For discussion
on 16 January 2001

Legislative Council on Economic Services

Replacement of Route Surveillance Radar and Enhancements of Six Air Traffic Control Systems

Introduction

This paper consults Members on the proposals of the Civil Aviation Department (CAD) to –

(a) replace the Route Surveillance Radar at Mount Parker (RSR); and

(b) enhance six critical Air Traffic Control (ATC) Systems.

The estimated total cost of the two proposals is some $156 million.

Replacement of RSR

Background

2. The existing RSR at Mount Parker is a primary surveillance radar used in Hong Kong for ATC purposes. It provides air traffic controllers with essential information on the range and bearing of aircraft and covers up to 200 nautical miles (NM) from Hong Kong.

3. The RSR has been in continuous service for more than 22 years. Intensive and expensive maintenance is required to upkeep its performance at an acceptable level. The number of man-hours spent in the maintenance of the RSR, and the spare part costs, since 1997 are as follows –

Year	Man-hours	Spare Part Costs
1997	2 180 hours	$1,777,000
1998	2 080 hours	$1,625,000
1999	2 320 hours	$2,125,000
2000 (up to 30 November)	3 210 hours	$2,811,000

4. Despite intensive maintenance, the fault rate of the RSR still remained on average at 29 occurrences per year between 1996 and 2000. CAD expects that the fault rate will increase even more rapidly in the coming few years, causing more outages of the RSR.

5. Furthermore, as the concerned radar type has been out of production for over a decade, spare parts have become difficult to obtain, with a long delivery time sometimes up to 18 months. The RSR therefore has become increasingly difficult and costly to maintain. The supplier and the maintenance contractor of the RSR have advised that it would make better economic sense to replace than to repair and maintain the RSR.

6. If the proposed replacement is not carried out, the RSR will have to be de-commissioned in around 2003-04 when it reaches the end of its operational life. The other two primary surveillance radars in Hong Kong currently provide short and medium range coverage up to 140NM. They will not be able to provide the necessary long-range primary radar coverage(up to 200NM) and back-up on a 24-hour basis. Air traffic controllers will as a result lose an essential tool to detect aircraft position. This will hamper their ability to provide ATC services to ensure a safe, orderly and efficient air traffic flow. The situation will be particularly serious with aircraft which do not have transponders or have unserviceable transponders (since these aircraft will not be able to be detected by the secondary route surveillance radars), and are operating in the airspace between 140 and 200 NM (i.e. coverage beyond the two primary surveillance radars but within that of the existing RSR) from Hong Kong. Timely replacement of the RSR is therefore essential.

Proposed Replacement RSR

7. The proposed replacement RSR will incorporate the latest technology and design, which will enhance system stability and reliability (e.g. significantly longer mean time between failures), transmission and processing of signals, as well as system performance (e.g. better range, accuracy, and target detection capability during adverse weather conditions). A table setting out these improvements is at Annex A.

8. Based on latest market information, CAD estimates that the proposal will incur a non-recurrent cost of about $105 million to be amortised over a period of 20 years, which includes –

	$ million
Equipment provision and installation[1]	86.3
Existing building modification and re-provisioning of building services facilities	7.5
Flight calibration for radar commissioning	0.8
Technical work services by CAD maintenance contractor	0.5
Sub-total	95.1
Contingency (10%)	9.6
Total	104.7

Under the current plan, CAD intends to award a contract for the replacement RSR in early 2002 and commission the new radar by around the end of 2003.

Proposed Enhancement of Six ATC Systems

Background

9. The existing ATC systems were designed in the early 1990's and procured in the mid-1990's for the new Hong Kong International Airport (HKIA). Although the systems perform adequately at present, in view of the rapid advancement in ATC technology, CAD considers it desirable to enhance six critical ATC systems by utilising the latest technology which will expand the systems' capacities, functionalities and human-machine interface. This is important to ensure that the systems continue to be able to handle effectively the rapidly increasing density and complexity of air traffic movements in Hong Kong and in the Pearl River Delta Region[2]. The Airport Authority (AA) anticipates that over the next ten years air traffic will grow by some 6% per annum in terms of aircraft movements at the HKIA. The International

[1] Cost covers the replacement RSR, the protective radome, microwave link equipment, un-interruptible power supply, test equipment, installation, commissioning, initial spare parts and miscellaneous items (e.g. factory acceptance test and training for staff on equipment maintenance to be provided by the supplier).

