

They Told Us It Couldn't Be Done But We Didn't Believe Them

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Even as the Sea King enters its twilight years of service, its capability and relevance are at the highest levels since the Cold War. This comes as a result of efforts to optimize the helicopter from anti-submarine warfare (ASW) to its current main operational role: surface surveillance of non-military vessels in a low threat environment.

The increase in relevance is the result of recent efforts to use the Sea King as a tool to facilitate the transition to the Cyclone. It became apparent that the delays to the Cyclone, the reluctance to modify the Sea King and the inability to provide other training tools for the crews was resulting in an untenable situation. Crews were not being given the ability to 'train as you fight' and their ability to move through the training process was reduced. In short, they were not being given the skills and experience that would be needed to optimize the use of the Sea Kings and the Cyclones which would replace them.

Traditionally, Sea King crews would train with ASW as their primary focus in order to fill their role as part of the Cold War mission of ASW convoy escort. Although dated, their equipment served them well and they gained experience in a staggered training approach. The crews learned basic ASW during their initial training, and then during their first tour were repeatedly exposed to advanced ASW. In garrison they continued to hone their skills in the Operational Flight and Tactics Trainer (OFTT) but, again, the emphasis was on open ocean ASW.

With the end of the Cold War, this focus on ASW at sea changed and as early as 1991 the mission switched to surface surveillance. Crews returning from these deployments found themselves thrust back into the OFTT and forced to re-certify using ASW tactics and procedures. The disparity between how 12 Wing trained and how they 'fought' grew greater as the deployed role of surface surveillance became the de facto role of the Sea King.

Although their crews could adapt to new missions, the Sea Kings were not able to quite as easily since they lacked the tools of modern surveillance. It was integrated radar, Automatic Identification System (AIS) for surface vessels, and user accessible imagery that were most needed to prepare crews for the Cyclone, and a system that fused this data together would be ideal. It was clear that something needed to be done to ensure that training could continue that would bridge the gap before the arrival of the Cyclones.



Credit: Internet

Medal commemorating CH-124 Sea King 50th anniversary.

The idea of using the Sea King as a transitional tool isn't new. In preparation for the introduction of the EH-101, six Helicopter Towed Array Support (HELTAS) Sea King aircraft were converted from the normal dipping configuration. Until the mid-1990s, these aircraft gave valuable insight into the world of sonobuoy ASW and passive acoustics, and HELTAS crews were very successful in their use of this technology. However, with decreased ASW opportunities, the challenges of maintaining readiness with a split fleet, and the eventual cancellation of the EH-101, the capability degraded to the point that it was abandoned. For the arrival of the Cyclone helicopter, the Sea King would once again serve as the platform for transition but it would take the form of a role change away from ASW to a much-needed shift into surface surveillance.

The enabling factors were there – in particular, the emergence of cost-effective technologies combined with specialized expertise in 12 Wing at Shearwater, Nova Scotia – combined with a need to make the change to a surface surveillance role, and this led the development of what is now known as Augmented Surface Picture (ASP).

In order to challenge the crews, continue their training and provide as much capability as possible, the following elements needed to be integrated in the Sea King:



Early photo of two Sea Kings in formation over Halifax Harbour.

- the capability to track and display a high volume of contacts;
- the ability to display tactical maps, in conjunction with the contacts, in order to give awareness of the operational environment;
- a digitized radar, integrated with the above tactical plot, to facilitate radar tracking;
- the Automatic Identification System (AIS) to provide initial identification of contacts;
- a method to display near real-time imagery of contacts of interest; and
- the ability to import data before flights from external systems and to export it after completion of the mission.

A prototype was rapidly built, using a laptop, to ensure the system goals could be met. This was then used to demonstrate to the weapon system managers and procurement authorities what was possible and what would be needed. The initial demonstration was basic – it showed the ability to develop the surface picture and ingest AIS data on a single laptop – and it was hoped that this would then become the basis for an acquisition of the capabilities.

