New technology gives electric ROVs a competitive edge
Hitec Subsea invests in technology and man machine interfaces. These investments is put to work in Remotely Operated Vehicles (ROV's) and other areas within the subsea robotic industry.
Dear Colleges

I would like to thank the members and the sponsors for the opportunity to publish this number of FFU-Nytt in connection with ONS 2000.

FFU – Forening for Fjernstyrte Undervannsteknologi (Association for Remote Controlled Technology) main objectives are to communicate knowledge and contact between authority, educational establishment, research, operators, and sub contractor companies.

FFU publishes FFU-Nytt (Newspaper) 4 times a year. This year an improved Internet site has also been established, www.ffu-nytt.no, where you are welcome to visit us.

The last year has been a challenge for many companies, where few if any new contracts have been awarded. The oil companies' economy is better than ever. Statoil's profit was NOK 7.9 billion before and NOK 2.3 billion after tax in the first quarter of 2000. Despite this fact the industry is still waiting for new subsea construction work, and the concern now is employee reductions.

The most positive in the business must be the Maintenance and Repair contracts. M&R work has become an important part of the ROV companies' income. And in the future these contracts will be of great importance for the industry. I believe that in the near future a number of new companies will find the way to this growing market. Also new Engineering companies have been established in the last few years, as a result of mergers between some of the big actors in the subsea market.

I hope you find FFU as an interesting organisation, and we wish all of you welcome to enjoy us as members.

Pål Espen Antonsen
PROMASTER: A NEW APPROACH TO HANDLING OF MODULES AND HEAVY OBJECTS IN DEEP WATER

The Promaster has been designed to provide a tool for the launch and recovery of modules and heavy objects of up to 1000 ton in deep waters down to 3000 metres with high precision in position accuracy and with the avoidance of any additional guidelines or other guiding systems. The system comprises a thruster module, a Launch And Recovery System, and a surface control system all installed on a monohull offshore ship.

Authors: Francois Bernard, b&a industries. Svein Moldskred, Haugesund Offshore Services

The last 5 years have seen an explosive growth in the use of oil and gas technology installed directly on the seabed in increasingly deeper waters in order to reduce the costs of producing a barrel of oil. As the production frontiers are getting deeper and deeper, a new generation of remotely operated vehicles seems to be required in order for sub-sea installations to remain economically viable. 1998 saw the barrel price fall below $10 resulting in cutbacks in all areas of production and developments offshore. Although the price of oil has climbed back in 1999, the target level to justify field developments is still below $15 per barrel. The challenge therefore is to develop a technology that will assist in maintaining oil production at sustained profitable levels at below $15 per barrel and in some cases even below $10.

THE PROMASTER DEVELOPMENT

Against this background, b&a Industries has developed the Promaster which intends to provide a radically new approach to the deployment and safe installation of virtually any loads to a depth of 3000 meters while cutting down both installation time and costs. The Promaster is a powerful tool, which uses a newly developed, self-contained and fully automated positioning and controlling system by which an absolute positioning accuracy of 1.5 meters through a 1000 meter water column is believed to be reachable. Structurally, the system comprises a main module and a counter module joined together by a frame, itself harbouring a hydraulic clamping device capable to mate with a load. Furthermore, a set of four powerful Curvtech thrusters (4 x 1.5 Te) mounted on turn tables and on each part of the modules two by two, ensure translation and torque control means, enabling the tool to direct the behaviour of the load while being deployed through the entire water column. In order to enhance torque control (Max. 260 kNm) the structure is designed such that the counter module can travel along its horizontal axis, while maintaining its Centre of Gravity (COG).

Keeping in mind the coherence of the Promaster design with other on-going projects, it was decided to provide the tool with the possibility to also mate loads up to 40 tons directly under the main module by a single docking pin arrangement. Last but not least a special tooling and power plant platform able to swivel 270 deg. form an integral part of the Promaster system.

The Promaster Thruster module

The STAR System
STAR denotes “Storage, Transport, Application & Removal” and was specifically designed in order to bundle two or more cables made from different materials, moving unsynchronically and at different speeds with respect to each other – in this case, a synthetic fibre main lifting rope and an umbilical. The aim of such a development is to prevent “cables” from getting entangled or getting damaged while paid-in or out to great depth. The entire machine is automated and will be able to cope with displacement speeds of up to 2.4 m/s dictated by the Promaster heave compensated and constant tension winches arrangement.

The Promaster Launch & Recovery System (LARS)
The LARS consist of a 60 tones SWL A-Frame, a 60 tones SWL main lifting winch actively heave compensated and a set of 20 tones SWL umbilical winches constant tension controlled. The winches are asymmetrically positioned in relation to the frame assembly allowing equipment to be positioned between the legs of the A-Frame without interfering with the various cables. The assembly harbours a latching system comprising a rotary table allowing orientation of the lift if required and several damping mechanisms. For optimisation, a secondary heave compensation unit has been installed in the latching assembly of the Promaster, which can be actuated for final docking of the load at depth.

Present status and Marketing
The system is presently under construction in The Netherlands. France, Denmark, Norway and in the UK and it is planned to have its first deepwater tests during first part of 2001. New developments of the system are constructed under patent rights or are under patent pending. The Promaster system will be marketed and made available for service operation on dedicated ships to users around the globe. b&a Industries has appointed Haugesund Offshore Services to represent the Norwegian market.
MacArtney controlling ocean systems - optically

Nexus fibre optic telemetry system - the new multibeam sonar multiplexer developed by MacArtney

Focal Technologies fibre optic telemetry system - video/data multiplexer model 903

Jupiter - a tool control system from Zetechtics

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Stjerneklart i dypet

West Tech AS i Haugesund introduserer en ny generasjon undervannskamera. Den digitale teknikken overfører stjerneklare foto fra dypet til oppdragsgiver på land i løpet av få minutter.

