

ITEM FOR FINANCE COMMITTEE

CAPITAL WORKS RESERVE FUND

HEAD 708 – CAPITAL SUBVENTIONS AND MAJOR SYSTEMS AND EQUIPMENT

Civil Aviation Department

New Subhead “Provision of air navigation service equipment to support the Three-Runway System at the Hong Kong International Airport and replace existing aged air navigation service equipment”

Members are invited to approve a new commitment of \$2,958 million for the provision of air navigation service equipment to support the Three-Runway System at the Hong Kong International Airport and replace existing aged air navigation service equipment.

PROBLEM

To support the implementation of the Three-Runway System (3RS) at the Hong Kong International Airport (HKIA), new air navigation service (ANS) equipment is required. Besides, some existing ANS equipment items will soon reach the end of their serviceable life. They have to be replaced and upgraded to cope with the expected increase in air traffic.

PROPOSAL

2. The Director-General of Civil Aviation, with the support of the Secretary for Transport and Housing, proposes to create a new commitment of \$2,958 million to provide new ANS equipment to support the 3RS at the HKIA, and replace and upgrade existing aged ANS equipment.

/JUSTIFICATION

JUSTIFICATION

Need for ANS Equipment

3. To provide safe, reliable and efficient air traffic control (ATC) services for flights arriving at or departing from the HKIA and aircraft overflying the Hong Kong Flight Information Region (HKFIR), which covers a total area of 276 000 square kilometres, appropriate provision of ANS equipment is essential. At present, ANS equipment is installed at the two existing ATC towers (one as main tower and one as back-up), ATC centres¹ and various on-airport and off-airport locations². With the additional runway and associated taxiways under the 3RS, new ANS equipment is required to ensure safe and efficient operation of the additional runway in accordance with the requirements of the International Civil Aviation Organization (ICAO)³. The installation of some of these new ANS equipment items will also support the operation of the existing runways and associated taxiways. For example, we need to install new detectors/sensors related to the Advanced Surface Movement Guidance and Control System on the new airfield providing surveillance of both existing and new runways and associated taxiways.

4. Apart from new ANS equipment as mentioned in paragraph 3 above, some existing ANS equipment items located both on-airport and off-airport have been in use for some 20 years and need to be replaced. For example, the off-airport radar needs replacement and upgrading even without the implementation of 3RS. They should be replaced with upgraded equipment items which can meet the latest requirements of ICAO and cope with the expected increase in air traffic to be brought about by, among others, the full implementation of 3RS.

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¹ Currently, the two ATC towers housing ANS equipment are located near the existing two runways to support ATC services for aircraft operating at the HKIA. In addition, an ATC centre located at the Civil Aviation Department (CAD) Headquarters and a backup ATC centre on airfield both with ANS equipment support ATC services for aircraft operating further away from the HKIA but within the HKFIR.

² The off-airport locations installed with ANS equipment include Victoria Peak, Mount Butler, Cape D'Aguilar, Tai Mo Shan, Sha Chau, Mount Parker, Beacon Hill, Tung Lung Island, Cheung Chau, Siu Mo To, Lung Kwu Chau, Shek Uk Shan and North Lantau.

³ Hong Kong, being part of China which is one of the 192 Contracting States of ICAO, has an obligation to comply with the standards set by ICAO.

The Proposed ANS Equipment

5. The proposal comprises –
- (a) provision of new/replacement and upgrading of existing ANS equipment and associated facilities at on-airport locations to support the air traffic growth to be brought by, among others, the full implementation of the 3RS and to enhance the handling capacity of the HKIA; and
 - (b) replacement of existing aged ANS equipment at off-airport locations to ensure the continuous provision of ANS as some existing equipment items are about to reach the end of their serviceable life. The opportunity is also taken to upgrade the equipment to support the air traffic growth to be brought by, among others, the full implementation of the 3RS.

Provision of New/Replacement and Upgrading of ANS Equipment and Associated Facilities at On-airport Locations

6. The present ANS equipment at the existing ATC towers, ATC centres and various on-airport locations supports the existing Two-Runway System operation of the HKIA. Under Public Works Programme project 3069GI, a new ATC tower⁴ will be constructed for providing ATC services to support the 3RS operation in conjunction with one of the existing ATC towers, both as main towers. For details, please refer to the relevant Public Works Subcommittee paper (i.e. PWSC(2018-19)25). New ANS equipment with various advanced functions and enhanced air traffic handling capabilities as detailed in Items 1 to 3 at Enclosure will be provided at the new tower (and existing towers/centres where appropriate) in order to maintain safe, reliable and efficient ATC services to increased number of aircraft landing and taking off at the HKIA. New technologies will be employed to improve operational efficiency. For example, digital tower facilities (Item 2 at Enclosure) will be installed to enhance the visual capabilities of air traffic controllers by making use of high-resolution surveillance cameras.

