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MULTILATERAL FUND UNDER THE MONTREAL PROTOCOL
MEMORANDUM AND RECOMMENDATION
OF THE COUNTRY DIRECTOR FOR CHINA
OF THE
INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT
TO THE
REGIONAL VICE PRESIDENT, EAST ASIA AND PACIFIC REGION
ON A
PROPOSED OZONE PROJECTS TRUST FUND GRANT
IN THE AMOUNT EQUIVALENT TO \$100 MILLION
TO
THE PEOPLE'S REPUBLIC OF CHINA
FOR A
FOURTH MONTREAL PROTOCOL OZONE-DEPLETING SUBSTANCES
PHASEOUT PROJECT

December 1, 1997

Finance and Private Sector Development Sector Unit
East Asia and Pacific Region

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CURRENCY EQUIVALENTS

(As of January 1997)

Currency Name = Renminbi (RMB)
Currency Unit = Yuan (Y) = 100 Fen
\$0.12 = Y 1.00
\$1.00 = Y 8.3 0

WEIGHTS AND MEASURES

1 meter (m) = 3.28 feet
1 kilometer (km) = 0.62 miles
1 hectare (ha) = 10,000 square meters = 15 mu
1 kilogram (kg) = 2.204 pounds
1 metric ton (mt) = 2,204.6 pounds

ABBREVIATIONS AND ACRONYMS (main text)

AFFF	Aqua Film Foaming Foam
BEIDA	Beijing University
CFC	Chlorofluorocarbons
CIB	China Investment Bank
CITIC	China Investment and Trust Corporation
CTC	Carbon tetrachloride
DIA	Domestic Implementing Agent
GDP	Gross Domestic Product
H	Halon
HFC	Hydrofluorocarbons
HCFC	Hydrochlorofluorocarbons
ICB	International Competitive Bidding
MFEC	Executive Committee of the Multilateral Fund
MLF	Multilateral Fund for the Implementation of the Montreal Protocol
MMI	Ministry of Machinery Industry
MOF	Ministry of Finance
MP	Montreal Protocol
MPS	Ministry of Public Security
NEPA	National Environmental Protection Agency
ODP	Ozone-Depleting Potential
ODS	Ozone-Depleting Substances
OTF	Ozone Projects Trust Fund
PMO	Project Management Office
TCE	Methyl chloroform
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNIDO	United Nations Industrial Development Organization
USEPA	United States Environmental Protection Agency

FISCAL YEAR

January 1 - December 31

Vice President	:	Jean Michel Severino, EAP
Country Director	:	Yukon Huang, EACCF
Sector Manager	:	Hoon Mok Chung, EASFP
Staff Member	:	Helen Chan, Operations Officer, EASFP

CHINA

**FOURTH MONTREAL PROTOCOL OZONE-DEPLETING SUBSTANCES
PHASEOUT PROJECT**

PROJECT AND GRANT SUMMARY

Recipient: People's Republic of China

Implementing Agency: National Environmental Protection Agency (NEPA)

Beneficiaries: NEPA and participating enterprises

Amount: Up to \$100 million

Terms: N/A

Commitment Fee: N/A

Financing Plan: See Schedule A

Economic Rate of Return: N/A

Project ID Number: CN-MT-39838

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**MEMORANDUM AND RECOMMENDATION OF THE
COUNTRY DIRECTOR FOR CHINA
TO THE REGIONAL VICE PRESIDENT
EAST ASIA AND PACIFIC REGION**

1. I submit for your approval the following memorandum and recommendation on a proposed Ozone Projects Trust Fund Grant to the People's Republic of China for \$100 million to help finance a project to reduce ozone-depleting substances (ODS) consumption and production as called for in China's ODS Phaseout Program.

Background

2. The proposed project is the fourth in a long-standing Bank program to support China's efforts to phase out ozone-depleting substances (ODS)¹ under the Montreal Protocol on Substances that Deplete the Ozone Layer (MP). As an implementing agency under the Multilateral Fund, the Bank has helped China's National Environmental Protection Agency (NEPA) develop ODS sector strategies and phaseout programs. Annex 1 provides basic information on the status of ODS in China, details on the MP program and Bank involvement. China's Country Program (CP) is summarized in Annex 2.

3. This proposed ODS IV project would initiate a sectoral policy-based approach to ODS phaseout. In the proposed project, a phaseout program would be developed for each ODS sector based on an overall sector strategy to include all actions required to meet a phaseout objective within a given time frame. All elements in a sector are evaluated: phaseout schedules, costs to both China and the Multilateral Fund for Implementation of the MP (MLF), policy instruments, technical assistance activities and enterprise level actions in a way that the most efficient and cost-effective phaseout option would be chosen for the sector. The agreement of the Executive Committee of the Multilateral Fund (MFEC) in February 1997, which determined that grant funds approved under a sector approach could be disbursed based on performance indicators, helped to make this approach feasible. This approach should be a substantial improvement over the current project by project financing approach in the first three ODS projects (para. 14).

4. Based on a sector phaseout program prepared by the Chinese and agreed with the Bank, MFEC would agree in principle to the total funding level to be covered by MLF for the entire sector over the phaseout period. Upon approval of specific annual programs, MLF would deposit in advance the agreed annual funding into the Bank's Ozone Trust Fund (OTF) account. The Bank would advance grant funds to China based on agreed mechanisms and performance indicators.

¹ ODS produced in China are chlorofluorocarbons (CFC)-11,12 and 113, halon (H)-1211 and 1301, carbon tetrachloride (CTC) and methyl chloroform (TCE). Abbreviations and acronyms are shown in Annex 1.

