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TA-ENG: SESC - FFG DIVISION

FFG COMBAT SYSTEM LEARNERS GUIDE

VERSION 2.01, DATED 10 Dec 2014

SECTION 1 – OVERVIEW

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Chapter 1. FFG Statement of Operating Intent

References:

- FFG – Adelaide Class Statement Of Operating Intent (V1.0 Approved & Signed by COMAUSFLT Sep 2012)

Introduction

1. The RAN has four Adelaide Class Guided Missile Frigates (FFG) that entered service from 1983. These are long-range escorts that provide Anti-Ship Missile Defence (ASMD), anti-submarine warfare; surveillance, reconnaissance, and interdiction capability. They are able to counter simultaneous threats from air, surface and sub-surface. In conjunction with the ANZAC Class Helicopter Capable Frigates (FFH) they provide the Surface Combatant Force capability of the Fleet.

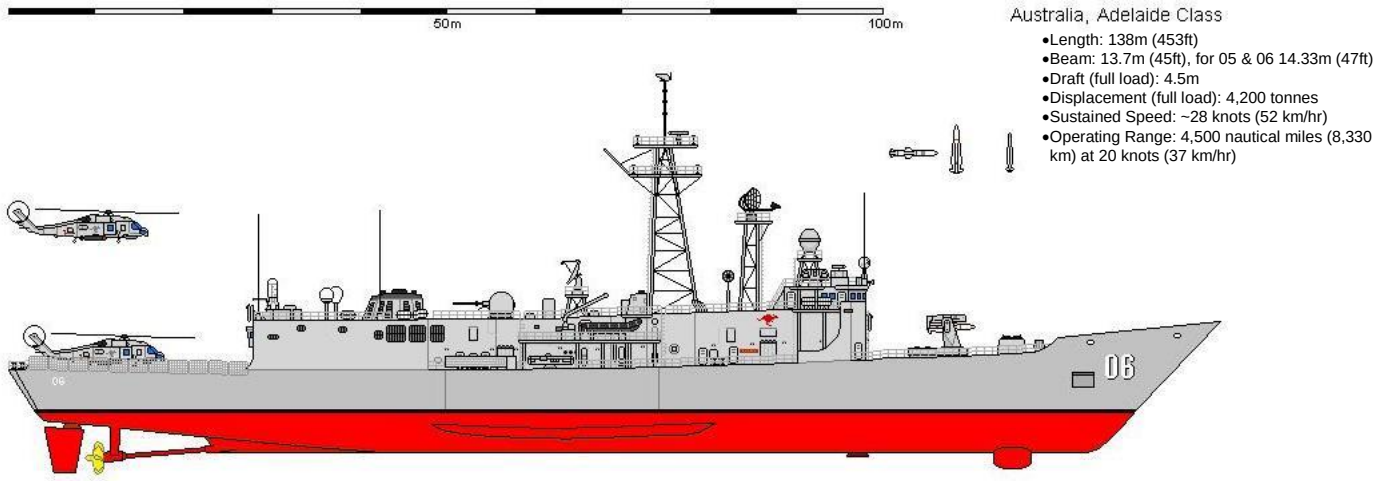

Figure 1-1: RAN FFG

2. The FFG is operated as part of the Frigate Group under Commander Surface Force (COMSURF). For operations, the FFG will be force assigned to Commander Joint Operations (CJOPS). When not force assigned to CJOPS, the Director General Maritime Operations (DGMAROPS) is responsible for tasking via the Fleet Activity Schedule (FAS). DGMAROPS is responsible for coordination of all the bids for ships time to meet ADF Preparedness requirements, training, domestic and international engagement and participation in major exercises.

3. Operating roles include:

   a. Anti Surface Warfare (ASuW),

   b. Anti Air Warfare (AAW),

   c. Anti Submarine Warfare (ASW),

   d. Escort of amphibious forces in transit,

   e. Escort of Mission Essential Units,

f. Air support using embarked helicopters,

g. Control of fighter intercept,

h. Maritime Surveillance,

i. Maritime Patrol and Response,

j. Protection of shipping, Offshore Resources and Territories,

k. Air Defence in Maritime Areas and Northern Approaches,

l. Defeat of incursions on Australian Territory,

m. Protection of Important Civil and Defence Assets, and

n. Self Defence.

Roles

Primary Roles

4. The primary roles of the FFG are to:

   a. assist in the preservation of the security and integrity of Australia through the exercise of maritime capability in the Area of Direct Military Interest,

   b. be able to mount an effective military response to any short term contingency, and

   c. operate with and complement other air, surface and subsurface Australian Defence assets and other military assets from partner nations.

Secondary Roles

5. The secondary roles of the FFG are to:

   a. carry out Search and Rescue (SAR) operations;

   b. support border protection operations and protection of vital national assets in conjunction with other agencies;

   c. provide support and contribute to Humanitarian Assistance and Disaster Relief (HADR) operations as tasked; and

   d. provide support to diplomatic activities on behalf of the Commonwealth of Australia.

TASKS

6. In the performance of the mission, FFGs are expected to undertake various tasks in peacetime and during periods of tension or conflict. Tasks may be undertaken independently by the ship or as part of a Task Group or joint force in open-ocean or littoral environments.

7. In peacetime the FFG would normally be involved in training for their role in conflict, contributing to the development of operational tactics and doctrine (including interoperability with other surface combatants), and in national and international exercises.

FFG Primary Tasks

8. Primary tasks of the FFG include:

   a. Maintenance of operational capability/readiness;

   b. Protection of shipping, offshore resources and infrastructure;

   c. Demonstration of National presence;

   d. Participation in National and international exercises and other Defence Cooperative activities;

   e. Training; and

   f. Maritime Surveillance, patrol and response tasks, including fisheries, law enforcement and environmental protection patrols, and intelligence collection.

FFG Secondary Tasks

9. Secondary tasks of the FFG include:

   a. Search and Rescue (SAR);

   b. Collection of environmental data;

   c. Development of operational tactics and doctrine, including interoperability with surface combatants; and

   d. Disaster relief, including medical and emergency evacuation of personnel.

RULES, CRITERIA AND CONVENTIONS

10. Australian Maritime Tactical Instructions (AMTI), which are detailed in AMTP l0(H) (Change 1) provide instructions for the tactical employment of ADF Surface ships, submarines and aircraft in addition to tactical instructions on all aspects of maritime warfare. The principles for the operational employment of the Surface Combatant are provided in AMTI 0103.

11. COMSURF has a Materiel Sustainment Agreement (MSA) with the FFG System Program Office (SPO) such that ships and shore installations have adequate engineering and logistic systems to support the platforms from a "cradle to grave" concept. This MSA is expected to be the mechanism for conducting FFG sustainment activities for the Life of Type. FFGSPO has Integrated Material Support (IMS) and In-Service Support (ISS) contracts with BAE Systems and Thales, respectively, to assist in these activities.

12. Design specifications shall take cognisance of the soon to be released ABR 6813 - Naval Certification and Assurance Manual. (ABR 6813 will form the basis for the replacement of ABR 5454 -RAN Regulatory framework and Certification).

13. Vessels are required to comply with RAN Safety Policies including those defined in Dl(N) OPS 40-3 (Electronic Navigation); DI(N) OPS 56-4 (Collision Avoidance Regulations); DI(N) ADMIN 37-17 (Safety Management Systems); DI(G) OPS 16-3 (Electromagnetic Capability); and ABR 862 (Maritime Explosive Ordnance Safety Manual).

14. RAN Fire Safety System Requirements are contained in DEF(AUST)5000 Volume 07 Part 02.

15. Vessels are required to comply with MARPOL and RAN Environmental Policy, including those defined in DI(N) OPS 19-1 (Disposal of shipborne waste); ADF Maritime Activities Environmental Management Plan (MA EMP) and DI(N) OPS 19-4 (Management of Ship Biofouling).

OPERATIONAL USE

16. Of the six FFG procured for the Australian Navy, the two oldest platforms were decommissioned and the remaining four received a war fighting upgrade to improve the ships survivability in the modem maritime threat environment. The additional missile systems installed resulted in the addition of extra ballast and restrictions in the number of missiles that could be carried to ensure the trim and stability remained within acceptable limits.

17. The four FFG, together with the eight ANZAC FFH, undertake all the operational tasking that requires a major fleet unit to operate in a combatant role. 'Their primary wartime role is to escort Navy's amphibious units and other Mission Essential Units (MEU). However, in peacetime, these ships perform the full gambit of primary and secondary roles as articulated above.

Operational Scenario Summary

18. Three operational scenarios have been chosen which identify the full functionality of the FFG:

a. Scenario 1 - Open ocean escort/self defence; the requirement to provide protection to amphibious mils and/or MEU and self defence in open ocean and with a medium threat environment;

b. Scenario 2 - Self defence in a littoral environment; the requirement to provide self defence in ASMD in the littoral in a medium Lima1 environment; and

c. Scenario 3 - Defensive support in a littoral environment; the requirement to contribute ASMD to an amphibious unit(s) in a high threat environment in the littoral to support disembarkation/embarkation of personnel, vehicles and equipment.

OPERATING PROFILES

19. The following operating profiles are used to describe the generic operations undertaken and hence provide guidance as to the inherent capabilities required under each profile, such as embarked crew and their minimum competences, survivability requirements, etc.

a. Operating Profile 1 - Operations. Vessel able to undertake full range of Operating Scenarios described in paragraph 18 across the full spectrum of operations, including war, diplomatic and constabulary tasking (Scenario 1. 2 or 3).

b. Operating Profile 2 - Training. Vessel able to undertake training up to and including High End War Fighting (HEWF) exercises (i.e. high intensity, several weeks long, conducted in State 2 with periods in State 1 of up to 6 hrs, during

significant concurrent activity) such as Exercise TALISMAN SABRE and Exercise RIMPAC. [AFTP 1(C) Ch 401]

c. Operating Profile 3 - In Transit (may be in company with other vessels/Fleet units). Vessel undertaking a transit voyage with minimum training being carried out in order to reposition the vessel. Passage Exercise (PASSEX) may be in company (limited intensity exercises conducted by ships transiting in company), usually conducted in State 2 or State 3, and usually limited to one activity at a time. [AFTP 1(C) Ch 401]

SHIP CONFIGURATION

20. The standard configuration of the FFG is maintained throughout the anticipated roles with the addition of specific elements as required to enhance capability for designated operations. Any deviation from the standard ship configuration is to be managed in accordance with ABR 6492 (Navy Technical Regulations Manual); DEF(AUST)5000 (where appropriate) and FFGSPO Configuration Management Plan.

21. The ship carries a standard marine communications suite which is augmented by a military communications package and includes Global Maritime Distress Safety System (GMDSS).

22. The ship's lifesaving equipment provides life rafts and RAN Emergency use life jackets (Pattern 50N) for each member of the ship's complement plus 10 per cent spare carrying capacity and 30 spares, in accordance with ABR 1977 (RAN Manual of Shipborne Lifesaving and Survival Equipment). Fire-fighting and damage control equipment is fitted throughout the ship with many compartments having fixed fire-fighting systems installed.

23. Radiation Hazards (RADHAZ) and procedures are detailed in FFG Class RADHAZ Standard Operating Procedures (SOP). Other procedures are detailed in FFG Class Standing Orders.

24. The ship's company comprises 184 Naval personnel (15 Officers and 169 Ship's Company). There is additional space for 12 Aircrew and, due to supplementary manning requirements for operations and training, it is current practice to embark an accommodation module in the Starboard hangar, accommodating another 12 personnel. There arc three accommodation modules available and allocation is based on priority of need.

25. The ship may operate with a reduced complement for short notice assignments such as SOLAS, humanitarian assistance, disaster relief, and a non-combatant evacuation operation in a permissive environment. However, each reduced complement case is to be considered on its merits with an appropriate risk assessment being conducted by the Commanding Officer and subsequent endorsement/approval being obtained from the Fleet Commander through COMSURF.

26. The FFG Flight Deck configuration can receive one medium size helicopter, such as S-70A-9 Blackhawk, S-70U-2 Seahawk, AS-350-B Squirrel and Allied helicopters as detailed in ABR 5419 (Ship/Helicopter Operations Manual) and Allied publication APP 2/MPP 2 (Helicopter Operations from Ships other Than Aircraft Carriers (HOS'TACs)).