Encl.

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⁴ Pending the commissioning of the new ATC tower by end 2024, the new third runway scheduled for commissioning in 2022 will be under the control of an interim ATC tower constructed on top of the Airport Authority Hong Kong (AAHK)'s premises for aircraft recovery equipment store. The interim ATC tower will be fully funded by AAHK to allow CAD and Hong Kong Observatory to provide ATC and aviation weather service respectively during the interim Two-Runway System operation (i.e. the operation of the new third runway and the existing South Runway). Upon the commissioning of the new ATC tower, all ATC and aviation weather service functions for the new third runway will be transferred to it. The interim ATC tower will be decommissioned as the new Third Runway Passenger Building, which will be commissioned by end 2024, will block part of its view of the new taxiways.

7. In addition, ANS equipment for the purpose of supporting communication between air traffic controllers and pilots, detecting aircraft movements and navigating aircraft to the runways and associated taxiways as detailed in Items 4 to 8 at Enclosure will be procured/replaced and upgraded to support the 3RS operation at HKIA. For example, Ground Based Augmentation System (Item 6 at Enclosure), which makes use of satellites to support precision approach and landing of aircraft, will be employed to enhance operational efficiency and support complex flight procedures. Furthermore, various associated/ancillary facilities, e.g. Closed Circuit Television and Recording System as detailed in Item 9 at Enclosure will also be procured.

Replacement/Upgrading of Existing Aged ANS Equipment at Off-airport Locations

8. Apart from the on-airport ANS equipment, off-airport ANS equipment is installed at various locations throughout Hong Kong for providing timely aircraft information to facilitate the work of air traffic controllers. For example, primary surveillance radars and secondary surveillance radars are installed at various locations in Hong Kong to provide surveillance of aircraft within the HKFIR. These systems are detailed in Items 10 to 12 at Enclosure.

9. Most of the existing off-airport ANS equipment items have been in continuous service for nearly 20 years. While their performance has been maintained through on-going maintenance and enhancements, they are reaching the end of their serviceable life. They have to be replaced with upgraded capabilities to meet the latest ICAO requirements/technical standards and be equipped with enhanced information processing capability for the continuous provision of safe and efficient ANS. For example, the upgraded radars will be equipped with advanced surveillance capabilities for greater precision. In addition, these off-airport ANS equipment items are not originally designed to cope with the projected increase in aircraft movements of the 3RS operation. They have to be upgraded in order to support the increased traffic to be brought about by the implementation of the 3RS. Furthermore, replacement or refurbishment works for the aged ANS equipment shelters and associated building services/electrical and mechanical facilities, antenna towers, etc. are also required to ensure continuous and reliable provision of ANS.

/ALTERNATIVES

ALTERNATIVES CONSIDERED

10. CAD has considered other alternatives, including whether it would be possible to further extend the serviceable life of the existing aged ANS equipment at off-airport locations through enhanced maintenance. Considering that such equipment is about to reach the end of its serviceable life, it would be increasingly difficult, if not impossible, to source spare parts for maintenance. Further, the potential risk to the provision of reliable service will also increase with time. CAD therefore considers the proposal is the only viable option which is essential in supporting air traffic growth at the HKIA and within the HKFIR, fostering growth and development of the aviation industry and economy of Hong Kong, and maintaining the status of the HKIA as a leading international airport and Hong Kong as an international aviation hub.

FINANCIAL IMPLICATIONS

Capital Expenditure

11. CAD estimates that the capital expenditure of the proposal is \$2,958 million, with the following breakdown –

(I) *Provision of New/Replacement and Upgrading of ANS equipment and Associated Facilities at On-airport Locations (\$1,371 million)*

			\$ million
(A)	New ANS Equipment for ATC Towers/Centres		
(i)	Controller Working Positions (CWPs)		200 ⁵
(ii)	Digital Tower Facilities		80
(iii)	Air Traffic Flow Management Facilities		90
			/(B)