Av Thor H. Nordahl. Foto: West Tech AS


Høy bildekvalitet
Østebøvik hevder at kameraet er det beste av sitt slag i verden. Det er tenkt brukt på ROV for å dokumentere arbeid og inspeksjon på en ny og bedre måte enn det som hittil har vært tilgjengelig i markedet. Kameraet (i standardversjon) er trykktestet for bruk ned til 3.000 meter. Ein av dei første brukarane er undervannsentreprenøren Stolt Offshore AS i Stavanger som til nå har fått levert to kamera og har flere på leie.


Ved hjelp av medfølgende software, kan operatøren umiddelbart se kvaliteten på bildet som er tatt og enten streke det ut og ta nytt eller hente det opp til systemets PC på direkten. Deretter kan bildet sendes videre til land ved hjelp av e-post.
— Det nye med SDS-kameraet er den høy og svært gode bildekvaliteten (2.1 Megapixels/1600x1200 billedpunkt) som mulig-gjør utstrakt bildebehandling.

Høy kvalitet: En sjøanemone i Smedasundet fotografert med det nye digitale undervannskameraet.

Innstrått bildebunn ja kan få resultater av inspeksjonen på det aktuelle objektet. Dess-uten kan vi tilby ein pris som er langt under konkurranende produkt med lavere oppslåning, sier Geir Egil Østebøvik.

I slutten av april månede i år ble der utført en test sammen med Bloms Oppmåling med kameraet, hvor Bloms ville se om dette var brukbart som grunnlag for fotogrammetri eller 3-D målinger ved at det ble tatt bilder fra flere vinkler av et objekt. Det vis- te seg da at kameraet er i stand til å gi en oppslåning på 0.8 mm og hvor Bloms var meget fornøyd med resultatene. Målingene ble gjort ved å telle billedpunkter (pixels). Fra offshore om bord i MRV "Seaway Kingfisher" ble kameraet brukt tidleg i året, hvor brukerne var svært fornøyd med resultatene. Fra prosjektlederen fikk vi følgende uttalelse: "Jeg har nettopp sett gjennom de digitale bildene som ble tatt offshore fra Seaway Kingfisher og de er bare helt fenomennale! Superb kvalitet! Noe med det mest imponerende jeg har sett på lenge. Gratulerer! Dette lover meget bra!" Det er alt 20 ansatte i West Tech AS, men bemanningen vil bli noe høyere. Det er budsjettet med rundt 20 millioner kroner i omsetning i 2000 og kanskje det doble i løpet av noen år.
Ung jubilant

West Tech AS feiret ett år den første juli i sommer, og er fornøyde med tingenes tilstand i sitt første leveår. - Så langt har det beste gått som planlagt. Vi ligger i tråd med forventningene og budsjettene og så langt ser alt bra ut, forteller Thor Nordahl i West Tech.

Som basis har det Haugesund baserte selskapet en serviceavtale med Stolt Offshore med en tidsramme på 3 år fra starten, hvor West Tech skal ha service og vedlikehold av Stolt Offshore’s utstyr som er plassert i Norge. Denne avtalen har gitt etttåingen et godt grunnlag for videre utvikling.

- I løpet av siste år har vi lagt store samar i utvikling av egne produkter, som for eksempel mekanisk "Mini-latch" og "Maxi-latch", Digital Stills Camera med høy oppslåning for undersøksbruk, forbedret 3-fingret i for Schilling manipulatorer, spesi-al-lys for fiskeopdrett, "kraft-blokk" for tetharket til små farkoster (opp til 30 mm diameter).

HPR-transducer oppheng for redningssekskapet, slepe-fisk med kamera for søk ned til 100 meters vanndyb med lys, spesialklo for håndtering av nedi-hulls verktyg/wireline verktyg på børedekk, hydrauliske kompensatorer og en rekke spesialverktøy for ROV for å nevne noen, sier Nordahl.

På service-siden overhales blant annet Schilling manipulatorer, pastelutfyst y for dykkere og alle typer hydrauliske verktyg.

- Vi tar også service på sleperinger fra Focal, hvor vi har spesialkompetanse på utskifting og testing av de elektriske komponentene. West Tech er dess-uten i stand til å levere komplette ROV-systemer fra de minste observasjons-ROV’er til store, avanserte, arbeids-ROV-systemer samt å drive service og vedlikehold på samme. Vi kan også stå for daglig drift av ROV-systemer for kunder, avslutter Thor Nordahl markedsfører ved West Tech.

Statoil Gullfaks Phase II bundels

By Trond Inge Ramsnes

Halliburton Subsea have recently launched towed and installed their biggest bundles to date for the Gullfaks Phase II development for Statoil. The 14km bundle constructed and installed in two 7km sections weighed in at an overall 18000Te - 9000Te each section. The size of the outer carrier pipe was also the largest to date at 1.257m (49.5") in diameter.

Gullfaks Phase 2 is a subsea gas recovery development of 8 wells (plus future option of 4 wells) tied back to the Gullfaks C platform in 200metres waterdepth. There are several similarities with the 10km long Gullfaks Phase I development, which tied back to Gullfaks A platform and was installed by Halliburton Subsea in 1998.

These similarities are:

a) the use of 13% Cr material for the Production Flowlines.

b) the inclusion of Controls within the pipeline bundle.

c) the inclusion of hot water heating in the bundle to prevent hydrates forming.

d) the use of fibre optics for real-time flowline temperature monitoring.

