3.1 SIGNIFICANT SHIPS

AKIZUKI CLASS DESTROYERS

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The Japan Maritime Self-Defence Force (JMSDF) destroyers *Suzutsuki* (DD-117) and *Fuyuzuki* (DD-118) – respectively the third and fourth members of the *Akizuki* (DD-115) class of generalpurpose destroyers – were both commissioned in March 2014. Together with *Akizuki* herself – commissioned in March 2012 – and *Teruzuki* (DD-116) – commissioned in March 2013 – they completed the four-ship class. The ships were conceived as a new type of 5,000-ton (standard displacement) general-purpose destroyer. They were the first of this type to be ordered by the JMSDF since as far back as the *Takanami* class (DD-110 to DD-114), which were commissioned between 2003 and 2006. In addition to undertaking missions envisaged for previous general-purpose destroyers, the new ships were conceived to meet the requirements of a new operational concept, explained in further detail below.

The lead Japanese *Akizuki* (DD-115) class destroyer pictured in April 2012, shortly after delivery. The latest in a long line of JMSDF general-purpose destroyers, the class incorporates improved local area air defence capabilities to protect specialist air-defence destroyers acting in the ballistic missile defence role. *(Japan Maritime Self Defence Force)*

The Japanese *Hatsuyuki* class general-purpose destroyer *Isoyuki* (DD-127) pictured at Portsmouth UK in July 2013 during a global training deployment. The *Hatsuyuki* class marked a significant departure from older Japanese destroyer designs, not least its use of surface-to-air and surface-to-surface missiles, as well as an integrated command system. It can be regarded as the start of an evolutionary design process from which the current *Akizuki* class can be traced. *(Alexander Waters)*

DESIGN BACKGROUND

The development of modern general-purpose destroyer designs for the JMSDF can be traced back to the Japanese Showa 52 year (1977), when the first member of the *Hatsuyuki* (DD-122) class was authorised.[1] Eventually extending to a class of twelve ships (DD-122 to DD-133) commissioned between 1982 and 1987, the ships marked a significant departure from previous Japanese escort designs. Notably, they added surface-to-surface and (shortrange) surface-to-air missiles to the traditional gunbased armament found on older classes. Moreover, they were able to operate an anti-submarine (sea control) helicopter. Other enhancements included the installation of an integrated combat management system and the use of gas turbine propulsion. The class was the first in a series of general-purpose destroyer designs, viz.:


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The *Akizuki* class is a further evolution of JMSDF general-purpose destroyer designs that include the *Hatsuyuki*, *Asagiri*, *Murasame* and *Takanami* classes. This series of images of *Akizuki* taken in April 2012 depicts the ship's overall configuration to good effect. A high freeboard hull is surmounted by two main superstructure blocks, with the two funnels in between corresponding to the arrangement of the two independent main engine compartments. The four paired panels of the FCS-3A multi-function radar are split between the forward and aft superstructure and arranged so as to provide 360° coverage. Much of the armament is concentrated forward of the bridge, although surface-to-surface missiles are located between the funnels. Although not an inherently

stealthy design, the hull and sides are angled to limit radar reflections, the lattice mast of previous designs has been replaced by a stealthier structure and equipment such as torpedo tubes hidden within the ship's hull. *(Japan Maritime Self Defence Force)*

- *Asagiri* class: Eight ships (DD-151 to DD-158) commissioned between 1988 and 1991.
- *Murasame* class: Nine ships (DD-101 to DD-109) commissioned between 1996 and 2002.
- *Takanami* class: Five ships (DD-110 to DD-114) commissioned between 2003 and 2006.

Of these ships, the last two classes were noteworthy in using vertical launch systems (VLS) for both surface-to-air and anti-submarine missiles.

These four classes' integrated combat capabilities meant that they were well-equipped to expand the previous anti-submarine warfare orientation of older JMSDF escort vessels, being able to perform a full range of surface combatant missions to counter threats on, below or above the water. They can undertake operations in the direct defence of Japan, the surveillance of its surrounding waters and protection of vital trade routes. More recently, missions have expanded to encompass a broader range of international duties. These have included the support of Japanese contributions to global stabilisation and peacekeeping operations, as well as participation in anti-

terrorist and anti-piracy task forces.

A significant development during this period has been the proliferation of various missile technologies, often associated with the changed environment following the end of the Cold War. Of these, the most concerning is, possibly, the much wider availability of ballistic missiles. It is a well-known fact that Japan itself is exposed to the risk of ballistic missile attack. To counter this threat, it was decided to apply upgraded air-defence facilities initially developed by the US Navy to the four Aegisequipped *Kongou* (DDG-173) class air-defence destroyers commissioned between 1993 and 1998. More specifically, this included improvements to the detection and tracking capabilities of the ships' SPY-1D multi-function radar and changes to their weapons-control software to permit the launch of Standard SM-3 interceptor missiles to permit the destruction of ballistic missiles in the exo-atmosphere. The necessary work was undertaken under the FY2004–2007 defence budgets.[2] It was subsequently extended to the two new *Atago* (DDG-177) class Aegis-equipped destroyers that were commissioned in 2007 and 2008.

Although work on developing maritime-based countermeasures to the threat of a ballistic missile attack have therefore progressed steadily, the programme has resulted in the emergence of a significant vulnerability. Whilst the SPY-1D radar that is fitted to current Aegis-equipped ships has excellent capabilities to detect and track both high-altitude and low-altitude targets, there have been concerns over the extent of its ability to undertake both functions simultaneously. As such, an Aegis destroyer undertaking a ballistic missile defence (BMD) role might find itself less able to counter a direct, lowaltitude attack, for example from a sea-skimming anti-ship missile.

It seems that the *Akizuki* class were developed with precisely this scenario in mind. In essence, the new destroyers are equipped to undertake an additional local area-defence role in addition to retaining general-purpose capabilities. As such, they are able to protect ships sailing in consort from air and missile attack as well as providing for their own point defence needs. This local force defence mission contrasts with the role of the specialised airdefence destroyers, which have a wider area-defence focus. This additional role has inevitably resulted in detailed changes in configuration and – particularly – equipment from previous general-purpose destroyer classes.

