A Quarterly Magazine from ABS

Fall/Winter 2013

Surveyor

ABS

Tidal Turbines Take Manhattan

The seabed around Manhattan Island may soon become as crowded as its streets. In January of 2012, the US Federal Energy Regulatory Commission (FERC) approved the first commercial license for a tidal energy project in American waters, giving New York-based Verdant Power the right to install up to 30 tidal energy generators on a 21-acre site at the bottom of New York City's East River.

Technically, the East River is not a river at all, but a tidal straight connecting Long Island Sound (an estuary of the Atlantic Ocean) with New York Harbor. That said, it flows like a river, with currents reaching peak speeds of more than six feet per second.

Headquartered on Roosevelt Island, a narrow strip of populated land in the East River passing under the 59th Street Bridge, Verdant Power has spent the past ten years developing a new tidal turbine technology to turn the famous river into a power source.

Early prototype testing conducted between 2002 and 2006 convinced FERC to permit demonstration units to be developed and sited. Between 2006 and 2009, the company installed an array of six turbines in three rows at a unit spacing of 100 feet, each mounted on monopiles driven into the riverbed. The year-long demonstration indicated that the turbines achieve a peak efficiency of 38 to 44 percent in water speeds of 1.8 to 4.2 knots. The electricity they generated powered a supermarket and a parking facility on Roosevelt Island, delivering a total of about 50 MWh of electricity over the course of the demonstration.

Now licensed by FERC for pilot-scale facilities build-out, Verdant expects to have the first piece of its system in place during 2014. The company hopes to be able to generate 2.4 GWh of electricity annually, and one day to sell its product to the local power company. If successful, this will be the world's first commercial grid-connected tidal turbine array.

Many eyes are watching this pilot project. In the New York region alone, the St. Lawrence and Niagara Rivers are also said to have good potential as sites for tidal power generation. ❖

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COVER:

Attention to detail is the name of the game. In this picture, surveyors inspect the teeth of a jackup leg as a next-generation rig undergoes construction to ABS class. New technologies for the offshore energy sector, ranging from an innovative jackup rig to prototype ocean power generation systems, are featured in this issue of *Surveyor*.

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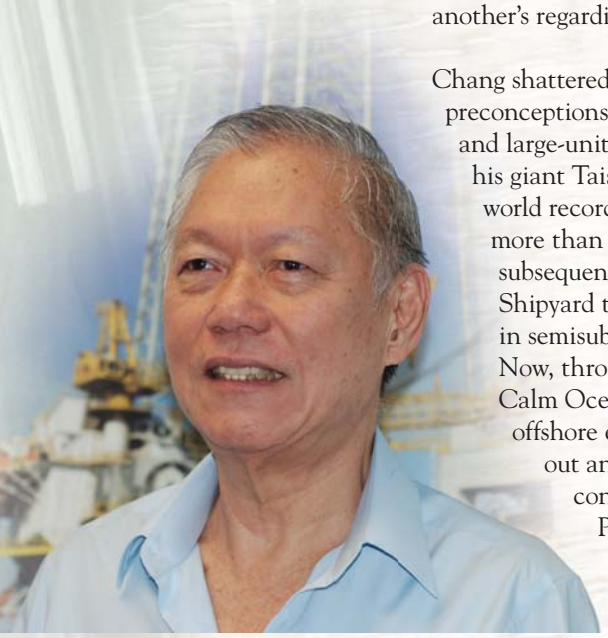
Innovation Spotlight:

Taisun of the Sea

Jackup meets jacket in a new 'do-all' rig design.

Having changed one industry's mindset about cranes, Brian Chang now hopes to change another's regarding jackups.



Brian Chang,
Chairman,
Calm Oceans Pte. Ltd.

Chang shattered the shipbuilding sector's preconceptions about heavy lift capacity and large-unit construction when his giant Taisun gantry crane set a world record by raising a weight of more than 20,000 metric tons and subsequently led Yantai Raffles Shipyard to a place of prominence in semisubmersible construction. Now, through a new venture named Calm Oceans Pte. Ltd., the veteran offshore entrepreneur is rolling out another mindset-breaking concept: the Mono-Column Platform (MCP), a high-payload, multipurpose jackup unit with only one leg.

This radical departure from convention makes the equally radical promise of being an economical platform for all manner of offshore exploration and development in water depths to 500 feet. The key to its bold offer is an innovative design that, Chang says, is versatile enough to be the foundation of a new family of efficient, accelerated and relatively low-cost development solutions that could make feasible even the most marginal offshore resources.

The prototype MCP, named *Calm Ocean 101*, is currently under construction to ABS class in China. When delivered in late 2014, it will look like nothing else at sea: a broad, square deck surrounding a lone open-truss square jackup leg measuring 20 meters on each side. The biggest such leg yet built, its perimeter is so large that, says Chang, the operator will be able to drill through its center, similar to the way a drillship uses a moonpool. In addition, the massive leg will protect the drillstring and risers like a fixed jacket structure.

These two features, coupled with the unit's 5,000-ton payload capacity, will enable the MCP to transition seamlessly from development drilling to production service and, when the field is depleted, to depart without leaving behind a structure that needs to be removed.

At least one aspect of the unit's design is familiar. The MCP is a 'mat-supported' rig, meaning the bottom of its leg is fixed to an independent second hull (the 'mat') that is ballasted and jacked down to the sea floor. A concept pioneered by Bethlehem Steel in the early years of offshore exploration, the mat base works somewhat like a snowshoe, distributing the weight of the rig over a large area and enabling it to stand securely on even very soft soil.

Although the mat eliminates the risk of 'punching through' soft layers of seabed, it does need to rest on a flat surface. Because the independent leg (spudcan) jackup is able to stand securely on virtually any topography, it became the offshore industry's favored choice for exploration and today is the rig type most commonly used in shallow-water projects.

Often, exploration with a spudcan jackup is followed by development drilling with a jackup and tender vessel and then installation of a fixed jacket production platform. While an effective solution, its expenses – which include building, installing and (eventually) removing the jacket – contribute to the cost barriers that keep many small or 'marginal' oil and gas fields undeveloped.

The evolution of the mat concept embodied in the MCP proposes to change all that. First envisioned some 30 years ago by Chang and then-partner Peter Nimmo (a senior designer at Bethlehem Steel who later became President of Baker Marine) and now realized by the Calm Oceans team, the MCP hopes to bring the mat rig back into the spotlight as the centerpiece of some daring new development scenarios for shallow-water fields of any size.

Making Marginal Fields Feasible

Chang has four decades' experience in jackup construction, and says he is building the MCP in response to years of client requests for economical, higher-load capacity jackups and to today's heightened desire to develop marginal oil and gas fields – a desire particularly strong among national oil companies struggling to meet rising domestic energy demands while production from their primary reserves decreases. Many of these companies see at least part of the solution coming from the small, isolated oil and gas fields in their areas that have heretofore been uneconomical to develop.

For example, in February 2013, India's Oil and Natural Gas Corporation announced a $1.3 billion investment in offshore development in the Arabian Sea would include eight marginal fields. In July, Malaysian national oil company Petronas announced incorporation of a new subsidiary that will focus on development and production from small, marginal and mature oil and gas fields locally and abroad. A month later in Nigeria, where marginal fields account for just over 2 percent of total national production, the government announced its first positive outlook in more than a decade on increasing that figure, saying that years of encouragement under the country's Marginal Fields Program were finally beginning to pay off.

A scenario proposed by Calm Oceans for large-field development using diversely outfitted MCPs.

At the same time, enterprising private firms have also been at work seeking to monetize marginal assets. In September, Canada-based Enegi Oil announced plans to develop marginal North Sea gas fields using a new technology that the company says can be applied to 116 'stranded' fields in the area. Meanwhile, Australian startup Hydra Energy has acquired clusters of marginal fields in local waters and been seeking innovative ways to bring them to market. Public and private interest in marginal field development is so high, in fact, that a special conference on the subject took place in Kuala Lumpur in November.

"For every oilfield that gets developed there are at least 20 more marginal fields that are put on the shelf because they are classified as uneconomical," Chang says. "I know of a huge number of marginal fields in waters less than 500 ft deep that the MCP could be used to produce."

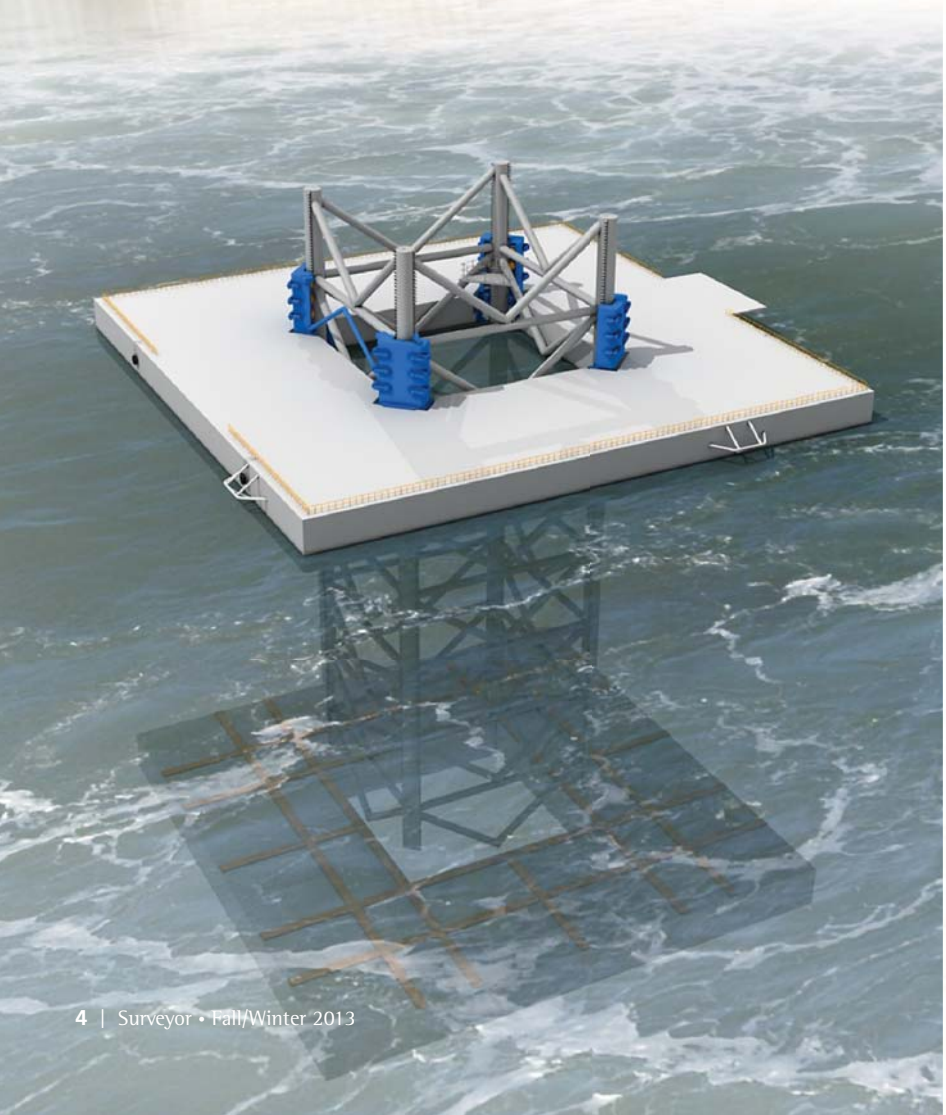
While Calm Oceans is not exclusively targeting marginal fields, Chang expects that to be the application where the MCP makes its breakthrough. Compared with standard jackups, he says its unique combination of increased deck space, higher payload, operational flexibility and lower construction costs will put a lot of forgotten fields on the map.

To illustrate the possibilities of the new design, he compares it with a standard triangular jackup that fits the same footprint, a square 65 meters on a side. The traditional rig, with three triangular truss legs, needs nine jacking units; the MCP needs only four, which both simplifies engineering and construction and lowers building costs by reducing the amount of flanges, valves and piping by up to 60 percent and cabling systems by about 50 percent. Having one central leg also gives the MCP more open deck space. While usable deck area on the triangular design is in the 1,900-m² range, usable deck area on the MCP is 60 percent greater at 3,200 m². In addition, the unit can be outfitted with a rail track onto which a modular drilling package can be mounted. Drilling can then be done off the side of the rig, through a detachable slot, as well as through the leg.