5. The proposed project would comprise several ODS sectors.² The first sector is the halon sector, which was chosen due to halon's high ozone-depleting potential (ODP).³ Other ODS sectors would be added when they have been prepared. Each sector proposal and program would be submitted to MFEC for funding approval when they are prepared. However, the basic institutional, financial and monitoring framework and mechanisms being developed in the project are designed for application to all sectors.

Government Strategy and Policies Initiated

6. China joined the Vienna Convention for the Protection of the Ozone Layer in September 1989, and ratified the Montreal Protocol on Substances that Deplete the Ozone Layer and the London Amendment in 1991. As a developing country with low per capita consumption of ODS, China is an Article 5 country classified by the Protocol and is eligible to receive grant funds from the MFEC for its ODS phaseout activities.

7. In January 1993, the Chinese Government approved its Country Program for Phaseout of Ozone Depleting Substances. This established the Government's commitment to a complete phaseout of controlled ODS by 2010, provided sufficient funds to support eligible incremental costs were made available by MFEC and the technologies needed for non-ODS substitutes were transferred. This commitment has become more important now that CFC consumption and production in developing countries are to be frozen in 1999.⁴ China's overall phaseout strategy has been articulated in sector plans for each of the major ODS sectors.

8. **Policies Already Initiated.** China banned new ODS-based production facilities in halon and aerosol sectors, in 1990 and 1991, respectively. New CFC production facilities were banned in December 1993. In November 1994, China banned new installations of halon extinguishers in nonessential areas and this policy has been effective since October 1995. In June 1997, the Government announced the ban of CFC to be used as propellants in all aerosol products (with the exception of CFCs in medical and essential uses), which

² Selected ODS sectors would be implemented independently with different phaseout schedules.

Of the \$100 million (could be more than three sectors):

First sector—(\$62 million), halon sector

Second sector—(\$xx million), CFC production sector

Third sector—(\$xx million), another ODS sector

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1998	2010
-----	-----
2000	2006
-----	-----
2000	2010

³ Ozone-Depleting Potential (ODP) is the relative ozone destroying effect of 1 kg of a chemical compared to 1 kg of CFC-11, i.e., CFC-11 has an ODP of 1 and halon 1211 has an ODP of 3 because halon is three times more effective in destroying the ozone layer than CFC-11.

⁴ Under the London Amendment of the MP, the 1999 CFC consumption and production freeze means that effective July 1, 1999, CFC consumption and production level in any Article 5 country cannot exceed the average of the 1995-97 consumption level of that country. There is also a 2002 halon consumption and production freeze with 1997-99 as the average.

will be effective on December 31, 1997. China has started an environmental label system (green label) in 1994. More than 40 types of refrigerators from about 10 enterprises have been awarded the green label. While these and new policies under consideration represent important steps, these policies would have been more effective if China had developed more efficient monitoring and enforcement mechanisms.

9. **Policies Under Consideration.** Two policy actions are under consideration: (a) a ban on new ODS-based production facilities in every sector, expected to be announced by the end of 1997 and effective in 1998; and (b) a tradable production quota system for halon production, expected to be promulgated and effective late 1997. Other policies, such as export and import control for ODS, export licensing, control of ODS-based products and ODS-based production facilities, and ODS tax have been under consideration.

ODS Sector Issues

10. China is, by far, the largest producer and user of ODS among developing countries, and therefore in the world, following the phaseout of ODS in developed countries at the end of 1995. As shown in Table 1 of Annex 1, ODS production in China reached almost 85,500 tons in 1996, and ODS consumption was nearly 91,300 tons. This is the expected peak year for both production and consumption in China and is concentrated in CFC-11, CFC-12 and halon 1211. Different ODS sectors have their own distinct profiles as summarized in Box 1. Nonetheless, all sectors have a number of important and common characteristics that influence the strategy and policies of ODS phaseout. Annexes 3 and 4 contain more information on halon and CFC production sectors.

- (a) **Rapid Growth.** Over the past decade, China has experienced rapid growth of industries using ODS, particularly aerosol, refrigeration and air-conditioning, fire-fighting, electronics and foam. This growth reflects the industrialization and urbanization of the Chinese economy and the growth of consumer incomes and exports. Demand for products containing ODS is strong and would continue to grow rapidly in the absence of phaseout programs.
- (b) **Geographic Dispersion of Enterprises.** The ODS sector encompasses some 10,000-15,000 enterprises that are scattered throughout the country, and is dominated by town and village enterprises sponsored by local communities. This is particularly relevant to the foam, solvent and service industries. Many of these rural enterprises are the chief employer in the locality. In most cases, they lack technical and financial capabilities to convert from ODS to non-ODS products and to alternative businesses.
- (c) **Profitability of ODS.** Based on technology available to Chinese enterprises, ODS production has been a profitable industry in the face of growing demand for consumer products using CFCs and halon. Strong

consumer preferences have emerged, on grounds of quality, price and convenience, for products using ODS.

- (d) **Noncompetitiveness of Alternatives.** On a worldwide basis, substitute technologies for ODS are evolving continually. Some alternatives are controversial, such as high flammability of hydrocarbons. Some alternatives are transitional substances,⁵ yet expensive to acquire, such as HCFC 22 for the commercial refrigeration sector. Some alternatives result in expensive capital and operating costs, such as HFC 134a and HFC 227. As of today, these substitutes are not yet well-established in China.
- (e) **Weak Regulatory Framework.** Development of appropriate policies has picked up in recent years, but regulatory framework for ODS has yet to be strengthened. Institutions involved in regulating ODS-related matters are inexperienced, and ODS policy implementation has often been sporadic and incomplete. Enforcement mechanisms are inadequate and yet to be developed.
- (f) **Multinational Corporations.** In spite of the enormous size of the Chinese market and its rapid growth, only a very small number of joint ventures between Chinese enterprises and multinational corporations have developed in ODS industries. Official policies encouraging self-sufficiency by Chinese corporations in ODS consumer industries also play a major role. This is in marked contrast with some other developing countries where ODS phaseout has been prompted substantially by internal corporate policies of multinational firms, and partly by the fact that developed countries have banned ODS imports (para. 12). Hence, little such pressures for ODS phaseout has existed in China and is unlikely to emerge in the medium term.