The *Mursame* class destroyer *Ikazuchi* (DD-107) pictured off the Japanese coast in February 2016 – a snow-capped Mount Fuji is in the background. The overall configuration of the *Akizuki* class is similar to the preceding *Murasame* and *Takanami* class general-purpose destroyers but this resemblance hides some significant differences. In particular, the *Akizuki* class was developed to undertake a local area defence role in addition to retaining GP capabilities. *(US Navy)*

DESIGN CONFIGURATION

The new *Akizuki* class design is typified by the combination of an evolutionary approach to structural design with the incorporation of the latest weapons technology, particularly with respect to sensors and other electronics, as described below. Please refer also to Table 3.1.1 for additional detail.

Overall Configuration: The *Akizuki* class's overall hull design can be traced back to that adopted for the first time in the *Hatsuyuki* class more than thirty years ago and which has been followed – with variations – by all subsequent general-purpose destroyer classes. It provides for a high freeboard by means of a shelter deck arrangement that – in the *Akizuki* class – extends from bow to stern.[3]

In terms of overall layout, the main superstructure comprises a bridge forward, two funnel blocks and a hangar structure aft. There is also a helicopter landing area at the stern. Both the hull and superstructure are inclined to reduce the ship's radar signature. The main mast on top of the bridge has also adopted a stealth configuration – first seen in the *Atago* class – compared with the more traditional lattice structure used in most previous Japanese destroyer classes.

A notable characteristic is the arrangement of the arrays that form the class's principal radar system. The FCS-3A multi-function radar has replaced the conventional rotating arrays found on previous general-purpose destroyer designs. This new system – also

found in an earlier version on the *Hyuga* (DDH-181) class helicopter-carrying destroyers – incorporates four sets of paired fixed panels of two different sizes.[4] Two sets are mounted at 04 deck level on the forward superstructure to cover forward port and starboard quarters; two further sets are located at the same level on the aft superstructure to cover the corresponding areas aft.

Much of the principal armament is located forward of the bridge. This includes a singlebarrelled 127mm Mk 45 gun, a 32-cell Mk 41 VLS and a Phalanx close-in weapons system (CIWS), the latter mounted on a raised platform ahead of the bridge superstructure. Surface-to-surface missile launchers are located in the area between the two funnels and there is an additional CIWS mount on top of the hangar. There are twin torpedo tubes port and starboard in the forward superstructure.

The class's hangar can accommodate up to two helicopters. The flight deck incorporates a Mk 6 recovery, assist secure and traverse system (RAST). This is used to assist the recovery of a helicopter and safely transfer it to the hangar. Ship's boats comprise an 11m work boat located to starboard of the forward funnel and a 7.6m fast rigid hulled inflatable boat (RHIB) located to port of the aft funnel. The boats are hoisted and recovered by means of hydraulic davits.

In the interior of the ship, the superstructure at No. 1 deck level houses officer accommodation. The combat information centre (CIC), communications room, machinery control room, galley and recreational spaces – as well as additional accommodation – are located on No. 2 level, connected by a through-deck passage. The machinery and equipment spaces, as well as magazine and storage areas are located at lower levels, along with some additional accommodation space.

Two views of the second *Akizuki* class destroyer, *Teruzuki* (DD-116), pictured at speed. The class's propulsion system comprises four licence-built Rolls-Royce Spey SM1C gas turbines installed in a COGAG (combined gas and gas arrangement). These produce a maximum speed of 30 knots. *(Japan Maritime Self Defence Force)*

Propulsion: The propulsion system installed in the *Akizuki* class destroyers comprises four sets of Rolls-Royce Spey SM1C gas turbines, which are used under a combined gas and gas (COGAG) arrangement. The turbines drive two shafts fitted with variable-pitch propellers. The propellers are five-bladed skew types, chosen so as to reduce underwater noise. The designed maximum speed is 30 knots.

There are two main engine compartments, each containing two gas turbines and associated reduction gear. Turbines No. 1 and No. 2, which drive the port shaft, are installed in the forward (No. 1) engine room, whilst turbines No. 3 and No. 4, driving the starboard shaft, are located in the aft (No. 2) engine room. One consequence of this arrangement is that the port shaft is longer than the aft shaft. There is a funnel above each of the two engine rooms, from which emissions from the gas turbines are emitted by means of ducts. The two engine rooms are divided from each other by an auxiliary machine room, thereby reducing the risk of loss of propulsion from a single hit. In similar fashion, the three electrical generators that provide power for ship 'hotel' functions are split between the two main engine compartments and the electrical generator room, thereby further enhancing survivability.

As previously mentioned, the machinery control room is located at No. 2 deck level. It contains the main consoles from which ship propulsion, generation and electricity distribution are remotely controlled by means of a platform management system. The machinery control room also acts as the principal damage control centre, acting as a

communications hub from which damage such as fire, flooding, gas escape and bulkhead breakdown can be dealt with promptly and effectively.

ELECTRONIC OUTFIT

The equipment installed on the *Akizuki* class destroyers has been designed to allow them to combine the previous general-purpose destroyer role with the new 'local area defence' mission envisaged for the new design. To meet this combined requirement, the ships are equipped with some of the most sophisticated and modern technology developed by the Japanese defence sector.

Combat Management System: The heart of the *Akizuki* class's war-fighting capabilities is provided by its combat management system (CMS). This integrates the ship's various sensors, communications systems and weapons to allow it to conduct its role as a major surface combatant to maximum effect. The deployment of indigenous combat management systems in JMSDF general-purpose destroyers can be traced to the OYQ-5 tactical information processing and combat direction system, which was first installed in the *Hatsuyuki* class.[5] The OYQ series has since been progressively upgraded to take account of progress in both digital and communications technology, including the use of commercial off the shelf (COTS) equipment.

