

For discussion  
on 26 February 2007

## **Legislative Council Panel on Economic Services**

### **Replacement of the Civil Aviation Department (CAD)'s Air Traffic Control System and Development of a New CAD Headquarters on the Airport Island**

#### **Purpose**

This paper briefs Members on the project to (i) replace the existing air traffic control (ATC) system of the Civil Aviation Department (CAD) and (ii) develop a new CAD headquarters on the Airport Island to house the new ATC system and all CAD functional divisions. These two components are inextricably linked and a dedicated team will be set up by CAD to ensure the success of the project. Apart from seeking Members' support for funding approval for a replacement ATC system, this paper also invites Members to support the creation of a supernumerary D2 post to head the project team, and a permanent D1 post to lead the Air Traffic Management Standards Office which is an integral component of this important project. A further submission will be made to this Panel in the fourth quarter of 2007 to seek Members' support for the funding application for the construction of the new CAD headquarters to be located at the Airport Island, the details of which are being finalized.

#### **Justifications**

##### Functions of CAD

2. CAD's primary functions are two-fold: providing ATC services and regulating the civil aviation industry. It provides ATC services and flight information to flights arriving or departing the Hong Kong International Airport (HKIA) and aircraft overflying the 276,000 km<sup>2</sup> Hong Kong Flight Information Region (HKFIR). As a regulator, it sets

aviation safety and security standards; oversees the compliance by Airport Authority (AA), airlines and aircraft maintenance organizations with such standards; and maintains a licensing system for aviation professionals. It also participates in the work of the International Civil Aviation Organization (ICAO), implements ICAO standards and ensures airlines' compliance with the relevant air services arrangements.

### Growing Air Traffic

3. Under the progressive liberalization policy, Hong Kong's aviation sector has been growing rapidly since the opening of the new airport in 1998. Over the past eight years, air passenger and cargo throughput has increased by 59% and 120% respectively. The number of aircraft movements at HKIA has grown by 72% to reach 280,000 movements in 2006, or a daily average of 768 movements, which well exceed the 202,000 movements forecast for 2005 in the 1991 New Airport Master Plan by 39%. Over the same period, overflight traffic through HKFIR has also grown by 95% to reach 140,000 movements.

4. In the regional context, the Pearl River Delta (PRD) region is one of the fastest growing areas for air traffic. It is expected that the combined annual traffic at the five airports in PRD region (Hong Kong, Guangzhou, Shenzhen, Macao and Zhuhai) will increase from the present 0.7 million aircraft movements to 1.8 million movements by 2020. In its latest long-term development plan, *HKIA 2025*, AA envisions that by 2025, HKIA would handle 490,000 movements by 2025, or an average of about 1,300 daily movements.

5. Other than the robust growth in air traffic, our ATC system has been subject to additional strain due to the high concentration of airports in PRD region, which has created a congested airspace that greatly reduces the efficiency of ATC management. The situation has been exacerbated by the equally significant growth of air traffic to/from Macao airport, which takes up a substantial part of our ATC capacity as it relies heavily on ATC services provided by CAD.

## Need to Replace the Existing ATC System

6. For the following reasons, our ATC capability will need to be enhanced as the traffic at HKIA continues to grow :

- (a) the existing ATC system is approaching its full design/handling capacity;
- (b) the system, which has been in operation since the opening of the HKIA in 1998, will reach the end of its usable life by around 2012. Some components of the existing system are already out of production and the system is being sustained through the redeployment of existing parts where possible;
- (c) designed in the early 1990's, the existing system cannot support some of the functionalities common in state-of-the-art ATC systems : such as automatic display of essential flight data to controllers, traffic situation analysis, and calculation of optimal arrival sequence and landing times of aircraft; and
- (d) again, because our system was designed and installed in the early 1990s, interoperability with other ATC systems (i.e. the exchange of operation-related data between systems), which is essential for strengthening inter-agency coordination to enhance ATC efficiency, would be seriously undermined if the improvements envisaged were not made. In this connection, it is noteworthy that ATC systems used by other ATC authorities in our vicinity, such as Guangzhou, Shanghai, Beijing, Taiwan, Singapore and South Korea, either have been or are in the process of migrating to more up-to-date systems.

7. For the reasons set out above, it is recommended to replace the existing ATC system by a completely new system that is on par with the most advanced systems adopted globally. With much enhanced data transmission, processing and display power, the new system can provide up to twice the existing system handling capacity, thereby meeting the traffic growth by 2025 as forecast by AA.

