



文、圖 | 陳建彰

Article, photos | Chen Chien-zhang

海巡署岸際雷達系統 簡介與運用成效

- 雷達系統整體架構示意圖
An illustrated drawing of the radar system's overall framework



An Introduction to the Coast Guard Administration's Shore-range Radar System and its Utilization Yield

- 岸際雷達天線外觀圖
A frontal drawing of the shore-range radar antenna



壹、前言

海巡署依海岸巡防法執行海岸巡防任務；平時負責維護台灣地區海域及海岸秩序，與海洋資源之保護利用，確保國家安全，保障人民權益；戰爭或事變發生時，依行政院命令納入國防軍事作戰體系。

自 90 年度起至 92 年度共計 3 個年度，完成本署岸際雷達系統籌建計畫；以原海巡部建置之岸際 RD-250 雷達站，重新調整遷架外，並同步籌補新型雷達，有效綿密雷達監控我國四週海域，24 小時全天候監控海面，提高監控操作效能，俾利海巡任務遂行。有關系統建置目標如下：

- 一、24 小時全天候綿密雷達有效監控 12 海浬以內海面目標，掌控近岸

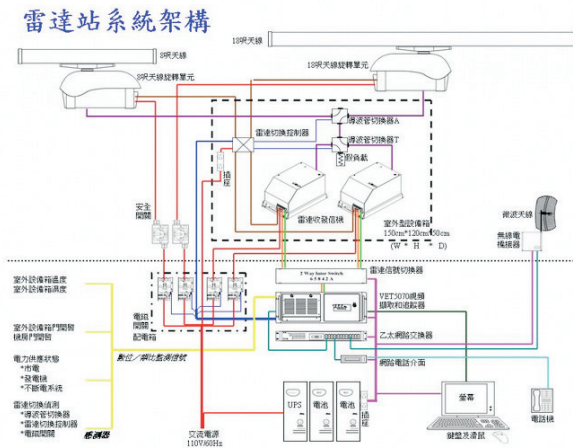
Part I Foreword

The Coast Guard Administration is responsible for carrying out coastline patrol and law enforcement missions as empowered by the Coastline Patrol and Protection Law; at normal time it is responsible for maintaining the order of sea territories and coastlines in the Taiwan region, protect the use of ocean resources, and ensure national safety and protect the people's equity; at the onset of a warfare or incident, it is streamlined into the national defense military combat system by the order of the Executive Yuan.

The administration's shore-range radar system's launching plan has covered three fiscal years spanning from 2001 to 2003, which is build upon revamping and relocating the initial Coast Guard Department's shore-range RD-250 station, but also a synchronous development of a new radar for an effective, close-knit radar reconnaissance over Taiwan's bordering seas in a 24-hour round-the-clock surveillance of the seas, aiming to excel the system's monitoring and operating yield and ensuring a smooth sailing of the Coast Guard missions; the system launching objectives are profiled as follows,

1. A 24-hour round-the-clock close-knit radar system that effectively monitors sea targets within a 12 nautical mile range for grap-

- 前端雷達站系統架構示意圖
An illustrated drawing of the front-end radar station's system framework



● 前端雷達站設備機房配置圖
A layout drawing of the front-end radar station equipment room

海域小型船舶動態(如漁船、舢舨)，強化日、夜間海域偵蒐能力，反制不法活動情事發生。

- 二、設定第一線岸際雷達為無人站台，採遠端遙控方式，雷達回跡完整傳至大隊勤指中心研判，提昇作業能力，同時達到節約第一線雷達操作人力之目的。
- 三、系統結合電子海圖，同時顯示雷達回跡及沿海地區、港口、港灣之相關位置，以清晰的顏色作顯示，監測航道與海上船隻動態，擴增預警縱紳，有效掌控及管理海上船隻活動，提高偵閱操作效能，以符攔截於海上，阻絕於岸際，查緝於內陸之任務目標，達精減岸際巡邏執勤人力。

為利讀者瞭解本署「岸際雷達系統」整體功能及系統完成後之運用成效，將於以下各詳中分別說明。

貳、岸際雷達系統架構與功能簡介

依據岸際雷達系統設備所處位置，可區分為「前端雷達站」、「總、大隊勤務指揮中心」及「本署資訊機房」三大部分。

整體岸際雷達系統架構中，「前端雷達站」為系統偵獲目標資訊主要來源，「總、大隊勤務指揮中心」以船舶管理系統為基礎，用於操控與監控前端雷達站相關設備

pling the status of near-coast small boat activities (such as fishing vessels, sampans) to greatly excel the reconnaissance capability at sea during the day and at night and to counter illicit measures from occurring.