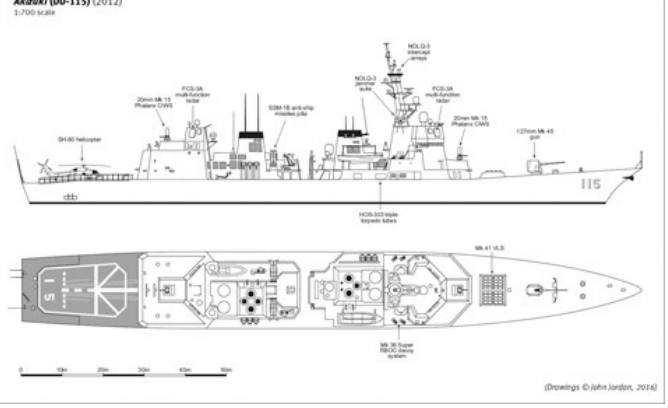
The OYQ-11 system found in the *Akizuki* class is a direct development of the OYQ-10 system installed in the *Hyuga* class. It has a fully distributed architecture and is linked to the ship's various sensors and weapons by the NOYQ-1B integrated ship-wide network. The combination of OYQ-11 and various components such as the FCS-3A firecontrol system, the OQQ-22 sonar system and the NOLQ-3D electronic warfare system provides functionality similar to the US Navy's Aegis. Operator interface is by means of multi-function UYQ-70 consoles. The system incorporates a high level of automation, based on a series of pre-programmed war-fighting rules, to speed response times.[6]

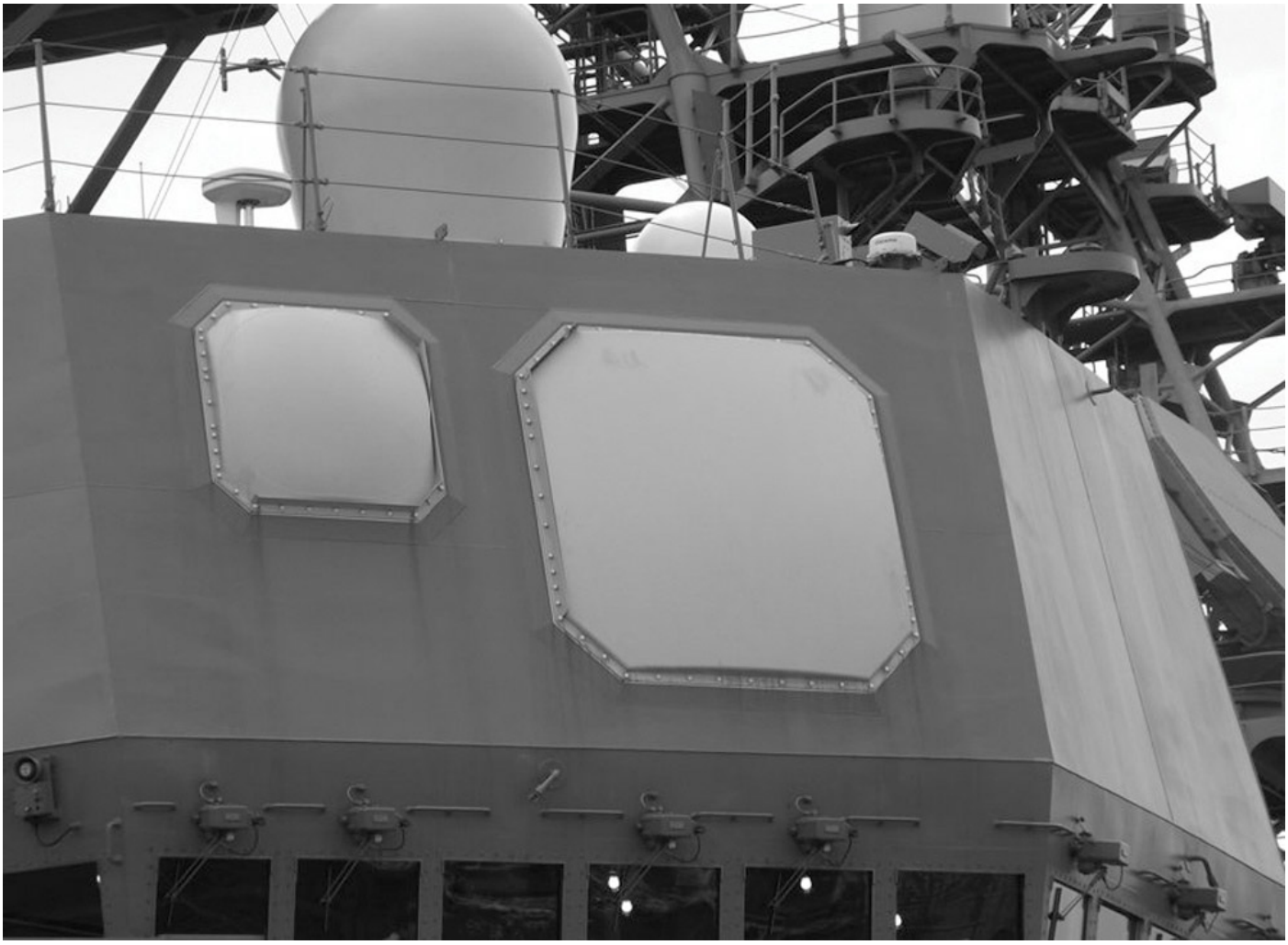
Table 3.1.1.

AKIZUKI (DD-115) PRINCIPAL PARTICULARS

Building Information:	
Fabrication Commenced:	17 July 2009
Launched:	13 October 2010
Commissioned:	14 March 2012
Builders:	Mitsubishi Heavy Industries (MHI) at its Nagasaki shipyard, Japan.
Dimensions:	
Displacement:	5,050 tons standard displacement, 6,800 tons full load displacement.
Overall Hull Dimensions:	151.0m x 18.3m (maximum) x 5.4m. Depth is 10.9m.
Equipment:	
Missiles:	4 x Mk.41 8-cell VLS modules for a total of 16 quad-packed ESSM surface-to-air missiles and 16 ASROC anti-submarine rockets. 2 x quadruple launchers for SSM-1B surface-to-surface missiles.
Guns:	1 x 127mm Mk.45 Mod 4 62-calibre gun. 2 x 20mm Phalanx CIWS. 12.7mm machine guns.
Torpedoes:	2 x triple HOS-303 324mm anti-submarine torpedo tubes for Type 97 lightweight torpedoes.
Aircraft:	Space for two medium (10-ton class) or one heavy (15-ton class) helicopters. 1 x SH-60K sea control helicopter normally embarked.
Countermeasures:	NOLQ-3D electronic warfare suite, including both ESM and ECM. 4 x Mk.137 launchers for SRBOC Mk.36. Type-4 towed decoy system. OLQ-1 torpedo defence system, including Type 1 Mobile Decoy (MOD) and Floating Acoustic Jammer (FAJ).
Principal Sensors:	1 x FCS-3A multifunction radar. 1 x OPS-20C navigation radar. 1 x OQQ-22 integrated sonar suite, including OQR-3 towed array.
Combat System:	OYQ-11 advanced combat direction system. Comprehensive communications system includes Links 11 and 16.
Propulsion Systems:	
Machinery:	COGAG. 4 x RR Spey SM1C gas turbines each rated at c. 12MW total produce up to 64,000shp through two shafts.
Speed:	Designed maximum speed is 30 knots.
Other Details:	
Complement:	A typical crew comprises c. 210 personnel.
Class:	Four ships have been constructed: *Akizuki* (DD-115), *Teruzuki* (DD-116), *Suzutsuki* (DD-117) and *Fuyuzuki* (DD-118).