⁵ Subsequent to the meeting of the Legislative Council Panel on Economic Development on 28 May 2018, CAD has carefully reviewed and concluded that the more advanced integrated CWPs should be adopted in the new ATC tower. By integrating the information provided to controllers and minimising the number of displays, operational efficiency and aviation safety can be enhanced. In the longer run, the integrated CWPs would provide better efficiency gain for tower operation in general. In the interest of aviation safety, the integrated CWPs will be adopted in the new ATC tower as well as the existing main and backup ATC towers to ensure consistency in operation procedure of all tower operations. Taking into account the above, the total cost for installing the 19 positions needed in the new ATC tower and the replacement of a total of 26 positions in the existing main and backup ATC towers (or 45 integrated CWPs in total) is \$200 million. This estimate has been adjusted from the original estimate of \$350 million, mainly through cost savings from re-using the AAHK-procured back-end systems for the interim ATC tower and associated interface modifications and connections with existing systems (including the Air Traffic Management System).

		\$ million
(B)	New/Upgraded ANS Equipment on the Airport	
(i)	Radio Communication System	90
(ii)	Instrument Landing System	70
(iii)	Ground Based Augmentation System	90
(iv)	Surface Movement Radar	250
(v)	Advanced Surface Movement and Guidance Control System	160
(C)	New Associated/Ancillary Facilities	
	Other Associated/Ancillary Facilities (including but not limited to, Aeronautical Data Analysis Tools, Obstacle Lighting System, Communication Infrastructure, Fault Reporting Centre Facilities, Air Traffic Control Tower Interfaces, Closed Circuit Television and Recording System, Geospatial Database and Charting System, Simulators, etc.)	130
(D)	Professional Services	60
(E)	Contingency	151
	Sub-total	1,371

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(II) Upgrade/Replacement of Existing Aged ANS Equipment at Off-airport Locations (\$1,587 million)

	\$ million
(A) Communications	
Communication System	315
(B) Navigation	
Doppler Very High Frequency Omni-directional Radio Range and Distance Measuring Equipment	60
(C) Surveillance	
Surveillance System	455
(D) Site Refurbishment Capital Works	530
(E) Professional Services	70
(F) Contingency	157
Sub-total	1,587
Total	2,958

12. On paragraph 11(I)(A) to 11(I)(C), the estimate of \$1,160 million is for the provision of equipment, installation, testing, commissioning and operational/technical training for the new/upgraded ANS equipment and associated facilities at on-airport locations.

13. On paragraph 11(II)(A) – 11(II)(C), the estimate of \$830 million is for the provision of equipment, installation, testing, commissioning and operational/technical training for the upgrade/replacement of existing aged ANS equipment at off-airport locations.

14. On paragraph 11(I)(D) and 11(II)(E), the estimate of \$130 million is for the consultancy on procurement, design, safety assessment, cutover and transition of new and replaced/upgraded ANS equipment; as well as on-site technical support/assistance during installation, integration, testing, commissioning cutover, transition and decommissioning as necessary.

15. On paragraph 11(II)(D), the estimate of \$530 million is for the replacement or refurbishment works for the aged ANS equipment shelters and associated building services/electrical and mechanical facilities, antenna towers, etc.

16. On paragraph 11(I)(E) and 11(II)(F), the estimate of \$308 million represents an approximately 10% contingency of the total cost estimate at \$2,958 million.

17. The estimated cash flow requirement of the proposal is as follows –

Financial Year	\$ million
2018-19	1
2019-20	28
2020-21	553
2021-22	404
2022-23	526
2023-24	284
2024-25	410
2025-26	253
2026-27	233
2027-28	266
and onwards	
Total	2,958

Recurrent Expenditure

18. CAD estimates that the additional recurrent expenditure arising from the proposal will be \$89 million per annum in full year. A breakdown is provided below –

	\$ million
(a) Day-to-day technical support	36.8
(b) Hardware and software maintenance	38.9
(c) Spare parts	13.3
Total	89.0

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19. In compiling the cost estimate, CAD has obtained indicative quotes from potential suppliers for major cost items. To minimise the impact of possible underestimation, CAD has obtained quotes from major suppliers worldwide and provided for project contingency per the established practice. CAD will exercise prudence and due diligence in proceeding with the procurement of equipment and services.

20. According to the “user pays” principle, the costs for CAD to provide ANS will be fully recovered from airlines (through en-route navigation charges (ENCs)) for overflying aircraft without taking off/landing at the HKIA, and from AAHK (through ATC services charge) for aircraft taking off/landing at the HKIA. In setting the ENCs and the ATC services charge in future, CAD will take into account the depreciation cost of the capital expenditure estimated at \$2,958 million, additional recurrent cost estimated at \$89 million per annum and inflation with a view to recovering the full ANS costs.