The bundle comprises 2x14"Production and 1x8"Test line, 2x4.5"Heating lines, 2x2.5"Methanol lines and Controls Tubing/Cables. The fibre optic for temperature monitoring is installed, into a tubing conduit pre-installed in the bundle, from the platform once the system is completed. The towhead structures at each end of the bundles contain docking porches for the connection of all tie-in spools and umbilicals using diverless connection tools. Three of the bundle towheads weighed 100Te each and the platform riser towhead weighed in at 150Te.

The bundles were constructed and launched from the Halliburton Subsea Wester Site in Wick, Scotland and were both installed diverless in a single campaign of 24 days. The steel production risers, which were also in Halliburton Subsea’s scope were fabricated at Hinnavan in Stavanger and towed to the field by the Controlled Depth Tow Method (CDTM). Buoyancy tanks were attached to the steel risers which were clamped in a flat pack arrangement. Once they were towed out and lined up with the platform J tubes, the clamps and buoyancy tanks were removed and the risers pulled into the J tubes. The 12”production risers were each pulled into spare 16”J-tubes at Gullfaks C platform with pull-in loads of 50Te despite the tight tolerances.

The production tie-in spools between the bundle sections and the bundle to risers, were heated by ‘piggy backed’ hot water lines encapsulated within the insulation system. This feature prevented hydrates being formed in the low points typically found in tie-in spools.

The completion of the Gullfaks Phase II bundles marked 43 bundles installed to date from the Wick site. Halliburton Subsea have one further bundle to be launched during the 2000 season, and a further two bundles committed for launch in the 2001 season.

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Elektrisk ROV bygget på åpen ramme

ROV-systemene fra Seaeye Marine er korrosjonsfrie og lite vedlikeholdsrevene. Produktene fra det britiske selskapet blir av mange regnet som det ypperste innen elektrisk ROV er. I Norge er det fortsatt bare Rockwater som bruker systemene, mens langt flere bruker selskapets ROV er i Sør-Europa, Asia og Australia.

Av Thor H. Nordahl, West Tech AS

Seaeye Panther utstyrt med SM 5 thruster


Seaeye Marine produserer også sine egne børsteløse likestrøms (DC) thrustermotorer som blir brukt gjennomgående på alle ROV-typene de produserer. Disse blir bygget individuelt, trimmet til perfeksjon og grundig testet i vann og trykktank før de legges ut for salg/bruk. De fleste ROV-modellene i Seaeye's produktregister har thrusterne montert i en vektor-konfigurasjon for optimal utnyttelse og manøvrerbarhet. Thrustermotorer har gjennom årene oppnådd å få meget gode skussmål fra brukere verden over.


ROV-systemene fra Seaeye Marine blir av mange regnet som målestokk for små elektriske ROV-systemer og de er brukt verden over i olje-industrien med oppgaver som bore-støtte, dykker-observasjon, lette til mellom-store arbeidsgiveren, survey og generell observasjon.


Batteri-flasken på farkosten kan skiftes på få minutter slik at en kan oppnå tilnærmet kontinuerlig operasjon med dette systemet. Seaeye BOSS bruker samme thruster-teknologi som de andre modellene i Seaeye's produktregister.

Seaeye Tiger utstyrt med SM 4M thruster
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Electric LARS Lightens the QUEST’s On-Deck Handling System

By Wes Gerriets, ALSTOM Schilling Robotics

The new QUEST electric launch and recovery system (ELARS) from ALSTOM Schilling Robotics is so small and light that you would never guess it is used to handle a work-class ROV. The small ELARS size is made possible by the QUEST’s reduced umbilical cross section size (only 27 mm for a 3000-meter system), which greatly reduces total umbilical weight. The estimated system shipping weight, including the QUEST WROV, TMS, winch/ELARS, and 3000 meters of umbilical, is 21,775 kg (48,000 lb).

ALSTOM Schilling Robotics is currently building a prototype of its all-electric LARS, which features proven ALSTOM AC vector drives. As designed, the system is much smaller and lighter than typical A-frame LARS equipment. The programmable all-electric drive system offers cable recovery speeds over 1.3 m/sec and active heave compensation for safe docking of the WROV and TMS. From the control van console, the operator can precisely monitor and control winch performance. Standard features include a Lebus-style grooved drum, a failsafe brake system, and automatic level winding.

The innovative deck configuration facilitates installation and mobilization, and allows the WROV and TMS to be transported while connected to each other on the skid base. The LARS/WROV/TMS equipment is lifted as one unit, simplifying placement and reducing crane dependence.

Rather than swinging the WROV/TMS package through an A-frame for launch and recovery, the QUEST ELARS simply lifts the WROV/TMS off the deck and then moves the entire winch and gantry assembly on a track system to the deck edge. This track system has important advantages:

• Since the WROV/TMS package is not constrained by the width of an A-frame, larger tooling packages can be safely deployed.
• The TMS and WROV are less likely to be damaged by contacting the LARS equipment during recovery.
• LARS on-deck weight and complexity are significantly reduced.

The track concept is not new in the offshore industry. A similar track system is often used in saturation diving to move the bells from the cursor to the DDC. Also, entire drilling and workover systems are now moved between moon pools on tracks.
The electric QUEST WROV system from ALSTOM Schilling Robotics is based on a set of simplified, integrated subsystems for propulsion, control, and communication, and is the first WROV in 30 years to be engineered from the ground up. All aspects of the system, from training, operations, and maintenance through packaging and transport, have been studied, tested, and prototyped to identify the best practical solutions.

By Wes Gerriets, ALSTOM Schilling Robotics

Tools and Sensors
Installing tools and sensors is an important (and often difficult) part of any WROV mission. The QUEST is designed to make this task simple and efficient.