[2] Apart from the HKIA, there are four other airports (Macau, Zhuhai, Shenzhen and Guangzhou) in the Pearl River Delta all of which are very close to one another.

Civil Aviation Organization (ICAO) and the Airport Council International forecast that air traffic in the Asia Pacific Region will grow at about 6% to 8% per annum. The enhanced ATC systems will contribute to the maintenance of Hong Kong's status as an international and regional aviation centre, and to upkeep HKIA's competitive edge.

The Proposed Enhancement

10. The six critical ATC systems suggested for enhancement are -

(a) Radar Data Processing and Display System (RDPDS);

(b) Flight Data Processing System (FDPS);

(c) Radar Simulator (SIM);

(d) Speech Processing Equipment (SPE);

(e) Automatic Message Switching System (AMSS); and

(f) Aeronautical Information Database System (AIDB).

The functions of the six ATC systems as well as the proposed enhancement are set out at Annex B.

11. The proposed enhancement will allow more time for controllers to execute their primary functions of air traffic planning and surveillance in a time-critical operating environment. It will also expedite the dissemination to controllers of more updated flight and meteorological information, including changes to flight plans and weather conditions. All these benefits will help upkeep flight safety and improve the operational efficiency and effectiveness of ATC operations. Furthermore, the enhancement will increase the processing capacity of the ATC systems by up to 20% (in terms of aeronautical data that can be handled) and automate a number of manual processing functions to cater for the expected growth in the volume of air traffic and aeronautical data. In this regard, the ICAO plans to introduce new ATC procedures for the airspace over the South China Sea in November 2001 (such as a new direct route from Hong Kong to Bangkok and new parallel routes between Hong Kong and Singapore). These new procedures will increase the airspace capacity and present an opportunity to boost air traffic over the South China Sea. It is important that the capacity of our ATC system continues to be able to meet increased demand. Specifically, the

enhancement of the SIM for training of radar controllers will help upgrade their operating techniques under inclement weather conditions and their performance in handling busy traffic and emergency situation.

12. The six ATC systems are integrated to permit direct exchange of real-time flight operational data, such as flight plans, Air Reports, Notices to Airmen (NOTAMs), meteorological data, etc., which is essential to maintain efficient ATC operation. Therefore, they have to be enhanced in parallel in order to match with each other's capabilities.

13. Based on latest market information, CAD estimates that the proposal will incur a non-recurrent cost of about $51 million to be amortised over a period of 15 years, which includes –

ATC System	**$ million**
RDPDS/FDPS	15.4
SIM	2.9
SPE	17.8
AMSS	1.9
AIDB	8.1
Sub-total	46.1
Contingency (10%)	4.6
Total	50.7

The proposed enhancement will mainly be in the form of the provision of additional software. It is hoped that the enhancement could be completed in the latter half of 2002.

Recurrent Cost of the Two Proposals

14. All recurrent costs arising from the two proposals will be absorbed within CAD's existing provision for the maintenance of its ATC equipment and facilities.

Implications for Fees and Charges

15. ATC services are provided by CAD with costs recovered from the Airport Authority through ATC Services Charge (for aircraft landing at the HKIA) and from aircraft operators through En-route Navigation Services Charge (for aircraft overflying Hong Kong but not landing at the HKIA). Upon the implementation of the two proposals, it would be necessary to increase the ATC Services Charge by about 0.3% in 2002-03 and a further 0.6% in 2004-05, and the En-route Navigation Services Charge by about 0.8% in 2002-03 and a further 1.7% in 2004-05.

Consultation

16. The proposed replacement of the RSR at Mount Parker and enhancement of the six ATC systems were supported by the Aviation Advisory Board, which comprises representatives from the Airport Authority, the Hong Kong Tourist Association, airlines, freight forwarders and exporters.

Way Forward

17. We plan to seek the approval of the Finance Committee on 9 February 2001 for the non-recurrent funding of the two proposals. Members' views on the two proposals are invited.