Calm Oceans also reports that the MCP will offer both environmental performance and a payload that are significantly above average: at its maximum 500-ft depth, the unit will be able to withstand 15-meter (50-ft) wave heights, while at 400 ft depths it will take 30-meter waves, equivalent to what harsh environment rigs offer; and, with 24 pinions (6 per side), each carrying about 450 tons, the platform has a theoretical net deck load of between 5,000 and 6,000 tonnes. At press time, this innovative unit was undergoing review by ABS.

With the added deck space and high payload, the MCP will accommodate a great deal of equipment that triangular rigs cannot, Chang says. In addition, because the mat support distributes the rig's weight, the unit exerts a load on the seabed of 3 tons per m², as opposed to 40 tons per m² exerted by the independent-leg rig – potentially a make-or-break difference for projects proposed in areas with soft soil or an otherwise low-load-bearing seabed.

The MCP also offers advantages in the all-important area of capital expenditure (capex), he notes. "You can still get a three-leg jackup in China for under $200 million, but it won't be something you can use in 400 feet of water or in harsh environments," he says. "For that level of specification you have to look to the top-of-the-line jackups or a semisubmersible, either of



CALM OCEAN 101 will look like nothing else at sea: a broad, square deck surrounding a lone open-truss square jackup leg measuring 20 meters on each side.

MCP jackup legs under construction in China.

which costs about $670 million today. By comparison, our unit costs much less due to efficient use of steel, materials and labor."

While Calm Oceans is not positioning the MCP as an across-the-board replacement for standard cantilever jackup platforms working on wellhead platforms, it does say the unit has great potential for greenfield operations and as a temporary or permanent support for brownfield operations.

The company has produced concept drawings for the platform in drilling, production, power generation and accommodations services. Its unique package of attributes leads Chang to declare the unit ideal for large greenfield projects and to propose several new development scenarios through which the MCP might lead a revolution for marginal resources.

Offshore Development Under a New Mindset

Chang's first alternative scenario involves early monetization of resources. "A typical project scenario starts with a jackup doing exploration and drilling test wells; then another jackup comes back to do proving wells; then, after the front end engineering and design (FEED) study on the total development, another unit comes out to produce. That means you spend millions of dollars and 36 to 120 months before getting first oil. You could do all that with one MCP, from exploration – if conditions are right – to production, with significantly reduced capex and a much shorter timeline," he says. Among his suggestions is a phased-in development scenario, perhaps using more than one MCP, that would yield early first oil.

"Say, for example, you get 4,000 barrels of oil per day on your first well. With a normal jackup, you have to flare off this initial gas and oil because, although you have a test separator on board, there's no room on the rig for real processing equipment. Wouldn't it be better if you could process that initial oil and put the money in your pocket instead of sending it into the air? With an MCP, you can," he says. "If you just install some simple processing equipment on board and pipe the oil into a tanker, you can start producing on Day One. You can be producing even while you are making the long-term decisions for the field. The important thing is that you can be getting oil within three months of the drill bit going into the ground, instead of three years. If the field is proven to be uneconomic, then at least you can drain whatever is possible before capping it."

Another capex-lowering feature of the MCP springs from flexibility with drilling equipment. "You don't need to buy a new $60 million drilling package for our unit," he says. "You could, but you could also take a used modular drilling package out of storage and mount it on our rails – you could even mount a land drilling rig on board if it has the specifications you need."

A welder building MCP legs.

Further, because the MCP supports drilling and processing equipment, it will also allow the operator to explore neighboring areas of interest through horizontal drilling, without interrupting production, he adds. This leads him to his second new scenario: how a rabbit-sized operator can handle an elephant field.

"Let's say you're a small energy company and you discover a monster oilfield," he proposes. "You go into debt up to your neck just to drill your additional wells and then, when you're confronted with the investment in a central processing platform, the financial burden becomes so great that the only practical alternative is to sell your interests to one of the big boys," he says. "With our solution, you can forget about central processing – just build or hire another MCP and outfit it with a complete processing plant," he says, pointing out that a typical 20,000 to 30,000 barrels-per-day production facility with drilling capabilities makes for a deck load of about 3,000 tons, well within the unit's capacity. If output ramps up, more MCPs could be brought on site.

"Remember, while you're producing, you can also be drilling more wells," he says. "You can spread MCPs over a big field, with each platform doing its own drilling and processing and the outputs all piped to an FSO. And when you are done, you don't have lost assets that you need to decommission; you have working assets that people want."

His third scenario involves a new strategy for monetizing gas fields. "The typical scenario for a gas field is to drill the well, produce the gas and pipe it to shore, where it is burned in a power plant. We suggest the MCP can offer a new business model to the resource owner: instead of selling gas to the power company, put gas turbine generators offshore and sell electricity," he says, pointing out that the lower capex of laying electrical cable instead of gas lines could be critical to making isolated gas fields profitable.

"The power generation scenario can be better for the resource owner because, since the rig itself is portable, he can move the whole setup, including the power plant, to a new location when the field plays out. That's an ideal solution when an area contains a number of small gas fields," he says.

"The ability to relocate and adapt equipment is one of the most important factors when looking at small field development," he adds. "For example, you cannot relocate a jacket, which means spending an additional $40 to $60 million per well. If, instead, you commit a little more money on our unit, you have a tool that can be redeployed to other fields or hired out when you're done," he says, pointing out that the design's versatility effectively makes it a portable artificial island – so much so that Chang has taken to referring to it as offshore real estate.

"The MCP can be used for exploration, if conditions are right, for development, for production, for workover, for housing and, I'm sure, for applications that haven't even been thought of yet," Chang says. "A lot of small field developers could really run with this solution." ❖

Marginal Fields Make News

From Ireland to Australia, technology advances and government incentives are combining to stimulate development of marginal offshore oil and gas fields.

The definition of a marginal or stranded field is, basically, contextual. It refers to any field that, at a given moment in time, is deemed unprofitable to develop. Such assessment is based on a number of factors that change over time, including the market price of oil, the overhead costs of the developer, burdens imposed by local tax and regulatory regimes and, very importantly, available technology for the practice known as enhanced oil recovery (EOR).

One typical scenario involving marginal fields is when oil majors sell declining assets to smaller companies whose lower operating costs make continued development of the field worthwhile. The shallow-water Gulf of Mexico is full of such handed-over projects. Now, offshore fields around the world that were never developed and others that have been shut down for years are being seen in a new light.

Since 2010, tax breaks and other incentives from governments around the North Sea, including the UK and Holland, have helped stimulate use of new solutions to bring small fields into production. In November this year, Providence Resources and Advanced Buoy Technology (ABT) partnered to develop two marginal fields in the Celtic Sea offshore southern Ireland, using unmanned production buoys developed by ABT. One of those fields, Helvick, was found in 1983. Its discovery well flowed 9,900 barrels per day of oil, but the field was determined not viable because of its small size and the low oil price at the time.

Similarly, reservoirs that once flowed but were shut down when their flow rates slowed are being reawakened. Late last year, Scotland-based Unmanned Production Buoy (UPB) was awarded rights to develop the decommissioned Angus and Fife fields in the UK central North Sea, once operated by Hess using floating production systems. The company expects its first commercial units to be online in 2016, with the first three deployed in marginal fields offshore England, Ireland and Denmark. These unmanned buoy systems expand on technologies currently used offshore for utilities, power generation and the remote control of wells, by adding processing and hydrocarbon storage systems, and are said to be economic for fields with daily production rates under 5,000 barrels per day.

In Southeast Asia, where demand for oil and gas is steadily increasing, one emerging hot-spot for marginal field development is Malaysia. In 2010, the Malaysian Government began offering tax incentives for investment in both EOR and marginal field development projects, even waiving export duties on total oil production from small fields and giving tax allowances of up to 100 percent of capital expenditure for EOR projects. Earlier this year, Malaysian national oil company Petronas formed a new subsidiary, Vestigo Petroleum, to focus specifically on development and production activities from small, marginal and mature fields in Malaysia and elsewhere.

In 2011, Petronas implemented a new production arrangement called a risk service contract (RSC) to stimulate marginal field developments. Under an RSC, Petronas is the project owner while a contractor group is the service provider; the contractor provides up-front development costs and is compensated based on production and performance. Just over 100 marginal fields were identified under Malaysia's 2010 Economic Transformation Program, with total reserves estimated at 600 million barrels of oil. About 25 of them have been marked for development through RSCs.

The decision to push development of marginal fields has proven to be a wise one. Recently, one field named Cendor, which for a decade had been identified as marginal and was abandoned by an international oil major, turned out to be one of Malaysia's biggest-ever finds, following an aggressive appraisal and development campaign by the contractors. For Petronas, pursuing marginal fields through RSCs has proven to be a risk worth taking. ◆

WEST GEMINI, one of the drillships involved in the pilot CHIP program.

FROM THE FRONT LINES:

First Steps in the Self-Inspection Revolution

A pilot program explores a radical evolution in the survey cycle for drilling rigs.

The Client Hull Inspection Program (CHIP) is an experimental initiative from ABS that explores an evolutionary path forward in asset integrity management and in the relationship between classification and its clients. In a radical departure from traditional practice, CHIP allows for limited self-inspection of non-critical structures by specially trained and certified crewmembers, not witnessed by a surveyor, the results of which are scrutinized by a surveyor at a later date through document review and, if approved, are credited to the vessel's survey status.

For owners of high-value floating offshore equipment in particular, the CHIP concept represents an opportunity to increase rig profitability by reducing the amount of asset downtime related to the inspection requirements of the five-year survey cycle. The basic idea is to incorporate into the unit's day-to-day maintenance routines the inspection of structurally non-critical areas. If validated by the attending surveyor, the records of these inspections will be allowed to stand for those that the surveyor would normally provide. Then, provided enough valid inspections are performed in advance, the accumulated reports should noticeably reduce the number of inspections needed during the special survey and, thereby, reduce the overall duration of the unit's downtime.

This time savings translates into dollars for the rig owner, who normally loses at least several weeks of income while operations are shut down for the quinquennial survey. With some

units earning half a million dollars or more each day, shaving downtime by even 24 hours per rig can add up to substantial savings.

The CHIP initiative is currently being tested aboard six modern drilling units – three semisubmersibles and three drillships – operating in three different regions of the world, as part of a carefully watched pilot program involving ABS and Norwegian rig owner Seadrill. For Seadrill, which has a large fleet of drilling rigs in operation today, even minimal success with CHIP aboard each rig would produce significant benefits for the organization. The pilot program started up in 2012, has completed its first run aboard one rig during 2013 and will be proving itself aboard the others during 2014.

Recently, *Surveyor* sat down with Seadrill's Compliance Manager for Operation Excellence, Claus Bang Olesen, to discuss the pilot program from the client's perspective.

SURVEYOR: What led Seadrill to engage with ABS in the CHIP program?

CLAUS BANG OLESEN: At Seadrill, we constantly try to improve the way we do things, to find new ways of approaching our work and, thereby, to stay ahead of the competition. Our basic idea with CHIP is to use the natural stops that occur during normal operations to fulfill inspection requirements – not to avoid them, but to do them in the right place at the right time, so to speak.

The goal is to develop a sort of 'continuous safety regime', in which we don't have to take the rigs out of service for long periods to do all the required inspections at one time, but can do at least some of them as opportunity permits. For example, if we have to go into a tank to replace a sensor, we have to clean and inert the space; this is an opportunity to inspect the tank structure as well. There is potential to eliminate a great deal of downtime for the rigs.

S: That's quite a radical departure from the status quo.

CBO: It is, but also isn't. The concept has been developing in the shipping industry for a long time, and current regulations are open to it. It's 'radical' just because it hasn't been done until now. And, bear in mind, this program only applies to the hull and compartments, not any critical structure. There's a lot of equipment, like cranes and drilling equipment, that we cannot inspect – not yet, anyway. The agreement we have with ABS is that we can check up to 70 percent of the tanks, depending on the unit type, without having a surveyor present, and we present the work for audit and random check by the surveyor at the annual hull survey.

S: Was special crew training needed to get this permission?

