The Transformation of the JASDF's Intelligence and Surveillance Capabilities for Air and Missile Defence

Desmond Ball and Richard Tanter

Over the past decade, the Japanese Air Self-Defence Force (JASDF) has undergone an extraordinary transformation with respect to the intelligence and surveillance elements of its air and missile defence capabilities. Advanced sorts of ground-based signals intelligence (SIGINT) and radar systems have been developed and are mostly now operational around the country. Older systems have been extensively upgraded. All of the air intelligence and radar systems have been thoroughly integrated into a single complex, with the radar systems comprehensively networked, and the electronic intelligence (ELINT) collection, early-warning, and aircraft and missile tracking activities coordinated and the intelligence products correlated at several levels. Moreover, the HQ of the JASDF's Air Defence Command has now moved to the HQ of US Forces Japan at Yokota Air Base, providing it with direct access to the US space-based missile launch detection system as well as other US missile defence assets. Many of the new facilities are clearly situated to monitor electronic activity in North Korea and to track North Korean longrange ballistic missiles that might be aimed at or pass over Japanese territory. Others, now emplaced on Okinawa and elsewhere down the Ryukyu Island chain, are part of broader efforts by Japan to expand its collection of electromagnetic signals emanating from China and to strengthen its defences against China's modernising air, maritime and missile forces. The new capabilities should provide Japan with the ability to detect, track and intercept relatively small numbers of long-range (including nuclear-armed) missiles, such as North Korea could launch, with a high degree of confidence. In the case of China, the initial priority is to complete ELINT and radar coverage of Chinese air activities around the islands south of Okinawa. Against Chinese strategic nuclear forces, equipped with a wide array of delivery systems, the situation remains problematic.

Japan's most recent National Defence Program Outline, approved by the cabinet in December 2010, stated that, as one key response to the complex, post-Cold War security environment Japan now faces, upgrading and expanding the Self Defence Force's (SDF) intelligence capacities will be a priority for the government. The Outline commits the SDF in future to "ensure information supremacy through continuous ISR [intelligence, surveillance and reconnaissance] in the country and its surrounding areas".¹ Yet what is most remarkable is that over the past decade the SDF has already very considerably expanded these capacities. This article examines one aspect of those developments to date: the Air Self Defence Force's intelligence and surveillance capacities for air and missile defence.

The Japanese Air Self-Defense Force (JASDF) maintains an extremely comprehensive architecture of ground-based radar and electronic intelligence (ELINT) systems for airspace surveillance, intended to provide early warning of air or missile attacks and to provide tactical intelligence for air and missile defence systems. These systems have been—and continue

¹ Ministry of Defense, National Defense Program Guidelines for FY 2011 and Beyond.

Approved by the Security Council and the Cabinet on 17 December 2010,

http://www.mod.go.jp/e/d_act/d_policy/pdf/guidelinesFY2011.pdf>, p. 10. Note: hard copies of all internet material retained by the authors.

to be—dramatically upgraded and expanded. Several new signals intelligence (SIGINT) stations have recently been established, stretching from Kyushu down to Miyako-jima, at the southern end of the Ryukyu Island chain, more than 2000 km south of Tokyo and about 380 km east of Taiwan. The JADGE (Japan Air Defence Ground Environment) early warning and air defence system is being modernised, with new J/FPS-4 and J/FPS-5 radar systems designed for long-range detection and tracking of ballistic missiles as well as aircraft.²

The JASDF has several organisations involved in the collection and processing of ELINT for both intelligence and early warning purposesincluding Air Information Collection Units, of which Nos. 1, 2 and 3 are at Wakkanai, Nemuro and Okushiri in Hokkaido, other ELINT units associated with JADGE stations, and ELINT ground stations responsible for processing and analysis of ELINT collected by the JASDF's SIGINT/ELINT aircraft. Until recently, the different units reported to different and poorly coordinated agencies, including the Air Defense Command (ADC) at Fuchu Air Base, the JASDF's ELINT processing centre at Hyakuri Air Base, the JASDF's Intelligence Division, and the Air Staff Office at the Ministry of Defense HQ in Tokyo. The process is now much more streamlined, with all the JADGE radar surveillance data and the SIGINT/ELINT collected by the JASDF's SIGINT ground stations and SIGINT aircraft being sent in near real-time to the ADC, which relocated to new facilities currently nearing at Yokota Air Base in March 2012,³ and to the Joint Staff Office at the Ministry of Defense (MoD) HQ, formed in March 2006, for further processing, correlation and analysis.⁴

Known as the BADGE (Base Air Defence Ground Environment) until 2009, the JADGE radar system is being upgraded throughout the country, from Hokkaido (where a new J/FPS-4 system has been installed at Tobetsu) down to Okinawa (where a new J/FPS-5 system is currently being built at Yozadake). However, the JASDF's new SIGINT stations are primarily concerned with intercepting Chinese and North Korean aeronautical and maritime communications and electronic emissions. Two of the four J/FPS-5 radar systems being constructed will be focussed on Chinese missile trajectories and the other two on North Korea.

² In Japanese language official usage the acronym JADGE (pronounced ジャッジ・システム in Japanese) stands for 自動警戒管制システム, which translates directly as "Automatic Warning and Control System", in contrast to the official English language expansion of "JADGE": Japan Air Defence Ground Environment. Similarly, the English "Base Air Defence Ground Environment" stood for 自動警戒管制組織—literally "Automatic Warning and Control Organisation".

³ 'Air Defense Command Commences Operations at Yokota AB', *News*, US Air Force, 29 March 2012, http://www.af.mil/news/story.asp?id=123295956>>.

⁴ On 9 January 2007, the Japan Defense Agency (JDA) was replaced by the Ministry of Defense (MoD).

The North Korean test-launch of a *Nodong-1* intermediate-range ballistic missile (IRBM) in May 1993, and more especially the test-launch of a *Taepodong* inter-continental ballistic missile (ICBM) in August 1998, prompted Japan to embark with increasingly growing enthusiasm on the acquisition of a ballistic missile defence (BMD) system, consisting according to current plans of about 200 *Patriot* Advanced Capability (PAC)-3 interceptors for terminal missile defence and eight *Kongo*-class *Aegis* destroyers fitted with SM-3 missiles for mid-course interception.

The commitment to BMD has also involved the integration of the JASDF's early warning networks, including both its JADGE radar system and its signals interception stations, into the US BMD capabilities, including those developed for defence of the US homeland against missiles whose trajectories pass over or within range of Japan. In the case of the JADGE network, although it had originally been constructed by the US Air Force, the JASDF had through the 1970s, 1980s and 1990s been strongly opposed to sharing it with the United States, only conceding around 2005. Lieutenant General Bruce Wright, commander of both US Forces Japan (USFJ) and the US Air Force's 5th Air Force, based at Yokota Air Base, has described the rapidly growing partnership as "an Air Force alliance".⁵

JASDF COMINT/ELINT/ESM Stations

The JASDF now has at least seven SIGINT stations, the last three of which have been built by Toshiba since 2004. The stations are operated by JASDF Air Information Collection Units and organisationally form the Radio-wave Collection Group of the Air Intelligence Wing (also called the Operational Intelligence Unit), based at the JASDF's Air Defense Command HQ at Yokota Air Base, in western Tokyo. No. 1 and No. 2 Warning Data Processing Units are also based with the Air Intelligence Wing at Yokota. Two of the Air Intelligence Collection Units, No. 1 at Wakkanai and No. 3 at Okushiri, are directly subordinate to the Air Intelligence Wing at Yokota, while the new units in Kyushu and at Miyako-jima report to the 2nd Warning Data Processing Unit at the JASDF's base at Kasuga, near Fukuoka, the HQ of the JASDF's Western Defence Sector, which performs second-echelon processing and analysis while relaying the information to Yokota.⁶

The collection stations are equipped with a variety of HF, VHF, UHF and SHF⁷ antennas for intercepting air communications, providing early-warning

⁵ John A. Tirpak, 'Air Force Alliance for the US and Japan', *Air Force Magazine*, June 2007, http://www.airforce-magazine.com/MagazineArchive/Pages/2007/June%202007/ 0607japan.aspx>.

⁶「航空自衛隊 府中基地」('Fuchu JASDF Base'), Ministry of Defense, <http://www.mod.go.jp/ asdf/fuchu/>; 'Radio-wave Measurement Facility at Miyako-jima: Chinese Military Intelligencegathering', *Okinawa Times*, 24 October 2006; 「春日基地」航空自衛隊 ('Kasuga Air Base JASDF'), Ministry of Defense, <http://www.mod.go.jp/asdf/kasuga/ butaishoukai/index.html>.

Radio frequencies:

of aircraft movements by detecting and tracking their electronic emissions, and collecting electronic intelligence for the development of ESM (electronic support measures) and ECM (electronic counter-measure) systems and techniques. Some of them also have their own associated jamming and other ECM systems. The equipment suites have been called successively J/FLR-2, J/FLR-3, J/FLR-4 and J/FLR-4A 'ground radio-wave measurement systems'. These systems are all manufactured by Toshiba, and they are all still in service.

For example, Toshiba received a contract for 14,542,500 yen in June 2005 for "regular repair" of a J/FLR-2 system.⁸ In May 2006, Toshiba was awarded another contract for 16,905,000 yen for "regular repair" of a J/FLR-2 system.⁹ In August 2006, it received a contract for 3,731,700 yen for "regular repair" of a J/FLR-2 "ground radio-wave measurement system".¹⁰ In May 2007, it received another contract for 15,516,900 yen for "regular repair" of a J/FLR-2 system.¹¹ In February 2007, Toshiba also received a contract for 56,364,000 yen to provide twelve alternating-current motors, described as "components of the J/FLR-2 radio-wave jamming system".¹²

In September 2005, Toshiba was awarded a contract for 23,919,000 ven for "regular repair" of a J/FLR-3 "ground radio-wave measurement system".¹³ In May 2006, it received a contract for 5,565,000 yen for "preliminary surveys" of the "regular repair" requirements of a J/FLR-3 system.¹⁴ In August 2006, it received another contract for 25,823,700 yen for "regular repair" of a J/FLR-3 system.¹⁵ In September 2006, it received a contract for 30,810,150

HF—High Frequency: 3-30 MHz;

VHF-Very High Frequency: 30-300 MHz;

UHF—Ultra High Frequency: 300 MHz -3 GHz; SHF—Super High Frequency: 3-30 GHz.

⁸ 'Table of Contracts, June 2005', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture, Japan Defense Agency.

⁹ 'Table of Contracts, May 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture, Ministry of Defense, <http://www.mod.go.jp/asdf/3dep/sonota/zuikei/riyuu/1805.pdf>.

¹⁰ 'Table of Contracts, August 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture, Japan Defense Agency, <http://www.dii.jda.go.jp/asdf/3depotprocure/sonota/zuikei/riyuu/ 1808.pdf>.

¹¹ 'Table of Contracts, May 2007', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture, Ministry of Defense, <http://www.mod.go.jp/asdf/3dep/koukyou/zuikei1905.pdf>.

¹² 'Information Disclosure on Contracts (Acquisitions, etc), February 2007', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture, <http://www.mod.go.jp/asdf/3dep/koukyou/

zuikei1902.pdf>. ¹³ 'Table of Contracts, September 2005', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture, Japan Defense Agency, http://www.dii.jda.go.jp/asdf/3depotprocure/sonota/zuikei/ riyuu/1709.pdf>.

Table of Contracts, May 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture.

¹⁵ 'Table of Contracts, August 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture.

yen to provide 29 "maintenance ropes", being "components of the J/FLR-3 radio-wave measurement system".¹⁶

HOKKAIDO: WAKKANAI, NEMURO, OKUSHIRI

The Air Information Collection Units at Wakkanai and Nemuro were established in the 1970s. Wakkanai is located at the northwest corner of Hokkaido, about 45 km across the Soya Strait from Sakhalin Island; Nemuro is in the northeast corner, opposite the Northern Territories, occupied by Russia since the Second World War. The primary purpose of these units originally was to collect ELINT on Soviet Air Force activities to provide both tactical intelligence for the JASDF and support for the development of ESM systems for JASDF aircraft. They also intercepted Soviet Air Force communications relating to these activities, such as pilot-to-pilot chatter and ground-to-air orders.

The 1st Air Information Collection Unit at Wakkanai had eighty staff in 1988. These are divided between ELINT operations, conducted at a site just below the BADGE station (formerly called Hill 2 by US Air Force SIGINT personnel, whereas the JADGE station is on Hill 3), and COMINT operations conducted at the JASDF's large SIGINT complex at Hill 1, nearer the point of Cape Noshyappu. While the JADGE station tracks aircraft, the ELINT unit at Hill 2 monitors their radar and other electronic emissions, and the COMINT unit at Hill 1 intercepts their radio communications.

The 2nd Air Information Collection Unit at Nemuro is situated in lush farmland on the northeast side of the township, with the Meiji Peace Park on its southwest side. It has a staff of more than 100, and maintains a complex consisting of an administration and operations building, and six demi-circular radomes, ranging from about four metres to seven metres in diameter, housing parabolic UHF/SHF antennas; a three metre high cylindrical or thimble-shaped dome, housing a UHF antenna; a 6-element VHF DF array and a 6-element UHF DF array; and several other VHF and UHF antennas. Its collection equipment has not changed since 1991-92, when the fifth and sixth radomes were installed.

The JASDF established a third COMINT/ELINT collection station, maintained by No. 3 Air Information Collection Unit, on Okushiri Island in 1991.¹⁷ It is part of a large SIGINT complex located about one kilometre southwest of the JADGE station. Planning for this station began in 1983, and it opened for operations in May 1990, although construction had not yet been completed. Its purposes were reportedly "to monitor Soviet communications in Siberia"

¹⁶ 'Table of Contracts, September 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture, http://www.mod.go.jp/asdf/3dep/sonota/zuikei/riyuu/1809.pdf>.

