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CAPITAL AND OPERATING COSTS IN THE HALON FIRE EXTINGUISHER SUB-SECTOR

Introduction

1. At its 19th Meeting, the Executive Committee decided that "there was no need at present to amend any of the existing provisions of the guidelines for halon fire extinguisher conversion projects and noted that the Fund Secretariat and the implementing agencies would develop a joint paper proposing an addition to the guidelines to address capital and operating costs" (decision 19/33).

2. The existing guidelines were based on a paper presented to the 16th Meeting of the Executive Committee (UNEP/OzL.Pro/ExCom/16/16) prepared by the Fund Secretariat with input from the World Bank. ExCom 16/16 anticipated project costs ranging from US $50 to 200 thousand with an average project cost of US $81,472.

3. The average grant of projects approved under the guidelines is US $76,000. Grants have ranged from about US $30,000 for a plant producing about 500 fire extinguisher units per year to about US $280,000 for a plant producing about 300,000 fire extinguisher units per year.

4. Halon fire extinguisher conversion projects are important because halon has a high ozone depleting potential (ODP) and substantial phase-out can be achieved at relatively low costs.

5. Under the existing guidelines, projects for large-producing enterprises have received proportionately lower grants than small-producing enterprises. This is due to the relatively low capital costs for conversions and the lower operating costs for the alternative agents. In addressing this situation, the Executive Committee decided that flexibility should be shown in the case of large halon-producing enterprises (decision 18/4). The Executive Committee also requested Article 5 countries with several halon fire extinguisher manufacturers to include in their sub-sector phase-out request for funding a plan for the distribution of the country's total sectoral incremental costs to address any unintentional market distortions (UNEP/OzL.Pro/ExCom/18/75, Annex V).

6. During the review of the guidelines requested at the 18th Meeting, it was determined that the implementing agencies and the Secretariat should convene a meeting of halon experts to discuss the capital and operating costs of fire extinguisher conversion projects.

7. In preparation for that meeting, the Secretariat retained a consultant to prepare a discussion paper on the subject. The consultant and representatives from the World Bank and the Secretariat visited the largest fire extinguisher production facilities in North America and conferred on a draft technical paper prepared for discussion at the meeting of halon experts. The meeting of halon experts was convened and attended by halon experts representing UNIDO, the World Bank and the Secretariat. The consensus reached from these meetings and discussions is presented in this document.

Capital costs required for conversions

8. The widely used substitutes for halon 1211 are dry chemical, carbon dioxide and foam. The Executive Committee has approved five projects to convert to these agents under the existing guidelines.

Dry chemical

9. Dry chemical fire extinguishers are expected to be the alternative of choice for most conversions because for most uses, dry chemical is as effective, if not more effective, than halon for the same size fire extinguisher. ABC-powder is expected to represent 85 per cent of the market after conversion of the sector as affirmed in decision 18/4. In general, dry chemical can be classified as ABC (ammonium phosphate) or BC (sodium or potassium bicarbonate) powder.

10. Much of the equipment used in the production of halon fire extinguishers can be used without any modifications for ABC and BC fire extinguishers. Low-pressure cylinders (capable of a pressure of 13.4 bar) are used for both halon and dry chemical agents in most cases. Therefore, the same type cylinders used for halon can be used for dry chemical, albeit, with some minimum tooling which may be required for dry chemical valves and nozzles. Some minimal tooling or changes to die punch sizes may also be required for those halon fire extinguishers that have service pressures that are too low to produce effective dry chemical extinguishers.

11. Filling machines for both ABC- and BC-powder are different from those required for halon fire extinguishers. The provision of different filling machines is, therefore, essential.

12. While enterprises must have air compressors for pressurising halon fire extinguishers, dry chemical fire extinguishers must be pressurized with dry air. A dry air supplier can be attached to existing compressors.

13. Other possible incremental costs for dry chemical fire extinguishers may include, depending upon the baseline:

- quality control equipment,
- cylinder neck cleaning,
- dust collection,
- storage/loading,
- testing/certification/prototype design,
- training from the supplier, and
- technical assistance to verify that the equipment is being operated according to specifications.

14. In rare cases, a manufacturer may produce cartridge-propelled dry chemical fire extinguishers for a specialized market. Cartridge-propelled units are used in applications where the industrial owner chooses to recharge his own units at remote locations such as in strip mining, forestry operations, and remote construction sites. Stored pressure cylinders are considered the industry standard, and are more effective, more reliable and safer than cartridge-propelled units.