27. FFG standard configuration consists of the following Propulsion and Electric Power Generation Machinery, Sensors, Weapons, Passive Defence Systems, Aircraft and Boats:

a. Propulsion
   i. 2 x LM2500 Gas Turbines
   ii. 1 x Controllable Pitch Propeller
   iii. 2 x Auxiliary Propulsion Units
b. Electric Power Generation
   i. 4 x Caterpillar Ship's Service Diesel Generators
c. Sensors
   i. Air Search Radar
   ii. Fire Control Radar
   iii. Surface Search and Navigation Radar
   iv. Hull mounted sonar
   v. Mine Obstacle Avoidance Sonar (MOAS) (not in all units)
   vi. Torpedo Detection Towed Array
d. Weapons
   i. 76mm gun
   ii. Ship Launched Torpedo (MU90lMK46)
   iii. Vertically launched Evolved Sea Sparrow Missile (ESSM)
   iv. Harpoon Missile
   v. Standard Missile (SM2)
   vi. 20m Phalanx Close in Weapon System (CIWS)
   vii. Mini Typhoon System (not permanently fitted)
   viii. 12.7mm machine gun
   ix. Crew served weapons
   x. Demolitions
e. Passive Defence Systems
   i. Nulka Active Missile Decoy System
   ii. Towed Torpedo Decoy System
   iii. Chaff
f. Aircraft
   i. Sikorsky S-70B-2 Seahawk (not permanently embarked)
   ii. Other light and small helicopters as per ABR 5419 (not permanently embarked)
g. Boats
   i. Up to 2 x 7.2m Rigid Mull Inflatable Boats (RHIBs)
   ii. Up to 2 smaller ships boats
   iii. HMAS Sydney's boat configuration and capability differs to the other FFGs due to one boat deck only

28. Vessels are able to embark, under emergency conditions and for short periods only, additional troops or civilians in event of vessel responding to Humanitarian Aid and Disaster Relief duties.

Rate Of Effort and Planned Life

29. The FFGs have a planned life of approximately 30 years and this will vary for each hull and their individual Life of Type evaluations. They are to be available for Material Readiness Days (MRD) of 305 days per annum. The ship is also limited by RAN personnel tempo (PERS TEMPO) of 290 home port days over two calendar years. [CN01 Product Schedule and AFTP 1(C) Chap 201]

30. Vessels are operated on a five year docking cycle, with maintenance periods every 10 months. The maintenance periods will include Intermediate Maintenance Availability (IMAV) (six weeks), Selected Restricted Availability (SRA) (15 weeks) and Docking Selected Restricted Availability (DSRA) (15 weeks). In addition, '0' Level maintenance is conducted by ship's staff or Fleet Support Unit (FSU) personnel in accordance with the FFGSPO Class Maintenance Plan. Any deviation from the approved Usage Upkeep Cycle deemed necessary to meet urgent operational needs will require endorsement by COMSURF and approval by the Fleet Commander. Subsequently, the ship's program shall be adjusted accordingly to allow for recovery of any deferred maintenance.

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Chapter 2. Combat System Purpose and Function

Purpose

1. In order to fulfil its designated roles and missions, the FFG is fitted with a 'Combat Data System'. The RAN FFG Combat System is a system of components (equipment, computer programs, trained personnel and procedures) that interact in a controlled and coordinated way so as to efficiently conduct warfare against an adversary across one or more mission areas. The purpose of this Combat System is to:

Integrate the ships sensors and weapons to provide for the rapid evaluation of potential threats that may come from any air, surface or subsurface platforms, and effectively counter those threats.

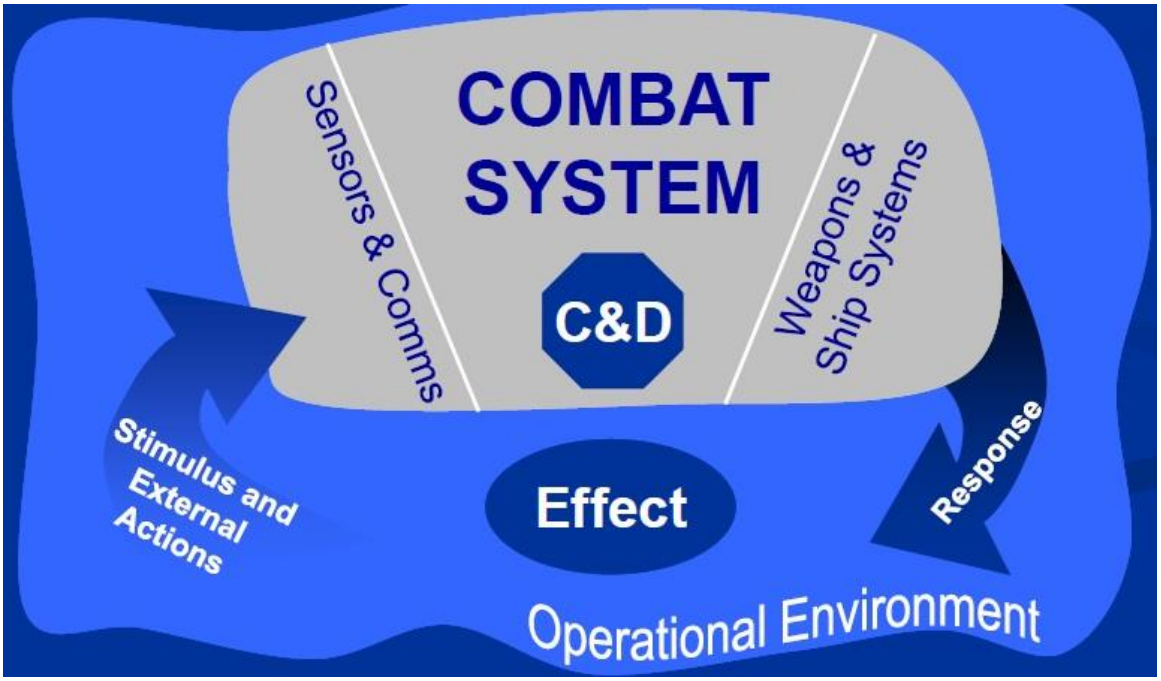

Figure 2-1: Combat System Purpose

Primary Functions

2. To achieve it's purpose, the function of the combat system can be split into a sequence of three primary functions:

Tactical Picture Compilation

3. What's out there? This involves observing the surrounding environment and gathering information about it:

a. Detecting entities: all functions required for the ship to sense objects using above and below water sensors. Detection methods include active and passive sensing and also entity identification using secondary radar; Identification Friend or Foe (IFF).

b. Detect Electromagnetic Emissions: provides the combat system with the ability to detect and monitor entity emissions in the microwave and infrared (IR) bands.

Microwave emissions are active transmissions from external radar systems including search, track, Continuous Wave (CW), and IFF type radars.

c. Track physical objects: Gives us the ability to predict the objects position into the future.

d. Identify, discriminate and/or classify objects.

Threat Evaluation and Weapon Assignment (TEWA)

4. Does a specific track pose a threat to our mission? If so, what response should we take?

5. This assessment is facilitated by using the Tactical Picture we have compiled to gauge whether there are any threats to our mission/objective. This involves:

a. Adhering to doctrine and procedures;

b. Communicating and coordinating with other assets;

c. Considering current 'Intelligence'.

d. Assessing the tactical situation (automated decision aids provided by the combat system can be used here)

Engagement

6. Engagement is taking action to neutralise a threat. It is a process that renders the threat incapable of completing its mission. Neutralisation can be achieved either by destroying or damaging the threat entity using weapons (hard kill), or by deceiving the threat through decoys and/or ship manoeuvring (soft kill).

14-Step Engagement Sequence

7. The three primary functions can be further split into fourteen discrete steps which comprise the '14-Step Engagement Sequence' depicted on the following page.

8. The following Fourteen-step Engagement Sequence descriptions are Anti-Air Warfare (AAW) focused, however the sequence can also be applied to Surface (Su) warfare, Anti-Submarine Warfare (ASW), and even Mine Hunting.

9. Steps three through five are grouped together because the order in which they occur depends on the particular sensor being used. Steps nine through thirteen are grouped within step eight (Scheduling), because the majority of decision making for each of these steps is performed as part of the scheduling function. The table below provides a description of each step:

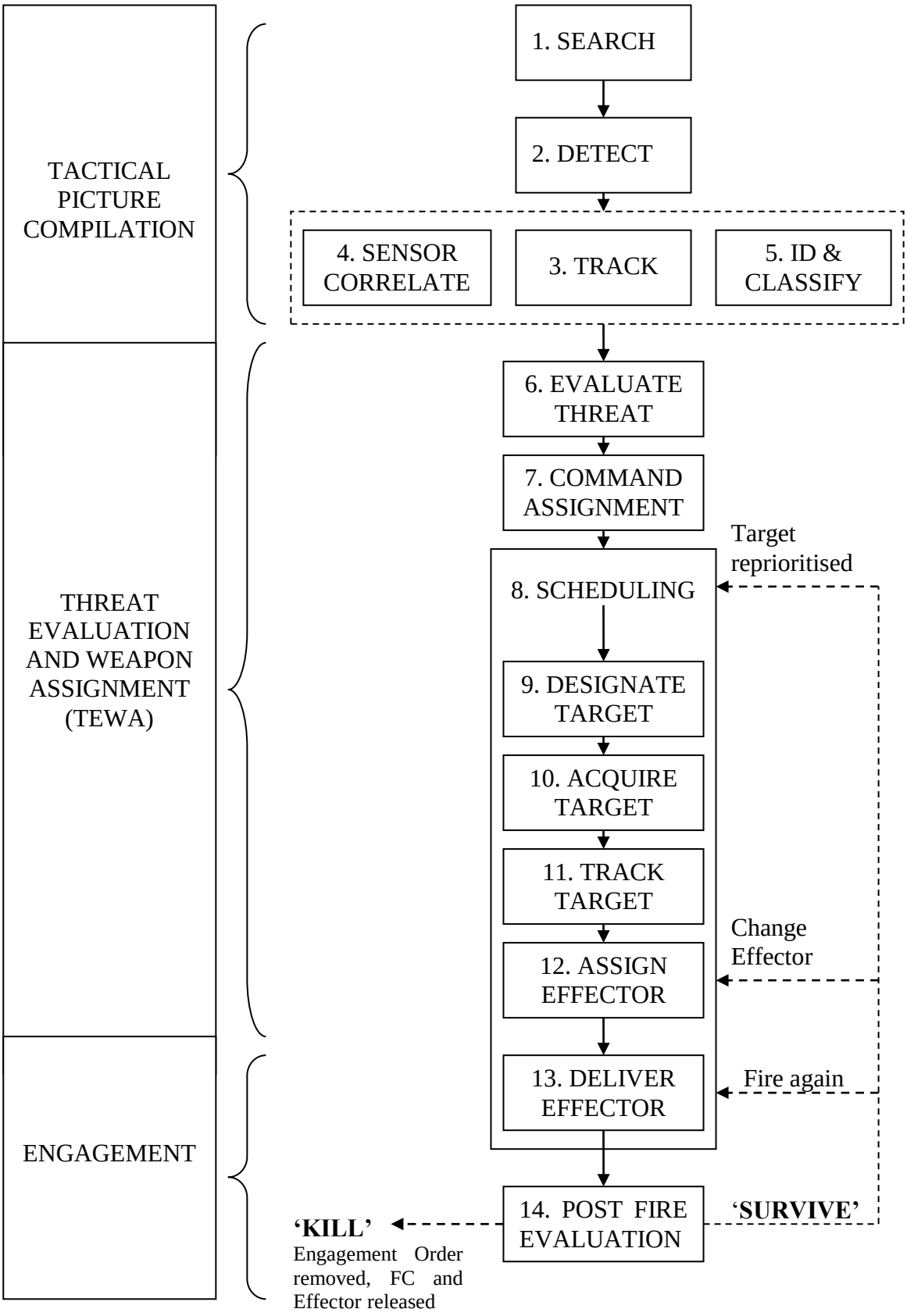

Figure 2-2: Fourteen-Step Engagement Sequence

Step	Function	Description
1	Search	Investigate within a designated volume for objects in that volume. Considerations: • What volume needs to be searched? (Horizon / Surface / Sub-Surface, etc) • What sensors are available? • What is the coverage/range of those sensors? • What can each sensor measure? (Range / Bearing / RF parameters, etc) • What are the accuracies and spatial resolutions of these sensors? • What restrictions does the mission impose? (e.g. EMCON)
2	Detect	Determine whether an object can be detected within the search volume – is anything there not part of the natural environment? Considerations: • Detection is the successful outcome of the Search function; • Target properties, clutter and environmental conditions combine to modulate how well a sensor can detect objects; • Early detection is important as this provides more time to react to a threat.
3	Track	Determine the locations and velocities of objects that have been detected using multiple object detections, then predict where those same objects will be in the future. Considerations: • We want to predict where tracks will be in the future: o Because a track's behaviour can assist in the identification and threat evaluation of that track; o To accurately deliver an effector, as the track will have moved in the time it takes the effector to reach it. • Velocity estimation (speed and direction) is critical to projecting tracks into the future; • The most up-to-date information about individual tracks is kept in a digital 'Track File'.
4	Sensor Correlate	Merge multiple detections and tracks across different sensors to form and maintain a 'fused system track' of a target. Considerations: • Detections can be correlated among multiple sensors. The accuracy/reliability of data from each sensor can be ranked to determine the best track data; • Other information sources can be sought for detection confirmation, such as remote track correlation via a Tactical Digital Information Link (TADIL).