¹⁷『安保、自衛隊そして憲法と北海度』、日本平和大会北海度実行委員会 (*The Alliance, the SDF, the Constitution and Hokkaido*, Hokkaido Action Committee, Japan Peace Conference, October 1991), p. 14.

and to collect ELINT.¹⁸ It was expanded in 1991-93.¹⁹ It consists of an operations building and thirteen radomes, including a cylindrical one like at Nemuro, measuring from about 3 metres to about 12 metres in diameter. According to a Japan Defense Agency (JDA) advertisement for computer mechanics in 2007, the units at Wakkanai, Nemuro and Okushiri, together with a unit at Misawa, form a Surveillance Intelligence Group.²⁰ Wakkanai, Nemuro and Okushiri units used to report to the Warning Data Unit at Misawa, but it was disbanded in October 2005; the Wakkanai and Okushiri units now report directly to the Intelligence Air Wing at Yokota.

HONSHU: TAKAO-YAMA

It was reported in 1998 that the JASDF also maintained a COMINT unit inside the JADGE station at Takao-yama, on the Shimane-hanto, across the southern part of the Sea of Japan from South Korea, and overlooking the Miho SIGINT station, with its large Circularly-disposed Antenna Array (CDAA).²¹ It presumably monitors air-to-air, air-to-ground and ground-to-air communications associated with the radar findings. As with the Miho SIGINT station, its focus is on North Korean communications.

KYUSHU: SEBURI-YAMA, FUKUE-JIMA

Toshiba received a large contract for a J/FLR-4 ground-based radio-wave measurement facility in 1997.²² On 6 June 2005, it received a contract for 8,295,000 yen for a preliminary survey of the "regular repair" requirements for a J/FLR-4 system.²³ On 27 October 2005, it was awarded a contract for 44,482,200 yen for the "regular repair" of a J/FLR-4 system, to be completed by January 2006.²⁴ On 26 June 2006, it received a contract for 6,669,600 yen for an "RF Tuner Unit" for the J/FLR-4 "radio-wave measurement system", and a contract for 9,267,300 yen for a preliminary survey of the "regular repair" requirements for another J/FLR-4 system.²⁵ In September 2006, it received a contract for 105,244,650 yen for the provision of three

¹⁸ Aviation Week & Space Technology, 19 December 1983, p. 73; Asian Defence Journal, May 1990, p. 107.

¹⁹ 安保、自衛隊そして憲法と北海度』、日本平和大会北海度実行委員会 (The Alliance, the SDF, the Constitution and Hokkaido, Hokkaido Action Committee, Japan Peace Conference, October 1991), p. 14; Edmond Dantes, An In-depth Look at the Asia-Pacific Air Forces and Future Procurement', *Asian Defence Journal*, January 1993, p. 28. ²⁰ 'Computer Mechanic (305-1)', http://www.jda.go.jp/jasdf/asdf/gaidansu/index.htm.

²¹「防衛情報」Der Angriff!メイン掲示板 98.5(5) No.0751-No.0800, ('Defense Intelligence', Der Angriff Main Bulletin Board, 25 May 1998), http://obuchi.naikaku.com/angriff/log/oldmain/03/ na980505.html>.

²²「続・平和立国日本の虚像、松下和也 ('The Pretence of Peaceful Country Japan', Matsushita Kazuya), Janjan News, 27 April 2004, http://www.news.janjan.jp/government/0404/ 0404223500/1.php>.

²³ 'Table of Contracts, June 2005', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture, http://www.mod.go.jp/asdf/3depotprocure/sonota/zuikei/riyuu/1706.pdf.

http://www.mod.go.jp/asdf/3depotprocure/sonota/zuikei/riyuu/1710.pdf>. 25 'Table of Contracts, June 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture,

<http://www.dii.jda.go.jp/asdf/3depotprocure/sonota/zuikei/riyuu/1806.pdf>.

"base-band receiver units" for a J/FLR-4 system, as well as a contract for 4,223,250 yen for "regular repair" of a J/FLR-4 system.²⁶ As would become evident from the subsequent J/FLR-4 program schedule, these contracts related to the development of the J/FLR-4 system and the installation and initial maintenance of the J/FLR-4 facility at Seburi-yama in Kyushu.

The new ELINT/COMINT station was established by the JASDF in 2004-06 at Seburi-yama, home of the 43rd Air Control and Warning (AC&W) Group, and probably the first J/FPS-3 JADGE station to have been converted to a J/FPS-4. The J/FLR-4 SIGINT facility is operated by the JASDF's Air Information Collection Unit No. 4.

Construction of the new facility began in the spring of 2004 and was mostly completed by around May 2005. It consists of a "huge building", located on the western side of the mountain, measuring 20 metres high, 70 metres long, and 30 metres wide, and two large towers with the top five metres enclosed in two-tiered electromagnetically-transparent covers. In the case of the larger tower, the diameter of the lower part of the two-tiered cover is about 14.8 metres and that of the top part is about 11.3 metres; in the case of the smaller tower, the diameters of the two tiers are about 10.5 and 9.3 metres. With a collection of HF, VHF and UHF antennas, the station is reportedly concerned with monitoring Chinese and North Korean signals.²⁷ According to a JDA press release in October 2006, the station was scheduled to become operational in early 2007.²⁸

Data collected at the Seburi-yama SIGINT station is processed and analysed by the 2nd Warning Data Processing Unit (until March 2001 called the Warning Data Unit) at the JASDF's base at Kasuga, and then forwarded to the Operational Intelligence Unit at the Air Defense Command HQ at Yokota.²⁹

The JASDF decided in 2006-07 to establish a SIGINT station on Fukue-jima, off the northwest side of Kyushu, 1050 km southwest of Tokyo.³⁰ It had

²⁶ 'Table of Contracts, September 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture.

²⁷ 'Sehuri Mountain Bases Communications Group', <http://www.peace-fuk.net/sehuri/ sefuri.html>.

²⁸「宮古島に電波測定施設 航空自衛隊分屯基地」('The Radio Measurement System in Miyakojima, JASDF Sub-base'), *Ryukyu Shimbun*, 24 October 2006, <http://ryukyushimpo.jp/news/ storyid-18270-storytopic-3.html>.

²⁹ 'Radio-wave Measurement Facility at Miyako-jima: Chinese Military Intelligence-gathering', Okinawa Times, 24 October 2006. See also 'Kasuga Air Base', JASDF, <http://www.mod.go.jp/ asdf/kasuga/butaishoukai/index.html>.

³⁰ The Fukue-jima Detachment Sub-Base is sometimes referred to as the Miiraku base, after the name of the village close by. The facility sits at the top of a hill known as Higashi no Dake, which was an observation site during the Russo-Japanese War as well as the Pacific War. See Nagasaki Peace Committee, 「京ノ岳監視所: 住民が24時間警戒」('Higashi no Dake Observation Post: Locals Kept a 24 Hour Watch'), http://www.nagasaki-np.co.jp/peace/2005/kikaku/03/07.html.

initially considered three candidate sites, comprising Shimokoshiki-jima and Okino Erabu-jima as well as Fukue-jima.³¹ On 4 November 2006, the JDA announced that the selection had been narrowed to two sites, Fukue-jima and Shimokoshiki.³² It announced the decision to proceed with the Fukue-jima site on 6 March 2007. The *Sankei Shimbun* reported that it was another "electromagnetic surveillance facility to monitor Chinese military activity".³³ In January 2009, a Chinese report said that construction of the new listening station at Fukue-jima began in August 2007, and that in December 2008 the Ministry of Defense decided to "comprehensively upgrade" the new station.³⁴ According to the Nagasaki Peace Committee, construction was to start in 2011.³⁵ The Ministry of Defence confirmed in its fiscal year 2012 procurement plan that the Fukue-jima station is to be a J/FLR-4A facility, due to open in April 2014.³⁶

ΟΚΙΝΑΨΑ: ΜΙΥΑΚΟ-JIMA

The decision to construct another JASDF ELINT/COMINT collection station on the beautiful island of Miyako-jima was first reported in November 2004. These reports said that a "communications intelligence team" was to be dispatched to the island, and that the purpose of the station was "to intercept and handle communication signals of Chinese warships and aircraft".³⁷ The same reports said that the JDA "believes that a station on Miyako Island is not enough, and another one must be added at a southwest island to intercept and decode the rival's radio communications signals".³⁸ About 100

 ³¹ 'The Ground Radio-wave Measurement System in Nagasaki, Response to Military Threat of China', Sankei Shimbun, 7 March 2007, <http://www.sankei.co.jp/seiji/seisaku/070307/ ssk070307000.htm>; 'Japan Increases Surveillance of China', *Taipei Times*, 8 March 2007,
 http://www.taipeitimes.com/News/world/archives/2007/03/08/2003351427.
 ³² 'East China Sea Radio-wave Detection Increase: Collection of Chinese Information

³² 'East China Sea Radio-wave Detection Increase: Collection of Chinese Information Strengthened', *Sankei Shimbun*, 5 November 2006, http://sankei.co.jp/news/041105/morning/05iti001.htm.

³³ 'The Ground Radio-wave Measurement System in Nagasaki, Response to Military Threat of China', *Sankei Shimbun*; 'Japan Increases Surveillance of China', *Taipei Times*.

³⁴ 耀龙 「日媒及专家极力渲染中国潜艇、战机威胁:日扬言可攻击中国舰船

国防时报」国防时报数字报刊 (Yao Long, 'Japanese Media and Experts Try Hard to Exaggerate the Threats of Chinese Submarines and Aircraft'), *National Defence Journal*, 10 January 2009, http://gfsb.newssc.org/html/2009-01/10/content_399901.htm.

³⁵「福江島にスパイアンテナ装置建設へ」Peace Papers, ながさき平和委員会 ('Spy Antenna Construction Equipment to Fukue-jima', Peace Papers, Nagasaki Peace Committee), 30 November 2010, http://www7b.biglobe.ne.jp/~chi-tan/news/ news101130.html>.

 ³⁶「平成24年度調達予定品目(中央調達分)電子音響課」('FY2012 Procurement Plan Items (Central Procurement), Electronic and Acoustic"), Equipment Procurement and Construction Office, Ministry of Defence, http://www.epco.mod.go.jp/supply/jisseki/choutatuyotei_dennon.pdf.
 ³⁷ 'Japan Intends to Set Up Intelligence Station at East China Sea', *People's Daily Online*, 9

 ³⁷ 'Japan Intends to Set Up Intelligence Station at East China Sea', *People's Daily Online*, 9
 November 2004, http://english.peopledaily.com.cn/200411/09/eng20041109_163229.html.
 ³⁸ Ibid.

million yen was included in the fiscal year 2005 defence budget for "system design expenses" relating to the Miyako-jima station.³⁹

Construction of the station at Miyako-jima began on 23 October 2006.⁴⁰ A large area had been cleared and levelled by February 2007, and construction of the new barracks building was underway.⁴¹ It is officially called a Land Radio Wave Measurement Facility, and is located in Nobaru village in the Ueno area. The *Yomiuri Shimbun* reported on 24 October that the new station would collect both ELINT and COMINT concerning Chinese air activities, and that data would be used to develop electronic countermeasures (ECM). It said that:

The facility is expected to collect electronic information such as radar signals and radio transmissions. It will analyse the data to enhance its understanding of the behaviour and capabilities of other countries' aircraft. The government will also use the accumulated data to help it draw up effective measures to prevent other countries from using radar and other electronic devices.⁴²

A JASDF official said: "All around Japan we need to know what is happening and be ready to catch the information".⁴³

Miyako-jima is located about 180 km east of islets claimed by both Tokyo and Beijing, called the Senkakus in Japanese and Diaoyu in Chinese. On 25 August 1995, the JADGE radar station at Miyako-jima detected two aircraft flying close to the Senkaku Islands, in apparent violation of Japanese airspace; they were believed to be Chinese Air Force Su-27s fighters, but this was not confirmed.⁴⁴

The 2006 defence budget contained 2.4 billion yen for "building new base facilities, barracks and equipment" at Miyako-jima. The prime contract was awarded to Toshiba in Tokyo for J/FLR-4A "terrestrial radio wave measurement equipment".⁴⁵ Another 2.5 billion yen for the J/FLR-4A

³⁹ 'Radio-wave Measurement Facility at Miyako-jima: Chinese Military Intelligence-gathering', *Okinawa Times*, 24 October 2006.

⁴⁰ Ibid.

⁴¹ 'Miyako Jima: Base Update', 23rd-Det. 1, AC&W Squadron Frank Odell,

http://www.geocities.com/fodellus/91miyako-01.html

⁴² 'Info Gathering Boost Eyed for East China Sea', Yomiuri Shimbun, 24 October 2006, http://newsonjapan.com/cgi-bin/news/link.cgi?ID=40203. See also 'Japan to Deploy New Radar to Monitor Chinese Activity', *International Herald Tribune*, 23 October 2006. ⁴³ Wivelo to Hert New Suprime Stations', *International Herald Tribune*, 26 October 2006.

⁴³ 'Miyako to Host New Surveillance Station', *JapanUpdate.com*, 26 October 2006, ">http://www.japanupdate.com/?id=7174>.

⁴⁴ 'Archive: A Chronology of News Events, January-September 1995', Ryukyu-Okinawa History and Culture Website, http://www.niraikanai.wwma.net/pages/archive/chron1.html.

⁴⁵「18年防衛費 重要施策を見る」朝雲新聞 ('Important Defence Measures—2005 Budget', *Asagumo News*), 9 March 2006, <http://www.asagumo-news.com/news/200603/060309/ 06030904.html>; 'Miyako to Host New Surveillance Station', *JapanUpdate.com.*

"ground radio-wave measurement system" at Miyako-jima was also included in the 2007 defence budget.⁴⁶

The JASDF station at Miyako-jima stretches along a ridge, 108.6 metres in altitude at its highest point, running from northwest (where the J/FPS-2 JADGE radar is located) to southeast, roughly parallel to R 201 (between R 78 at the northern end and R 246 along the southern side), in the southern part of the island. The J/FLR-4A facility is located at the southeastern end, directly up the hill from the main entrance to the base. Construction of the new four-storey airmen's barracks was completed in April 2008, at which time the old barracks near the top of the hill at the southeastern end were demolished.⁴⁷ By April 2008, construction of the massive twelve-storey J/FLR-4A main operations building was well underway, with its length running northwest-southeast, in front of the old barracks. By January 2009, construction of this building was nearing completion, with flanking extensions facing north and south added, covering the previous site of the old barracks. Two large two-tiered antenna-bearing towers, southeast of the main building, connected by a roofed walkway, were also nearing completion.

