ISSN 1972-7011

ENERGY TECHNOLOGIES FROM ITALY 2013

Gruppo italiaenergia

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RECENT ACCOMPLISHMENTS FROM THE ITALIAN UPSTREAM OIL & GAS INDUSTRY

In recent years, the Italian industry has been very active in developing new technologies and new high tech assets for oil and gas production and processing.Most often, the new assets, such as pipelaying vessels, oil production rigs, etc., were developed on the basis of numerous advanced and proprietary technology features.

New, developing markets have also been entered, such as the oil sands production and processing in Canada, offshore gas production in China, Australia, Brasil and others.Active positioning is in place for the development of newly found oil & gas fields, such as currently in Mozambique and elsewhere.

In this way, the Italian industry confirms its position as one of the world leaders in the global oil & gas markets, particularly in its upstream segments, onshore and offshore.

These market and technical development activities have been carried out by the oil companies, foremost by ENI, as well as, with equal intensity, both by Italian general contractors as well as by multinational companies with large Italian divisions. This article, by no means exhaustive, illustrates selected contributions from a number of key players, such as ENI, GE, Hydro Drilling International, Drillmec and Saipem.

Castorone: the World Most Advanced Pipelayer for the Challenges of Giant and Ultra-deepwater Projects

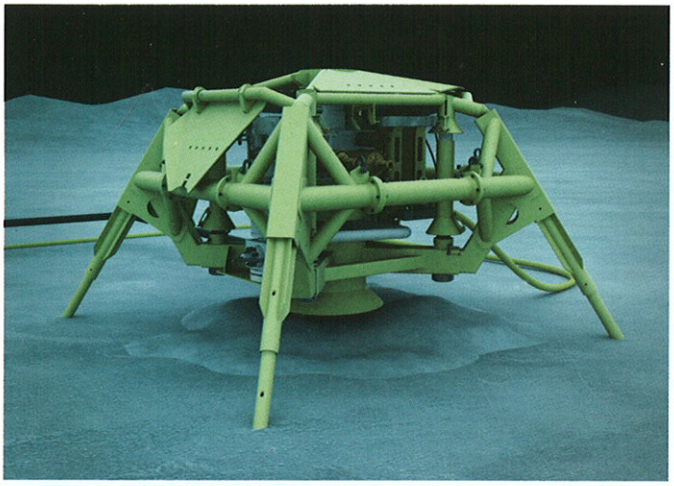
The new vessel Castorone, one of the most advanced and - with a length of 330 m - probably today the largest pipelayer in the world, is a concentration of technologies and efficiencies: she is now replacing the CastoroSei as Saipem's flagship vessel for the laying of large and deep sealines.

Currently under completion, the Castorone is due to start operations in 2013 with four assignments in deep waters in the Gulf of Mexico and in Brazil, and later with the installation of the 900 km long Ichthys LNG project trunk-line in the Australian offshore. Fully dynamically positioned (Class 3 DP), designed for high productivity laying of large sealines also in deep waters and in extreme environments, the Castorone will meet the challenges of the present and future markets, ranging from the high productivity S-lay of large trunklines even in Arctic environment and of sealines in waters deeper than 2,000 m, to the J-lay of sealines in ultra-deep waters, exceeding 3,000 m.

The added value provided by this huge vessel is her extremely high productivity in a very broad range of scenarios, allowing shorter laying schedules and therefore much better project economics. This is extremely important particularly for very long pipelines, as well as in all cases in which varying water depths along the route require the vessel's ability to rapidly adapt her stinger configuration.

The Castorone is characterized by a number of distinctive proprietary technologies that witness her technical excellence. In particular, with the classification as Ice Class A0 (IA Baltic)/Class 3 Dynamic Positioning, the vessel has a unique flexibility

Castorone in the shipyard



GE Oil & Gas S-Series SVXT subsea system

Saipem FDS-2 ship alongside FDS in operation at the Usan project in Nigeria

in the employment of either the S-lay or the J-lay techniques. Her transit speed is 13 knots, the storage capacity is around 20,000 t and there is the possibility of subsequent upgrading to the pipe joints unmanned loading and offloading. The best Saipem welding, coating and quality control systems are utilized. Heavy in-line bulky items can also be installed.

e-cd™ -Drilling with Continuous Circulation

Following a tradition of innovation in drilling technologies, in 2005 ENI has introduced to the industry a proprietary concept of continuous circulation drilling called e-cd™, ENI-circulating device, as a fundamental part of ENI's proprietary MPD (Managed Pressure Drilling) system called e-nbd™(ENI-near balance drilling). Continuous circulation is applied through special e-cd™ subs connected to the drill pipes. This allows not only the control of the pressure into the well, common to conventional MPD (Managed Pressure Drilling) system, but also an uninterrupted mud circulation during the makeup or breakout of drill pipes, virtually during all the operations in the well, thus preventing undesirable pressure shocks on the formation.