5	Identify / Classify	Determine a suite of classifying parameters for each object in the track file. This includes for instance Symbology, IFF, EW, platform name/type and other possible identifying parameters.
		Considerations:
		• This function is critical to all subsequent combat system actions because:
		  ○ We do not want to engage friendly forces (fratricide);
		  ○ Accurate ID of a hostile target will assist in committing the most appropriate effector(s) for engagement.
		• Information from sources external to the combat system (such as mission intelligence or a remote unit's tactical data) may be used or even essential.

6	Evaluate Threat	Assess each track and determine whether it is threatening a point within the defended area or volume of the system. If a track is determined to be a threat, decide which available weapon would be most effective in neutralising that threat.
		Considerations:
		• Is it a threat?
		  ○ Manual determination – relies heavily on ID & classification data
		  ○ Automatic determination – relies heavily on accurate track velocity estimation.
		• If it is a threat, which weapon should be paired to it?
		  ○ Manual weapon-threat pairing – relies on knowledge of effector capabilities and limitations
		  ○ Automatic determination – relates track data to lookup tables to provide effector recommendation.

7	Command Assignment	Order given by the Commanding Officer (CO) or their delegated Principal Warfare Officer (PWO) / Air Warfare Officer (AWO) to engage a target that has been evaluated as a threat. Also known as "Ordered for Engagement" (OFE). The type of OFE may reflect the weapon-threat pairing considered in the previous step.
		Considerations:
		• Overall responsibility remains with the CO (vicarious liability):
		  ○ Rules Of Engagement (ROE);
		  ○ National Intent
		  ○ Second/third order effects
		  ○ Tactics
		  ○ Safety for non war-time engagements.
		• Command assignment may also be granted by enabling automated engagements (which command may veto at any time):
		  ○ QR-Auto;

		○ Automatic Self Defence (ASD) mode. • The OFE may reflect the weapon-threat pairing: ○ Engage Missile Order (EMO); ▪ Engage Missile ESSM ▪ Engage Missile SM ○ Engage Gun Order (EGO); ○ Engage Decoy; ○ Fire Torpedo.
8	Scheduling	Regularly re-perform threat ranking on targets that have been OFE to ensure the prioritised engagement schedule is up-to-date and reflects the most effective plan for achieving the mission. Considerations: • Target proximity, severity, engageable segment (considers FC & Weapon blind zones etc); • (Re)Consideration of the most suitable FC and Effector based on the threat. Considerations listed at steps 9 and 12 are regularly (re)evaluated by the scheduler; • System resources must be prioritised for use: ○ Firing Channel (FC) designation; ○ Effector assignment. • Once a track is OFE, scheduling is on-going throughout the engagement sequence until all OFE tracks are neutralised. • Engagement priorities may change rapidly – even in mid-engagement (e.g. enemy missile launched or pop-up target detected).
9	Designate Target	Assign the most appropriate FC to the target that has been OFE. Considerations: • FC capability: ○ Effective range; ○ Some FCs allow multiple Effector options, other FCs have only one. • Appropriate selection of FC relies on accurate track identification; • Designation may be manual, automatic, remote or local depending on the FC; • Blind arcs – Due to the physical position of an FC, own-ship superstructure may block its ability to track targets at certain bearings.
10	Acquire Target	The FC sensor searches for the target, using the 'coarse' positional data provided by the search sensors. Considerations: • Search pattern - bearing & elevation (little or no elevation data may be available depending on the search radars

		used); • Accurate range determination (little or no range data may be available if an EW sensor used); • Manual assistance may be employed depending on the fire control system.
11	Track Target	Maintain highly accurate target positional data for the combat system as the target and own-ship move. Considerations: • Fire Control loop - continuous error feedback (e.g.; monopulse tracking) and predictive tracking; • FC Radars accurately track targets in 3-dimensions; • FC Radars can also measure axial speed (Doppler).

12	Assign Effector	Assign the effector chosen in step 6, to the FC.
		Considerations:
		• Effectors include Weapons (hard kill) and Decoys (soft kill);
		• Effector availability & scheduling (if there are multiple engagements being performed).
		  ○ Some effectors may be simultaneously assigned to multiple FCs, others are restricted to only one FC.
		• If an OFE does not define the exact effector to be used, or if the target goes outside the currently assigned effector's engagement envelope, another effector may need to be chosen based on:
		  ○ Availability;
		  ○ Effector suitability for a given target (kinematic envelope, damage potential, cost!);
		  ○ Maximise re-engagement opportunities;

13	Deliver Effector	Provide a control system for the effector in order to maximise the probability of neutralising the threat.
		Considerations:
		• Effector type:
		  ○ Missiles
		  ▪ Semi-active homing;
		  • Home All the Way (HAW): constant CWI;
		  • Mid-Course Guidance (MCG): occasional guidance updates then terminal CWI.
		  ▪ Active homing (fire & forget).
		  ○ Gun:
		  ▪ Ballistics calculation & corrections.
		  ○ Decoys (generally fire & forget).
		• Sudden emergence of a higher priority threat requiring sensor resources may break the current engagement before the effector is delivered.

14	Post Fire Evaluation	Assesses the observable outcomes of an engagement to infer whether the threat has been neutralised or not.
		Considerations:
		• Most appropriate sensor:
		  ○ A-scope;
		  ○ FC elevation;
		  ○ Visual / Electro-Optic (depends on range);
		  ○ Remote spotter.
		• Quantity and quality of information decreases with time;
		• Possible re-engagement if target survived;
		• If no PFE is supplied, an automated system may assume the neutralised threat is still there and attempt re-engagement. If the threat *was* neutralised, an unnecessary re-engagement would tie up valuable system resources and may adversely affect their availability for scheduling of other threats.

Chapter 3. FFG Combat System Equipment Overview

Hardware Elements

1. The FFG Combat System is comprised of five main hardware elements which facilitate the CS primary functions and engagement sequence. These Elements are:

a. Sensor Element
b. Command & Decision Element
c. Fire Control Element
d. Effector Element
e. Support Element

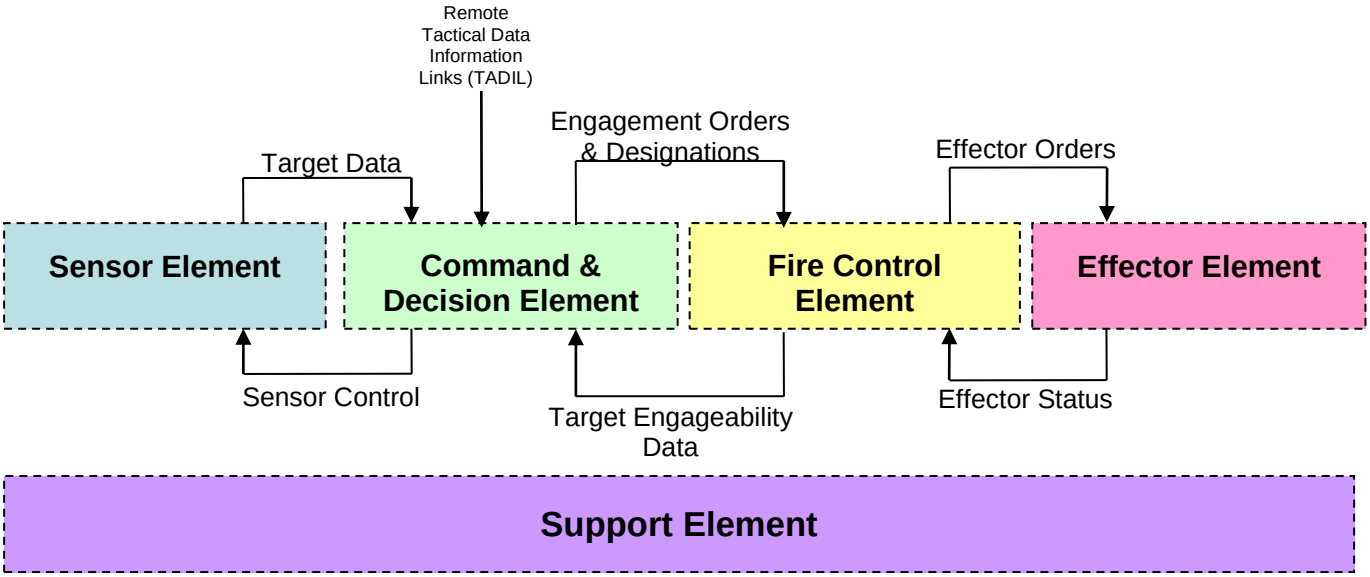

Figure 3-1: Hardware Elements

2. These hardware elements effectively sort the various sub-systems and equipment into functional ‘sub-capabilities’. Responsibility for the technical integrity of the equipment within each element is given to a specific section of the ships Weapons Electrical (WE) department.

Sensor Element

3. The systems and equipment associated with the Sensor Element are primarily used to facilitate steps 1 & 2 of the 14-step engagement sequence, providing target and tactical information to the Command & Decision Element in order to contribute to the primary function of building the Tactical Picture. Types of equipment in this element include:

a. Radars
b. Electronic Warfare (EW) Sensors
c. Optical / IR Sensors
d. Sonar

4. The Sensor Element is maintained on the FFG primarily by the WE Department 'CSO2' section. FFG Sensors include:

a. AN/SPS-49A(V)1 Long Range Air Search Radar
b. AN/SPS-55 Surface Search & Navigation Radar
c. Mk92 Mod12 Combined Antenna System (CAS) Surface and short-range Air Search Radar
d. Enhanced Raphael C-Pearl Electronic Support (ES) system
e. Electro Optical Tracking System (EOTS)
f. Spherion Hull Mounted Sonar (HMS)
g. ALBATROS Torpedo Detection System (TDS) Towed Array
h. Mine & Obstacle Avoidance Sonar (MOAS)

