## Legislative Council Panel on Development

#### Procurement of One Set of Large Format Digital Aerial Camera System

#### Purpose

This paper is to consult Members on the proposed procurement of one set of large format digital aerial camera system to replace the existing film-based aerial camera.

## Background

2. Aerial photographs play an important role in the development of Hong Kong. Such photographs record images of ground features of an area by using an aerial camera. They have long been widely used in mapping, land administration and development, civil engineering projects, environmental monitoring, security operation, aircraft crash investigation, etc. They are also adopted as historical records and court evidence.

3. The Survey and Mapping Office (SMO) of the Lands Department (LandsD) has taken up the responsibility for providing aerial photography service with its own large format aerial camera for all government bureaux/departments (B/Ds) and the general public for over 30 years. Two typical types of aerial photographs, colour and near-infrared, taken by LandsD are at **Annexes I** and **II**.

4. LandsD's existing aerial camera is a specially designed large format camera, called RMK-TOP. It is a heavy-duty equipment with a 9 inch by 9 inch film format weighing 250 kg and measuring 720mm (L) x 720mm (W) x 1,000mm (H). Its components consist of a camera body, two lens cone and two film magazines like a conventional analogue camera. In addition, it has some advanced features to control the process of photo shooting and provide navigation functions. The components of the existing aerial camera are shown at **Annex III**. The existing aerial camera was acquired in 1995 with its second lens cone purchased in 2001. It is mounted and for shared use on two aircraft of the Government Flying Services (GFS). The set-up of an aerial camera on an aircraft is shown at **Annex IV**.

5. LandsD uses the existing aerial camera to conduct regular aerial photography work. On average, LandsD shoots more than 10,000 aerial photographs at different flying heights covering the whole territory of Hong Kong every year. As at November 2010, LandsD maintained some 246,000 aerial

photographs. More than 40 B/Ds and many private companies are active users of aerial photographs. To produce aerial photographs in a digital format for their use, LandsD is required to undergo the processes of film-developing and film-scanning after photography.

6. Moreover, LandsD is one of the key parties in the Government's emergency set-up for aircraft crash and salvage, natural disasters and other emergency incidents in providing aerial photographs and aerial photography service to B/Ds concerned. LandsD has actively participated in a number of emergency incidents, such as "Aircraft Accident at the Hong Kong International Airport in November1993 (Boeing 747 – 400, REG B165)" and "Incident of Landslides at Lantau after Rainstorm on 7 June 2008".

## Need to Replace the Existing Aerial Camera

7. The existing aerial camera has been used for over 15 years since 1995, and has exceeded its normal serviceable life of 12 years. The manufacturer of the aerial camera announced that manufacturing of this type of aerial camera and its essential replacement parts had been terminated since 2008 and repair or adjustment service for the major components such as the lens, navigation telescope and DOS-based (an operating system designed in 1970s) computer terminals could no longer be provided. Thus, the existing aerial camera has become an obsolete product and will become irreparable in the near future due to a lack of replacement parts and technical support. There is no alternative equipment that can perform similar functions in LandsD.

8. The overall level of performance of the existing system is rated far below 50% as compared to its original level of performance. Major faults of the existing aerial camera are encountered from time to time leading to prolonged downtime and high repair cost. Due to normal wear and tear, there have been a number of major repairs or overhauls in the last five years. For example, the three incidents in 2005, 2007 and 2008 led to a prolonged downtime of five months, two months and three months respectively. During the downtime, no aerial photography service could be provided to B/Ds and the general public. The costs incurred for the three repairs were \$400,000, \$130,000 and \$590,000 respectively, which were considered very high and not cost-effective. The frequency of overhaul and repair is anticipated to increase due to ageing problems and the maintenance cost is estimated to be at least \$600,000 in each of the coming three years.

9. The existing aerial camera, which was launched in the market in 1990s, employs outdated technology at the present standard to perform image capture, shooting processes, navigation and many other functions, such as use of films to record images, manually controlled photo shooting processes and computer programmes running on DOS-based computers. All these out-dated features of the existing aerial camera attribute to the slow, poor and unreliable performance of the camera as compared with the modern computer technology employed in a digital aerial camera. It has also limited LandsD's capability to provide more efficient and better aerial photography service to meet contemporary requirements.

