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IN THIS ISSUE

04 > *CAIRN ENERGY MANGALA DEVELOPMENT PIPELINE PROJECT*

06 > *INTECSEA DEVELOPING TOOLS FOR REGIONAL PIPELINE FEASIBILITY STUDIES*

09 > *ARCTIC PRODUCTION FLOW ASSURANCE USING DIRECT ELECTRICAL HEATING*

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Q1 – 2012

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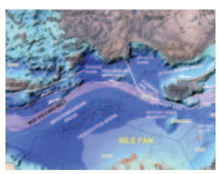
Front Cover Image:
Cairn Energy Project – Page 4

Inside this Issue

p.4
Cairn Energy Mangala Development Pipeline Project



p. 6 INTECSEA Developing Tools for Regional Pipeline Feasibility Studies

INTECSEA is at the forefront of multi-disciplinary, regional, technical, and commercial pipeline routing feasibility studies in the Eastern Mediterranean Sea.

p. 8 BPPS Gas Supply Project – EPCM

Black Point Power Station (BPPS) requires alternate gas supply by 2013 because of the depleting Yacheng 13 gas field.

p. 3 President's Letter

p. 9 Arctic News

Arctic Production Flow Assurance Using Direct Electrical Heating

p. 10 INTECSEA Delivers Subsea Training for PETRONAS

Flow Assurance Challenges Delivered in Kuala Lumpur

p. 11 Inside INTECSEA

News, recognitions and events

Exploring the Future

by Uri Nooteboom

We all plan for the future which, unfortunately, is the least predictable part of our lives. Since the indefinite aspect of the future makes it difficult to plan for, we reduce it to a manageable timeframe that is either of interest to us or that we can fathom and think we can predict and control. For most businesses the future is a 3-5 year business plan, for governments it seems to be the next election; and for a vast segment of the population, it is the next paycheck.

Very few people or organizations seem inclined to plan for the future beyond the next generation, if not their own; it either doesn't affect us or we simply don't have the wherewithal as a society to dwell on the distant future. Even if we wanted to, implementation of any plan that extends beyond generations would pretty much be doomed to fail given the absence of participation from those future stakeholders. The world is left to planning its future, one - two at best - generations at the time.

One of the longer term future issues that keep our industry preoccupied is the question of how much fossil fuel can be extracted from the earth in the next several decades. Peak oil has been debated for quite some time and there is still no general consensus whether the phenomenon is yet to come or has already occurred. Estimates of the world's remaining hydrocarbon reserves keep changing every time new sources are discovered. We simply don't know for certain how much remaining production we can count on. It is a given that at some point in time we will run out of fossil fuel.

Thirty years from now there will be an additional 2 billion people on this earth. Alternative energy sources will need to be developed and efficiency will have to increase dramatically to limit consumption and waste. I have no doubt we will be able to achieve both. New technologies yet undiscovered will be developed that in turn will be made possible by ever increasing computer power. According to Moore's law, computer power defined by the number of transistors that can be placed on an integrated circuit will double roughly every 18 months to 2 years; recent developments in single-atom transistors may even significantly improve on that time line. In 30 years our computers could be 100,000 to a billion times more powerful than today.

There is nothing new in this accepted fact that computer power will keep increasing; we have become accustomed to having the next generation I-device or smartphone at our disposal with ever increasing frequency. Most of this computer technology is pushed onto its audience; ready or not. Nobody asked for an iPad until Steve Jobs gave us one. We'll figure out what to do with it, how to improve our lives or business with it once it is upon us.

What will next year's hardware and software look like? Nobody knows for sure, except it will be better and faster. And the year after? Same thing; better and faster...which inevitably leads us to a phenomenon referred to as Singularity.

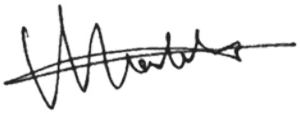
For non-computer geeks, Singularity signifies the time when computing power - which has been increasing exponentially and will continue to do so – has reached the point where machine intelligence is able to learn and improve on itself above and beyond human capability. According to Kurzweil and other followers of this phenomenon, this might happen in about 30 years. Brain/computer integration will be reality; that is, if we want to stay ahead of machines. Humankind will be changed forever: subservience to machines or immortality?