2. The designation of the frontline shore-range radar as unmanned stations that utilize a remote control means to transmit complete radar echoes back to the squad command center for discerning serves to enhance the operating capability, and achieve the objective of conserving the frontline radar operating manpower.
3. The system integrates electronic navigation maps and displays at the same time radar echoes and relevant locations of the coastal area, harbor entries, harbor bays, displayed in crisp and clear colors for monitoring the status of the navigation courses and boat activities at sea, which further expands the depth and width of alert, and effective help to grapple and manage boat and vessel activities at sea. The system improves the administration's reconnaissance and surveillance capabilities, helps to intercept potential crimes at sea, curtails potential harm at the shore, and helps to crack down inland mission objectives, thus achieving the goal of cutting down coastal patrol duty manpower.

To facilitate the reader understand the overall functions of the Administration's "Shore-range radar system" and its implementation yield following the installation, a further description is provided in the following sections of the chapter.

Part II Shore-range radar system's framework and functional profiling

The coastal radar system by location can be divided into three parts - the front-end radar station, the headquarter/head duty squad command center, and the Administration information equipment room.

Under the overall coastal radar system framework, the front-



外，並對所獲之目標資訊做第一次的顯示與處理，而「本署資訊機房」中，主要將前端各艙大隊勤務指揮中心所獲之目標資訊，經過數位化轉換及再次比對處理後，透過本署既有海巡資訊骨幹網路，依系統賦予之使用權限及所轄責任區域，將系統所獲之海面目標資訊以近即時之傳送分享至本署各單位運用。有關系統相關設備功能，於以下三點分別說明。

一、前端雷達設備

為詳約第一線雷達操作人力之目的，前端岸際雷達站係規劃為無人站台，透過數據鏈路，由後端各岸巡總、大隊勤務指揮中心直接操控，另各雷達站均採雙機複式配置，收發信機與雷達天線均可視天候、海象狀況由勤務指揮中心雷達操作人員調整切換；當任何一組收發信機或天線故障時，可自動切換由另一組接替工作。

將前端雷達站台相關設備加以顯示，其中包含8忍、18忍天線各一組，以及2組收發信機，以雷達視頻信號擷取設備，將雷達所偵獲之雷達回跡擷取後回傳各岸巡總、大隊勤務指揮中心；另對於前端雷達站設置相關環境監控設備，將前端雷達站台之環境監測資訊，包含溫度、濕度、電源狀況、機房開啓與關閉之相關資訊，透過微波（或專線）鏈路回傳各岸巡總、大隊勤務指揮中心，使操作人員瞭解雷達站台相關環境資訊，更可對系統運作外在環境全般掌握。

此外，考量系統正常運作之可靠度，於前端雷達哨預留雷達操作工作站1套，以避免因數據鏈路中斷或遠端遙控及交換單元故障時，後端各總、大隊勤務指揮中心操作人員可立即前推接替，提高系統運作存活，以利勤務遂行。

二、勤務指揮中心系統設備

end radar station derives the system detected target information as the major source, and built upon the “head bureau/squad duty command center’s vessel traffic system” as the backbone, which is not only used to maneuver and monitor relevant equipment at the front-end radar stations, but also execute initial display and process on target information derived. While at the Administration information equipment room, it primarily serves to convert the target information that the head bureau and squad duty command centers derived from the front-end radars through digitalization and comparison before the data are routed through the Administration’s existing Coast Guard information backbone network to share with all administration units for utilization by authorization clearance and regional jurisdiction. With regard to relevant system related equipment functions, a further description is provided in the ensuing three subsections.