10. Partial upgrading of the existing 15-year-old aerial camera is not cost-effective and practical because all major components are beyond economical repair and with out-dated technology.

11. The existing aerial camera is a film-based model, which has the following operational and occupational safety issues -

- (a) The length of a roll of aerial film and the number of available film magazines restrict the number of aerial photographs that can be taken in each flight even though more working hours in suitable aerial photography weather conditions are available;
- (b) The developed aerial films contain raw data and have to be kept perpetually. However, their condition is deteriorating - they have developed mould and scratches are found on them. It is costly to maintain developed aerial films in a good condition, which requires a specially designed dust-free aerial film store room that has to be kept under appropriate temperature and humidity and has to be equipped with special fire extinguishing installation;
- (c) 3,000 litres of environmental-unfriendly chemical waste is generated from film-developing per year during the process of film developing. Handling and disposal of the chemical waste is complicated. As long as aerial films are used, generation of chemical waste will remain a crucial problem requiring special attention; and
- (d) The film magazine is very heavy and bulky, each weighing 28 kg and measuring 550mm (L) x 370mm (W) x 260mm (H) as shown in diagram (iii) at Annex III. Injuries can be easily caused to the camera operator in the course of loading/unloading on board where there is an unstable, turbulence and bumpy flying situation. It is not uncommon that the camera operator suffers from bruises under such a situation.

12. The film-based aerial camera has not only exceeded its normal serviceable life, but the necessary consumables and peripherals for it are also becoming obsolete. Aerial film is an essential supporting consumable. Due to a decreasing demand for film-related products, it is envisaged that manufacturing of photography film including aerial film will cease in the market before long. Moreover, film-development and film-scanning are two essential processes in using the existing aerial camera. LandsD has an aerial film processor and three photogrammetric scanners (or called film scanner) as shown at **Annex V** to support these two processes respectively. They have been acquired for four to six years and

are approaching the end of their usable life spans which are eight and six years respectively. The manufacturers have announced that these types of equipment are fading out in the market. Without aerial films and the peripheral equipment, LandsD's aerial photography service will become paralysed if it continues to use its exiting aerial camera.

## The Proposed System and Its Benefits

13. The proposed new system is a large format digital aerial camera (LFDAC) system featuring state-of-the-art technology, comprising a digital camera, photogrammetric software and hardware system, and an office-based digital image data offline storage system with a capacity of at least 800 terabytes<sup>1</sup>. It will improve the efficiency and effectiveness of LandsD's aerial photography operations and enable the Department to provide better customer service. The set-up of a digital aerial camera on an aircraft is shown at **Annex VI**. The new system will bring about the following benefits –

- (a) LandsD will be able to provide reliable aerial photography service and produce of better quality aerial photographs to support the work of various B/Ds and to the public;
- (b) with the new system's advanced automated functions determining the settings for shooting and navigation processes, the accuracy and efficiency of aerial photography work of LandsD will be improved;
- (c) the digital data storage device of the new system will have the following advantages:
  - (i) the working time will no longer be limited by the number of film rolls available on board the aircraft and productivity of aerial photography can be increased;
  - (ii) the digital data storage device will save the operator from the trouble of having to load/unload bulky film magazines, and will hence improve operational and occupational safety;
  - (iii) storage of digital data is more secure, reliable and durable; and
  - (iv) production of aerial photographs from digital data is more environmentally friendly without producing toxic chemical waste from film-developing as in the past;
- (d) better performance in radiometric sensitivity will be achieved, particularly under a less favourable lighting and atmospheric condition

<sup>&</sup>lt;sup>1</sup> 1 terabyte (TB) equals 1000 gigabytes (GB).

commonly encountered in Hong Kong, and this will increase the time periods suitable for aerial photography. As a result, more aerial photographs can be produced and higher frequency of update on the records can be achieved. It is estimated that the utilisation rate of the proposed system will increase by 10% to 15% as compared with the existing aerial camera;