CBO: Yes. One of the steps in making CHIP happen was participation in a special ABS training program for our personnel, in which they learned the classification perspective, the things to look for and the acceptance criteria, and how to report their findings.

S: What did you need to do to pursue this goal?

CBO: Three main things. The first was to establish our agreements with class, to create a base for making this happen – this involved a tremendous amount of paperwork. Second, we also needed to implement the software control for the CHIP, which is the ABS Hull Inspection and Maintenance Program (HIMP). And the third piece, the core of the CHIP itself, was the training and education of our hull inspectors. CHIP training is basically a three-day course. Over the first two days you learn to inspect the hull and structures; the third day is training in the HIMP software package.

Claus Bang Olesen, Compliance Manager for Operation Excellence, Seadrill

These training and education sessions helped very much with our team building. It was very good for our staff to meet with ABS and the surveyors, to learn how they think and how they approach structures. They gave our people a wider understanding of the hull, what is important to look after, and how to document their inspections in the correct way.

WEST ORION, one of the drilling rigs enrolled in the pilot CHIP program.

S: How did you select the people for this project?

CBO: We selected them from our rig crews. We need qualified inspectors on board at all times, so that we are ready to take advantage of any inspection opportunity, whenever it comes up. There has to be someone on board who can perform an inspection and someone who can approve it. For that reason, we trained our senior management, both on the marine and technical sides. The management on board acts as hull inspection surveyors and the technical leader onshore as the controlling part.

S: To properly train a surveyor takes quite a long time. Did the people you select have special backgrounds to prepare them for this limited inspection work?

CBO: They are, of course, highly experienced seamen and technical staff who, in the course of their careers, have dealt with many technical issues on rigs and ships. Our agreement with ABS is that, after these crewmembers complete their training, they practice on board, document some inspections and, when we deem them ready to be evaluated, an ABS surveyor comes out to the rig to witness a live test of their abilities. When the surveyor approves the way they inspect and report, ABS issues a certificate stating the crewmember is approved for this survey task.

S: Was it tough to get flag State approval for the project?

CBO: Not at all. About 90 percent of our fleet is flagged with Panama. When we proposed CHIP as our hull inspection solution, we sent comprehensive program documentation to the Administration. We then met with them, where our proposal was accepted; they even commented that they thought it was a very good idea.

S: Then, what's been the biggest challenge so far in getting this program underway?

CBO: I would say, getting the people on board to use it.

S: Is it that some people embrace the responsibility and others do not?

CBO: Yes. It involves mindset. It's just like in the office when you introduce a new program or way of doing things: some people get interested and want to follow it, while others resist the change. It falters if everybody doesn't buy in, because it's a team effort. Everybody has a role and must do their part.

S: So, the success of the program on board is 'personal' to the rig?

CBO: In a way. We track the rig's progress and compare its performance, to keep the guys up to speed, but it is very much a matter of how seriously the people on board believe in the system and how well they use it. In a way, it's similar to what surveyors see when they go on board the rigs. They can easily tell which rigs are more positive towards following the class system. We see the same things.

So, while we expect the crews to inspect 20 percent of their tanks each year, so that they've done 100 percent of what they are supposed to when the five-year period is up, how each rig actually follows the program is, ultimately, decided by the rig's management. Some rigs

may choose to wait until the end of the five-year period and try to do everything at once; that's also a possibility, because the system allows you to do your inspections at your convenience. The risk, of course, is that, if you wait too long, you end up having to do all the inspections when the surveyor is there and you don't save any time at all.

S: Do you see the future of CHIP including equipment and machinery inspection?

CBO: Yes. The next step would be drilling equipment, but that step will take some time. You can easily tell if a tank is rusted, but equipment issues are not always so obvious. A pipe handler, for example, has many different components that can fail at different times – hydraulic motors, bearings, hoses, cylinders, lifting gears and many items that wear at different rates and can present a potential danger if not changed in time. So, to take that step we have to be sure that we have the right measuring parameters and acceptance criteria in place. Ultimately, we would like to know when parts start to wear so that we can plan their repair, instead of just coming to a point at which we have to replace many items at once.

S: Does your experience so far indicate your initial hopes and expectations will be met?

CBO: Yes. Our goal was basically to avoid too much downtime in connection with the five-year survey cycle. Based on the first rig's experience, the program has been a success. It cuts downtime, and the people coming to do the five-year survey don't have to worry about minor things, but can concentrate on the critical items.

Of course, it's difficult to assess the program based on one rig. We need data from a few, and those are coming up this year and next. But as we see it now, the program definitely has been beneficial. Our experience to date is a pointer that we are headed in the right direction and that this is a good idea.

S: So it's looking good for you, but Seadrill is a very big company with a lot of resources. Looking forward, do you see smaller operators being able to implement CHIP one day?

CBO: Yes, definitely. You don't need a large staff to run the program – our own implementation team is of rather modest size. I see it possible that this regime could become commonplace in five years' time.

S: Assuming all goes well with the pilot program, have you any words of advice for those companies wishing to follow Seadrill?

CBO: Yes – just do it. Like anything worthwhile, it's easy to do if you're willing to put in some hard work. And remember: training is the key to it all. ❖

On this page, two snapshots taken during an early self-inspection aboard the WEST ORION.

Offshore Transformation

A shipyard finds new life and prominence by transforming from ship repairer to offshore builder.

Seven years ago, COSCO Nantong Shipyard was purely a ship repair facility. Times were good then, but yard management saw the impending market downturn and made the bold decision to try breaking into the demanding world of the offshore construction specialist. Within a few years, the yard expanded, built new, dedicated facilities named COSCO (Qidong) Offshore Co. Ltd and, today, is the flagship enterprise of the new Offshore Division of the COSCO Shipyard Group. During the past seven years, the shipyard has delivered 34 projects including 16 floating production, storage and offloading (FPSO) and floating production and offloading (FSO) units; four deepwater DP-3 drilling units; four jackups and a variety of offshore support vessels; and has a further 55 projects under construction. Of the 89 total offshore projects the yard has undertaken so far, 55 are under ABS class. These include 14 FPSO conversions; one newbuild FSO; nine jackups; seven drilling tenders; and some 20 offshore support vessels of various types, including DP-3 pipelayers and platform service vessels.

Xu Xiulong,
Deputy General Manager,
Offshore Technical Center,
COSCO Shipyard Group

The Qidong offshore base has a total land area of about a million square meters, featuring a 300,000-dwt capacity graving dock served by a 600-ton capacity gantry crane, two 350-m slipways with 200-ton gantry cranes and berth space totaling more than 2,000 linear meters. Now building a solid reputation in the offshore sector, COSCO's Nantong operations are booked through much of 2014.

How this builder succeeded while others struggle to survive is a story of bold vision, a bit of luck and a boatload of hard work. The vision: recognizing the building boom to be a bubble, while it could still support transition to a new area of activity. The luck: good timing in making the leap. And the hard work: the combined, ongoing efforts of the yard management and workforce to take the transformation from aspiration to achievement.

FORMULA FOR CHANGE

"Ship repair and conversion is big business in China and, while the market was still hot, COSCO Nantong began looking for a way into the future; management saw that the many shipyards which had sprung up and entered the market during the good times were causing overcapacity and beginning to drive down prices. We knew our future lay elsewhere, and decided to take a chance by entering the offshore business – and we prepared to make the required upgrades in equipment, service delivery and workforce skills," says Xu Xiulong, Deputy General Manager of the COSCO Shipyard Group's Offshore Technical Center.

The COSCO Shipyard Group contains six facilities, located in Nantong, Qidong, Dalian, Guangdong, Zhoushan and Shanghai. Today, offshore projects are built at several of the yards, but, wherever such work is undertaken, from design to yard supervision the project is run with the supervision and assistance of Xu and the Technical Center team.

Xu credits three important steps in managing the change from repair and conversion to newbuilding offshore equipment: first, establishing the Offshore Technical Center to provide a foundation for technology absorption and skills development; second, bringing in knowledgeable staff with offshore-specific business and technical expertise; and third, expanding the facilities so that the yard could compete in the offshore market.

"Expansion was very important to our plan, but, before we could expand, we needed to get projects," Xu says. "Fortunately, at the end of 2006, Chinese shipyards were fully booked and so were the yards in Singapore. This gave us the opportunity to get offshore projects."

One of the first actions by the Technical Center to support the new work was to bring experienced engineers on board to work alongside and train the shipyard's staff.

"We recruited many engineers from Singapore yards," says Xu. "We also needed support from the classification societies – especially ABS, which is the world's most experienced class society in offshore projects. Because we had been a repair and conversion shipyard, we started out in the offshore business by converting tankers to FPSOs," he explains.

"We approached MODEC, which is one of the world's leading FPSO operators. They were willing to work with us, knowing we had ABS' help backing us up. They were satisfied with our work and we have completed ten projects for them so far. ABS Singapore gave us massive support in these early efforts," he says. "Then, in 2007 we got our first jackup newbuilding project, for an ABS-classed Super M2 unit. We built the business slowly from there and by 2008 saw that we could justify expansion. Once our new facility was partially ready in 2009, our workload grew very rapidly and the business really took off."

As the facilities expanded, the Technical Center staff also grew, from 30 engineers in 2007 to 480 today. At first, they drew expertise from Singapore's technology labor pool. The majority of staff added to the Center since then has been selected from the local shipbuilding sector, technical institutes and universities. In establishing the project management skills for offshore work, the shipyard has followed a well known philosophy, in which each project has dedicated technical team, led by a project manager and engineering staff, which includes owner's representatives and classification society engineers.

TRANSFORMING THE WORKFORCE

Along with the facility upgrade and development of offshore engineering capabilities, a critical component of COSCO Nantong's transformation was upgrading the skills of its workforce. An ongoing exercise in continuous improvement, this skills-building effort has enabled the yard to increase productivity, decrease rework and develop trust from a demanding marketplace.

"We have learned many lessons in rebuilding the workforce, because of the higher quality level required by offshore construction," Xu says. "We began by sorting out the most experienced, skilled workers and assigning them to offshore projects. Even though they were very experienced with shipbuilding, they needed to improve their skills to reach the levels of quality and reliability required for offshore work. We passed through this learning curve with some struggle, which required us to train and retrain the workers until we were confident in their abilities. We were helped greatly in this by welding and quality-related courses from ABS," he adds.

A critical component of COSCO Nantong's transformation was upgrading the skills of its workforce.

"One very important difference in changing from the shipyard to the offshore sector is that offshore has very strict requirements for materials traceability in welding – every key weld needs full documentation and traceability, and the welds also have third-party nondestructive testing (NDT) inspection – NDT is required much more for offshore work than for ship repair. This required re-certification of the welders, especially regarding critical welding tasks for jackups and semis, and also some skills-building development of our quality control staff, which included NDT training courses from ABS," Xu says.

COSCO Nantong still performs ship repair, but that work now only accounts for about 5 percent of yard revenue. Still, the activity remains valuable in that it provides a practical training ground for new welders, who work alongside experienced colleagues as they develop the skills required for offshore work. This career path includes training as quality inspectors so that, as the welders advance through higher certifications, they can help educate their colleagues.

An FPSO under construction to ABS class by COSCO Offshore.

"This is a continuous process – with offshore construction, you can never be satisfied with your quality level but must always strive to be better," Xu says. "At first we experienced a lot of difficulties with clients; particularly during the first three years. We received many complaints," he recalls. "At first, owners would send large site teams, sometimes more than 30 people, to oversee and watch us. Under this double pressure from owners and class we had a very hard time, but this resulted in a significant increase in our quality – from 20 percent rework at the start to less than 2 to 3 percent today."

Now, he says, the yard has acquired a new level of respect, and a soaring profitability to go with it. In 2006 the shipyard's revenue was about 1 billion yuan (nearly $164 million). In 2013 it will be 9 billion and next year is expected to reach 10 billion.

"In China, many yards these days aren't getting projects, and their revenue is decreasing year by year. We, instead, have 75 percent capacity already booked for 2014 and our revenue is increasing year by year," Xu says.

LEADING LIGHT OF CHANGE

Springing off the success of the Nantong enterprises, in September 2012 the COSCO Shipyard Group formally established an Offshore Division. In making the announcement, Group General Manager Wang Yuhang declared the new division's main responsibilities to be: growing the offshore business; pursuing technology innovation; and hiring and cultivating new offshore technology professionals. He further pointed out that, as the shipbuilding and repair markets continue to slide, the survival of the Group may well be determined by the success of its Offshore Division. Currently, offshore sector income accounts for between 60 and 70 percent of the Group's revenue.