8. The replacement project requires careful planning. Given the lead time for invitation of various tenders, system installations, test-runs and relevant staff training, we expect that the new systems will commence operation by end 2012. Before the commissioning of the new ATC system, CAD will continue to enhance its ATC capacity and efficiency through :

- (a) continuing its discussion with the civil aviation authorities of the Mainland and Macao on measures to improve the use of airspace and the coordination of air traffic management in the PRD region;
- (b) further improving the ATC equipment within the constraints of the existing system;
- (c) recruiting and training more controllers; and
- (d) applying new ATC technology and streamlining flight procedures where possible.

#### Need to Develop a New CAD Headquarters

9. Aviation is a highly specialized and multi-disciplined industry. Its regulation requires close collaboration among different functional divisions of CAD. At present, CAD's headquarters and five functional divisions are scattered among four different locations, namely :

- (a) the Government-owned ATC centre on the air-side of HKIA, where CAD's Air Traffic Management Division (ATMD) is housed;
- (b) the leased premises at the Air Freight Forwarding Centre on the land-side of HKIA, housing the Flight Standards and Airworthiness Division (FSAD) as well as the Engineering and Systems Division;

- (c) the rent-free premises provided by AA at the Passenger Terminal Building on the land-side of HKIA, housing the Airport Standards Division; and
- (d) the Government-owned premises at the Queensway Government Offices, where the CAD headquarters and the Air Services Divisions are accommodated.

10. Scattered accommodation is highly undesirable from the operation angle. It hinders efficient communication among the divisions and between divisions and headquarters. It slows down CAD's response time in emergency situations such as serious aircraft incidents. It also prevents CAD from providing convenient and one-stop service to the aviation industry based at HKIA. Besides, staff performing ATC functions account for 65% of CAD's manpower, and they are now working at the ATC Centre located on the restricted air-side, the access to which is subject to time-consuming airport security checks. Importantly, scattered accommodation has also resulted in the duplication of administrative and support efforts, and led to unnecessary travel between the scattered offices as well as time spent in undergoing security screening between the land and air sides.

11. A co-located CAD headquarters will also provide timely accommodation for the replacement ATC system, which would require a space three times the size of the existing ATC Centre. However, in-situ replacement is not possible given the limited space and the disruption that this will cause to the ongoing ATC services which must be provided. Expansion of the existing centre is also not a viable option because of the lack of adjoining land and the disruption that might be caused to existing services. Further expansion of the ATC Centre on the air-side would also aggravate the inefficiency problem associated with the air-land side transfer.

12. Against the above, we propose to develop a new CAD headquarters on the land side of the Airport Island to house the new ATC system and the whole Department. Co-location will resolve the many shortcomings of the existing situation of scattered accommodation. It will enhance CAD's productivity through the speedy provision of

services and effective regulation of the aviation community, and maximize synergy among the various stakeholders also located on the Airport Island.

#### Annex A

13. With the consent of AA, a site at the southeastern part of Airport Island to the north of the Dragonair and China National Aviation Corporation (CNAC) Building, as shown in Annex A, has been identified as the location for the new CAD Headquarters cum ATC centre. A study completed by the Architectural Services Department (ArchSD) in end November 2006 has confirmed that the project is technically feasible. After the relocation, all CAD offices including the ATC centre and its associated operational facilities will be housed under one roof. Whilst the equipment at the current Control Tower and the Backup Tower on the air-side will be upgraded in tandem with the other parts of the ATC system, they will remain at the existing location to provide air traffic controllers with a close and unobstructed view of the runways, taxiways and airport apron. We are finalising details of the building project and will revert to this Panel with a detailed proposal in the fourth quarter of 2007.

### **Manpower Requirements**

#### Project Team

14. The procurement, installation and testing of the replacement ATC system and construction of the CAD headquarters are key elements of a highly complicated project. Having considered the scope and volume of work involved, we propose to set up a dedicated team within CAD to ensure timely completion of the project and the smooth commissioning of the replacement ATC system. The team will be headed by an Assistant Director-General of Civil Aviation (ADGCA) (D2), who will act as the overall project coordinator to secure funding approvals for the project; liaise with the works agents, AA and other relevant parties to ensure timely completion of the CAD building; and oversee the procurement and smooth commissioning of the replacement ATC system.