<u>Carbon dioxide</u>

15. As with dry chemical extinguishers, much of the equipment used in the production of halon fire extinguishers can be used without any modification for carbon dioxide fire extinguishers, but new filling and filling control equipment is essential.

16. Unlike halon that can be filled into a low-pressure cylinder, carbon dioxide must be filled into high-pressure cylinders and some minimum tooling may be required for the valves and gauges. High-pressure cylinder manufacturing is so specialized and capital-intensive that in most countries, manufacturing high-pressure cylinders is centralised and includes the manufacturing of other cylinders used for the storage at high pressure of certain chemicals, gases, diving apparatuses and many other applications. Therefore, it will usually be most economical for cylinders for carbon dioxide fire extinguishers to be purchased from a high-pressure cylinder manufacturer rather than manufactured by the fire extinguisher enterprise.

17. As for dry chemical extinguisher conversions, testing, technical assistance and training should be provided by the equipment supplier with expert verification after installation.

18. Other conversion costs might include leakage control, an inverter rack, pneumatic belt vice, and a slip joint valve wrench.

19. A large refrigerated storage tank and associated piping to provide a supply of liquid carbon dioxide may be required for high levels of production. It is probable that enterprises with a low annual level of output will have liquid carbon dioxide provided in supplier-owned high-pressure cylinders.

<u>Foam</u>

20. Generally, foam has a limited number of applications. Foam is used when dry chemical will cause serious damage to the item being protected, the item being protected is not electrically energized, and a carbon dioxide extinguisher is not available. For the purpose of this analysis, a maximum of 5 per cent of the conversion projects are expected to convert to foam.

21. As with dry chemical and carbon dioxide fire extinguishers, most of the equipment used to produce halon fire extinguishers can be used for the production of foam extinguishers. Due to potential corrosion of a foam/water agent, the cost of preparing the internal surface of the steel cylinder for painting and painting the internal surface is necessary. Therefore, sand blasting and systems for internal painting are eligible incremental costs.

22. Some minimum tooling may be required for valves and nozzles for foam/water extinguishers. As with conversions to dry chemical and foam/water extinguisher production, testing, technical assistance and training should be provided by the equipment supplier with expert verification after installation.

23. Filling foam extinguishers requires the input of the foam mix in water which can be done manually and the pressurisation of the cylinder which is a simple process not requiring sophisticated machinery at low-production levels. Therefore, filling equipment for low-volume enterprises might not be necessary. For manufacturers whose annual production is greater than 50,000 units, however, filling, filling control, and quality control equipment may be required to maintain baseline levels of production.

Summary of capital costs

24. Capital costs can vary according to the baseline condition, the alternative chosen, and the halon sector phase-out approach. The analysis assumes two types of conversions that are dependant upon the baseline condition: a high cost conversion for enterprises with a more advanced baseline operation and a low cost conversion for enterprises with a less advanced baseline operation. Table 1 presents the range of capital costs estimates for conversions to each alternative.

Table 1

Incremental Capital Costs (in thousand US dollars)

	Capital Costs		
Alternative	Low	High	Average
Dry Chemical	44.0	135.0	89.5
Carbon dioxide	28.5	73.5	51.0
Foam	44.5	78.0	61.3

25. The primary difference in low and high capital costs for dry chemical conversion projects relates to the higher cost for filling equipment. It is also assumed that capital costs will also be required for storage, connections to storage, and valve/nozzle/gauge tooling equipment for the high cost conversion projects which are not expected to be required for low-cost conversion projects.

26. The main difference between the low and high range of capital costs for carbon dioxide projects is the provision of costs for storage tanks. Filling and leakage control equipment is also provided only for the high-cost carbon dioxide conversion projects. The difference in the cost range for foam projects relates to possible higher costs for inner coating and nozzle tooling equipment depending upon the baseline.

27. The filling equipment required for the low-capital cost conversion projects could lead to an unavoidable expansion of capacity. However, this effect is mediated by the fact that the other equipment required to enable an increased level of capacity such as storage, connections to storage, and valve/nozzle/gauge tooling equipment is not provided to enterprises with a low-level of annual production.

