SHARPEYE™ MARITIME SECURITY AND LAW ENFORCEMENT CASE STUDY

SharpEye™ solid state radar technology used for a maritime security and law enforcement application in Maryland, USA

INFORMATION DOCUMENT

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CHANGE HISTORY

Date	Issue	Summary of change	Name
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REFERENCED & RELATED DOCUMENTS

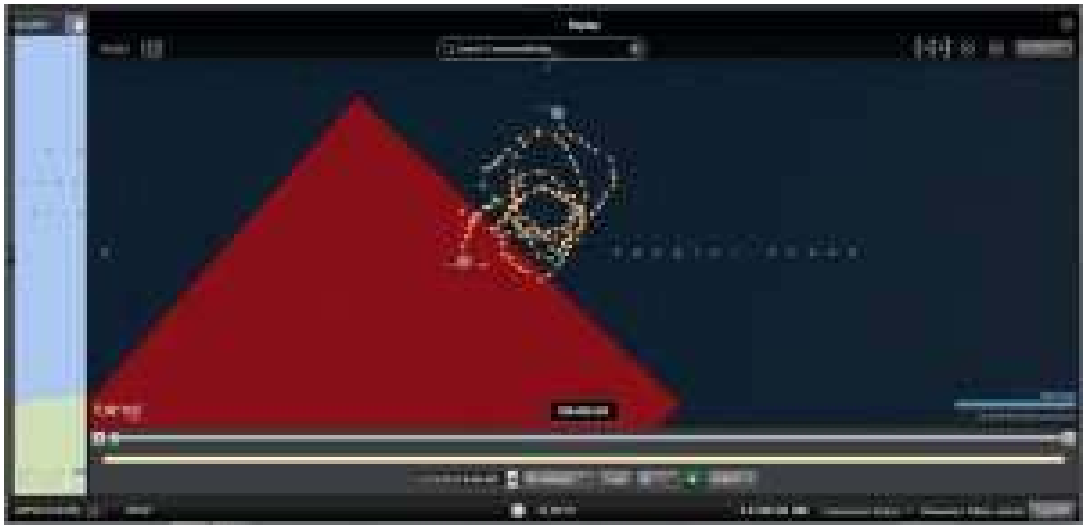
NUMBER	TITLE	REVISION	DATE	AUTHORITY

November 26, 2013 – Maryland Natural Resources Police (MNRP) announce the arrest of two watermen for poaching at an oyster sanctuary in Tangier Sound, Maryland, USA.

The SharpEye™ radar located on Deal Island, Maryland and commissioned just weeks before as part of MNRPs new MLEIN (Marine Law Enforcement Information Network) was used to detect and track a workboat identified as motoring in a pattern indicative of an oyster dredging operation.

The watermen encroached on an oyster sanctuary in Tangier Sound and observed from a distance and out of site in a cove by a MNRP police boat using a remotely connected laptop that displayed the SharpEye™ radar image from the fixed radar tower located on Deal Island. The SharpEye™ radar provided detection and tracking information to the MLEIN system, which was recorded for later playback and evidence.

The radar also enabled the direction of cameras on to the small workboat enabling the MNRP officer to track and watch the watermen crossing a boundary of the sanctuary set aside by the State for oyster population replenishment.



A screen shot of the MLEIN radar image produced by the Kelvin Hughes SharpEye™ radar transceiver and antenna of the targeted workboat inside the boundary of the oyster sanctuary.

Source:MNRP Access DNR http://news.maryland.gov/dnr/2013/11/26/nrp-radar-network-continues-to-thwart-oyster-poachers/

Kelvin Hughes LLC, of Alexandria VA, a wholly owned subsidiary of Kelvin Hughes Limited, London, UK supplied two Doppler X-Band SharpEye™ radars to the MNRP as part of a 4-radar network. The SharpEye™ radars were specifically selected to overcome problems experienced using traditional magnetron marine navigation radars, such as not being able to detect at longer ranges across the bay and up the rivers, false tracks, clutter from the land/coastal environment and operation in inclement weather such as heavy rain.

The incident began at about 8 a.m., when a MNRP officer, aboard a patrol boat tucked in a cove of the Manokin River, watched a vessel make four passes into the oyster sanctuary in Tangier Sound, West of the Big Annemessex River. The officer sped to the location as the workboat attempted to flee the sanctuary.

Chesapeake Bay area showing Deal Island and Tangier Sound North of Tangier Island.

The MNRP have developed and implemented the MLEIN system as part of the Oyster Restoration & Aquaculture Development Proposed Regulations July 2010 which is part of a plan implemented by the Governor of Maryland.