15. The ADGCA post will be supported by 41 non-directorate staff comprising :

- (a) 2 Air Traffic Controllers (ATCO) I and 17 ATCO II to be created in two batches in 2007-08 and 2008-09<sup>1</sup>, together with 6 Air Traffic Flight Services Officers I (AFTSO I) and 3 Aeronautical Communications Officers I (ACO I) to be temporarily redeployed, who will be responsible for planning and design of the operational requirements of the new system, preparation of tender specifications, installation, testing and evaluation of the new system and designing new operation and flight procedures;
- (b) 2 Electronic Engineers (EE) to be created in 2007-08, together with 1 Senior Electronics Engineer and 2 EE to be temporarily redeployed, and 7 Non-Civil Service Contract Technical Officers (NCSC TO) to be employed, who will be responsible for planning and designing the system requirements and specifications, conducting tender exercises to procure the various components of the system, overseeing system installation and commissioning and performing integration testing and safety assessment of the ATC facilities; and
- (c) 1 Senior Architect (SA), already created on a supernumerary basis, mainly to assist in monitoring and coordinating the construction part of the project.

Particularly with regard to (a) above, a team of the proposed size is the minimum requirement. When CAD last relocated the ATC centre and control tower from Kai Tak to Chek Lap Kok, a project team including 67 ATC specialists and 18 engineering officers was established.

16. The work of the team involves, at the initial stage of the project, very substantial inputs in the planning, tendering and design of the CAD building which need to cater for the specialized requirements of a modern ATC system. Meanwhile, the team has to make an early start in drawing

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<sup>1</sup> The 2 ATCO I and 7 ATCO II will be created in 2007-08 whereas the other 10 ATCO II will be created in 2008-09.

up the detailed requirements to prepare for the procurement of the ATC system (comprising 17 major sub-systems and other ancillary systems). In the middle part of the project, the team has to coordinate and arrange for the training of all the existing ATC staff by phases without affecting the normal operations of the department. Towards the end of the period, the team has to closely coordinate and monitor the transition from the existing ATC system to the new system which must be completed in a seamless manner without causing any disruption to the continuous provision of ATC service. The above are all labour intensive tasks requiring heavy ATC expertise. A list of the critical tasks involved is at Annex B.

Annex B

17. Given the complexity and tight timeframe of the project, it is considered appropriate to pitch the team leader post at D2 level such that he can make use of his breadth and depth of knowledge and experience to provide critical steer and inputs, take proactive actions to resolve issues affecting the timely implementation of the project, and maintain close liaison with all stakeholders. The proposed supernumerary ADGCA post, reporting directly to the Director-General of Civil Aviation, will be required for five and a half years from October 2007 to March 2013 to see through the preparation and implementation of the entire project. This duration is necessary as the officer is responsible not only for the development of the new CAD headquarters but also the preparatory work including staff training and commissioning of the ATC system. The CAD organization chart including the proposed project team and the job description of the supernumerary ADGCA post are at Annexes C and D respectively.

Annex C

Annex D

18. Entrusting the leadership and coordinating role to an existing officer is not feasible when the existing directorate officers in CAD are all working at full capacity due to the increased workload arising from the fast growing air traffic. Sharing the duties among several posts is also impractical given the need for unified leadership and high-level coordination to see through the project.



## Air Traffic Management Standards Office

19. As an integral component of the project, it is also necessary to set up an Air Traffic Management Standards Office (ATMSO) to oversee the safety of CAD's ATC operations on an ongoing basis. The proposal to set up the ATMSO is in line with the findings of a study in 2000 by the United Kingdom Civil Aviation Authority (UKCAA) on Hong Kong's ATC operations, which recommended the setting up of an office which is separate from the division responsible for providing day-to-day ATC service to oversee the latter's operations. This arrangement, which provides a more objective check and assessment of ATC operations, is in line with the international best practice and is instrumental in upholding our safety standards<sup>2</sup>. For this reason, CAD has since 2003 set up a skeleton unit to perform some of the essential functions on a temporary basis. However, this temporary arrangement has added pressure on the already stringent staffing situation in CAD, particularly with regard to the air traffic control side, and is becoming unsustainable as air traffic at the HKIA continues to grow.

20. With the need to replace the ATC system confirmed, it has now become clear that an ATMSO should be established on a long term basis to review the safety standards of the entire ATC system and ensure compliance with the latest international standards in the run-up to the establishment of the replacement system and beyond. Given the experience and expertise required to perform this key regulatory function, the ATMSO should be led by a permanent directorate officer at the rank of a Chief Air Traffic Control Officer (CATCO) (D1), who will be supported by one ATCO I and one ATCO II. These posts are proposed to be created in the third quarter of 2007. The organization chart of the proposed ATMSO and the job description of the permanent CATCO post are at Annexes E and F respectively.

Annex E

Annex F

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<sup>2</sup> The recommendation was also supported by Members of this Panel when they discussed the UKCAA's recommendations in April 2001.