11. The characteristics and issues of different major ODS sectors listed in Box 1 below have played an important role in shaping ODS phaseout strategy in China, with the result that:

- (a) **Phaseout is costly due to the size of the ODS sector.** Ideally ODS production and consumption should be phased out as quickly as possible as continued production translates into an increasing stock of ODS. However this would involve premature replacement of production assets, bringing forward replacement investments, and the need to replace a large ODS stock accumulated from past production.

⁵ Refers ozone-depleting substances that are not 100 percent ODS free, but their ODP is much lower than CFCs (e.g., HCFC has an ODP of only 0.05.) They are allowed under the MP, but are transitional because they will eventually be banned, e.g. total phaseout of HCFC for developing countries is year 2040.

- (b) **Rapid phaseout is complicated.** Substitutes and technical assistance are not readily available, and comparable substitutes for some ODS, such as halon 1301 and CFC 12 in refrigeration, have not yet been found. Furthermore, improvements in the policy and regulatory framework are necessary for the success of phaseout strategies. Phaseout is further complicated by the absence of clear MP eligibility guidelines in some sectors, such as the CFC production sector.

BOX 1: BRIEF OVERVIEW OF MAJOR ODS SECTORS

Characteristics	Issues	Characteristics	Issues
<p>Halon 1211</p> <ul style="list-style-type: none"> • 14 producers in 1996 • 72 extinguisher producers • Over 2,000 service centers • Fire protection demand grows rapidly since 1990, relying heavily on halon • Phaseout target—2006 <p>Halon 1301</p> <ul style="list-style-type: none"> • One producer • about 1/3 exported in 1996 • Phaseout target—2010 	<ul style="list-style-type: none"> • High cost and poor quality of substitutes • Definition of “Essential uses” of halon not clear • High cost of premature retirement of halon-based equipment • Recycle cost high and lots of training needed • Very high ODP • Substitutes very expensive 	<p>Production</p> <ul style="list-style-type: none"> • 40 CFC factories, mostly small and medium production capacity; lack technical and financial capabilities • Production growing fast • Production equals consumption in 1996 • Phaseout target—2010 	<ul style="list-style-type: none"> • High cost due to premature retirement of facilities • High chemical value of substitutes • Sophisticated, capital-intensive technology
<p>Aerosol</p> <ul style="list-style-type: none"> • Many small fillers • Insufficient purification equipment • Demand growing, but growth rate declining • 3 large projects being implemented • Phaseout target—1998 • ODS used—CFC 12 	<ul style="list-style-type: none"> • Most substitutes are hydrocarbon • Availability of high-quality hydrocarbon • Safety • Low funding eligibility according to incremental cost methodology • Establishing basis for long-term sustainability 	<p>Industrial/Commercial Refrigeration</p> <ul style="list-style-type: none"> • 130 production enterprises, (71 compressor producers) majority state-owned • Capacity larger than demand • Phaseout target—2010 • ODS used—CFC 12 	<ul style="list-style-type: none"> • Poor quality of Chinese equipment • Low standards of service/maintenance • Access to technology—difficult and expensive • High cost of replacement technologies • Need to close many compressor factories
<p>Foam</p> <ul style="list-style-type: none"> • Large number of small scale enterprises; most lack technical capability • Uses in auto, consumer products and building industries ensure expansion • Many different technologies available for conversion • Phaseout target—2010 • ODS used—CFC 11,12 	<ul style="list-style-type: none"> • Inadequate knowledge of substitute technology • Difficulty in reaching large number of enterprises and obtaining information about sector • High cost of most substitute technology with little or no financial benefit to beneficiaries 	<p>Household Refrigeration</p> <ul style="list-style-type: none"> • About 40 producers, all operating below capacity • Growth rate high • Industry relatively modern and aware of ODS issues • Phaseout target—2010 • ODS used—CFC 11, 12 	<ul style="list-style-type: none"> • Availability of substitute raw materials • Many substitutes being developed • Funding eligibility limited • Safety

12. **Impact of Industrialized Countries’ Policies.** Industrialized countries responded to the Montreal Protocol with a variety of policy instruments, inter alia, bans, tradable permit schemes, voluntary agreements, taxes and public awareness campaigns. These

measures were effective in phasing out ODS production in those countries. With the interdependence of global markets, these measures have put in motion an international phaseout. Due to the involvement of multinational corporations and the dependence of many developing countries on (a) exports to countries that no longer allow ODS-based products, and (b) imports of ODS produced in industrialized countries, ODS phaseout policies of these countries have already had a worldwide impact. Availability of substitute technology and MLF financing has resulted in reduced ODS consumption in many developing countries ahead of the MP requirements. For sectors (such as aerosol, foam and refrigeration) whose phaseout have been driven by global market forces, the phaseout lag between developed and developing countries has been around five years.

13. The Bank started MP operations in 1991 and has continuously been developing and supporting ODS projects in 19 countries across almost all regions. To date, 25 projects are under implementation and eight have been completed. The Bank introduced the umbrella project approach at the end of 1993 and as of today, there are 13 umbrella projects under implementation in eleven countries. The first two China ODS projects (ODS I—FY93 and II—FY94) were completed on June 30, 1997. The ODS III of \$90.1 million (FY95) is an ongoing umbrella project. As of October 30, 1997, MFEC has committed \$68 million to 52 subprojects.