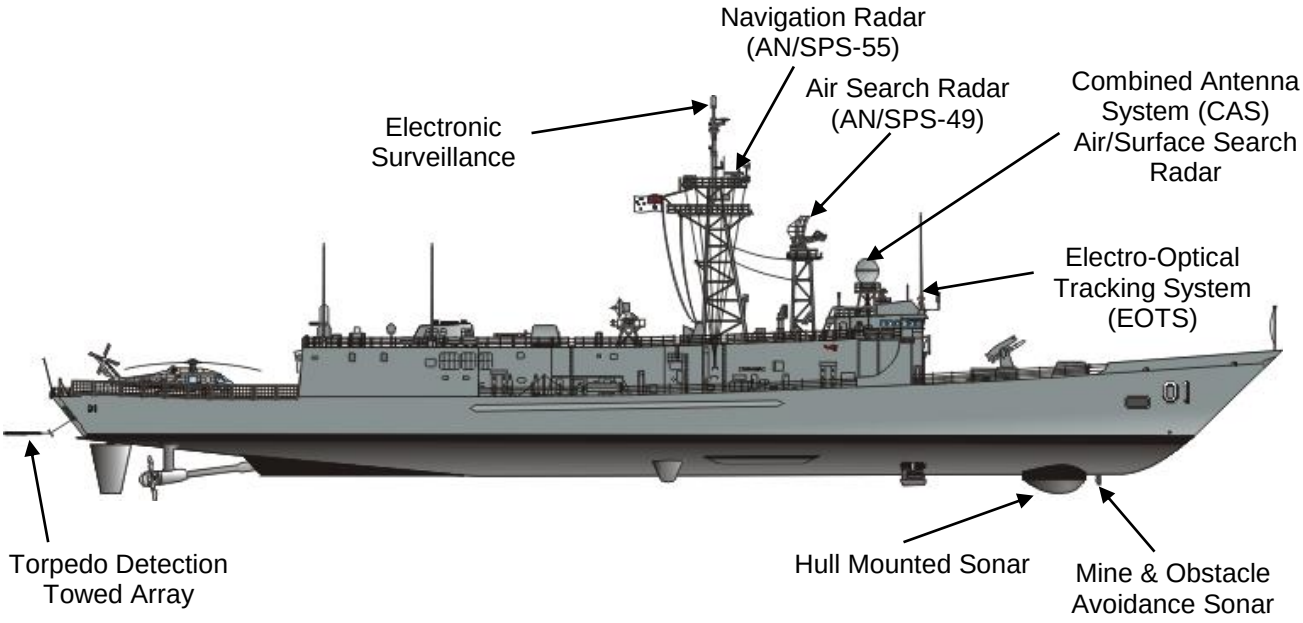

Figure 3-2: FFG Sensor Locations

Command & Decision Element

5. The systems and equipment associated with the Command & Decision Element (also known as Command & Control – C2) are primarily used to facilitate steps 3 through 7 of the 14-step engagement sequence. These steps fall under the first two primary Combat System Functions:

a. Tactical Picture Compilation
   i. collect, correlate and track Sensor element data in real time (these tasks require that C&D equipment exercise control over equipment in the sensor element);
   ii. collect, correlate and track remote tactical (Link) data in real time
   iii. Provide operators with a representation of the real time tactical environment and tools to identify and classify the tracks;

b. Threat Evaluation & Weapon Assignment
   i. provide threat evaluation and engagement recommendations, and automation options (decision aids); and
   ii. provide weapon system engagement co-ordination and monitoring facilities (these tasks will generate Orders For Engagements (OFE), and 'Firing Channel' designations for equipment in the Fire Control Element. The Fire Control Element will in turn provide target engageability and other data back to the Command and Decision Element).

6. Like the Sensor Element, the Command and Decision (C&D) Element is also maintained primarily by the WE Department 'CSO2' section. The primary FFG systems in the Command and Decision Element include:

a. Radar Integrated Automatic Detect and Track (RIADT)
b. Advanced Display System (ADS), which includes:
   i. ADS Servers
   ii. ADS Consoles
   iii. Australian Distributed Architecture Combat System (ADACS) Software
c. Common Data Link Management System (CDLMS)
d. Helicopter Data Link (HDL)
e. Underwater System (UWS) Sonar Operator Console (SOC)
f. IFF Beacon Video Processors (BVP)

Fire Control Element

7. The systems and equipment associated with the Fire Control Element are primarily used to facilitate steps 8 through 14 of the 14-step engagement sequence, which all contribute the primary function ‘Engage’. The equipment in the Fire Control Element provides:

a. prioritisation of threats (targets that have been Ordered For Engagement). This function is more commonly known as ‘scheduling’ (this information is also fed back to the Command and decision element);

b. Fire-Control Channels (FC) to:

i. More accurately track the threat; and

ii. Control effectors (effector orders are sent to equipment in the Effector Element).

8. The Fire Control Element is maintained primarily by the WE Department ‘CSO1’ section. Major systems include:

a. Mk92 Mod12 Fire Control System, which includes:

i. Combined Antenna System (CAS) – FC-1 & FC-4/5

ii. Separate Track & Illuminating Radar (STIR) – FC-2

iii. Target Designation Transmitters (TDT) / EOTS – FC-3

b. Close In Weapon System (CIWS) – FC-6

c. Harpoon Weapon System (HWS) – FC-7

d. Ship-borne Presetter System (SPS) Djimindi –Torpedo fire control

e. Active Missile Decoy (AMD) Fire Control System (FCS)

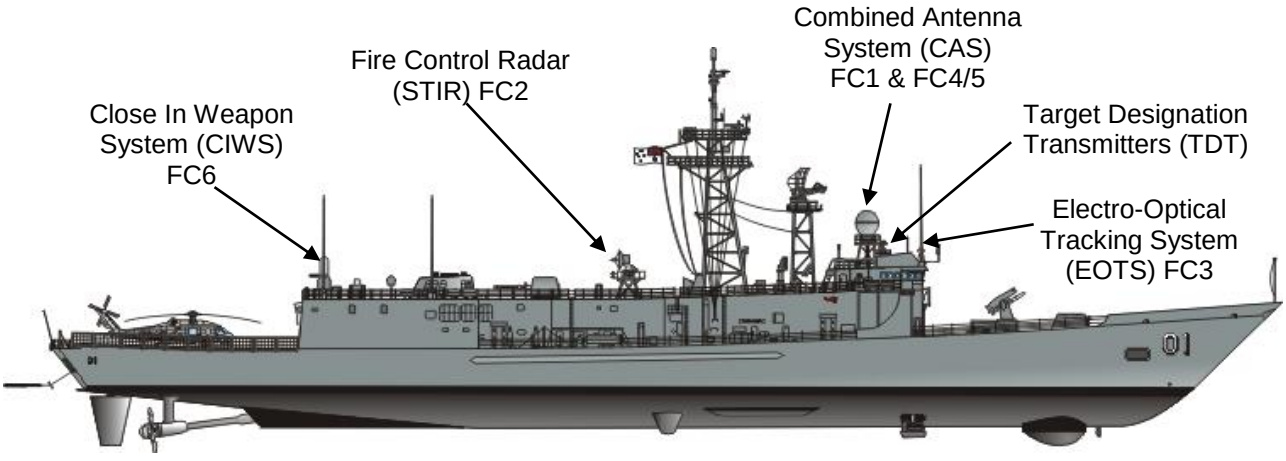

Figure 3-3: FFG Fire Control Locations

9. Effectors options are limited to certain Fire control Channels. The following table depicts the possible pairings:

Firing Channel	Equipment	Mode	Effector
FC-1	CAS Track	Air / Surface	SM-2 / ESSM / 76mm
FC-2	STIR	Air / Surface	SM-2 / ESSM / 76mm
FC-3	EOTS	Air / Surface	76mm Gun (via Mk92 FC-5 'fire' button)
FC-4	CAS Search (Track While Scan)	Surface	76mm Gun
FC-5	CAS Search (Track While Scan)	Surface / NGS	76mm Gun
FC-6	CIWS	Air (close Range)	CIWS
FC-7	Harpoon Weapon System	Surface	Harpoon Missile
FC-11-16	WCP (AN/UYK-43)	Air / Surface	None
SPS/Voice	SPS / Internal Comms	Surface / Sub-surface	SVTT: Mk46 / MU-90
HDL/Voice	HDL / External Comms	Surface / Sub-surface (long range)	S-70B-2: Mk46 (ALT)
AMD	AMD	Air	NULKA
Decoys	Internal Comms / SKWS / LRCR	Air	Seagnat Chaff / PIRATE IR / LRCR
Decoys	Internal Comms / SKWS / NIXIE	Sub-surface	Lescut / NIXIE

Figure 3-4: Firing Channel - Effector Pairing

Effector Element

10. The systems and equipment associated with the Effector Element are primarily used to facilitate step 13 of the 14-step engagement sequence by 'launching' effectors when ordered (effectors are controlled by the Fire Control Element, and feed back their status to the fire control systems). Effectors provide the ability to have an effect/impact on the operational environment. Typical equipment in the Effector Element includes:

a. Weapons (Hard Kill)
   i. Missiles
   ii. Guns
b. Decoys (Soft Kill)

11. The Effector Element is maintained primarily by the WE Department CSO3 section. Major equipment in the FFG Effector Element includes:

Weapons (Hard Kill)		Decoys (Soft Kill)	
Guided Missile Launching System (GMLS)	Standard Missile – (SM2) Harpoon Missile	Active Missile Defence (AMD)	NULKA
Mk75 76mm Gun	HEPD HEIR HEVT TP	Soft Kill Weapon System (SKWS)	Seagnat PIRATE LESCUT
Vertical Launch System (VLS)	Evolved Sea Sparrow Missile (ESSM)	AN/SLQ-25C NIXIE towed Acoustic Decoy	Not fitted to HMAS *Sydney*
Surface Vessel Torpedo Tubes (SVTT)	MU 90 Torpedo Mk 46 Torpedo		
Mini Typhoon	Fitted for operational requirements only		

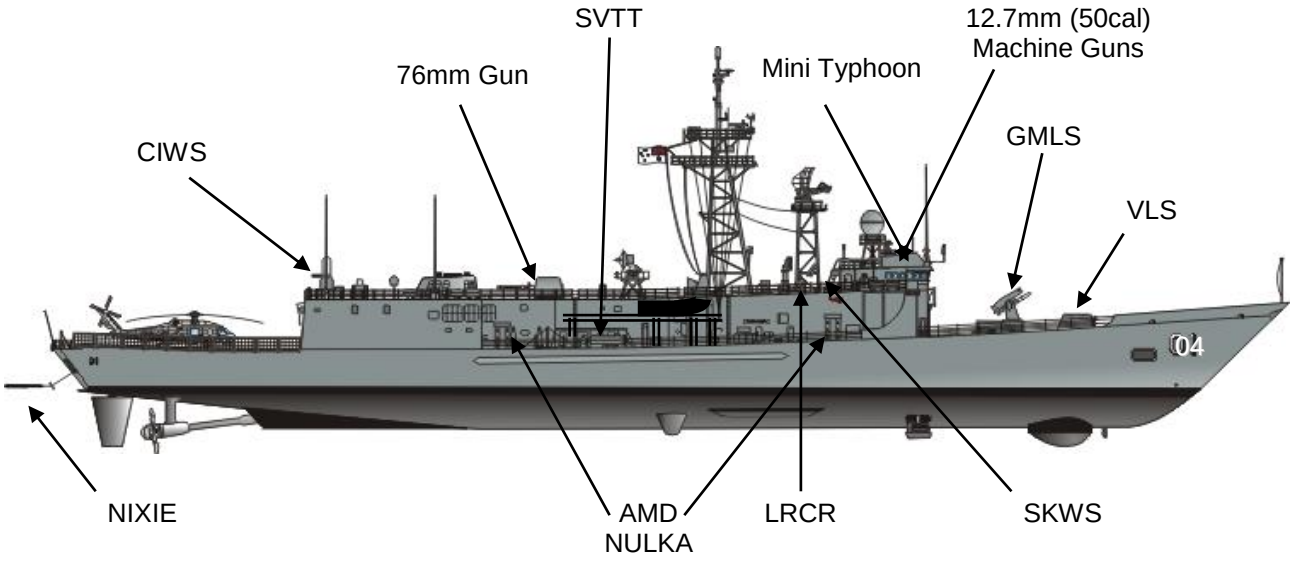

Figure 3-5: FFG Effector Locations

Support Element

12. The WE systems and equipment associated with the Support Element indirectly support all fourteen steps of the engagement sequence, providing own-ship and environmental data, and communications facilities both internal and external to the ship.