Actually, Hollywood already imagined this phenomenon and has exploited it long before Singularity became a topic of interest. It is the premise of the Terminator movies where John Connor is saved to lead the war between humans and machines sometime in the future.

I would be surprised if anyone is actively planning for this possibility, although some computer thinkers may be trying to figure out how to prevent it from happening. In the next 20 years or so this will demand some serious global cooperation and planning; one can only hope it will be getting more attention than climate change.

As Stanley Kubrick's HAL 9000 said: "I know I've made some very poor decisions recently, but I can give you my complete assurance that my work will be back to normal".

You be the judge.



"Thirty years from now there will be an additional 2 billion people on this earth. Alternative energy sources will need to be developed and efficiency will have to increase dramatically to limit consumption and waste. I have no doubt we will be able to achieve both."

Cairn Energy Mangala Development Pipeline Project

by Madhveshachar Mohan

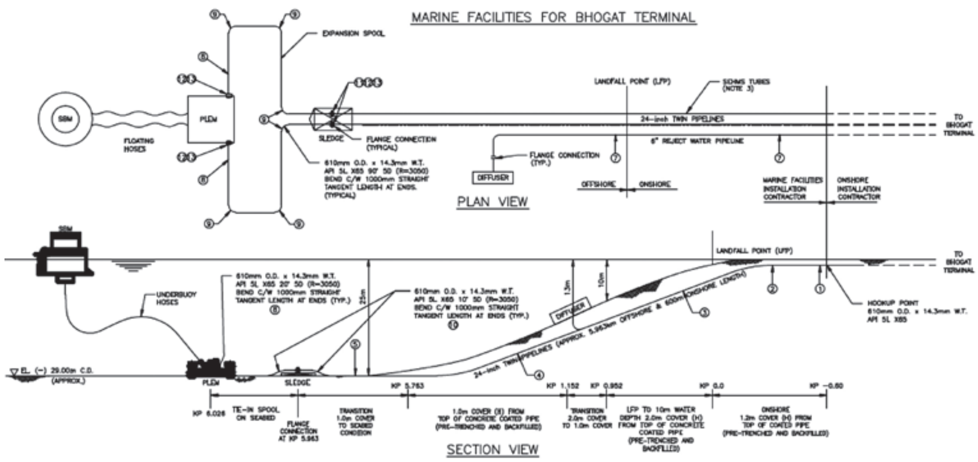
Cairn Energy India Pty. Ltd. ('CEIL') is the operator of Block RJ-ON-90/1 (the 'Block') in the State of Rajasthan, India, and operates the Block. CEIL is currently in the process of implementing a pipeline to transport crude oil from the Block at Barmer, Rajasthan to a coastal terminal facility in Gujarat called Mangala Development Pipeline Project (MDPP).

The pipeline project involves an oil evacuation pipeline and gas pipeline of approximately 675 km, pumping/export terminals and related facilities (such as pumping stations, blending facilities, pigging stations, metering skids, etc.) for transportation of at least 150,000 barrels per day crude oil from the upstream process terminal at the Mangala Field to the downstream delivery/terminal points as designated including the Crude Oil Tankfarm (COT) facilities at Bhogat off the coast of Arabian Sea in Gujarat.

The Marine Facilities for Bhogat Terminal shall comprise of pigging facilities at Crude Oil Tankfarm (COT) located off Bhogat, 24-inch twin loading buried pipelines (onshore 8km and offshore 6km), Pipeline End Manifold (PLEM), Single Point Mooring (SPM) System and other associated components for crude oil loading from Bhogat Terminal to the export oil tankers; recirculation/flushing system using Light Crude Oil (LCO); and LCO import through an SPM system from marine tankers to Bhogat Terminal.

INTECSEA was then appointed by Leighton Contractors India Pvt. Ltd. ('LCL1') as the design engineering consultants to execute detailed engineering design of the twin 24-inch pipelines for the Mangala Development Pipeline Project.