The J/FLR-4A system at Miyako-jima is slightly different to the J/FLR-4 system at Seburi-yama. In the case of the larger tower, the diameter of the lower part of the two-tiered cover is about 17.5 metres and that of the top part is about 10 metres; in the case of the smaller tower, the diameters of the two tiers are about 14 and 12 metres. They are closer in size to the J/FLR system at Wakkanai, rather than to that at Seburi-yama. (A new antenna structure has also been built nearer the northern end of the complex, just south of the J/FPS-2 radome). A photograph of the station taken on 21 June 2009 shows that construction had essentially been completed (although there were still two tall cranes at the site). Two radomes, each about 5.5 metres in diameter, are on the roof of the main building.⁴⁸ The station was scheduled to become operational in 2009-10, and was reported operating in 2012.⁴⁹

In April 2012 the SIGINT facilities at Seburi-yama and Miyako-jima monitored telemetry from the North Korean *Kwangmyŏngsŏng-3* longrange

⁴⁶ 'Radio-wave Measurement Facility at Miyako-jima', Okinawa Times; 'Guidelines for Applicants for Electroacoustic Equipment in Fiscal Year 2007', Equipment Procurement and Construction Office, Japan Defense Agency, http://www.epo.jda.go.jp/supply/kouji/kouzi-dai53go.pdf>. ⁴⁷ 'Miyako Jima: Base Update'.

⁴⁸ 'Travel Note', 21 June 2009, <http://prunus.ti-da.net/e2512977.html>.

⁴⁹「宮古島に電波測定施設 航空自衛隊分屯基地」**琉球新聞** ('The Radio Measurement System in Miyako-jima, JASDF Sub-base', *Ryukyu Shimbun*); 「尖閣漁船衝突事件以降、中国の戦闘機

[・]偵察機の活動が急増」, *Chosun Online*, 28 December 2010, <http://d.hatena.ne.jp/naviarea26-10/20101229/p6>.

missile, although there were delays in passing on the information to ground and sea-based missile defence units. 50

In February 2008, the Ministry of Defense announced that it was tendering for components for a second phase of the J/FLR-4A system being installed at Miyako-jima. The components were to be delivered to the No. 4 Collection Unit's premises at Kasuga by 26 February 2010, for subsequent delivery to Miyako-jima.⁵¹ In January 2009, the Ministry requested bids for components for Part 3 of the J/FLR-4A system at Miyako-jima, to be delivered to the new base by 26 February 2010.⁵² The total budget of the Miyako-jima J/FLR-4A system was approximately 2.6 billion yen.⁵³

Data collected at Miyako-jima will be transmitted to Kasuga for processing and analysis, and then forwarded to the Air Defense Command at Yokota.⁵⁴

A Chinese report also said that

the intelligence listening station in Miyako-jima and the one in Fukue-jima, working in coordination with each other, are able to help the JSDF to monitor the movement of the PLA in the whole East Sea and the Taiwan Strait ... [and that] Japan will rely on the two large intelligence listening stations to focus on the movement of the PLA's vessels and aircraft coming down to the East Sea from the Bohai Sea and Yellow Sea.⁵⁵

In late 2007, the Ministry of Defence requested proposals for prospective contracts for components for a new J/FLR-4A system, presumably for the facility at Fukue-jima; the deadline for submissions was 29 February 2008. The components included omni-directional antenna systems, operations panels, radio receivers, beam-scanning systems, "special purpose

⁵⁰「空自地上部隊が電波を探知 自前の情報生かせず」('ASDF Ground Elements Fail to Capitalise on their Own Signals Intelligence'), *Sankei Shimbun*, 19 April 2012, http://sankei.ip.nsp.com/oplitics/news/120/19/1300002-n1.htm

<http://sankei.jp.msn.com/politics/news/120419/plc12041901300002-n1.htm>.
⁵¹ 'Open Tender for Ground Radio-wave Measurement System J/FLR-4A (Miyako-jima No. 2)', 1
February 2008, http://www.epco.mod.go.jp/kokok/11-481/announcement20080125210841.
pdf>.

⁵² 'Official Announcement No. 400: Public Bid for Ground Radio-wave Measurement System J/FLR-4A (Miyako-jima), Part 3', 22 January 2009, < http://announcement20090109221000.pdf>. ⁵³ 政策評価書 (要旨) (事後の事業評価). 事業名:宮古島地上電波測定装置関連施設整備事業. 担 当部局:経理装備局施設整備課。政策体系 2 - 2 施設整備. 実施時期: 平成 2 1 年 1 2 月 ~ 2 2

年1月. (Post Project Evaluation (Summary) Policy Evaluation Report. Name of project: Miyako-jima Ground Radio Wave Measuring Device, Related Development Projects. Department in charge: Equipment Finance Bureau, Maintenance Division. Policy system 2-2 Facility Development. Implementation period: December 2009—January 2010), Ministry of Defence, http://www.mod.go.jp/j/approach/hyouka/seisaku/results/21/jigo/youshi/09.pdf. ⁵⁴ 'Radio-wave Measurement Facility at Miyako-jima', *Okinawa Times*, op.cit.

⁵⁵ Yao Long, 日媒及**专**家极力渲染中国潜艇、**战**机威**胁**:日**扬**言可攻击中国舰船

国防时报 ('Japanese Media and Experts Try Hard to Exaggerate the Threats of Chinese Submarines and Aircraft').

computers", and signal processing units.⁵⁶ At the same time, the Ministry also contracted for some 165 components of a J/FLR-3 system, comprising a wide variety of antennas, radio receivers, computers and operations panels, suggesting that construction of another J/FLR-3 is also underway. Indeed, thirteen of the contracts were for components for common "J/FLR-4A -3" systems, suggesting that the new J/FLR-4A and new J/FLR-3 are located at the same facility.⁵⁷

In July 2008, the Ministry of Defence requested applications for contracts for another 53 J/FLR-3 components. These were all for equipping an operations room, such as magnetic tape units, disc drives, display screens, network analysers, "record controllers", and keyboards.⁵⁸ They suggest either that the operations room at the original J/FLR-3 station was being substantially refurbished or that J/FLR-3 elements were being installed at one of the new J/FLR-4A stations then still under construction (i.e., Miyako-jima or Fukue-jima).

Through 2008, the Ministry of Defence also issued a series of "guidelines" for applicants for "service contracts" for Toshiba J/FLR-4A systems. One, issued on 21 January, involved "J/FLR-4A system development".⁵⁹ In December 2008, guidelines were announced for "service contracts" for an "Antenna C" and an "antenna element assembly" of a J/FLR-4A system.⁶⁰ Further contracts for a Toshiba J/FLR-4A Ground Wave Measurement System were announced by the MoD on 29 December 2008.⁶¹

AIRBORNE SIGINT/ELINT

The JASDF's airborne SIGINT/ELINT units maintain ground processing and analysis facilities at their respective home bases. For example, the 501st Air Reconnaissance Squadron at Hyakuri Air Base, northeast of Tokyo, which operates the JASDF's seventeen RF-4EJ reconnaissance aircraft, also maintains an ELINT ground processing station at Hyakuri. The RF-4EJs are equipped with ELINT pods produced by Mitsubishi Electronics Corporation (MELCO) and based on the Analyseur Superheterodyne Tactique (ASTAC) system produced by Thompson-CSF in France, which are capable of

⁵⁰ 'Public Announcement No. 352: Guidelines for Applicants of Service Contracts for Communications and Electronic Equipment', Ministry of Defense, 4 December 2008, http://www.mod.go.jp/asdf/3dep/koubooyobikikaku/pdf/201205kouji352.pdf>.

⁵⁶ 'Guidelines for Applicants for Parts for Communications and Electronic Equipment', Ministry of Defense, 9 June 2008, http://www.mod.go.jp/asdf/3dep/koubooyobikikaku/pdf/20kouji1.pdf. ⁵⁷ Ibid.

 ⁵⁸ 'Guidelines for Applicants for Parts for Communications and Electronic Equipment, Fiscal Year 2008', Ministry of Defense, 20 July 2008, http://www.mod.go.jp/asdf/3dep/koubooyobikikaku/pdf/20_kouji171.pdf>.
 ⁵⁹ 'Public Announcement No. 23: Project Completion Guidelines for Applicants of Service

 ⁵⁹ 'Public Announcement No. 23: Project Completion Guidelines for Applicants of Service Contracts for Communications and Electronic Equipment', Ministry of Defense, 21 January 2008, <http://www.mod.go.jp/asdf/3dep/koubooyobikikaku/pdf/20_kouji23.pdf>.
 ⁶⁰ 'Public Announcement No. 352: Guidelines for Applicants of Service Contracts for

⁶¹ 'Public Announcement No. 372: Procurement List', Ministry of Defense, 29 December 2008, http://www.mod.go.jp/asdf/3dep/koubooyobikikaku/pdf/201219Kouji372.pdf>.

detecting, analysing and locating modern threat radars in a dense electromagnetic environment. The pods contain a UHF data-link for air-toground transmission of the intercepted ELINT data to the ground processing station, which enables a very rapid build-up of the electronic order of battle of the observed area. Data are also stored in a recording system in the pod for post-flight analysis at Hyakuri.⁶²

The JASDF JADGE System

The JADGE system was designed in the 1960s to detect, track and identify aircraft approaching Japan's territorial airspace by means of an integrated network of 28 surveillance stations on mountains and hill-tops all around the Japanese coastline. In addition to providing early warning of air threats, they are a fundamental component of Japan's air defence posture, linked directly to fighter aircraft bases and to *Patriot* anti-aircraft and anti-missile missile batteries.

The JADGE system consists of the Combat Operations Center (COC), located at the HQ of the JASDF's Air Defense Command, four Sector Operations Centers (SOCs), the 28 surveillance stations, and associated communications and data links. Many of the JADGE stations have associated ELINT facilities which contribute to both the early warning mission and the preparations for electronic warfare in defence of Japan's airspace. The system has been continually modernised and enhanced over the past three decades, especially with respect to its electronic countermeasures (ECM) and electronic counter-counter-measures (ECCM) capabilities. Many of the sites are now connected to the command and control centres by optical fibre cables as well as satellite communications (Satcom) systems.

The JASDF's Air Defense Command HQ and the JADGE COC are located at Yokota Air Station. However, in October 2005 the JASDF and the US Air Force (USAF) agreed, as part of the US-Japan agreement on the 'U.S.-Japan Alliance: Transformation and Realignment for the Future', to relocate them to Yokota Air Base, in Kanagawa prefecture, about 50 km west of the city, which also houses the HQs of US Forces Japan and the 5th US Air Force Japan, the highest US and USAF HQs in Japan, as part of plans to implement a joint missile defence system. In November 2005, the *Yomiuri Shimbun* reported that the Yokota base "will function as the control center of the missile defence system and other air defence facilities in Japan", and that "it will also play a key role in boosting SIGINT or signals intelligence cooperation between Japan and the United States".⁶³ Construction began in 2007, and an "initial operating capability—a major milestone toward

⁶² Martin Streetly (ed.), Jane's Radar and Electronic Warfare Systems, 1998-99, 10th edition (Coulsdon, Surrey: Jane's Information Group, 1998), p. 436.
⁶³ Martin Sioff (New Janes BMD Dadar Tractic Data and Line in Tractic Data an

⁶³ Martin Sieff, 'New Japan BMD Radar Tracks Russian Missile Test', Space War, 15 November 2005, http://spacewar.com/news/radar-05zb.html.

becoming a full operational headquarters", is expected by "spring 2011", and the newly located ADC commenced operations in March 2012.⁶⁴



Figure 1. JADGE air defence system map

⁶⁴ Major Jason Medina, 'Joint Initiative Transforms Air Defense in Asia', *Air Force Link*, 15 May 2007, http://www.af.mil/news/story_print.asp?id=123053320; 'Air Defense Command Commences Operations at Yokota AB', *News*, US Air Force, 29 March 2012, http://www.af.mil/news/story.asp?id=123295956>.

The four SOCs are located at Misawa, the HQ of the ADC's Northern Defense Sector and also the Northern Aircraft Control and Warning (AC&W) Wing, as well as the 3rd Air Wing and the 6th Air Defense Missile Group; Iruma Air Base, about 20 km northwest of Fuchu Air Station, the HQ of the Central Defense Sector and the Central Aircraft Control and Warning Wing, the HQ of the JASDF's Electronics Development and Test Group, the home base of the JASDF's Electronic Warfare Training Unit, which operates six YS-11E and one EC-1 signals intelligence (SIGINT) aircraft, and the HQ of the 1st Air Defense Missile Group; Kasuga, just south of Fukuoka airport in northern Kyushu, the HQ of the Western Defense Sector, the Western Aircraft Control and Warning Wing, and the 2nd Air Defense Missile Group; and Naha in Okinawa, the HQ of the Southwest Defense Sector, the Southern Aircraft Control and Warning Wing, and the 5th Air Defense Missile Group. The Aircraft Control and Warning Wings use the JADGE data "in identifying targets, allocating targets to combat aircraft or to surface-to-air guided missile (SAM) units and swiftly performing intercept control".65

The ELINT facilities at the JADGE complexes complement the radar systems in the early warning mission. Aircraft approaching Japan's territorial airspace, if using radars, IFF (Interrogation/Identification Friend or Foe) transponders, or emitting some other electromagnetic signal, can be detected at far greater ranges by passive radar-listening facilities than by active radar searches—perhaps more than 800 km, depending on the altitude of the aircraft and the strength of its radar signal or other electronic emissions. In peacetime, the collected ELINT contributes to the maintenance of continuously-updated tables of electronic order of battle (EOB) concerning ground-based and airborne emitters of interest to the JASDF, as well as to the development of electronic support measure (ESM) systems and techniques for countering notional threat emitters. In conflict situations, these ELINT facilities would provide the electronic basis of the air defence of Japan-directing fighter aircraft to intercept attacking aircraft and guiding SAMs to destroy attacking aircraft and air-to-surface missiles, using the imitative transmitters to jam and deceive adversary radars, and winning the ECM/ECCM competition.