21. The capital expenditure will be amortised evenly over the estimated useful life of 20 years starting from end 2024 and included in the costs of the provision of ANS. The actual amounts to be charged will depend on the proportion of air traffic landing/taking off at the HKIA and overflying the HKFIR, inflation and other factors. The apportioned ANS costs will be recovered from airlines (through ENCs) and AAHK (through ATC services charge).

22. It is worth noting that airlines with aircraft overflying the HKFIR have to pay ENCs to CAD. The majority of these airlines are non-Hong Kong registered airlines. Our ENCs are considered relatively low as compared with similar charges levied by nearby economies. Hence, the expected increase in ENCs should not undermine the competitiveness of Hong Kong. CAD will endeavour to consult relevant stakeholders, including AAHK and the aviation industry, before revising the ATC services charge and/or ENCs in future.

IMPLEMENTATION PLAN

23. Subject to funding approval, we plan to commence the project in the fourth quarter of 2018. The proposal will be implemented by phases, with the required ANS equipment ready to support the commissioning of the new third runway in 2022 and full commissioning of the 3RS by end 2024. The upgrade and replacement/refurbishment of off-airport ANS equipment will continue after the full commissioning of the 3RS until end 2027.

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24. All new and upgraded/replaced ANS equipment will be provided in full compliance with the safety and technical requirements of the ICAO as well as the latest technical standards. In light of the complexity and scale of the proposal, experienced external experts/consultants will be engaged to provide professional services. The scope of service covers consultancy on procurement, design, safety assessment, cutover and transition of new and upgraded/replaced ANS equipment; as well as on-site technical support/assistance during installation, integration, testing, commissioning cutover, transition and decommissioning as necessary.

25. The progress of implementation will be subject to a number of factors such as the availability of the new ATC tower, on-airport and off-airport equipment shelters, which in turn depend on the progress of reclamation and construction/refurbishment of the said infrastructures. It also involves multiple contracts which entail careful planning of interface issues. CAD will work closely with the Architectural Services Department, AAHK, building/construction contractors and systems suppliers to closely manage progress and ensure seamless co-operation. External experts/consultants will also be engaged to provide independent advice and assessment to CAD as mentioned in paragraph 24 above. CAD will liaise with, and seek views from, the aviation industry as appropriate on the project implementation. CAD will also consult frontline staff on the provision of ANS equipment with human interface to gather their views from operational angle.

PUBLIC CONSULTATION

26. We sought views from the International Air Transport Association and the Aviation Development and Three-runway System Advisory Committee in January 2018. They generally supported the provision of new ANS equipment for the 3RS operation and the replacement/upgrading of existing aged ANS equipment. We also consulted the Legislative Council Panel on Economic Development on 28 May 2018. The Panel did not raise objection in principle to the submission of the funding proposal to the Finance Committee. Some Members suggested that the cost for the CWPs should be reviewed to achieve cost reduction. Taking into account the suggestion, we have proposed to adopt the more advanced integrated CWPs, further reviewed the detailed cost breakdown and reduced the cost estimates (please see footnote 5 above).

**Functional Description of
the Proposed Air Navigation Service (ANS) Equipment**

**(I) New/Replaced and Upgraded ANS Equipment and Associated Facilities
at On-airport Locations**

Item	Equipment/Systems	Functional Description
(A) New ANS Equipment for Air Traffic Control (ATC) Towers/Centres		
1	Controller Working Positions (CWPs)	To support the safe and efficient air traffic operation at the Hong Kong International Airport (HKIA), the CWPs will be used in conjunction with additional ANS equipment, including but not limited to surveillance/flight data displays and associated systems, electronic flight strips, voice communication system, and operational information display of various air traffic services information, etc. Taking into consideration the technological advancement, cost-effectiveness, safety and efficiency, the Civil Aviation Department (CAD) will adopt the more advanced integrated CWPs whereby the bulk of information presented to air traffic controllers will be consolidated (including surveillance/flight data, electronic flight strips and various air traffic services information, etc.) to minimise the number of display screens ¹ .

¹ As Airport Authority Hong Kong (AAHK) will be responsible for the procurement and installation of the integrated CWPs for the interim ATC tower, CAD plans to request AAHK to procure and install the integrated CWPs for the new ATC tower and existing main and backup towers as well. This will ensure that the same type of CWPs as specified by CAD is used for all ATC towers and will achieve cost-effectiveness.