## Implications of the Proposal

### Financial Implications

21. The total capital cost of the project, to be completed by 2012, is estimated to be \$3,155M, with the following break-down :

	\$M
(a) replacement ATC system (including backup system) and associated training system	1,565
(b) building cost of the CAD headquarters	1,590*
	<hr/> 3,155

\* Preliminary project estimate at the third quarter of 2006 price levels  
{TPI = 700 (provisional)}

### Annex G

A detailed break-down of the costs of the individual components of the replacement ATC system is set out at Annex G. Detailed break-down of the building project estimate will be given when we revert to this Panel with our finalized proposal.

22. The additional notional annual salary cost of the proposed supernumerary D2 and permanent D1 posts at mid-point are \$1.36 million and \$1.14 million respectively, whereas the full annual average staff cost, including salaries and staff on-cost, for the two posts are \$1.83 million and \$1.55 million. Based on the proposed set-up of the project team and ATMSO in paragraphs 15 and 20 above, the notional annual salary cost of the 23 additional posts of non-directorate supporting staff at mid-point is \$16.82 million, and the full annual average staff cost, including salaries and staff on-cost, is \$28.79 million. These non-directorate posts will be created within the resources allocated to CAD.

23. We have included the necessary provision in the 2007-08 draft Estimates to meet the cost of the staffing proposal. Sufficient provisions will also be set aside to meet the recurrent costs of the CAD building and the replacement system after completion of the project.

### Impact on Charges

24. Under the existing “user-pays” principle, the amortised project cost and the recurrent cost for providing air traffic control service will be recovered through the ATC service charges collected from AA (which in turn will take into account the ATC service charges when determining the landing charges that it collects from the airline operators) and en-route navigation charges (for overflying aircraft without landing at HKIA) collected directly from airlines by the Government. The total ATC service charges collected from AA are estimated to increase from the existing level of \$638 million to \$845 million in 2013. However, since the number of flights using HKIA is expected to increase from 140,000 to 176,000 during the same period, it is likely that the cost per flight will only see a mild increase of less than \$300, or about 6%<sup>3</sup> of the existing figure. Likewise, it is not envisaged that the en-route navigation charge, currently at \$4.8 per nautical mile, will see any significant change arising from the project when the increased costs are expected to be cancelled out by the increased traffic.

### Economic Implications

25. The proposal to replace the ATC system would ensure the continued provision of safe and reliable ATC services in line with traffic growth. This is crucial to maintaining Hong Kong’s status as an international and regional aviation centre amidst keen competition posed by other airports in the region. The estimated additional cost transferred to the industry is not significant. Therefore, there should be net benefit to the Hong Kong economy. It is estimated that consequential to increased flights permitted by the proposal, the increase in value added of air transport activities will reach \$16.2 billion per year in current market prices by 2020. In addition, there will be indirect positive impact on the

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<sup>3</sup> Assuming that AA will fully pass on any additional ATC service charges to the airlines. The cost per flight may be lowered after 2013 should the number of flights using HKIA increase further as projected by AA.

trading, logistics and tourism sectors which rely heavily on our world-class airport.

### **Implementation Plan**

26. CAD plans to implement the project according to the following schedule :

<b>Activity</b>	<b>Target completion date</b>
Funding approval for the new ATC system, creation of two directorate posts and CAD headquarters	May 2007 (system and posts) December 2007 (headquarters)
Tender invitations for various components of the new ATC system	August 2008 – March 2010
Award of contracts for various components of the new ATC system	September 2009 – October 2010
Equipment Delivery	April 2011 – July 2011
Installation and integration of the new ATC system for testing and evaluation	February 2012
Operational evaluation and controller training	December 2012
Transition to and Commissioning of the new ATC system	December 2012
Delivery of backup ATC system	January 2014
Installation, integration and commissioning of backup ATC system	January 2015

## **Public Consultation**

27. CAD has sought comments on the project from representatives of the aviation industry, including International Air Transport Association, Board of Airline Representatives, AA, Airline Operators Committee, airlines holding the Air Operator's Certificates issued by CAD, Hong Kong Aircraft Engineering Co. Ltd. and Hong Kong Air Traffic Control Association. Some representatives are concerned about the possible increase in ATC and En-route Navigation Charges resulting from the financial investment by CAD in the project and have asked for greater transparency in any adjustment to these charges in future. In general, the industry representatives support the replacement of the ATC system and the building of a CAD headquarters on the Airport Island, which they agree will help sustain the healthy growth of the aviation industry.

28. Separately, noting that the proposal can meet the development needs of our aviation industry, the Aviation Development Advisory Committee has also indicated its support for the proposal.