Although the demonstration was able to define the operational need, it wasn't able to eliminate the technical risk. However, it was able to mitigate the risk enough to initiate a project to progress to a flight trial. The highest technical risk that had to be overcome was the integration of the analogue radar that had been installed in the 1970s with very little improvement since. Other goals were to determine how to integrate the required hardware into the aircraft and confirm that the AIS receiver could utilize an existing antenna.

The first step in creating the system was to develop a means of creating the main signals that the Sea King radar provides, as this would form the basic framework for ASP. As in the legacy OFTT, the ASP system needed to be provided with all the inputs it would receive in flight, so a PC-based system, ingeniously called Stimulator, was developed. In addition to generating appropriate radar returns for land mass it was also capable of creating over 600 concurrent radar contacts, in real time, for ASP to track. In comparison, the radar generator in the OFTT can only create eight.

Once Stimulator was available, the next task was to create the ability to capture these radar signals in ASP. Although dedicated hardware existed, an off-the-shelf USB oscilloscope coupled with an existing piece of test hardware was used at a fraction of the cost of purpose-built hardware. This, however, only captured the signal,

and software was then required to accept these millions of radar samples per second and display them on screen in a format that could be used by the crew. Commercial software was available to do this but, again, to reduce cost custom software was written at 12 Wing. The final sensor component of the demonstration model was an AIS/GPS receiver, interfaced to existing aircraft antennas.

Two laptops were carried for the demonstration; the first placed in the rear cabin solely to capture the sensor data. The second was set on the Tactical Coordinator's (TACCO) work tray, as a representative workstation, and the aircraft flew for a single flight in October 2009. The results of this flight demonstrated that there was very little technical risk left in developing ASP and as long as normal design considerations were taken into account, the risk to achieving an airworthiness clearance was also low.

The real risks were operational. First, there was the risk that the operational need would not be met and therefore the capability of the Sea King would actually further decrease. Second, there was the risk that the acceptance of a lower ASW readiness state would not be offset by a higher surface capability. And finally there was the risk that not all normal technical clearance processes could be carried out due to the rapid and in-house nature of the system development. The Chief of the Air Staff (CAS) and Chief of Military Staff (CMS) were briefed about these risks and accepted them, thereby giving authority to proceed, and provided funding for six mission kits.

As the development proceeded, initial design work was completed at 12 Wing on integrating two displays into the tactical console. Two military-specification (MILSPEC) tablet computers were procured and a place to put them was studied, but it was found that they would not be acceptable for flight. As well, dedicated radar hardware and software was obtained and tested but this also required a computer capable of hosting it which made the overall system more complicated and expensive. And finally, a rugged keyboard was tested to replace the existing console work tray.

Throughout the development of the prototype system, the intention was to obtain a solution from industry but it became apparent that the price would be beyond available funds. Therefore, it was decided to develop the system in-house, implementing the software deployed in the demonstrator, developing a more robust radar interface, acquiring a less expensive AIS/GPS receiver, adding an integrated hand-held camera and mounting two laptops to the tactical console in order to provide a two workstation environment. The camera would be interfaced into ASP so that images were immediately available at each workstation and could become part of the surface picture. Additionally, a miniature heading sensor was placed on the camera so that a bearing line would appear on the plot to help identify specific contacts.

Two shortcomings were quickly apparent from flight testing of the new system. The TACCO laptop vibrated

too much to be useable and the less expensive AIS/GPS receiver did not perform nearly as well as the demonstrator. Design modifications were rapidly implemented that had the TACCO laptop replaced by a tablet-style notebook directly mounted on the console and a return to the demonstrator AIS/GPS receiver. This was, once again, test flown to ensure suitability and became the final prototype at a hardware cost of approximately \$45,000 per aircraft install, for both workstations.

Given the low total cost of the system, it was now possible to fit all Alpha model Sea Kings (all but six aircraft in the fleet) with the TACCO workstation while maintaining the original concept of six Sensor Operator (SENSO) workstations as mission kits to be installed when surface surveillance is the primary role.