14. The **key operational lessons learned** from all Bank-supported ODS operations are:

- (a) The current **project-by-project financing scheme** under MLF has the following limitations.
 - (i) Use of grants to finance closure or conversion of ODS facilities does not encourage enterprises to seek the least-cost solution. This has led to multiple levels of reviews for their ODS phaseout projects.
 - (ii) Individual project financing understates the phaseout costs to the economy, since costs incurred outside beneficiary enterprises are not taken into account under the incremental cost methodology.
 - (iii) Financing projects individually does not always achieve an overall ODS reduction, but sometimes results in a production shift to other enterprises.
 - (iv) Lack of transparency in subproject selection has resulted in poor phaseout planning. Some subprojects were implemented by enterprises with inadequate technical and financial capabilities.
- (b) **Lack of a comprehensive national phaseout strategy and strong government commitment** to phaseout at the sector level have often accentuated the above problems. In view of the 1999 CFC consumption

and production freeze, implementation of enforceable domestic policies to constrain ODS consumption and production is becoming imperative and needs to be accelerated.

15. All these lessons apply to China. Chinese ODS phaseout activities further require: (a) sound sector phaseout strategies as a precondition for a national program, (b) flexibility in project design, and (c) provision of training to national implementing agencies and implementing consulting firms.

Rationale for Bank Involvement

16. The Bank has been an implementing agency for the MP since 1991. Bank assistance for the achievement of timely ODS phaseout in China, the single largest producer and consumer of ODS, will also produce major global environmental benefits. ODS phaseout efforts fit into the environmental strategy under the China Country Assistance Strategy presented to the Board in March 1997.

Project Objective and Design Parameters

17. The project objective is to assist China in phasing out ODS production and consumption to fulfill its MP obligations in a timely and cost-effective manner. The following design parameters will help the project to achieve this objective:

- (a) policy and incentive structure to drive ODS phaseout;
- (b) adequate monitoring and enforcement mechanisms;
- (c) efficient delivery mechanisms for channeling grant funds from MLF to China and to beneficiaries;
- (d) greater flexibility to China in grant utilization and management;
- (e) lower total phaseout costs to China and to MLF; and
- (f) upfront funding agreement in principle from MLF on total eligible incremental costs for specific ODS sectors.

Project Design and Financing

18. The proposed project would be the last free-standing ODS project for China (para. 2). Both the ODS III and ODS IV projects are designed as umbrella projects. When grant amounts are fully committed under both projects, additional funds could be made available by MLF (through amendment of the ODS III and IV Grant Agreements) to finance ODS phaseout activities. Reflecting lessons learned, the sectoral ODS IV project is expected to become the primary ODS vehicle. However, ODS III will continue to finance subprojects better suited for that instrument (e.g., only a few remaining plants to be addressed in the sector).

19. **Eligible Sectors.** The proposed ODS IV project would support sectorwide and policy-based phaseout programs in multiple ODS sectors, starting with halon. The chemical production would likely be the next sector. Other eligible sectors are under identification. Institutional and financial arrangements are being designed to the extent possible for application to all ODS sectors, yet would allow flexibility for modifications specific to an individual ODS sector. Preliminary work on the production sector started in mid-1997. As soon as MFEC approves funding for the first annual program in the halon sector, preparatory work on the production sector would follow.

20. Sectors become eligible for inclusion in ODS IV once they have been appraised and detailed phaseout programs are prepared for approval by Bank management and MFEC. Such appraisal would encompass: sector-specific issues, policy instruments, performance and monitoring indicators and enforcement mechanisms, phaseout schedules and cost calculations. The most cost-effective phaseout solution in each sector would be determined on the basis of an economic cost model that calculates the total cost to China and the total eligible incremental cost to be requested from MLF. The model developed in Annex 5 was based on the halon sector, but could be modified to adapt to characteristics of other sectors.

21. **Project Cost and Financing.** Total project costs estimated in Schedule A are based on current understanding of different ODS sectors, but this is not a detailed cost estimate, which would be prepared/verified as part of sector appraisal as has been done for halon. The total halon phaseout costs to China are estimated at about \$200 million (constant 1997 prices). These costs include financial flows over a period of about 13 years as well as profits forgone from premature retirement of halon equipment. The Chinese government is requesting MLF financing for about 31 percent (\$62.7 million) of the total cost, which corresponds to the estimated range of eligible incremental costs. Cost elements not eligible for MLF financing would be financed by the enterprises or the government.

22. **Use of Grant Funds.** Grant funds for enterprise level activities would be used for three cost elements: (a) ODS reduction activities (either production or consumption) for plant closures or conversion activities, substitute chemical production, halon recycling and banking, and other eligible activities as defined by MFEC; (b) technical assistance and training activities to local implementing agencies and beneficiary enterprises, which would help the Government in efficient and timely ODS phaseout; and (c) local management costs for implementation of the ODS phaseout program.

23. Together with the CFC production sector and other sectors to be identified, total phaseout costs in the ODS IV Project may exceed \$400 million. A total of \$100 million of grant assistance is expected from MLF. An *umbrella agreement* between the Trustee and the Government, with NEPA as the executing agency, would be used.

24. **Annual Programs.** Every year, NEPA, together with relevant sector ministries, would prepare annual programs for each sector for the following year based on

performance in first half of the year and achievements in phaseout activities in past years. Each annual program covers a calendar year. However, the first annual program of each sector could cover a period of 6 to 18 months, depending on starting date of the sector program; but would always end in December so that subsequent annual programs would start in January of the following year. For the halon sector, the first annual program would be for the calendar year 1998. Preparation of subsequent annual programs should start no later than the seventh month of the year and be agreed by NEPA and the Trustee in the second half of every year. (This schedule may be adjusted as necessary to match the MFEC meeting schedules.) The annual program would then be submitted to MFEC for approval and fund release. *A first year annual program for the halon sector, approved by MFEC and the Trustee, would be a condition of effectiveness of the grant.*

25. Each annual program would include the following:

- (a) sector phaseout schedule,
- (b) performance of activities of previous years and any agreed remedial actions for the current year (not required for the first annual program of any sector),
- (c) performance of activities of current year (not required for the first annual program of any sector),
- (d) description of activities in the following year—ODS phaseout target and national production and consumption level of the year, policies to be implemented, enterprise-level activities, and technical assistance and training activities,
- (e) total annual grant for the following year, and
- (f) performance indicators of the following year.