The detailed engineering design commenced in November 2009 and lasted 6 months. The twin pipelines were installed successfully in May 2011.



System Configuration
The basis for the detailed design is the system configuration shown in Figure 1 (left).

The scope of detailed design included the following key items:

- Pipeline mechanical design
- Pipeline hydraulic study
- Installation engineering
- Pre-commissioning, commissioning and start up manuals
- Operations control and maintenance manual
- Risk assessment and risk management studies
- HAZOP studies
- Pipeline lateral buckling design
- Dropped objects/trawl gear impact study
- Preparation of additional pipeline specifications

Pipeline Mechanical Design and Installation
The offshore twin pipelines were installed with Skin Effect Heat Management System (SEHMS). The design of the system was excluded from the EPC Contractor Scope and supplied by CEIL as Free Issue Material (FIM). The pipelines were also fully insulated to maintain the flow integrity of the Crude (R.J. Crude-Rajastan Crude) oil by reducing its high viscosity characteristics. The crude to be transported will be sweet crude with the following main characteristics:

- Wax content 20-38 wt%
- Wax appearance temperature (WAT) 50-65°C
- Wax dissolution temperature (WDT) 70°C
- Pour point untreated 40-45°C

With such challenging wax content properties of the crude, detailed flow assurance temperature survivability analyses were carried out to establish the start-up, ramp-up, cool down, shut down and normal operating scenarios. The flow assurance studies were carried out using the sophisticated hydraulic computer program OLGA which handles transient flows. The main objective was to determine a suitable operating philosophy prior to and after exporting the R.J. crude to the tanker. The crude potentially forms wax below 65°C (WAT), thus suitable insulation and R.J. crude handling methods are essential to maintain the overall operating temperature of 65°C in the twin 14 km pipeline as well as the marine hoses. The temperature loss during the R.J. Crude export from COT (Crude Oil Terminal) to the tanker in 24 hours was found to be negligible (less than 1°C). This indicated that the insulation in the pipeline is adequately designed to prevent heat loss.

Other suitable recommendations were also provided for start-up, ramp-up, cool down and shut down scenarios to ensure successful operations of the crude transfer. *The pipeline external coating data proposed and installed are as shown below:*

Typical Pipelines External Coating Data

Description	Units	Dual Layer FBE	PUF	HDPE	CWC
Type of Coating	-	Corrosion Coating	Insulation Coating	Casing	Concrete Coating
Coating Thickness	mm	0.25 × 2	90	5	100
Coating Density	kg/m3	1440	60 (160 for bends)	965	3040
Thermal Conductivity	W/m °C	0.22	0.04	0.25	2.9

For a majority of the pipeline route, the seabed soil conditions were found to be weak to moderately strong, highly to moderately weathered calcarenite/limestone. The presence of rock combined with severe environmental parameters posed many challenges to the pipeline trenching efforts by a dredging contractor.

Due to the presence of SEHMS(Skin Effect Heat Management System) tubes which were welded on to the linepipe, the feasible option for pipeline installation was narrowed down to the on-bottom pull method. This method of on-bottom pull was selected to avoid any damage (if it were to be installed by other methods such as S-lay) to the SEHMS tubes and also to take advantage of the straight route between the LFP and PLEM.

The detailed engineering was completed within a budget of 6 months, which was on-time and to the client's satisfaction.

INTECSEA Developing Novel, GIS-Based Methods and Tools for Regional Pipeline Feasibility Studies in the Eastern Mediterranean Sea

by John R. Brand, Ph.D

Recent large gas discoveries in the geologically complex deepwater Levant Basin of the Eastern Mediterranean Sea have opened up considerations for long-distance, deepwater subsea tie-backs and transportation pipeline systems in the region. Pipelines will experience significant changes in water depth and cross a number of geologic regions each with their own distinct features and conditions relevant to successful routing and engineering of pipelines. INTECSEA is at the forefront of multi-disciplinary, regional, technical, and commercial pipeline routing feasibility studies in this region; utilizing its extensive subsea engineering project experience and developing novel, GIS-based route evaluation methods and tools. Future projects will continue to advance these methods and tools further than the current state-of-the-art discussed here.