## **Way Forward**

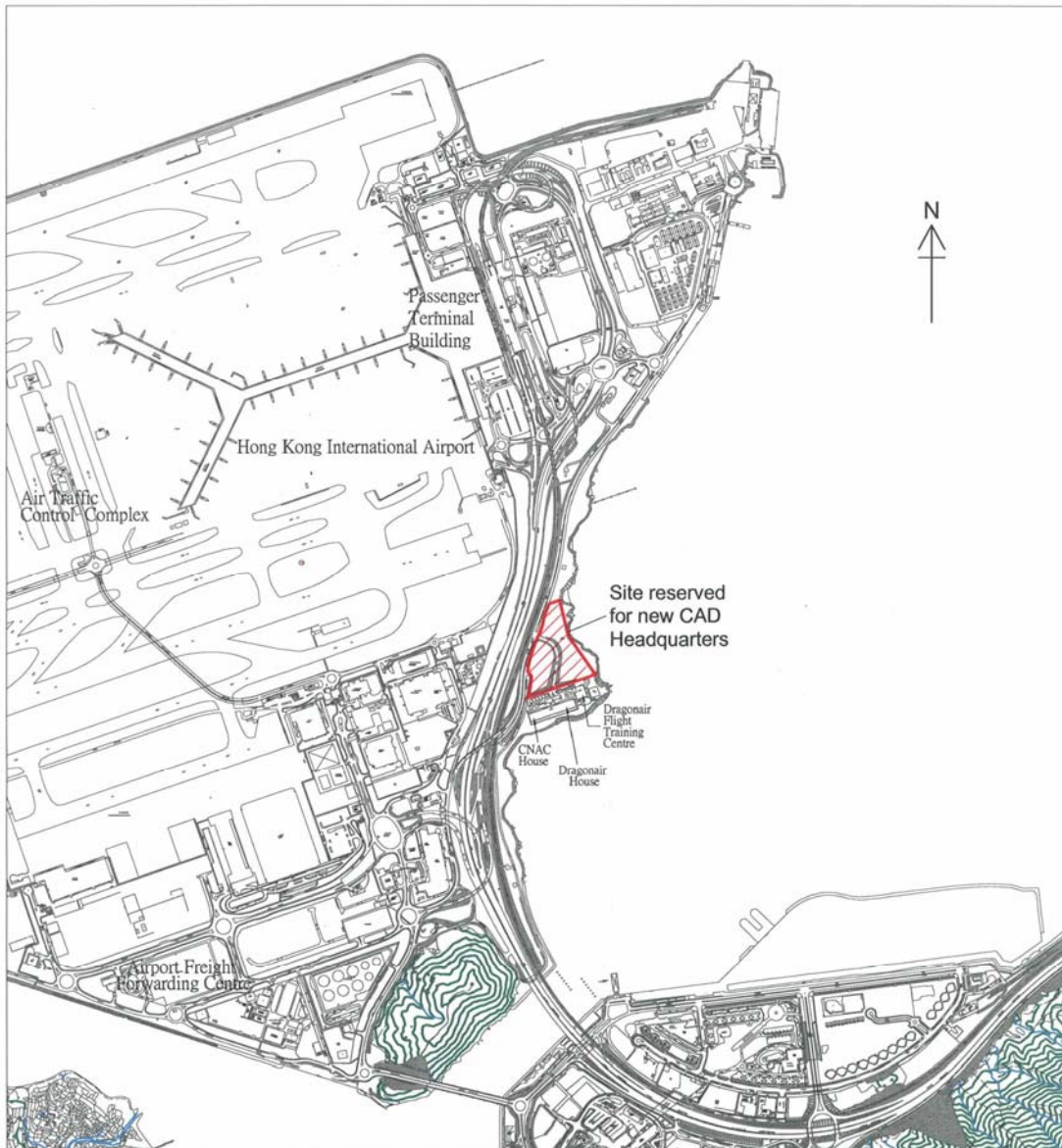
29. Subject to Members' views, we will submit the proposed creation of the two directorate posts as set out in paragraphs 15 and 20 above to the Establishment Subcommittee of the Finance Committee for discussion on 25 April 2007. We also plan to seek funding approval from the Finance Committee on 11 May 2007 for the replacement ATC system. We will brief the Panel on the details of the development of the CAD headquarters in the fourth quarter of 2007 when the details are available and seek funding approval from the Finance Committee for the same afterwards.

