For discussion **FCR(2006-07)43**
on 9 February 2007

ITEM FOR FINANCE COMMITTEE

CAPITAL WORKS RESERVE FUND
HEAD 708 – CAPITAL SUBVENTIONS AND MAJOR SYSTEMS AND EQUIPMENT
Hong Kong Observatory
New Subhead "Replacement and enhancement of high performance computing system"

Members are invited to approve the creation of a new commitment of $48.5 million for replacing the high performance computing system of the Hong Kong Observatory.

PROBLEM

The existing high performance computing (HPC) system of the Hong Kong Observatory (HKO) is approaching the end of its serviceable life and needs to be replaced to enable the HKO to continue to provide reliable weather forecasting and warning services.

PROPOSAL

2. The Director of the HKO, with the support of the Secretary for Economic Development and Labour, proposes to replace the existing HPC system at an estimated cost of $48.5 million.

JUSTIFICATION

Numerical Weather Prediction

3. Like other modern weather centres elsewhere, the HKO is adopting Numerical Weather Prediction (NWP) as the basic tool for weather forecasting.

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It is a technique of simulating the evolution of the atmosphere on HPC systems. Such simulation requires very intensive computing resources to solve the complex mathematical equations involved. In the past few years, NWP technology has been advancing rapidly and helped improve the accuracy of weather forecasting.

Limitation of the Existing HPC System

4. The normal serviceable life of HPC systems is five years. The existing HPC system of the HKO was installed in 1999. It has a peak performance of 0.02 TeraFLOPS[1], which is very low as compared with that of some other meteorological centres[2]. With limited processing power, the existing system can only be configured to support running NWP models at two horizontal resolutions of a coarser 60-km version over a larger domain and a finer 20-km version over a smaller domain.

5. The existing HPC system is relatively outdated compared to current HPC technology. NWP model outputs generated from the existing system lack the quality of resolution required to adequately capture spatial differences and differentiate the detailed topography of Hong Kong. This limits the HKO's ability in providing forecasts on regional weather condition and short-lived weather phenomena with dimensions of a few kilometers (such as rainstorms). Moreover, the existing system only allows NWP models to be run optimally at three-hourly intervals. This updating frequency is not adequate to deal with fast developing weather situations. As a whole, the existing system constrains the HKO from providing more timely and detailed weather forecasts and warnings, particularly at times of inclement weather.

Proposed System

6. With the latest advances in computing technology, new NWP models have been developed in the past few years to offer the following benefits –

(a) a suite of refined models with enhanced horizontal resolutions to resolve spatial differences;

(b) more frequent model runs to capture rapid changes of inclement weather; and

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[1] TeraFLOPS is a common metric used for measuring the performance of computing systems. 1 TeraFLOPS means performing 1 million million floating point operations per second.

[2] Examples are the Guangdong Meteorological Bureau (1.1 TeraFLOPS), Beijing Meteorological Bureau (planned acquisition of a system of around 6 TeraFLOPS in 2007), Korea Meteorological Administration (18.5 TeraFLOPS) and China Meteorological Administration (21.6 TeraFLOPS).

(c) more advanced data analysis techniques to provide meteorological information of a better quality.

7. With a view to taking advantage of latest technological advances to provide more timely and detailed weather forecasts and warnings, the HKO commissioned an HPC technical study in 2006. Taking into account the operational requirements applicable to Hong Kong in terms of model resolution, updating frequency and dimensions of forecast domain, the consultant recommended replacing the existing system by an enhanced system with a peak performance of 3-5 TeraFLOPs, configured to run a suite of high resolution NWP models with horizontal resolutions ranging from 2 km to 20 km. On the basis of the findings of the HPC technical study, and to allow room to support future development, we propose to replace the HKO's existing HPC system by an enhanced one with a peak performance of around 5 TeraFLOPS.

8. With the proposed replacement system, the HKO's capacity in applying the latest NWP technology will be strengthened and its forecasters will have more timely and detailed objective guidance for formulating weather forecasts and time-critical warnings of inclement weather. Specifically, the HKO would be better equipped to simulate and issue warnings of short-lived and localised weather phenomena (such as rainstorms), and provide more refined forecasts to facilitate weather-sensitive aviation and maritime operations as well as planning of outdoor sport activities and public functions. Moreover, the higher processing power of the proposed HPC system would provide room for meeting possible future needs, such as research on wind distribution. Such enhanced capabilities would enable the HKO to provide members of the public with more detailed and timely weather forecasts and warnings as well as value-added weather information services for enhancing public safety and better protection of property.