The idea came from the analogy between wells and the human body. To some extent, a well is like a living organism that reacts to external stimuli, such as the pressure applied by the drilling mud.

Let's push the analogy further, considering the continuous circulation of the mud in the well like the circulation of blood in the human body. The heart, which in the well can be represented by the MPD system and the pumps, ensures a pumping of blood adequate to the circumstances, intensifying it in conditions of stress and limiting it in conditions of repose. Clearly, if the heart ceases to function even momentarily, the circulation of the blood is affected and the organism suffers. Likewise, the well gets the maximum benefit from the uninterrupted circulation of mud that makes possible constant and monitored pressure in the system.

To date, the e-cd™has been and continues to be successfully applied in hundreds of applications in many different places such as Alaska, Angola, China, Congo, Egypt, Ghana, Italy, Kazakhstan, Libya, Nigeria, Pakistan and Tanzania.

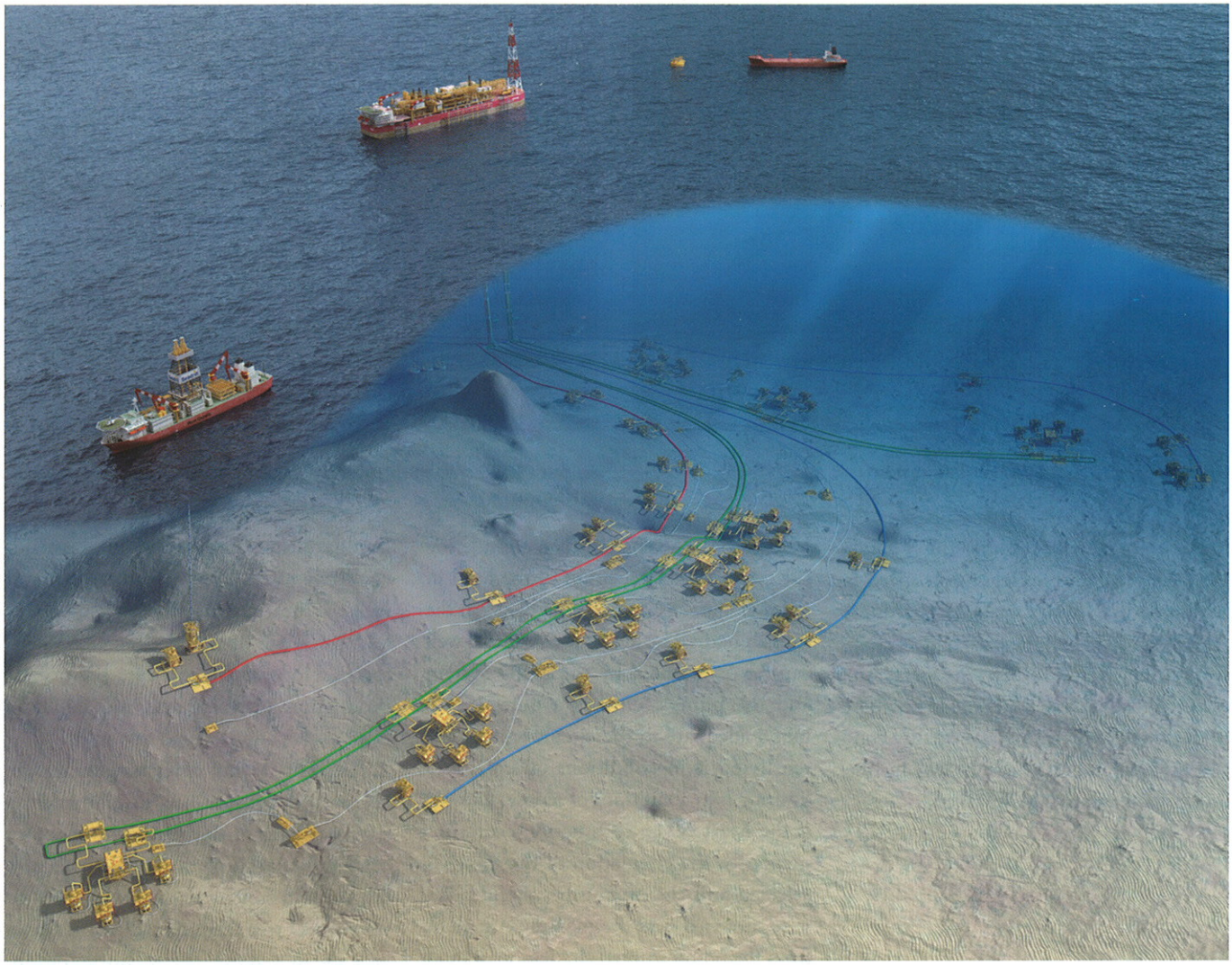
The next development goal is to make the ENI system fully automated, reducing to a minimum the possibility of human error and incidents. We are currently investigating a number of options to develop a remote controlled mechanical arm for manipulating the e-cd™ subs.

