity profile
Focussed Electric Log	Formation conductivity	Conductivity profile
Dual Neutron	Porosity	Formation porosity profile
Nuclear Magnetic Resonance	Water content distribution	Permeability profile

may also be triggered by diminished abstraction rates or the need to upgrade pumps and filters to meet increased demand.

For water bottling companies, soft drinks manufacturers and breweries a continual supply of high quality water is also required. Water is extracted from specific aquifers which have a desirable level of trace elements within them and casing integrity is vital to ensure that only water from the chosen aquifer is abstracted.

Other industries which by necessity consume large volume of water can potentially benefit from having in-house water supply boreholes with appropriate inspection and maintenance programmes.

Underground mine workings once abandoned are often left to flood with groundwater and contaminants from the disused mine can leach into groundwater supplies if not managed. This is of obvious concern when the ores removed included heavy/dangerous metals. Pumping stations may be set up to abstract water from boreholes drilled into the mine workings to avoid contamination and these require regular borehole monitoring inspection.

The last remaining deep coal mine in the UK was closed in 2015 leaving a legacy of deep mine workings which were allowed to flood. These remaining shafts still require routine inspection both for structural integrity and to monitor the water column. Camera surveys, water sample collection and temperature conductivity logs are regularly undertaken by the custodians.

The old deep coal mines, although abandoned for mineral extraction, have enjoyed a new lease of life by companies extracting methane for small scale power generation purposes. Boreholes leading down to the interconnected mine networks need routine inspection usually involving a camera survey to ensure a regular methane supply. An exciting further development of these structures could involve the extraction of geothermal energy from the deepest mines.

With all probes capable of being deployed from a single vehicle set up, down to depths in excess of 1,000m, Robertson Geo provides calibrated data sets which inform the borehole owners of the historical condition of their boreholes. Whatever the legal requirements are the benefits of having such documented records over time cannot be overstated.

More info can be found at www.rgeo-services.com

BUSY TIMES OFFSHORE

Robertson Geo has extensive international experience as a specialist provider of services and equipment to the renewable energy markets with a proven results-based record of reliability in securing the highest quality subsurface calibrated data from both on-shore and with systems suitable for heave compensated drill ships or jack-up rigs from the harshest of offshore locations.

This has been a busy time for Robertson Geo's offshore logging engineers with continuous work at wind farm projects both around the UK waters and the USA.

Coastal Virginia Offshore Wind (CVOW), US

THE CVOW PROJECT is currently the second offshore wind project in the US and is the first project to be installed in federal waters under the Bureau of Ocean Energy Management (BOEM) process.

The project proposal is a three-phase deployment of approximately 880 MW each, with the total capacity of 2640 MW in the commercial lease area. This would make it the largest single offshore wind project in the United States and aims to generate enough clean energy to supply power to 650,000 households at peak wind.

Pending approval, this wind project is scheduled to being construction in 2024 and be completed by 2026. The exact number of wind turbines being deployed is subject to design layout and site conditions but is estimated at 180 turbines. Norfolk, Virginia – 27 miles off the coast of Virginia Beach, site spanning 2135 acres.

The Robertson Geo PS Logger®, 2,000m marine winch, Micrologger 2 and winch controller units were used on this project. Boreholes were logged between the depths of 90m to 120m.

The PS Logger® is a static tool which takes shots at designated depths in order to measure the P and S wave velocities at each targeted depth. Where the ground conditions were deemed stable by the on-board engineers and drillers, data was collected at half meter intervals. In zones of potential instability data was collected at one meter intervals, with sands and clays being predominant across the site. This equipment was deployed from the Geoquip Marine vessel, the 'Dina Polaris' for the initial boreholes. Following which the Robertson Geo engineer was transferred to a second vessel, the 'Saentis' where the remaining boreholes were logged. This was done using a similar system of Robertson Geo equipment, previously purchased by Geoquip Marine.

BUSY TIMES **OFFSHORE**

Hornsea Two Windfarm, Yorkshire, UK

DUE TO BE fully operational in 2022, Hornsea Two will span an offshore area of 462km^2.

Its location is 89 km off the Yorkshire Coast in the North Sea, its proposed 165 Siemens Gamesa 8mw turbines will have the capacity of 1.4GW providing power to well over 1.3 million homes.

Field logging operations were conducted with the winch mounted under the rooster box. The Robertson Geo marine winch remained in this position throughout this phase of the project. Three Arm Caliper, High Resolution Acoustic Televiewer, PS Logger® and Formation Density probes were successfully deployed at multiple locations for sea bed investigation.