13. The WE equipment in the Support Element is maintained primarily by the WE Department CSO4 section. Primary systems/equipment include:

a. Navigation Aids
   i. Navigation Data System (NDS)
      1. Automatic Identification System (AIS)
   ii. Global Positioning System (GPS)
   iii. AN/WSN-7B Laser-Ring Gyrocompass
   iv. Mk27 Gyrocompass
   v. Electro Magnetic (EM) Log (provides ship's speed through water)
   vi. Anemometers (Wind Speed & Direction)
   vii. AN/UQN-4 Echo Sounder
   viii. Expendable Bathythermograph (XBT) and Tactical Environmental Support System (TESS)

b. Internal Communications
   i. Interphone System
   ii. Sound Powered Phone System
   iii. PABX Phone System
   iv. Announcing Systems
   v. Alarm Circuits
   vi. Closed Circuit Television Camera

c. External Communications
   i. Tactical Bearers (ship-to-ship)
      1. High Frequency (HF) voice/data
      2. Very High Frequency (VHF) voice/data
      3. Ultra High Frequency (UHF) voice/data
      4. AN/WQC-2A Underwater Telephone (UWT)
   ii. Strategic Bearers (ship-to-shore)
      1. Maritime Advanced SATCOM (Satellite Communications) Terrestrial Infrastructure System (MASTIS)
      2. SATCOM/DAMA (Demand Assigned Multiple Access)
      3. INMARSAT / Specialist Communications Modernisation Program – Maritime (SCMP-M) - SAILOR 500 Fleet Broadband

4. NINSHORE

iii. Switching Systems

14. There are other (non-WE) Support Element equipment and systems such as:

a. Organic Vehicles
   i. Helicopter
   ii. Rigid Hull Inflatable Boats (RHIB)

b. Platform Systems
   i. Power (generation / conversion / distribution)
   ii. Cooling (liquid & air-conditioning)
   iii. Pressurised air

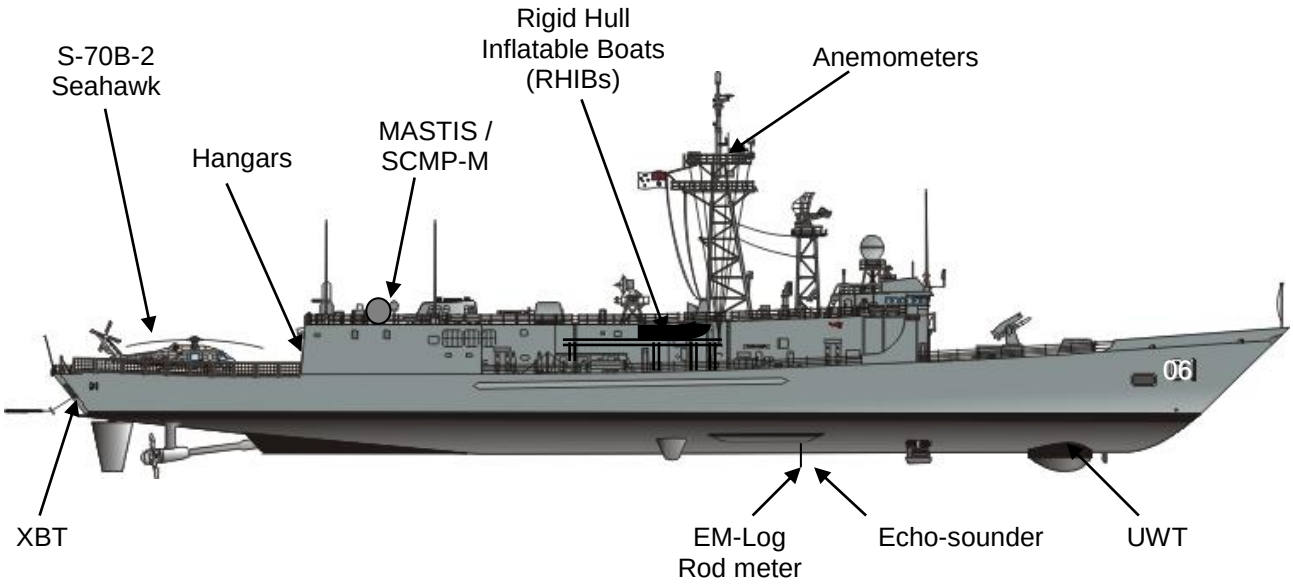

Figure 3-6: FFG Support System Locations

Combat System Context Diagram

15. The systems and equipment within the Hardware Elements described above facilitate the functions of the fourteen step engagement sequence and in-turn the primary functions of a Combat System. The Combat System Context Diagram (Figure 3-7) was developed to graphically depict which Hardware Elements facilitate which Functions. The Primary Functions and Fourteen Step Engagement sequence line-up vertically with the respective Hardware Elements. The Context Diagram does not depict FFG equipment and is therefore not class specific, i.e. this model can be applied across many different types of combat system.

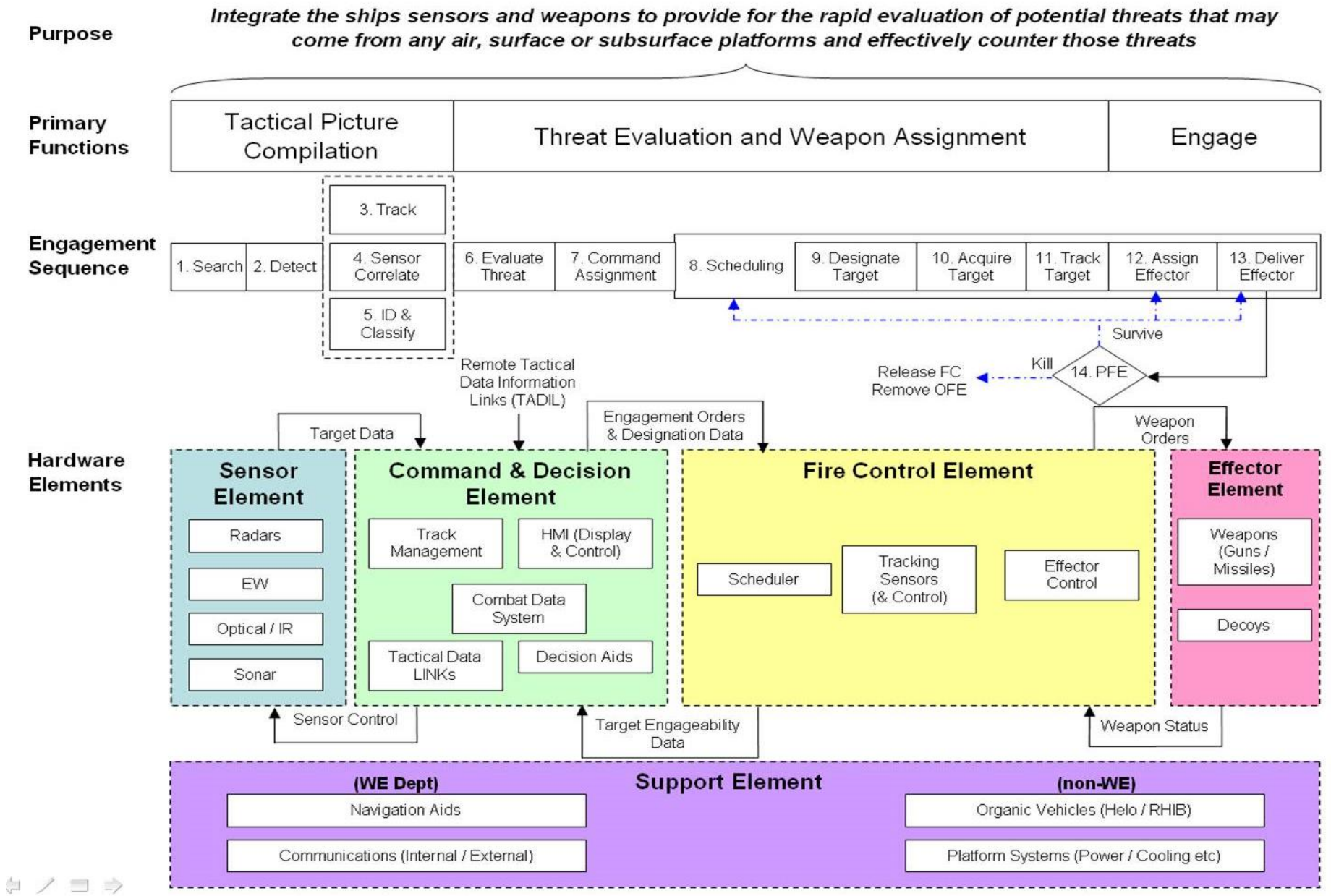

Figure 3-7: Combat System Context Diagram

Simplified FFG Combat System Diagram

16. The Simplified FFG Combat System Diagram (Figure 3-8) has been arranged to correspond to the layout of the Hardware Elements in the Combat System Context Diagram. The Simplified Combat System Diagram is RAN FFG specific, and depicts the major systems / equipment and how they interact at a high level. Some of the equipment in this diagram has not yet been covered in this learners guide, but appears in later sections & chapters.