The locations and other particular details of the 28 JADGE air surveillance stations are given in Table 1.⁶⁶ Nine are in the ADC's Northern Sector, including six in Hokkaido and three in northern Honshu; eight are in the Central Sector, which covers the central part of Honshu; seven are in the Western Sector, which covers western Honshu and Kyushu, including Tsushima Island; and four are in the Southwestern Sector, stretching down

⁶⁵ Japan Defense Agency (JDA), *Defense of Japan 1990* (Tokyo: The Japan Times, 1990), p. 105.

⁶⁶ Table 1 is available on the *Security Challenges* website,

http://www.securitychallenges.org.au/index.html, under vol. 8, no. 3.

the Ryukyu island chain from Okino Erabu-jima in Kyushu's Kagoshima prefecture to Miyako-jima, about 300 km southwest of Okinawa Island.

Nearly all of the stations were originally established by the US Air Force in the late 1940s and the 1950s; it constructed about fifty sites.⁶⁷ Some of them had been sites of Japanese radars during the Second World War, such as Nemuro, Kyoga-misaki, Kume-jima and Miyako-jima.⁶⁸ They were mostly transferred to the JASDF in 1959-60. The stations in Okinawa were transferred to the JASDF in 1972-73: the last one was Yozadake, in Itoman city, just south of Naha, at the southern-most point of Okinawa Island.⁶⁹ They were equipped with a variety of radar systems, including AN/CPS-1, AN/CPS-5 and AN/FPS-3 long-range search/early warning sets, and AN/CPS-4, AN/TPS-10D and AN/FPS-6 height-finding sets. They often had associated direction-finding (DF) facilities, as at Wakkanai, Mishima Island, Seburi-yama and Okino Erabu-jima;⁷⁰ they were sometimes co-located with SIGINT units. The JASDF stations still use the US unit designations, such as the 18th Air Control and Warning (AC&W) Squadron at Wakkanai, the 45th AC&W Squadron at Tobetsu, the 46th at Sado-jima, and the 19th at Unijima on Tsushima Island in the Korea Strait/Tsushima Kaikyo. For a decade or two they used the US radars, most of them not being replaced with Japanese systems until the 1980s. More recently, in August 2003, a US veteran who was given a tour of Kume-jima found that while the radars and radomes had been replaced, the operations and maintenance areas had hardly changed. He later wrote that "the Ops area itself is the same! I mean exactly. It's like a time warp". The "old plotting boards" were still operational, including "the main board with the island images, and the ADIZ drawn in; the weather board and the 'comm' board", as well as "one of the

⁶⁷ Gene Carlton Smith, 'A Radar Network for Japan—Post WWII', <http://members.aol.com/ gsmithsan/RadarNet.htm>. See also 'Radar Units—So Japan', <http://sojapanradargroup. multiply.com/photos>.

⁶⁸ Japanese General Staff and War Ministry, Operational History of Japanese Naval Communications, December 1941 – August 1945 (Laguna Hills, California: Aegean Park Press, 1985), pp. 117-30.

⁶⁹ 'Minutes of 623rd [ACW] Membership Meeting—1 April 2006', *U. S. Air Force - 623rd AC&W Squadron - Okinawa and the Ryukyu Archipelago*, http://www.623acw.com/bylaws/minutes2006.html.

⁷⁰ Richard E. Waldron, Site 18: Short Stories from an Isolated Air Force Radar Detachment in Japan during the Korean War and the Cold War (Quincy, Massachusetts: Squantam Publishing Company, 2005), pp. 116-7; 'DF and Radar [at] Mishima', http://beta.communities.msn.com, mx/610thACWSqRadarSitesSouthernJapan/det17mishima.msnw>; 'Map of Southern Japan with Detachment Locations', ;">http://groups.msn.com/610thACWSqRadarSitesSouthernJapan/ yourwebpage.msnw>; 'Old DF Van', http://www.angelfire.com/pe/623ACW/det4/032.html. See also 'DF- Mishima', Radar Units—So Japan, http://sojapanradargroup.multiply.com/ photos/album/8/DET_17_PHOTOs_Mishima#> and http://sojapanradargroup.multiply.com/ photos/album/8/DET_17-_PHOTOs_Mishima#photo=5>.

very old black radar scopes". Even "the crummy old broken green tile on the [console] deck [was] still there".⁷¹

J/FPS-1

The first-generation BADGE system involved the J/FPS-1 radar system, produced in Japan by NEC (Nippon Electric Company) and other subcontractors under licence from Hughes Aircraft Company in California, which entered service in 1971. The system was one of the first major post-war Japanese defence programs to be awarded to local industry, albeit in a joint venture with a US company (but with NEC holding 51 percent of the equity). It was selected by the JDA in the Second Defense Buildup Plan (1962-66) to be the highlight, worth a total of nearly 30 billion yen, of the new Japanese industry policy of promoting the development of indigenous defence technology.⁷²

The J/FPS-1 system was installed at seven sites, including Wajima (23rd AC&W Squadron), on the Noto Peninsula, protruding into the Sea of Japan; Otakine-yama (27th AC&W Squadron) and Mineoka-yama (44th AC&W Squadron), across the eastern approaches to Tokyo; Kasatori-yama (1st AC&W Squadron) and Takao-yama (7th AC&W Squadron) in the western part of Honshu; and Seburi-yama (43rd AC&W Group) in Kyushu. They were all replaced by J/FPS-3 systems in the 1990s.

J/FPS-2

The second-generation BADGE system was the J/FPS-2, which was installed at eleven sites from 1979 to 1990. It was developed by NEC, but with extensive collaboration with Mitsubishi Electric, Toshiba and Fujitsu.⁷³ It is a 3-dimensional radar which employs a planar phased array with phase/frequency scanning in elevation and mechanical rotation in azimuth. It reportedly has a maximum range of about 370 km (200 nautical miles).⁷⁴ It

 ⁷¹ John London, 'Addendum to Kume Trip Report—Sept 15, 2004', http://623acw.com/hist/Londonaddendum.html.
 ⁷² Richard J. Samuels, *"Rich Nation, Strong Army": National Security and the Technological*

⁷² Richard J. Samuels, "Rich Nation, Strong Army": National Security and the Technological Transformation of Japan (Ithaca, New York: Cornell University Press, 1994), pp. 165-6. Note a Chinese military source presented a different account: "In order to raise the automated capabilities of air defense systems and their reaction speeds, when setting up BADGE systems, Japan decided to switch to a three coordinate radar. Moreover, beginning in 1962 and onward, they carried out their own test manufacturing of phase controlled arrays and three coordinate technology. In 1964, they test installed antennas. Following that, they test manufactured a successful receiving device, radiating device, and display device, etc. The Sanyo Electronics Company, in 1971, set up the solid state J/FPS-I three coordinate 3D radar. By 1977 they had equipped altogether 7 J/FPS-I radar stations. These radar stations opted for the use of computers to carry out processing. They had automatic altitude measuring capabilities, a search distance of 600 km, and were a great improvement over the previous". Chen Xiaolin, 'Japanese Military Radar Equipment', Foreign Technology Division, CONMILIT, FTD-ID(RS)T-0067-91, 5 June 1991 [US military translation of original Chinese source].

⁷³ Samuels, *"Rich Nation, Strong Army*", p. 315.

⁷⁴ 'Radar Site (J/FPS-2) (1980/Japan)', Harpoon Headquarters,

http://www.harpoondatabases.com/Platform.aspx?DB=3&Type=Facility&ID=661>.

uses advanced digital processing techniques for clutter rejection and ECM (electronic counter-measures)/ECCM (electronic counter-counter measures), enabling it to automatically detect and track aircraft in severe jamming environments.⁷⁵ It is enclosed in a large (12-metre diameter) radome.

The first J/FPS-2 system was installed at Kamabuse-yama, the 42nd AC&W Squadron's base above the city of Ominato, on the Shimokita Peninsula in the northeast of Honshu. The second was installed at Mount Kinpoku on Sado-jima, just off the coast of Niigata City in the Sea of Japan, noted for its extremely harsh winters. The others were installed at Wakkanai, Nemuro (26th AC&W Squadron), Yamada (37th AC&W Squadron), Omaezaki (22nd AC&W Squadron), Mishima Island (17th AC&W Squadron), Uni-jima, Shimokoshiki (9th AC&W Squadron), Yozadake in Okinawa (56th AC&W Squadron), and on Miyako-jima (53rd Squadron). Seven of the original eleven J/FPS-2 stations are still in service, while four of them have been upgraded with the J/FPS-5 system.

J/FPS-3

The third-generation J/FPS-3 system was developed by Mitsubishi Electronics Corporation (MELCO), with extensive participation by NEC. It comprises separate long-range (search) and short-range (height-finding) rotating phased-array radars which rotate at 6 rpm and 15 rpm respectively, housed in a pair of 17-metre diameter radomes, built by Sumitomo Denki. The long-range search radar operates in the L-band (1-2 GHz); it has a detection range of about 650 km for targets at an altitude of 20,000 metres and 390-460 km for targets at 10.000 metres. The short-range system operates at 3 GHz in the S-band, with a range of about 150 km. The system also includes two false (or imitative) signal emitters, a signal processing unit, and an underground control and operations room. Resistance to ECM is achieved by pulse compression, two wide-band frequencies, and low antenna side-lobes, while anti-anti-radiation missiles provide protection against anti-radar missiles.⁷⁶ The first three J/FPS-3 systems were installed at Kyoga-misaki (Kyoto prefecture), Kamo (Oga Peninsula, Akita prefecture) and Otakine-yama (Fukushima prefecture) in 1989-91. Six J/FPS-3 stations were operational by the mid-1990s.⁷⁷ Seventeen J/FPS-3 stations were completed by the end of the 1990s, including the replacements of the seven J/FPS-1s. Kasatori-yama was converted from a J/FPS-1 to a J/FPS-3 system in the 1996-97 budget year.⁷⁸ Seburi-yama was converted in 1998.

⁷⁵ Streetly (ed.), Jane's Radar and Electronic Warfare Systems, 1998-99, p. 26.

 ⁷⁶ Ibid. Note also Chen Xiaolin, 'Japanese Military Radar Equipment': "These radars also include a decoy radiating station approximately 400 meters away from the basic station".
 ⁷⁷ Streetly (ed.), *Jane's Radar and Electronic Warfare Systems, 1998-99*, p. 26.

⁷⁸「航空自衛隊 笠取山分屯基地開庁 5 0 周年記念行事」, 北大路機関 ('Air Self Defense Force Kasatori-yama Base Opening, 50th Anniversary Commemoration Event', Kitaoji Kikan), 25 July 2006, http://harunakurama.blog.ocn.ne.jp/kitaooji/2006/07/post_bdc5.html>.

All of the JADGE stations have two VHF aeronautical-band antenna platforms mounted on large steel towers. One of these antenna sets is used to monitor aeronautical transmissions, including those of hostile or suspicious aircraft, as well as to receive IFF signals from JASDF and other friendly aircraft; the other is for transmitting to JASDF and other aircraft, including relaying of intercept vectors to air defence fighter aircraft.

The JADGE system is comprehensively networked and thoroughly integrated. Each station automatically shares its data, including its radar images, with its neighbouring stations, as well as providing it up the command chain to its Sector Operations Center (SOC) and associated fighter and missile command centres. Each station has a HF radio system, commonly involving a doublet aerial strung between two tall masts. Each station also has at least two pair of large parabolic dishes for VHF tropospheric-scatter radio communications, with an effective range of more than 150 km. The station at Kamo has three pair, directed at Okushiri, Sado-jima and Kamabuse-yama. The station at Kamabuse-yama also has three pair, directed north to Erimo, south to Misawa and west to Kamo. One pair at Yamada is directed at Otakine-yama. A pair of 6-metre diameter tropospheric dishes at Wajima is directed at Kyoga-misaki. At Kyoga-misaki, the tropospheric dishes are located at the 35th AC&W Squadron's HQ on the shore-line down the mountain-side from the JADGE station; one pair is directed north to Wajima and one pair south to Takao-yama. A pair at Yozadake are directed at Miyako-jima. The station at Fukue-jima has two pair of tropospheric dishes built by Nippon Denki; one pair is directed at Unijima and the other at Seburi-yama.⁷⁹ The dishes at Kasatori-yama are J/FRQ-8 systems.⁸⁰ The tropospheric antennas at Sado-jima are mounted on large square supports to withstand the winter weather. Most stations also have microwave dishes either for communicating directly with nearby units or connecting with the national telecommunications network.

In 1987, the JDA announced plans to establish an Integrated Defense Digital Network (IDDN) to provide reliable, secure and survivable communications links between its Central Command Post and major elements of its command, control, communications and intelligence (C³I) facilities, including the JADGE stations. The IDDN involves duplicated microwave (UHF) circuits and satellite communications (Satcom) services.⁸¹ An important feature of the IDDN was its potential inter-operability with US digital networks.

⁷⁹ 長崎平和委員会「福江島分屯」(Nagasaki Peace Committee, 'Fukue-jima Detachment'), http://www7b.biglobe.ne.jp/~chi-tan/miiraku.html.

