For discussion **FCR(2000-01)69**
on 9 February 2001

ITEM FOR FINANCE COMMITTEE

CAPITAL WORKS RESERVE FUND
HEAD 708 - CAPITAL SUBVENTIONS AND MAJOR SYSTEMS AND EQUIPMENT
Civil Aviation Department
New Subhead "Replacement of Route Surveillance Radar"

Members are invited to approve the creation of a new commitment of $104.7 million for replacing the existing Route Surveillance Radar at Mount Parker.

PROBLEM

The existing Route Surveillance Radar (RSR) at Mount Parker is approaching the end of its useful operational life and has become increasingly difficult and costly to maintain.

PROPOSAL

2. The Director-General of Civil Aviation (DGCA), with the support of the Secretary for Economic Services, proposes to replace the RSR.

JUSTIFICATION

3. The RSR at Mount Parker is a primary surveillance radar used in Hong Kong for air traffic control (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.

4. The RSR has been in continuous service for more than 22 years. It has deteriorated to such an extent that frequent 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** …..

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

5. Despite frequent maintenance, the fault rate of the RSR still remained on average at 29 occurrences per year between 1996 and 2000. The Civil Aviation Department (CAD) expects that the fault rate will increase even more rapidly in the coming few years, causing more outages[1] of the RSR.

6. 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 supplier and the maintenance contractor of the RSR have advised that it would make better economic sense to replace than to repair and maintain it.

7. The other two primary surveillance radars in Hong Kong, currently complementing the RSR in the provision of ATC services, will not be able to provide the necessary long-range primary radar coverage and back-up on a 24-hour basis. Without a properly functioning RSR, air traffic controllers will lose an essential tool to detect aircraft position. This will hamper their ability to provide ATC services. The situation will be particularly serious with aircraft which do not have transponders or have unserviceable transponders, and which are operating in the airspace between 140 and 200 NM from Hong Kong. Timely replacement of the RSR is therefore essential.

8. The replacement RSR proposed 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 the Enclosure.

Encl.

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[1] As in the case of any electronic equipment, faults do occur occasionally to ATC equipment including the RSR. In the event of an RSR outage, contingency ATC procedures using other radars or shifting the operation to a non-radar mode are in place to ensure safety of air traffic. However, the contingency procedures may result in a reduction in airspace capacity.

FINANCIAL IMPLICATIONS

Non-recurrent Cost

9. Based on latest market information, DGCA estimates that the proposal will incur a non-recurrent cost of $104.7 million (to be amortised over 20 years), broken down as follows –

		$ million
(a)	Equipment provision and installation	86.3
(b)	Existing building modification and reprovisioning of building services facilities	7.5
(c)	Flight calibration for radar commissioning	0.8
(d)	Technical work services by CAD maintenance contractor	0.5
	Sub-total	95.1
(e)	Contingency (10%)	9.6
	Total	104.7

10. As regards paragraph 9(a), the cost covers the replacement RSR system, the protective radome, microwave link equipment, un-interruptible power supplies, 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).

11. As regards paragraph 9(b), the cost covers the modification of the existing RSR Station at Mount Parker to accommodate the new radar equipment, antenna and radome, the reprovisioning and renovation works on the building services facilities.

12. As regards paragraph 9(c), the cost covers the flight calibration charge payable to flight check service providers. Before commissioning, the replacement RSR will have to be calibrated in accordance with the prescribed international standards.

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13. As regards paragraph 9(d), the cost covers the expenses for CAD's maintenance contractor to provide technical services for dismantling the old RSR radar, assisting in the new equipment installation on site and integrating the new radar information/signal into the existing ATC systems.

14. The cashflow in the coming years is estimated to be as follows –

Financial year	$ million
2001-02	21.1
2002-03	5.4
2003-04	68.5
2004-05	9.7
Total	104.7

Recurrent Cost

15. The replacement RSR will be maintained by CAD's maintenance contractor and no additional staff will be required for CAD. Depending on the exact equipment to be installed, DGCA estimates that the spare parts and light and power consumption will cost $1.86 million per annum (made up of $1.5 million for spare parts and $0.36 million for light and power). All recurrent costs arising from the proposed replacement will be absorbed within CAD's existing provision for the maintenance of its ATC equipment and facilities.

Implementation Plan

16. DGCA plans to implement the proposal according to the following schedule –

Activity	Target completion date
Invite tender	May 2001
Award of contracts	January 2002
Station building modifications	February 2003
Equipment delivery	April 2003
Installation and commissioning	End 2003

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17. It is expected that there would be a four-month period between decommissioning of the existing RSR and commissioning of the replacement radar. During this period, the positions of aircraft outside the coverage of the remaining primary surveillance radars will be provided to air traffic controllers by the secondary route surveillance radars, with greater separation between aircraft being applied as a safeguard measure. In addition, CAD will notify airlines and pilots of the special arrangement. For aircraft with an unserviceable transponder, control will be reverted to a non-radar mode with even greater aircraft separation to maintain flight safety. CAD has considered the forecast traffic level in 2003 and the availability of the remaining radars, and considers it an acceptable interim measure to cater for the replacement of the RSR.