26. **Policy Instruments.** Policy instruments for each ODS sector will be different and will be developed when the sector is being appraised during ODS IV implementation. The halon phaseout program introduces two new policy instruments that are designed to eliminate production of halon 1211 by the end of 2006, four years ahead of the mandatory total phaseout under the Montreal Protocol and production of halon 1301 by 2010. The proposed tradable production quota and bidding systems, as detailed in Annex 6, would make phaseout activities more market oriented and cost effective.

27. **The Proposed Tradable Production Quota System.** The Ministry of Public Security (MPS) introduced a production permit system for all halon agent producers in 1991. This permit system has effectively barred new entry into the sector since then. To supplement this, NEPA and MPS plan to introduce a regulation on a tradable production quota system for all halon producers by the end of 1997 for application to halon production beginning in 1998. Only those halon producers with production permits would

be issued production quotas. Once effective, the regulation would give NEPA and MPS the authority to: (a) establish national baseline quota and baseline quota for each producer in December 1997, (b) issue national quota and quota for each enterprise in following years, and (c) impose penalties for noncompliance. China agreed on a national halon baseline production of 9,950 mt for halon 1211 and 618 mt for halon 1301 on which grant funding would be requested for the halon sector. Individual enterprises' baseline quota would consider their actual production from 1994 to 1996. Producers with production quota would be free to trade their unused quotas to other halon producers and quota trades would have to be approved by NEPA. Local government agencies, including environmental protection bureaus and fire-fighting bureaus of public security bureaus would be responsible for verification and supervision of halon production, and would report to NEPA and MPS of their findings. Any violations, such as production exceeding quota, production without permit and quota, late and false reporting, etc. would be prosecuted according to penalties specified in the regulation. The Trustee has reviewed the draft regulation on production quota and found it acceptable. The draft regulation would be promulgated and effective immediately upon MFEC's approval of the first annual program, expected to be the end of 1997. *The adoption of the regulation on a production quota system for halon extinguishing agent, acceptable to the Trustee, would be a condition of effectiveness of the grant.*

28. **1997 Production Audit.** The Trustee had initiated a halon production audit in October 1997 which covered 80 percent national production level in 1996. This audit confirmed the actual production levels in 1994 to 1996 as reported by NEPA and MPS, and provides a solid foundation to start the halon phaseout program in 1998. The auditing team also provided some guidance to local auditing agencies on audit requirements and procedures of production audits.

29. **The Proposed Bidding System for Halon Agent Producers.** Once the quota for individual enterprises are established in late 1997, halon agent producers would be encouraged to exchange their production quota to the Government in return for grant funds through a bidding system. The annual halon reduction target in the annual program is the bidding target and the approved annual grant for that particular annual program is the grant the Government uses to compensate those quota during the year. Halon producers would submit bids—offers to exchange their halon quota—for a specific unit price (Yuan/kg per unit of ODP phaseout—the unit reduction compensation). The producers could either exchange all their quota at any particular year or exchange some of their quota for grants, depending on their own business plans. Bid winners would be offered grants by the Government which would exchange sufficient quota necessary to meet the annual phaseout target and within the grant budget. Once bid winners sign contracts with the Government, their production permit would be canceled by MPS and their quota would be either be canceled or revised by NEPA. If total quota purchased through bidding is less than the annual phaseout target, quota reduction would be made pro rata among remaining producers to achieve the annual program targets without compensation.

30. **The Proposed Bidding System for Halon User Industries.** There would be no halon consumption quota. As halon production is reduced over the years, there would be both necessity and economic incentives for halon user industries (halon fire extinguishers and systems manufacturers) to reduce halon consumption and develop alternate products. Offering grants to them would expedite the process of conversion as China needs to maintain fire-fighting capacity and standard, and to meet the 2002 halon production freeze. The enterprises could either close down their halon extinguishers production or convert to nonhalon fire extinguishers and systems. Again the lowest bidders would be offered grants by the Government. Bidding documents for both halon production and consumption have been prepared and the Trustee found them satisfactory.

31. The proposed quota and bidding systems are designed for the halon sector. Yet they could be applicable to other ODS sectors as well, with some modifications. These mechanisms would give ODS producers and user industries an opportunity to decide whether to stay in the ODS business and for how long within the phaseout period. It would enhance transparency of ODS production and consumption and offer all parties equal opportunity to participate. Simultaneously, bidding would allow competitive forces to restructure different ODS industries, and the phaseout program would be more cost effective. In this respect, the project is supportive of the Chinese government's overall enterprise sector reform strategy, and the ability of enterprises to trade their quotas freely would enable mergers and liquidation of nonviable businesses as the phaseout progresses.

32. Like other new programs, these mechanisms are new to China and new to the ODS program; thus it may take time for the system to be operating efficiently. Nonetheless, through close supervision activities (para. 38), controls on disbursement (para. 49), and policies that are already in place and to be promulgated (paras. 27-31), the program is expected to achieve phaseout targets at the minimum even if full efficiency may not be attained until later years. Operating procedures would be refined as China gains experience. NEPA and MPS would provide training to local government agencies and halon enterprises to familiarize them with the halon phaseout strategy, annual phaseout targets, bidding procedures and principles, bid compilation, and consequences of nonparticipation in bidding in the next few years. These training constitutes an integral part of the phaseout program.