⁸⁰「航空自衛隊 笠取山分屯基地開庁 5 0 周年記念行事」,北大路機関 ('Air Self Defense Force Kasatori-yama Base Opening, 50th Anniversary Commemoration Event', Kitaoji Kikan), <http://barunakurama.blog.ocn.ne.in/kitaoji/2006/07/post_bdc5.html

http://harunakurama.blog.ocn.ne.jp/kitaooji/2006/07/post_bdc5.html.
⁸¹ Japan Defense Agency, *Defense of Japan 1987* (Tokyo: The Japan Times, 1987), pp. 119-21.

In the early 1990s, the United States provided the JASDF with the Link 11 tactical data link for its JADGE system. The Link 11 uses HF radio (2 to 30 MHz, with a range of up to 300 nm) and UHF FM radio (with a range of up to 25 nm), and is used by the JASDF for exchanging data between the JADGE stations, with the air defence command centres, and with JASDF aircraft (particularly the UHF radio).

In the 1990s and early 2000s, the BADGE stations were all equipped with the US Link 16 Joint Tactical Information Distribution System (JTIDS)/Multifunctional Information Distribution System (MIDS), which provides a secure, jam-resistant, high-speed digital data link in the L-band of the UHF spectrum for exchanging tactical pictures between the stations and fighter aircraft.⁸² Most of the JADGE stations now have UHF or SHF satellite communications (Satcom) systems. For example, there are small radomes, about 3-metres in diameter, housing Satcom antennas at Wakkanai and Kamabuse-yama. The stations on Sado-jima and the island of Mishima have larger radomes with Satcom antennas.

THE J/FPS-4 SYSTEM

In 1998, the JDA announced that ten new J/FPS-3 stations were operational and noted that, as the replacement of the seven J/FPS-1 sites was proceeding, it would be relatively inexpensive to incorporate improvements which amounted to a new J/FPS-4 system.⁸³ Plans for the development of a fourth-generation BADGE system were announced by the JDA in its 'Fiscal Year 1999 Defense Buildup' statement.⁸⁴ In August 2002, the JDA announced its decision to implement a BADGE modernisation program. It stated that:

More than ten years have passed since the initial operation of the BADGE [-3] System in 1989, and the system now requires improvements to its capabilities to keep up with the higher performance of weapons. In order to ensure the continued viability of air warning and control capability in the future, it was decided to modernize this capability by renewing its configuration and components with advanced technologies.

More specifically, a data processing and communication capacity as well as a function to track high-velocity targets will be improved, and the expandability of the system will be enhanced for flexible modifications in the future.⁸⁵

⁸² 'Radar Site (J/FPS-2) (1980/Japan)' and 'Radar Site (J/FPS-3) (2000/Japan)', Harpoon Headquarters, http://www.harpoonhq.com/encyclopedia/HTML_Files/facilites_files/facilites_files/facilites_db/662.htm.

⁸³ 航空自衛隊 '98 空自の勢力と機能 ('Air Self-Defense 98: ASDF Force and Function'), シ リーズ. 最新世界の軍隊 (World Armies Latest—series), <http://www.geocities.co.jp/HeartLand-Suzuran/2319/JapanAirForce.html>.

⁸⁴「平成11年度の防衛力整備」 ('Fiscal Year 1999 Defense Buildup'), Japan Defense Agency, 1999, <http://www.clearing.mod.go.jp/hakusho_data/1999/honmon/frame/at1103010300.htm>.
⁸⁵ Japan Defense Agency, *Defense of Japan 2002* (Tokyo: Urban Connections, 2002), p. 168.



Figure 2. J/FLR-4 SIGINT system at Seburi-yama, Kyushu, October 2010

Figure 3. J/FLR-4 SIGINT system at Seburi-yama, Kyushu, October 2010





Figure 4. J/FLR-4A SIGINT system at Miyako-jima, January 2009

Figure 5. Prototype J/FPS-5 radar system at Chiba



Funds for installation of the first J/FPS-4 system were included in the 2002 budget.86

Conversion from the J/FPS-3 to the J/FPS-4 system involves several enhancements. The most obvious feature is the replacement of the J/FPS-3 search radar and associated radome with the new J/FPS-4 search radar. The prime contract for the design and manufacturing of the new radars was awarded to Toshiba Electro-Wave Products in Tokyo, but major elements were contracted to other companies, including MELCO and Tokimec Inc.

Tokimec Inc. (subsequently using the restored company name of Tokyo Keiki) was contracted to develop a critical component of the search radar, designated the J/FPS-20, under a technical assistance agreement with Raytheon Aircraft Company in the United States.⁸⁷ According to Tokimec/ Tokyo Keiki's Annual Reports, it was initially mainly engaged in research and development work, which was largely completed in fiscal year 2005.88 Subsequently it received contracts for repair and maintenance services. Its Annual Report for the year ended 31 March 2007 noted that it had received an increase in orders for "repairs and spare parts for FPS-4 ground search radar systems".⁸⁹ Components were still being supplied in 2010.⁹⁰

The J/FPS-4 radomes, designated NCW-29/GPS, are built by Sumitomo Electronic Co Ltd. In June 2006, Sumitomo Electronic in Osaka was awarded a contract for 15,960,000 yen for repair of a NCW-29/GPS "hard radome".⁹¹ In July 2006, the JASDF awarded a contract to Sumitomo for 13.23 million yen for repair of another NCW-29/GPS.⁹² Another contract was tendered in October 2007 for the installation of "one [NCW-29/GPS] set", to be completed by the end of August 2009.⁹³

The updating of the J/FPS-3s also involves the addition of a J/FYX-2 program, produced by MELCO, which receives target data transmitted directly from the J/FPS-5s to the J/FPS-3s. In March 2006, MELCO was awarded a 343.35 million yen contract for installation of a J/FYX-2 system at

<http://iapan.people.com.cn/2003/5/21/200352192116.htm>.

⁸⁶「小泉上台后 日本自卫队提高武备悄然坐大」('After Taking Office, Koizumi Quietly Expands Japan's Self-Defence Force, Improves Weaponry'), japan.people.com, 20 May 2003,

⁸⁷ 'Table of Contracts, September 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture.

Tokimec Inc., Annual Report 2006, p. 3, http://www.tokyo-keiki.co.jp/e/pdf/annual2006.pdf>.

⁸⁹ Tokimec Inc., Annual Report 2007, p. 3, http://www.tokyo-keiki.co.jp/e/pdf/annual2007.pdf>. ⁹⁰ Tokyo Keiki Inc., Annual Report 2010, p. 3, <http://www.tokyo-keiki.co.jp/e/pdf/

annual2010.pdf>.

¹ 'Table of Contracts, June 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture.

⁹² 'Table of Contracts, July 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture, http://www.mod.go.jp/asdf/3dep/sonota/zuikei/riyuu/1807.pdf>. ⁹³ 'Official Announcement No. 99', Japan Defense Agency, 11 October 2007,

http://www.epo.jda.go.jp/kokok/11-99/announcement20071012195528.pdf>

an unidentified J/FPS-3 station.⁹⁴ The J/FPS-4 system also has more advanced ECM and ECCM capabilities compared to the J/FPS-3.

Seven J/FPS-3 sites have been completely upgraded to J/FPS-4s. The first three J/FPS-4 stations, which became operational in 2008, were at Seburiyama, in Saga prefecture, Kyushu; Kasatori-yama in Mie prefecture; and Kamo, on the Oga Peninsula in Akita prefecture. The next four, completed in 2008-09, were Wajima in Ishikawa prefecture; Otakine-yama in Fukushima prefecture; Kyoga-misaki in Kyoto prefecture; and Tobetsu in Hokkaido, where the obsolete radar/radome ceased operations in April 2007.⁹⁵ It has been observed that new hemi-spherical radomes have been added at Kamo, Wajima and Tobetsu.⁹⁶

Another six J/FPS-3 sites have also been or are being upgraded with major elements of the J/FPS-4 system, including the installation of a new radar/radome. These are Abashiri, Okushiri, Mineoka-yama, Takao-yama, Fukue-jima and Kume-jima. The modernisation of this batch will mean that all of the original seven J/FPS-1 sites will have been converted to J/FPS-4s. In the case of Abashiri, Google Earth imagery taken in 2003 suggested that new construction was underway at that time. One of the radomes at Okushiri was upgraded in 2004-07. A veteran from Site 29 who visited the base in May 2003 was told that one of the radomes "was scheduled for replacement within the next year or so".⁹⁷ In September 2004, the JDA announced that construction of the new radome would begin before the end of the fiscal year (31 March 2005).⁹⁸ The new radome was officially opened on 3 March 2007.⁹⁹ On 12 March, the Public Affairs Office at the HQ of the Northern Air Defense Force at Misawa advised that the radome pictured on the Home-page of its web-site had been removed.¹⁰⁰ In the case of Mineoka-yama, Google Earth imagery and other photographs taken since 2003 show only a single radome. The second, missing radome may have contained the long-range search radar, made redundant by the success of

<http://www.geocities.co.jp/Technopolis-Mars/9578/cyoutatsu17.html>.

⁹⁷ Nick Gualillo, 'Site 29 Revisited 2003', Air Force Travels Japan-Philippines-US,

<http://www.ehako.com/news/newsbk2/3515_imode_msg.shtml>.
⁹⁹ 'The Mayor's Activities', Okushiri Town Council, 3 March 2007,

⁹⁴ 『特別レポート(2) 契約本部17年度契約実績を読む』 ('Special Report (2) on FY2005 Contracts, JDA Supply Contract Headquarters'), Missiles and Arms,

⁹⁵ Ministry of Defense, 'Overview of Japan's Defense Policy', <http://www.mod.go.jp/e/d_act/ d_policy/ pdf/english.pdf>; 'Nike Radar Base Closed', Hokkaido Shimbun Press, 10 July 2007, -http://www.hokkaido-np.co.jp/news/society/37044.html>.
⁹⁶ 'Air Self Defense Force Kasatori-yama Base Opening, 50th Anniversary Commemoration

Event'.

<http://www.warhawk1940.com/NorthernJapanNickGualilloRevisited.txt.html>.

⁹⁸ 松浦 純「空自奥尻分屯基地 新型レーダー配備へ] ((Matsuura Jun, 'JASDF Sub-Base at Okushiri to Deploy New Radar'), Hakodate Shimbun, 12 September 2004,

<http://www.town.okushiri.lg.jp/chocho/ugoki0703.html>.

¹⁰⁰ Correspondence from the Public Affairs and Liaison Office, HQ Northern Air Defense Force, Misawa, 12 March 2007. See also 「航空自衛隊 北部航空方面隊」('Northern Air Defense Force, JASDF'), <http://www.mod.go.jp/asdf/nadf/top/top-koredeiku.htm>.

the prototype J/FPS-5 at nearby lioka. In the case of Kume-jima, 2.1 billion ven was included in the fiscal year 2006 defence budget for the installation of a J/FPS-4 system.¹⁰¹ The total cost of the Kume-jima J/FPS-4 radar over the five years of its planning and construction to 2008 was approximately 23 billion yen.¹⁰²

In October 2005, Toshiba was awarded a contract for 13.461 million yen to repair components on seventeen J/FPS-4 systems by 31 January 2006, suggesting that all of the J/FPS-3 stations had been or were being converted to J/FPS-4 facilities.¹⁰³ In September 2005, Toshiba also received a contract for 36.56 million yen for "system maintenance" of a J/FPS-4 radar.¹⁰⁴ In May 2006, it received a contract for 2.625 million yen for "revamping [of J/FPS-4 systems] on site", to be completed by 30 June 2006.¹⁰⁵ On 6 June, it received a contract for 39,700,500 yen for "regular repairs" at a J/FPS-4 site.¹⁰⁶ In August 2006, it received contracts for 5,932,500 yen for regular repairs of a J/FPS-4 radar, 5,066,250 ven for "technical services" in relation to the J/FPS-4 system, and 3,055,500 yen for "system maintenance" of a J/FPS-4 radar.^{107⁻} Further contracts worth 112 million yen were awarded to Toshiba for repairs, renovation and routine servicing of J/FPS-4 systems in the period from September 2006 to January 2007.¹⁰⁸ In October 2006, Toshiba also received another four contracts worth some 72 million yen for J/FPS-4 equipment, including 38 million yen for the provision of another J/FPS-4 "primary radiation array".¹⁰⁹

In September 2005, Tokimec was awarded two contracts amounting to 155.26 million yen to repair 108 J/FPS-20 components.¹¹⁰ In June 2006, it was awarded a contract for 25.819.500 ven for "regular repair" of J/FPS-20

http://www.mod.go.jp/j/approach/hyouka/seisaku/results/20/jigo/youshi/05.pdf

¹⁰¹「18年防衛費 重要施策を見る」朝雲新聞 ('Important Defence Measures—2005 Budget', Asagumo News), 9 March 2006, http://www.asagumo-news.com/news/200603/060309/ 06030904.html>.

¹⁰² 平成20年度政策評価書(事後の事業評価). 担当部局:経理装備局施設整備課. 実施時期: 平成20年12月~21年1月。事業名: 久米島固定式3次元レーダー装置

⁽J/FPS-4)関連施設整備事業. 政策体系: 施設整備. (2008 Post-project evaluation report. Project name: Kume-jima three-dimensional radar facility (J/FPS-4). Department in charge: Equipment Finance Bureau, Maintenance Division. Implementation period: December 2008—January 2009), Ministry of Defence,

¹⁰³ 'Table of Contracts, October 2005', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture. ¹⁰⁴ 'Table of Contracts, September 2005', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture.

 ¹⁰⁵ 'Table of Contracts, May 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture.
 ¹⁰⁶ 'Table of Contracts, June 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture.
 ¹⁰⁷ 'Table of Contracts, August 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture.
 ¹⁰⁸ 'Table of Contracts, September 2006', JASDF 3rd Supply Depot, Sayama, Saitama

Prefecture. ¹⁰⁹ Table of Contracts, October 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture, 18 October 2006. http://www.dii.jda.go.jp/asdf/3depotprocure/sonota/zuikei/rivuu/1810.pdf>.

