

How to protect your port's hidden underwater perimeter

Lessons from the new multi-sensor installation at the Port of Long Beach

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Night has fallen over the control centre of the Port of Long Beach (POLB), one of two harbors servicing the metropolis of Los Angeles and the entire country. A container ship fully loaded with clothes and electronics is coming alongside. As one of the most important gateways for trade between the U.S. and Asia, last year POLB handled more than 6.2 million containers. All movements at the port are closely monitored from the operation room, both over the water's surface and, importantly, under the water.

Suddenly, a symbol appears on one of the many monitors. The advanced Kongsberg sonar security system has detected an object moving in a direct line and heading for the harbor basin. A yellow icon on the screen initially defines the object as unidentified. At the same time, powerful computers are working to interpret the signals reflected by the object. The operators watch closely – is there a foreign diver in the harbor, or is it just a harbor seal?

Security a top priority

The sonar program is the culmination of efforts that began before 9/11 and accelerated in 2005 when Long Beach received an initial US\$3.8 million grant from the Department of Homeland



The Port of Long Beach, which has installed a new state-of-the-art multi-sensor underwater security system.

Security for an underwater surveillance system with both fixed and mobile elements. The fixed system includes sonar heads installed at various choke points in the port. A key aspect of the system is the signal processing software that allows operators to determine whether the sonar is detecting divers, seals, sharks or



A screenshot from the Kongsberg Defender III system, showing a hostile diver target and track.



A typical port security control room, from which operators monitor inputs from radar, sonar, and CCTV cameras located around the port.

TYPICAL UNDERWATER SURVEILLANCE SYSTEMS

C-Scope Underwater Surveillance System

The general system comprises different types of sonars, both active and passive, sonar processing software and software for sensor fusion, track management and classification. Countermeasures are an integral part of the system giving the operator full control from detection to reaction.

C-Scope command and control unit

- Multi Sensor Integration User Interface

Active sonars

- DDS9000, 85-95 kHz
- LASAR 40, 30-45 kHz
- LASAR 5, 3-8 kHz

Passive sonar

- PASAR – Passive Awareness Sonar, 10-2500 Hz

Conductivity, Temperature and Depth – Vertical Profiler

- Automatic CTD measurements for Sonar Performance Analysis

Countermeasure

- C-Guard, air gun
- C'Inspector, Underwater Vehicle

The information is brought together by an Integrated Geographical Information System, the software and computer hardware that displays a common operating picture or COP to users. Information to the COP requires a number of computers to process data from different sensors including active sonar and possibly passive sonar.

The selection choice of sonar types (active, passive) and range capabilities are typically constrained by the geographic boundaries and physical structures such as breakwaters and bathymetric conditions. Instruments to measure water conditions and compute sound velocity will aid greatly in optimizing system performance.

Confirmation of targets may be carried out using robotic surface vehicles or Remotely Operated Underwater Vehicle (ROV) operating below the surface.

Ports are usually governed by multiple security and police agencies both federal and local, which will play a large role in deciding what agency responds and how they respond. Interdiction of intruders can take place in the harbour or at the land/water interface. Countermeasures employed will differ depending on where the interdiction takes place, on land or in water and the type of intruder, whether it is surface or subsurface. Armed response teams would deploy in boats or RHIBs to deal with sub-surface threats. These teams would use lethal or non-lethal measures against underwater intruders. An ROV can be used to deliver a lethal or non-lethal response following target confirmation.

swimmers. The result is that Long Beach now has one of the most advanced sonar surveillance systems in the world, and, given its emphasis on security, is now one of the most technologically advanced and secure ports in the world.

Securing business continuity

As the second-busiest port in the United States, it makes sense for Long Beach to maximize security of commerce and prevent interruptions. Combined with the Port of Los Angeles, the complex ranks as the sixth busiest in the world; officials have estimated the economy would lose about \$1 billion a day if these two ports were shut down for any reason. Since the port is responsible for more than 1 million jobs across the country, any lengthy stoppage would also dramatically affect the rest of the nation's economy.

Given the economic importance of this and many ports, in the event of a disaster it is POLB's priority is to recover and get back on its feet quickly, to ensure the continuation of commerce through the port complex.