Atlantic Shores Offshore Wind, US

ATLANTIC SHORES OFFSHORE Wind is a joint venture between Shell New Energies and EDF Renewables.

The lease area has the potential to produce 2500MW of clean, renewable energy to residents across the mid-Atlantic Coats, enough to power nearly one million homes.

The ocean survey and buoy deployment has begun in 2020, with the expectations of delivering electricity by 2026.

The project is located on the US Outer Continental Shelf within the New Jersey Wind Energy Area – 10 to 20 miles off the coast of New Jersey between Atlantic City and Barnegat Light, strategically positioned to provide energy to both New Jersey and New York.

Robertson Geo engineers were deployed onto the 'Saentis', a drillship owned by Geoquip Marine. The engineers ran a PS Logger® and 2,000m marine winch system owned by Geoquip Marine but purchased from and manufactured by Robertson Geo. Seismic CPT and PS Logging were conducted on various boreholes, up to the targeted depth of 80m.

Due to the current pandemic, Covid-19 tests and isolation after testing, were conducted on each individual who was to embark on the ship. Daily temperature checks were also carried out while on-board the vessel and rapid Covid tests were made available on the ship should there be any potential suspected cases.

The versatile 2000m marine winch comes on board the Saentis to deploy subsurface probes at Atlantic Shores.

Ground Characterisation Project in Leeds, England

High Resolution Optical and Acoustic Televiewers were used in a ground characterisation project to replace an existing city centre commercial building with a twenty eight storey student residence. The biggest logistical problem for this Robertson Geo Logging team being the limited amount of space as one of the boreholes was close to a pedestrian walkway, another was on the side of a very busy street with trees in the way.

Registered Trade Mark granted for the Robertson Geo industry reference technology...

THE PS LOGGER® GEOPHYSICAL PROBE

NO ONE HAS more experience of the capabilities of the PS Logger® probe. Robertson Geo has been part of its innovation, development and manufacture from the start since 1979. Today it is routinely deployed for major civil engineering and offshore projects as the industry reference go to probe for determination of soil and rock strength.

The PS Logger® is a full waveform acoustic probe, designed to measure compressional and shear wave velocities in soils and rock formations. It operates using indirect excitation rather than mode conversion as in a conventional sonic. It is capable of acquiring high resolution P and S wave data in borehole depths of up to 500m.

- Site investigation – foundation studies, windfarms, offshore structures, dam safety
- Physical properties of soil/rock – shear modulus, bulk modulus, compressibility and Poission's ratio Earthquake engineering – characterization of strong motion sites
- Velocity control for seismic reflection surveys

Two new dedicated sites completed

The groundbreaking downhole camera **RGeo-eye®** system now has its own site; seeing is truly believing on **www.rgeo-eye.com**

The industry reference technology for high resolution seismic measurements up to a 500m depth from a single borehole, that's the **PS Logger®** and to celebrate the granting of Trade Mark status newly granted to Robertson Geo we have created its own site for this important geophysical tool on **www.pslogger.com**

Robertson Geo YouTube Channel

See our YouTube channel for product videos, tutorial and workbox videos and downhole video capture from our RGeo-eye® system.

Check out our new Robertson Geo YouTube channel.

ON-SITE FOR HUGE RAIL PROJECT Manchester, England

THE HS2 HIGH speed rail project remains one of Europe's biggest construction developments.

From inception Robertson Geo has provided important geophysical ground characterisation at each stage of the development. As part of this continuing commitment, work has started on Phase 2b near the market town of Knutsford, Cheshire just south of Manchester, England.

This section of works requires a large suite of tools from optical and acoustic televiewers, a dual-axis caliper and gamma probe, formation conductivity, resistivity and density, fluid temperature, conductivity and flow, full wave sonic and PS Logger® probes to gain the subsurface data of the ground conditions.

Access to the rural drilling site was available via the track-matted surface surrounds and with such a large suite of tools. Robertson Geo utilised one of its fleet of purpose built long wheelbase logging vehicles, deploying the subsurface probes via the 2,000m winch. Data was captured on-site by the Micrologger2 surface interface supported by Winlogger, the user friendly MS Windows based operating system providing the field data acquisition capability.

This part of the project is ongoing and to date Robertson Geo has successfully logged twenty boreholes on this stretch of the development providing vital geotechnical data for use in the design process for the HS2 development.

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