Complex Regional Geology Presents Challenges to Routing Feasibility

The complex geologic setting of the Eastern Mediterranean Sea, as shown in Figure 1, presents a number of challenges to the siting of subsea facilities and routing of pipelines in the region.

Regional plate tectonics dictate the overall geologic setting and very large-scale features such as the Hellenic and Cypriot Arcs, Mud Volcano Belt, Mediterranean Ridge, Eratosthenes Seamount, and numerous basins, rises, and ridges. Tectonics in this area are some of the most active in the world, causing frequent earthquakes and occasionally very large (>8.0 Richter), devastating seismic events. Shallow-buried salt is deformed in the subsurface by the interplay of regional and local tectonic stresses to form a highly irregular seafloor consisting of fault scarps and successive, linear ridges. All this occurs along with historic, large-volume sediment input from the Nile River forming the Nile Delta complex and deepwater Nile Fan consisting of numerous, deep, crisscrossing channels, steep channel walls, and turbidity current and levee/overbank deposits. This geologic setting poses many hazards, risks, and engineering challenges to pipeline routing such as crossings of large, active faults and fault scarps, slope stability and turbidity currents, seismic ground accelerations, potential for liquefaction, expulsion features, soils variability, on-bottom stability, and spanning.

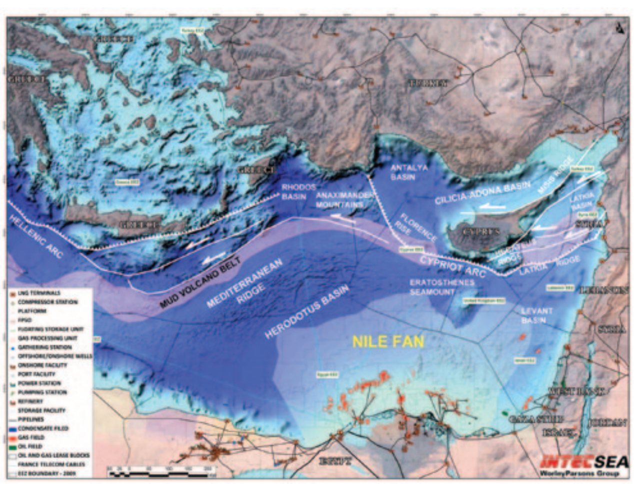
GIS-Based Routing Feasibility Methods and Tools

The Survey and Geoscience Group in Houston, TX is using Geographic Information Systems (GIS) to integrate geologic, survey, and pipeline engineering analytical data into a single regional geo-database, and, develop methods and tools to assist in optimal route selection and engineering of pipelines passing through complex geologic regions such as the Eastern Mediterranean.

Comparative GIS-based Route Scenario Evaluation Method

Comparative route scenario evaluation for the Eastern Mediterranean is based on establishing a solid geologic model. Expected geologic conditions are derived from the geologic model formed by assessing all data in the GIS geo-database and defining geomorphologic provinces with distinct conditions. Anticipated soil conditions are then estimated based on the processes necessary to form the geologic structure, shallow stratigraphy, and seabed features observed in the province. Engineering considerations are then formed by review of how the natural conditions may influence the proposed pipeline and umbilical routes. Together, these properties form the basis for expected routing and conditions that influence route selection and will influence the final routing and engineering design. Each route is then individually assessed based on the provinces crossed, conditions of interest in that province, and % length of pipeline passing through that province. The result is a comparative route feasibility matrix that ranks various natural and manmade conditions for each route and the

Figure 1: Regional Geology of the Eastern Mediterranean Sea.



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anticipated level of engineering effort, based of current Standard Engineering Practice (SEP) expected for each condition along each route. To address uncertainty with respect to conditions and their impact on routing, the matrix further provides a routing % estimate of how the route length may be additionally influenced by the presence of each given condition when further detailed studies are conducted. The matrix subsequently provides a sum of the potential % the route length that may change due to conditions not fully resolved by the data available at the time.