## **Advice Sought**

30. Members are invited to note and comment on the proposal.

Economic Development and Labour Bureau  
15 February 2007

**Proposed Site for the CAD Headquarters**



**Critical Tasks to be Undertaken by the Project Team**

2007-08

- Define overall system design and operational requirements including the human-machine interfaces for some 17 major components and other ancillary facilities of the ATC system
- Liaise with adjacent ATC authorities on the interface and protocol standards for the inter-operability of the new ATC system with their systems

2008-09

- Define training requirements in the tender and contract specifications for the various components and ancillary facilities
- Formulate the training plan for the operations of the new ATC Centre and revised flight procedures
- Prepare tender documents for the procurement of the various components and ancillary facilities

2009-10

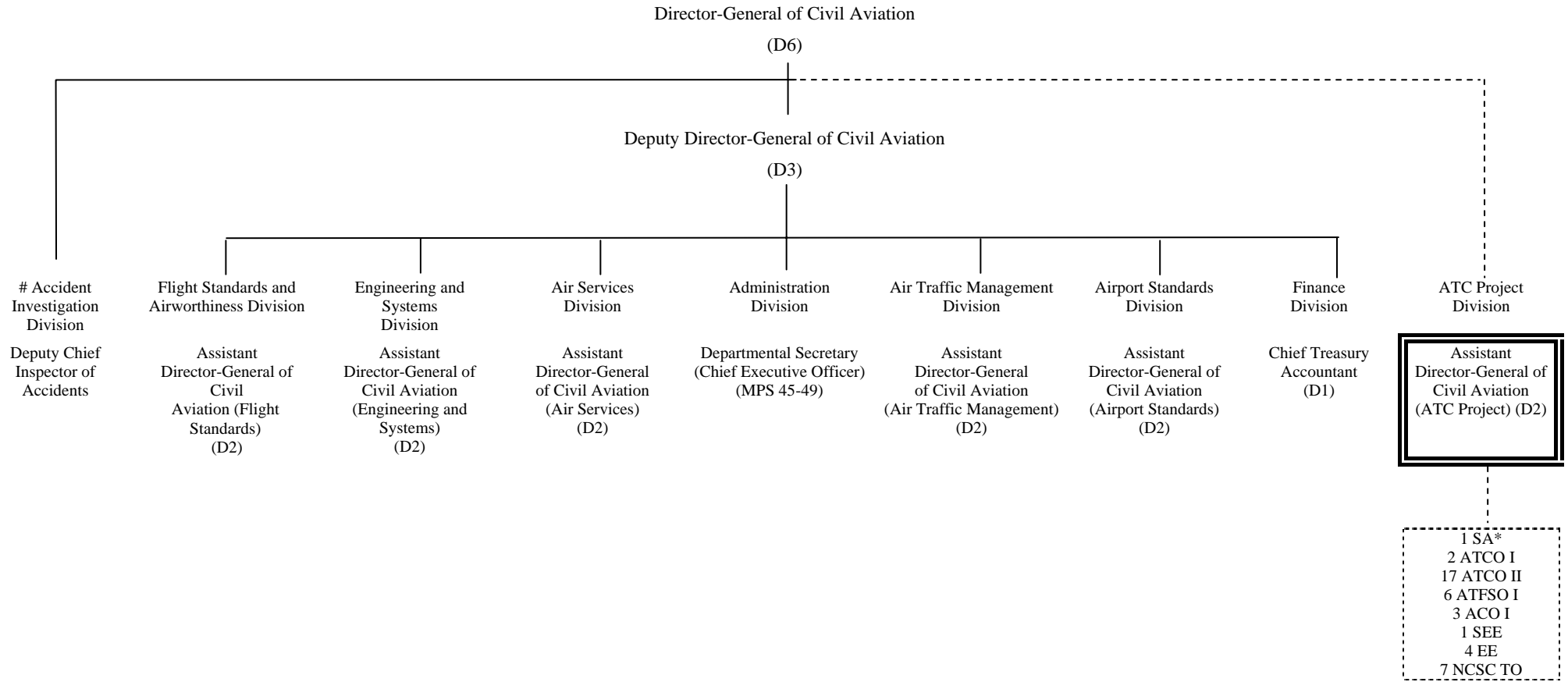
- Conduct tender evaluations and award contracts for the various components and ancillary facilities
- Participate in the “train-the-trainer programme” in the factories of the various equipment suppliers
- Prepare the training materials to suit Hong Kong’s traffic configuration and operating environment, including the system degradation on failure, and failure recovery procedures
- Draft course plans for subsequent training of operational controllers in various operational streams
- Formulate the work plan for transition and parallel operations of the two ATC Centres

## 2010-11 and onwards

- Monitor the production of the relevant equipment, attend factory acceptance testing, and supervise the site installations
- Carry out site testing, acceptance and integration of the various components and ancillary facilities
- Conduct classroom and hands-on training and refresher courses on operating the new ATC system and revised operational and flight procedures
- Provide relief for more than 200 operational controllers who will have to undergo training related to the new ATC system in batches
- Design and carry out drills for the ATC Centre transition and parallel operations
- Plan and execute the transition between the existing and new ATC Centres and their parallel operation at the initial stage



**ORGANIZATION CHART  
Civil Aviation Department**



# The Director-General of Civil Aviation is also Chief Inspector of Accidents. The Accident Investigation Division is mobilised only when required by drawing specially trained staff from other Divisions.