Note:
The ships completed after *Akizuki* have a slightly higher standard displacement and are equipped with the indigenous Type 07 variant of ASROC.





The main radar system on the *Akizuki* class is the indigenous FCS-3A, a development of the FCS-3 system installed in the *Hyuga* class. It comprises four pairs of fixed panels, one pair above the bridge being shown here. *(Tomohiko Tada)*

Radar Equipment: The principal radar system found onboard *Akizuki* and her sisters is the multifunction FCS-3A, sometimes claimed to be the most advanced radar system in the world. An example of the latest generation of active phased arrays, the FCS-3A is the core component of the Type 3A antiair warfare defence system. As previously mentioned, the radar itself is an improved version of the FCS-3 system fitted to the *Hyuga* class.

Initial research and development work on the FCS-3 system was initiated by the Technical Research and Development Institute (TRDI) of the Japan Defence Agency (now the Japanese Ministry of Defence) during the 1980s. A development prototype was subsequently mounted on the trials ship *Asuka* (ASE-6102) during the 1990s. Production of the radar was assigned to Mitsubishi Electric Corporation.

Fuyuzuki (DD-117) entering harbour in wintry conditions; the helicopter-carrying destroyer *Hyuga* (DDH-181) can be seen undergoing maintenance in the background. The image shows the ship's stern arrangement, including the trumpet-like horns for the Type 4 towed torpedo-defence array to starboard. Also evident is the asymmetrical arrangement of the hangar doors and the rear panels for the FCS-3A radar system. *(Japan Maritime Self Defence Force)*

As installed in the *Hyuga* class, the FCS-3 system includes four large antennae mounted on the superstructure to provide 360° coverage in similar fashion to the SPY-1 panels associated with the US Navy's Aegis. Each of the four arrays operates in the 4,000–8,000 MHz US Navy C (NATO G/H) band and comprises numerous transmitting/receiving (Tx/Rx) modules formed from gallium arsenide (GaAs) semiconductors. These arrays are used to form electronically-controlled beams to search for, detect and track potential targets.[7] There are also four smaller arrays, operating in the 6,000–11,000 MHz US Navy X band (NATO I/J band), that are used as fire-control radars for the semi-active homing Evolved Sea Sparrow missiles (ESSM) that comprise the principal air-defence armament.[8]

A detailed view of the forward superstructure of *Teruzuki* showing the paired arrays of the FCS-3A radar system. The larger arrays work in the NATO G/H bands to search for and track potential targets; the smaller arrays undertake fire control functions and operate in the higher definition NATO I/J bands. *(Tomohiko Tada)*

The FCS-3A variant of the system installed in the *Akizuki* class incorporates significant enhancements over the earlier FCS-3 version, extending its detection and tracking range whist improving its performance in overcoming sea- and land-based clutter when operating in coastal waters. The improvements to range were achieved by exchanging the conventional GaAs modules used in the original system for semiconductors formed from gallium nitride (GaN) to increase output power. The enhancements in coastal performance are due to the development of enhanced signal processing algorithms. Additional software improvements also allow the FCS-3A system to control the ship's main 127mm gun as well as its surface-to-air missiles.

Given the primary radar system's multi-function capabilities, there is no need for additional arrays such as those for surface search. However, an OPS-20C radar system is shipped for navigational purposes and this can also be used to monitor surface targets at close range. It comprises two small rotating antennae – a main array and a smaller subsidiary antenna – located on the mast.

This view of the forward superstructure of *Teruzuki* shows some of the countermeasures equipment fitted to the class. The ESM elements of the NOLQ-3D electronic warfare suite are fitted on platforms towards the top of the mast whilst two

hexagonal box-like ECM jammers are fitted on sponsons at the mast's base. Also visible at a lower level are two sixbarrelled Mk 137 launchers for the Mk 36 SRBOC decoy system. *(Tomohiko Tada)*

Electronic Warfare Equipment: The *Akizuki* class's integrated NOLQ-3D electronic warfare suite encompasses both electronic support measures (ESM) and electronic countermeasures (ECM). The main ESM detection equipment is positioned towards the top of the mast, with two ECM jammers located to port and starboard of its base at No. 5 deck level. The system is complemented by two pairs of six-barrelled Mk 137 decoy launchers for the Mk 36 Super Rapid Bloom Offboard Countermeasures (SRBOC) decoy launching system, which can fire both radio wave distorting chaff and infrared decoys.

Sonar Equipment: In addition to their air-defence role, the *Akizuki* class's general-purpose configuration also means that the ships must be well-equipped for anti-submarine warfare. This requires incorporation of both a hull-mounted and towed array sonar in the design. The hull sonar installed in the class is an OQQ-22, a modified version of the OQQ-21 installed in the *Hyuga* class. A large sonar with both active and passive functionality and capable of operation in a range of frequencies, the OQQ-21 was also tested on the *Asuka* before installation in operational vessels. The OQQ-22 variant installed in the *Akizuki* class lacks its predecessor's flank arrays but is paired with an OQR-3 towed array, a development of the system found in previous general-purpose destroyers. The sonar system's processors can also handle signals transmitted, for example, by sonobuoys deployed by the ship's anti-submarine helicopters.