Implementation Arrangements

33. **Project Management Office (PMO).** NEPA would be the national implementing agency with the overall responsibility for the success of the project. NEPA established a PMO in 1993 to manage China's ODS operations, which include ODS programs with all MLF international implementing agencies.⁶ The PMO comprises staff from: (a) NEPA's Foreign Economic Cooperation Office (FECO), which manages investment projects and technical assistance programs from international and bilateral sources; and (b) staff from

⁶ UNDP, UNEP, UNIDO and the Bank.

NEPA's Pollution Control Department, which handles policy and technical issues concerning ODS phaseout. PMO staffing in 1997 totals 20. It has managed three Bank ODS operations, five ODS Project Preparation Advances, and all UNDP and UNIDO projects. PMO staff includes procurement and disbursement officers from the Disbursement and Procurement Division in FECO for all accounting, disbursement and procurement matters. PMO's capability has improved steadily in the past three years; yet additional training and strengthening will be required as its role and responsibilities increase.

34. Under the project, PMO would be assisted by an experienced implementation consultant firm as the domestic implementing agent (DIA) for enterprise phaseout activities and by NEPA's technical departments in policy and technical issues. The project would receive policy and management guidance from the National Leading Group, which is headed by NEPA. The concerned sector ministry would play a key role for each sector. MPS is the ministry in charge of the halon sector. For the halon sector, PMO set up, in mid-1997, a team within PMO to take care of all day-to-day halon-related activities. The team comprises officials from MPS, PMO, DIA and the Center of Environmental Science of Beijing University (BEIDA).

35. The PMO would have the overall responsibility for ODS Country Program implementation. The PMO would, inter alia: (a) ensure that sector phaseout programs are consistent with the Country Program; (b) contract out daily supervision of enterprise phaseout activities to a DIA; (c) supervise bidding carried out by DIA; (d) monitor compliance with key ODS phaseout policies; (e) verify compliance of production quota and enforcement of other policy instruments, (f) set up and manage on a day-to-day basis a monitoring system to track project implementation with a new Management Information System (MIS); (g) implement technical assistance activities in the annual programs with other sector ministries; (h) report on program progress; and (i) oversee preparation of audit reports. *During negotiations, assurances were obtained from the Recipient that NEPA would maintain the PMO, with competent staff in adequate numbers.*

36. **Assistance of the Domestic Implementing Agent(s) (DIA).** NEPA would be assisted by an experienced implementation consultant firm(s), selected by NEPA and endorsed by the Ministry of Finance (MOF), to supervise all enterprise phaseout activities. Based on terms of reference and selection criteria agreed with the Trustee, NEPA has selected the China National Chemical Construction Corporation (CNCCC) as the DIA. CNCCC was selected competitively among three potential independent consultant firms that are legal entities and have a minimum of three years' experience in project and financial management. Under the guidance of PMO, the DIA would: (a) conduct bidding for grant allocation, (b) supervise implementation of enterprise-level activities in the annual programs, (c) help PMO in keeping the MIS current with enterprise, project implementation and financial information, (d) prepare progress and completion reports on enterprise phaseout activities, and (e) identify and alert PMO on any issues that may arise during implementation. Initially, one DIA could be selected. As

additional sectors are introduced and the program expands, NEPA may solicit assistance from other consultant firms. *During negotiations, assurances were obtained from the Recipient that at least one domestic implementation agent acceptable to the Trustee would be employed during life of the project.*

37. Project Implementation Manual. A draft manual with detailed operating procedures for the ODS IV project has been prepared and discussed with the Trustee. Overall institutional arrangements and financial mechanisms would be applicable to all ODS sectors, yet many operating procedures, such as the halon production quota, bidding, disbursement conditionalities, monitoring indicators and verification procedures are specific to the halon sector. Thus when new sectors are added to the project, supplemental procedures specific to those sectors would be added. Any revision of the manual would be subject to the Trustee's review and agreement. *Adoption of a project implementation manual, satisfactory to the Trustee, would be a condition of effectiveness of the grant.*

38. Project Supervision and Halon Production Verification Procedures. Verification procedures would be different for each ODS sector and would be developed when new sectors are added to the project. For the halon sector, supervision and verification at different levels are as follows:

- (a) Chinese government's monitoring and enforcement mechanisms—
 - (i) For halon agent production closure projects—
 - a. when bid winners (for halon agent closures) sign ODS reduction contracts with NEPA and MPS, NEPA would cancel their production quota. Thus NEPA could control production quota issued.
 - b. DIA is responsible to supervise closures of the halon agent producers. Local environmental protection bureaus (EPBs), and fire-fighting bureaus (FFBs) would also verify their closure activities.
 - c. The remaining halon agent producers (not project beneficiaries) would have to report to local EPBs and local fire-fighting bureaus (FFBs) and NEPA on their quarterly halon production. After local authorities verify (including on-site investigation) and confirm production, they would report their findings to NEPA and MPS.
 - d. MPS would visit halon producers whenever necessary, especially if there are violations. If not, at least once a year. NEPA would supervise and/or participate in the MPS

factory visits as required to ensure compliance with the annual program.

(ii) For halon fire extinguisher closure and conversion projects, and other ODS reduction enterprise-level activities—

- a. DIA would be responsible for supervision of enterprise project implementation and would report directly to NEPA and MPS.
- b. Local EPBs, FFBs and sector supervisory departments would also visits enterprises randomly to supervise implementation and verify closures, conversion and other activities. They would report to NEPA and MPS on their findings.
- c. NEPA and MPS would verify information received from DIA and local government agencies by visiting enterprises occasionally. Before commissioning of projects, either NEPA or MPS would confirm project completion before NEPA's commission.