Route scenarios are ranked, and, the results are used to fine-tune and optimize conditions along each route, or, select a final route. The results are also used to help plan for additional surveys or studies that will be required based on observed geologic conditions.

Regional Wall Thickness Tool

The Eastern Mediterranean basin is quite deep, with water depths in the center of the basin commonly exceeding 3,000 m with local areas, particularly along plate-tectonic boundaries, exceeding 4,000 m. Water depth plays a significant role in determining nominal wall thickness required to safely install and operate deepwater pipelines. It is also a basic engineering criteria to keep routes as shallow as possible in order to minimize pipe wall thickness, reduce pipe material costs, and allow for more installation vessel options for the pipelines.

Typically, 2-dimensional water depth profiles are cut and checked against wall thickness calculations for feasibility and, if not feasible, the routes are changed and new profiles cut and checked. A novel GIS-based regional wall thickness tool has been developed whereby the nominal pipe wall thickness depths established from traditional engineering calculations are thematically applied to the water depth grid over an entire region, in this case, the Eastern Mediterranean. The result is a nominal pipe wall thickness map for the entire region.

Thickness Map

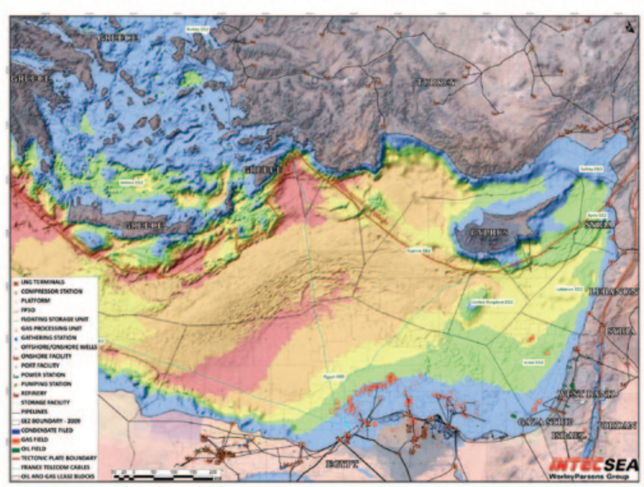
There are three primary benefits to using this new tool. First, routing is optimized in the selection process given full consideration to nominal pipe wall thickness and its implications for feasibility, installability, and cost. Second, this optimization of the route to minimize pipe wall thickness is visually proven from the map as it is obvious where wall thickness changes occur according to the depth range developed from the engineering analysis. Third, it moves quantitative engineering criteria up early in the route selection process, therefore cutting the cycle-time to final route selection.

Further Developments On The Horizon

Further development of the GIS methods and tools discussed above are already planned, but will require close coordination of personnel from engineering and geoscience disciplines. These developments include:

- Performing the literal pipeline wall thickness directly in GIS,
- Beginning to include commercial cost information in the province assessment which feeds into the overall comparative route ranking,
- Import a library of installation vessels with top-tension and installation depth capabilities into GIS and cross-reference to wall thickness and water depth grids,
- Establishing installation rates of progress in GIS for building preliminary schedules and budgets based on correlation with other data, and
- Engineering level-of-effort, or, complexity multipliers to pipeline costs for complex areas based off known costs for designing pipelines using SEP.

Figure 2: Regional Pipe Wall Thickness Map



BPPS Gas Supply Project – EPCM

by Chia Hong Kiat

Castle Peak Power Company Limited ("CAPCO") is a joint venture between ExxonMobil Energy Ltd. (60%) and CLP Power Hong Kong Limited ("CLP") (40%). On behalf of CAPCO, CLP is managing the Construction Works of the Black Point Gas Supply Project ("BPGSP") in the Black Point Power Station in Hong Kong.

Black Point Power Station (BPPS) requires alternate gas supply by 2013 because of the depleting Yacheng 13 gas field. Consequently, Hong Kong and People's Republic of China Governments signed a Memorandum of Understanding (MoU) in August 2008 to supply gas to Hong Kong.