The *Akizuki* class also benefits from a torpedodefence system that is integrated with the sonar system. The new OLQ-1 torpedo-defence system comprises both the Type 1 self-propelled Mobile Decoy (MOD) and the Floating Acoustic Jammer (FAJ). The former is deployed by a quadruple MOD launcher similar to a lightweight torpedo-tube mounting that is enclosed within the ship's superstructure. Launch is by means of compressed air. Each decoy has a diameter of 15.2cm, a length of 100cm and weighs approximately 25kg. The decoy emits an acoustic signal to lure approaching torpedoes away from the ship. The FAJ is deployed from a single launcher on the centreline forward of the second funnel. The launcher can train 130° to port and starboard, has between five and eighty degrees elevation and a maximum projection range in the order of 1km. The decoy falls into the sea on a parachute after flying a pre-determined range and, again, attempts to distract incoming torpedoes by means of an acoustic signal. The *Akizuki* class is also equipped with the Type 4 torpedo-defence towed array that is already operated by the *Hyuga* class and some other ships. It is deployed from two trumpet-like openings on the starboard side of the stern.

Communications Equipment: As might be expected, a comprehensive range of

communications equipment is installed in the *Akizuki* class. Satellite communications systems include antennae for the X band NORA-1C and Ku Band NORQ-1 networks. These connect, respectively, with the Superbird B2 and Superbird C2 satellites. In each case, the relevant equipment is housed in spherical radomes located on the mast and superstructure. In addition, USC-42 satellite communications antennae are fitted to facilitate joint operations with the United States Navy. A further system – the NORC-4B – provides services such as voice telephone, facsimile and data connectivity through the Inmarsat commercial network. The ships are also equipped with a specialised helicopter data link system – ORQ-1C-2 – that is used to exchange data, for example with respect to antisubmarine operations, between the ship and helicopters in flight. The relevant equipment is housed in a radome fitted to a platform towards the top of the mast.

In addition to satellite communications systems, several whip aerials are mounted for radio communications. These are most frequently used to support tactical digital information links, most notably the Link 11 and Link 16 systems used by the United States and its allies.

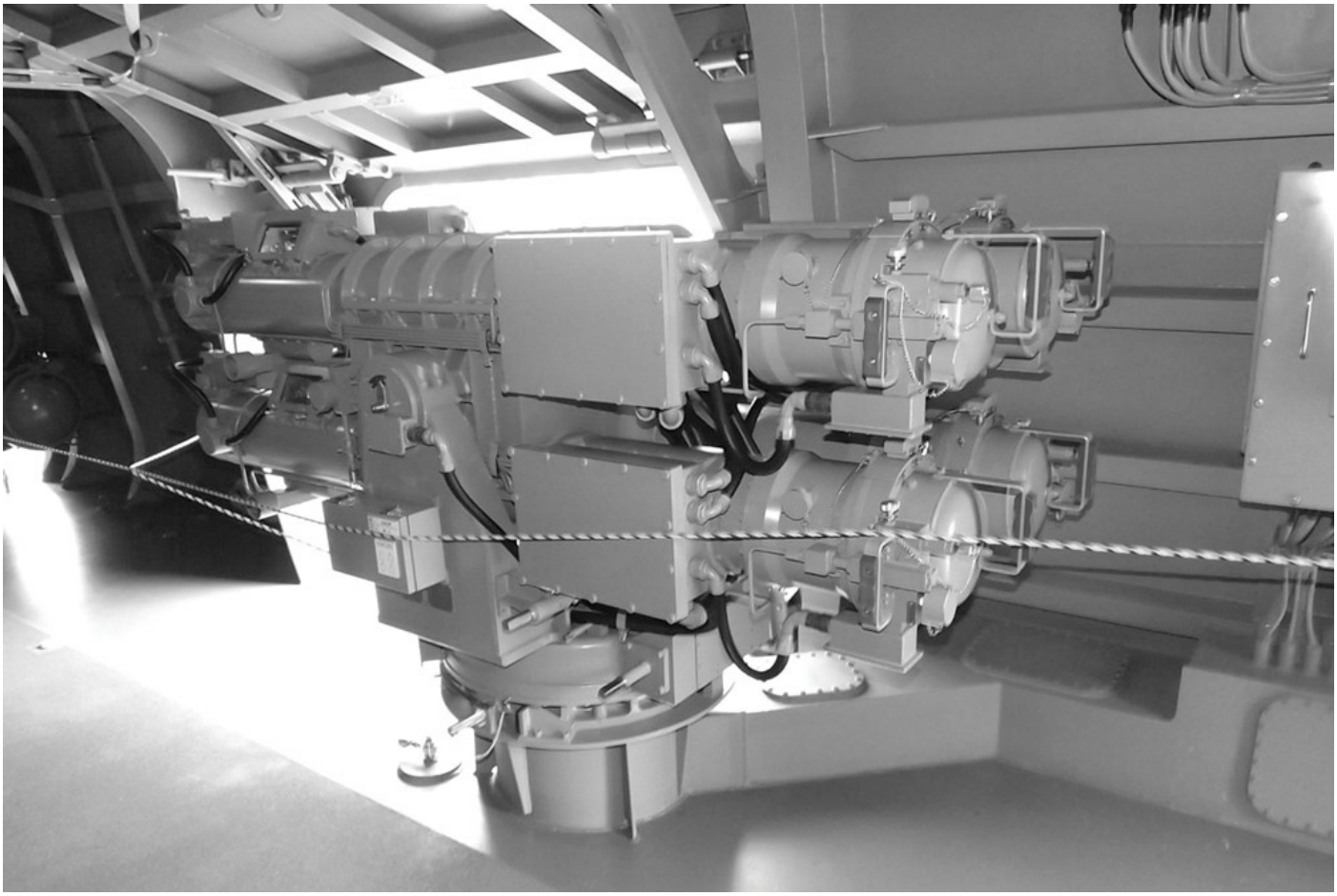
A detailed view of the aft superstructure of *Teruzuki*, showing the rear FCS-3A radar

panels, the aft Phalanx close-in weapons system and some of the equipment used to facilitate helicopter landings. The class is fitted with two Mk 15 Phalanx systems, which are located forward and aft so as to provide 360° coverage. *(Tomohiko Tada)*

WEAPONRY

As for the class's electronics systems, the *Akizuki* class's weaponry is amongst the most modern deployed by the JMSDF. Much of it reflects the strong US Navy influence that is present amongst much JMSDF equipment, albeit a steady process of indigenisation and adaptation to local requirements is also evident.