Economic Services Bureau/Civil Aviation Department
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Annex A

Differences between Existing Primary Surveillance Radar and Proposed Replacement Radar at Mount Parker

Item	Existing Radar	Proposed Replacement
A. Technology Used and Basic Design		

Item	Existing Radar	Proposed Replacement
Technology	- Vacuum tube (Klystron) technology with discrete components. Klystron ($850K each at current price) has to be replaced in 3 years' time. - 1970's signal processing technique. - Transmitter using water cooling system.	- Fully solid-state technology with microprocessor control to enhance system stability and reliability. - Latest signal processing technique for better subclutter target visibility. - Transmitter using air or liquid cooling system for improved reliability and/or efficiency.
B. Functions and Performance		
Range Accuracy	0.3-0.4 NM	0.1 NM
Azimuth Accuracy	0.5 degree	0.2 degree
Detection Range	200 NM	200 NM
Start-up Time	20 minutes.	2 minutes.
Mean Time Between Failures	About 240 hrs	3,000 hrs
Performance under adverse weather	Target detection probability will drop to around 80%.	Target detection probability will drop to about 95%.
C. Auxiliary Equipment		
Un-interruptible Power Supply	Not available.	To be included.
Remote Control and Monitoring System	Simple switch relay mechanism.	Local and remote maintenance workstations providing in-depth control, monitoring and system diagnostic capabilities.

Annex B

Enhancement of Six Air Traffic Control Systems

(a) Radar Data Processing and Display System (RDPDS)

Functions

The RDPDS is a critical part of the ATC System. It processes data received from seven radars and displays information on aircraft positions and related data, such as aircraft callsign, track altitude and aircraft speed, etc. The information is needed for traffic control in the approach/departure and en-route phases of flights.

Proposed enhancement

(i) Improve the Human Machine Interface (HMI), allowing the system to change automatically to default mode after system restoration, more flexible modification of flight routes, and more detailed presentation of aircraft equipage on flight plans and radar displays.

(ii) Increase the capacity for entry of data on flight plans.

(iii) Upgrade system security to prevent unauthorised creation or modification of data.

(b) Flight Data Processing System (FDPS)

Functions

The FDPS processes flight plan data including the estimated time of departure/arrival, flight levels, estimated times at reporting points, cruising speed etc. and prints flight progress strips needed by controllers to keep track of flights.

Proposed enhancement

Similar to those in respect of the RDPDS.

(c) Radar Simulator (SIM)

Functions

The SIM is a replica of the operational system employed for controllers' training and procedure evaluation.

Proposed enhancement

Increase the range of operating scenarios under different weather conditions for training purposes. At the same time, the HMI functions will be improved to achieve better operational efficiency.

(d) Speech Processing Equipment (SPE)

Functions

The SPE is a digital voice switching system which enables controllers to communicate with pilots, controllers in other operational positions and neighbouring ATC units etc. via intercom, telephone, hotlines and/or VHF/HF radios.

Proposed enhancement

(i) Improve the generation and control of audio alerts, control of additional VHF communication channels and coverage of controller communication groups to meet expanding operational requirements.

(ii) Expand system capacity to cope with 20 Inter Area Speech Circuit (IASC) channels instead of the current 12 IASC channels.

(e) Automatic Message Switching System (AMSS)

Functions

The AMSS is a message switching system supporting the exchange of aeronautical messages (over the Aeronautical Fixed Telecommunication Network (AFTN)) among Civil Aviation Department (CAD), neighbouring ATC units and other users such as airlines. The AFTN messages contain

ATC service information, weather data and other operational information which is essential to flight operation.

Proposed enhancement

(i) Enhance system capability to include automatic processing of Air Reports[1] from aircraft deviating from their pre-planned flight routes (say for avoidance of adverse weather).

(ii) Improve the HMI to allow more prompt and efficient processing, transmission, reception and retrieval of AFTN messages.

(f) Aeronautical Information Database System (AIDB)

Functions

The AIDB is an operational aeronautical database and information display system which supports the reception, distribution and handling of aeronautical information, such as aircraft arrival/departure information, Notices to Airmen (NOTAMs), meteorological information/forecast, etc. The AIDB also provides for electronic transfer of aeronautical data between CAD and other organizations including airlines and overseas ATC units.

Proposed enhancement

(i) Expand system capacity to process 500 000 NOTAMs instead of the current 200 000.

(ii) Add warning alarms on expiry and missing NOTAMs to guard against the possibility of information loss; compile different NOTAM statistics and classifications of NOTAMs; add "search" facility for quick search of NOTAM messages so as to improve the efficiency and reliability of NOTAM processing.

(iii) Enable automatic compilation of Pre-flight Information Bulletin to expedite the presentation of NOTAMs and flight data.

[1] "Air Reports" are reports from aircraft in flight on its position, operational and/or meteorological information.

(iv) Provide technical consoles and associated facilities in the Aeronautical Information Centre (AIC) to streamline its operations and provide a more ergonomic working environment.