18. CAD has also considered the option of installing the replacement radar at another site before decommissioning the existing radar, so that the replacement radar can be commissioned before the decommissioning of the existing radar. However, the existing site at Mount Parker provides the least obstructed radar coverage. Moreover, the option would incur additional costs of around $90 million (a rough estimate) in works such as site development. Therefore, CAD does not recommend this option.

Impact on Fees and Charges

19. The amortised project cost of the replacement will be recovered via the ATC and En-route Navigation Services Charges[2]. Upon the implementation of the project in 2004-05, we estimate that the two charges will increase by about 0.6% and 1.7% respectively.

20. The increase in ATC Services Charge in 2004-05 would be shared by over 110 000 flights. As such, the additional cost per flight is estimated to be around $37[3]. We believe that the benefits of the proposed replacement accrued to flight safety and ATC efficiency will outweigh the additional cost. Therefore, the competitiveness of the HKIA will be upheld by the proposal.

21. The increase in En-route Navigation Services Charge applies only to overflying aircraft which do not use the HKIA. Therefore, it will have no impact on the competitiveness of the HKIA.

/Consultation …..

[2] ATC services are provided by CAD with the costs recovered from the Airport Authority (AA) through ATC Services Charge (for aircraft landing at the Hong Kong International Airport (HKIA)) and from aircraft operators through En-route Navigation Services Charge (for overflying aircraft without landing at HKIA).

[3] Assuming the AA will recover all the additional ATC Services Charges from airlines.

Consultation

22. The replacement of the RSR at Mount Parker is supported by the Aviation Advisory Board. We consulted the Legislative Council Panel on Economic Services on 16 January 2001 and Members supported the proposal.

BACKGROUND INFORMATION

23. There are two principal types of radar system used for ATC, namely primary surveillance radar (PSR) and secondary surveillance radar (SSR). A PSR transmits radar pulses and detects the reflected signals from the aircraft concerned. It provides information on the range and bearing of aircraft in the form of a target blip on the radar screen. An SSR provides information on the position, altitude and identity of aircraft in the form of target label on the radar screen. It does so by transmitting interrogation signals to trigger the transponder on board an aircraft, which in turn transmits special coded signals back to the SSR to provide the concerned information. Thus, effective operation of an SSR is subject to the availability and proper functioning of the aircraft's transponders. Not all aircraft have transponders. Some military aircraft, for instance, do not. A PSR, on the other hand, does not rely on any transponder. To provide an adequate radar picture with a continuous display of aircraft target, both PSR and SSR are essential.

24. The existing PSR network to support the ATC in Hong Kong consists of three PSRs, which provide approach, medium range and en-route control respectively. They are –

(a) Approach Surveillance Radar (ASR) at Sha Chau, providing a short-range coverage up to 64 NM;

(b) Terminal Area Radar (TAR) at Tai Mo Shan, providing a medium-range coverage up to 140 NM; and

(c) RSR at Mount Parker, providing a long-range coverage up to 200 NM.

25. The ASR and TAR were commissioned in 1997 and 1998 respectively and specifically designed for the new HKIA. The RSR, installed in 1978 for the then Kai Tak Airport, was not replaced at that time as its useful life is estimated to be up to 2003-04.

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26. At present, there are four SSRs in Hong Kong, three of which being paired with the three PSRs mentioned in paragraph 24 above. The fourth SSR serves as a backup. Such overall radar network configuration was recommended by the Airport Master Planning Consultants and has proved to be appropriate based on operational experience gained since the opening of the HKIA.

27. For aircraft located outside 200 NM from Hong Kong, CAD applies procedural control whereby aircraft are separated using "time" standards (typically ten minutes between aircraft following the same route at the same altitude, equivalent to approximately 80 NM in distance). When aircraft are being controlled and separated using radar, the minimum distance between aircraft may be reduced to 3 to 10 NM depending on the location of the aircraft and the radar equipment in use. The procedural control obviously cannot cope with a high volume of air traffic which is typical in the airspace within 200 NM of Hong Kong. Therefore, CAD needs to use radar with adequate performance to ensure a safe, orderly and expeditious air traffic flow within about 200 NM from Hong Kong.

28. The current proposal is to maintain the effective operation of one of the components of Hong Kong's entire ATC system. There is also a need to enhance ATC operations at the system level, which is the subject of a separate proposal for Members' consideration vide FCR(2000-01)70.

Economic Services Bureau
January 2001

Enclosure to FCR(2000-01)69

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

Item	Existing Radar	Replacement Radar
A. Technology Used and Basic Design		
Technology	- Vacuum tube (Klystron) technology with discrete components. Klystron ($850,000 each at current price) has to be replaced in three 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 to 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 hours	3 000 hours
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.