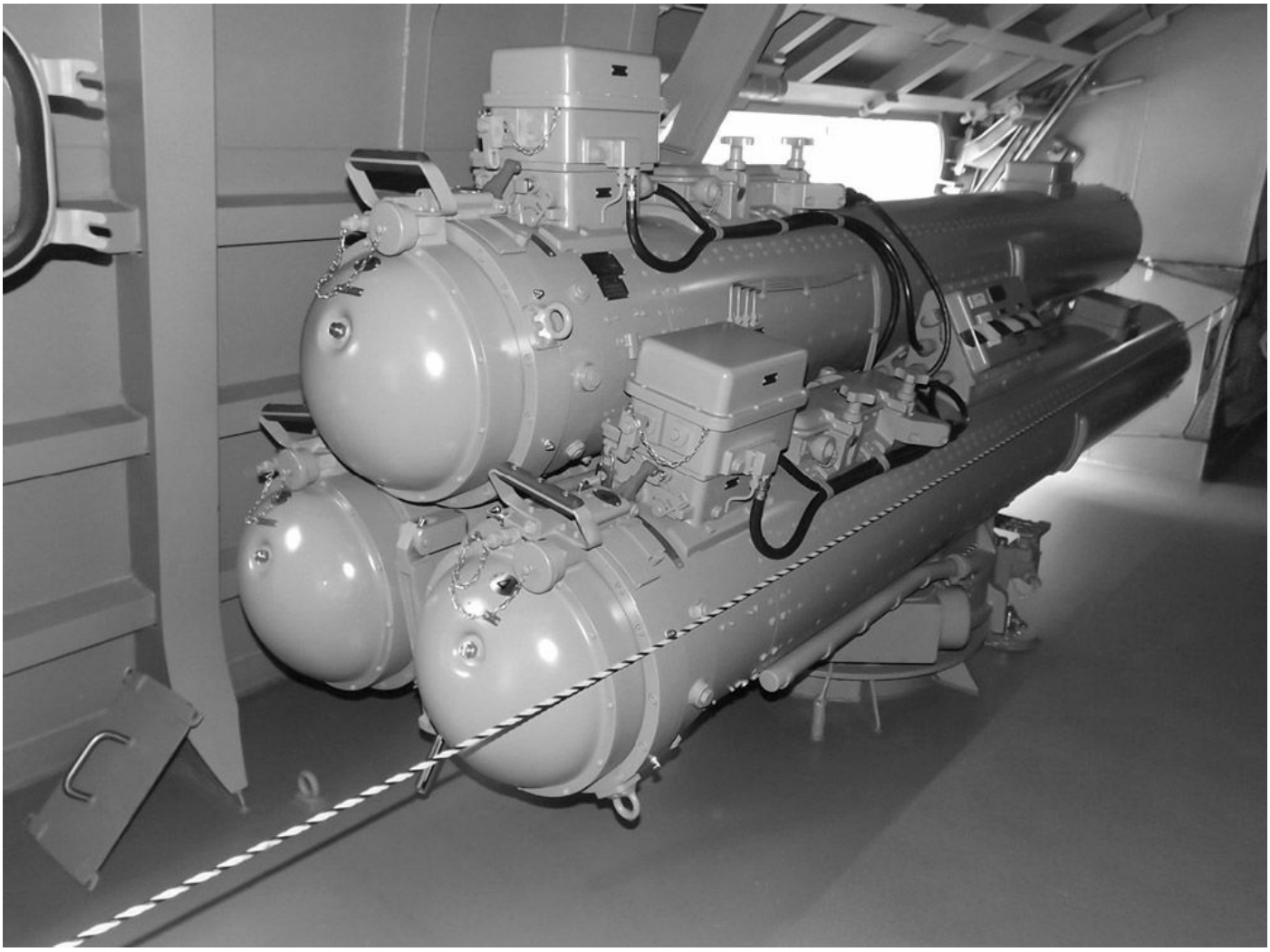
Guns: The main gun – mounted on the class's foredeck – is a 127mm Mk 45 Mod 4 62-calibre singlebarrelled weapon, the latest iteration of a gunnery system first developed for the US Navy in the 1960s. The barrel is eight calibres – roughly 1m – longer than the US Navy's older 54-calibre 127mm weapons and the Italian company Oto Melara's equivalent weapon. The additional length makes the gun more suitable for shore bombardment than previous weapons in the series, extending range from 13nm to 20nm (c. 24km to c. 36km). It also allows for greater precision.



In addition to a Type 4 towed torpedo-defence array, the *Akizuki* class are equipped with a new torpedo-defence system incorporating both the Type 1 self-propelled MOD mobile decoy and the FAJ floating acoustic jammer. These images show the torpedo tube-like launcher for the MOD and the mortar-like launcher for the FAJ. *(Tomohiko Tada, Yasu Osugi)*

Akizuki and her sisters are also fitted with two Mk 15 Phalanx close-in weapons systems, which combine a rotating, six-barrelled 20mm Gatling gun with a small Ku band (12,000–18,000 MHz) target acquisition and tracking radar. One mount is located forward of the bridge and one on the hangar roof to provide 360° coverage. Phalanx was originally developed to provide point-defence against anti-ship missiles but the latest Block 1B variant also has enhanced capabilities against small surface vessels, as well as other asymmetric threats, such as drones.

The class is also capable of using 12.7mm machine guns from mountings that have been prepared on the sponsons that extend from either side of the bridge.