1. Front-end radar equipment

To achieve the objective of conserving the frontline radar operating manpower, the front-end shore-range radar station has been developed as an unmanned station, which is controlled by the various head bureau and squad duty command centers via digital routers. In addition, all radar stations have been fitted with a dual backup mechanism, where the transponders and radar antennas can be switched and maneuvered by duty command center radar operators depending on the oceanographic conditions; when any transponder or antenna malfunctions, the system automatically switches to the backup unit that immediately takes over the task.

The relevant equipment at the front-end radar station is displayed, which comprises of an 8ft and 18ft antenna, two transceivers, using the radar AV signal retriever equipment that routes the radar feedback signals detected by the radar to the duty command center at various head bureaus and squads. In addition, relevant environmental surveillance equipment installed at the front-end radar stations serve to transmit environmental surveillance data gathered at the front-end radar stations, including the temperature, humidity, power status, equipment room on/off status, back to the various head bureau and squad duty command centers via microwave or exclusive line transmission, allowing the operators a clear view of the environmental data around the radar stations, and a clear grasp of the overall environment in which the system operates.

Moreover, taken into account the reliability of the system’s normal operation, the front-end radar post has had one radar operating workstation reserved, which can be switched on by the duty center at various head bureaus and squads in the event the main system’s digital router should be disrupted, or the remote control or exchange unit should malfunction, serving to excel the system’s dependability and to facility smooth duty execution.

2. Duty command center’s system equipment

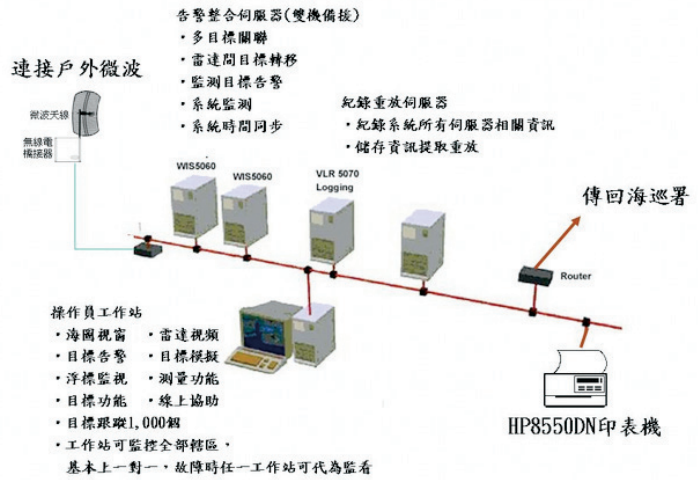
To improve the deficiency of discerning radar targets and topography feedback by conventional operators manning radar system,

為改善傳統雷達操作人員對於雷達目標與地形回跡之間不易判別之問題，整體岸際雷達系統係以船舶交通系統(Vessel Traffic System, VTS)為基礎，操作人員可於監視器之顯示幕中，同時顯示雷達回跡(echo)及沿海地區、港口、港灣之電子海圖(ECDIS)，以清晰的顏色作顯示，監控航道與海上船動態，有效掌控及管理海上之活動船隻，改善傳統雷達作業模式，僅有雷達回跡，不易判讀及研析，全憑藉雷達操作人員長久累積經驗，方可判斷目標與相對地理位置之缺點。整體勤務指揮中心系統相關設備及架構，包含「告警整合伺服器」、「紀錄重放伺服器」、「操作員工作站」等設備；「告警整合伺服器」係具備多目標關聯、雷達間目標轉移、監測目標告警、系統監測、系統時間同步等功能；「紀錄重放伺服器」係紀錄與儲存系統所有伺服器相關資訊、目標航跡資料與提取回放使用；「操作員工作站」為雷達操作人員之工作平台，具備中文文化之介面、海圖顯示、目標告警、目標模擬等相關功能外，在勤務指揮中心內，每一部操作員工作站均可遂行遠端遙控，啟動轄區雷達，偵測工作環境等作業，並提供一對一、一對多工作站作業模式操作前端雷達。同時，每處勤務指揮中心可同時監控、追蹤 1000 個以上海上目標。

三、海巡雷達資訊系統入口-雷情顯示系統

「海巡雷達資訊系統入口-雷情顯示系統」係植基於90年度海巡資訊系統(CGAIS)之架構，整體建置雷達資訊之閘集、過濾、儲存、管理、分析及顯示等功能外，並整合本署已完成建置運作勤務應用系統相關資訊，如安檢資訊系統、海洋巡防總局衛星船位控管資訊系

