

# Beyond the sky

An integrated solution for the world's first satellite launch unit at sea

Jane-Helen Pedersen, Jacqueline Rolffs

In recent years, launching satellites has become a viable commercial business and a number of companies compete for a share in this highly specialized market. One company that stands out from the crowd is Sea Launch, an international consortium that operates from a floating platform in the Pacific Ocean. ABB provides Sea Launch with mission-critical services. With its reliability and know-how, ABB is helping to ensure the continued success of the Sea Launch enterprise.



The Sea Launch Company is a market leader in the competitive field of commercial satellite launch services. This international consortium provides cost-effective, heavy-lift launch services and is the only company in the world that launches commercial satellites from a floating launch platform. The company has established its reliability through extensive heavy-lift launch experience and has a solid group of satisfied customers. ABB was instrumental in Sea Launch's early success and continues to provide mission-critical services to the company.

#### Unique capabilities

With its unique capability to launch satellites at zero-degree inclination on the Equator, Sea Launch is able to offer maximum lift capacity and the most direct route into orbit. This allows for an increase in payload mass and maximizes the lifetime of satellites in orbit. In seven years of commercial operations Sea Launch has established a firm customer base of leading global telecommunications companies who rely on Sea Launch and its world-class services to develop their own businesses.

#### Unique international partnership

After completing their initial research in 1995, the Seattle-based Boeing Commercial Space Company initiated Sea Launch by joining forces with Aker ASA (formerly Kvaerner) in Norway, Rocket and Space Corporation (RSC)-Energia in Russia and SDO Yuzhnoye/PO Yuzhmash in Ukraine. Their aim was to construct, build and manage a satellite launch unit, complete with payload and rockets. An offshore launch site on the equator was chosen for direct insertion into equatorial orbit – as well as to reduce environmental risks and to minimize costs.

Within five years, the platform and the Assembly and Command Ship <sup>1</sup> had been built and the first demonstration payload-launch was successfully carried out on March 27th, 1999. Since this first mission, the company has carried out a further 19 successful launches. This is a testament to the company's robust performance in a relatively flat market.

#### Unique location with advantages

Located on the Equator at 154° West in international waters of the Pacific Ocean, the launch site benefits from the uniquely calm weather of the doldrums. The light wind conditions in this region result from the convergence of the Northern and Southern Hemisphere trade winds and allow Sea Launch to provide a reliable launch schedule.

The systems delivered by ABB are classified as mission-critical and directly affect the rocket segment.

The Sea Launch Company also benefits from the diversity of skills and experience brought by its various partners. It has been able to optimize its resources by integrating diverse systems and technologies <sup>Factbox</sup>.

#### ABB's mission-critical systems

All launch operations are remotely controlled by the English- and Russian-speaking units on the *Sea Launch Commander*. These operations include the erection of the rocket on the launch pad, automatic mating of fueling and electrical umbilicals, countdown, liftoff and flight.

ABB's role is to deliver integrated automation, safety and complete electric

power generation and distribution systems to both the self-propelled *Odyssey* Launch Platform and the *Sea Launch Commander* <sup>1</sup>. All of these systems are classified as mission-critical and directly affect the rocket segment. They include, for example, the trim/heel control system (to keep the platform level) and the Russian oxygen-monitoring system, which is important during fueling of the rocket (around 900 I/O signals are integrated into the ABB system).

During the development stages of Sea Launch, ABB engineers were needed to deal with teething problems in software applications and some equipment. These, however, were quickly dealt with and ABB's main responsibilities are now to train operators, provide assistance during launch operations and to adapt the ABB systems to the modifications that are made after each launch. An engineer from ABB Marine in the Netherlands has participated in each Sea Launch mission to date <sup>3</sup>.

#### Ingenuity at large

ABB Marine in Rotterdam was responsible for the installation and commissioning of the automation system on board the *Sea Launch Commander*, and for implementing, modifying and commissioning the human machine interface (HMI) for the KBTM

<sup>1</sup> The *Sea Launch Commander*; a floating mission control center and rocket assembly factory





## Ingenuity at large

**Factbox** The partners and their roles

Boeing, in the USA, is responsible for managing the Home Port facilities in Long Beach, California, and for the development and operation of the payload unit. Boeing also manages launch operations, including the operation of the launch control center, mission design and systems integration.

Aker ASA, based in Oslo, Norway, is responsible for the marine segment of the program. This included refurbishment of the launch platform (a modified, off-shore oil-rig) at Kvaerner Rosenberg in Stavanger, Norway, and construction of the *Sea Launch Commander* at Kvaerner Govan in Glasgow, Scotland.

The Yuzhnoye Design Bureau and the Yuzhmashzavod Production Association in Ukraine manufactures the two first stages of the Sea Launch rocket, the Zenit-3SL. This is a modified version of a reliable, quick-response system that was brought into operation in the early 1980ies.