  Supernumerary D2 post proposed to be created

  Other Non-directorate posts to be created in phases

\* existing supernumerary post

**Job Description**  
**Assistant Director General of Civil Aviation (ATC Project)**

**Rank** : Assistant Director General of Civil Aviation (D2)

**Responsible to** : Director General of Civil Aviation

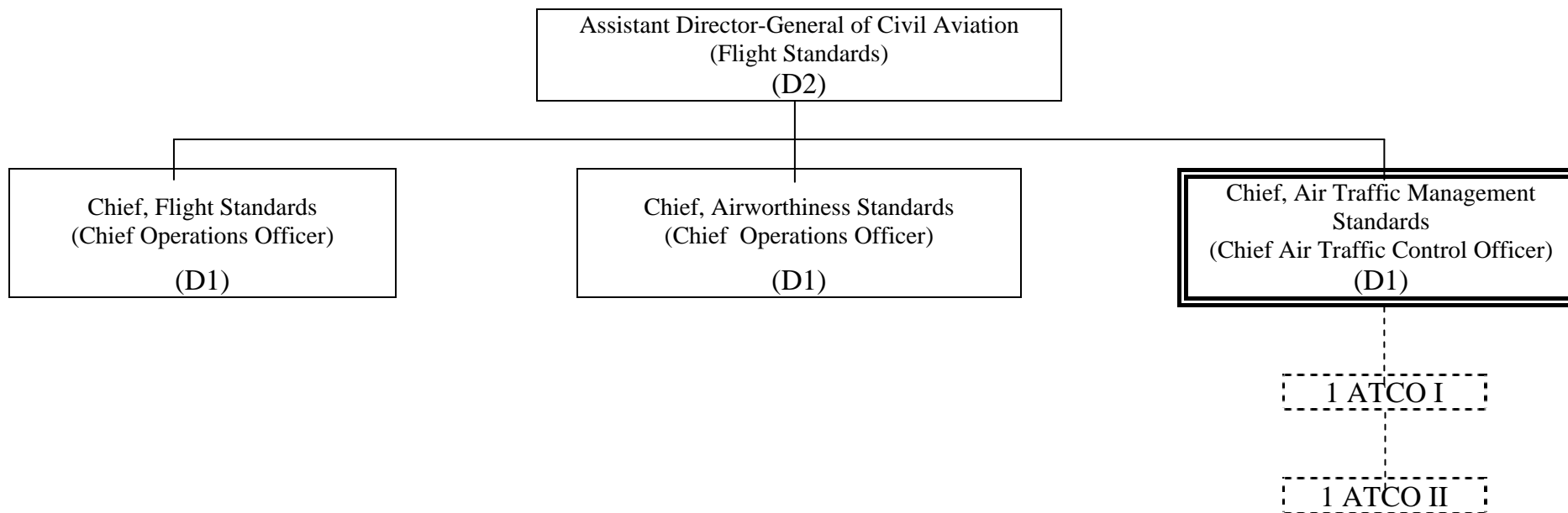
**Main Duties and Responsibilities :**


1. To lead a designated team within CAD to oversee and coordinate the replacement of the ATC system and development of a new CAD Headquarters on the Airport Island (the Project);
2. To head the Steering Committee comprising representatives from CAD, EDLB and other relevant bureaux/departments for securing funding approvals and overseeing the implementation of the Project including the timely installation and commissioning of the new ATC system;
3. To act as a focal point of contact with all relevant bureaux/departments for the implementation of the Project, and to represent CAD in its liaison and negotiation with the non-government organizations, including Airport Authority, the building contractor, equipment suppliers, and security, maintenance and other service providers;
4. To coordinate divisional inputs and to resolve any policy and design issues to ensure timely preparation of the various tender documents, assessment of bids received and award of the tenders for the replacement ATC system and the CAD building;
5. To coordinate divisional efforts to draw up and implement a transition plan, which includes devisal of flight procedures and phased training for all ATC staff for operating the new system; timely delivery, installation and testing of ATC equipment; relocation of offices; the contingency plan for any delays; and a detailed operational plan to ensure a seamless transition from the existing ATC system to the new system;
6. To closely monitor throughout the entire stage of building construction of the CAD building for early detection and rectification of any slippage, mismatches to design or building defects to ensure that the building can be completed on time and to the satisfaction of the users;