CAPCO has currently identified gas supply from two sources as mentioned below:

1. Natural gas from second West Est Pipeline (WEII)
2. Re-gasified LNG from the proposed new LNG import terminal at Shenzhen

The gas is supplied via a 20 km 32-inch subsea pipeline from Dachan Island in Shenzhen to BPPS. Following the successful completion of the FEED design of the submarine pipeline and the gas receiving facilities (GRS), WorleyParsons (INTECSEA) is retained to execute the Detail Engineering, Procurement and Construction Management Support of the new works and modification works required in the gas receiving facilities (GRS) and BPPS modification. The construction of the GRS/BPPS modification is carried out by CAPCO's Construction Contractor. The procurement service of major and long lead time materials is carried out by WorleyParsons (INTECSEA). These materials are free-issued to the Construction Contractor for the execution of the Construction Works. The construction of the subsea pipeline is by China National Petroleum Offshore Engineering Company Ltd. utilizing Laybarge CPOE 101, and the modification of the existing gas turbines in BPPS is carried out by GE.

Arctic Production Flow Assurance Using Direct Electrical Heating

by Rebecca Roth, Duane DeGeer and Mike Paulin

Flow assurance is an integral part of the design and operability of in-field development and is becoming an ever-increasing critical step in assuring reliable flow in today's longer and deeper subsea tieback possibilities. Depending on the specific ice loading and ice coverage conditions of a particular region, field developments in Arctic and Cold Regions are considering Subsea Active Processing Technology (SAPT) and all-subsea completions (no host facility) as a means of production. In these instances, direct electrical heating (DEH) can be considered a reliable option for efficiently heating the producing flowlines and maintaining an acceptable level of flow assurance. DEH opens up areas of development otherwise not considered viable by production companies by enabling operation to stay within the hydrate formation regions and above wax appearance temperatures.

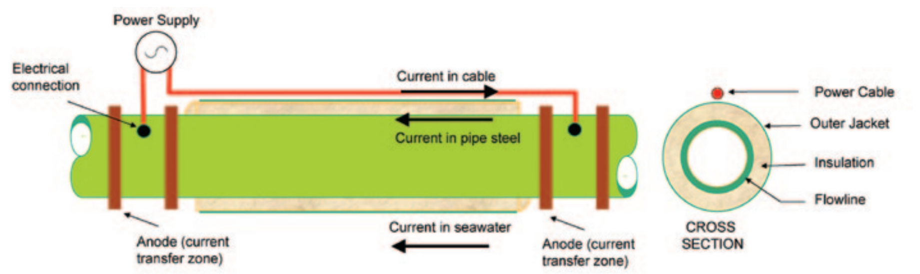


Figure 1: Open Loop (Wet Insulated) Direct Electrical Heating

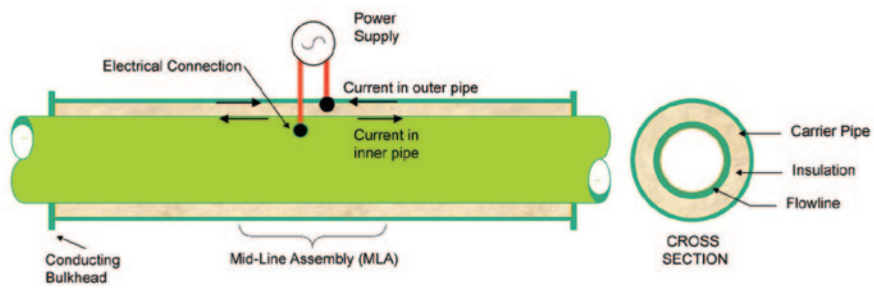


Figure 2: Center-Fed Pipe-in-Pipe Direct Electrical Heating

If enabled at the onset of a shut-in, Direct Electrical Heating can be used to maintain the temperature of a flowline's content above the hydrate and/or wax appearance temperatures. If the flowline has been allowed to cool down during a shut-in, a DEH system can be used to elevate the temperature to allow for start-up of production. The DEH heat is generated in the pipe wall as a result of the electrical resistance of the steel.