Item	Equipment/Systems	Functional Description
2	Digital Tower Facilities (DTF)	The DTF will make use of high resolution surveillance cameras to provide panoramic views of the airfield environment to the air traffic controllers. The DTF will provide enhanced visual capabilities as well as alerting functions to enhance air traffic controllers' situation awareness and facilitate ATC monitoring of aircraft on aprons, taxiways and runways, especially during night time and low visibility conditions.
3	Air Traffic Flow Management (ATFM) Facilities	The ATFM facilities aim to ensure an optimum flow of air traffic through the HKIA and Hong Kong Flight Information Region (HKFIR) by balancing demand and capacity. The ATFM facilities will exchange relevant operational data with overseas ATFM systems and local ANS equipment for demand/situation prediction in order to deduce the required airspace capacity thus facilitating ATFM planning.
(B) New/Upgraded ANS Equipment on the Airport		
Communications		
4	Radio Communication System (RCS)	The RCS includes, but not limited to, the Very High Frequency/High Frequency Communication System on airfield supporting radio communications between air traffic controllers and aircraft on ground or flying in the vicinity of the airport, search and rescue operation and broadcasting of aerodrome and weather information to pilots, the Trunk Mobile Radio Facilities enabling air traffic controllers to have direct radio communications with Airport Fire Contingent and AAHK for daily ATC operation, and the Microwave Link System (MLS) transmitting and relaying data and remote control and status indication signals, etc. The existing RCS will be replaced and upgraded.

Item	Equipment/Systems	Functional Description
Navigation		
5	Instrument Landing System (ILS)	The ILS, consisting of Localizer, Glide Path and Distance Measuring Equipment (DME), at each of the runway ends, provides accurate azimuth and descent guidance signals for use by aircraft for landing on the runways. Two new ILSs will be provided at runway ends of the new runway, and four existing ILSs at each of the existing runway ends will be replaced and upgraded.
6	Ground Based Augmentation System (GBAS)	The GBAS makes use of the Global Navigation Satellite System for supporting satellite-based precision approach and landing of aircraft at the HKIA. The GBAS provides approach path data, corrections and integrity information to appropriately equipped aircraft landing at the HKIA.
Surveillance		
7	Surface Movement Radar (SMR)	The SMR consists of a network of radars on airfield providing primary surveillance of aircraft and vehicles approaching/positioned on runways and taxiways. The existing SMR will be replaced and upgraded.
8	Advanced Surface Movement and Guidance Control System (A-SMGCS)	The A-SMGCS consists of a network of detectors/sensors on airfield providing secondary surveillance of aircraft approaching/positioned on runways and taxiways. The existing A-SMGCS will be replaced and upgraded.
(C) New Associated/Ancillary Facilities		
9	Other associated/ancillary facilities (including but not limited to, Aeronautical Data Analysis Tools, Obstacle Lighting System,	These are associated/ancillary facilities that need to be provided so as to make the new ANS equipment fully equipped for functional use.

Item	Equipment/Systems	Functional Description
	Communication Infrastructure, Fault Reporting Centre Facilities, Air Traffic Control Tower Interfaces, Closed Circuit Television and Recording System, Geospatial Database and Charting System, Simulators, etc.)	

(II) Upgrading/Replacement of Existing Aged ANS equipment at Off-airport Locations

Item	Equipment/Systems	Functional Description
(A) Communications		
10	Communication System	It includes, but not limited to, the Very High Frequency/High Frequency Communication System at off-airport locations supporting radio communications with aircraft flying within the HKFIR, search and rescue operation and broadcasting of aerodrome and weather information; and the MLS transmitting and relaying data and remote control and status indication signals, the data lines providing alternative paths to the MLS, etc.
(B) Navigation		
11	Doppler Very High Frequency Omni- directional Radio Range (DVOR) and DME ²	The DVOR and DME are radio navigational aids that provide direction and distance information respectively for the aircraft flying to/from Hong Kong.

² Two sets of DVOR/DME equipment are planned to be replaced and upgraded, subject to prevailing operational needs.

(C) Surveillance		
12	Surveillance System ³	It includes, but not limited to, the Primary Surveillance Radar (PSR), Secondary Surveillance Radar (SSR) and ground receivers which provide the respective primary and secondary surveillance of aircraft in approach/terminal and en-route airspace within the HKFIR, etc.

³ Five sets of PSR/SSR equipment are planned to be replaced and upgraded, subject to prevailing operational needs.