Meanwhile, COSCO Nantong's success has lit a path that other Chinese yards are now following, with endorsement from the highest levels of government and their industry.

In January this year, the China Association of the National Shipbuilding Industry (CANSI) released a gloomy report on the country's shipyards, noting that in 2012 shipyard output dropped by 21 percent and new orders by 43 percent over the previous year, continuing a slide that had begun five

Key to the future for COSCO Group's Offshore Division is cultivation and retention of a skilled workforce.

years before. CANSI says that there are about 1,650 shipyards in China and estimates that as much as half of them could collapse during the next few years. Industry observers note that some 38 percent of yards in China have not won newbuild contracts since 2012. In fact, Fearnley Consultants told one newspaper that, of 128 shipyards founded during the 2003 to 2008 building boom that it tracked, 57 hadn't delivered a ship since 2011 and at least 75 appeared to have ceased operations altogether. Further, according to a July report from State news agency China Daily, the combined profits of 80 major shipbuilders monitored by the CANSI fell 54 percent in the first half of this year, to 3.58 billion yuan ($584 million).

Even yards with big backers are not immune to the market's ills. Take as example the announcement in May 2013 that COSCO would close its Lianyungang Shipyard. In a case of unlucky timing, the yard had been jointly established by COSCO and the Lianyungang Port Group in 2008, just before the building boom began winding down. The shareholders decided to dissolve the company, which had been suffering severe losses in an ever-weakening market and showed no signs of improvement.

The only bright spot in the CANSI report was recognition that Chinese builders had increased their market share of global offshore construction from less than 10 percent in 2011 to more than 15 percent in 2012. Consequently, the organization concluded that, while China's national shipbuilding industry will "remain in the doldrums," the offshore sector "will remain active, especially the floating offshore equipment market." The report also suggests corrective actions the yards can pursue, such as increasing their rate of diversification into offshore products and forming international skills-building alliances as they do so.

COSCO Shipyard Group Chairman Ma Ze Hua underscored CANSI's assessment in his annual message to shareholders this year. Noting the continued depression in the shipbuilding market, and newbuild prices that have fallen by as much as 45 percent since 2008, he reported a decline in turnover for the Group of 10 percent ($500 million) along with a small gain in gross profit.

"I believe our diversification has given the Group some cushion against difficult market conditions, as we have been able to secure more offshore marine contracts with the experience and credibility we have gained over the past few years," Ma said. "Looking ahead, our strategy to strengthen the offshore marine business remains a key focus. We hope to further expand our capability in this sector by increasing our expertise and technical knowledge to offer more cost-effective and reliable solutions to our customers."

COSCO Nantong's transformation has also made an impression among China's privately-held shipbuilders. The most prominent example may be Rongsheng Heavy Industries Group, the nation's biggest private shipbuilder, which in July sought government assistance to cure financial ills brought on by a lack of ship orders. Last year, the builder established an offshore office in Singapore with the goal of offering lower-than-market prices to get a local foothold. Fortunately, there appears

to be plenty of work, and a fair amount of it will be offshore rig construction. Analysts are predicting a rise in the global onshore and offshore construction markets to upwards of $1.26 trillion in 2017. This marks a considerable increase from $989 billion in 2012.

Success in the offshore world has raised COSCO Nantong to a new level of prominence in China, and made it an example for other yards to follow. This status was brought into the spotlight during the Chinese Communist Party's 12th National People's Congress this past March. At one point during the event, Xi Jinping, the Party's newly appointed General Secretary, called on COSCO Nantong General Manager Ni Tao to field some questions about opportunities for shipbuilders in the offshore sector, about China's capabilities to build for that industry and about the challenges the country's shipyards need to overcome in order to pursue excellence.

FACING THE FUTURE

As COSCO Offshore looks forward, Xu sees the road ahead for China's builders filled with opportunity but also littered with challenge. Four in particular top his list.

"The first challenge looking forward is how to get orders," Xu says. "Winning new projects is becoming increasingly difficult for all Chinese shipyards; there's just too much capacity. Then, once a yard gets a project, the next challenge is how to deliver on time – this may be the biggest challenge for Chinese shipyards today.

Next is a technical challenge for the yards, in that there needs to be an improvement of basic engineering skills – there is a wide knowledge and experience gap to close between Chinese yards and our advanced competitors in Singapore. This leads to the fourth challenge, the issue of finding, training and retaining skilled manpower."

China's industrial development has put its top yards in a position familiar to shipbuilders around the world, as skilled engineers, welders and project managers are constantly approached, and poached, by other industries offering higher pay than shipyards can. This means the builders are in a constant cycle of training and education. One way COSCO Offshore meets this challenge is through partnerships with technical colleges, in which they identify high-potential students and cultivate their offshore sector talents.

As many yards face acquisition or closure, market analysts have taken to speculating how many will finally be left standing when the dust settles. Xu says that, broadly speaking, most of the survivors will likely be State-owned companies, which have the advantage of access to financial support in hard times.

"State-owned companies are quite stable because we have very strong financial support from the government. That's why, even though some yards are not doing such good business, they can survive," Xu says. "The privately-held or listed companies are having a very hard time now. We are seeing failures and will see many of them close down in the next

Welder training at COSCO Offshore.

few years. For them it is very difficult to get loans from banks. State-owned builders like COSCO, on the other hand, have priority to get orders from State-owned companies; they can get loans from banks, can issue refund guarantees and can get bank guarantees on international orders much more easily than private companies can do right now. That's why I think the long-life shipyards in China will be the State-owned enterprises."

Reinforcing his views are reports that, in the first half of this year, State-owned yards won three-quarters of all new shipbuilding contracts in China. Many of the winning yards had the backing of two shipping 'policy banks' responsible for State spending, a possible sign that the government is using lenders as a paring knife to trim the now overcrowded marketplace. This would be in harmony with a Cabinet statement from July that it would cut off credit to force consolidation in industries plagued by overcapacity.

Overcapacity has been a matter of much discussion in China this year. In July, the China State Council issued a statement announcing a three-year plan to control overcapacity in five key industries: iron and steel, cement, plate glass, electrolytic aluminum and shipbuilding. In August, the Council released the *Implementation Plan about Accelerating Structural Adjustment and Promoting Reform and Upgrading of the Shipbuilding Industry (2013-2015)*, its action plan for the shipyard sector. The main focus of the plan is to accelerate innovation and strictly control capacity, stabilizing the sector's international market share through greater support. This lines up with the current Five-Year Plan, which runs through 2015 and names among its goals upgrading shipbuilding standards with an eye to developing higher value-added products. The Council statement also said that, besides restricting new shipbuilding capacity, the government is encouraging mergers and acquisitions of troubled yards. On a brighter note, the Council statement also said companies should be confident that "the potential in the domestic market remains relatively large."

Altogether, Xu has a certain optimism regarding COSCO Offshore and the yards that wish to learn from its experiences. One valuable lesson other yards can learn is the importance of working with classification societies to help develop their technical skills sets. Assistance from ABS, he says, was critical to COSCO Nantong's transformation.

"The most valuable help we received from ABS has been in the areas of engineering and production efficiency. Their training courses have been invaluable, and their technical assistance has helped us reduce our costs by helping us learn how to save time," he says. "ABS has helped us take on many challenging offshore projects – and not just us, but many yards in China," he adds. "Without their help, we would not have been able to deliver so many projects so successfully to the clients." ❖

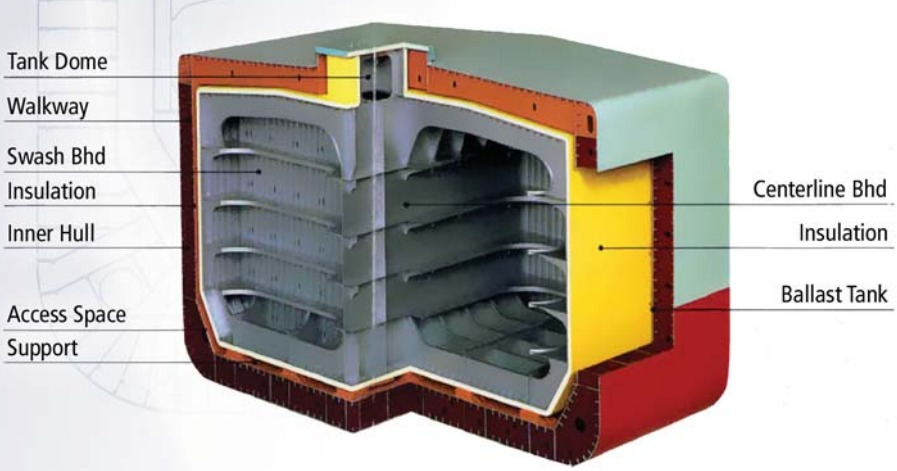
Tank Support for the LNG Revolution

IHI's cargo system may help the LNG world take its next evolutionary step.

A modern descendant of the very first LNG containment system for ships may become one of the key technologies carrying gas transport and trading into tomorrow.

Developed in Japan by Ishikawajima-Harima Heavy Industries (IHI), this containment system has spent a long time waiting for its day in the sun. It received approval in principal from ABS in 1983, made its first appearance on an LNG carrier in 1993 and now, in its 2013 edition, is poised to help the natural gas industry grow, evolve and meet the needs of a changing world. Although the IHI Group merged its shipbuilding division with Universal Shipbuilding to form Japan Marine United (JMU) at the beginning of this year, the containment system retains its original name: the IHI-SPB tank.

SPB "Type B" Tank



Based on the design of traditional bulk liquid cargo spaces, the IHI-SPB is a prefabricated metal tank designed for transporting liquefied gases. It has a particular combination of characteristics that is drawing intense interest from the energy sector, among operators considering building floating LNG facilities, and from the shipping sector, among owners contemplating the emergence of an LNG spot market.

The principal attractions of the IHI-SPB tank are a proven immunity to sloshing problems that allows LNG ships to go to sea partially loaded, even in harsh weather, and a customizable geometry that, among other benefits, results in the kind of flat-deck vessels needed for floating processing plants.

Special Type with a Long Lineage

SPB is an acronym for Self-supporting, Prismatic IMO Type B independent tank containment system – 'independent' meaning the cargo hold is not integral to the ship's hull; 'prismatic' referring to the tank's beveled geometry; and Type B denoting its classification under the *IMO Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk*, more commonly known as the International Gas Code (IGC).

The IGC defines three type categories for independent LNG cargo tanks. Type A tanks are designed primarily using recognized standards of classical ship structural analysis and constructed of a plane surface. The Code limits this type of tank to a vapor pressure of less than 0.7 bar and, where minimum design temperature is below -10°C, requires a complete secondary barrier capable of containing the cargo for a period of 15 days in the event of a ruptured or leaking tank.

IMO Type B independent tanks are defined as "designed using model tests, refined analytical tools and analysis methods to determine stress levels, fatigue life and crack propagation characteristics." One of the key characteristics for Type B designation is compliance with the so-called 'leak before failure' concept, under which crack propagation analysis by fracture mechanics techniques must demonstrate that, should a crack in the system develop, its growth will not be rapid enough to allow excessive leakage into the cargo hold. A partial secondary barrier, which may consist of a spray shield and 'drip pans', is required for independent Type B tanks with minimum design temperatures below -10°C. Prior to the IHI-SPB, all Type B tanks were spherical vessels of the Moss-Rosenberg design.

Type C tanks are spherical or cylindrical pressure vessels, like those typically seen topsides on liquefied petroleum gas (LPG) carriers; they are the type indicated for the fuel tanks in concept drawings for TOTE's groundbreaking gas-fueled containerships and Waller Marine's articulated tug-barges for local LNG distribution and supply. Both projects will be classed by ABS.

The first maritime LNG containment system was a prismatic tank of the Type A variety, installed in a World War II-era cargo ship converted for gas carriage under ABS class in 1958. Renamed *Methane Pioneer*, the ship brought LNG from Lake Charles, Louisiana to the Canvey Island terminal in England. The success of that conversion – the vessel

JMU says the shape flexibility of the IHI-SPB makes it an ideal alternative to the Type C tank, shown here in concept renderings for TOTE's groundbreaking gas-fueled containerships and Waller Marine's articulated tug-barges.