Q. Can I install and run hydraulic tools?
A. Standard equipment on the QUEST WROV includes a 7.5-kW electro-hydraulic power unit (HPU) that outputs 19 liters per minute at 207 bar. The HPU is powered by a QUEST electric ring motor that drives a fixed displacement CIIG pump. One unique feature of the QUEST HPU is that up to three pumps can be “stacked,” allowing one motor to selectively drive any one of the pumps. This feature lets the operator create flexible systems for tool operation or fluid delivery. Since the pumps are hydraulically independent, “dirty” hydraulic fluid, water/glycol, or preservation fluid can be delivered without contaminating the system. Since the drive motor is the standard QUEST brushless DC ring motor, fluid pressure (which is controlled by motor torque) and flow (which is controlled by motor speed) can be precisely regulated from the operator console.

Q. How many SeaNet connection ports are available for additional equipment?
A. With a full load of standard equipment, the QUEST SeaNet communication hub has 12 unused digital RS-232 connection ports and 4 unused analog/digital connection ports (for cameras, sonar, etc.). Standard equipment includes one ORION 7P and one RigMaster manipulator, HPU, eight-function hydraulic manifold, color camera, SIT camera, pan & tilt unit, five high-intensity discharge lights, sonar head, aft viewing camera, Doppler velocity log, Novatech strobe, and RF beacon.

Q. What electrical power is available for optional tooling?
A. The QUEST WROV offers several options for auxiliary electrical power. For sensors and small tools (including the SeaNet actuators), up to 250 W is available at each 26-VDC SeaNet connection port. For equipment with higher power requirements, two 15-kW connection points provide 600 VDC each. These 600-VDC feeds can power additional QUEST ring motors (for suction-piling skids, dredges, pull-in skids, etc.), or can operate standard electric motors.
always available at the GUL, allowing
the operator to direct electrical current
to the active tool. For dedicated tooling
systems (such as trenchers), additional
conductors can be added to the umbilical.
A 150-kW umbilical for 3000-msw
operation has a diameter of only 31 mm.
Q. How can I interface rental (hired) equip-
ment to the QUEST?
A. For items that cannot be easily conver-
ted to the SeaNet connection system,
we supply a small interface bottle that
features standard, threaded penetrations
on one end bell and SeaNet connectors
at the other end bell. Inside are terminal
strips for interconnection and space for
any required power supplies. The inter-
face bottle allows the operator to easily
and quickly install and remove tempo-
rary equipment.

**QUEST WROV Size and Capability**
Because the QUEST is noticeably smaller
than most hydraulic work-class ROVs,
some people have asked whether the
QUEST can be used for construction sup-
port, survey, IRM, and other work-class
applications. The answer is a definite
"yes."
Q. The QUEST looks smaller than typical
hydraulic WROVs. How does its per-
formance compare?
A. The QUEST WROV is smaller; the
standard 3000-msw vehicle is 1.7 m
wide x 2.3 m long x 1.6 m high. Approx-
imate air weight (including a full suite of
standard equipment) is 2275 kg, in
contrast to standard hydraulic WROV's
that typically weigh more than 4000 kg.
Because the QUEST vehicle is not loa-
ded with equipment needed to produce
hydraulic thrust (such as large, heavy,
main HPUs, valve manifolds, and
piping), the QUEST’s frame and
buoyancy unit can be smaller and ligh-
ter. And because the electric thrusters
provide more output than most 150-hp
WROVs, the QUEST is much faster
(with speeds greater than 4 knots) and
more controllable. The ability to direct
maximum power to a specific set of
thusters (a feature not possible with
standard open-loop hydraulic systems)
also increases vehicle control.
Q. What is the QUEST’s standard through-
frame lift capacity?
A. The QUEST frame has a 2-tonne
through-frame lift, allowing it to accom-
modate heavy tool skids. The design is
DnV-certified and is tested prior to deliv-
ery. Mechanical "quick connect"
points allow skids to be safely and easi-
ly interchanged while the vehicle is on
deck.
Q. How much reserve buoyancy (lead)
does the QUEST have for the installati-
on of optional equipment?
A. In its standard configuration, the 3000-
msw QUEST includes 160 kg of lead to
accommodate optional equipment.

**Electric Thrusters**
An innovative electric ring motor provides
the power for the QUEST’s thruster, TMS
drive, and HPU drive.
Q. How can the thruster have only one
moving part?
A. On the QUEST 600-volt, brushless DC
electric ring motor, windings and lamin-
ations are on the outer perimeter (sta-
tor) and the permanent magnets are in
the inner rotor. (This arrangement is the
reverse of most general-use motors.)
The thruster blades are fixed to the
rotor, which is the only moving part in
the entire propulsion system. This
design features an open center that
allows debris to pass through. Also,
because the motor is not in the flow
path, thrust is equal in both directions.
Q. I’ve heard that the thruster does not use
rolling bearings or dynamic fluid seals.
How can this be so?
A. Ball and roller bearings typically require
a sealed housing with lubrication, which
in turn generally requires high-speed
shaft seals. This design has frequently
proven to be unreliable in operation and
difficult to service in the field. The
QUEST electric ring motor uses inno-
\*\*\*vative hydrodynamic bearings that
require only seawater for lubrication.
(\*\*\*This design is similar to the journal
bearings in an automotive engine
crankshaft, except the QUEST’s mater-
ials are plastic.) The natural pumping
effect of the bearing system directs
water through filters that screen out
sand and debris.
Q. How powerful are the thrusters?
A. The QUEST’s electric thrusters have a
sustained thrust of 205 kg when measu-
red in the worst case (static condition
with no flow around the shroud). While
hydraulic thrusters with the same throat
diameter can demonstrate similar thrust
in laboratory settings, this performance
is never achieved in ROV applications.
Typically, the hydraulic pressure and
flow delivered to the thruster motor is
50% or less of the rated power due to
pressure losses across valves and vis-
cous losses through small-diameter
tubes, hoses, and fittings. Efficiency is
also lost through depth-related increases
in viscosity and decreases in lubricity.
Q. How can the thruster be used to power a
TMS or HPU?
A. For applications requiring a direct
mechanical drive (the HPU pump and
the TMS drum and tensioning sheave),
the thruster blades are simply replaced
with an adapter plate. The electric ring
motors for these devices are identical
and interchangeable, and technicians
can easily swap motors in the field.