The regulations are designed to expand Maryland's oyster sanctuary network, identify and preserve Maryland's public shellfish fishery areas (wild oyster harvest areas) and establish the processes and requirements for leasing areas in State waters for aquaculture.

SharpEye™ X-Band Upmast Radar situated on Deal Island, Chesapeake Bay. co-located on the radar tower are surveillance cameras and communications dish.

The MLEIN system has been designed to monitor vessel activity and assist first responders enabling maritime law enforcement officers to be more effective in enforcing conservation law and responding to emergencies.

Maryland's portion of the Chesapeake Bay, is monitored 24/7 by the Natural Resources Police (NRP) at their Sandy Point Communication Centre.

NRP responds to more than 3,000 maritime calls a year, including vessels in distress, accidents, search and rescue missions and boating law violations.

By coordinating information among law enforcement agencies, MLEIN will eventually allow officers to view incidents in multiple jurisdictions through radar tracking and capable electro-optical cameras.

As the system develops across jurisdictions, officers will be more efficient in monitoring the bay areas and able to target specific problems such as oyster poaching.

Funding for MLEIN was provided through an approximate $1M Port Security Grant from the Department of Homeland Security and additional grants, totalling approximately $2M.

The SharpEye™ radar system comprises the state of the art *solid state*™ X-Band 200W transceiver integrated inside the radar antenna-turning unit housing enabling an upmast installation. The tower supports the radar and 5.5m (18ft) antenna.

The radar is able to detect small, low radar cross section targets such as boats used by poachers. In addition, the SharpEye™ technology brings a multitude of capabilities and cost savings to the user, which culminates in enhanced situational awareness.

SharpEye™ provides earlier warning of the presence of small targets as well as larger targets in all weather conditions at longer ranges, where other radars cannot.

The superior performance is coupled with a low cost of ownership/through life costs and high reliability through its solid state electronics, negating the use of a magnetron in the transmitter.

SharpEye™ X-Band Upmast Radar transceiver

With the patented pulse sequence, where it transmits simultaneously short, medium and long pulses, Doppler processing of the radar returns and low transmit peak power, the operator receives the advantages found only previously in military radar systems, but at a price that is affordable for wide use.

Applications for the radar span commercial shipping, naval navigation and enhanced situational awareness, helicopter control and recovery at sea, vessel traffic services systems, coastal surveillance and land based border security, civil infrastructure security and mobile and deployable security and surveillance systems on vehicles.

The latest variant of SharpEye™ from Kelvin Hughes includes GaN (Gallium Nitride) transistor technology. The first radar of its kind to do so, SharpEye™ is able to transmit up to 300W of peak power whilst still maintaining its covert low probability of transmission intercept advantage. This means more mean energy will reach the target thereby improving detection performance even further.

GaN transistor technology enables the output power transistors to be driven harder without reducing performance. They are inherently more efficient, with a higher power density and thermal capacity than GaAs (Gallium Arsenide) transistors, reducing the physical size of the unit and improving heat management.

Traditional radar systems require a high peak output power to deliver sufficient energy to a target, whereas SharpEye™ uses advanced techniques to deliver energy with a significantly reduced peak power output. Magnetron radar for example provides bursts of RF energy up to 30kW whereas SharpEye™ provides controlled pulses of RF energy transmission up to 300W.

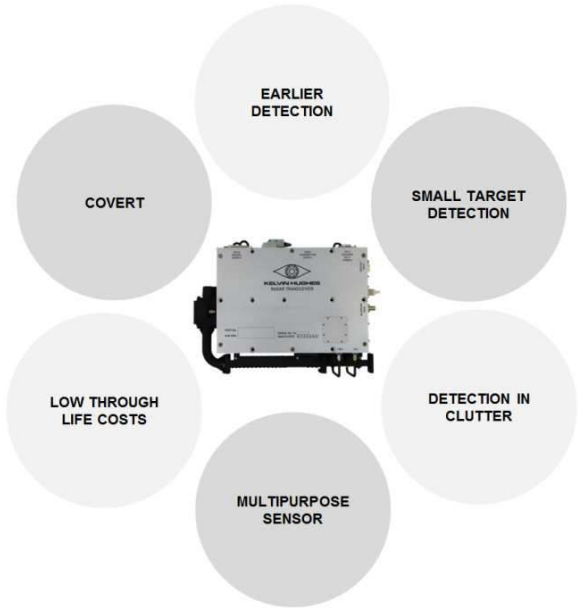
Using a patented three-pulse sequence, SharpEye™ is able to provide optimal detection of targets at short, medium and long rang simultaneously, whereas other radars have to compromise between resolution and detection range.

Using advanced pulse compression techniques, SharpEye™ is able to operate at high resolution across the entire operating range of the radar – a vital advantage when monitoring small targets.