When the new Panama Canal opens in 2015, it will give easy cross-ocean access to much of the current world LNG carrier fleet.

remained in service for a decade and finished up doing LPG storage – may have significant repercussions in light of today's changing gas markets.

When the new Panama Canal opens in 2015, it will give easy cross-ocean access to much of the current world LNG carrier fleet; this could help dismantle the current regional pricing of natural gas and give rise to a consistent worldwide market in which gas is traded like oil. If that happens, a regular spot market for LNG may develop. This is where JMU sees an opportunity: LNG traders would need tankers that can travel with partially loaded tanks. As membrane containment systems cannot do this and, as they make up most of the world fleet, there could be an opening for a new segment of vessels designed with partial loading in mind. Some of that demand could be filled by ships built or converted using the IHI-SPB tank.

ABS-classed SANHA, the world's first LPG FPSO.

Another ancestor of the SPB tank made LNG transport a global business in 1964, when the first purpose-built LNG carriers, ABS-classed *Methane Progress* and *Methane Princess*, entered service between Algeria and England. These vessels used an update of the prismatic Type A concept developed by the Conch Company, in which the inner hull was lined with insulation and the tanks rested on wooden support blocks.

IHI began building prismatic Type A tanks for LPG, ammonia and ethylene carriage in 1960 and, in 1980, after making a name in those sectors, focused its formidable engineering abilities on the challenge of evolving the Conch concept into a freestanding or 'self-supporting' Type B tank. Rigorous studies were made to substantiate the design, including ship motion analysis, finite element method (FEM) analysis of the tank and hull, fine-mesh FEM analysis of local structures, fatigue analysis and crack propagation analysis. Even the insulation system, which is not load-bearing, was subject to extensive model tests. The tests further demonstrated the suitability of the system to withstand dynamic loads caused by ship motion and thermal cycling, and proved its liquid leakage protection for a continuous fifteen-day period.

"We are not the pioneers of this technology," says Kazuo Watanabe, General Manager of Engineering for JMU and author of several important papers on SPB system applications, most recently regarding the technology's use in the world's first FPSO for LPG, the ABS-classed *Sanha*. "The sophisticated computer analysis capabilities that became available in the 1980s enabled us to fully analyze, redevelop and improve upon the Conch concept, and make it work as a Type B tank."

Raising the Future Through the Past

SPB technology first entered service in 1993 aboard *Polar Eagle* and *Arctic Sun*, a pair of ABS-classed vessels built at the IHI shipyard in Aichi and delivered to Philips/Marathon, to serve a long-term contract delivering Alaskan LNG to Tokyo Gas. Although only those two vessels were built with the SPB system, their sterling record during twenty years of nonstop service on one of the world's most severe and challenging runs thoroughly proved the strength and durability of the tank design. Standing on that track record, the shipbuilder now sees an opportunity for its containment technology to take an important place in emerging LNG markets and applications.

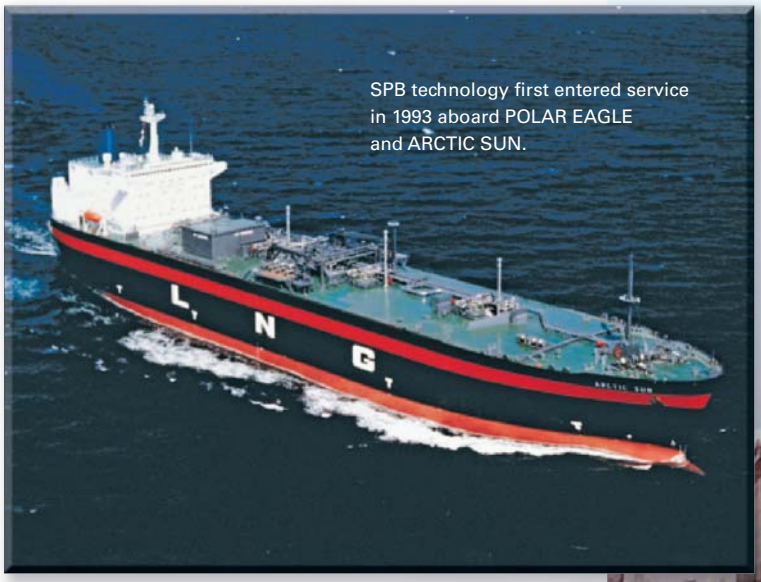
"Because we completely eliminate the sloshing problem and have proven its ability to handle partial loading under the worst sea conditions, we believe the SPB containment system is good for any application," Watanabe says. "We see it as ideal for floating terminals, where the tanks are constantly in a state of partial filling. In addition, the SPB tanks allow for a completely flat deck, which can then support terminal equipment," he says, adding that bunkering vessels and shuttle tankers will also benefit from the SPB tank's ability to handle partial loading.

Internally, the tank itself is modeled on conventional bulk liquid cargo holds: a stiffened plate structure subdivided into four spaces by a centerline liquid-tight bulkhead and swash bulkheads. As in a traditional bulk liquids carrier, these bulkheads control the natural frequency of the cargo; preventing ship motions from creating resonance with the liquid, they eliminate sloshing problems altogether. This means tanks can be loaded to any level at any time. In fact, when Alaskan LNG production wavered during the vessel's last seven years in service, the *Polar Eagle* and *Arctic Sun* made numerous voyages under slack loading conditions, without incident or delivery delay.

"The capability for partial loading also allows a ship to quickly leave the berth in the event of an emergency," says Watanabe. "It also makes the SPB best suited to floating terminals and facilities for production, storage and regasification, the tanks of which are often only partially loaded. In addition, SPB ships have a flat top deck, which is very useful for floating facilities like terminals and production systems."

Kazuo Watanabe, General Manager of Engineering, JMU

Installation photo of the IHI-SPB system shows the prefabricated tank customized to fit the vessel's hullform.



SPB technology first entered service in 1993 aboard POLAR EAGLE and ARCTIC SUN.

Robots cutting the skin plate at the start of production of the IHI-SPB tank.

"We can deliver possibilities for efficiency improvement as well," he adds. "Because the tanks are made to follow the vessel's hullform, ship designers will be free to pursue improved propulsive efficiency by creating LNG carriers with finer forms than you see today. The other containment systems do not allow for much hullform refinement."

The IHI-SPB tank is prefabricated at the shipyard and installed in the vessel without welding or any rigid connection to the hull. Instead, it rests on wooden chocks that are set into mounting structures in a key-and-keyway arrangement. Longitudinal and transverse movement of the tank is prevented by one series of chocks along the longitudinal centerline of the vessel and another series running perpendicularly to the centerline. The effect of this arrangement is to isolate the containment tank, allowing it to experience forces in only one direction and freeing it from torsional stresses due to twisting of the hull. The setup also allows the tank to shrink or expand with temperature change, which significantly reduces internal thermal stresses.

The IHI tank is made of aluminum alloy (for LNG applications) or 9-percent nickel steel (for LPG and other liquids), and is covered by insulating material. This insulation is not load-bearing, which gives the manufacturer freedom to offer a range of materials that can achieve boil-off rates as low as 0.1 percent.

New Future, New Ideas

Looking forward, Watanabe stresses the spotless performance of the two existing SPB-equipped LNG carriers as proof positive that the technology can help the LNG sector evolve and advance into new markets and services, and takes a moment to dispel a malicious rumor about the product that resurfaces in industry presentations, discussions and chit-chat from time to time.

"There has been a persistent rumor over the years that the SPB tank is somehow 'prone' to fatigue; we don't know for certain who started it, but it is absolutely untrue," he says. "The containment system performed flawlessly for 20 years in some of the world's harshest seas. The ships never experienced a service delay or structural problems with the tanks in all that time – and that includes numerous voyages under partial loading and very tough weather."

Ken Okabayashi, Business Director for ABS Japan, agrees. As a surveyor he attended the vessels during their construction and during many years of their maintenance stops in Yokohama-area shipyards. "Our Yokohama office was involved with the maintenance of the SPB ships for 20 years, and our surveyors attended them when they came here for required regular maintenance inspections," he says. "I don't know where these claims that they experienced trouble came from, but we know they never suffered any damage, and certainly no fractures. We inspected the tanks regularly, and I can tell you their condition was like the surface of a mirror, same as originally built, even after two decades at sea," he adds.

The main factor that kept SPB technology out of the LNG building boom of the last decade was not performance, but price. Until last year, an SPB containment system for an LNG carrier cost about 15 percent more than a comparable membrane system. Today, according to the manufacturer, the SPB premium is less than 10 percent over a membrane system. As orders

increase, JMU expects production efficiencies to further lower costs – aided, eventually, by efficient licensees building tanks in other countries. The first step in this direction came in 2003, when JMU licensed SPB technology to major Korean shipbuilder Samsung Heavy Industries.

Initially, IHI-SPB tanks will be constructed at JMU's Aichi shipyard. Right now, the company can build one 50,000-m³ capacity tank per month, but says it can readily increase that rate to match demand. The Aichi Works facility was developed back in the days when everyone believed million-ton crude carriers would be built, so there is plenty of room for expansion.

"Because this is truly an independent tank, it is easy for us to supply it to other shipyards or licensees," Watanabe says. "One big advantage of our system is that, wherever you can build a hull, you could build an LNG carrier."

Most enquiries for SPB systems to date have come from energy companies considering floating production, storage and terminal facilities for offshore developments, but recently, with Japan looking to increase LNG imports over the coming decade, interest in the system among domestic shipowners has begun to rise. Although JMU is focusing its efforts on marketing the SPB tank for these applications, the company has also developed concepts for future niche markets based around uniquely-shaped SPB tanks. Among these concepts are proposals for coastal terminals and solutions for small- and even micro- scale LNG scenarios that make use of the SPB's flexible morphology.

"If a small facility doesn't have enough land area for storage, it could have them at the shoreside, the tanks set into a landfill or a water enclosure, either gravity-based or afloat. Ships would then connect to the terminal via a mooring dolphin," Watanabe says. "In fact, if all that is needed is small or temporary storage, we could mount one of our tanks on the back of a mooring dolphin. Because we can make the tank in whatever shape is necessary to fit the application, we can make SPB structures to support even very small LNG facilities."

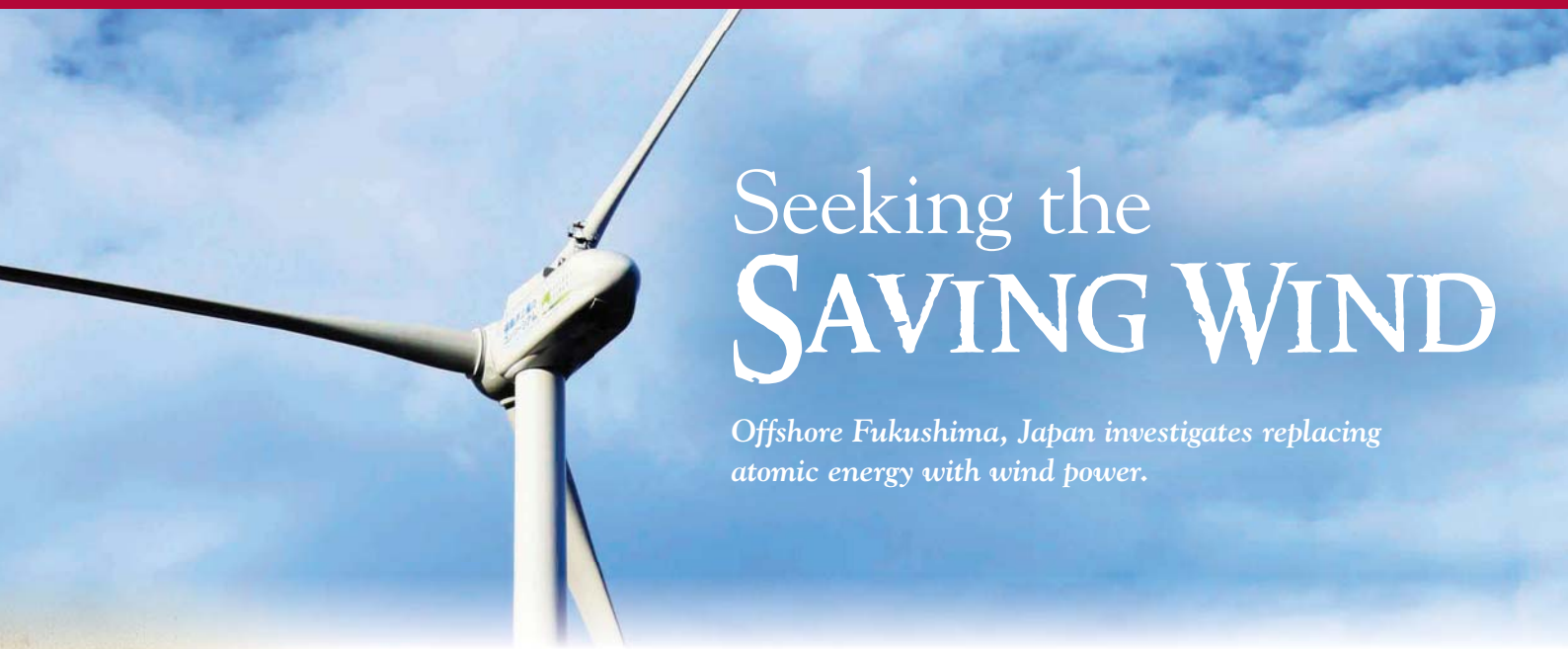
"Because it can be made to fit into any available space in the ship, the SPB is ideal for the fuel tanks in gas-powered vessels," he adds. "In fact, ABS granted an approval in principle for this application in 2011, when we developed a concept design for a gas-fueled containership."