GE Technology Meets Unique Needs of Drilling Projects in Adriatic Sea

When ENI'se&p division decided to drill two new production wells in the Bonaccia East gas field of the Adriatic Sea, a major challenge arose. Typically, these types of wells – located in sea depths of about 82.50m – are operated from fixed platforms. However, in this case the nearest production platform was too far away from the locations of the new wells.

A feasibility study determined that the best way to proceed was to implement a subsea tieback of the two new wells to an existing Bonaccia platform through a new sea line and control umbilical, using subsea vertical tree technology installed by a jack-up in a daisy chain configuration. Cost optimization, exploitation of existing facilities and reduced environmental impact were the main drivers in this decision.Although this scenario was not the first one of this type in the world, it was definitely new for the Italian offshore industry. It is also the first time that the operations on subsea wells were carried out by using a jack-up drilling rig.

Headquartered in Florence, GE Oil & Gas offers subsea systems designed to operate safely and efficiently worldwide in the harsh shallow water environments. For the challenging Bonaccia project, GE supplied two VetcoGray S-Series Subsea Vertical Xmas Trees (SVXT). The SVXT technology, which is based on more than 20 years of VetcoGray experience in shallow water operations, integrated with the latest GE Oil & Gas technologies, has proved to be a successful alternative to fixed platforms for the development of marginal oil and gas fields in harsh shallow water environment.



The Usan URF Subsea Project for Elf Petroleum Nigeria

The S-Series is designed to be deployed using standard offshore jack-up drilling rigs (JUDR), requiring no major modifications to facilitate the deployment of these subsea systems. The systems are installed and tested from the JUDR with no assistance from remotely operated vehicles (ROVs) or divers. The system design is based on an in-depth understanding of the environmental challenges, including weather, sub-surface currents, poor visibility and fishing interaction. The resulting features include smaller tree and fisher-friendly wellhead protection structures, as well as an innovative barrier philosophy that removes the need for a separate tree cap.

The S-Series SVXT tree design and unique tree valve arrangement facilitate a significantly smaller stack-up height. This enables far smaller and lighter assemblies to assist installation by JUDRs. The unique tree valve design utilizes field-proven technologies from both vertical and horizontal tree systems. Aligned with smart installation tooling, this design removes the need for a diver or ROV during installation, making the system safer and more cost effective to install than previously available solutions.

In addition to advanced technology, a key factor leading to the success of the Bonaccia project was the project team commitment to developing flexible solutions to overcome the challenges that arose during the execution phase. The success of this project demonstrates that the subsea tieback development through vertical trees with jack-up drilling operations can be successfully implemented in order to exploit new shallow water marginal fields, as well as drilling new infilling wells in mature gas fields.

New Technologies in New Deepwater Field Development Markets

Since 1998, Saipem has acquired and successfully carried out numerous deepwater field development projects, mainly in the South Atlantic, both in West Africa and Brazil. In several cases this also implied the first application of new technologies.

Two major trends are now clearly visible in this market: ever deeper water depths and activities also in new geographical regions. Saipem is moving in both directions with new project acquisitions and - thanks to its top class technologies and assets –it aims

to lead the path towards even tougher future challenges. Key to this market segment is the integrated development of novel technical solutions and the utilization of dedicated, fit for purpose advanced installation vessels.

