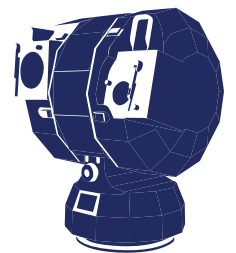




# Sea Eagle FCEO

Naval Electro-Optical Fire Control System



# Sea Eagle FCEO

Sea Eagle FCEO (Fire Control Electro-Optical) is an advanced electro-optical fire control system optimised for the control of naval guns against air, surface and shore targets. Capable of controlling any in service naval gun, the system provides 24 hour detection, acquisition, tracking, identification and engagement of air and surface targets through its thermal and TV sensors.

## Key Features

- 24 hour target identification by long range thermal imager and daylight TV camera
- Automated slewing to search radar contact indications
- Automatic target acquisition and tracking
- Anti-air, anti-surface, naval gunfire support direct and naval gunfire support indirect engagement modes
- LEAP range table based ballistic prediction for all calibres of naval guns including extended range ammunition
- Semi-automated splash spotting
- 24 hour passive surveillance through high performance thermal imager and TV camera
- Programmable azimuth scan sectors with automatic target detection
- Display of a panoramic view of the scanned sector with marked detected targets
- Automated capture of target snapshot images
- Designed to be operated as a fully integrated element of a multi-function console based combat system or through a dedicated standalone console

The system has been designed to significantly reduce through life costs when compared to similar systems. This has been achieved by the following key elements:

- Reduced initial acquisition costs
- Lower ship impact through lower equipment mass and reduced ships cabling
- Reduced logistics support commitments through increased equipment reliability and application
- Programmable processing elements
- Reduced training requirements through the employment of a high level of automated operation

Further information regarding the system's associated integrated logistics support package can be found later in this document.

# System Outline

Sea Eagle FCEO uses an advanced electro-optical sensor suite to provide target acquisition, tracking and gun engagement 24 hours a day. The system employs sophisticated processing techniques to enhance target tracking and gun ballistic prediction, subsequently increasing overall gun system effectiveness.

## Electro-Optical Sensors

The electro-optical sensors consist of a midwave thermal imager, colour TV camera and eye safe, high repetition rate laser rangefinder. They have been selected to provide effective target detection, acquisition, tracking and recognition within the engagement envelope of the system (see engagement timeline diagrams in the key performance data section later in this document).

## Electro-Optical Director

The Sea Eagle FCEO director performance has been optimised to meet the requirements for the precise tracking of dynamic air and surface targets in the worldwide naval environment. The director offers high acceleration and velocity to reduce acquisition times, coupled with smooth tracking under both auto tracker and line of sight gyro control to ensure engagement accuracy.

## Gun Prediction Control

The performance of Sea Eagle FCEO has been specifically designed to match the engagement ranges of current and future naval guns in both anti surface and anti air modes. A range of interface options are available, which ensures the system is able to control any naval gun mounting, both new design and existing inventory.

## Operation

Sea Eagle systems have been designed to be controlled from either a dedicated operator's console or from a combat system's multifunction console. For dedicated applications, a range of console configurations are available to suit different vessel layout arrangements and space limitations.



# System Operation

Sea Eagle FCEO is an advanced electro-optical fire control system capable of controlling any in service naval gun. The system has been designed to provide a high level of automated operation that reduces operator workload and training. In addition to the fire control capability, the electro-optical sensors allow Sea Eagle FCEO to be used as a high performance surveillance system for applications such as search and rescue, threat surveillance and observation, as well as direction of ship based weapon systems.

The system's sensors can detect, acquire and track targets 24 hours a day. Target identification is conducted by the electro-optical sensors, the performance of which is enhanced by the application of image processing techniques. Target engagement of the system has been optimised for the control of naval weapons from small to medium calibre (typically 30mm – 76mm).

## Target Engagement

The primary sensor of Sea Eagle FCEO for target engagement is the midwave thermal imager and laser rangefinder. These elements are capable of detecting, acquiring and tracking targets 24 hours a day. The performance envelope against typical targets is shown in the key performance section of this brochure.

The electro-optical sensors can also be used for passive surveillance, such as search and rescue and blind pilotage. The system can receive target indications from external sensors such as a search radar or target designator sights.



## Weapon Control

The system is capable of controlling any in service naval gun mounting in anti-air, anti-surface and naval gunfire support modes. A range of interface formats are available to match both new build and earlier design mountings.

The Gun Processor Units (GPU) use LEAP encoded range tables for the ballistic prediction process. The overall prediction and gun control chain is optimised to reduce delays and provide precision aiming in all modes of engagement.