As SPB tanks are, by nature, custom-built for each ship, they can be tailored to fit any hullform. This raises the possibility of converting existing ships for LNG service, presenting a potential boon to nascent markets needing shuttle tankers and shipowners looking to change the direction of a half-built vessel. One step towards that end was taken last August, when an owner signed a letter of intent with JMU to convert several large oil-ore carriers to LNG service. That project never came to pass, but the effort did move the concept briefly across the international stage. While all this may not mean the coming of a future world fleet containing combination carriers with liquefied gas capacity, or parcel tankers hauling LNG as just another hazardous cargo, it does seem to signal interesting times ahead.

Ken Okabayashi, Business Director, ABS Japan

"The SPB tank can now compete with any containment system for LNG carriers; the cost is down and the need is here for its no-sloshing feature, especially for floating LNG terminals," Watanabe concludes. "It is the right time for us to enter the market again." ❖

At IHI, robots are used to make the internal structures, welding every cross joint.

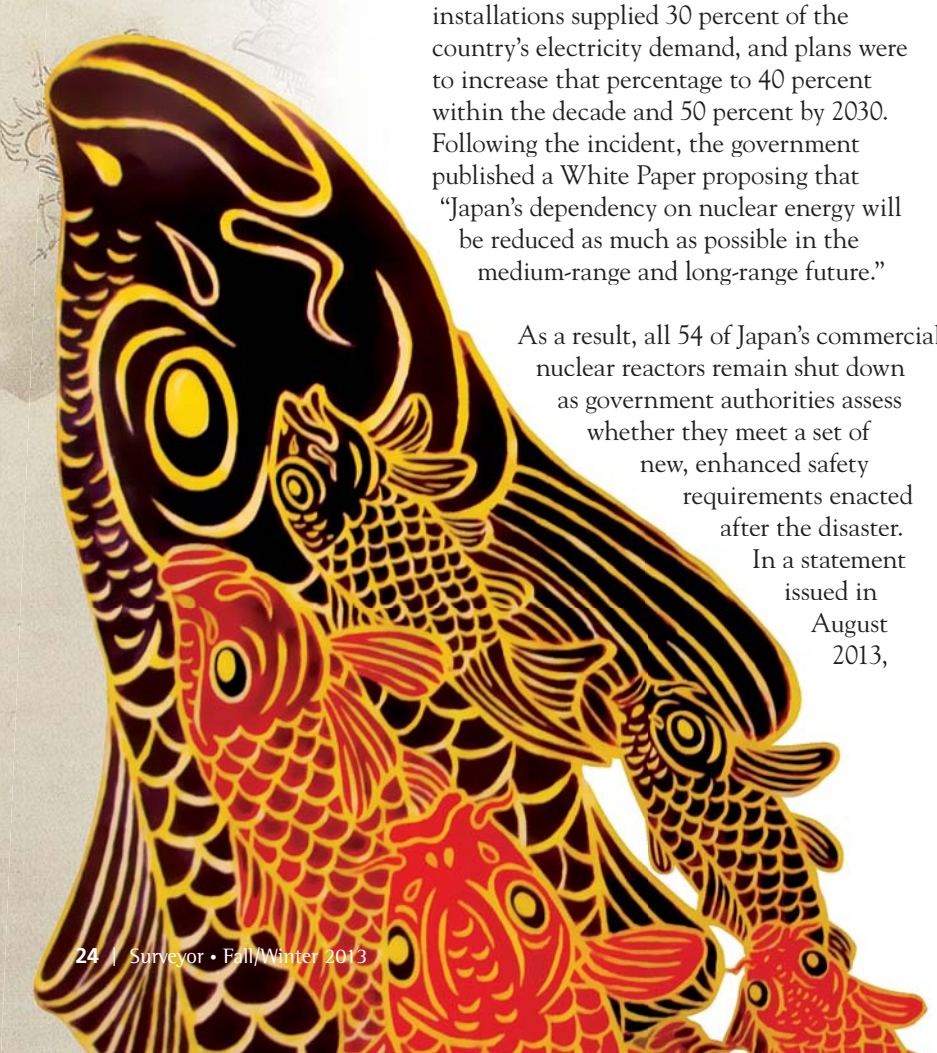


Seeking the SAVING WIND

Offshore Fukushima, Japan investigates replacing atomic energy with wind power.

The Great East Japan Earthquake of 2011 caused much of Japanese society to reevaluate the country's relationship with atomic energy, and to focus anew on alternate sources of electric power. The area hit hardest by the disaster was the Tohoku region in northeastern Honshu, Japan's main island, where coastal devastation was followed by a meltdown of three nuclear reactors at the Daiichi power plant in Fukushima Prefecture, which is about 250 kilometers (160 miles) northeast of Tokyo.

Before the Fukushima meltdown, nuclear installations supplied 30 percent of the country's electricity demand, and plans were to increase that percentage to 40 percent within the decade and 50 percent by 2030. Following the incident, the government published a White Paper proposing that "Japan's dependency on nuclear energy will be reduced as much as possible in the medium-range and long-range future."



As a result, all 54 of Japan's commercial nuclear reactors remain shut down as government authorities assess whether they meet a set of new, enhanced safety requirements enacted after the disaster. In a statement issued in August 2013, the Institute of Energy Economics Japan said the first nuclear reactor restart will come by July 2014. This followed earlier statements by Kenzo Oshima, Commissioner of Japan's Nuclear Regulation Authority (NRA), who said that the Authority expects some nuclear plants may restart in 2014, but, as of now, it is not known how many. The NRA has begun processing assessment applications, but says it will take at least a year to finish the evaluations. "It is hard to imagine that all the applications would be rejected, though we don't know what the outcome will be at the moment," Oshima told the press in August.

Reducing reliance on atomic energy means increasing the use of more expensive alternatives, and the Japanese Government is currently grappling with the challenge of balancing costs and benefits as it tries to develop a solid vision of the country's future power portfolio. This will be a difficult job, as the cost increases threaten to be substantial. In 2012, the use of fossil fuels rose by 21 percent over the previous year, leading some forecasters to predict that, if Japan restarts 25 percent of its reactors by March 2015, the annual cost of fossil fuel imports will increase by some 7 trillion yen (about $70 billion) over the same expenses as of March 2011.

Expectations are that Japan, already the world's third largest importer of liquefied natural gas (LNG), will significantly increase its use of the fuel. LNG imports are predicted to rise by 1.7 percent through March 2014 (reaching 88.3 million tons per year) and a further 1.5 percent by March 2015 (reaching 89.7 million tons annually). This is fueling excitement in the local shipbuilding and shipowning sectors, which see the changing world of natural gas as a new source of economic stimulation and revival.

Renewables on the Rise

Besides increasing use of natural gas, Japan is also seeing an explosion of interest in 'renewable' energy sources, particularly wind, solar and ocean energy. While supporting a re-start of its nuclear power sector, the government is also committed to growing its renewable energy sector. The Administration's target is to have renewable energies supply between 25 and 35 percent of total power generation in the country by 2030, by which time its investment in these sources would total some $700 billion.

The government is not alone in investing in the country's future. Private-sector investment groups are also taking a role. In October, the domestic Ohisama Energy Fund and Japan Green Fund announced plans to raise 1 billion yen (about $10 million) to provide loans for wind and solar projects that boost local economies, with the Institute for Sustainable Energy Policies helping such developers set up business plans. International interest in this market is also growing, with Goldman Sachs announcing recently intentions to invest up to $487 million in Japanese fuel cell, solar, wind and biomass projects.

The key to developing alternate energy sources in any country is the government subsidy mechanism known around the world as the 'feed-in tariff' (FIT), which is an artificially high electric rate the government pays providers in order to keep alternate-energy power providers in business. Japan's FIT rates are so generous that analysts are predicting the incentives will spur installation of 25 gigawatts of alternate energy in the years to come.

In April, the Japanese Government approved what may be the world's highest FIT for solar power, 37.8 yen (40 cents) per kilowatt-hour for the next 20 years. This level of support has stimulated a number of concrete developments that have made Japan one of only five countries that can claim to have ten gigawatts of cumulative installed solar photovoltaic capacity.

The Great East Japan Earthquake of 2011 caused much of Japanese society to focus anew on alternate sources of electric power.

Three Energy Scenarios for 2030

	2010	2030				
		0% Scenario		15% Scenario	20%–25% Scenario	Current Strategic Energy Plan
		Before Additional Measures	After Additional Measures			
Share of Nuclear Energy[1]	26%	0% (-25%)	0% (-25%)	15% (-10%)	20%–25% (-5% to -1%)	45%[2]
Share of Renewable Energy[1]	10%	30% (+20%)	35% (+25%)	30% (+20%)	25%–30% (+15% to +20%)	20%
Share of Fossil Fuels[1]	63%	70% (+5%)	65% (current level)	55% (-10%)	50% (-15%)	35%
Share of Nonfossil Energy Sources[1]	37%	30% (-5%)	35% (current level)	45% (+10%)	50% (+15%)	65%
Electricity Generated	1.1 trillion kWh	Approx. 1 trillion kWh (-10%)	Approx. 1 trillion kWh (-10%)	Approx. 1 trillion kWh (-10%)	Approx. 1 trillion kWh (-10%)	Approx. 1.2 trillion kWh
Final Energy Consumption	390 million kl	310 million kl (-72 million kl)	300 million kl (-85 million kl)	310 million kl (-72 million kl)	310 million kl (-72 million kl)	340 million kl
Greenhouse Gas Emissions (comp. to 1990)[3]	-0.3%	-16%	-23% (-21%)	-23% (-22%)	-25% (-25%)	(Approx. -30%)

1. Shares are those of total electricity generated. Figures in parentheses indicate percentage point changes from 2010, before the Great East Japan Earthquake.
2. The share of nuclear energy in the current Strategic Energy Plan (53%) is the share of large-scale power sources, excluding cogeneration and private power generation.
3. For CO_2 emissions, figures in parentheses indicate energy-related emissions only.

Source: Energy and Environment Council, "Options for Energy and the Environment." issued on 29 June 2012.

Construction of an advanced spar floating substation by JMU.

Now, several new initiatives are poised to boost that power even further. In one, which began soon after the new FIT was approved, the government granted permission for a 400-MW solar power facility on a remote island near the city of Sasebo, to be developed and operated for 20 years by a consortium set up by German solar power company Photovolt Development Partners GmbH. The project is expected to cost upwards of 100 billion yen ($1.1 billion), according to local news sources, and the electricity will be supplied via undersea cables to a local electricity provider in Sasebo.