"Business continuity" is a critical aspect for shippers and for the port. Each year, Long Beach puts about \$25 million on security and \$15 million on capital expenses toward a more secure port. In fact, more than 30% of non-personnel expenses are related to security, public safety and business continuity. During the last ten years since 9/11, POLB has also received about \$120 million in federal grant money for security enhancements.

Back in 2001, there were 35 security cameras overlooking a port that includes 10 piers and 80 berths. Today, security officials have access to about 350 cameras. Long Beach has over 150 cameras in the port complex that can be monitored in the command centre, and additional agreements with tenants and the



The workhorse of the Underwater Surveillance System is the DDS-9000 sonar with 70 systems delivered worldwide.

nearby Port of Los Angeles for sharing video monitoring feeds. The integration of sonar and radar within their system enables them to maintain a watch above, on and below the water.

Deep within the command centre, there is a room in which port security systems operators work, where they monitor combined inputs from radar, sonar and cameras. Most of the equipment, especially radar and sonar, is able to view and identify what is in and around the water. It also looks for oddities – things that cannot be properly identified – and this is where the advanced software signal processing comes in.

Processing and analyzing signals

Kongsberg was the first company in the world to provide multi-sensor integration for underwater surveillance. An underwater surveillance system such as the POLB's assesses and combines data from multiple sonars placed on the seabed or under the water line. These sonars transmit signals to powerful computers that are fed with complex algorithms and statistical tables. "This is where the data is processed, filtered and interpreted," explains project manager Oddbjorn Eriksen of Kongsberg Defence Systems Norway.

"This is world-class processing of signals. The ability to classify an object in the water is one of Kongsberg's major strengths, but also one of our most difficult processes. We have a number of doctors of engineering working with signal processing alone. They are continuously working on further developments and improvements to the system," explains Mr. Eriksen who also holds a doctoral degree in engineering.

Another aspect is that the Port of Long Beach has a rich marine fauna, and this really puts the advanced sonar system processing technology to the test. Computer analysis of incoming signals is required in order to distinguish genuine threats from marine life. At the same time, the system aims to make sure that the marine life is not harmed by the sonar waves in the water. This involves the ability to turn down the intensity of the sonar wave when sea mammals are nearby.

Other ports next

The POLB system is already making waves elsewhere. Ports around the world have shown a high level of interest in seeing Kongsberg's advanced underwater surveillance system in action. In all cases, the purpose is similar to that of Long Beach: to maintain port continuity of operations by monitoring all underwater activity, and then intercepting potential threats before they have a chance to disrupt activity at a significant port and exact a significant penalty to the national economy.

HOW TO BUILD YOUR UNDERWATER SONAR SECURITY SYSTEM

- **Define your objectives**

First, define your objectives, boundaries, response times and use of force.

- **Talk to other ports**

Find out from other ports what system they have and the process used to select a supplier. They may have a valuable checklist to streamline your process.

- **Research and review suppliers**

Use the Internet to conduct a review of potential suppliers.

- **Talk to the suppliers**

You learn more by asking the suppliers to showcase their products and technology.

- **Ask how the potential supplier overcame obstacles**

No project is without challenges. Ask other ports and the suppliers how challenges were overcome and what obstacles you can expect. You also need to let the suppliers know potential problems that you foresee coming up. Ask for an overview on how they would address those challenges.

- **Training**

How do they organize your staff's training and how responsive are they to your needs?

- **Maintenance and repairs**

How well do they stand behind repairing and maintenance programs for their products and services?

What is the supplier's plan for upgrades?

What is their standard for long term parts availability?

- **Questions to ask:**

Where are the supplier's products used now?

When was the supplier's last installation completed?

Who would be the supplier's project manager and team members?

What problems have you faced in previous installations and how did you address those?

ABOUT THE COMPANY

Kongsberg Mesotech Ltd. designs and manufactures multibeam sonar for underwater surveillance, principally for Diver Detection. Systems can be placed in fixed or mobile installations. Signal processing, target identification, tracking and classification are achieved using Kongsberg software. Customers include the US Navy, US Coast Guard and other naval and security services.

ENQUIRIES

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