**Electric Power Transmission and
Conversion**
By using new technologies and applying
power conversion techniques not previous-
ly used on ROVs, we have made the
QUEST’s power system small and effici-
ent.
Q. I have heard that you are using a transmission frequency higher than 50/60 Hz. Does this improve system performance?

A. The QUEST uses 3-phase, 3-k-VAC power transmitted down the umbilical and tether at 600 Hz, allowing a significant reduction in power transformer size and weight. (A 60-Hz transformer with the same output rating weighs approximately 365 kg, five times more than the 73-kg QUEST transformer.) The electrical system allows the QUEST WROV to perform better simply because there is less ROV weight and size for the thrusters to push through the water. The reduced complexity of the electrical system also makes troubleshooting and maintenance much easier.

Q. Can the QUEST operate from the ship’s mains?

A. The QUEST electrical system does not require any special filtering or conditioning for incoming power. The system operates on voltage levels from 380-575 VAC and at frequencies as low as 45 Hz. Assuming that the ship can supply at least 100 kVA for the system, there is no need for a dedicated generator or MG set. If a generator is needed because ship’s power is unavailable, the QUEST WROV can use a generator that is significantly smaller (125 kW), lighter, and less costly.

Q. Why are the QUEST umbilical and tether so much smaller?

A. Using innovative electrical and optical transmission techniques has allowed us to significantly reduce cable size and complexity. The umbilical contains only three conductors (plus one spare) for main ROV/TMS power, in contrast to hydraulic systems that require up to 21 individual conductors just for power. Since the QUEST does not use AC induction motors, only one power circuit is required for the entire subsea system. For telemetry, just one single-mode fiber is required for all data and video transmission. A second terminated fiber is installed as a backup. Reducing the cable content and complexity shortens the time required for cable termination. Rather than using dozens of copper conductors and multiple fibers, the QUEST system needs only three power conductors and one fiber. This reduction in complexity also reduces the potential for connection errors. Since the QUEST umbilical is significantly smaller and lighter, the deck handling equipment can also be smaller and lighter. The in-water weight of the umbilical (for a 3000-m system) is only 5.5 tonnes, while comparable hydraulic WROV umbilicals weigh more than 12 tonnes. With a diameter of 27 mm, the smaller umbilical allows a much smaller deck footprint for the winch and LARS. The smaller umbilical size also makes the deployed vehicle less likely to be affected by currents or dragged off the work site.

Tether Management System

By using equipment from the QUEST vehicle for TMS power, telemetry, and drive systems, we have created an electric TMS with superior operation and reliability.

Q. What improvements are featured in the QUEST TMS?

A. The TMS has a shuttling drum and a straight tether path that avoids the stresses and twisting common in typical designs. By eliminating tether twisting, cable life (especially for the optical fibers) is greatly extended. Because the cable drum and cable tension wheel are driven by standard QUEST electric ring motors, speed and line tension are variable from the control station. An innovative clutch mechanism and constant tension operation reduce snap-load on the tether during ROV docking.

The TMS uses a standard SeaNet hub for telemetry and a QUEST voltage converter for power. These parts are interchangeable with those on the QUEST WROV.

Since the TMS is essentially a QUEST vehicle without the buoyancy system, configuration is simple and fast. Adding sensors, cameras, or tools is a "plug and play" operation. Even thrusters can be added by simply bolting on standard QUEST units and connecting the power and telemetry. The QUEST TMS can also be easily converted to a garage-style unit.

Materials

Q. Your communications often mention the use of plastic materials in QUEST WROV subsystems. How far have you taken the use of plastics?

A. Currently, engineering thermoplastics are incorporated into the electric ring motor, hydraulic compensator, SeaNet connector, SeaNet hub connection ports, and much of the mounting hardware. For example, the ring motor features an injection-molded frame, and the stator and rotor are completely encapsulated in thermoplastic. The thruster uses plastic bearings and blades. We have invested heavily in injection-mold tooling to produce parts that are much lighter and essentially will not corrode.

Control Station

Q. At the Underwater Intervention 2000 conference, you exhibited a modern-looking control console and video/VGA display system. Will this system be included with every QUEST WROV?

A. At the beginning of the QUEST development program, we engaged human factors specialists to recommend ways to improve general operation and reduce operator fatigue and errors. As a result, the standard QUEST control system includes:

- Two-station operator console with individual touch-screen GUI displays
- Four universal hand controllers (to replace outmoded joysticks)
- TheaterView information display system (to replace 19-inch, rack-mounted monitors)
- Operator-selectable control modes, including Doppler-based ROV-DP (a first for a production WROV)

Pictures and Captions

Photo of operator console: The TheaterView system in the control station improves operator awareness and reduces fatigue. Photo of thruster parts: In the QUEST thruster, the rotor is the only moving part. Photo of the thruster: The QUEST thrusters are efficient and reliable. Photo of QUEST and TMS: Parts commonality between the QUEST vehicle and TMS simplifies maintenance and spares provisioning.
Ny elektrisk trencher

Stavanger selskapet Rovco AS har utviklet en ny type elektrisk trencher som kun veier ti tonn. Selskapet kjenner ikke til at det eksisterer andre elektriske trenchere på markedet i dag, og viser til de mange fordeler ved RTS 2000 "MERLIN".