One attention-getting renewables-oriented initiative was begun this year by the Panasonic Corporation, which formed a consortium of nine companies to work with the city government of Fujisawa, about 50 km west of Tokyo, in transforming the site of a former Panasonic factory into the 47-acre, 1,000-home Fujisawa Sustainable Smart Town. Built from the ground up, the town will incorporate such green basics as built-in roof solar panels, intelligent street lighting and electric vehicle recharging stations. It is expected to begin receiving residents sometime next year.

That said, it isn't only corporate giants benefiting from alternate energy subsidies in Japan. As the financiers and manufacturers maneuver for public funds, government support of solar power has helped many households 'go green', and is even helping Japan's small farmers stay in business.

Through an innovative technology called 'solar sharing', farmers can generate solar power while growing their crops. They do this by installing a light, tubular frame holding solar cells – a kind of solar pergola – above their vegetables, grains and fruit trees. This past April, once it was scientifically proven that the installations do not prevent plants from receiving the proper amount of sunlight or otherwise interfere with their growth, the Ministry of Agriculture, Forestry and Fisheries approved the use of such systems on crop-producing farms, a practice previously prohibited. Proponents of the technology claim that it could cover the country's current electricity needs if installed on about 7 million acres of farmland. Japan has 11.3 million acres of farmland, but how much of that is suitably situated for solar sharing remains to be determined.

Following the Wind

Another kind of high-tech farming is also raising hopes of a cleaner future through renewable energy: wind farms, on land and at sea. The Japanese Government is sponsoring a wind power experiment off the Fukushima coast that is attracting worldwide attention, because it seeks to prove and commercialize floating wind turbine technology.

Designating Fukushima Prefecture as the 'pioneer land for renewable energy', the government set aside funds to develop what could become the world's largest offshore wind farm. The experimental units are being installed about 20 km offshore Fukushima, and will link into the same electrical grid as the nuclear plants.

As water depths in the areas of most favorable wind speeds range between 100 and 150 meters, which is too great for fixed structures, the effort is focused on developing a floating turbine solution.

In late 2011, Japan's Ministry of Economy, Trade, and Industry (METI) organized a consortium of 11 organizations to bring the Fukushima Experimental Offshore Floating Wind Farm Demonstration Project – also known by the shorthand name Fukushima Forward – to reality. These are: international trading house Marubeni (as project integrator); the University of Tokyo (as technical advisor); Mitsubishi Corporation; Mitsubishi Heavy Industries (MHI); Japan Marine United (JMU); Mitsui Engineering & Shipbuilding (MES); Nippon Steel; Hitachi Corporation; Furukawa Electric; Shimizu, an engineering and construction corporation; and the Mizuho Information & Research Institute. Their joint aim, to develop a gigawatt-level wind farm, is seen as a flagship project in a technology development effort dedicated to boosting Japan's renewable energy resources and revitalizing the Tohoku regional economy.

The total cost of the experiment is estimated at 18.8 billion yen (approximately $188 million). Stage One, now underway and due to be completed by March 2014, involves construction of the world's first floating electrical substation and a 2-MW wind turbine mounted on a four-column semisubmersible hull. This phase also calls for evaluating floating platforms and turbines, developing new electrical components and corrosion- and stress-resistant materials, establishing measurement methods and collecting meteorological and oceanographic data. Stage Two, which will run into 2016, involves deploying two 7-MW turbines mounted on an advanced spar-buoy and a three-column semisubmersible.

Shipbuilders Help Wind Farmers

The Fukushima Forward units currently on site are a 2-MW floating turbine built by MES and a floating electrical substation built by JMU. The Mitsui unit, the first of three competing designs that will be evaluated during the experiment, will be joined over the coming year by an 'advanced spar' built by JMU and a V-shaped semisubmersible developed by MHI.

With the turbine tower mounted on the center column of a triangular four-column semisubmersible hull, the MES design is the most conservative of the three experimental units. The turbine it uses is of the downwind type (in which the nacelle faces the wind) and is to be mounted so that it will be slightly inclined in relation to the surface. The engineers expect this will maximize its power output, on the theory that, because of the inclination, the rotating plane will get more wind than would an upwind-type turbine.

"The government asked us for very short design and building periods, so we decided to take a conservative approach to the design," explains Akihiko Imakita, General Manager of Business Development for MES. "If there were a steady wind from certain directions, we might have considered an asymmetrical design. But, because we have to account for typhoons, where the wind direction is unpredictable and changes quite a lot, we chose to develop a symmetrical structure."

The MES hull is kept in place with catenary moorings having a spread of approximately 1.6 km. Should the design be selected for an eventual wind farm, this mooring spread will just fit within the recommended spacing of the turbine units (ten times the blade diameter of 7-MW turbine, which is 160 meters), according to Imakita. The unit's design and mooring plan were developed out of Mitsui's long corporate experience in offshore engineering. In fact, MES worked together with its MODEC subsidiary, an offshore industry leader, in system design and installation.

In contrast to the conservative MES unit, the unit being built by Mitsubishi Heavy Industries follows a more radical concept: a V-shaped hull, without bracing, which has an upwind-type turbine (blades facing the wind) atop a tower mounted at its apex. Now under construction in MHI's Nagasaki Shipyard, the unit is expected to be onsite during 2014.

"The V-shaped floater is a unique concept," says Masao Komatsu, Director of MHI's Offshore Planning Group. "We developed it under the thinking that, since the goal is to create a commercial wind farm, whatever we designed would have to be produced reliably, efficiently and in quantity. We also needed to have low construction costs, short building time and low installation costs. Thinking such things, and also trying to maximize its performance as a floater, we developed this V-shaped hull," he explains.

"The hull has a simple shape that could be built in the port, and allows the wind tower to be installed easily," he adds. "We have made very detailed calculations and fine-mesh FEM analyses; we performed a tank test in a wind tunnel, and we are confident the design will perform as expected."

Akihiko Imakita, General Manager, Business Development, Mitsui Engineering & Shipbuilding, with models of the MES floating wind turbine.

Masao Komatsu,
Director,
Offshore Planning Group,
MHI

Peaceful Coexistence is Essential

In 2012, the Fukushima prefectural government published a new energy vision, the stated goals of which include meeting 100 percent of its energy needs through renewable sources by 2040. One key to meeting that target is offshore wind power. In fact, the prefectural government has expressed hopes that the experimental project will lead to development of a large wind farm industry in the region.

One of the challenges to meeting this expectation is establishing peaceful coexistence between the wind farm and the local fishing and fish processing industries. In pursuit of this, the consortium is working hard to maintain good relations with the fishermen. Still dealing with contamination issues from the meltdown, the fishermen are concerned that the structures will further force a restriction of their activities.

Complicating the outreach efforts is the fact that the area where the wind turbines will be located is an excellent fishing ground. The deputy chief of the local Fisheries Cooperative Association told the *Mainichi Daily News* that, "If the fishing ground is destroyed, we will not be able to make a living. It is a life-or-death issue." Another official also told the paper that high among the fishermen's concerns is interference with their occupation due to submarine electrical cables. "We fear we may not be able to do trawl fishing anymore – that's the main line of our business," he said.

The government says it will consider possible compensation after the project is actually carried out. In the past, according to the fishing association, when private companies built an offshore platform and laid a gas pipeline in waters off Fukushima, local fishermen were paid one billion yen (about $10 million) in compensation.

Ultimately, whether Japan chooses to develop offshore wind farms will depend on the cost. At the end of the experiment, the various participants will report on the building and installation costs, and on the technical outlook for the project. One of the cost factors in their decision, an unknown at this point, is the feed-in tariff.

Being a policy matter, the FIT awarded to various technologies is subject to change, and rates are reviewed annually. So, for example, the first available FIT rate for solar, obtained by some of the solar sharing farmers, was 42 yen (about 42 cents) per kWh for 20 years; after some reductions, today's rate is around 12 percent lower. Even though FITs tend to drop as the number of companies using the supported technologies rises, Japan's basket of FIT rates remains among the most generous in the world – for example, the present rate for large wind power installations (above 20 kW) is 23.1 yen/kWh, which is about 2.5 times the rate in Germany and France.

After a slow start, the wind-power FIT appears to be having its desired effect. According to a recent METI report, interest in wind power in Japan is growing. The ministry says that there are now ten land-based projects that have passed environmental assessment and are in the building stage, and 70 more that are under review for environmental impact. While other offshore wind experiments are underway or planned for Japanese waters – for example, a small turbine is being tested in the Goto Islands offshore Nagasaki, and a hybrid wind/wave power generator is set to be deployed off the country's west coast – the eyes of the world are on Fukushima Forward, which, if successful, just might show the way to feasibility for other such projects and help other nations increase their energy self-sufficiency.

The spirit and the hope of the experiment were summed up in the closing words of an address, now known as the Fukushima Declaration, delivered by Yuhei Sato, Governor of Fukushima Prefecture, on the first anniversary of the disaster.

"Today the eyes of the entire world are on Fukushima. Through our journey of revitalization, we will show the world a new kind of society: one that balances community development and global environmental conservation," Sato said. "We will demonstrate the importance of mutual support among local residents and the promotion of regional culture and pride. Joining our hearts together as one, we will face the challenges ahead."

"Today on this first anniversary of the Great East Japan Earthquake, I make this Fukushima Declaration to the people of the world: We will create once again a beautiful Fukushima; we will build a dynamic and vibrant Fukushima; and we will show the world and pass down to future generations Fukushima's revitalization process." ❖

INNOVATION SNAPSHOT:

Hybrid Turbine Draws Power from Wind and Water Simultaneously

In March 2013, the Mitsui Ocean Development & Engineering Company (MODEC) set many tongues talking when it exhibited an innovative new environmental power generation system at Tokyo's Wind Expo 2013. Named The SKWID, for Savonius Keel & Wind Turbine Darrieus, the floating power generator is a hybrid unit combining a Darrieus-type vertical wind turbine above the waterline and a Savonius-type waterwheel generator below.

These types of turbines function equally well despite directional changes in their respective elements. MODEC further says the wind turbine's rectangular swept area catches twice as much wind as the circular swept area of standard propeller-like units of equal diameter and, therefore, is capable of delivering twice as much power from the same wind farm area. The split-cylinder-shaped buckets of the current turbine, meanwhile, are said to be able to harness even very weak currents. The developer also claims the turbine is "insensitive to marine growth on the buckets and is harmless to the marine ecosystem, as it rotates slowly at the speed of the current."

The configuration MODEC chose for its Darrieus turbine is the 'giromill' (or egg-beater) type, in which straight vertical blades are attached to a central tower via horizontal supports. According to a spokesman, MODEC chose this configuration for reasons of performance, stability and ease of maintenance – the SKWID's nacelle is at the same level as its float, making it unnecessary to climb to the top of the turbine to perform maintenance. MODEC believes that easy maintenance of the individual units is a very important factor for the successful operation of offshore wind farms.

The current generator was developed in a joint project with Japan's New Energy and Industrial Technology Development Organization. The float structure supports the power generation assembly via a set of gimbaled rubber mounts to isolate the generator assembly from wave motions. According to MODEC, the location of the heavy generator assembly gives the SKWID a low center of gravity and, thereby, excellent stability. The Savonius current turbine also acts like a ballast giving the SKWID self-righting capabilities. In addition, the manufacturer claims the unit will be "more cost-competitive than any other floating wind power generation system."

A full-scale prototype unit is currently under construction. When built, the wind turbine section will rise 47 meters above sea level, while the tidal turbine below the water will have a diameter of 15 meters.

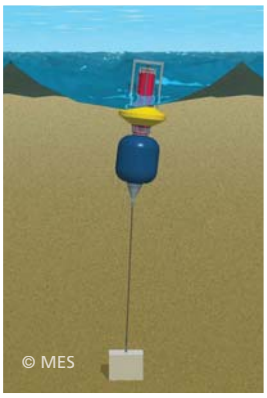
According to MODEC, component testing has been progressing on land and the prototype SKWID now under construction is due to be on site by the summer of 2014 and operating by autumn. The unit will be installed in 55 meters of water 1.2 km off Kabe Shima Island, located near Karatsu, a city in Saga prefecture just across the Tsushima Strait from Busan, Korea. ◆

Stimulating Offshore Innovation

At the May 2012 meeting of Japan's Headquarters for Ocean Policy, then Prime Minister Yoshihiko Noda stated that, "For Japan, which is a marine nation surrounded entirely by the sea, it is important to carry forward the development and use of marine resources and the maintenance of marine research. The policy for initiatives to promote the use of maritime renewable energy decided today, including wind-power-generation, should be the basis for constructing a new society in terms of energy." With this focus on ocean energy, Japan has produced some interesting and innovative ideas so far. Here we take a look at six intriguing designs ranging in development from drawing board to prototype stage.