Control of the weapon engagement is conducted from the operator's console using flow line controls to prompt critical steps in the engagement sequence supported by a combination of video, text, numeric and graphic presentations to report the current situation.

In addition to engaging targets being tracked by the EOD, Sea Eagle FCEO is also capable of operating an anti surface track, with scan mode using target range and bearing data being generated by a surface search radar.

## Operation

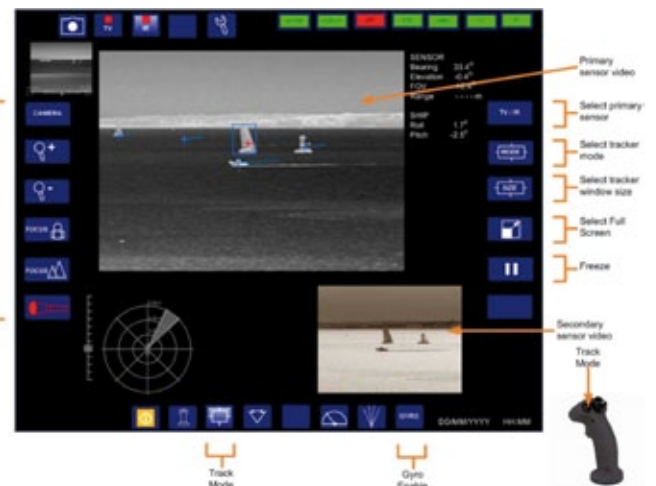
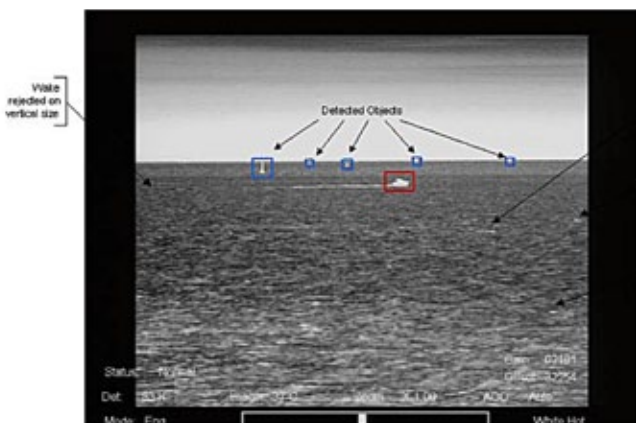
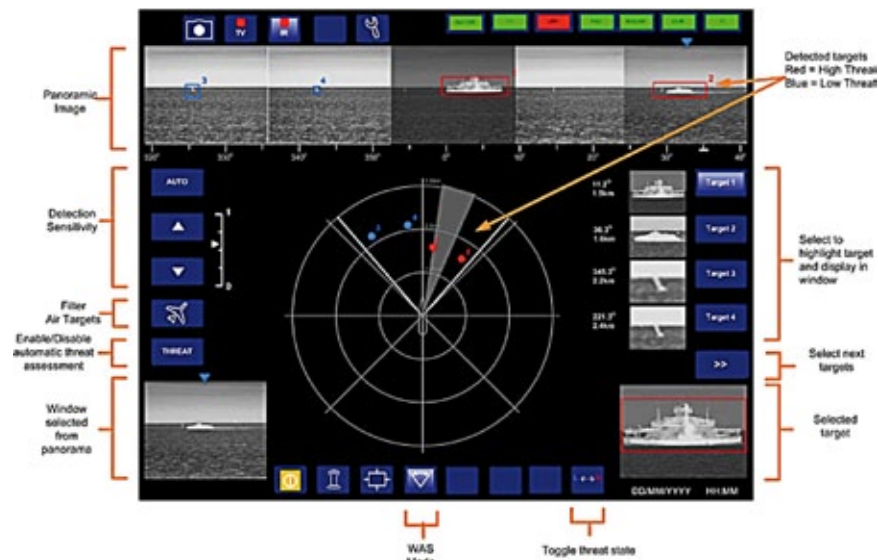
Sea Eagle FCEO has been designed to provide a high level of automated operation, therefore reducing operator workload which leads to improved performance under high stress conditions and lower training requirements.

The system will automatically detect, acquire and track targets with the electro-optical sensors.