The Liwan Subsea Tie-back EPIC Project FOR Husky Oil is one of the most recent acquisitions in this market segment, also thanks to the outstanding capabilities of the newly developed vessel FDS2.This assignment is opening the Chinese market to the deepwater field development arena. Saipem's scope of work includes designing and laying 2 x 79 km x 22" flowlines as well as many smaller flowlines, an 80 km long umbilical and the deployment of 400 t of manifold packages, all in 200 to 1,400 m water depth.

Operating in the South China Sea environment will constitute a new challenge because of the typhoons and of the high sea currents,typical of this area. In fact, the local conditions are restricting the offshore operating window to the good season. This, in turn, calls for a high level of productivity to complete the planned operations within the available time.

The Usan URF subsea field development project on the EPICbasis was acquired from Elf Petroleum Nigeria back in 2008 and recently completed. In this case Saipem was assigned a full field development scope, including design, construction (mostly in Nigeria) and installation of umbilicals, flowlines, jumpers, risers as well as the offloading system and the anchoring of both offloading buoy and FPSO. Based on Single Hybrid Risers (SHRs), the project saw the debut of the FDS2, and featured a highly innovative pre-installable, de-coupled Oil Offloading System and the first large diameter piles (5 m OD) ever driven in deep water (700 m). The other elements were more than 60 km of production and water/gas injection flowlines, 7 SHRs, 72 km of main umbilicals and 16 FPSO anchors.

Rig HH220 Archimede in operation on well HBC1, Herzaz Area, Algeria

Night operation on well HBC1 with Rig HH220 Archimede,Kerzaz Area, Algeria

The HH Series Hydraulic Drilling Rigs

During the mid '90s a work team of engineers from ENI, Saipem and Drillmec started working on a special project, partially funded by the EU under the umbrella of the Thermie program, with a very challenging objective: to develop a new land-drilling rig, fast moving, able to work in remote locations with a minimal disturbance to the local environment in terms of noise, emissions and visibility. Very high levels of safety for the workers and better performances than the conventional rigs had to be granted. After a few field tests made with an existing Drillmec 100 T hydraulic water well rig, upgraded to the Oil& Gas standards, the first HH rig (G125) was launched in July 1996. It represented a dramatic change in the conservative land drilling industry. This new rig appeared as quite different from the conventional rigs of the same size, both in the overall shape and in the working system, comprised of hydraulic automated equipment. The new futuristic design allowed to avoid the use of drawwarks, to eliminate the need of the derrick man and to drastically reduce the crew number.

The new HH rigs attracted the interest of many customers, both operators and drilling contractors; a wide range of additional advanced technology models was rapidly generated, ranging from 75 Ton to 350 Ton of static hook load capacity.

Nowadays the reliability of the "HH" Rigs technology is well established worldwide, because of the quality of the equipment, the outstanding safety records achieved by the extended use of automation and the environmental friendly features, coupled with excellent performance. Over 120 HH units of various models and special designs are now working in over thirty countries in five Continents with growing success,

in any kind of environment and climate, from Iceland to North Africa as well as in U.S.A., Europe, South America, Australia and China.

The joint efforts of the operator (ENI), the drilling contractor (Saipem) and the rig manufacturer (Drillmec) have been able to convert the result of a sophisticated high-tech project into an actual industrial product, with a tremendous potential for the Oil& Gas and geothermal drilling markets worldwide. A very good example of efficient cooperation and a clear success of the Italian technology.

The desert environment had been considered as one of the most difficult challenges for the application of hydraulic rigs. The reasons for this may be found in the sensitivity of hydraulic oil to temperature, the risk of oil pollution by sand and the lack of knowledge of the hydraulic systems by most of the rig mechanics, particularly in remote areas.

ENI believed, supported by manufacturers and by the experience of working with such rigs, that the desert challenge was achievable. Hence it contracted Hydro Drilling International HH220 "Archimede" rig for a new exploration campaign to be held in Algeria on the Kerzaz Block. The same rig had been working in Italy in the last four years for the Enigroup along with its twin HH220 "Leonardo".