Using Doppler processing techniques, SharpEye™ is able to, reject clutter and make more effective use of the reflected energy received, to enable the processor to extract target information from unwanted returns.

SharpEye™ performs high levels of processing in the transceiver itself before outputting radar video to the radar processor for processing into a format that provides radar tracks on a display.

It is the combination of these specific techniques and many other features of the radar that make SharpEye™ unique in its performance as a sensor. The result is radar with the following benefits:



SharpEye™ radar benefits and unique attributes

Earlier detection – The range of the radar is largely determined by the height of the antenna, however the radar itself has to be able to determine target velocities. It has been found when comparing a magnetron radar with a SharpEye™ radar that it will detect a target in a sea state 4 - 20% earlier, conditions improve or hinder this but as an example this could be the difference between detecting a small yacht at 11NM or 9 NM out from a low level fixed radar tower.

Small target detection - SharpEye™ sees further but also sees more, including targets as small as 0.5m^2 RCS (Radar Cross Section) at several kilometres depending on whether the SharpEye™ radar application is surface search over sea or water, or surveillance in a land environment.

Many attributes enable SharpEye™ to detect and provide a means to form a target track. A key element however is the Doppler processing, which enables the land clutter or sea and rain clutter to be filtered out, without filtering out the targets of interest.

Optimum transmitted power usage, simultaneous transmission on all range scales, no-noisy magnetron energy bursts and pulse compression providing superior range resolution across all the radar range scales, enables detection of small contacts.

Examples of low RCS targets could be walking men, small motor vehicles, low altitude aerial targets, helicopters, RHIBS or RIBs, small wooden fishing boats, jet skis, periscopes, unmanned surface vehicles (USVs), and both cooperative and uncooperative targets.

Detection in clutter - The extremely stable and low noise threshold transmitter and receiver design (a large part of the technology that makes it a SharpEye™ radar), patented simultaneous 3 pulse sequence in a single transmission and the Doppler processing function within the receiver enables clutter to be removed without picture degradation. Clutter examples include waves in high sea states, heavy rain, fog and snow, sand storms, tree lines and long grass moving in the wind.

A clearer, clutter free picture with contacts of interest easily identified onscreen that can be tracked, is what the radar operator wishes to see.

Low Through Life Costs - SharpEye™ and the SBS range for Coastal Surveillance applications provides through a low cost of ownership solution, thanks to the upmast location of the transceiver.

An upmast transceiver (SBS-800 system) made possible by maintenance free technology, significantly reduces integration costs of a coastal surveillance radar tower/installation as no air conditioned hut is needed with all the access requirements i.e. security fencing, lighting, health and safety requirements and regular road access.

Onmast mounted transceiver (SBS-900 system) provides dual transceiver redundancy when applications or IALA standards dictate this. By having a transceiver that operates without producing significant heat that requires dissipation and is very small in terms of physical size it can be located in an enclosure part way up the mast / tower structure for the antenna.

Again, its high reliability and maintenance free advantage significantly reduces integration costs of a coastal surveillance radar tower/installation.

Another side benefit of having upmast solutions is the length of waveguide, which delivers the RF energy from the SharpEye™ transceiver to the antenna is reduced significantly compared to a downmast solution. This means there is virtually no signal loss in this part of the circuit thereby "making more" of the transmitted and received energy, improving target detection performance and reducing costs further.

Further savings come from:

- No magnetron – no spares holdings
- No magnetron – no maintenance requirements
- No magnetron and LRU design – no fault finding training and capability support required
- No magnetron and high reliability – upmast solution possible, saving on infrastructure design and installation costs also reduced signal loss through long lengths of wave guide that is no longer needed

Interoperability - Another significant differentiator is the interoperability of a SharpEye™ system, i.e. it does not interfere with other systems and the transceiver is not susceptible to interference from other radar transmissions.

A single supplier or a mixed supplier system will often make up a coastal surveillance system of overlapping areas of coverage. SharpEye™ will fit seamlessly in to the radar environment whilst also not contributing to the saturation of the transmission spectrum in the area. This is a key benefit to the local VTS station, security agencies and port traffic that have sensitive radar systems in operation and competing for space in the frequency spectrum.

When assessing an application such as this one in Chesapeake Bay it is clear why law enforcement agencies are turning to radar and when doing so, are looking for systems that overcome the traditional problems associated with radar.

This quote from a Maryland resident made to Kelvin Hughes sums up the impact a system such as MLEIN and the contribution SharpEye™ made to the MNRP capability.

"Since I live in Maryland, so now I can brag to my community (and others I know who live by the shore), that I know the radar that is helping to protect the Bay. It's a big deal around these parts".

Author: Mark Bown – Group Marketing Manager, Kelvin Hughes

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