# Surveillance, Target Acquisition & Tracking

The Sea Eagle systems feature a video processing system that provides a high level of automation to the surveillance, acquisition and tracking functions. The selection of the operator interface is customer option. It will be supported by a software application running on either a Chess Dynamics designed dedicated console or a multifunction console (MFC) within another company's combat management system (CMS). The CMS MFC application will not be generated by Chess and is not presented here, but will be compatible with the rest of the ship's CMS. The Chess application will be customised to the specific requirements of the customer and an example of one such operator interface is outlined below. The operator interface is viewed through a high resolution display that presents the different video streams in a completely flexible layout, with on-screen presentation of ancillary data and semi-transparent video overlays for key user interface items. The system is normally configured with a baseline suite of display formats that can be adjusted to suit specific customer requirements. In the surveillance mode, the system can perform a number of scan patterns with automatic detection of contacts. Scan patterns range from continuous 360 degrees to defined arcs, which are displayed as a continuous strip together with a plan representation of system contacts. A typical view is shown below:



Real time tracking of multiple contacts in the field of view enables the operator to assign contacts as targets to be engaged. A typical tracking display is shown above.

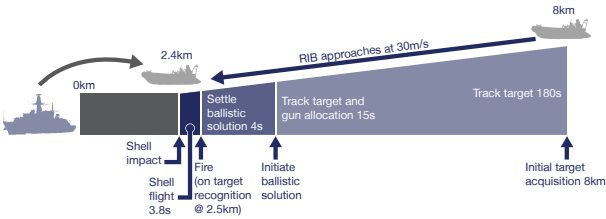
The image above shows the system operating in tracking mode, showing the thermal imager in auto-tracking mode.



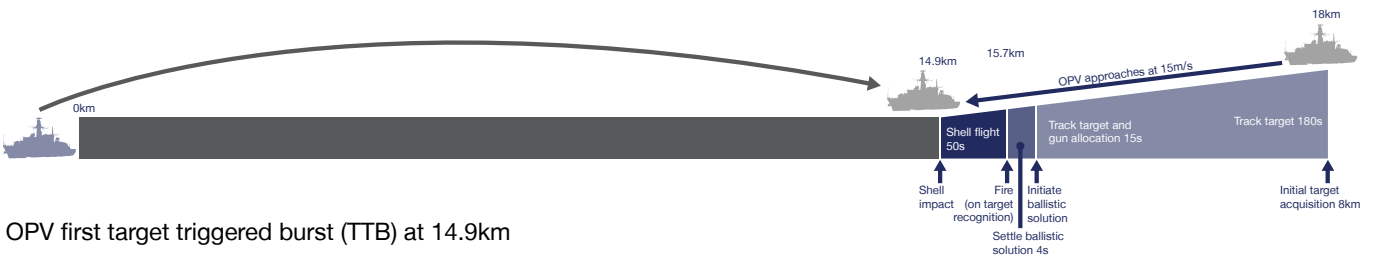
# Key Performance Data

The following data provides an overview of the key system performance parameters and is provided for guidance purposes. More detailed performance data is available on request.

The engagement timelines shown below provide an overview of typical Sea Eagle system engagements and has been derived from sensor, director and processor performance data.



RIB first target triggered burst (TTB) at 2.4km



OPV first target triggered burst (TTB) at 14.9km



Fixed wing aircraft first target triggered burst (TTB) at 6.3km

## Key Parameters

- Mass

Above decks weight - less than 85kg

Combined below decks weight (including seated console) – less than 90kg

- Director

Static Pointing Accuracy better than 0.3 milliradians (~1 minute of arc)