There are two types of DEH systems -- single pipe and pipe-in-pipe (PIP). The single pipe DEH system (aka open loop or wet insulated system) uses the production pipe and a piggy-backed power cable as the electrical circuit (Figure 1). The PIP DEH system uses the inner and outer pipes (connected by a conducting bulkhead at the far end) as the electrical circuit (Figure 2).

INTECSEA has been at the forefront of DEH developmental work since 2003 when the company worked closely with Shell during the entire lifecycle of the Na Kika electrical heating system, installed in the Gulf of Mexico in 5800 to 7000 feet water depth. Unique among other DEH systems, the Na Kika system is intervention-ready, meaning that the pipe-in-pipe flowline is divided into several heated segments, and the subsea transformer and power cable can be deployed from a vessel of opportunity and "plugged in" to any segment for heating when needed.

INTECSEA's scope included development of the 1.2MW intervention-ready, single phase power supply; interface management of the design, manufacturing, and testing of the MLA; qualification of the 2MVA wet-mate connectors; and development of the portable topsides power system.

Although the Na Kika DEH system is pipe-in-pipe DEH, INTECSEA takes a solution-neutral approach in feasibility studies, providing unbiased evaluation of all DEH system options.

If enabled at the onset of a shut-in, Direct Electrical Heating can be used to maintain the temperature of a flowline's content above the hydrate and/or wax appearance temperatures. If the flowline has been allowed to cool down during a shut-in, a DEH system can be used to elevate the temperature to allow for start-up of production.

Overall the course was a huge success, and PETRONAS has already requested INTECSEA engineers write some “Recommended Practices” to be used as internal standards to guide their move into deep water exploration and production.

INTECSEA Delivers Subsea Training for PETRONAS

by Ashley Helmer

INTECSEA recently developed and delivered three subsea engineering courses for PETRONAS, the National Oil Company (NOC) for Malaysia. PETRONAS was initially tasked with managing Malaysia’s oil and gas resources, and entered the international arena in 1991 when they secured their first overseas venture as operator in Vietnam. They now have an exploration and production presence in 22 countries accounting for almost a quarter of their oil and gas reserves. PETRONAS has reached the threshold that other countries achieve after several years. They have exhausted efforts in shallow water oil and gas reservoirs and are being forced to move into deeper waters in order to continue to discover new reserves. They had little to no experience in deepwater. That is where INTECSEA came in.

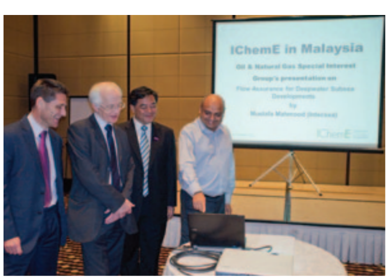
Training for Deepwater

INTECSEA hosted the last of a three-course training program October 18th – 20th at the Saujana Hotel in Kuala Lumpur. The training was titled “Subsea Hardware Manufacturing, Critical Quality Assurance and Testing,” and was directed towards industrial engineers. These courses were designed by INTECSEA engineers, including Jack Lim, Lead Subsea Hardware/Tree Engineer and Monteiro Neto, Lead Subsea System Engineer, both from the Kuala Lumpur office. Jim Burton, Subsea Engineering Discipline Manager from Houston, was the instructor of the training and also helped develop material. Engineers from PETRONAS also heard from Suhaimi Ismail, Operations Director of INTECSEA Malaysia. The courses covered production planning, design, processes and quality, and included presentations related to the actual hardware that will be manufactured. The training is now owned by PETRONAS and can be taught throughout their organization.

Overall the course was a huge success, and PETRONAS has already requested INTECSEA engineers write some “Recommended Practices” to be used as internal standards to guide their move into deep water exploration and production. Congratulations to all those involved from the Kuala Lumpur and Houston offices on their successful execution of subsea training for PETRONAS!

Flow Assurance Challenges Delivered in Kuala Lumpur

by Johan Samad



Mustafa Mahmood, Flow Assurance Manager at INTECSEA’s Kuala Lumpur office delivered a presentation on Deepwater Flow Assurance Challenges at the Institution of Chemical Engineers (IChemE) Malaysia Branch Special Interest Group on Oil & Natural Gas (SONG) February meeting.