Following testing and evaluation, a Sea King with this configuration was deployed with HMCS *Toronto* for Joint Interagency Task Force South in fall 2010 with highly encouraging results. ASP provided an immediate increase to the situational awareness of the crew, and the ability for the crew to pass significantly enhanced information to the ship both during and after flight. The AIS that is now included on the Sea King provides a level of information about merchant vessels never before available to the crew, as well as extending the AIS horizon of the ship. In addition, the increased performance of the camera, coupled with integration into the main tactical display simplified the process of conducting long-range visual identification.

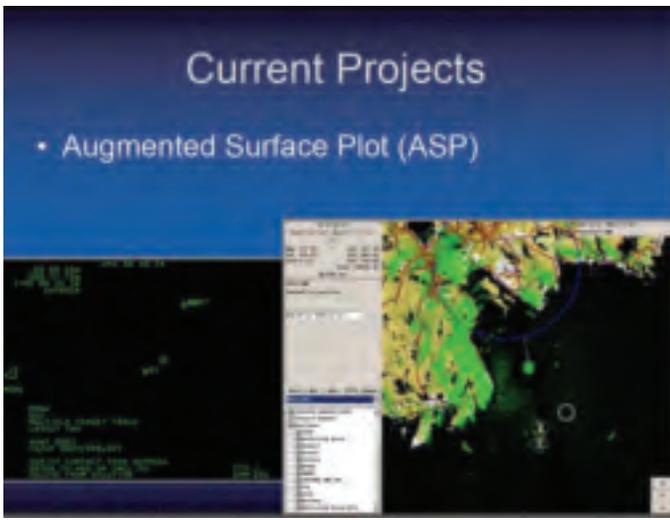
But it was the fusion of this data on to an overlaid radar plot that has restored the relevance of the Sea King as an extension of a ship's sensors. No longer are they simply a platform tasked with visual identification of ship-held contacts. Now crews are able to analyse multiple fused data sources to help identify targets of interest. And overall, the system has been successful enough that all ships proceeding on major deployments since the initial installation on HMCS *Toronto* have requested, and been provided with, ASP-fitted aircraft. Of course, success results in its own set of problems. As a result of immediate demand for the capability, 12 Wing and the Aerospace and Telecommunications Engineering Support Squadron (ATESS) needed to create seven production prototypes until the final modification kits were available. The increase in operational effectiveness was, however, undeniable.

In order to maximize the benefits of ASP, it was decided to run the project as a series of spiral developments. This would allow the team not only to make the transition rapidly from one effort to another while the approval system ran its course, but would also allow risks to be minimized by compartmentalizing each phase. The



Credit: Warrant Officer Randolph Rice, (Public Affairs), Ottawa

Members of the Royal 22^e Regiment are helped aboard a Canadian troop-carrying CH124B by a crew member from the flight deck of USS *Gunston Hall* during the Integrated Tactical Effects Experiment (ITEE) taking place on the eastern seaboard November 2006.



A Sea King Augmented Surface Plot (ASP) visual.

failure of one spiral would not affect the core. As the spiral continued, the advance in capability would drive the discussion towards what could be accomplished in the next phase and so on. Adoption of this plan helped to enable rapid development and, while still high risk, allowed sights to be set on high reward items.

At a briefing of the capabilities of ASP to the Commander of 1 Canadian Air Division in November 2010, the potential for the Sea King to provide full motion video to a facility on the ground was raised. This had been proposed as one avenue for development, and the potential for developing this capability shifted attention to Tactical Common Data Link (TCDL). TC DL is a high bandwidth link that moves network packets and is normally associated with full motion video. It requires modern computers to interact with the network and control the link. Prior to ASP, TC DL could not be used in the Sea King. However, not only could ASP enable video via TC DL from the aircraft's forward-looking infrared turret, but the ASP information could also be extended to the ship via TC DL.