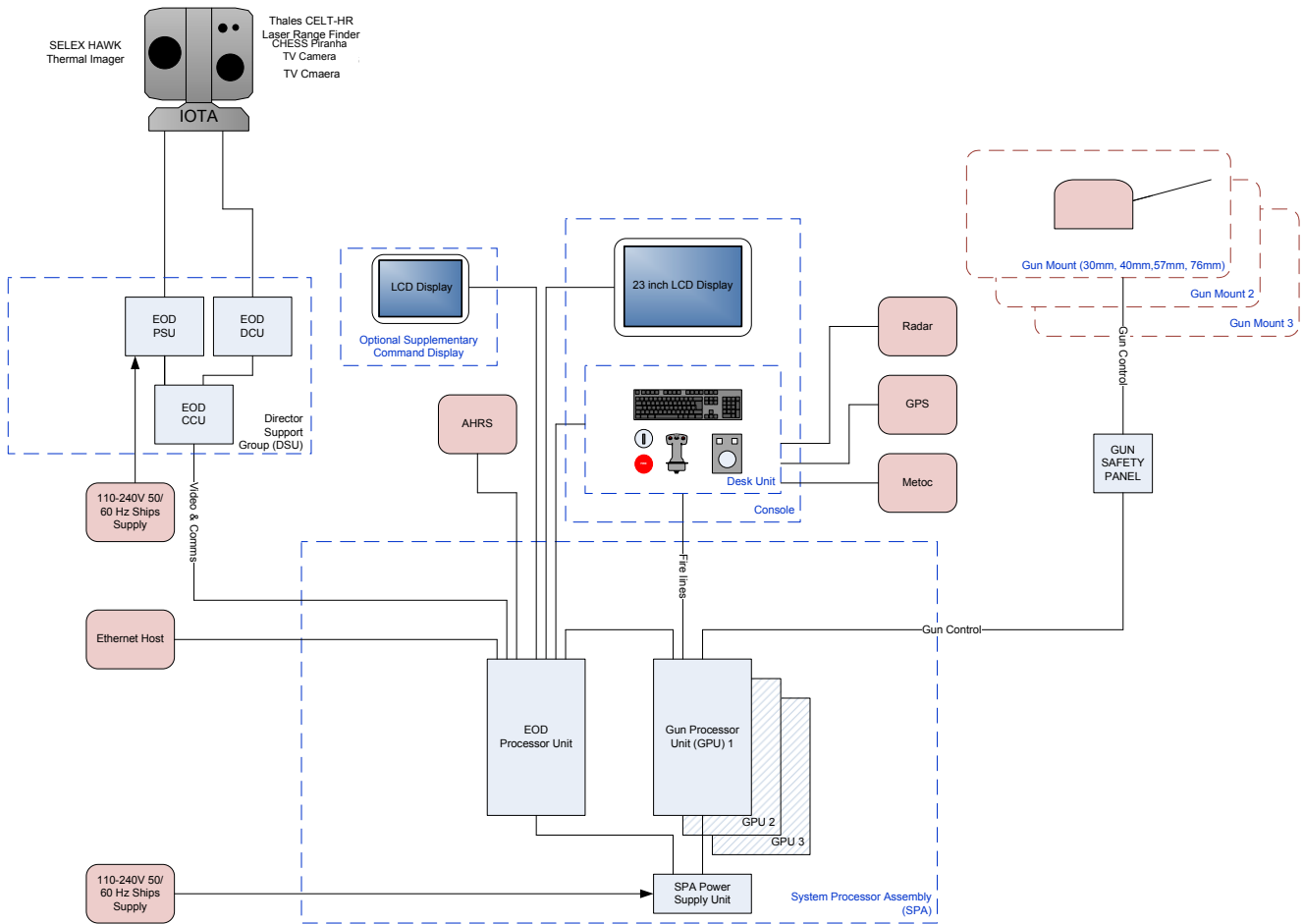
Acceleration 2 Rad/sec<sup>2</sup> (azimuth and elevation)

Velocity 2 Rad/sec (azimuth and elevation)

## Environmental Performance

Sea Eagle systems have been designed to meet the requirements of Def Stan 08-123; systems have seen extensive operational deployment worldwide and have significantly exceeded their base maintenance schedules without any deterioration in performance.

# System Configuration



## Electro-Optical Director

The Electro-Optical Director (EOD) comprises the above decks director and the below decks Director Support Group (DSG).

The EOD is a precision, gyro stabilised elevation over azimuth, direct drive unit fitted with three electro-optical sensors:

- Midwave (3-5 micron) thermal imager with zoom optics
- Colour TV camera with zoom optics
- Eye safe, high repetition rate laser rangefinder

All three sensors are environmentally sealed and can be changed onboard. They are fitted to the director using a precision dovetail unit that permits exchange of sensors without the need for a mechanical alignment procedure. The EOD is fitted with quick release covers that provide an outer level of weather protection for the sensors and contain outer optical windows and wiper units. The DSG consists of director electronics and power supply units and are located below decks within 10m of the director.



# System Processor Assembly

This assembly performs a range of functions through two processing units:

## EOD Processor Unit (EPU)

- Director control
- System interfacing and control
- Target detection and tracking
- Wide angle surveillance

