



**Government of the Republic of Trinidad and Tobago
Ministry of Energy and Energy Industries**

FEATURE ADDRESS

BY

THE HONOURABLE MINISTER

OF ENERGY AND ENERGY INDUSTRIES

ON THE OCCASION OF

THE SEG'S WORKSHOP ENTITLED

ADVANCES IN MARINE SEISMIC TECHNOLOGY

November 11, 2019

Hyatt Regency

Port of Spain

Good Morning and welcome to the opening of the Society of Exploration Geophysicists' (SEG) workshop, *Advances in Marine Seismic Technology*. I stand before you this morning with the great privilege of presenting the feature address for the first SEG workshop to be held in the Caribbean Region. Hopefully, this event marks the first of many workshops that will be hosted in Trinidad and Tobago (T&T).

I expect that this event would attract vast amounts of interest, which it rightly deserves, as it invites a wide cadre of industry experts to share the expanse of research done and be exposed to new and improved technologies available for acquisition, processing and interpretation of seismic data. The world around us is changing every day, as is technology and it is during events such as these, that the opportunity arises for various groups to join together to learn, to share and to apply the knowledge gained to improve the Oil and Gas Sector. I have an immense appreciation for forums such as these since they fuel the necessary discussions required to advance sub-surface technologies.

We, at the Ministry of Energy and Energy Industries (MEEI), of the Republic of Trinidad and Tobago believe that the leveraging and application of advancing technologies can only be beneficial to our Oil and Gas Sector and by extension, our country. Since 1930, T&T has seen

the implementation of geophysical surveys as a means of de-risking our oil and gas prospects. We, the Ministry, have supported the use of geophysical techniques in the continued development of the sector by approving and regulating the conduct of several shallow and deep marine seismic surveys across the many Blocks.

Ocean Bottom Nodes (OBN) Seismic Surveys

Since 2016, our Ministry has approved and regulated the conduct of four (4) Ocean Bottom Node (OBN) Seismic surveys; a combined 3,838 sq. km with 1,750 sq. km of full fold seismic data to the tune of more than US\$130M. These are:

1. BPTT and EOG Resources jointly over Teak, Samaan and Poui (TSP), Galeota Ridge, South East Coast Consortium (SECC) and Modified U(a) in 2016-17,
2. Shell Trinidad and Tobago Limited over Blocks 5a, 5c, 5d, 6b and E in 2017,
3. BHP over Blocks 2c and 3a in 2018 and
4. EOG Resources, this time by themselves, over SECC, Pelican Block and U (b) also in 2018.

With the addition of these excellent seismic volumes, the view of Trinidad and Tobago's Geology has never been this good. We have had up to six (6) seismic vessels in operation at the same time! De-blending algorithms are now accepted as standard, and we are bearing the fruit that these efficiencies afford.

Broadband Seismic Acquisition

In 2014/15, BHP, in conjunction with their deep-water Production Sharing Contracts (PSC) partners BG International (acquired by Shell), BPTT and Repsol (now Perenco), acquired one contiguous 3D broadband seismic dataset over their assets in the Northern and Southern Deep Water. The massive seismic vessels, PGS' Titan Ramform and Titan Atlas acquired over 21,000 square kilometers of high quality broadband seismic data over 25 Deep Water blocks. Included in this, as part of this joint survey, is data acquired over 16 unlicensed blocks, namely: Block 24 and TTDAAs Blocks 1, 2, 4, 8, 9, 10, 11, 12, 15, 16, 18, 19, 27, 32 and an Open Area west of Block 23(b).

These partnerships have processed and reprocessed these volumes and have now settled on an excellent final product. Several hydrocarbon discoveries have been made and this area continues to be explored.

Ocean Bottom Cables Seismic Acquisition

Not only did we step from conventional streamer to broadband streamer to OBN acquisition, but we also saw OBC (Ocean Bottom Cables) seismic acquisition. BPTT conducted a two phase OBC survey in 2011-13 covering a total of 1000 sq. km. Compared to a towed streamer configuration, the OBC survey demonstrated improved imaging from deploying the cables on the sea floor, particularly in areas that are difficult to image like where there are steeply dipping structures. The resulting data was also able to image around observed acoustic interferences such as shallow faulting and shallow gas and provided the needed bandwidth, spatial resolution and amplitude fidelity to image deeper segments in the areas of interest.

Petrotrin also conducted an OBC seismic survey in 2014 of just over 500 sq. km, which was merged with reprocessed legacy data. In this merged dataset, imaging of the shallow reservoirs and imaging below the mid-Miocene unconformity, which in the past proved problematic, had marked improvements. The significant uplift in this dataset has created great opportunities to develop reservoirs within the Shallow Pliocene and Miocene intervals in the Trinmar/North Marine acreage and identify new exploration plays at the Miocene and deeper stratigraphic levels.

Multi-Client Geophysical AS (MCG) CAMDI Project

MCG (Multi Client Geophysical AS) proposed to the Ministry in 2013 the multi-client acquisition of a long offset 2D seismic survey. This survey was designed in two (2) grids; a widely spaced regional grid and a closely spaced grid. The regional component of the survey spans Barbados, St. Vincent and the Grenadines, Grenada and the Tobago Trough, while the detailed segment of the survey consists of cross-border coverage of the Tobago Basin (between Tobago and Grenada). This Caribbean Atlantic Margin Deep Imaging (CAMDI) project allows better geological understanding of the Southeastern Caribbean Region. I am pleased to announce that acquisition of this survey was successfully completed in March of this year. The PSTM (Pre-Stack Time Migration) volume of this dataset became available in September and the PSDM (Pre-Stack Depth Migration) volume is on schedule for year-end. Initial looks at the long-offset (12km) 2D PSTM Seismic volume shows great imaging down to 9.5 seconds. We are indeed very excited to view the final depth volume, as initial looks of the time volume brought with it very high expectations.