Av Ole Klemsdal

Rovco ble etablert i januar 1999 av Sveinung, Atle og Helge Haugvalstad. Selskapet drev den første tiden med operasjonell trenching for Dykkertjeneste, med Telia sine trenchere. Raskt så de muligheten for å utvikle sin egen trencher, som kunne unngå problemene rundt breakdown som de hydrauliske systemene sliter med. Lösningen ble en elektrisk trencher, og arbeidet med å bygge "MERLIN" begynte i januar i år.

Utgangspunktet vårt var å analysere markedet, for å kunne utvikle komponenter som mangler i de eksisterende systemene. Gradvis i utviklingen av nye komponenter så vi en elektrisk trencher vokse frem, kombinasjonen med nyutviklede komponenter som kunne samkjøres med eksisterende elektriske løsninger på markedet, forteller Sveinung Haugvalstad.

**Letteste på markedet**

Pr. i dag kjenner vi ikke til noe annet sel-skap i verden som har utviklet en elektrisk trencher. I tillegg har vår trencher bedre kapasitet enn samtlige andre hydrauliske løsninger, mener Haugvalstad.

All hydraulikken er fjernet fra selve trenc-heren, og resten av komponentene er flyttet opp i en container på båten. Dette gjør at effektiviteten blir mye bedre, og breake down blir mye lavere. I tillegg reduseres trencherens vekt, som gjør den enkel å sjø- sette og løftes ombord. Rammerstrukturen som er bygd opp av GRP rør i et fagverk, har også sin positive innvirking på vekten til "MERLIN". Rørkonstruksjonen er fylt med oppdriftsmiddelde (buoyancy), som gjør at den er den letteste farkosten på markedet i dag med tilsvarende effektivitet. Den har derfor ikke de store oppdriftsblakkene som kjenner egene de hydrauliske løsningene, og derfor er den mye sikrere i forbindelse med sjøsettning og løfting ombord. Vi bruker egne ledere helt fra kontroll kon- teiner igjennom umbilical og ned til de forskjellige enhetene for å få et sikrere sys- tem. Om en av komponentene stopper, vil fortsatt alle de andre fungerer og vi trenger derfor ikke å stoppe operasjonen for å reparere den ene enheten, den tar vi når vi skal til overflaten for å gjøre planlagt vedli- kehold.

**Flere oppdrag på gang**

I dag mobiliserer vi for operasjon i forbindelse med Troll, i sammen med det neder- landske selskapet Noordhoek. "MERLIN" er også under evaluering for et prosjekt der man skal legge ned en fiberoptisk kabel i Nordsjøen, og dette arbeidet skal foregå nå i vinter.

---

**Vehicle Specifications:**

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<td>1 of SIT Camera 1 of Colour &amp; Zoom Camera 6 of Colour Camera</td>
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<tr>
<td>Lights</td>
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<td>Pitch &amp; Roll</td>
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<td>Sonavision 4000</td>
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<td>Auto Heading / Auto Depth</td>
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</tr>
</tbody>
</table>

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HYDRA™ e-MAGNUM

A new era of electric ROVs

By Erik Hestnes Sæstad

Electrically powered workclass ROVs are not new, in spite of the hype and image presently being projected. In fact the first ROV, the U.S. Navy’s CURV, was all-electric. This unit recovered the hydrogen bomb off the coast of Spain in the 1966. In the deepwater telecommunications industry the first cable recovery/burial workclass ROVs, Scarab I and II, were electrically powered with electrohydraulic HPUs to run tools in 1978. In the Oil and Gas industry the first workclass ROV, the TROVE, was all electric and to this day remains one of the best handling, most maneuverable workclass ROV ever built. Oceaneering developed the U.S. Navy’s Deep Drone series in the late 70’s – a deepwater, all electric workclass ROV that continues to perform yeoman service worldwide today, i.e. the recovery of the “Egypt Air” wreckage, fall last year. This is but a brief summary of all electric workclass ROVs. In reality, electric workclass ROVs have been operational for over 40 years, versus a little over 20 years for their hydraulic cousins. Therefore the eMagnum is more an evolution, rather than a revolution.

Major milestones in this ongoing effort are:

* Development and operation of the first commercial 6000 fsw rated electric ROV in 1978 – Scarab I and II.
* Development of the first commercial 8250 fsw rated ROV in 1982 – Hydra™ 2500.
* Development of the first all electric 10,000 fsw rated workclass ROV in 1984 – Deep Drone.
* Development of the first 25,000 fsw rated electric ROV in 1986 – CURV III.
* Development of the first family of high performance deepwater workclass ROVs in 1993 – the Magnus Series.
* Development of the high performance family of deepwater workclass ROVs in 1997 – the 150 hp Millennium Series.
* Development of the first, Magnus, Millennium, or E-Magnum compatible deepwater inspection ROV, the Hydra™ Minimum.

The development of the 100hp e-Magnum is the most recent capability produced in Oceaneering’s ongoing commitment to continuous improvement in deepwater operations. This to remain the industry leader in well proven during 14 years of operating the CURV 3 on 6000fsw, the Technodyne 107/110HP thruster.

The eMagnum is a 100hp system designed to be able to fully run all 7 thrusters, without any decrease in power, in other words it can maintain the horsepower evenly in the complete working envelope!

The e-Magnum's all electric propulsion, means that each thruster is independent of the others. As a result, failures do not cascade throughout the system. A hydraulically powered system can experience failures, or degradation, in the primary HPUs, valves, filters, and piping, all of which will impact performance. However, it is worth noting that Oceaneering’s all hydraulic Hydra Magnus are the dominant deepwater ROV, carrying out well in excess of 60 percent of the worldwide ROV work deeper than 5000 fsw in the Oil and Gas Industry today! That's more than twice as much as the next two ROV operators combined.