The campaign started in the month of August 2011 and completed in June 2012, totaling three exploration wells. The rig, manufactured in 2008, has been fully verified before the start of operations, rigged up, tested and packed for shipping. Hydro Drilling studied a few additional solutions to take into consideration the difficulties of the project by adding a chiller unit for cooling the hydraulic oil, replacing the oil with a specific one adapted for desert areas and reinforcing the air filters of generators to avoid the sand and gypsum to enter in the cooling system.

The area of operations can be considered very remote also for the Algerian standards. It was located more than a hundred km into the sand desert, with very poor road access. The drilling performance of the rig has been fully satisfactory considering that NPT for the whole project was far below 2% of total time; such time has been mostly spent in additional maintenance required on equipment subject to the harshed environmental conditions, with "sandblasting" storms and temperatures which attained 55 °C in summer and -3 °C during the winter, with a very wide temperature range between day and night.

Another issue was related to the staffing of the rig: in fact the HH220 system is fairly different from traditional drilling rigs,so despite Algeria being able to provide good quality workforce, there were no technicians trained on this type of rig. The solution put in place by Hydro Drilling was to implement a training program whereby all expatriate workers were shadowed by an Algerian worker in order to accelerate the training.

The lesson learnt from the campaign was that hydraulic rigs are fully suitable to work in the desert, provided that the contractor puts in place a thorough analysis of the potential problems caused by a different environment, implements customized rig modifications and increases the equipment of the rig in terms of spare parts and consumables, in order to avoid as much as possible non-productive time due to logistic difficulties in procuring replacement parts.

Processing of Bitumen from Canadian Oil Sands

Over the last decade, the commercial exploitation of Canadian *oil sands* has grown considerably to become a significant factor on the world energy supply stage.

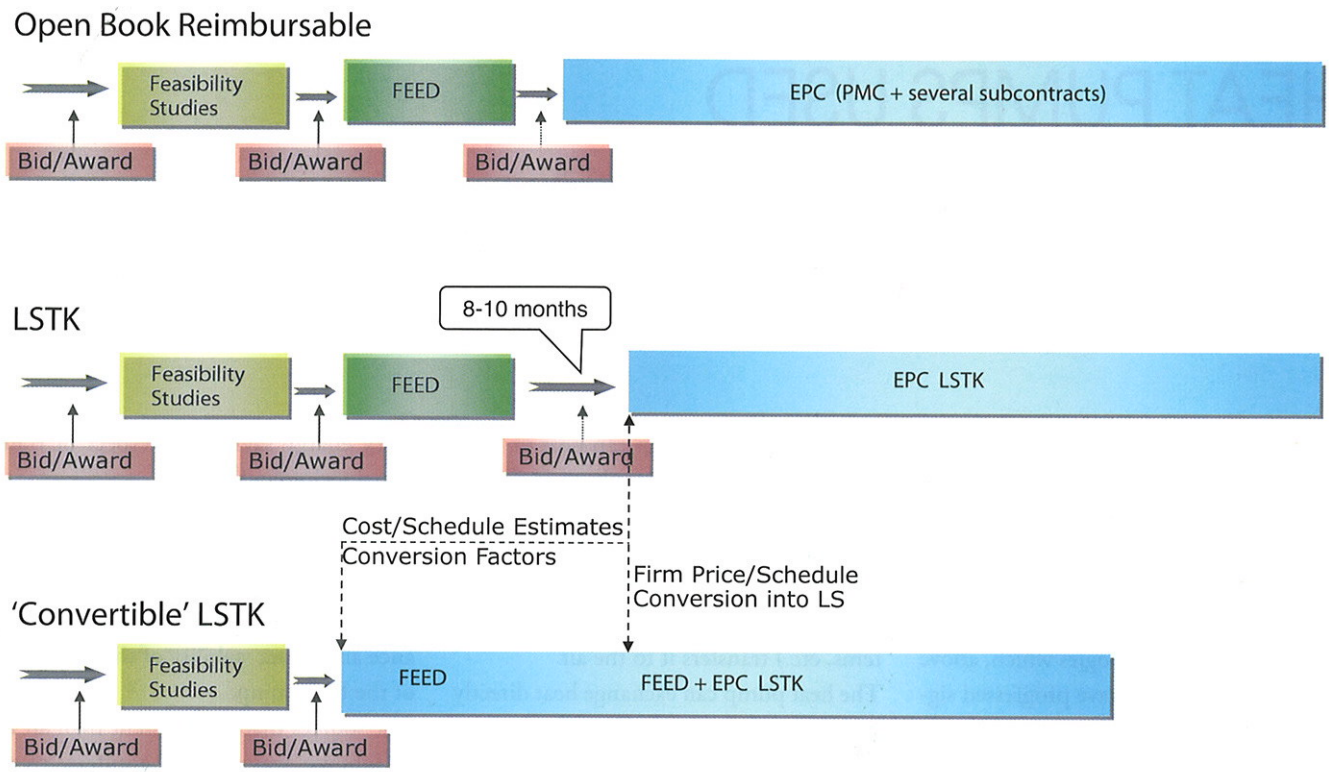
A decade ago, Saipem has entered the Alberta oil sands processing market with the first contract award from Canadian Natural Resources Ltd. to design and build a complex based on three hydrotreaters to process 60,000 bpsd of naphtha, distillate and gasoil, as part of the major Horizon Project. A second, follow-on contract was awarded to Saipem in early 2011, for the FEED and later for the design and execution on an EPC basis of a similar complex for Horizon's Phase II.