Multi-Client Invest AS (MKI, a subsidiary of Petroleum Geo-Services (PGS) ASA) Reprocessing of the 2008 Patao High 2D seismic data

In 2017, Multi-Client Invest AS (MKI, a subsidiary of Petroleum Geo-Services (PGS) ASA) reprocessed the 2008 Patao High 2D survey. This

reprocessing project obtained improved geophysical data and thus geological understanding of the Deep Water North Coast Acreages as well as the Deep Water East Coast Acreages. Using modern seismic processing workflows and technologies, MKI started over with the raw data and delivered a depth volume that has achieved significant uplift over the previous time volume.

Onshore Seismic Acquisition

Over the last decade, several onshore seismic surveys were completed. In 2009, Parex acquired 215 line kilometres of 2D seismic data over the Central Range Block. In 2010, Petrotrin acquired 307 square kilometres of 3D seismic onshore southwestern Trinidad better known as the *Northwest District Survey*. In 2012, Voyager Energy Trinidad Limited acquired 411 square kilometers of 3D Seismic over the Guayaguayare Block. In 2013, Parex Resources acquired another approximately 60 line kilometres of 2D seismic over the Central Range Block and as recently as 2016, Lease Operators Limited (LOL) acquired 51 line kilometres of 2D seismic over the Rio Claro Block.

On these varying datasets, some interesting geological structures can be seen. They contain varying ranges of frequencies. In some cases, the

seismic did seem to predict the structure reasonably well and other times there were no reliable seismic amplitude response.

Due to near surface issues, 2D and 3D seismic data quality on land is generally very poor. Thus, seismic so far has had limited impact on risk reduction for prospects onshore. Varying processing flows have been employed. For example, Reverse Time Migration (RTM) processing, gave the result with the best signal to noise ratio for the North West District volume.

The 2016 LOL 2D survey showed better structural continuity and improved resolution, both in the shallow and deep-water, than previous onshore seismic volumes. Post-processing flows were utilized to enhance steep dips and brought well resolved structural continuity and coherency into the sections, and additional focusing to the thrust, and faulted regions. This survey has provided an excellent point of reference for any future imaging.

While acknowledging the improvements in marine technology, we are hopeful that in the very near future, we can host a similar workshop on *Advances in Land Seismic Technology*, so that the learnings and outcomes can be applied to our *fruitful*, yet complicated onshore blocks. Industry

experts and I, believe that there are many undiscovered oil reserves in deep cretaceous traps, similar to recent discoveries in Guyana.

Anticipations from this conference

T&T is now in a unique position for the next Deep Water Bid Round. BHP and its partners' successful wells in the Deep Water combined with high quality 3D data over open Deep-Water blocks, the recently acquired Regional long-offset 2D data plus the reprocessed lines done by MKI, should result in a very successful Deep Water Bid Round in 2020. This time, for a large number of blocks that can be offered, there is already high quality seismic data. We expect some very innovative proposals for work commitments as operators seek to get the most out of these dataset.

At a time where Seismic Processing has gotten to a stage of de-blending, FWI and new migration techniques being commonplace, we are very interested in the discussions that will be held on its recent developments and applications. We are eager to partake in the discussions about seismic interpretation activities and to understand how innovative interpretation tools can be used to leverage volumes to the technical limit. We are also keen to see what new innovations are being applied to seismic vessels, sources, nodes and streamers.

With node technology, we enter into the realm of 4D surveys, which we have not yet leveraged here in T&T. With the exception for the Deep and Ultra Deep areas, we are in mature basins so we need to start thinking 4D, which will aid the industry in T&T to recover optimally available hydrocarbon resources and to locate previously bypassed oil and gas reservoirs.

We look forward to addressing deep-water issues in as much detail as possible but this does not mean that we are not also interested in solutions to shallower water issues as well. The results of the Shallow Water Bid Round will be announced in the coming weeks, and new findings will go nicely towards the work commitment for these blocks.

I anticipate that all the new advances that will be presented at this workshop will be avidly discussed and ventilated. I know that the Ministry staff present at this conference await with baited breath.

The MEEI, as custodian of all the information acquired by all the operators, have seen the majority of advances in seismic analysis and interpretation. Are there any new advances that the operators and the MEEI will be introduced to over the next two days?

Shallow Water Seismic Acquisition

On perusal of the workshop's agenda, so many questions jump to mind: Shallow water imaging has always proved problematic, and this begs the question, is a particular design of OBN the solution? How much better can OBN get?

Can Direct Arrival Travel Time Inversion be used as a Means to Refine Nodal Positioning and Timing?

I see that we are now working on improving the source efficiency. Is this the improvement that we need?

Does the Trident array mean that mammals will stay away from the acquisition area altogether? If it is so, then there will be no need for stoppage during the acquisition of seismic, which will lead to increased efficiencies, thus resulting in reduced costs.

I wonder how the high fidelity broadband seismic produced by Multicomponent Towed Streamers compares to OBN data.

We have had introductory talks with a Controlled Source Electromagnetic (CSEM) method provider. We are keen to see the advances in this technology and the de-risking that it allows.

So many questions are brought to mind with respect to seismic surveys, and this workshop provides discussions and solutions to appease these curious enquiries.

Conclusion

In closing, I will like to highlight the high importance of this SEG workshop. As the first in the Caribbean region, it will provide great benefits and tremendous value to the Oil and Gas Sector of the Caribbean through the upcoming presentations and discussions.

I wish everyone involved, participants and presenters alike, a successful workshop ahead. Let us make the best of this opportunity.

Ladies and Gentleman, I thank you.