勤務指揮中心系統架構示意圖



● 勤務指揮中心系統設備架構示意圖
An illustrated drawing of the duty command center's system equipment framework

the entire shore-range radar system has been developed upon the foundation of the vessel traffic system (VTS), allowing the operator to display radar eco on the monitor screen the electronic sea map (ECDIS) of the coastal region, the harbor and harbor bay areas, in crisp, clear color display for monitoring the interactive boat movements at navigation courses and at sea, effectively monitoring and managing of ships sailing at sea. It greatly improves the operating modes of conventional radar systems that are marred by the deficiencies of radar echoes that are difficult to discern and study, and rely largely on the operator's experience accumulated over time to discern the target and topographical location.

Relevant equipment and framework of the overall duty command center system comprise of the alert integration server, record reset server, operator workstation among others; the alert integration server comes with functions of a multiple target linkup, inter-radar target shifting, target monitoring alert, system surveillance, system timing synchronization; the record reset server records and stores relevant system server information, target echo data, data retrieval and reload; the operator workstation serves as a working platform for radar operators, which comes with functions of a Chinese interface, sea map display, target alert, target simulation, and supports remote control, area radar activation, environmental detection by any operator station within the duty command center, as well as provides a one-to-one, and one-to-multiple workstation operating modes for accessing the front-end radars. In the meantime, each duty command center is capable of simultaneously monitoring and tracking over 1,000 targets at sea.

3. Coast Guard radar information system portal - radar display system
The "Coast Guard radar information system portal - the radar display system" has been built upon the 2001 Coast Guard infor-



統、本署數位中繼式無線電通訊系統之載具定位資訊等，以及鏈結中央氣象局之氣象等資訊，以共同系統顯示畫面，顯示相關海面目標動態資訊，將海面目標動態、歷史航跡以及與勤務有關之相關資訊加以顯現，並提供使用者自行依據轄屬之地區特性，自行設定威脅與告警之參數條件，協助各級主官獲得當面海上目標活動狀況並做為勤務運用決策下達之參考依據。

雷情顯示系統為本署各級單位共同獲得即時海面動態資訊之主要資訊系統，本系統以網際網路地理資訊系統（Web GIS）為顯示基礎平台，將各岸際雷達所偵獲之目標動態資訊，結合電子海、陸圖顯示於相對之地理位置，使各單位使用者明確了解靜態地理資訊與動態目標活動情形；系統並提供繪圖、標示、定位、座標轉換等使用者依據個人需求自行設定功能選項，在本署海巡資訊骨幹網路所及之服務範圍，使用者可依個人之使用權限登入使用，獲取相關海面動態資訊。

此外，系統結合本署安檢資訊系統之船隻出港資訊，當勤務指揮中心雷達操作人員所獲目標經確認並輸入漁船統一編號（商、貨輪船則輸入傳之名稱）後，使用者經雷情顯示系統，查詢安檢資訊系統之出港資訊後，可將該目標之出港日期、時間、出港位置、相關船隻基本資料顯示於系統畫面中。

參、運用成效

本署岸際雷達系統自 93 年元月完成建置啟用後，對於本署對於海域執法、救難及服務等多有成效，諸如監看海面即時目標動態、近海海事糾紛、協助查緝走私偷渡、支援防疫工

mation system (CGAIS) framework, through an overall development of a radar information gathering, sorting, storage, management, analysis and display functions, which also integrates to relevant data on the administration's duty application system that has already been installed and running, such as the security inspection information system, the Maritime Patrol Directorate General satellite vessel position monitoring/control information system, the Administration's relayed wireless communication system of carrier positioning system and so forth, as well as streamlined to the Central Weather Bureau's meteorological information, using system shared display screens for prompting relevant sea target movement information, prompting interactive sea target movements, history navigation routes and duty related information in one. It also provides the user with programmable regional characteristics charts, programmable threat and alert reference parameters that would serve as a reference point for higher officers of all levels in deriving the latest sea target activity status and for duty implementation decision.

