

## **ITEM FOR FINANCE COMMITTEE**

### **HEAD 45 - FIRE SERVICES DEPARTMENT Subhead 603 Plant, vehicles and equipment**

Members are invited to approve a new non-recurrent commitment of \$22.4 million for improving existing breathing apparatus sets in the Fire Services Department.

#### **PROBLEM**

The heavy weight of the existing breathing apparatus (BA) sets used by the Fire Services Department (FSD) causes physiological stress to firemen during fire-fighting and search and rescue duties. Moreover, the steel cylinders are liable to sparking upon impact with other objects under explosive environment, thus exposing the firemen to additional risks.

#### **PROPOSAL**

2. The Director of Fire Services (D of FS) proposes to improve the BA sets by replacing the heavy steel cylinders with new light-weight carbon composite cylinders, replacing the back plates with ergonomically designed ones and modifying/replacing charging plants, ancillaries and storage facilities compatible with the new BA sets at an estimated cost of \$22.4 million.

#### **JUSTIFICATION**

3. In carrying out rescue operations, firemen use BA as an essential life supporting equipment to work in an irrespirable atmosphere, such as oxygen deficient environment and toxic/irritant fume filled condition. A standard BA set basically comprises a cylinder, a back plate and a pneumatic unit.

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4. The BA set currently used by FSD weighs about 17 kilogrammes (kg), including a steel cylinder which weighs about 11 kg. The protective clothing weighs about 9.5 kg. Therefore, the total load that fire-fighters have to bear during fire-fighting and search and rescue operations is 26.5 kg. In addition, the steel cylinders may cause sparks on impact with other objects. This poses a potential hazard to fire-fighters working under an environment filled with explosive gas vapours.

5. Studies conducted by some overseas institutes have revealed that when firemen work in an irrespirable atmosphere, carrying BA sets and wearing protective clothing, their hearts are exposed to stress close to their limits owing to thermal stress combined with hard physical work and psychological stress in darkness. These conditions are liable to cause significant harm to both the cardio-respiratory and thermo-regulatory systems of the fire-fighters. The bio-mechanical analysis carried out in these studies also showed that the positioning of the BA set has a significant bearing on the amount of muscular effort required of the fire-fighters carrying it.

6. Having consulted the Occupational Medicine Division of the Labour Department, D of FS proposes to use instead carbon composite BA cylinders which weigh only 4.7 kg each. This will cut down significantly the total load by about 24%, thus lessening the physiological strain on fire-fighters. Besides, as carbon composite cylinders are fully wrapped by carbon fibre and resin epoxy, it will eliminate the risk of sparking from impact with other materials. (Please see Figure 1 at the Enclosure.) Many overseas fire brigades, for example Japan, the United Kingdom and the United States etc., have already been using the light-weight carbon composite cylinders and their experience fully confirms the merits. D of FS has conducted an in-house evaluation, after some on-site tests with firemen using such kind of cylinders during fire drills and operations from March to June 1998, and the findings indicate that these carbon composite cylinders well suit the local operational environment.

Encl.

7. To conform with the size of the new cylinders and the ergonomics of the fire-fighters, D of FS recommends replacement of the back plates. The new back plates will enable the load of the equipment to be more evenly distributed on the back of the fire-fighter, and keep the weight at the base of the lumbar spine. Fire-fighters will then have better manoeuvrability when performing arduous activities, such as climbing a ladder or penetrating into the fire ground with a bulky hose line, and be better protected from getting spinal injury. (Please see Figure 2 at the Enclosure.) This proposal is beneficial to the firemen from occupational health and safety points of view and will help enhance their operational efficiency in performing fire-fighting and search and rescue duties.

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8. As regards the pneumatic units, they are fully compatible with the new cylinders and will continue to be used by firemen. However, the change of the cylinder type will necessitate the replacement of one charging plant which the Director of Electrical and Mechanical Services considers technically not feasible for modification due to its obsolescence, and modification of three existing charging plants, all the brackets fittings on fire appliances, storage racks at BA store rooms, BA entry control boards and connection pieces for existing pneumatic driven equipment.

**FINANCIAL IMPLICATIONS**

9. The estimated non-recurrent cost of the proposal is \$22.4 million, made up as follows -

	<b>\$'000</b>
(a) Replacement of 3 100 BA cylinders	12,400
(b) Replacement of 912 back plates	1,300
(c) Modification works related to BA charging plants, ancillaries and storage facilities	3,600
(d) Replacement of one charging plant	1,500
(e) Emergency stock reserve	1,500
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Sub-total	20,300
(f) Contingency (10%)	2,030
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Total	22,330
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<b>Say</b>	<b>22,400</b>
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10. D of FS estimates that the net additional annually recurrent expenditure is \$955,000, made up as follows -

	<b>Existing \$'000</b>	<b>New \$'000</b>	<b>Additional \$'000</b>
(a) Hydraulic test of BA cylinders	180	300	120
(b) Routine maintenance/repair	2,890	3,725	835
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Total	3,070	4,025	955
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11. As regards paragraph 10(a) above, the additional sum of \$120,000 covers the increased expenditure due to more frequent hydraulic test required of the carbon composite cylinders.