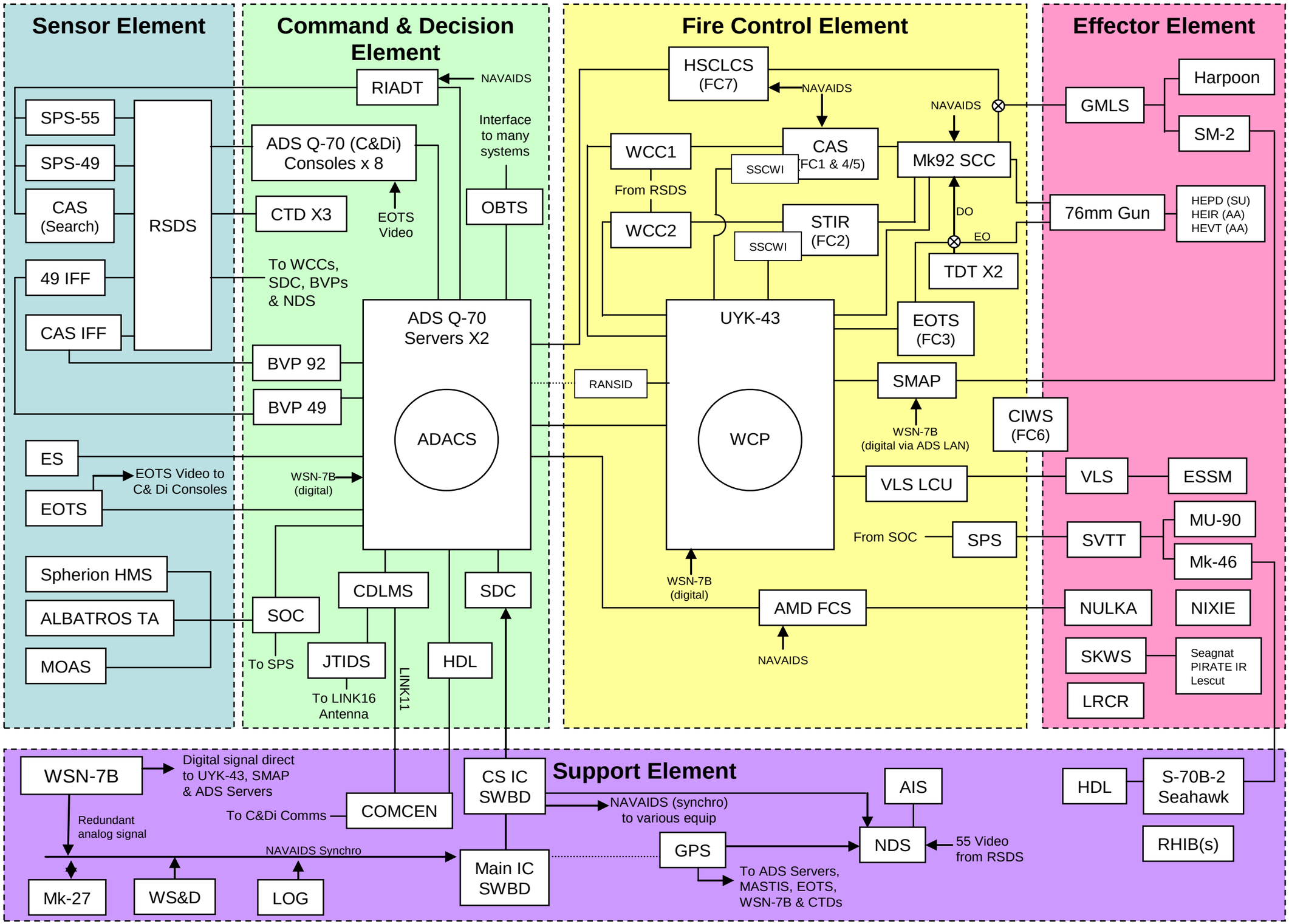

Figure 3-8: Simplified FFG Combat System Diagram

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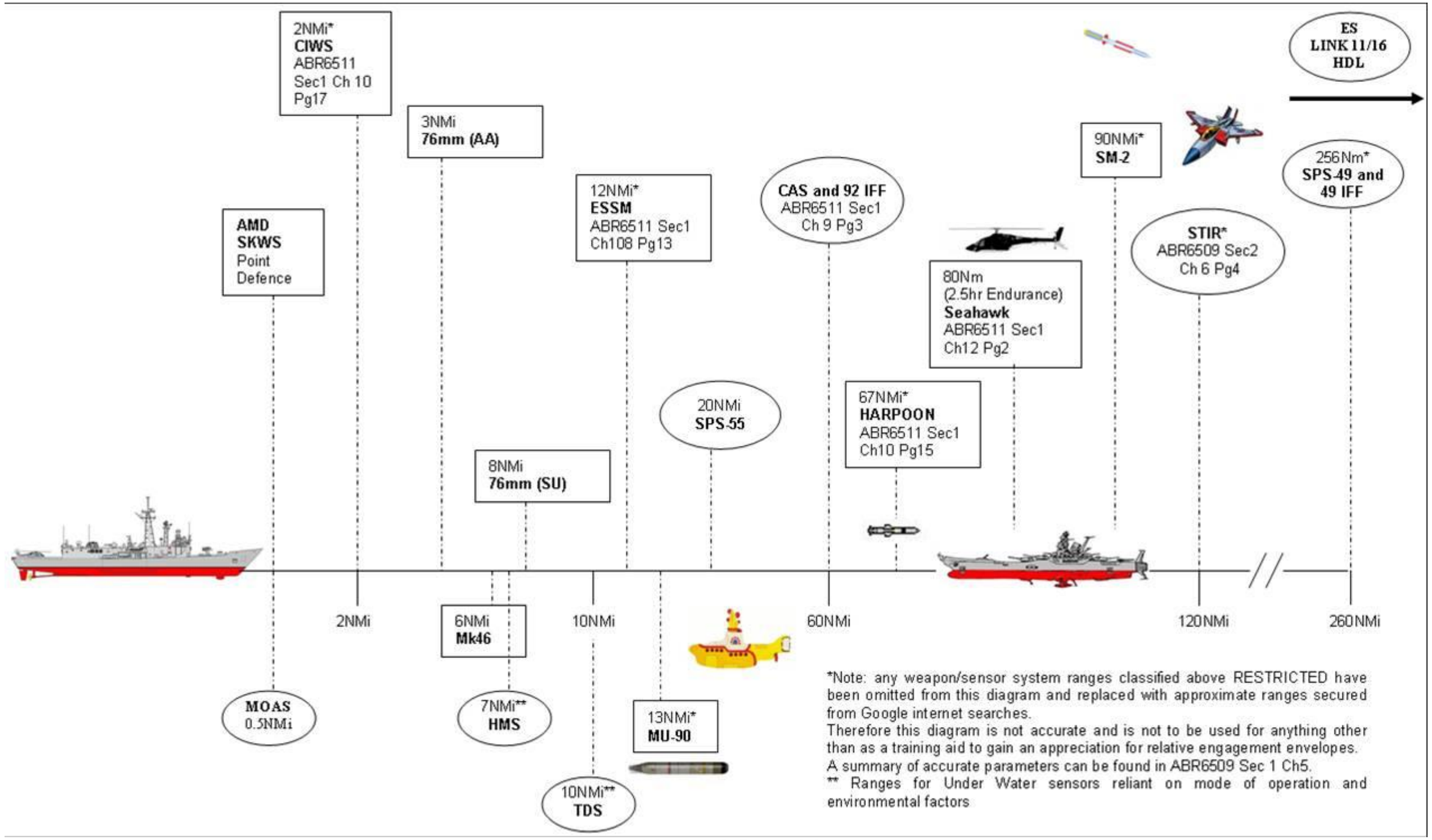

Figure 3-9: FFG Sensor and Effector Relative Ranges

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Chapter 4. Combat System Manning

WE Department Manning

References:

A. •AFTP 1(C) Chapter 312

B. •RAN FFG Class Standing Orders Chapter 501

C. ABR 5476 - Royal Australian Navy Shipboard Combat Survivability—Damage Control Policy

Combat System Organisation (CSO) Work Centres

1. The Weapons Electrical Engineering (WEE or commonly known as just WE) Department is fundamentally divided into four Combat System Organisation (CSO) work centres, complemented by a Regulating section. The WE Department Structure can be seen in the diagram over the page. The four main work centres CSO1 though CSO4 have been mentioned earlier in the description of Combat System Hardware Elements.

2. For administrative, maintenance and configuration control management purposes, each work centre is managed by a Petty Officer Electronic Technician (POET) known as the Work Centre Supervisor (WCS). Two Chief Petty Officer Electronic Technicians (CPOET) known as 'Head of Section' (HOS), oversee the management of two CSO work centres each, as shown in the table below.

Work Centre Title	WCS	HOS
CSO1: Fire Control Systems	CSO1 PO (08D)	CSO1/3 CPO (03D)
CSO3: Weapon Systems	CSO3 PO (28D)	
CSO2: Command & Surveillance	CSO2 PO (13D)	CSO2/4 CPO (10D)
CSO4: Communications & NAVAIDS	CSO4 PO (24D)	

Table 1: WE Department Senior Sailor Positions

Weapons Electrical Engineer Officer (WEEO)

3. In RAN frigates and submarines, the WEEO is responsible for the management of the WEE Department and provision of technical advice to the Commanding Officer (CO). The WEEO has responsibility for the material condition of Weapons Electrical (WE) systems and is the technical authority in the Ship for all WE systems within the authority delegated to them and in accordance with the requirements of the Navy Technical Regulatory Framework, AFTP1 Chapter 310, and other extant directives.,

4. The WEEO is responsible for the morale and well being of all members of the WEE Department and is the Divisional Officer for all Senior Sailors in the department. Professional development of WEE officers in the department and the training of Assistant WEEOs (AWEEO) are to be given a high priority. The WEEO should discuss the progress of these officers on a regular basis with the FWEEO.

5. The WEEO will act as a member of the Command Team and as detailed at reference C perform the role of Whole Ship Adviser (WSA) during the Action State. The WEEO is to ensure the Deputy WEEO (DWEEO) gains an appreciation of the WSA role during Action Stations and DC incidents.

6. A detailed list of responsibilities appears in FFG Class Standing Orders Chapter 501 Annex A.

Deputy Weapons Electrical Engineer Officer (DWEEO)

7. The DWEEO is responsible to the WEEO for matters placed in his/her charge, and the general day to day running of the WE department. They will act as the HOD in the WEEO's absence, with limited authority as delegated by the CO and WEEO.

8. The DWEEO should take an active role in planning of WEE department activities, in consultation with the WEE Department Regulator and the ship's Operations Officer (OPSO).

9. The DWEEO is responsible to the WEEO for the morale and well being of the WEE department and is the Divisional Officer for junior sailors in the department. The DWEEO is in no way to be considered a training position; however, the professional development of the DWEEO toward a recommendation for the WEE Charge Qualification (CQ) is important. This development should be experiential and every opportunity should be taken to expose the DWEEO to the responsibilities of the WEEO.

10. A detailed list of responsibilities appears in FFG Class Standing Orders Chapter 501 Annex B.

Assistant WEEO (AWEEO)

11. AWEEOs are classified as officers under training and are borne primarily to obtain their Weapons Electrical Engineer Officer's Certificate of Competence (WECC) and Harbour Watch Keeping Certificate. They are not line managers within the department; however, they will assist the WEEO and DWEEO in routine matters, research, and other ancillary ship duties to ensure they develop their generalist knowledge and experience base, as well as gain a good understanding of how the different departments interact to achieve whole ship missions and goals. AWEEOs are to train and work within the WE department as directed by the WEEO.

12. AWEEOs may be allocated routine divisional officer duties (Assistant Divisional Officer) and up to two additional ancillary duties at the discretion of the Executive Officer (XO), in consultation with the WEEO, in order to develop their understanding of these roles for future postings.

13. A detailed list of responsibilities appears in FFG Class Standing Orders Chapter 501 Annex C.

Head Of Section (HOS)

14. The HOS is responsible through the DWEEO to the WEEO for the management of their sections' personnel and equipment. They are the primary advisor to the WEEO and DWEEO of the equipment and personnel in their charge. All CPOs are to assist the DWEEO in the short term planning of the department goals and objectives, as well as developing the plans with which to achieve these goals.

15. The WEEREG will be responsible for planning and administrative management of routine departmental and inter-departmental activities.

16. A detailed list of responsibilities appears in FFG Class Standing Orders Chapter 501 Annex D.

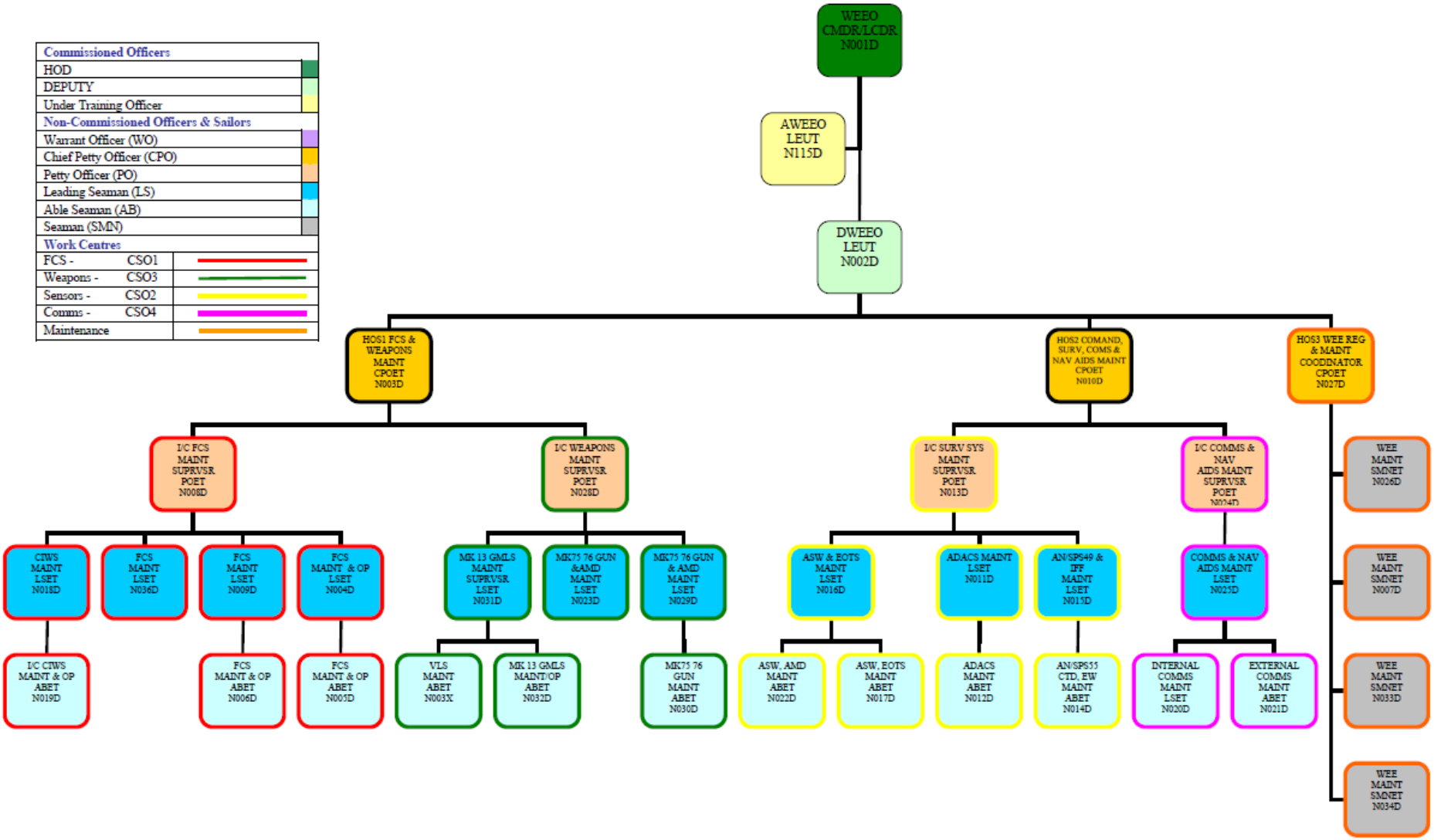

Figure 4-1: WE Department Scheme Of Compliment (SOC)

FFG Action Information Organisation (AIO) Manning

References:

A. ABR5273 - Action Information Organisation User Instructions

B. RAN FFG Class Standing Orders Chapter 203

C. ABR6511 – Section 2

D. ABR6509 – Section 1 Ch 3

17. The Action Information Organisation (AIO) is a team of officers and sailors whose aim is to produce a clear, concise and up-to-date tactical picture for appreciation by the Command. The AIO team includes officers and sailors of various specialisations who man the Combat Information Centre (CIC) or Operations (Ops) Room, which consists of RADAR, SONAR, Electronic Warfare (EW) equipment, optical sensors and Electronic Information Exchange (EIE) equipment, as well as out-stations such as the Bridge, Communications Centre and Lookout positions. The Ops Room is considered as the centre of the organisation; however, the fighting efficiency of the ship directly reflects the performance of the entire AIO team, whose efforts culminate in the display of the tactical picture in the Ops Room in wartime and peacetime.