The Magnus has an outstanding record for reliability and performance, last year averaging less than 0.5% downtime, relative to dive time, on a fleet of worldwide deepwater operations. Before start-up of our active
pilot/tech training, we saw a system downtime in average of 3.5%. Then, by the help of, among other elements, the training was decreased to 0.5% downtime after three years.

The e-Magnum has been specifically designed to be fully interchangeable with the Magnum. Essentially from the Control Van to the ROV-end of the tether, the systems are identical. Either ROV can plug into the end of the tether and operate through the same overall system – tether, cage, umbilical, winch, control systems, consoles, etc.

We have focused on the interchangeability instead of minimizing size, this to be able to adapt the eMagnum to the standard Magnum system. Some might say that we go against the trend of smaller and lighter vehicles and tms systems, that might be true, but for a very good reason! The umbilical is a Rochester standard that weighs 3010kg/km in water, and we still use the 1045kg side-entry cage. This because we need the ability to deploy the system in rough sea states, which requires rapid transit through the splash-zone. And in deepwater operations the weight of the cage prevents from drift-off due to strong current. In addition the cage is situated with a Vector Orientation System, thrusted cage to better handle the demands of deepwater operations. The E-Magnum can be changed to a Magnum, or vice versa, in less than 12 hours.

The benefits of this approach are enormous, and more than offset by the tradeoff from not optimizing on smaller size. To replace one ROV with the other requires only a tether re-termination and the entering of the new control program, which would be on a separate control window. By adopting this concept Oceaneng has minimized the need for an entire new series of parts spread throughout the system. Essentially 85 percent of the Magnum and e-Magnum are identical. This further simplifies inventory control, logistics, and more importantly, the need to train/retrain technicians on an entirely new ROV system. For all practical purposes, the only new training required will be associated with the electric motors powering the thrusters and their speed control modules. As these are significantly less complex than the hydraulic system, the training and execution will be straightforward.

We believe that this reduction in complexity will result in improved operational efficiencies. Oceaneng’s approach means that during the period when there are a limited number of the E-Magnums available, the first few years for example, there will be no scenario that can cause an operation significant lost time. If an E-Magnum is damaged, lost, suffers a serious failure, etc. it can be replaced by a standard Magnum in transportation time plus 12 hours.

Backup, replaceability, interchangeability and

preventive maintenance is absolutely critical in deepwater operations because of their inherently high costs. This situation becomes even more critical if the operations take place in remote areas.

The e-Magnum should not be viewed as a “better” ROV than the Standard Magnum. The systems are different in that each provides certain unique capabilities. The Magnums and Millennums are able to use their hydraulic flows to not only power the ROV but to operate the widest range of subsea tooling possible. There is virtually no subsea tooling or workskid that cannot be supported by these two systems. Conversely, the e-Magnum utilizes a smaller HPU to operate an isolated 10GPM hydraulic supply for manipulators as well as the full range of tools found in deepwater drilling and completion operations, such as torque tools and cutters, etc.

The e-Magnum is not short of work capability in any way, except with respect to total hydraulic flow. It is important to examine the workscopes involved before making a final choice between the systems. As noted above, probably the most unique and valuable aspect of the e-Magnum and

Magnum is their interchangeability. Never before has there been the ability to customize the ROV work system to a degree that it can execute the scope of work in the most optimal manner possible. The ability to interchange the systems, once or multiple times, throughout an extended program that has a varying series of workscopes insures that the future deepwater programs do not have to be planned around a specific ROV’s strengths and weaknesses.

With the Magnum/e-Magnum concept we now tailor the workclass ROV to match the workscopes and allow subsea equipment designs, etc. to take advantage of this flexibility.

17 = Interaction between thruster and water in the nozzle

The e-Magnum represents the next major step forward in deepwater ROV capability and performance. Its enhanced performance, combined with anticipated reduction in downtime, offers another way, potentially a better way, to support deepwater drilling and completion operations. Combine the e-Magnum, with the electric Minimum, and you have created a deepwater capability of unparalleled reliability and capability not previously achievable. The combination will save several days of rig time per year, over the conventional ROV concepts offered by the balance of the industry.

The first years of this century offers exciting new opportunities, as the industry continues to add the capabilities and competencies of both its personnel and the hardware they operate. This approach is best typified by Oceaneng’s philosophy of excellence: e = mc²

e = excellence: first in, last out, always

m = motivation: individually and organizationally; sustained over time.

c = competence: individual and organizational knowledge, training, expertise, and experience throughout the organization.

c = capabilities: hardware; technologies; infrastructure; backup

All these areas need to be developed if we are to take advantage of the promise offered by any one of them.
NUI has delivered handling system for Hugin-3000

A service friendly and compact handling system for launch and recovery of autonomous vehicles

By Jon B. Seim

Last Autumn NUI a/s commenced engineering work on a container-based system for handling towed vehicles from the stern of support vessels. The design is based on NUI's experience with offshore handling of the Hugin-600 AUV "NUI Explorer". This offshore experience was an important criterion when Kongsberg Simrad a/s awarded NUI the contract for construction of a compact handling system for their Hugin vehicle. This is part of their delivery of a complete 3000 meter version, the Hugin-3000 system, to the US company C&C Technologies based in Lafayette, Louisiana.

The HUGIN 3000 system represents the third generation HUGIN technology and is a result of an extensive development effort from Kongsberg Simrad and FFI (Norwegian Defence Research Establishment) over the last three years. Construction started last Autumn and in June this year NUI handed over the system in Horten. A few weeks later the system was shipped to the US.

The system comprises 2 standard 20-foot containers - a Lanch&Recovey container for a hydraulically operated Ramp/Stinger mechanism, and a Service container for battery service and maintenance.