## Gun Processor Unit (GPU)

- Weapon ballistic prediction
- Gun interface and control

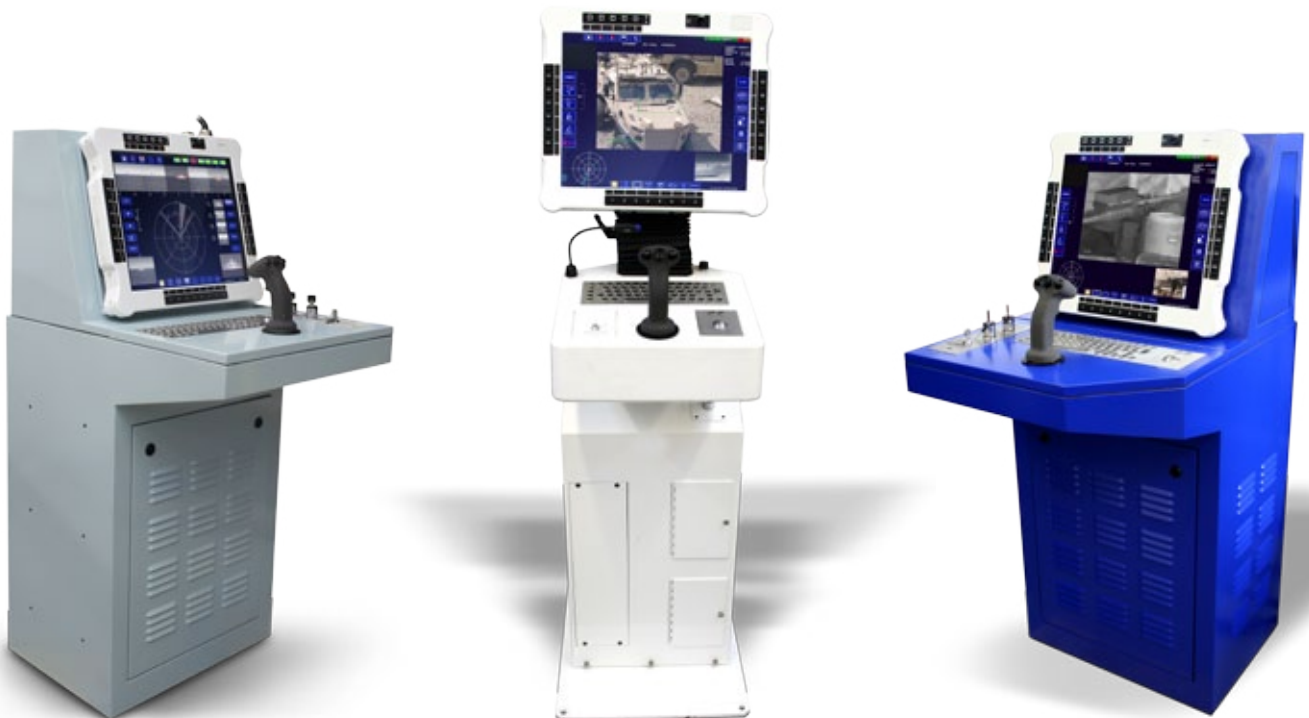
Where a vessel has more than one gun mounting, each mounting has a dedicated GPU.

# Operator's Console

Sea Eagle systems have been designed to be controlled from either a dedicated operator's console or from a combat system's multifunction console.

The dedicated console is available in a number of configurations including a seated desk unit, and separate display and control panel for integration into a bridge console system.

All console layouts feature ergonomic design that reduces operator workload and subsequently fatigue. System controls are configured to be intuitive in operation, helping to reduce training requirements.



# Integrated Logistics Support

## Support Philosophy

Sea Eagle systems have been designed to reduce through life costs with a holistic approach to logistics support. Based on experience gained in the support of a wide range of naval systems, the Sea Eagle support philosophy has been developed to achieve optimum availability of the systems.

## Maintenance

Sea Eagle systems have been designed to require the minimum of periodic maintenance. Any maintenance that is required can be accomplished in the minimum time without the need for special tools or test equipment.

## Training

Operator and maintainer training courses are available for a ship's crew and base support personnel. Courses can be adapted to meet specific training philosophies and styles and can be provided on electronic media to aid the assimilation of the training into a navy's own training regime.

## System Commissioning & Engineering Support

A full programme of system commissioning is established with the customer and shipyard in order to ensure timely and effective installation, integration and introduction into service of Sea Eagle systems. Engineering services are available as required to supplement customer resources in the support of operational systems.

## Logistics

- **Spares**

Onboard and base spares holdings are optimised in consultation with the Sea Eagle customer in order to ensure required system availability is maintained throughout the service life of the system.

- **Repairs**

An optimised repair loop is established in consultation with each Sea Eagle customer in order to ensure the minimum repair turnaround time for defective LRUs.

- **Configuration Management**

As with all Chess Dynamics products, Sea Eagle systems are subject to a detailed configuration management process. This ensures that throughout the service life of the system, spares and repairs support will be available when required.

Much of the key functionality of the systems is provided through software implementation, which is the subject of continued development. Advances in performance through periodic software updates are offered to customers for incorporation into in-service systems in conjunction with an on-going support contract.





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