7. To provide policy inputs and set up guidelines in respect of maintenance, management and security requirements for the new building, and to participate in the selection of service providers and establishment of the related administration procedures;
8. To periodically report to the Senior Management of CAD and EDLB on the progress of the Project's implementation; and
9. To conduct, as and when necessary, consultation sessions with industry players like International Air Transport Association, Board of Airline Representatives, and the Hong Kong-based airlines and aircraft engineering companies so as to keep them informed of the progress of the Project and the new ATC system, and seek to address their concerns thereof.

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**Organization Chart of  
Air Traffic Management Standards Office  
In Flight Standards and Airworthiness Division**



 Permanent CATCO post proposed to be created

 Other non-directorate posts to be created

**Job Description**  
**Chief, Air Traffic Management Standards**

**Rank** : Chief Air Traffic Control Officer (D1)

**Responsible to** : Assistant Director-General (Flight Standards)

**Main Duties and Responsibilities :**

1. To vet, endorse and regularly review the Air Traffic Management (ATM) operational procedures developed by the air navigation services provider to ensure their compliance with the safety policies and safety regulatory requirements set by ATM Standards Office (ATMSO);
2. To oversee the implementation of an independent check-and-balance mechanism on the safety of ATM operations through conducting regular inspections and audits to the air navigation services provider and recommending strategies and action plans for enhancement of safety;
3. To develop, implement and regularly review the air traffic controller licensing policies and procedures, and oversee the administration of the air traffic controllers' licences, control ratings and associated medical certificates in accordance with the Hong Kong air navigation legislative requirements;
4. To administer the Flight Standards and Airworthiness Division's Mandatory Reporting Scheme on reportable occurrences related to ATM operations by analysing those occurrences and providing recommendations for safety promotion in accordance with the Articles and Schedules of the Air Navigation (Hong Kong) Order, 1995;
5. To liaise and collaborate at senior levels with other aviation regulatory authorities, government agencies or international organizations and ICAO to review safety issues of mutual concern with a view to enhancing the ATM safety standards and regulations in Hong Kong;
6. To act as Accidents Investigator, as and when the Director-General of Civil Aviation decides to mobilise the Accident Investigation Division, to investigate into aircraft accidents and serious incidents, and to review ATC incident investigation reports submitted by air navigation services provider; and
7. To assume overall management of the ATMSO and to ensure that its staff are properly trained and equipped to perform its regulatory functions.

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**Estimated Capital Cost for the Replacement ATC System**

		<b>\$ million</b>
<b>(a)</b>	<b>Replacement ATC System (including backup system<sup>1</sup>)</b>	
(i)	Radar Data Processing and Display System/Flight Data Processing System (RDPDS/FDPS)	675
(ii)	Speech Processing Equipment	165
(iii)	Aeronautical Information Database	120
(iv)	ATS Message Handling System and Aeronautical Telecommunication Network	75
(v)	Cable/Microwave Link Network	120
(vi)	Centralised Monitoring and Control System	15
(vii)	Very Small Aperture Terminal	15
(viii)	Voice Recording/Playback System	23
(ix)	Telephone System	6
(x)	Secondary Surveillance Radar Situation Display System	3
(xi)	ATC Radio Telephony Workload Monitoring System	3
(xii)	Un-interruptible Power Supply System	8
(xiii)	Master Clock System	5
(xiv)	Radar Data Formatter	5

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<sup>1</sup> Similar equipment as the replacement system but of 50% capacity.

		\$ million
(xv)	Other Ancillary Systems/Facilities (including operating consoles, Information System Data Distribution Network, Barometric Pressure at Sea Level Alarm System, Interface Systems with AA, Hong Kong Observatory, Meteorological Display system, Specialised Controller Chairs, Cosmicheskaya Sistyema Poiska Avariynich Sudov-Search and Rescue Satellite-Aided Tracking Workstations, ATC Fast-Time Simulation System, etc.)	112
(xvi)	Contingency	150
	Sub-total	1,500
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<b>(b)</b>	<b>Replacement Training/Simulator Systems</b>	
(i)	Radar Simulator for RDPDS/FDPS	26
(ii)	Tower Simulator	28
(iii)	Computer-Based Training (CBT) System	5
(iv)	Contingency	6
	Sub-total	65
	<b>Total</b>	<b>1,565</b>