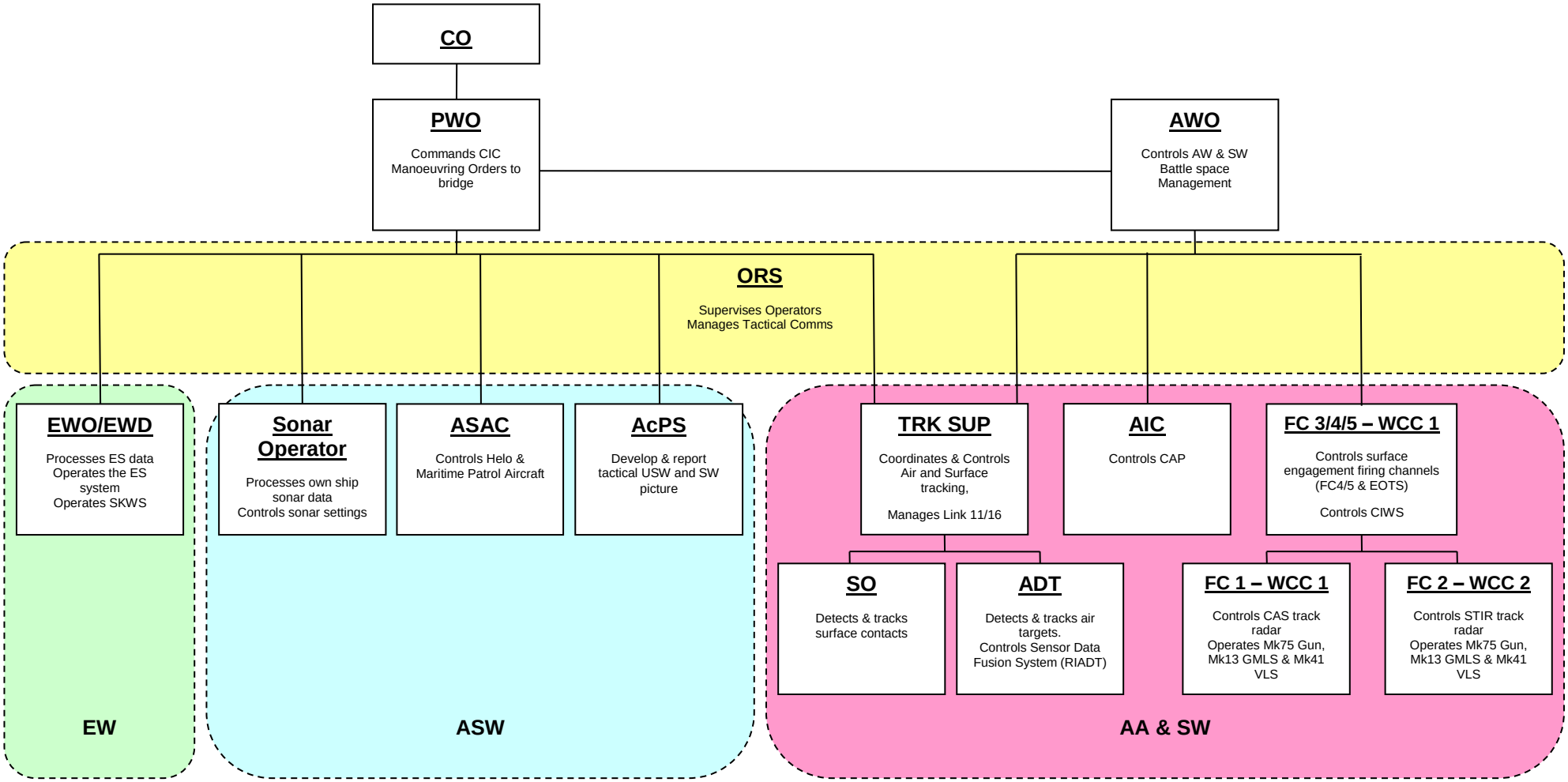

Figure 4-2: AIO Structure

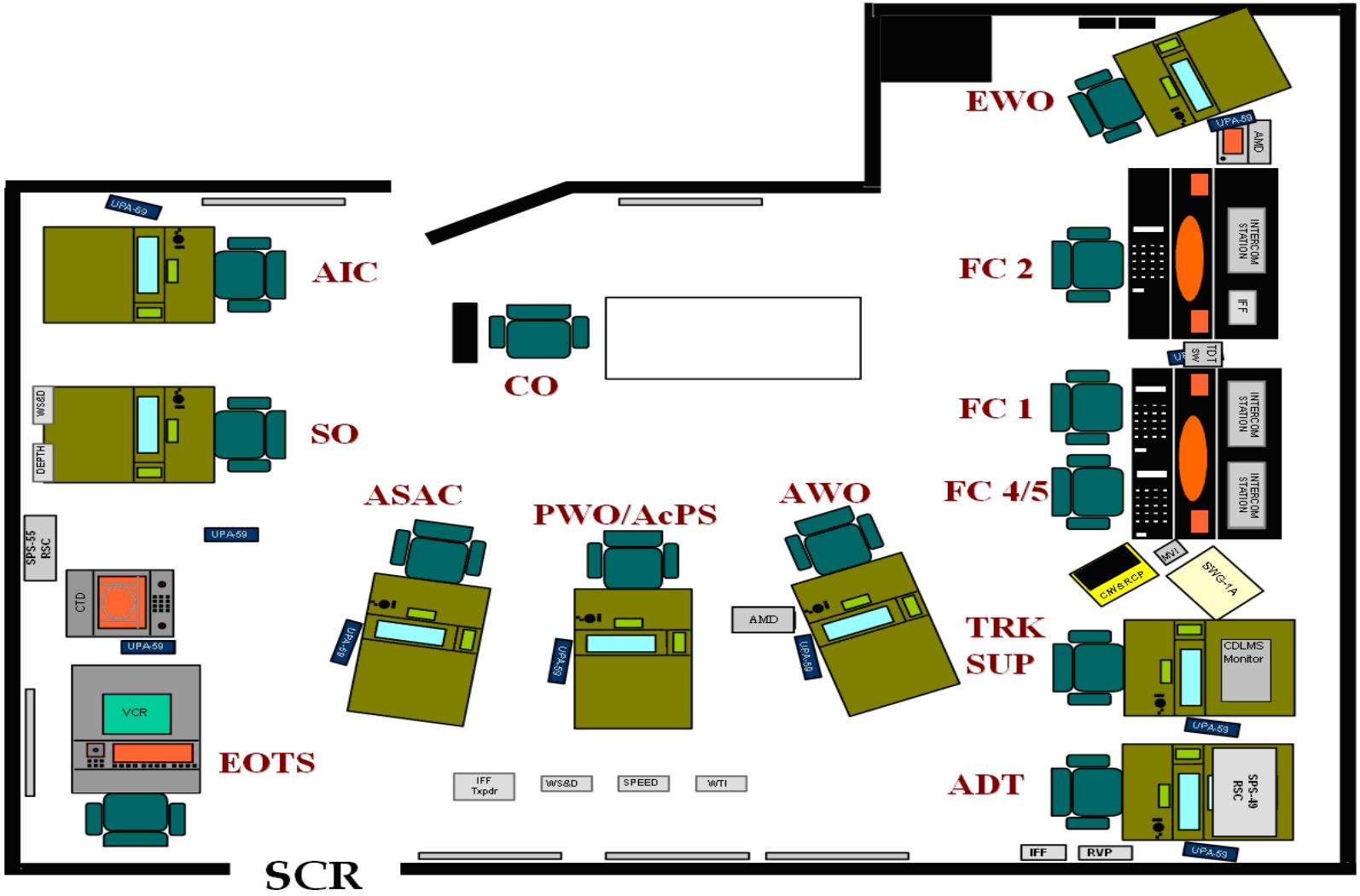

Figure 4-3: FFG Ops Room Layout

Control of the AIO

18. The Direction Officer (DO) is in overall charge of the AIO. Control varies when in harbour and at sea and is vested as follows:

19. In harbour - The Directions Officer is responsible for the control of the AIO;

20. At sea - (Cruising Watches) - When a PWO is not closed up the Operations Room Supervisor/ Leading Hand Of the Watch is responsible for control of the AIO to meet on watch needs, the OOW maintains RADHAZ safety. The CSM will produce night orders to administer departmental tasks. The DO retains overall responsibility; and

21. At sea - (Defence Watches/PWO closed up). The on watch PWO is responsible to Command for the control of the AIO.

Roles & Responsibilities

22. The following descriptions mention equipment that is covered in more detail later in this learners guide.

Commanding Officer (CO)

23. The Commanding Officer (CO) retains oversight of the entire combat system, particularly during the higher degrees of readiness. Although not physically situated at an operator position, the CO receives a broad operational picture by voice communications, both internally and externally. The CO has overall control of the combat system, either through direct commands or by delegation, usually the PWO, and AWO.

24. The CO's chair in the Operations Room is the primary position for the Commanding Officer during action and high operational tempos. In this position the CO has access to external communications via a VCS-945C remote speech processor, and internal communications including:

a. sound powered circuits (normally 1JS),

b. announcing circuits (1MC, 10MC), and

c. squawk box (21MC).

25. The Executive Officer assumes the responsibilities of the Commanding Officer when directed or in case of incapacitation.

Principal Warfare Officer (PWO)

26. The Principal Warfare Officer (PWO) controls the combat system from a C&Di console. To enable the PWO to control the ship and fulfil the command's delegations, the PWO is centrally located within the Operations Room with access to internal and external communications. Radio circuits are accessed, as with all other operator positions, via a VCS-945C. Internal communications include:

a. sound powered circuits via console intercommunication station (CIS) and/or barrel switches (normally 1JS), and

b. announcing circuits (1MC, 10MC, 29MC).

27. The PWO role within the Advanced Display System (ADS) provides controls for the oversight of combat system performance and weapon allocations, and the visual display of data which can be adjusted to suit the current operational environment.

Air Warfare Officer (AWO)

28. The Air Warfare Officer (AWO) tactically controls the Air Warfare (AW) and Surface Warfare (SW) fire control and weapons from a C&Di console. To enable the AWO to control weapons and fulfil the Command's delegations, the AWO is located within the Operations Room between the PWO and the Weapons Control Consoles (WCCs). Through the C&Di console, the AWO has access to internal and external communications. Radio circuits are accessed, as with all other operator positions, via a VCS-945C. Internal communications include:

a. sound powered circuits via console communications interface and/or barrel switches (normally 1JS with the PWO and CO, and 2JP with WCC operators), and
b. announcing circuits (1MC, 10MC, 32MC).

29. The AWO role within the Advanced Display System (ADS) provides controls for the command and control of weapon allocations, and the visual display of data which can be adjusted to suit the current operational environment.

Combat Systems Manager (CSM)

30. The Chief Petty Officer Combat Systems Manager (CPOCSM) is responsible to the designated PWO for the organisation, supervision and training of the Combat Systems Division. The duties of the CPOCSM include:

a. act as Divisional Chief for the Combat Systems Division;
b. production of the AIO Watch and Station Bill;
c. internal regulating of the Combat Systems Division in concert with the Whole Ship Coordinator;
d. employment of the Ops Room party;
e. controlling the AIO defect reporting system;
f. ensuring that Physical Security of AIO compartments is maintained;
g. progression of continuation and advancement training for all CSOs;
h. maintenance of various AIO Books, Logs and Records and ensuring they are prepared for periodic inspections;
i. the maintenance and cleanliness of AIO Compartments;

31. The CPOCSM is also responsible for ensuring that the Ops Room, Sonar Control Room (SCR) and EW Office (EWO) are prepared before the ship proceeds to sea.