(iii) An audit agency would conduct a performance audit after the end of each calendar year to verify national production level in the past year and implementation of the annual program. Details in para. 52.

(b) Trustee's supervision activities. The Trustee would send staff to visit China at least twice a year to supervise the halon program. Among other supervision activities, missions would visit some of the closure projects and all of the remaining halon producers to confirm actual halon production. The Trustee would also undertake an independent technical audit every year to verify annual halon production and consumption levels.

39. Substantial supervision resources would be required for project implementation. It is anticipated that supervision would be more time-consuming and budget-intensive than normal Bank projects because appraisals of other ODS sectors would be carried out under the supervision umbrella. As this is a new approach, the monitoring system is to be installed and many essential program activities are to be developed in the first two years of implementation. Supervision activities would be directed at the sector approach, and not at individual subprojects as in current ODS projects.

40. **The Management Information System (MIS) as a Monitoring Instrument.** An MIS would be set up in the project. It would be the main monitoring tool to track progress of all sector phaseout programs and annual programs. For the halon sector, all performance and monitoring indicators on halon production, consumption, substitute

chemical development and other relevant halon-related information would be entered by NEPA, DIA and MPS (and other sector ministries when their sectors are included in the ODS IV project). All progress reports would be generated from the system for NEPA and MPS for their management of phaseout programs.

41. The MIS would be developed in different phases over the next two to three years to accommodate other sectors as they are included in the ODS IV project. The terms of reference for the first phase of the MIS were finalized and agreed with the Bank in June 1997. Initially, it is expected to be a relatively simple system, but should be able to generate reports sufficient for NEPA for its project management.

42. **Progress Reports.** Each ODS sector would have its own set of progress reports and they would be prepared when it is included in the project. There would be four quarterly progress reports for ODS production sectors and two progress reports, the second and fourth quarterly reports, for ODS consumption sectors. All progress reports are due to the Trustee no later than 45 days after the end of each quarter. The Trustee has discussed and agreed with NEPA on progress report formats for the halon sector. All progress reports are responsibilities of NEPA and would be submitted to the Trustee from NEPA directly. When the MIS is operational, these reports would be generated directly from the system.

43. The agreed progress reports for the halon sector are:

- (a) first and third quarterly reports—on halon production from all halon producers, regardless whether they are project beneficiaries;
- (b) second and fourth quarterly reports—
 - (i) on enterprise activities—NEPA would confirm and summarize progress reports received from DIA; and
 - (ii) on other activities in the agreed annual program—NEPA would report on policy implementation, substitute chemical agents development, technical assistance and training activities, and other information on the implementation of the halon phaseout program.

These reports would provide sufficient indicators for the Trustee to monitor annual program progress, including ODS reduction targets, policy implementation and technical assistance activities. These progress reports would also be the Trustee's control mechanisms as they would be similar as the status reports which are disbursement conditions noted in para. 48, (c)(ii,c) and (d) (ii,c).

44. **Sequence of Events Leading to MFEC Endorsement of Financing and Disbursement Mechanisms of a Sector Approach.** There have been continuous interactions with MFEC on the financing mechanism of a sector approach:

- (a) July 1995—MFEC approved project preparation fund for the Bank and China to initiate the development of an ODS sector phaseout approach that is cost effective for both China and MLF.
- (b) November 1996—MFEC endorsed in principle the proposed sector approach concept based on a proposal submitted by the Bank. MFEC noted the need for the Committee to deal with modality and technical issues arising from the halon sector proposal and that a subcommittee would be set up for this purpose.
- (c) February 1997—MFEC agreed on an “initial guideline” that established the policy framework and modalities under which sector approaches could be funded, including endorsement of disbursement based on performance targets in the program, such as US dollars per unit of ODS phaseout.
- (d) May 1997—Based on a revised halon sector proposal dated April 1997, MFEC decided that a subcommittee would meet in September 1997 to discuss the revised halon sector proposal and prepare a decision by the committee for the November 1997 MFEC meeting.
- (e) November 1997—A final revised halon sector proposal and the 1998 annual program were submitted to MFEC in October 1997 for overall funding agreement in principle and funding request for the 1998 program. On November 14, 1997, MLF approved \$62 million (plus 3 percent local management fee) for the halon sector and \$12.4 million (plus 3 percent fee) for the 1998 annual program.

45. **MP Approval.** For each sector, MP approval is required on:

- (a) overall sector phaseout program,
- (b) annual sector programs with phaseout targets, policy instruments, enterprise-level activities and technical assistance activities, and
- (c) annual funding included in sector annual programs.

Procurement (Schedule B)

46. As this is a “performance-based” grant program, there would not be any tracking of procurement of goods and services for disbursement purposes, thus there would no procurement requirements for enterprise-level activities. For technical assistance activities and DIA’s implementation services, all consultant contracts in excess of \$100,000 for firms and \$50,000 for individuals would be subject to the Trustee’s prior review. All consultants would be selected in accordance with the “Guidelines on Selection and Employment of Consultants by World Bank Borrowers” dated January

1997. All contracts would be subject to postreview by the Trustee. NEPA and the domestic implementing agent(s) would maintain all relevant records for this purpose.

Disbursement (Schedule B)

47. **Disbursement Mechanism from the Trustee to China Through the ODS Phaseout Account.** Upon MFEC's approval of grant fund for the first halon annual program, grant funds would be deposited from the Trustee's OTF account into an ODS phaseout account opened at a bank designated by MOF. There would be one account for the project, with subcategories for each sector. The ODS phaseout account would be managed by MOF.