During these years, Saipem has invested considerably in local execution capabilities, by developing an engineering and project management office in Calgary, employing today over 700 professionals, and a new prefabrication yard, currently in the closing stages of development in Edmonton. The latter will allow in-house production of modules, which are typically trucked to Fort McMurray for site installation when the climatic conditions allow site construction. These large local establishments and the large employment of Canadian professionals allow optimum application of local legislative, industrial and labor requirements.

Equally importantly, as a differentiating feature, Saipem has introduced in this North American market the discipline and the speed of execution of LSTK contracts.This novelty was much appreciated,

Simulation of Saipem's oil sands bitumen processing project for Husky Oil Operations Ltd. in Ft McMurray, Alberta, Canada

Execution Approaches



"Convertible" LSTK contracts allow to save one yearof total execution time.

indeed sought for, by some Clients, in order to mitigate the chronic delays and cost overruns typical of oil sands projects during the last booming decade.

The most recent award, in 2011, is an upstream contract from Husky Oil Operations Ltd. for the design, procurement and construction of Central Processing Facilities for the Sunrise Oil Sands Project, Phase I, in Fort McMurray, Alberta. Two trains of this complex will process a total of 60,000 bpsd of bitumen, produced using SAGD technology, and will prepare it for downstream transportation and conversion.

The contract has adopted a novel contractual structure: a hybrid, "convertible" EPC LS scheme, recently practiced with success by Saipem in several world markets, where fast-track project definition and execution are required. According to this scheme, the initial project stages, typically Front End Engineering and Design, some detail engineering and the initial definition of some main subcontracts, are carried out on a "reimbursable", "cost-plus" contractual scheme, in order to take advantage of the customary speed and flexibility of these arrangements. Once – say, typically – about 60% of the engineering is completed, the contract is then "converted" into an LS mode, based on preagreed price conversion equations, to take advantage of the discipline imposed by the LS approach, in order to complete the project on schedule and within a preagreed price.

In addition to a much higher likelihood of completing "mega"-projects on time and within budget, these convertible schemes allow the Owners to save approximately a year, by bidding out a project contract only once (before the FEED), rather than twice (before the FEED and later before the EPC phases), and by operating in parallel paths over the entire project execution. This is particularly important when a fast-track project execution is desired to bring new capacity on stream quickly.

Saipem's novelties in the Alberta market were therefore the mastering of new oil sands processing techniques, the establishment of major and sustainable local design, fabrication and project execution capabilities in a highly competitive environment as well as the successful introduction of new contractual schemes, firstly EPC LS and later the "convertible" EPC LS contracts. ■

Acknowledgements

I am deeply grateful for their substantial contributions to:

- Angelo Calderoni, ENIe&p – Senior Vice President, Drilling & Completion (*Drilling with Continuous Circulation*)
- Stefano Dallera, GE Oil & Gas – Global Account Director for ENI (*GE Technology Meets Unique Needs of Drilling Projects in the Adriatic Sea*)
- Marco Cercato, Energy Services – President, and Marco Pellei, Hydrodrilling International – Sales and Marketing Manager (*HH Series of Hydraulic Rigs*
- Armando Favi, Saipem, Vice President, E&C Business Development Management (*Castorone* and *Deepwater Field Development*).