Operating costs/savings

28. Operating costs (savings) are calculated on the basis of the incremental costs of the agent, cylinder, utilities, and labour. In all proposals received to-date, labour and utilities costs, after conversion, are the same as those for the baseline halon extinguisher production.

Alternative agents

29. The costs of the alternative agents vary according to the agent chosen. Costs for halon are expected to increase as supplies are reduced. As the price of halon increases, operating costs are expected to be reduced and operating savings are expected to increase.

30. Costs for agents used in this analysis are based on consistent information provided in previous proposals. The cost of halon 1211, ABC-powder, foam, and carbon dioxide used for the purpose of this analysis in US dollars per kilogram are 3.67, 0.67, 1.36, and 0.03, respectively.[1] Dry chemical costs depend upon the particular agent. BC-powder is expected to cost less than ABC-powder but no proposals have included this agent as an alternative, thus far. Including BC-powder as an alternative would yield greater levels of operating savings.

Cylinders

31. In most cases, no additional incremental operating costs or savings are expected for cylinders for dry chemical and foam extinguishers. Additional incremental operating costs or savings for different valves, gauges, and nozzles would be eligible but should be minimal or nil, since the changes are minor. Costs for preparing cylinders for the input of the foam/water agent are provided as capital costs.

32. Since carbon dioxide must be contained in a high-pressure cylinder, additional incremental operating costs for cylinders are required for carbon dioxide fire extinguishers for most if not all projects, the exception being if it were found to be more economical to fund cylinder manufacturing at the enterprise. High-pressure cylinders are six to seven times more expensive than the low-pressure cylinders used for halons, dry chemical and foam/water filled extinguishers. In larger countries, the need for high-pressure cylinders would normally be addressed as part of a sectoral phase-out approach.

Summary of operating costs/savings

33. Under the existing guidelines, six months of operating costs and a deduction of six months of operating savings are allowed until 1998 when the transition period reverts back to four years of operating costs and savings without further Executive Committee action.

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1 For comparison, the 1996 average costs of fire extinguishers agents in North America are: ABC-powder--US \$0.19/kg.; BC-powder--US \$0.15/kg.; CO2--US \$0.04/kg.; and foam/water--US \$0.42/kg. as compared to halon when it was produced prior to 1994--US 0.73/kg.

34. Table 2 presents an analysis of the operating costs for the baseline case of halon fire extinguishers and the three alternatives under the existing guidelines. The analysis assumes the same cost for halon, ABC-powder, and foam extinguisher cylinders and an average level of agent consumption of 80 metric tonnes/year. It also assumes the costs for agents as described above.

35. In consideration of the range of fire extinguisher sizes, equivalent levels of fire protection should be taken into account in determining incremental operating costs and savings. A weighted average cost for halon, ABC-powder, and foam cylinders based on previous proposals was calculated to account for the different sizes and volumes of cylinders. The resulting weighted average costs (US $6.17/cylinder) is comparable to the cost of a 1 to 2 kilogram cylinder for halon, ABC-powder, or foam. However, a 3.5 kilogram cylinder is assumed for carbon dioxide cylinders since this is the minimum practical size for an effective carbon dioxide fire extinguisher. Since, normally, a 3.5 kilogram carbon dioxide provides twice the fire protection of a 1 or 2 kilogram halon extinguisher, the operating costs for carbon dioxide cylinders are adjusted, accordingly.

Table 2

Calculation of Incremental Operating Costs (Savings) for the Average Size Enterprise (in thousand US dollars)

Agent	Agent Cost	Cylinder Cost	Sub-Total	Incremental Operating Costs (Savings)
Baseline				
Halon 1211	147	153	300	--
Alternative				
ABC-powder	27	153	180	(120)
Carbon dioxide	4	500	504	204
Foam	54	153	207	(92)

Net Incremental Costs

36. A grant from the Multilateral Fund is determined by the net incremental cost which is the sum of the costs of eligible capital equipment plus operating costs minus operating savings.

37. Table 3 summarizes the net incremental costs for enterprises producing 50,000 units per year that converts to combinations[2] of two or three alternatives in thousand US dollars.

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[2] All combinations include an 85 per cent conversion to ABC powder.