¹¹⁰ 'Table of Contracts, September 2005', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture.

systems.¹¹¹ In August 2006, it received another two contracts, for 73,710,000 and 17,304,000 ven, for components and repairs of J/FPS-20 radars.¹¹² In September 2006, it received two contracts amounting to some 90 million yen for the repair of 103 J/FPS-20 components.¹¹³ In October 2006, it was awarded a contract for 28.224 million yen for another J/FPS-20 set, to be delivered by 22 December.¹¹⁴ In May 2007, Tokimec was awarded a contract for 28,150,500 yen for 'regular repair' of J/FPS-20 systems.¹¹⁵

THE J/FPS-5 SYSTEM

The new J/FPS-5 system was developed by the JDA's Technical Research and Development Institute (TRDI) to provide an indigenous capability for tracking ballistic missiles as well as high-speed aircraft. The development of a prototype J/FPS-XX system at the TDRI's No. 2 Research Centre at lioka, in Chiba prefecture, began in 2000, and construction was completed in 2003. It consists of a mammoth triangular structure, 30 metres high, with the sides 20 metres wide, which rotates on a circular rail. There is an 18-metre diameter radar face on each side.¹¹⁶

Testing of the Chiba J/FPS-XX was carried out by a 28-member JASDF unit in 2004-05. It was tested against fighter aircraft, simulated ballistic missile trajectories, and dummy/deception signals generated at the 'E-Aerial Training Range' at Kashimanada Bay in Ibaraki Prefecture, east of Tokyo and northeast of lioka.¹¹⁷

According to the JDA, the Chiba J/FPS-XX radar monitored the test of a Russian SLBM launched from a submarine in the Sea of Okhotsk in November 2005. It then "tracked the missile's flight for thousands of miles across northern Russia to the Barents Sea in the Arctic Ocean". 118

The JDA announced on 31 August 2005 that it was proceeding with the construction of four J/FPS-5 stations, all at current J/FPS-2 sites. It said that 18.8 billion yen was to be included in the fiscal 2006 defence budget for the program. The first has been constructed at Shimokoshiki in Kagoshima prefecture, Kyushu, where surveying and construction started in 2006.¹¹⁹

¹¹¹ 'Table of Contracts, June 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture.

¹¹² 'Table of Contracts, August 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture. ¹¹³ 'Table of Contracts, September 2006', JASDF 3rd Supply Depot, Sayama, Saitama

Prefecture.

Table of Contracts, October 2006', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture. ¹¹⁵ 'Table of Contracts, May 2007', JASDF 3rd Supply Depot, Sayama, Saitama Prefecture.

¹¹⁶「弾道ミサイル防衛の"目"」朝雲新聞 ('Defensive Technology: "Eye" of Ballistic Missile Defense', Asagumo News), 23 June 2005, < http://www.asagumo-news.com/news/200506/ 20050623/05062310.html>.

¹¹⁸ Sieff, 'New Japan BMD Radar Tracks Russian Missile Test'.

¹¹⁹ 'Missile Defense: Shimokoshikishima—Operating from 2009', Minami Nihon Shimbun [South Japan News], 1 September 2005, http://www.373news.com/2000picup/2005/09/ picup_20050901_1.htm>.

The fiscal year 2006 budget included 2.5 billion yen for the Shimokoshiki station.¹²⁰ In October 2008, the Defence Ministry informed local citizens that construction of the J/FPS-5 would be completed in March 2009, when the station would achieve its initial operating capability (IOC), and would be fully operational in September 2009. Construction of the radar was completed in November 2008.¹²¹ The Ministry said that the radar would begin test transmissions in December 2008.¹²² The cost of the Shimokoshiki J/FPS-5 facility was 32 billion ven.¹²³

The other three J/FPS-5 systems, to be located at Sado-jima in Niigata prefecture, Kamabuse-yama in Aomori prefecture, and Yozadake, on Okinawa Island, were to be operational by the end of fiscal year 2011.¹²⁴ In the case of Sado-jima, a request for tenders for construction of the radar foundation was issued on 16 May 2007. It specified that the foundation should be made of ferro-concrete, be 7 metres high, about 22 metres in diameter, and 1.5 metres thick, and be completed by the end of May 2008.¹²⁵ A photograph taken in November 2008 shows the radar structure under construction;¹²⁶ photographs in June and July 2009 show that construction had almost been completed, although the protective covers had

¹²⁰ 18年防衛費 重要施策を見る」朝雲新聞 ('Important Defence Measures—2005 Budget', Asagumo News), 9 March 2006, http://www.asagumo-news.com/news/200603/060309/ 06030904.html>.

¹²¹ 下甑島固定式3次元レーダー装置(J/FPS-5): 関連施設整備事業位置図」('Shimokoshiki Fixed Three Dimensional Radar (J/FPS-5)'), Ministry of Defense, (n.d.), <http://www.mod.go.jp/j/ approach/hyouka/seisaku/results/21/jigo/sankou/08.pdf>.

JASDF Puts Mobile Radar (TPS-102) on Public View at Shimonoseki', Minami Nihon Shimbun, 24 October 2008, <http://www.373news.com/modules/pickup/topic. php?topicid=1&storyid=13373>.

¹²³事業名:下甑島固定式3次元レーダー装置(J/FPS-5)関連施設整備事業 平成21年度 政策評価書(事後の事業評価)、担当部局:経理装備局施設整備課、実施時期: 平成21年12月~22年1月 「('Shimokoshiki Island Fixed Three-dimensional Radar Equipment (J/FPS-5): Project-related Facilities, FY 2009 Policy Assessment Report (postproject evaluation), December 2009-January 2011, Facilities Maintenance Division, Finance and Equipment Bureau, Ministry of Defence),

http://www.mod.go.jp/j/approach/hyouka/seisaku/results/21/jigo/honbun/08.pdf.
http://www.mod.go.jp/j/approach/hyouka/seisaku/results/21/jigo/honbun/08.pdf.
http://www.mod.go.jp/j/approach/hyouka/seisaku/results/21/jigo/honbun/08.pdf.

Japan News]. ¹²⁵ 'Construction of New Foundation, Engineering and Other Works at Sado Shima Radar Station', 16 May 2007, https://www.nikoukei.co.jp/SearchDisplay/Detail/Announcement.html ?sequential_number=005381537>.

¹²⁶ 中川なおみ 「ガメラ09」, 明日どうかなー? (Nakayama Naomi, 'Camera 09', What about Tomorrow?!),17 September 2009. <http://taiyoudesu333.blog95.fc2.com/blog-date-20090917.html>.

not vet been installed over the two radar faces.¹²⁷ The Sado-iima J/FPS-5 radar station began operations in July 2010.¹²⁸

Construction of the J/FPS-5 system at Kamabuse-vama began in early 2008: it is to be completed by the end of fiscal year 2010. Photographs taken in October 2008 show that the rotatable foundation had been completed.¹²⁹ By September 2009, construction of the radar structure was well underway.¹³⁰ Photographs taken in July 2010 show that construction had almost been completed, apart from the protective covers over the radar faces. Photos taken on 15 October show that the covers had been installed, with workmen sealing them over the radar faces. Construction was completed in March 2011, and the Kamabuse-yama J/FPS-5 system began operation in July 2011.¹³¹

Construction of the fourth station, at Yozadake, began in 2009, and the station opened in February 2012. $^{\rm 132}$

The Shimokoshiki and Yozadake stations are best-placed for monitoring Chinese missile trajectories, while the Kamabuse-yama and Sado-jima stations are best for monitoring missiles fired from North Korea.

The J/FPS-5 systems are able to directly exchange tracking data with the J/FPS-4 stations, and with the Aegis radar system aboard the Japanese Maritime Self-Defense Force's (JMSDF) Kongo-class destroyers.

Cooperation with the United States

The US-Japan relationship with respect to airspace surveillance and intelligence has been radically transformed over the last few years. The formation of an 'Air Force alliance' has been driven by Japan's ballistic

¹²⁷ Sansetsu 「 佐渡島ガメラレーダー直近画像」(Sansetsu, 'Sado Island Gamera Radar Most Recent Picture') 反証的、鍼灸・手技・心理臨床, 14 June 2009. < http://sansetu.exblog.jp/ 11260973/>.

¹²⁸ '佐渡 分屯基地:基地の沿革」航空自衛隊 佐渡分屯基地 ('Base History', JASDF Sado Subbase), <http://www.mod.go.jp/asdf/sado/02.html>.

¹²⁹「ガメラレーダー釜臥山に建設中!」ワンゲル地蔵堂だより, ('Kambuse-yama Gamera Radar under Construction!', The News from Wandervogel Jizo-do), 18 October 2008, <http://yotchin-jizou.cocolog-nifty.com/blog/2008/10/post-63be.html>.

¹³⁰「釜臥山のガメラレーダーの近況?」ワンゲル地蔵堂だより, ('Kambuse-yama Gamera Radar Latest?', The News from Wandervogel Jizo-do), 9 April 2009, <http://yotchinjizou.cocolog-nifty.com/blog/2009/04/post-8ffa.html>.

[「]ガメラレーダーって、何?」['What is the Gamera radar?'], 東北のかなめ [Pivot of Tohoku], 防衛省東北防衛局編集委員会編集発行, (Editorial Committee, Tohoku Defense Bureau, Ministry of Defense), vol. 16, 16 September 2011, <http://www.mod.go.jp/rdb/tohoku/kouhou-3/kaname16.pdf>, p. 2.

¹³² Ministry of Defense, 'Overview of Japan's Defense Policy'; 「与座岳分屯基地, 基地司令から の挨拶」('From the Commander', Yozadake Sub-base, JASDF), <http://www.mod.go.jp/asdf/ yoza/from_commander.html>.

missile defence program, prompted in turn by Chinese and North Korean ballistic missile developments. In particular, it has been motivated by the JASDF's appreciation that the necessary missile launch detection and initial tracking data could only be provided by the US Defense Support Program (DSP) infra-red missile launch detection satellite system, and that major technical and operational advantages benefits would accrue from access to US radar warning and tracking networks.

The JASDF has been much less willing to share airspace surveillance data with the US Air Force than the JMSDF has been with the US Navy with respect to their respective *Aegis* air defence systems. The United States had often asked Japan to share intelligence from the BADGE network. However, although "intelligence gathered by BADGE has been provided to US forces in the past on a temporary basis when conducting joint drills", Japan had been reluctant to do so because it wanted to secure the independence of its air defence network.¹³³ As a study of Japan's command and control system for theatre missile defence noted in 2000,

the Air SDF has emphasized the independent and autonomous nature of its BADGE system due to its primary role and mission to defend the Japanese archipelago by itself if necessary.¹³⁴

When the JDA decided on the BADGE system design in 1964, it "opted for one with no interoperability with U.S. forces".¹³⁵

The JASDF has been less willing to data-link with the USAF through the Link 11 than the JMSDF has been with the US Navy. When the United States provided the JASDF with Link 11 in the early 1990s, it also offered training and the possibility of integrating US and Japanese air defence intelligence systems. In early 1993, for example, the USS *Bunker Hill*, a *Ticonderoga*-class *Aegis* guided missile cruiser, "conducted several Linkexs [Link 11 exercises] with JASDF BADGE sites … in a move toward further integrating the Anti-Air Defense of the Japanese Islands". A report on the exercises noted that "the mutual cooperation and exchange of ideas and methods was beneficial to both sides".¹³⁶ However, although the JADGE system was data-linked with the JMSDF's E-2C *Hawkeye* aircraft through Link 11, the

¹³³ 'Stepped-Up Integration: ASDF Now Giving Radar Info to US', *The Japan Times*, 13 May 2007, http://search.japantimes.co.jp/cgi-bin/nn20070513a1.html.

¹³⁴ Masahiro Matsumura, 'Redesigning Japan's Command and Control System for Theater Missile Defense', *Defense Analysis*, vol. 16, no. 2 (2000), p. 155.

 ¹³⁵ Richard J. Samuels, Securing Japan: Tokyo's Grand Strategy and the Future of East Asia (Ithaca, New York: Cornell University Press, 2007), p. 104.
 ¹³⁶ USS Bunker Hill: Command History for the Calendar Year 1993, Department of the Navy,

¹³⁶ USS Bunker Hill: Command History for the Calendar Year 1993, Department of the Navy, http://www.history.navy.mil/shiphist/b/cg-52/1993.pdf>.

JASDF "employs its own encryption measures which make the tactical data inaccessible to the US side".¹³⁷

Air control and warning operations in the JASDF's Southwestern Defence Sector, encompassing Okinawa and the Ryukyu Island chain, have been an important exception to the general lack of cooperation. Because flights associated with the US Air Force base at Kadena comprises a large proportion of the air traffic in the region, the USAF's 623rd Air Control Flight has worked at the BADGE centre at the SOC at Naha Air Base in Okinawa since 1983. In August 2007, the USAF unit had thirty members.

We use four ground-based radars around Okinawa [Okino Erabu-jima, Kume-jima, Yozadake and Miyako-jima] which funnel information into the Southwest Direction Center at Naha Air Base.

The unit works 'side by side' with the JASDF's Southern AC&W Wing. In September 1983, elements of the unit deployed to northern Hokkaido to assist in controlling airspace for aircraft searching for bodies from KAL-007. It currently provides support to the 44th and 67th fighter squadrons based at Kadena. In time of war, members of the unit are able to deploy to one or more of the other three SOCs "depending on the location of U.S. aircraft needing support".¹³⁸

However, by 2008 the USAF 5th Air Force commander noted that by 2008 the JADGE system "represents a key improvement" in previously limited command, control, and information sharing arrangements with the JASDF. The Bilateral Air Operations Coordination System, to be headquartered at Yokota, was to be "the heart of our bilateral air and missile defense operations" and would provide "close and detailed bilateral coordination necessary when operating under unilateral and parallel lines of command and control".¹³⁹

The Japanese Government began to seriously consider the development of a BMD system following the North Korean test of its *Nodong-1* IRBM in May 1993. However, despite US entreaties, it was for several more years unwilling to engage in cooperative programs with the United States. Its interest in gaining access to US technology quickened following North Korea's *Taepodong-1* launch in August 1998, resulting in an agreement to conduct joint research on missile defence technology signed on 17 August 1999.¹⁴⁰ In December 2003, it announced its decision to proceed with the

¹³⁷ Masahiro Matsumura, 'Redesigning Japan's Command and Control System for Theater Missile Defense', *Defense Analysis*, vol. 16, no. 2 (2000), p. 155.