In fact, virtually any form of network traffic could be moved over this link.

Since an ASP-modified Sea King now had the requisite computers and network, the question was now where the antennas and radios could be mounted on the helicopter, especially since the connection between the antenna and radio must be short in order to obtain optimal range. The team held a brainstorming session and realized that the antennas could be mounted through the internal armament chutes and the radios mounted around these chutes. This would not only provide a simple means to mount the TC DL, it would also allow for rapid installation of what could prove to be a highly effective mission kit in an aircraft that had been modified for, but not with, the system.

A proof of concept system was quickly assembled and demonstrated in January 2011 in order to illustrate that, if funding were to be available, the system could rapidly be developed into a prototype system. By April 2011 an initial design had been manufactured, installed and tested, on the ground, in a Sea King, as a means of transferring full motion video, an ASP tactical plot, still imagery and a basic chat system.

The benefits go beyond simply providing an operational capability. TC DL has given the Sea King community abilities in intelligence, surveillance and reconnaissance that have never been available before. Sea Kings can now provide vast amounts of information in real time, to agencies at sea, in the air, or on the ground. This is both good and bad. The amount of data can be overwhelming at both ends of the link and this means that much thought is



HMCS *Algonquin* (DDG 283) accompanied by Sea King helicopters, returns to Esquimalt Harbour after a mission with Joint Interagency Task Force South, 23 October 2010.



A CH-124 Sea King helicopter from HMCS **Regina** fires flares during an exercise while on **Operation Artemis** in the Arabian Sea on 20 January 2013.

now required about the most effective way to employ the aircraft. Certain types of missions require the aircraft to be tightly bound to the ship, passing data back for further analysis, whereas in other missions the aircraft needs freer rein, allowing the crew to determine the best course of action. Striking a balance between the two will be a challenge in the future.

The current spiral of ASP was driven by both an equipment and training need. The systems in the Sea Kings were becoming harder to maintain, and crews qualified on both ASP and legacy configurations are difficult to generate and keep proficient. In order to realize the full potential of ASP while reducing personnel requirements, training for the existing tactical computer must be minimized. The new version of ASP software now includes support for ASW and search and rescue, has just finished operational test and evaluation (OT&E) and is about to become part of training. This means new training tools must be developed for both training units and operational squadrons.

ASP has succeeded for various reasons, not least of which is that it uses new technology smartly. An important lesson is that it is important to balance what is available

against what is really needed, not just what can be done. As well, ASP has succeeded because it was able to chop changes up into smaller pieces and be flexible and focused about what came next. It has balanced curtailing the wish list in the short term in order to avoid being pulled in different directions with supporting flexibility in the medium term. To do that you must have understanding and support from Command in order to provide the top-cover and direction required to meet the aim. ASP had all of these.

Remember that the effectiveness of a system is not enabled by a concise and all-encompassing set of functional requirements. This may provide the basis for the system but it is the implementation that makes or breaks a system in the operational environment. Translating the requirements of operators into easy to use and functional software has been one of the great successes of the project. Finally, working as a team to bring all the pieces together was crucial. The requirements team, implementation team, OT&E team, procurement and funding agencies, all have to be marching in step to accomplish this type of endeavour.

The transitional Sea King, and the Cyclone following it, will usher in a different era for maritime helicopters, one centred around connectivity. The full implications of this are just starting to be realized, but the Sea King is now capable of passing full motion video, imagery, two-way plot information and two-way chat, while in flight, something that has never before been possible. It is now imperative that the Cyclone not be seen as an ASW dipping helicopter like the Sea King was for most of its life, but rather as a joint force multiplier that can contribute to the new roles that are expected of it. 🙌

Credit: Corporal (Cpl) Brandon O'Connell, MARPAC Imaging Services, Esquimalt



HMCS **Vancouver's** Sea King helicopter with the ASP system and a new self-defence suite, conducts air surveillance operations off the coast of Libya during **Operation Mobile**, 13 September 2011.

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