Table 3

**Net Incremental Costs for Conversions
for the Average Size Enterprise (in thousand US dollars)**

Alternative	Average Capital Costs	Operating Costs (Savings) for a Six Month Transition Period	Net Incremental Costs by Transition Period for Operating Costs (Savings)			
			0 months	3 months	Current 6 months	4 years
ABC/CO2	140.5	(71.4)	140.5	104.8	69.1	(430.4)
ABC/Foam	150.8	(115.9)	150.8	92.8	34.9	(776.1)
ABC/C02/Foam	201.8	(86.2)	201.8	158.7	115.6	(487.8)

38. Under the current guidelines for considering a six-month transition period for operating costs/savings, the net incremental costs for an average size enterprise would range from US $34,900 to US $115,600.

Implications

39. The eligible capital costs described in this document provide sufficient equipment to meet all existing levels of production with the potential of an unavoidable expansion of capacity. The guidance contained in this document for eligible capital costs may provide assistance in project preparation.

40. Modifications to the six-month transition period for operating costs/savings until 1998 in the current guidelines would have an impact on the resource requirements for the Multilateral Fund. Table 4 presents an analysis of the net incremental costs in US million dollars for this sub-sector using the following assumptions:

- 200 enterprises in Article 5 countries each producing 50,000 units per year,
- average capital costs,
- an 85:15 ratio of ABC-powder to alternatives,
- a 2:1 ratio of carbon dioxide to foam,
- 80 tonnes of annual consumption,
- a discount rate of 10 per cent, and
- no agency fee

Table 4

Net Incremental Costs for Phasing-Out the Halon Fire Extinguisher Sub-Sector (in million US dollars)

Alternative	Average Capital Costs	Operating Costs (Savings) for a Six-Month Transition Period	Net Incremental Costs by Transition Period for Operating Costs (Savings)			
			0 months	3 months	Current 6 months	4 years
ABC/CO2	28.1	(14.3)	28.1	21.0	13.8	(86.1)
ABC/Foam	30.2	(20.1)	30.2	20.1	10.0	(130.7)
ABC/C02/Foam	40.4	(17.2)	40.4	31.7	23.1	(97.6)

41. Net incremental costs to phase-out the sub-sector should range from US $10 million to US $23.1 million under the current six-month transition period for operating costs/savings. By comparison, the total impact on Fund resources estimated in ExCom/16/6 for the phase-out of this sub-sector was about US $16 million, calculated as capital costs of US $28 million less operating savings of US $12 million for a six-month transition period.

42. If the transition period for calculating operating costs/savings were three months, incremental costs would range from US $20.1 million to US $31.7 million. If no operating costs or savings were considered, incremental capital costs would constitute net incremental costs which would range from US $28.1 million to US $40.4 million to phase-out this sub-sector.

Proposed revision of guidelines

43. This document addressed capital costs, operating costs/savings with a view to revise the current guidelines by expanding them to include guidance on capital costs and a possible revision to the transition period for operating costs/savings.

Capital costs

44. The eligible capital costs identified in this paper are consistent with previous guidance and approvals. They represent an agreement among the implementing agencies and the Secretariat on the basis of advice from experts in the field. As such, this paper provides guidance to those preparing projects for this sub-sector. Therefore,

> *the Executive Committee may wish to endorse the agreement on eligible cost categories as defined in this paper as an addition to the guidelines.*

Operating costs/savings

45. Due to the incremental operating savings from the lower cost agents as noted in ExCom/16/16 and confirmed in this document, over a transition period of four years, conversion projects in this sub-sector would not receive grant support from the Multilateral Fund. For this reason, the Executive Committee allowed a "window of opportunity" to provide support for halon fire extinguisher conversion projects by reducing the calculation of incremental operating costs/savings to six months until 1998 at which time the transition period would revert back to four years.

46. Since the decision establishing the guidelines, five of the 12 proposals submitted have been approved. Those approvals represent less than three per cent of the estimated number of fire extinguisher manufacturers in Article 5 countries and no proposals have been submitted since the 18th Meeting. The Executive Committee encouraged implementing agencies to submit proposals in its decision establishing the guidelines at its 16th Meeting and has approved funding for a sector strategy that is expected to phase out about 40 per cent of the halon fire extinguisher sub-sector in Article 5 countries. Therefore,

the Executive Committee may wish to consider priority funding for the preparation of projects in the halon fire extinguisher sub-sector in its business planning for 1997 and consider further modifications to the decision concerning the transition period for calculating incremental operating costs/savings in the light of the analysis presented in this document.