The radar display system serves as a main information system for administration units on all levels, through which to jointly derive real-time sea surface activity information; the system utilizes the World Wide Web Internet geography information system (Web GIS) as the display foundation platform that fully integrates interactive target information gathered by various shore-range radars and project the relative geographical locations combining the electronic sea, land maps, allowing all unit users a clear understanding of the stationery geography and interactive target movement status. The system also provides graphic charting, coordinate marking, positioning, coordinate conversion functions, which the user may define the function and menu choices according to individual requirements. Under the Administration's Coast Guard backbone information network and the range of services that it provides, the user can access the system through individual clearance to derive interactive sea surface information.

In addition, as the system is integrated to the administration security inspection information system's vessel incoming/outgoing information, when duty command center operator confirms a target received and keys in a uniformed fishing vessel registration number (or the name of large merchant ships or cargo ships), the user can prompt the system through the radar and inquire for a ship's outbound security inspection data, and prompt a target ship's port departure data, time, point of departure, and relevant vessel information, all within the convenience of the system screen.

Part III Utilization yield

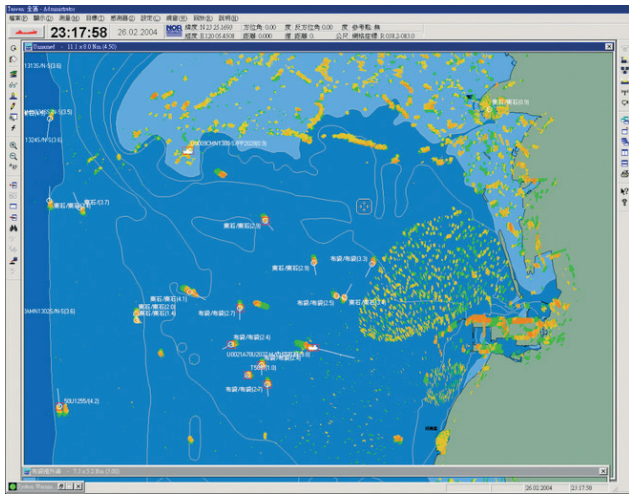
The administration's shore-range radar system, since installed and inaugurated in 2004, has provided significant yield to the Administration's law enforcement at sea⁹, in maritime rescue and services, such as monitoring real time target movements at sea, responding to near-coast maritime disputes, assisting in the crackdown of illicit smuggling, supporting quar-



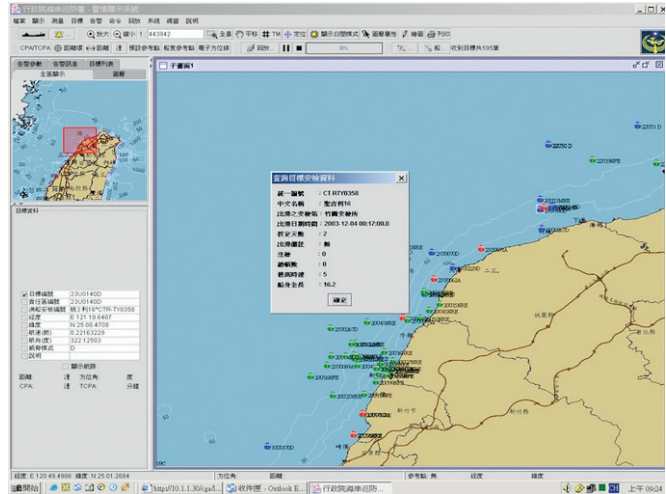
作及支援海難救援等案件處理，有關系統啓用後之岸際雷達系統實際績效摘要表如下。

antine work, support in maritime rescue missions. In a host of case responding; relevant field performance by the shore-range radar system upon its launching is recapped in the table below.