- (e) the photograph production time will be shortened without the need for film-development and film-scanning. With the simplified production processes, it is anticipated that the raw unprocessed aerial photographs can be made available nearly immediately after the flight, which is particularly useful for emergency survey;
- (f) data-sharing will be facilitated as the aerial photographs in digital form can be transferred through the telecommunication network or the Internet;
- (g) the quality of photogrammetric products (e.g. digital orthophoto<sup>2</sup>) will be enhanced as the image quality will be better than that of existing scanned aerial photographs;
- (h) the training time for new operators can be shortened as the functions of the proposed system are automated and its operation is easier; and
- (i) the expanded products and services resultant from the new capability of capturing near-infrared images will be very useful for photo interpretation particularly for identification of vegetation's health conditions, water bodies, geological features and hill fire sites. The LFDAC system can capture near-infrared spectrum together with the Red-Green-Blue colour images of ground features concurrently at the time of each shot (two separate flight missions is required to achieve this using the existing aerial camera). Therefore, it will greatly improve the efficiency of production, coverage and updating of near-infrared images. An example of using near infrared aerial photograph to identify unhealthy trees is illustrated at **Annex VII**.

## **Cost Savings**

14. We estimate that the procurement of the proposed LFDAC system will result in savings of \$1,200,000 per annum from the maintenance cost of the existing aerial camera, the film processor and the photogrammetric scanners and the cost of the aerial films and other essential supporting peripherals.

<sup>&</sup>lt;sup>2</sup> An image map compiled from aerial photographs.

#### **Financial Implications**

#### Non-recurrent Expenditure

15. It is estimated that the total non-recurrent expenditure for the acquisition, installation and commission of the LFDAC system is \$41,580,000 over a three-year period from 2011-12 to 2013-14, with a breakdown listed below –

		2011-12 \$'000	2012-13 \$'000	2013-14 \$'000	Total \$'000
(a)	Digital Aerial Camera	5,000	15,000	4,000	24,000
(b)	Image processing and photogrammetric software and hardware	1,000	4,000	1,000	6,000
(c)	Office-based offline data storage system	2,000	3,000	1,000	6,000
(d)	Modification of aircraft	200	500	300	1,000
(e)	Training	100	600	100	800
	Sub-total:	8,300	23,100	6,400	37,800
(f)	Contingency (10%)	830	2,310	640	3,780
	Total:	9,130	25,410	7,040	41,580

#### Recurrent Expenditure

16. The estimated recurrent expenditure is \$4,300,000 per annum from 2014-15 onwards. This will be partly offset by the annual savings of \$1,200,000 from the existing film-based aerial camera. The detailed breakdown is as follows –

	2013-14 \$'000	2014-15 onwards \$'000
Proposed digital aerial camera system		·
(a) Digital aerial camera unit maintenance	Note 1	2,800
(b) Computer hardware and software maintenance	Note 1	1,500
Sub	-total: 0	4,300

Less: Savings from the existing film-based camera	Note 2	Note 3
(a) Aerial Camera	(400)	(600)
(b) Film Processor	(34)	(50)
(c) Photogrammetric scanners	(200)	(300)
(d) Material cost of films, developer and other necessary consumables	(83)	(250)
Sub-total:	(717)	(1,200)
Total:	(717)	3,100

Note 1: Free maintenance warranty will be provided for the first year after the commissioning of the proposed system, i.e. from April 2013 to March 2014 tentatively.

- Note 2: With the proposed system becoming operative in 2013-14, LandsD will keep but scale down the existing system as a backup, in which one-third of the original maintenance cost is required to maintain its operation.
- Note 3: With the proposed system fully implemented in 2014-15, the existing aerial camera, the film processor and the aerial films will cease operation.

#### The Relevant Fees

17. The capital and recurrent cost of the proposed LFDAC system would in principle be recovered from the users according to the "user pays" principle immediately upon the commencement of services through setting new fee items in relation to provision of aerial photography and survey services with the LFDAC system and digital aerial photographs that are captured by the proposed new aerial camera.

18. It is pre-mature and infeasible to quantify the amount of the new fee levels at this stage because of insufficient information on pricing, throughput and usage of the system, which are subject to tendering results.