Operations Room Supervisor (ORS)

32. The Operations Room Supervisor (ORS) is a Petty Officer Combat System Supervisor (POCSS) who oversees the flow of tactical information and orders throughout the Operations Room, and in some cases, the combat system. The ORS’s broad responsibilities can be summarised as follows:

a. the efficient compilation and display of the operational picture gained from own ships sensors and from other units;
b. implementing equipment requirements;
c. implement manning requirements; and
d. directing on-watch training of personnel.

33. Although the ORS does not operate a console, a keen interest in the tactical picture is essential to keep up to date with events as they occur. The ORS can glean a great deal of information by listening to background conversations and viewing the plots from a short distance (i.e. over the shoulder of console operators). By example, the ORS can easily identify that a problem exists within the combat system by noting a colour change of the buttons in the status display area (SDA) of the C&Di consoles, even if not yet alerted to it by an operator.

34. The ORS has all Operations Room communications available, both internal and external. Generally, the ORS utilises the internal telephone system and/or squawk boxes to liaise with other sections of the ship, such as COMCEN staff for the control of tactical radio circuits, or RlCER to speak with maintainers.

Air Intercept Controller (AIC)

35. The Air Intercept Controller (AIC) is an officer or senior sailor who tactically controls airborne AW aircraft (i.e. Combat Air Patrol - CAP) from a C&Di console. The AIC C&Di console is port side forward within the Operations Room, i.e. the first console entering through the forward door. Through the C&Di console, the AIC has access to internal and external communications. Radio circuits are accessed, as with all other operator positions, via a VCS945C. AlC normally talks internally with the AWO via sound powered circuit 1JS, but may need to communicate on 22JS with Track Supervisor for Link-16 coordination, and ADT to clarify the air picture.

36. The AIC role is not a permanent function, therefore it is imperative that training occurs to integrate the AIC into both teams of Operations Room defence watch keepers. The On-Board Training System (OBTS) is well suited to conduct realistic part task training scenarios for the air warfare teams including the AIC.

FC-1 Operator

37. The FC-1 Operator is a (SMN)/ABET Mk92 Maintainer (from the WE Department) who, via the left hand position of Weapons Control Console 1 (WCC1), has primary control of Mk92 Combined Antenna System (CAS) Track, and is responsible for the acquisition, tracking and engagement by gun or missile of air and surface targets as directed by the AWO. All FC operator positions man sound powered circuit 2JP (battery control) to communicate with other fire control operating positions and the AWO. Tor the WCCs, 2JP communications are achieved using the LS-573 communications panels. Sound powered circuit X43J (weapon system service) is available as a redundancy in the event of 2JP failure.

FC-2 Operator

38. The FC-2 Operator is a (AB)/LSET Mk92 Maintainer (from the WE Department) who, via the Weapons Control Console 2 (WCC2), has primary control of Mk92 Separate Track & Illumination Radar (STIR) and is responsible for the acquisition, tracking and engagement by gun or missile of air and surface targets as directed by the AWO. Available internal comms are exactly the same as for FC-1.

FC-3/4/5 Operator

39. The FC-3/4/5 (usually referred to just as FC-4/5) operator is a LSET Mk92 Maintainer (from the WE Department) who, via the right hand position of WCC1, has primary control of Mk92 CAS Search for FC-4 & 5 surface gun engagements, control of the gun for FC-3 (EOTS) engagements, FC's 11-16 (in local mode), Close in Weapons System (CIWS, FC-6), and Harpoon Weapon System (HWS, FC-7) as directed by the AWO. Available internal comms are exactly the same as for FCs 1&2.

Track Supervisor (TRK SUP)

40. The Track Supervisor is normally a Leading Seaman Combat System Operator (LSCSO) whose primary responsibilities are data link management, correlation of the internal and externally reported pictures, supervision of air and surface plots, and identification of tracks. Identification functions have been partly devolved to the Air Detector/Tracker (ADT) role through access to, and control of Beacon Video Processors (BVP), however oversight and performance monitoring remains with Track Supervisor.

41. Through the C&Di console, the Track Supervisor has access to internal and external communications. Radio circuits are selected, as with all other operator positions, via a VCS-945C. Track Supervisor regularly converses internally with ADT and SO positions on 22JS. Coordination with the ASAC and AIC for Link-11 and Link-16 operations with aircraft may occur on either 22JS or 1JS. When conducting Link-11 only, or multi-link operations, the Track Supervisor will converse externally on the data support administration (DSA) radio circuit. If only Link-16 is being used, communications may be via one of the two digitised secure voice circuits incorporated in JTIDS.

42. The Track Supervisor role within the advanced display system (ADS) provides controls for the operation of data links via an 'x-window' session presenting the Common Data Link Management System (CDLMS) Human machine Interface (HMI). There is currently a configuration change being implemented to add a second screen to the TRK SUP so the x-window can stay permanently up without losing the ADS tactical picture.

Air Detector/Tracker (ADT)

43. The Air Detector/Tracker (ADT) is usually a Seaman or Able seaman Combat System Operator (SMN or ABCSO) whose role is the compilation and reporting of the air picture. This includes:

a. control of AN/SPS-49 A(V)1 early warning radar to maximise detection and tracking functions;
b. limited control of Mk 92 CAS Search radar to maximise surveillance functions;

c. control of RIADT to maximise automatic detection and tracking as part of the sensor data fusion process;
d. control of the BVP system to conduct IFF interrogations in support of the identification process;
e. maintenance of the air picture for currency and accuracy; and
f. reporting the tactical air picture via external radio communications.

44. Through the C&Di console, the ADT has access to internal and external communications. Radio circuits are selected, as with all other operator positions, via a VCS-945C. The ADT normally converses internally with the Track Supervisor, SO, and EWO via sound powered circuit 22JS, however will need to communicate at times with the AWO via 1JS. Close liaison with the AIC and ASAC is also important for the correct identification of friendly aircraft under their control.

Surface Operator (SO)

45. The Surface Operator (SO) is usually a (SMN)/ABCSO who is responsible for compilation and reporting of the surface picture, particularly in support of the Officer Of the Watch (OOW) for ship's safety of navigation. This includes:

a. control of AN/SPS-55 surface search radar to maximise detection and tracking functions;
b. limited control of Mk 92 CAS Search radar to maximise surface surveillance functions;
c. control of RIADT to maximise automatic detection and tracking as part of the sensor data fusion process;
d. maintenance of the surface picture for currency and accuracy;
e. reporting the tactical surface picture via external radio communications; and
f. reporting the surface picture internally to the OOW as directed.

46. Through the C&Di console, the SO has access to internal and external communications. Radio circuits are selected, as with all other operator positions, via a VCS-945C. The SO normally converses internally with the Track Supervisor, ADT, EWO, and OOW via sound powered circuit 22JS, however will need to communicate at times with the PWO via 1JS.

Anti-Submarine Air Controller (ASAC)

47. The Anti-Submarine Air Controller (ASAC) is normally a LSCSO. The primary responsibilities of the ASAC involve the tactical control of aircraft in SW, Under Sea Warfare (USW), and support missions such as vertical replenishment (VERTREP) or personnel transfers. An additional role is for aircraft safety during air defence exercises and weapons firings against targets towed by aircraft. Control methods for the ship's dedicated helicopters can be by voice orders or Helo Data Link (HDL) using tactical radios. The ASAC is also responsible for picture compilation, particularly in support of the PWO for USW; only the ASAC and PWO ADS roles have access to USW specific functionality. Reports from controlled aircraft are also entered by the ASAC if necessary.

48. Through the C&Di console, the ASAC has access to internal and external communications. Radio circuits are selected, as with all other operator positions, via a

VCS-945C. The ASAC normally converses internally with the PWO via sound powered circuit 1JS, however will need to communicate at times with the Track Supervisor, ADT and SO via 22JS. Close liaison with the AIC is also important for the safety of controlled aircraft.

Action Picture Supervisor (AcPS)

49. The Action Picture Supervisor (AcPS) is either an AB or LS CSO. The primary role of the AcPS is to support the PWO by developing and reporting by voice the tactical USW and SW picture. AcPS works closely with the PWO and the ASAC for picture compilation and access to the external communications net.

50. Through the C&Di console, AcPS has access to internal and external communications. Radio circuits are selected, as with all other operator positions, via a VCS-945C. The AcPS normally converses internally with the PWO and ASAC via sound powered circuit 1JS, however will need to communicate at times with the Track Supervisor and SO via 22JS.

51. The AcPS does not have a dedicated ADS role, instead AcPS utilises arrays from either the Surface Operator or the ASAC role. Using the ASAC role is preferable when available, as it provides access to the UWS array, as well as the Mark VAB for over-the-horizon targeting (OTHT). The ASW array, accessed through ASAC or SO role, provides AcPS access to ASW Screen inputs, Limiting Lines of Submerged Approach (LLSA) and Plan Cordon entry, manual entry of acoustic data, and the entry of Weapon Entry Points (WEP).

Sonar Controller (SC)

52. The Sonar Controller (SC) is normally a LSCSO (U) whose primary responsibilities include supervision of the Sonar Operator, and operating the Shipborne Presetter System (SPS) to fire torpedos. SC communications are limited to announcing circuit 29MC for liaison with the PWO. During firings, the SC may communicate with the maintainer at the Surface Vessel Torpedo Tubes (SVTT) via sound powered circuit 6JP.

Sonar Operator

53. The Sonar Operator is usually a (SMN)/ABCSO(U) who uses the Sonar Operator Console (SOC) to compile a below water plot derived from the Spherion Hull Mounted Sonar (HMS), the Albatros Towed Array (TA), and to a lesser degree the Petrel Mine and Obstacle Avoidance Sonar (MOAS). All three sonars are initialised via the SOC, with the HMS and TA controlled by the Sonar Operator.

54. The Sonar Operator does not normally man an internal communications circuit, instead listening to the HMS audio as a classification aid. However the Sonar operator may use 29MC in place of the SC.

Electronic Warfare Director (EWD)

55. The Electronic Warfare Director (EWD) usually a LSCSO (A). It is a supervisory role associated with the Electronic Warfare Operator. Although not physically seated at a console, the EWD is situated in the starboard forward corner of the Operations Room

adjacent to the Electronic Warfare Operator C&Di console. Prime duties within the combat system include:

a. supervise the operation of the ES system;
b. supervise (or conduct) Soft Kill Weapon System (SKWS) deployment;
c. supervise (or conduct) Long Range Chaff Rocket (LRCR) deployment;
d. supervise (or conduct) Active Missile Decoy (AMD) deployment;
e. supervise the operation of blanking equipment (AN/SLA-10B);
f. notate emissions for future analysis;
g. advise the PWO/AWO of ES detected emissions of interest; and
h. coordinate force EW detection, identification, and reporting when allocated Electronic Warfare Coordinator (EWC) duties.

56. The EWD does not have a dedicated VCS-945C. Although not essential, it is desirable for the EWD to have access to internal and external communications to effectively supervise ES operation and voice reporting. This allows the EWD to remain fully appraised of the tactical situation, and provides the opportunity to monitor the voice circuits for authenticity and accuracy. This is particularly important when conducting the force duty of EWC. The EWD can use one of the command desks VCS-945C/LS-537's, however priority must be assessed between EWD, Command Support System (GCCS) operator, and other requirements as applicable.

Electronic Warfare Operator (EWO)

57. The Electronic Warfare Operator (EWO) is usually a (SMN)/ABCSO(A). EWO is responsible for operating the Electronic Surveillance (ES) system at a C&Di console. The ES display is visible on the C&Di console via an ‘x-window’ session. Switching back and forth between ADS and the ES displays allows the EWO to remain cognisant of the overall picture, and provides EWO with a simple means to check for correlation of emitters. Switching between displays to ID a track is potentially quicker than seeking confirmation via sound powered communications.

58. Through the C&Di console, the EWO has access to internal and external communications. Radio circuits are selected, as with all other operator positions, via a VCS-94SC. The EWO normally converses internally with the Track Supervisor, ADT, and SO via sound powered circuit 22JS, however will need to communicate at times with the ASAC, PWO or AWO via 1JS.