Even though the mechanical system is packed into the 20-foot L&R container the Ramp / Stinger mechanism protrudes well into the water from stern heights up to 5.5 meters. This is made possible by the use of a telescopic mechanism that is tilted and extended when required for handling the Hugin vehicle in and out of the sea, and is contracted into the confines of the container during sailing and servicing. The double doors facing the sea are fitted with a hydraulic open/close mechanism for safety reasons.

Similar to NUI's Hugin-600 system the Hugin-3000 vehicle is powered by a state-of-the-art aluminium/oxygen semi fuel cell battery developed and produced by FFI. The Service container therefore includes a section equipped with tanks, pumps, valves and control system for storing, filling, draining and flushing the vehicle battery fluids. Workshop and spares facilities are located in the other section, separated from the fluids section by a wall. The Hugin-3000 system is constructed for use in tropical waters with both containers well insulated and equipped with powerful air-conditioning.

The Hugin-3000 vehicle is equipped with an extensive sensor suite for seabed mapping - multibeam echosounder, side-scan sonar and sub-bottom profiler. Accurate positioning is ensured by an integrated navigation system. In order to protect the transducers of all these sensitive instruments the Stinger is equipped with cushions along all its length and the design includes a shock-absorbing hydraulic tilt mechanism.

NUI's mechanical and hydraulic design has been based on detailed analysis taking into account the shock waves and acceleration forces encountered in adverse weather conditions. Even though the system is rated for such heavy loads the environmental forces exerted on the system are decoupled substantially through spring-loaded joints and a flexible mechanical / hydraulic design.

The delivery of this handling system proves NUI's capabilities within integrated electro / hydraulic / mechanical constructions from the design stage through the engineering and construction phases to final delivery and documentation.

**Pilot trening**

Simulatoren er programmert med full "feedback", slik at hvis en kjører i sjøbunn vil man miste sikt og hvis en parkerer på et ventiltak, vil man kunne se at ROV'en beveger seg hvis man kjører manipulatoren ned i taket.

Simulatoren kan benyttes i flere sammenhenger foruten å trene opp offshore personell. Den kan benyttes til å laste inn en bestemt struktur for å verifisere tilkomst, å trene personell til en bestemt jobb, eller til research i designfasen av subsea tooling.

Poeng ved å trene offshore personell på simulatoren før de reiser offshore:

- Kjenne farkost og kunne manøvrere den.(Sikkert og kontrollert.)
- Lære å navigere etter sonar.
- Lære konsekvensene av måten en flyr på.
- Lære teknikker for hurtig tilkomst, navigering og multioperasjon.

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www.nui.no/ffu.html

FFU vil arbeide for å:
- Formidle kunnskaper og erfaring innen fjernstyrte undervannsoperasjoner
- Skape kontakt mellom utdannelsesinstitusjoner, forskning, brukere, operatører, produsenter og offentlige instanser.
- Holde kontakt med andre aktuelle foreninger
- Skape god kontakt innen det undervannsteknologiske miljøet

FFU i dag
FFU har siden opprettelsen i 1988 opparbeidet en solid økonomi som har muliggjort egen sekretærfunksjon hos Norsk Petroleumforening. FFU har ca. 90 medlemmer og har gjennomført flere utredninger knyttet til aktuelle undervannsteknologiske problemstillinger. Resultatet av disse tilflytter medlemmene gjennom blant annet temaekveldene.

Hvem kan bli medlem?
Medlemmene kommer fra oljeselskaper, engineeringsskaper, kontraktører, offentlig forvaltning, forskning og utdanningsinstitusjoner. Se under for priser og kategorier.

Temakvelder
Gjennom temakveldene tilbys medlemmene faglige foredrag innen aktuelle temaer eller visning av nytt utstyr.

Foreningen har blant annet som mål med temakveldene å formidle informasjon mellom ulike interessegrupper innen bransjen.

Utstillinger, konferanser, fellesreiser
FFU er faglig representert ved undervannsteknologiske arrangementer i Norge. På denne måten søker foreningens å bidra til at tidsaktuelle temaer blir tatt opp. FFU arbeider også for at undervannsrelaterte konferanser, kongresser og møter blir lagt til Norge. FFU arrangerer fellesreiser for medlemmene til konferanser og utstillinger som ligger innenfor foreningens virksomhetsområde. I 1992 arrangerte foreningen turer til San Diego og Monaco.

Utredninger
Som et ledd i foreningens virksomhet har FFU initiert og gjennomført følgende utredninger finansiert av flere oljeselskaper:
- Behovskartlegging av forskning og utvikling innen fagfeltet fjernstyrte undervannsoperasjoner
- Behovskartlegging for utdanning innen fagfeltet fjernstyrte undervannsoperasjoner.

Norsk Oljemuseum
FFU vil gjennom sin virksomhet gi støtte til Norsk Oljemuseum og bidra til at utranger, men faglig interessant ustryr blir tatt vare på.

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<tr>
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<tr>
<td>Bedriftsmedlem</td>
<td>Deltakelse på FFUs arrangementer og aktiviteter åpen til alle ansatte - 25% rabatt</td>
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<tr>
<td>Assosiert medlem</td>
<td>Tillegg til bedriftsmedlemskap. Du får all informasjon, FFU-Nytt, invitasjon til temakvelder, etc. tilsendt direkte. Særlig aktuelt for store og/eller geografisk spredte virksomheter.</td>
<td>kr. 150,-</td>
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<td>kr. 950,-</td>
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<tr>
<td>Offentlig instans - Ny kategori!</td>
<td>Samme rettigheter som bedriftsmedlem, men kun for den offentlige forvaltning.</td>
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<td>Studentmedlem</td>
<td>Som personlig medlem, men redusert kontingent (hvis student)</td>
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