項目 Heading	類型區分 Type classification	案件摘要 Case abstract	備考 Remark
1	監看海面即時目標動 Monitoring real time target movements at sea	提供各級勤指中心全天候對近岸 12 浬目標監控。 Providing the duty centers of all levels round-the-clock target surveillance and monitoring within 12 nautical miles from the shore	
2	近海海事糾紛處理 Near-sea maritime dispute settlement	93 年 1 月 12 日屏東籍漁船遭外籍商船撞沉，協助高雄港務局調查。 Jan. 12, 2004 - Assisting in the investigation by the Kaohsiung Port Authorities in the capsized incident of Pintung-based fishing vessel impacted by a foreign merchant ship	
3	協助查緝走私偷渡 Assisting in the crackdown of trafficking and smuggling	92 年苗栗通宵沿海偷渡事件。 2003 - the coastal trafficking incident in Tungshiao, Miaoli 93 年 1 月 7 日金門查獲兩名台籍偷渡客，其中一人為公務員。 Jan. 7, 2004 - The trafficking incident of two Taiwanese (mainlanders) found in Kinmen, one being a civil servant 93 年 1 月 14 日金門查獲大陸高接梨穗。 Jan. 14, 2004 - Mainland hybrid pears found in Kinmen 93 年 1 月 15 日金門緝獲六名上岸採貝大陸漁民。 Jan. 15, 2004 - Six mainland fishermen gathering clams arrested ashore Kinmen 93 年 2 月 2 日金烈水道攔截兩艘大陸走私船，查獲上千公斤走私大陸農產品及花燈，並逮捕犯案的大陸廈門漁民。 Feb. 2, 2004 - Two mainland trafficking boats intercepted in the Kinmen navigation courses, yielding up to thousand kilos of mainland agricultural produce and lanterns, arresting involving mainland fishermen from Xiamen 93 年 2 月 23 日宜蘭地區查獲走私鱉蛋、牛蛙。 Feb. 23, 2004 - Illicitly smuggled eggs and bull frogs intercepted in the Ilan area 93 年 2 月 29 日金門岸巡總隊淨海專案查獲私貨 33 種、735 公斤，市價達一百多萬元。 Feb. 29, 2004 - An illicit goods crackdown by the Kinmen Coast Guard head quad, yielding 33 varieties of goods, valued in excess of \$1 million. 93 年 2 月 27 日第四岸巡總隊與第十三海巡隊共同緝獲「通順輪」走私洋煙案。 Feb. 27, 2004 - A cigarette smuggling incident aboard SS Tng Shuen jointly cracked down by the 4th Coast Guard head squad and the 13th Maritime Patrol squad 93 年 5 月 21 日澎湖岸巡隊查獲走私檳榔 May 21, 2004 - Crackdown of betel nut smuggling by the Penghu Coast Guard squad	40 件 / 每月 40 cases / month
4	支援防疫工作 Supporting the quarantine work	93 年 4 月 27 日金門防範 SARS 將八艘過界大陸漁船驅離。 Apr. 27, 2004 - the expulsion of eight trespassed mainland fishing vessels in Kinmen amid the SARS watch	
5	支援海難救生 Supporting maritime rescue	93 年 4 月東港「吉宏輪」海難事件。 Apr. 2004 - the SS Chi Hong maritime incident in Donggang	



● 岸際雷達系統工作畫面
A picture of the shore-range radar system in operation



● 雷情顯示系統與安檢資訊系統出港資訊結合顯示畫面
The radar monitor system and security inspection information system's port departure information combining display images

肆、結語

岸際雷達系統為本署遂行海域執法、海上救難及海事服務各項勤務遂行之主要系統，系統建置完成後，由成效數據顯示，現已為本署各級單位勤務海面動態資訊主要獲得來源，對本署海域執法、救難及服務等，均有顯著的提升。

有關岸際雷達系統成效與功能，除賴本署全體同仁共同努力，強化系統操作訓練之本職學能外，另對於如何結合系統功能與勤務運作流程改善精進之研究，亦為未來本署各項勤務系統發展與精進之議題。

參考資料

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(本文作者任職於海巡署通電資訊處)

Part IV Recapitulations

As the shore range radar system remains a key force in the Administration's maritime law enforcement, sea rescue and maritime service work, following the inception of the system, the performance data show that it has become a main source of information that various Coast Guard units turn to, and has contributed to significantly excel the Administration's law enforcement at sea, sea rescue and service work.

The shore range radar system's performance and functions not only rely on Administration associates' joint efforts to excel the system operating training for securing basic skills but also on refinement studies in terms of how best to integrate the system functions and duty operating procedures, which remains a crucial topic in the Administration's future duty system development and refinement.

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(The author is a officer of Communications, Electronics and Information, the Coast Guard Administration)