The event was held at the Grand Millennium Hotel in KL, and attracted more than 40 participants, mainly KL based Flow Assurance engineers. Judging from the lively Q&A session that followed, there was a fair bit of interest in the material delivered.

Also in attendance at the meeting were David Brown, CEO of IChemE, who happened to be visiting KL at the time, Mike Fox, Development Manager at Talisman Energy and Chair of SONG in KL, as well as Johan Samad, Manager of Projects at INTECSEA KL and Immediate Past Chairman of the IChemE Malaysia Branch (all pictured together above with Mustafa).

The IChemE Malaysia branch has the second largest group of members worldwide, after the UK, and SONG is the most largely followed Special Interest Group within the institution.

INTECSEA KL is planning further presentations at conferences in the region within the year.

Inside INTECSEA

The 2013 AOG International Exhibition and Conference will take place February 20-22 in Perth, Australia. More information is available at the AOG website: **http://www.aogexpo.com.au**

AOG

by Cynthia Calderon

The Australasian Oil and Gas (AOG) Exhibition and Conference, was held February 22-24, 2012 in Perth at the Perth Convention and Exhibition Centre. This year AOG received over 480 exhibitors from 16 countries and over 14,000 visitors from Australia and overseas. In addition to the exhibition, AOG included a conference, Oil and Gas Careers Day, and a variety of networking opportunities. The Subsea Australasia Conference ran in conjunction with AOG.

Attendees were able to see firsthand the very latest in subsea technology, asset management, flow control, safety and engineering from the world's leading EPC companies, operators, contractors, and service and supply companies.

INTECSEA's involvement included a booth in the Subsea Zone and, in conjunction with WorleyParsons, INTECSEA participated in the Oil and Gas Careers Day. In addition, Ash Palejwala (Flow Assurance Group Manager) and Linh Lee (Flow Assurance Engineer) presented a paper on behalf of Chevron titled "Erosion: Optimizing the Design Process to Avoid Excessive Conservatism."

Following is a small overview of the paper:

Conventional one dimensional erosion models such as API 14E, Tulsa University SPPS and DNV RP 0501, can lead to an overly conservative design due to their simplistic nature. By contrast, CFD modelling can identify complex flow patterns and erosion phenomenon that allow the design to be optimized. This has the potential to improve safety performance by minimizing erosion and other issues that could result in a failure, as well as providing significant cost savings and schedule benefits. CFD modeling is, however, a very labor intensive exercise that is far more sensitive to the quality of inputs and associated assumptions. The challenge for operators is to:

- Choose a conservative modular subsea equipment design. Due to the compact nature of modular equipment this can result in high erosion rates necessitating retrievability, or
- Choose a design that is optimised to minimise erosion. In this case, the inherently non-compact nature means it is non-retrievable and therefore a higher risk solution.
- Both options rely heavily on an understanding of the impact of operations on sand production. This presentation discusses the advantages and disadvantages of each approach.

INTECSEA Wins Again!

by Brandon Hughes

INTECSEA has been participating in the annual Petroleum Club regatta on the Swan river for many years now and has had guest crew from Chevron associated with the Wheatstone projects for the last three years. Each year there has been 12 to 14 Farr 36 yachts competing with very close and exciting racing with the occasional collision. Many of the crew have no previous experience of sailing or racing, but they are put to work on the winches and sheets, and spinnaker pole for the first time.

After half an hour of training it is into the racing with much shouting on the start line as the boats all try to be on the line at the same time, but also having to obey strict rules of the road – quite an experience for those new to the sport. A good start, finely tuned crew work, sail trim and tactics up the course are critical to the success of each yacht.

INTECSEA has now won the day two years in a row. This year it was an emphatic win with a first and a second. The day was finished off with drinks and dinner at the Royal Perth Yacht Club.

A very good day was had by all.

To contact your nearest INTECSEA office,
visit **intecsea.com/contact_us.asp**