 ¹³⁸ Scott D. Hallford, 'Small Kadena Unit, Big Air Force Job', *Air Force Link*, 20 August 2007,
 http://www.af.mil/news/story.asp?storyID=123064704.
 ¹³⁹ Maj. Gen. Larry D. James, 'Fifth Air Force Ready for the Future', *Air & Space Power Journal*,

 ¹³⁹ Maj. Gen. Larry D. James, 'Fifth Air Force Ready for the Future', *Air & Space Power Journal*, vol. XXII, no. 2 (Summer 2008), pp. 20-1.
 ¹⁴⁰ Don Kirk, 'U.S. and Japan to Join in Missile Defense to Meet Pyongyang Threat',

¹⁴⁰ Don Kirk, 'U.S. and Japan to Join in Missile Defense to Meet Pyongyang Threat', *International Herald Tribune*, 29 July 1999, http://www.iht.com/articles/1999/07/29/

development of a ballistic missile defence system. During discussions on information-sharing for missile defence in 2004, the United States reportedly stated that it "wants either full access to [the JASDF's] radar data or to be allowed to build its own radar station in Japan".¹⁴¹ A further agreement between the United States and Japan to intensify cooperation with respect to their missile defence programs was signed in Tokyo on 17 December 2004.142

The most important decisions were made by the Japanese Government around mid-2005, and codified in the report of the US-Japan Security Consultative Committee on the 'U.S.-Japan Alliance: Transformation and Realignment for the Future' in October 2005. The key decisions were to allow the United States to deploy an X-band 'theatre ballistic missile defence' radar at Camp Shariki in Japan, and to move the JASDF'S Air Defence Command HQ and BADGE COC from Fuchu to Yokota.¹⁴³ Subsequent discussions, in 2006-07, concerned mechanisms by which all the JASDF's radar data would be shared with the United States, and whereby Japan would gain access to US DSP satellite launch detection and early-warning information.

In June 2005, with the J/FPS-XX system at Chiba in "the final stages of development", at a meeting of the Japan-US Joint Command and Control Summit at USFJ HQ at Yokota, the United States requested access to J/FPS-5 data. Japanese officials said that Tokyo was expected to grant the request, and noted that the JMSDF and the US Navy were already sharing information between their Aegis-equipped cruisers.¹⁴⁴

On 15 January 2006, the chief of the JDA announced that agreement had been reached to integrate information networks with respect to missile defence by the end of fiscal year 2006.¹⁴⁵ A Japanese press report stated that:

> Both Japan's radar network and command systems [will] be connected to the USA's by March 2007. The information sharing is expected to enhance the two nations' capacity to intercept enemy [ballistic missile] attacks. For

http://missilethreat.com/missiledefensesystems/id.19/system_detail.asp. .">http://www.nti.org/gsn/article/us-wants-japan-to-share-radar-data/>. ¹⁴⁵ Martin Sieff, 'US Japan to Integrate BMD IT Networks', *Space War*, 18 January 2006, http://

japan.2.t.php>; Calvin Sims, 'U.S. and Japan Agree to Joint Research on Missile Defense', New York Times, 17 August 1999, http://www.nytimes.com/1999/08/17/world/us-and-japan-agree- to-joint-research-on-missile-defense.html>.

^{&#}x27;U.S., Japan Eye Shared Missile Defense', Kyodo News Service, 5 April 2004.

¹⁴² 'Japan, US Sign Missile Defense Agreement', *China Daily*, 17 December 2004,

<http://www.chinadaily.com.cn/english/doc/2004-12/17/content_401196.htm>.
¹⁴³ 'Text of U.S.-Japan Alliance Report', *Kyodo News Agency*, 1 November 2005, in 'Forward-Based X-Band Radar-Transportable', MissileThreat.com,

www.spacewar.com/reports/BMD_Watch_US_Japan_To_Integrate_BMD_IT.html>.

example, Japan's advanced early warning radar system, FPS-XX, [and] the FPS-3 'fence protection' system will be linked to U.S. early-warning satellites, the [X-band] radar that the US is expected to install [at Shariki] and U.S. Aegis destroyers.¹

On 1 May 2007, Japanese and US Foreign Ministry and Defense Ministers at a meeting in Washington agreed to expand "information-sharing in support of their missile defence" efforts. This officially codified the fact that "fullfledged provision of information" had been instituted by the JASDF with the installation of a 'permanent' link between the BADGE COC at Fuchu and the HQ of the US 5th Air Force at Yokota in late April.¹⁴⁷

X-BAND RADAR—AN/TPY-2 (FBX-T)

Collaborative work on the development of an X-band radar began in 1998 following the Taepodong-1 launch, and US officials formally proposed the deployment of an X-band radar in Japan in mid-2004. The JDA agreed in October 2005, in the report on the 'U.S.-Japan Alliance: Transformation and Realignment for the Future', to provide "the optimum site" for the new radar system.¹⁴⁸ The 'primary candidate' was reportedly Camp Shariki, situated on a wooded bluff on the edge of the Sea of Japan, near Tsugaru city, Aomori prefecture, in the northwest corner of Honshu.¹⁴⁹ Shariki is well-located for the detection and tracking of North Korean ICBMs on trajectories to the United States as well as IRBMs fired at Japan, and since 1980 it has hosted the JASDF's 21st Air Defence Missile Squadron with four Japanese-built *Patriot* missiles.¹⁵⁰

The AN/TPY-2 system (formerly the FBX-T: Forward-Based X-band Radar-Transportable), is a high-power phased-array radar manufactured by Raytheon in Massachusetts, reportedly costing \$2 billion,¹⁵¹ which provides surveillance, acquisition, tracking and kill assessment (SATKA) for ballistic missile defence. It is designed to be integrated with the hardware systems and software programs built for missile interceptors intended for Terminal High Altitude Area Defense (THAAD).¹⁵² Operating at a frequency of 10

<http://missilethreat.com/missiledefensesystems/id.19/system_detail.asp>.

¹⁴⁶ 'Missile Systems to be Connected to the American System', Japan High-Tech Update, 15 January 2006, http://www.triangletech.com/html/newsletter/january2006. <a href="http://http:/

^{2007, &}lt;http://search.japantimes.co.jp/cgi-bin/nn20070513a1.html>.

⁸ 'Text of U.S.-Japan Alliance Report'. Kvodo News Agency.

¹⁴⁹ 'Japan Base Could Host U.S. Forward Deployed X-Band Radar', Asahi Shimbun, 17 October 2005, in 'Forward-Based X-Band Radar-Transportable', MissileThreat.com,

¹⁵⁰ Teri Weaver, 'Two Soldiers Sent to "Battle Space" in Remote Japan', Stars and Stripes, 7 October 2007, <http://www.stripes.com/news/two-soldiers-sent-to-battle-space-in-remote-japan-

^{1.69605&}gt;. ¹⁵¹ Jennifer H. Svan, 'Army Shows Off New X-Band Radar in Japan', *Stars and Stripes*, 7 June 2006, <http://www.military.com/features/0,15240,100201,00.html>.

¹⁵² 'Ravtheon Wins Contract for Terminal High Altitude Area Defense Radar', Space Daily, 16 February 2007, <http://www.spacedaily.com/reports/Raytheon Wins Contract For Terminal High_Altitude_Area_Defense_Radar_999.html>.

GHz in the X-band, the AN/TPY-2 provides longer detection range than the JASDF's J/FPS-4 and J/FPS-5 radars, as well as a greater ability to differentiate missile shapes and distinguish between decoys and actual warheads.153

The FBX-T arrived at the US Air Force Base at Misawa in May-June 2006, where it was assembled and given preliminary 'system checks'.¹⁵⁴ It was then moved to Shariki, where operational tests began in late June.¹⁵⁵ The system consists of four trailers, containing the AN/TPY-2 radar antenna, computers for storing and processing data, an air-conditioning system, and an office unit for support personnel.¹⁵⁶

The FBX-T was officially activated at a ceremony at Camp Shariki on 26 September 2006.¹⁵⁷ It is maintained by two US military personnel and "100 or so" contracted technical and support personnel-some from Raytheon, who operate the AN/TPY-2 radar, and the rest from Chenega Blackwater Solutions, who provide security at the base.¹⁵⁸ The facility is part of the 94th Army Air and Missile Defense Command of the US Army Pacific Command.159

In August 2006, after ballistic missile test launches by North Korea the previous month, including an unsuccessful Taepodong-2 ICBM launch attempt, the Pentagon announced that a second site in the Western Pacific was under consideration for another FBX-T radar system. The four "candidate sites" are in South Korea, Guam, Kyushu, and Okinawa. It was

¹⁵³ 'Japan Base Could Host U.S. Forward Deployed X-Band Radar', Asahi Shimbun.

¹⁵⁴ Svan, 'Army Showing Off New X-Band Radar in Japan'.

¹⁵⁵ 'U.S. Eyes More Radar Against North', *The Japan Times*, 23 August 2006, <http://search. japantimes.co.jp/cgi-bin/nn20060823a9.html>.

Svan, 'Army Shows Off New X-Band Radar in Japan'.

¹⁵⁷ 'U.S. Army Activates High-power X-Band Radar Outpost in Northern Japan Amid N. Korea Concerns', International Herald Tribune, 28 September 2006. ¹⁵⁸ Weaver, 'Two Soldiers Sent to "Battle Space" in Remote Japan'; Teri Weaver, 'Tiny Base

Assimilates into Japanese Town', Stars and Stripes, 8 October 2007, http://www.stripes.com/ news/tiny-base-assimilates-into-japanese-town-1.69654>. "On 08 June 2005 Raytheon Company was awarded a contract by the Missile Defense Agency (MDA) for Contractor Logistics Support (CLS) of the Ballistic Missile Defense System (BMDS) radars. The contract has a potential value of \$260 million over the five-year period of performance. Under the innovative contract, Raytheon Integrated Defense Systems (IDS) will be responsible for operating and maintaining Forward Based X-Band Transportable (FBX-T) radars as part of the Missile Defense Agency's BMDS. The CLS contract covers all operations and sustainment of the forward based radars, including site surveys and site preparation; operational readiness certification; site operation and maintenance; mission preparation and support; radar performance reporting and analysis; depot support; and administrative and physical security. Under this contract, Raytheon will provide the warfighter with 'no doubt' reliability, ensuring that these radars work." 'Forward Based X-Band Transportable (FBX-T) Radar: AN/TPY-2 / TPS-X / Forward Deployable Radar (FDR)', GlobalSecurity.org, http://www.globalsecurity.org/space/ systems/fbx-t.htm>.

suggested that "the chances are higher for Kyushu and South Korea because they are closer to North Korea than Okinawa and Guam".¹⁶⁰

It was reported in August 2012 that the United States had decided to deploy the second X-band radar at "an undisclosed southern Japanese island". In addition, the United States was evaluating sites for a third X-band radar in Southeast Asia to create an arc for anti-ballistic missile purposes against North Korea and China.¹⁶¹

ACCESS TO DSP/SPACE-BASED INFRA-RED SYSTEM (SBIRS)

The integration of the JADGE network into the US BMD system has finally gained Japan direct access to the US DSP/Space-based Infra-red System (SBIRS) missile launch detection system. The *Nodong-1* launch on 29 May 1993 and the *Taepodong-1* launch on 31 August 1998 were both detected by the DSP-E satellites and the information processed at the Nurrungar station in Australia. Warnings were quickly communicated to Buckley in Colorado and thence relayed to Japan.¹⁶² In the case of the *Nodong-1* launch, the JDA had been informed by the United States beforehand that the launch was imminent, and was told it had been detected by the early-warning satellites as soon as the HQ of the US Forces Japan (USFJ) at Yokota Air Base had been notified. But by this time the missile had already been detected and was being tracked by the JASDF's radar station at Wajima, on the Noto Peninsula.¹⁶³ In January 1995, the United States stated that it was willing to provide Japan directly with DSP data, but only if Japan agreed to cooperate in a joint BMD development program.¹⁶⁴

In May 1996, the United States informed Japan that it had decided to provide DSP data to Japan, reportedly "in yet another attempt to encourage Japan to move more rapidly toward deployment of anti-missile defenses".¹⁶⁵ By the time of the *Taepodong-1* launch in August 1998, mechanisms had been

¹⁶⁰ 'U.S. Eyes More Radar Against North', *The Japan Times*, 23 August 2006,

<http://www.japantimes.co.jp/text/nn20060823a9.html>.

 ¹⁶¹ Adam Entous and Julian E. Barnes, 'U.S. Plans New Asia Missile Defenses', *Wall Street Journal*, 23 August 2012.
 ¹⁶² Note however that there were claims by the political head of the JDA at the time, Norota

¹⁶² Note however that there were claims by the political head of the JDA at the time, Norota Hosei, that the Agency's intelligence gathering over the launch was "humiliatingly poor". Norota used his claim that the JDA took over 10 hours "to announce that the rocket might have passed over mainland Japan" to support his argument that "Japan should launch its own intelligence needs satellites so that the country won't have to depend on the United States for defense information". 'Japan Needs Spy Satellites: Norota', *Japan Times*, 26 November 1998.

 ¹⁶³ 'Rabbits' Ears and Doves' Dreams: Information on North Korea's Missile Test-Firing Kept Secret—Only Bureaucrats Discuss Information with Foreign Minister and Others Kept in the Dark', *Mainichi Shimbun*, 14 August 1994, FBIS Translated Text, http://www.fas.org/news/japan/eas95192.htm , p. 1.
 ¹⁶⁴ Naoaki Usui, 'U.S., Japan Discuss Sharing Missile Warnings', *Space News*, 23-29 January

¹⁶⁴ Naoaki Usui, 'U.S., Japan Discuss Sharing Missile Warnings', Space News, 23-29 January 1995, p. 6.