FINANCIAL IMPLICATIONS

Non-recurrent Cost

9. Based on the latest market information as provided by the consultant and the Architectural Services Department, the estimated non-recurrent cost of the project is $48.5 million, with the following breakdown –

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			$ million
(a)	HPC hardware and software		35.00
(b)	Upgrading of power capacity at the HKO Headquarters		4.42
(c)	Site design and preparation		3.08
(d)	Contract staff and professional services		2.00
		Sub-total	44.50
(e)	Contingency		4.00
		Total	**48.50**

10. On paragraph 9(a), the estimate of $35 million is for the acquisition of hardware, software and associated peripherals of the proposed system, and expenses in relation to system delivery, installation, testing and training.

11. On paragraph 9(b), the estimate of $4.42 million is for the provision of adequate power supply for the operation of the proposed system, which involves construction of a new transformer room and an emergency generator room, and installation of a new transformer, an additional emergency generator and high voltage panels.

12. On paragraph 9(c), the estimate of $3.08 million is for the preparation of a computer room with the necessary support utilities, including cooling systems and uninterruptible power supply.

13. On paragraph 9(d), the estimate of $2 million is for the employment of two contract information technology staff for a period of 12 months to assist in project implementation, and for the professional services of an HPC specialist to fine-tune and optimise the performance of NWP models on the proposed system.

14. On paragraph 9(e), the estimate of $4 million represents an approximately 9% contingency on the cost items set out in paragraphs 9(a)-(d).

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15. The estimated cash flow requirement of the project is as follows –

Financial Year	$ million
2007-08	8.00
2008-09	39.00
2009-10	1.50
Total	**48.50**

Recurrent Cost

16. The additional recurrent expenditure arising from the project is estimated to be $4.03 million per annum from 2009-10 onwards. A breakdown is provided below –

		2008-09 $ million	2009-10 and onwards $ million
(a)	Light and power	0.55	0.94
(b)	Specialist supplies and equipment	0.05	0.12
(c)	Repair and maintenance	–	3.75
		0.60	4.81
(d)	Less: Annual savings	–	(0.78)
	Total	**0.60**	**4.03**

17. On paragraph 16(a), the estimate of $0.94 million is for the electricity charges of the proposed system and other support utilities, including cooling systems and uninterruptible power supply.

18. On paragraph 16(b), the estimate of $0.12 million is for the purchase of tape cartridges for archival of model-generated data.

19. On paragraph 16(c), the estimate of $3.75 million is for the maintenance of the proposed system and other support utilities, including cooling systems and uninterruptible power supply.

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20. On paragraph 16(d), the savings of $0.78 million represent the recurrent costs of the existing system which will be ploughed back to cover part of the recurrent costs of the proposed system.

21. The Economic Development and Labour Bureau and the HKO will absorb from within their existing resources the additional recurrent expenditure arising from the project. As staff efforts currently engaged in supporting the existing system will be redeployed to operate the proposed replacement system, there will be no additional recurrent staff cost incurred for the proposed system.

IMPLEMENTATION PLAN

22. We plan to implement the project according to the following schedule –

	Activity	**Target completion date**
(a)	System design, request for information from vendors, tender preparation and invitation	August 2007
(b)	Tender assessment and award of contract	February 2008
(c)	Site preparation and upgrading of power capacity at the HKO Headquarters (involving construction of a new transformer room and an emergency generator room; installation of a new transformer, an additional emergency generator and high voltage panels; preparation of a computer room with the necessary support utilities, etc.)	February 2008
(d)	System delivery, installation and acceptance test	July 2008
(e)	Fine-tuning and trial runs of NWP models	May 2009
(f)	System commissioning	May 2009

23. The existing HPC system will be of little resale value and very few components can be recycled. Disposal of some of the components, such as computer boards and monitors, may be of environmental concern. Relevant requirements and procedures will be followed in the disposal of these components. Other components will be disposed of in the normal manner.

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PUBLIC CONSULTATION

24. We consulted the Legislative Council Panel on Economic Services on 22 January 2007. Members generally supported the proposal, and requested the Government to set out more specifically the peak performance required for the proposed system and expedite the implementation process to enable early commissioning of the system. Our latest proposal as contained in this paper has addressed Members' comments by proposing to go for a replacement system with a peak performance of about 5 TeraFLOPS and to advance the implementation timetable by six months so that the new system will be commissioned in May 2009.

Economic Development and Labour Bureau
February 2007