Although they have an important local area air-defence role, the *Akizuki* class retain the powerful anti-submarine capabilities of previous Japanese general-purpose destroyer designs. In addition to embarked helicopters and torpedoes deployed by ASROC rockets, anti-submarine torpedo tubes are also shipped for short-range defence. These images provided a detailed view of the triple HOS-303 torpedo-tube mount and an external view showing the mount's enclosed position within the forward superstructure. The opening on the far left is for the quadruple MOD launcher that forms part of the torpedo defence system. *(Tomohiko Tada)*

Much of the *Akizuki* class destroyers' principal armament is located forward of the bridge, including a long 127mm Mk 45 Mod 4 62-calibre gun and a 32-cell Mk 41 VLS

for ESSM and ASROC missiles. These systems can be seen clearly in this picture of *Teruzuki* entering San Diego on 15 October 2014. *(US Navy)*

Guided Weapons: The *Akizuki* class's guided weapons systems include anti-aircraft, anti-submarine and anti-surface missiles. Of these weapons, the class's surface-to-air missile – crucial for the local force defence mission – is the RIM-162 Evolved Sea Sparrow Missile (ESSM). This was developed by the Raytheon Company for the United States and allied navies. A complete redesign of the original RIM-7 Sea Sparrow series used by the JMSDF since the 1980s, ESSM has a range in excess of 30km, making it suitable for local area defence requirements. On *Akizuki* and her sister-ships, ESSM is fired from the Mk 41 VLS located forward of the bridge. Sixteen of the launcher's thirty-two cells are nominally allocated to ESSMs. Each of these cells is capable of housing four quad-packed missiles, giving a total load-out of sixty-four missiles. In addition to its improved range, ESSM benefits from significant enhancements to guidance technology over its predecessor, including various target illuminations options dependent on the nature of the target and the tactical situation.

The VLS also houses vertically-launched ASROC (Anti-Submarine Rocket) missiles. The nominal outfit is sixteen missiles on the basis of one missile per cell. ASROC is a lightweight torpedo deployed by a solid-propellant rocket that is fired towards the sea area where a submarine detected by sonar is thought to be located. The torpedo separates from the rocket when the target area is reached, descending to the sea by means of a parachute. The torpedo operates as a homing weapon once it has been launched into the sea. The JMSDF originally used the US Navy's ASROC system but – from *Teruzuki* (DD-116) onwards – has now standardised on an indigenous Type 07 torpedo-projection rocket. Similarly, the weapon deployed by the ASROC system is the indigenous Type 97 torpedo.

Indigenisation has also progressed to the anti-ship missile armament carried by the class. Eight Type 90 SSM-1B are mounted in two quadruple launchers installed immediately forward of the second funnel. The SSM-1B missile has a turbojet engine and its maximum range has been reported as being in excess of 100km. The missile is closely related to similar weapons deployed from Japan Self-Defence Forces' land vehicles and aircraft.

Underwater Weapons: The principal anti-submarine weapon deployed on the class is the Type 97 lightweight torpedo. In addition to being utilised in vertically-launched ASROC missiles, these can also be launched from triple HOS-303 mountings that are located in both sides of the superstructure just forward of the first funnel. It can also be deployed by an embarked sea control helicopter.

The Type 97 weapon will soon be replaced by the new Type 12 torpedo, which was developed from the late 1990s onwards by the TRDI under the designation GRX-5.[9] The new torpedo has been specifically designed to have an improved performance in littoral

waters, where there is greater variability in areas such as temperature, water flow, salinity and seabed shape. It retains the propulsion system and warhead of its predecessor but incorporates a new sensor to deal more effectively with these conditions. The signal processing capabilities of the guidance system have also been improved.

Helicopters: The *Akizuki* class ships incorporate a helicopter hangar that is capable of accommodating two medium helicopters (c. 10-ton class) or one larger helicopter (c. 15-ton class). These correspond to the JMSDF's SH-60K sea-control and MCH-101 mine countermeasures and transport helicopters. Either of these types could be embarked depending on operational requirements but the usual complement is one SH-60K helicopter.

Based on the US Navy's Sea Hawk series, the SH-60K was developed as a successor to the SH-60J, with procurement commencing in FY2002. Sensors include a low-frequency dipping sonar, a forwardlooking infrared search and tracking system and an inverse synthetic aperture radar. The main antisubmarine weapons shipped are indigenous Type 97 lightweight torpedoes. These are supplemented with Hellfire air-to-surface missiles and 7.62mm light machine guns to counter a spectrum of hostile surface targets. The SH-60K is also equipped with the Ship Landing Assist System (SLAS). This allows automated landing on the flight deck so as to reduce the burden on a helicopter's pilot during landings at night or in bad weather.

The MCH-101 is based on the Finmeccanica Helicopters (formerly AgustaWestland) AW-101 series. Procurement of the type started in 2003 as a successor to the MH-53E Sea Dragon. In minehunting configuration, it is equipped with a towed sonar and laser scanner to facilitate high-speed searches of suspicious objects.

A view of *Akizuki* taken around the time of her commissioning. She was authorised under the FY2007 construction programme at a cost of c. US$700m and delivered in 2012. *(Japan Maritime Self Defence Force)*

CONSTRUCTION AND DEPLOYMENT

The four ships of the *Akizuki* class were authorised under the FY 2007, FY2008 and FY2009 construction programmes, with two ships being approved in the final year. The lead ship – DD-115 – cost JPY 74,972m or approaching US$700m at then current exchange rates (US$1 = JPY 110). The budget for the next ship amounted to JPY 68,987m, whilst a total amount of JPY 145,101m was authorised for the final pair.[10] Construction of the first three ships was allocated to Mitsubishi Heavy Industries' Nagasaki shipyard, whilst DD-118 was built by Mitsui Engineering & Shipbuilding of Tamano. Assembly of all the ships was completed within three years; please refer to Table 3.1.2 for key construction dates.

On commissioning, one member of the class has been allocated to each of the JMSDF's four, eight ship-strong escort flotillas. These flotillas are subdivided into two equally-sized escort squadrons, with the *Akizuki* class serving in the same squadrons as the *Kongou* class destroyers that are allocated to the ballistic missile defence role. In practice, the ships often deploy independently or as part of smaller groups; they have already operated as far away as the Indian Ocean and off the United States' west coast.