¹⁶⁵ Naoaki Usui, 'Pentagon to Supply Early-Warning Data to JDA', *Space News*, 10-16 June 1996, p. 28; Jeffrey T. Richelson, *America's Space Sentinels: DSP Satellites and National Security* (Lawrence, Kansas: University of Kansas Press, 1999), pp. 232-3.

established for the direct transmission of launch detection information from Colorado to the JDA HQ. In mid-2003, the US Air Force Space Command activated a Shared Early Warning System (SEWS) Centralized Distribution Facility in Colorado, for which a terminal had been set up at Yokota Air Base for the direct receipt of relayed DSP/SBIRS data.¹⁶⁶

On 5 July 2006, the DSP-E satellites monitored North Korea's test-launch of seven ballistic missiles, including a *Taepodong-2* and at least four *Nodong* missiles. The *Taepodong-2* flew for only 40 seconds before it exploded in mid-air about 1.5 km from the launch pad. The DSP data concerning the launches was evidently transmitted to Yokota; however, much of the data failed to reach the JDA HQ in real-time because the satellite communications system between Yokota and the JDA HQ "cut out several times".¹⁶⁷

JTAGS DEPLOYMENT

In March 2007, the Kyodo News Agency reported that the United States and Japan had agreed on the deployment of a Joint Tactical Ground Station (JTAGS), capable of receiving launch detection and limited tracking data directly from DSP satellites, at the Misawa Air Base in northeastern Honshu.¹⁶⁸ The transportable station was delivered to Misawa on 12 October 2007,¹⁶⁹ creating what a US media report described as "the world's most complex ballistic missile shield, a project that is changing the security balance in Asia".¹⁷⁰

The JTAGS program was initiated in the late 1990s to provide an in-theatre capability for receiving and processing raw wide-band infra-red data down-linked from the DSP satellites, with particular respect to tactical ballistic missiles, in order to obtain immediate and accurate information about missile launch locations and predicted impact areas, and to disseminate "warning, alerting, and cueing information" on tactical ballistic missiles, as well as their positions and velocity, to ballistic missile defence stations. The system is also able to process data concerning high-flying (*Slow Walker*) aircraft and hence track them by their infra-red emissions.¹⁷¹ (Five stations were built.

¹⁶⁶ Frank Morring, Jr., 'In Orbit: Spreading the News', *Aviation Week & Space Technology*, 30 June 2003, p. 21.

¹⁶⁷ 'North Korea's Nuclear Threat: Japan has 1 Minute for Interception Decision', *Daily Yomiuri*, 9 July 2006, http://article.wn.com/view/2007/07/09/NORTH_KOREAS_NUCLEAR_THREAT_Japan_has_1_minute_for_intercept/.

¹⁶⁸ Marin Sieff, 'USAF Japan Base Gets New BMD Information System', *Space War*, 7 March 2007, <http://www.spacewar.com/reports/USAF_Japan_Base_Gets_New_BMD_Information_ System.html>.

 ¹⁶⁹ 'Large-scale WMD Drill Launched Off Japan', *Space War*, 13 October 2007,
 http://www.spacewar.com/reports/Large-scale_WMD_drill_launched_off_Japan_999.html;
 Wendell Minnick, 'Japan Rising', *C4ISR: The Journal of Net-centric Warfare*, 4 January 2008,
 http://www.defensenews.com/print/article/20080104/C4ISR01/801040305/Japan-rising.
 ¹⁷⁰ 'At "JTAGS", Japan and the U.S. Press Ahead on Missile Defense', *Christian Science*

^{1/0} 'At "JTAGS", Japan and the U.S. Press Ahead on Missile Defense', *Christian Science Monitor*, 30 January 2008.

¹⁷¹ Richelson, *America's Space Sentinels*, p. 193; 'JTAGS: Joint Tactical Ground Station', GlobalSecurity.org, http://www.globalsecurity.org/space/systems/jtags.htm.

The others are located at Stuttgart in Germany, Osan in South Korea, Qatar in the Persian Gulf, and in Colorado). The JTAGS is able to process data from up to three DSP/SBIRS satellites. It consists of three antennas and a data processing station, and is maintained by about 24 US Army personnel. The detachment is part of E Company, 53rd Signals Battalion, under the 1st Space Brigade, US Army Space and Missile Defense Command/Army Strategic Forces Command (USAMDC/ARSTRAT).¹⁷² According to the detachment commander, "we spot the launch, pass the data to the radar at Shariki—or similar high-altitude radars—then they know where to aim their radar, track and send information to the high-altitude interceptors".¹⁷³ The data is also conveyed to Yokota Air Base and to the Japanese MoD in Tokyo.¹⁷⁴ The station was operational by late October.¹⁷⁵ It was "presented" to the Misawa City Mayor and "other civic leaders" at a small ceremony on 6 November 2007.¹⁷⁶ It was officially opened at a larger ceremony at Misawa on 22 January 2008, at which a red ribbon was jointly cut by the deputy commander of the US Space and Missile Defense Command at Peterson Air Force Base in Colorado and a senior official from the Ministry of Foreign Affairs in Tokyo. US officers said at the opening that

JTAGS receives infrared data directly from the Defense Support Program satellites and soldiers operating the JTAGS receive and process the data from the satellite sensors to warn and alert U.S. and Allied commanders [and that] the presence of JTAGS in Japan provides a more robust theater ballistic missile defense and warning capability.¹⁷⁷

The deputy commander of the Space and Missile Defense Command added that the deployment adds "useful 'redundancy".¹⁷⁸

Technical cooperation between the United States and Japan with respect to the operation of their BMD systems will be greatly expedited by the JASDF's willingness to relocate its ADC HQ and JADGE SOC to adjoin the HQ of the USAF's 5th US Air Force at Yokota Air Base. The 'Bilateral Master Plan' to guide implementation of the relocation, signed by senior JASDF and USAF officers on 15 May 2007, includes a Bilateral Air Operations Coordination

¹⁷² Contracting and Acquisitions Management Office, U.S. Army Space and Missile Defense Command/Army Strategic Forces Command (USAMDC/ARTSTRAT) (n.d.),

http://www.smdc.army.mil/2008/BusinessOpportunities.asp. ¹⁷³ Jennifer H. Svan, 'Space-based Missile Tracker Comes to Japan', *Stars and Stripes*, 31 October 2007, http://www.stripes.com/article.asp?section=104&article=57428&archive=true. ¹⁷⁴ Sieff, 'USAF Japan Base Gets New BMD Information System'.

¹⁷⁵ Svan, 'Space-based Missile Tracker Comes to Japan'.

¹⁷⁶ 'Misawa City Mayor Visit to JTAGS', Misawa Air Base, <http://www.misawa.af.mil/ photos/mediagallery.asp?galleryID=5440>.

 ¹⁷⁷ 'JTAGS Misawa Officially Opens', Misawa Air Base, 22 January 2008,
 http://www.misawa.af.mil/news/story.asp?storyID=123083067; Master Sergeant Allison Day,
 'Joint Tactical Ground Station Opens at Misawa', *Pacific Air Forces*, 23 January 2008,
 http://www.pacaf.af.mil/news/story.asp?id=123083463.
 ¹⁷⁸ Bradley K. Martin, 'Japan Hosts U.S. Missile-Detection Technology to Thwart Attacks',

¹⁷⁸ Bradley K. Martin, 'Japan Hosts U.S. Missile-Detection Technology to Thwart Attacks', *Bloomberg*, 24 January 2008, <a href="http://www.bloomberg.com/apps/news?pid=newsarchive&sid="http://www.bloomberg.com"/http://www.bloomberg.com/apps/news?pid=newsarchive&sid="http://www

Center (BAOCC) to "ensure robust coordination, interoperability and data sharing" between the United States and the JASDF.¹⁷⁹ The BAOCC, scheduled to become operational in 2011, will receive DSP/SBIRS data relayed from both Colorado and the new JTAGS at Misawa.

Conclusion

By mid-2012, the JASDF's four J/FPS-5 radars are all operational. The seventeen J/FPS-3 systems all have been converted to J/FPS-4s and internetted with the J/FPS-5s. The second stage of its new SIGINT facility at Miyako-jima has been completed, and the station at Fukue-jima will be operational. By the end of 2012, the JASDF will have been completely transformed—its modernised JADGE radar system and its enhanced SIGINT capabilities will be functionally integrated at Yokota, its airspace intelligence and surveillance information will be shared with the USAF in exchange for data from the DSP/SBIRS satellites and the X-band FBX-T radar at Shariki, and its aircraft and missile warning and tracking data will be being automatically exchanged with data from JMSDF and US Navy Aegis-class ships, all feeding into its air defence and BMD systems. With its 200 PAC-3 anti-missile missiles, together with the JMSDF's eight Kongo-class SM-3 carriers, it should be fairly confident of being able to detect, track and destroy all of the fairly limited number of missiles that its potential regional adversaries could launch against the country. This is particularly so in the case of a North Korean nuclear threat, though the situation with respect to China is more complex.¹⁸⁰

This new defence capacity does not come without cost. Beyond financial strains imposed on a contracting military budget, there are strategic costs, in two directions: heightened reliance on the United States on the one hand, and on the other, as a consequence, an ongoing embedded conflict with China. In both cases, the core of the difficulty is the necessity to receive timely missile launch warning data from the United States DSP/SBIRS satellites.

From a Chinese strategic perspective, the southwestern thrust of Japanese air and missile defence warning system, necessarily integrated with the US space-based warning capacities, coupled with US and Japanese *Aegis*-class ships, constitutes a significant counter to Chinese missile threats to Taiwan. More importantly still, the Japanese missile defence deployment implies Japanese involvement in any US missile defence counter to China's nuclear

 ¹⁷⁹ Major Jason Medina, 'Joint Initiative Transforms Air Defense in Asia', News, U.S. Air Force, 15 May 2007, < http://www.af.mil/news/story.asp?id=123053320>.
 ¹⁸⁰ See a detailed discussion of the possible role of Japanese missile defence capacities in the

¹⁸⁰ See a detailed discussion of the possible role of Japanese missile defence capacities in the event of different threat scenarios involving China, North Korea, Japan, and the United States by Tara Kartha, *Managing the Shift: Missile Defense and Japan's Options* (Tokyo: Japan Institute of International Affairs (JIIA), March 2003).

deterrence capacities—potentially to the point where in Chinese perceptions the viability of the deterrent force is nullified.

The international political implications of the integrated missile defence system were recognised by the Japanese Government when it stated formally that missile defence technological cooperation with the United States constituted a recognised exception to the long-standing ban on arms exports,¹⁸¹ and in April 2003, the Director-General of the Cabinet Legislative Bureau ruled that the Theater Missile Defense System then under joint study by Japan and the United States would not be prohibited by the Japanese Constitution.¹⁸²

Desmond Ball is a Professor in the Strategic and Defence Studies Centre at the Australian National University, Canberra. He was Head of the Centre from 1984 to 1991. desmond.ball@anu.edu.au.

Richard Tanter is Senior Research Associate at the Nautilus Institute, and Professorial Fellow at the School of Political and Social Sciences, University of Melbourne. rtanter@nautilus.org.

¹⁸¹ "In order to implement the abovementioned joint development, Japan needs to provide articles to the United States which fall under 'arms' in the Three Principles on Arms Exports. However, the statement of the Chief Cabinet Secretary was issued on December 2004, saying that "if Japan decides that it will engage in joint development and production of ballistic missile defense systems with the United States, the Three Principles will not be applied, under the condition that strict control is maintained". 'Exchange of Notes concerning the Cooperation on Ballistic Missile Defense between the Government of Japan and the Government of the United States of America', Ministry of Foreign Affairs, 23 June 2006, <http://www.mofa.go.jp/ announce/announce/2006/6/0623-4.html>. See also the recommendations of the Council on Security and Defense Capabilities in the New Era, in its August 2010 report 'Japan's Visions for Future Security and Defense Capabilities in the New Era: Toward a Peace-Creating Nation', http://www.kantei.go.jp/jp/singi/shin-ampobouei2010/houkokusyo_e.pdf, pp. 22-3, 46-7.
¹⁸² Richard J. Samuels, *Politics, Security Policy, and Japan's Cabinet Legislation Bureau: Who* Elected These Guys, Anyway? JPRI Working Paper No. 99 (March 2004), <http://www.jpri.org/publications/workingpapers/wp99.html>. Note however that the removal by the United States of the distinction between theatre missile defence and national missile defence under its current National Missile Defense System permits the interpretation of the Japanese component of the BMD system as being used primarily for the defence of the United States-i.e. as collective defence. Following a study of the actual role played by Yokosukabased US Navy Aegis-class ships, together with the Shariki transportable X-band radar, in tracking the DPRK missile launched on 5 July 2006, the peace researcher Umebayashi Hiromichi demonstrated that these activities were conducted, according to official US sources. as part of the defence of the United States: "That it is secondarily connected to the defense of Japan is just an excuse and does not alter this primary fact". As Umebayashi points out, this is a straightforward violation of the provisions of Article VI of the US-Japan Security Treaty. See Umebayashi Hiromichi, (translated by Richard Tanter), Missile Defence Response to the July 5, 2006 North Korean Missile Test By US Naval Vessels Home-Ported At Yokosuka, Special Report 07-054A, Nautilus Institute, 24 July 2007, <http://nautilus.wpengine.netdna-cdn.com/wpcontent/uploads/2011/12/07054Umebayashi.pdf>; Umebayashi Hiromichi, (translated by Richard Tanter), US Navy Set Missile Defence Operations Area in the Sea of Japan 190 Kilometres West of Okushiri: Japan as a Base for the Defense of the US Homeland, NAPSNet Special Report 06-42A, 30 May 2006, http://nautilus.wpengine.netdna-cdn.com/wp- content/uploads/2011/12/0642Umebayashi.pdf>.