#### **Implementation Plan**

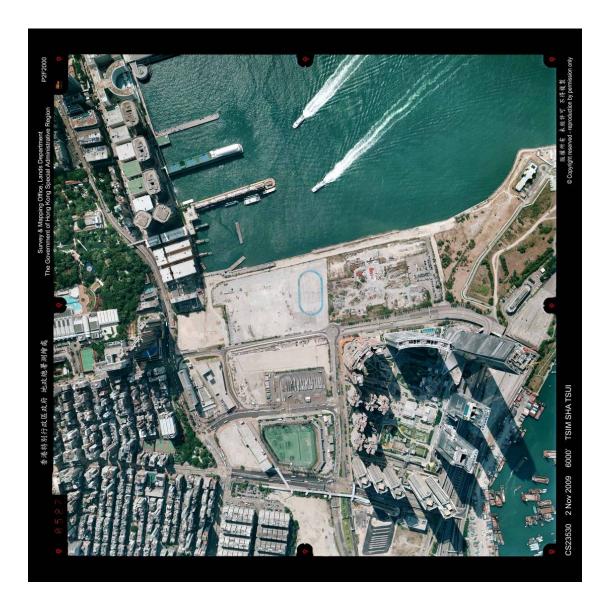
19. We plan to implement the replacement project according to the following schedule -

Activity <ul> <li>(a) Preparation of tender documents, invitation/evaluation/award of tenders, etc.</li> </ul>	<b>Target completion date</b> June 2012
(b) Delivery of the proposed aerial camera system	September 2012
(c) Installation and testing	December 2012
(d) Application for Civil Aviation Department certificate	June 2013
(e) Training	June 2013
(f) Commissioning	July 2013

20. The LFDAC system will be fixed on GFS's new fix-wing aircraft and will dovetail with GFS's replacement programme of its fix-wing aircraft targeting for commissioning in 2013.

21. Subject to Members' views, we plan to seek funding approval of the Finance Committee in May 2011 with a view to procuring the LFDAC system according to the above implementation plan.

Development Bureau Lands Department March 2011



Annex I: Normal Angle Vertical Aerial Photograph (Tsim Sha Tsui)



Annex II: Wide Angle Near Infrared Aerial Photograph (Hebe Haven)

# Annex III: Aerial Camera RMK-TOP

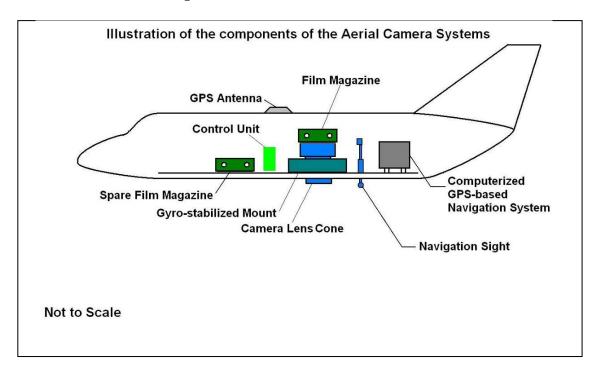




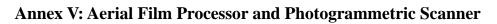
(v) A Computerized GPS-based Navigation System



(vi) Navigation Sight and Control terminal



Annex IV: Set-up of RMK-TOP Aerial Camera on an Aircraft

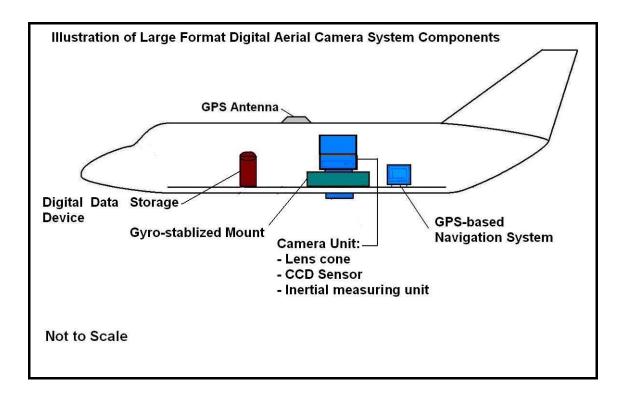




(i) Film Processor



(ii) Photogrammetric scanner (or called Film Scanner)



Annex VI: Set-up of a Large Format Digital Aerial Camera on an Aircraft



Annex VII: Identification of Unhealthy Trees Using Near-Infrared Aerial Photograph

(i) Color Aerial Photograph of Nov 2009: Circled is an unhealthy tree, which cannot be distinguished in colour aerial photograph



(ii) Near infrared aerial photograph of Jan 2010: the same tree circled in (i) having unhealthy condition is identified in this photograph