Table 3.1.2: *AKIZUKI* CLASS LIST

NAME	PENNANT	ORDERED	COMMENCED	LAUNCHED	COMMISSIONED	BUILDER
Akizuki	DD-115	FY2007 Programme	17 July 2009	13 October 2010	14 March 2012	Mitsubishi Heavy Industries Ltd, Nagasaki
Teruzuki	DD-116	FY 2008 Programme	2 June 2010	15 September 2011	7 March 2013	Mitsubishi Heavy Industries Ltd, Nagasaki
Suzutsuki	DD-117	FY 2009 Programme	18 May 2011	17 October 2012	12 March 2014	Mitsubishi Heavy Industries Ltd, Nagasaki
Fuyuzuki	DD-118	FY 2009 Programme	14 June 2011	22 August 2012	13 March 2014	Mitsui Engineering & Shipbuilding Co Ltd, Tamano

An image of *Akizuki* after her launch on 13 October 2010. She was built at Mitsubishi Heavy Industries' Nagasaki Shipyard, which was responsible for constructing three out of four members of the class. *(Japan Maritime Self Defence Force)*

Priority given to the expensive task of replacing the first-generation helicopter-carrying destroyers with the new *Izumo* (DDH-183) class has meant that it was not until FY2013 that further generalpurpose destroyers were authorised for the JMSDF. The design of the new 25DD Type – which also carries the 5,000-ton type destroyer designation used for the *Akizuki* class – continues the evolutionary approach adopted in previous generalpurpose destroyer classes. Similarities include continued use of the basic *Akizuki* hull design and ongoing specification of the FCS-3 series as the main radar system. However, it appears that the new class will have a greater orientation towards antisubmarine warfare than the *Akizuki* class. This is reflected in the specification of an innovative combined gas turbine-electric and gas turbine (COGLAG) propulsion system, as well as further enhancements to the sonar suite. It is also hoped that use of COGLAG propulsion will reduce overall life-cycle costs, with the emphasis on economy also reflected in a reduction in the Mk 41 VLS to only sixteen cells and concentration of the FCS-3 arrays on the forward superstructure. The authorised cost of the first unit was some JPY 70.1bn, somewhat less than *Akizuki*. Construction has been entrusted to Mitsubishi Heavy Industries at Nagasaki, with completion scheduled for March 2018. A second ship was included in the FY2014 defence budget.

Suzutsuki and *Teruzuki* pictured fitting out at Mitsubishi Heavy Industries' Nagasaki Shipyard in December 2012. Work on *Teruzuki* was relatively well advanced at this stage; she was commissioned on 7 March of the following year. *(Luck One)*

Fuyuzuki (DD-118) – the last member of the *Akizuki* class to be completed – seen operating with the US Navy aircraft carrier *Theodore Roosevelt* (CVN-71) and the

Indian replenishment tanker *Shakti* during the Malabar 2015 exercises in the Indian Ocean. The *Akizuki* class has already been deployed quite widely as the JMSDF continues to expand international engagements.

CONCLUSION

The *Akizuki* class general-purpose destroyers are now in operational service and ready to perform the extended local area defence mission that is inherent in the new design. The largest and most-capable DD-type destroyers yet to serve in the JMSDF, they are an excellent example of the evolutionary design approach that has achieved significant cumulative progress since the commissioning of the first of the *Hatsuyuki* class a little over thirty years ago.

Notes:

1. The *Akizuki* class destroyers were authorised in the Heisei 19 through to Heisei 21 years so they are referred to as 19DD, 20DD, 21DD and 21DD by the JMSDF. The Japanese Heisei era corresponds to the reign of Akihito, the current Emperor of Japan, which commenced on 8 January 1989. Accordingly, Heisei 19 corresponds to 2007. The previous Showa era relates to the reign of the former Emperor Hirohito between 25 December 1926 and 7 January 1989.

2. Launch tests of SM-3 Block IA interceptor missiles following completion of the necessary upgrade works were carried out in consecutive years from 2007 in the order of *Kongou* (DDG-173), *Chokai* (DDG-176), *Myoko* (DDG-175) and *Kirishima* (DDG-174). The tests were known as Ship Qualification Trials (SQTs) and allocated the numbers JFTM-1 to JFTM-4. During these tests, *Kongou, Myoko* and *Kirishima* were successful in shooting down simulated missile targets. The trial involving *Chokai* was unsuccessful because of problems with the guidance system of the LEAP (Lightweight Exo-Atmospheric Projectile) homing vehicle used in the final interception stage. For further details of the broader US Navy-led ballistic missile defence programme please refer to Norman Friedman's 'Ballistic Missile Defence and the USN' in *Seaforth World Naval Review 2013* (Barnsley: Seaforth Publishing, 2012), pp.184–91.

3. The *Akizuki* class carry a particularly distinctive resemblance to the preceding *Murasame* and *Takanami* classes. However, in addition to being around 1.5m broader than their predecessors, the new ships pay far more attention to stealth than older general-purpose destroyers, including a greater inclination of their hull and superstructure and expanded use of covered deck areas. Another significant difference is the use of propulsion machinery standardised on Rolls-Royce Spey gas turbines compared with the mixed Rolls-Royce/GE gas turbine plant of the previous two general-purpose destroyer classes.

4. The *Hyuga* class was described in the author's '*Hyuga* Class DDH-Type Destroyers: Japan's New Through-Deck Surface Combatants', *Seaforth World Naval Review 2014* (Barnsley: Seaforth Publishing, 2013), pp.88–103. It is interesting to note the considerable commonality in equipment between the two classes in spite of their significantly different roles.

5. The best English language summary of the development of the various combat management systems in the OYQ series is provided in Norman Friedman's *The Naval Institute Guide to World Naval Weapon Systems – Fifth Edition* (Annapolis MD: Naval Institute Press, 2006), p.78. The first systems – designated OYQ-1 and OYQ-2 were installed in the air-defence destroyers *Tachikaze* (DDG-168) and *Asakaze* (DDG-169) in the 1970s. The series has gone through several iterations subsequently.

6. The combination of OYQ-10 combat management system and the various other warfighting systems on the *Hyuga* class is known as the Advanced Technology Combat System (ATECS). ATECS is also often used to describe the similar combination found onboard the *Akizuki* class.

7. The system installed in the *Hyuga* class is also utilised for helicopter flight control.

8. FCS-3 was originally designed to operate with a surfaceto-air version of Japan's AAM-4 active radar guided air-toair missile, which carries its own active seeker for terminal guidance. When this variant was cancelled, the JMSDF had to develop a supplementary illumination system for use with the semi-active ESSM, which needs external radar illumination of the target in an engagement's final phase. It has been widely reported that Japan acquired the intermittent continuous wave illumination (ICWI) subsystem developed by Thales Nederland for their APAR multi-function radar for this purpose.

9. The Type 97 torpedo was previously developed under the designation GRX-4.

10. Data from the White Papers *Defense of Japan* for 1997 through to 1999 (Tokyo: Japanese Ministry of Defence).