12. As regards paragraph 10(b) above, the additional amount of \$835,000 is mainly to meet the higher unit cost of the spare parts for the new equipment.

**Implementation plan**

13. The D of FS plans to implement the proposal according to the following schedule -

	<b>Target completion date</b>
(a) Preparation of specifications and tender document	February 1999
(b) Tender processing, evaluation and award of contract	June 1999
(c) Delivery of goods and completion of modification works	December 1999
(d) Acceptance test and commissioning	January 2000

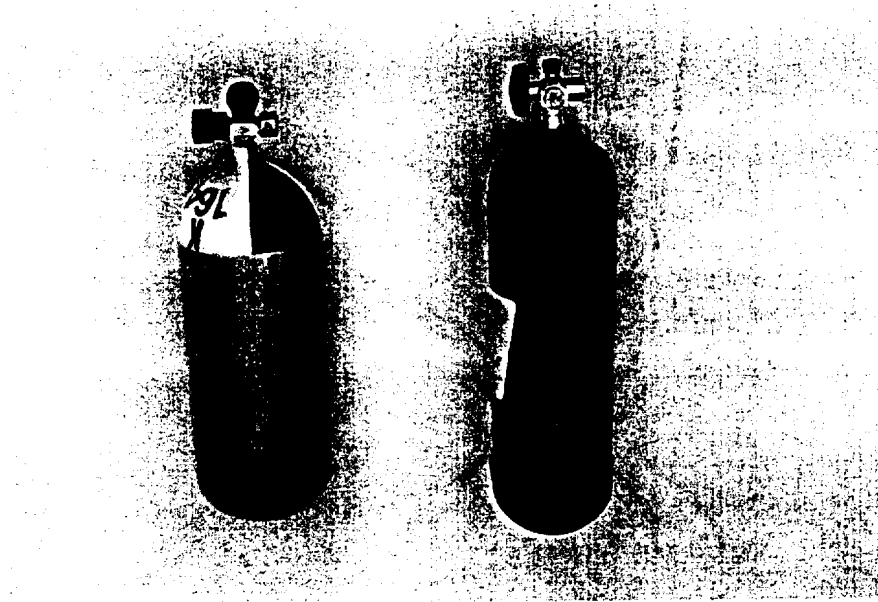
**BACKGROUND INFORMATION**

14. FSD has been using the existing type of steel cylinders for decades. With the advancement of technology, the BA equipment industry has started to make use of carbon fibre to manufacture light-weight and safe cylinders for fire-fighters, the manufacturing technology of which has been applied extensively in the aerospace industry to produce cylinders for space travelling.

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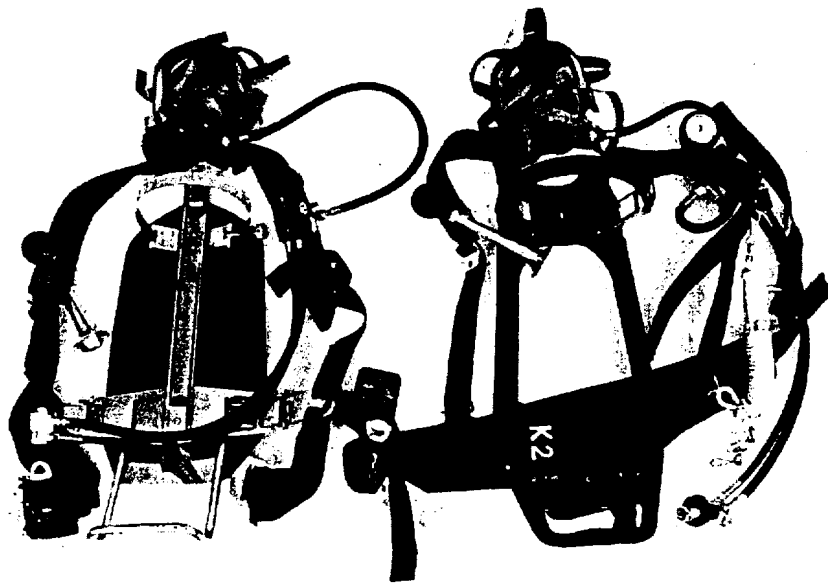
**Improvement of existing Breathing Apparatus (BA) sets  
in the Fire Services Department**

Figure 1 – BA cylinder



Existing BA cylinder (Left) and new light-weight BA cylinder (Right)

Figure 2 – Backplate of BA set



Existing backplate (Left) and new backplate (Right)