1. The Goto Islands Floating Turbine

In 2012 Japan's Ministry of the Environment began conducting tests of a small floating turbine deployed about one km off the coast of Kabashima Island in the Goto Islands near Nagasaki. In October, the 100-kW test unit was replaced by a 2-MW turbine mounted on a spar-type floater moored in 100-meter depths. It is the first floating turbine in Japan to be connected to the nation's power grid.

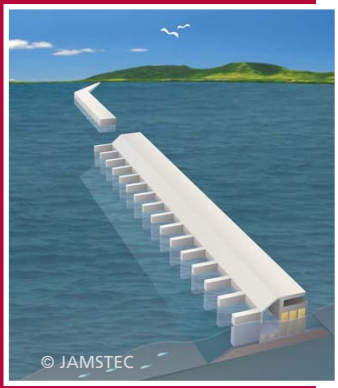


2. Buoy Generator

Mitsui Engineering & Shipbuilding (MES) awarded US-based Ocean Power Technologies (OPT) a 70-million yen (about $700,000) contract to jointly develop OPT's PowerBuoy technology for application in Japanese waters in 2012. Riding the rising and falling waves, the buoy converts its up-and-down motion into electricity by a power take-off that drives an electrical generator. OPT teamed with MES on improving the device's power capture capability, and a decision is expected sometime this year on the next steps toward ocean trials of a demonstration unit.

3. Oscillating Water Column in a Levee

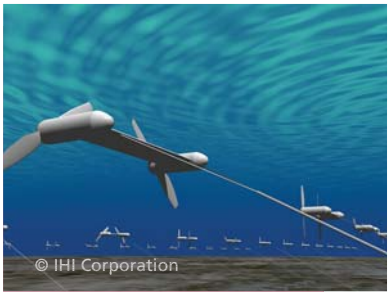
A new concept from Mitsubishi Heavy Industries (MHI) updates the technology pioneered on Japan's first ocean energy experiment, the Mighty Whale, which was decommissioned in the late 1990s. In this development, an oscillating water column (OWC) is mounted in a levee or breakwater. Waves entering the boxlike structure force the air inside through a turbine generator to produce power. An MHI subsidiary is slated to install a demonstration system in a breakwater located in the Tohoku region.



4. Freestanding Tidal Current Generator

Developed by Kawasaki Heavy Industries (KHI), these freestanding modular tidal current generators are now being tested in 50 meters of water at the European Marine Energy Center (EMEC) in Scotland's Orkney Islands. The propellers, 18 meters in diameter, rotate in the current to generate electricity, their direction automatically controlled to respond to the ebb and flow of the tide. The manufacturer reports that special surface treatment on the blades will stop marine organisms from adhering. In a deal worked out last March, EMEC, which provides purpose-built open-sea test facilities for wave and tidal generators, and the Ocean Energy Association of Japan agreed to cooperate on building Japan's first marine energy test center, with the KHI design as the first development project.

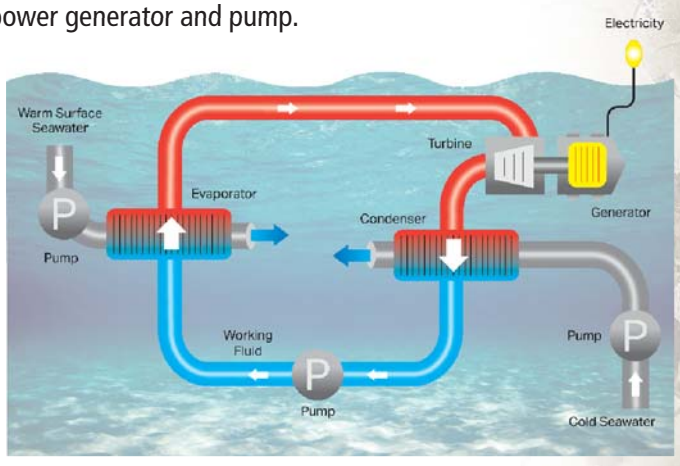
5. Floating Fin Tidal Current Generator



In 2011, Ishikawajima-Harima Heavy Industries Corporation (IHI), Toshiba, Tokyo University and the Mitsui Global Strategic Studies Institute announced a joint development project for a novel tidal current generator: a pair of widely-spaced propellers anchored to the seabed that floats like a kite. According to the developers, because the speed and direction of undersea currents do not change much, the units can stably generate electricity continuously for long periods. Moored near the seabed, they will be unaffected by surface conditions and will not restrict vessel operations and, because the turbines rotate in opposite directions, the rotary torques they produce cancel each other out, stabilizing the generator's position. The partners say the goal is to have a commercial version ready by 2020.

6. Ocean Thermal Energy Converter

In April 2013, Okinawa Prefecture announced the start of an experiment in Ocean Thermal Energy Conversion (OTEC) at the Okinawa Prefectural Deep Sea Water Research Center on Kume Island. The OTEC concept uses temperature differences between cooler deep and warmer shallow or surface waters to run a heat engine and produce electricity. The system consists of an evaporator, condenser, turbine, power generator and pump. A 'working fluid' – in this case, ammonia – is sent to the evaporator by the pump. Warmed by surface seawater, the ammonia vaporizes and drives a turbine that generates electricity. The vapor then enters the condenser, where cold subsea water liquefies it and the process begins anew. Companies participating in the design and construction of the 50-kW test unit are IHI Plant Construction Co. Ltd, Yokogawa Electric Corporation and Xenesys, an environmental engineering company. Testing and research will be conducted with the support of Japan's Saga University, a leader in OTEC technology, through the end of 2014.



© Institute of Ocean Energy, Saga University)

VIEWPOINT

When a Crazy Idea becomes a Vision

Brian Chang, Chairman, Calm Ocean Pte Ltd.

When Brian Chang owned the Yantai Raffles Shipyard (now CIMC Raffles), he built the biggest gantry crane in the world, which he named Taisun. Recently, Surveyor asked a question about innovation, which the famed entrepreneur answers in this viewpoint.

Q: The Taisun crane was the product of a daring vision that many people called crazy, and which took risk and sacrifice to realize. Now you are building a single-leg jackup rig. How do you know when a vision is a true vision, worthy of sacrifice, and not just a crazy thought?

Actually, I have battled with that question through my whole life. You are never able to find the answer to it at the time when you need to make your decision. In this latest case I needed to shed a lot of baggage first – and I needed to be free of the shipyard, which happened last year.

The time for making the decision, for committing to the idea, is really somewhere along the road. The moment comes when all the pieces fall together: when you have the time and the energy; when the potential customers are there; when the finance is possible; when you have the right partners to support development; and when the technology and the resources you need are available. Too early was usually my problem.

'Risking everything to follow a dream' sounds romantic, but it is a very difficult path to follow. You need strength to confront the many problems of different size that you will encounter along your way. You need a creative mind to find the way through to your target. Most of all, if you want to realize a big dream, you need to find the right people to help and support the work. Very often, you find support in young people, who aren't burdened by preconceptions or negativity and who are ready to try to do something that hasn't been done before.

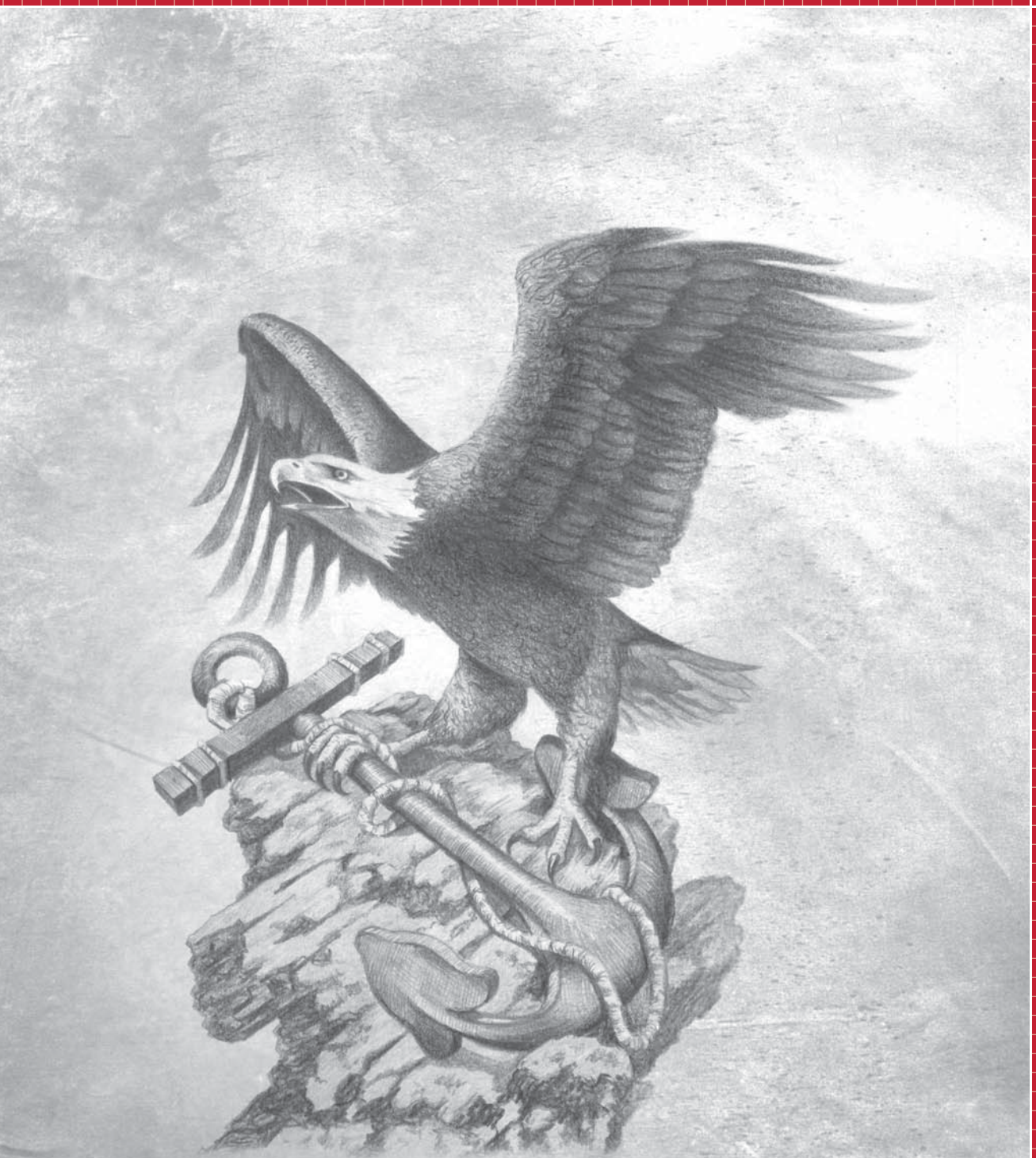
And, of course, you need the right technical assistance. For example, my extremely good friend Joop Roodenberg, the genius behind Huisman Equipment (builder of over 500 cranes) helped me solve the rigging system. Many people helped realize the Taisun. Everybody contributed a little bit; nobody by themselves could have made it. A giant crane using no hooks, no slings and no pad eyes seemed impossible.

In the end, we developed the world's best manufacturing process for semisubmersibles and we succeeded. If I didn't have the Taisun, I wouldn't have dared to sign up seven semis at one time. But as it is, with the Taisun crane, saving 2 million man-hours per rig, I could go ahead and sign them. That said, if we had this system but were only able to get orders for one semi, it would have been a total failure.

So, if you have the idea to do something totally new, you know it can become real when you see the possibility that all these different factors can come together. If one or a few of the pieces are in place and you go with that, the chances are you will fail. A seed will grow into a tree, but you can't grow a tree from a part of a seed. ❖

"We demand that big business give people a square deal; in return, we must insist that when anyone engaged in big business honestly endeavors to do right, he shall himself be given a square deal."

– Theodore Roosevelt
(1858-1919)



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