S.P. Korolev RSC Energia in Russia is responsible for managing rocket operations. It also produces the upper stage of the rocket, the flight-proven Block DM-SL, which deploys satellites into geosynchronous transfer orbit.



Moscow (Russian) oxygen-measuring application that is implemented in ABB's UNIX-based operating system. The Rotterdam group also participated in the commissioning of the *Odyssey Launch Platform*.

ABB Marine in Norway designed and delivered the electrical equipment and the automation systems for both the *Odyssey Launch Platform* and the *Sea Launch Commander*.

The ABB engineers involved in the early design of the electrical and automation equipment had to accommodate the complexities of this multi-national project. Launching satellites from the sea was a totally new application and certain technologies had to be adapted. For example, to prevent potential damage caused by excessive vibration experienced during launch, all critical components of the electrical and automation systems are fitted with vibration dampers.

The complexity of the project was compounded by the requirements of individual pieces of equipment, which were sourced from the USA, Russia, Ukraine and Norway, and by the international companies involved at every stage of the proceedings. The success of Sea Launch is a testament to the flexibility of all involved.

#### Lift-off preparations

During the first stages of launch preparation, the rocket segments and the

satellite itself are delivered to Sea Launch's Home Port facility in Long Beach, California. The satellite is encapsulated and mated with the rocket on board the *Sea Launch Commander*.

Two days prior to departure, the rocket is transferred to the rocket hangar of the *Odyssey Launch Platform*. The rocket is mounted onto the mobile transporter, which is used to erect it on the launch pad.

The *Odyssey Launch Platform* departs three days before the *Sea Launch Commander* and the two vessels meet near to the launch site to carry out final preparations.

At the launch site, the floating platform is ballasted to the desired draught of 21 m and specially trained personnel begin preparations. Most staff (240) are on board the *Sea Launch Commander*, while the remainder (68) work on the launch platform. Transportation between the two vessels takes place via a temporary bridge. Both vessels are equipped with dynamic positioning control.

The day before launch, the operators move from the launch platform to the command ship and control is transferred to a duplicate ABB console in the ship <sup>2</sup>. This console communicates via the extended ABB network and a so-called line-of-sight (telecom-

<sup>2</sup> ABB equipment used on board the commander vessel



- 3 The ABB engineer, who accompanies all launch missions, is viewed as a member of the crew



munication) connection with the platform.

ABB Marine designed and delivered the electrical equipment and the automation systems for both the *Odyssey Launch Platform* and the *Sea Launch Commander*.

After the rocket has been rolled-out and erected on the launch pad, the remaining staff are airlifted to the command vessel, by helicopter. At this point, full command is transferred to the remote unit on board the ship. The rocket is then fueled with a liquid oxygen and kerosene mixture and the transport/erector equipment withdraws to the hangar. Minutes after the hangar doors are closed, the rocket lifts off.

In 2005, Sea Launch celebrated the tenth anniversary of its inception, recognizing a decade of innovation in the launch services business. Progress continues with the support of a team dedicated to exceeding its customers' requirements and expectations. Sea Launch is committed to successful, on-schedule launches, building on its proven track record and strong reputation. It continues to win contracts from both new and returning customers in an endeavor that epitomizes the ingenuity with which ABB is so often associated.

#### Factbox ABB delivery of power and automation systems

##### Delivered for the *Odyssey Launch Platform*:

- Eight high-voltage generators (6 kV, 3600 kVA). 4 × 60 Hz, 2 × 50/60 Hz and 2 × 50 Hz.
- All high- and low-voltage switchboards for both the 60- and 50-Hz systems.
- All motors for the bow and azimuth thrusters.
- Silicon controlled rectifier (SCR) systems for the propulsion.
- Automation systems (2 × AC450 controllers, 2 × fireguards [ANX-95], 1 × safeguard 3000, 8 × AS500 operator stations, 1 × 800xA trending station).
- Protocol converter for the interfacing between the oxygen monitoring system and the ABB Advant System (HMI)

##### Delivered for the *Sea Launch Commander*:

- 2 high-voltage generators (6 kV, 6250 kVA, 50 Hz).
- 4 low-voltage generators (380 V, 1525 kVA, 50 Hz).
- All motors for the bow and azimuth thruster (6 kV).
- All high- and low-voltage switchboards for both the 60- and 50-Hz systems.
- Automation systems (3 × AC410 controllers, 1 × safeguard 400/1.4, 2 × fireguards [ANX-95], 4 × AS500 operator stations, 1 × 800xA trending station).

#### Jane-Helen Pedersen

CoE Marine Oil & Gas Vessels, ABB AS  
Oslo, Norway  
jane-helen.pedersen@no.abb.com

#### Jacqueline Rolffs

Marine Service Center, ABB b.v.  
Rotterdam, The Netherlands  
jacqueline.rolffs@nl.abb.com

For more information, please see  
[www.sea-launch.com](http://www.sea-launch.com)