48. Grant beneficiaries are enterprises that engage in ODS reduction activities; consultant firms, training institutes, and agencies that undertake technical assistance and training activities; and agencies that manage the project (para. 22). For each annual program of any sector, there would be four advance deposits over the year from the Trustee's OTF account into MOF's ODS phaseout account when China fulfills disbursement conditions as set up for each sector in the Grant Agreement and the Project Implementation Manual. The disbursement mechanism for all sectors would be the same, but disbursement conditionalities for each ODS sector would be slightly different, designed to accommodate sector characteristics and requirements. Disbursement requests would use Form 1903, which is prepared by NEPA PMO and submitted to the Trustee by MOF after its approval. No Statement of Expenditure would be required and disbursement could proceed when the Trustee is satisfied that disbursement conditions are met. All supporting documentation would be kept at NEPA and made available to the Bank for postreview. Disbursement during the year is based on implementation progress of the annual program. Disbursement for the following year (at the beginning of the following year) is based on: (a) actual halon production of previous year not exceeding targeted production level, (b) satisfactory implementation of annual program of previous year, and (c) approval of the following year's annual program by MFEC and the Trustee. Thus failure to achieve production phaseout targets and unsatisfactory performance of annual programs are the two indicators that could lead to withholding further release of advanced deposits.

49. For the halon sector, disbursement conditions and amounts to be disbursed are:

- (a) First disbursement:
 - (i) amount—funds for technical assistance and training activities and DIA's management fee.
 - (ii) disbursement conditions—annual program has been approved by MFEC and the Trustee.

- (b) Second disbursement:
 - (i) amount—50 percent of funds allocated to enterprise activities and NEPA's management fee,
 - (ii) disbursement conditions—
 - a. China confirms that halon production has not exceeded production set for the preceding program year *or* halon production during the first nine months for the preceding year has not exceeded 80 percent of the production target set for the preceding program year (not applicable to 1998), and
 - b. any other conditions as specified in the current annual program.
- (c) Third disbursement:
 - (i) amount—30 percent of approved grant fund allocated to enterprise activities and NEPA's management fee,
 - (ii) disbursement conditions—
 - a. China reports that actual halon agent production has not exceeded the production target set for the preceding year (not applicable to 1998),
 - b. all contracts for closures, conversion or appropriate government actions (e.g., quota allocation) that indicate that the production target set for the current program year is achievable,
 - c. progress report on annual program implementation is satisfactory to the Trustee, and
 - d. any other conditions as specified in the current annual program.
- (d) Fourth disbursement:
 - (i) amount—20 percent of approved grant fund allocated to enterprises activities and NEPA's management fee,
 - (ii) disbursement conditions—

- a. China announces production quota of following year to remaining halon producers,
- b. performance audit (1999 and after) are satisfactory to the Trustee,
- c. progress report satisfactory to the Trustee, and
- d. any other conditions as specified in the current annual program.

50. Should the performance audit submitted to the Trustee confirm that actual production did exceed production level set at the annual program, the Trustee would make no further deposits into the ODS phaseout account until proper adjustment of the current-year halon production level (including further reductions to compensate overproduction in previous year to avoid buildup of halon stock) and clearly agreed actions to ensure that current-year target (as revised) would also be met.

51. Unsatisfactory performance, established either through the regular reporting requirements or through findings by the Trustee's supervision missions, would lead to withholding release of subsequent advance deposits until satisfactory corrective action is taken. In such an event, the Trustee would assist NEPA to work out satisfactory remedial actions and seek assurances that the actions would be carried out according to the newly established schedules. Disbursement would resume only once the prior year's program level has been met and measures are in place to ensure current-year target (as revised) will also be met.

52. **Disbursement Mechanism from the China ODS Phaseout Account to Grant Beneficiaries.** Grant funds would be disbursed directly from the ODS account to recipients based on terms contained in "ODS reduction contracts." In the case of technical assistance and training activities, disbursement would be based on the terms contained in consultant or training contracts. Management fees for NEPA and DIA would be disbursed when disbursement conditions are met. These are detailed in the project implementation manual for any specific sector. For example, for the halon sector:

- (a) Closure projects—ODS reduction contracts would specify disbursement as follows:
 - (i) 10 percent—initial payment upon signing of ODS reduction contracts,
 - (ii) 70 percent—payment following dismantling of production equipment, and
 - (iii) 20 percent—payment upon NEPA's confirmation that enterprise decommissioning is complete.

- (b) Conversion projects—ODS reduction contracts would link disbursement to purchase of equipment necessary for conversion or other appropriate milestones,
- (c) Technical assistance and training activities—grant funds would be disbursed to consultant firms or institutions in charge of training based on contractual arrangements,
- (d) DIA's management fee—disbursement conditions are:
 - (i) 50 percent upon bidding completion,
 - (ii) 30 percent upon contracts signatures, and
 - (iii) 20 percent upon completion of all enterprise-level activities.
- (e) NEPA's management fee—payable when corresponding disbursement conditions (enterprise-level activities and DIA) have been met.

53. **Audits.** MOF and NEPA would appoint an independent audit agency, found acceptable to the Trustee, to conduct annual audits. Annual audits would comprise a financial audit of the ODS phaseout account and a performance audit of the agreed annual phaseout and production targets and the annual program. The performance audit would provide an independent verification of the agreed phaseout and production targets. There would be one performance audit for each sector every year. The terms of reference for the halon sector performance audit were agreed during negotiations.

Poverty, Environment Aspects and Resettlement

54. There are no relevant poverty or resettlement issues in the project. Although plant closures are envisaged, workers will be compensated according to current Chinese regulations and/or reemployed within the same factory.

55. The proposed project is an environmental project aimed at reducing ODS emissions, which have significant global impact but limited direct local impact. Most substitute chemicals are expected to be environmentally benign at local levels because they will be produced with more modern production facilities than ODS production facilities they replace. Enterprises will prepare environmental assessments according to Chinese regulations approved by NEPA. Local environmental bureaus are responsible for the environmental assessment reviews and supervision during project implementation stage. Some substitute chemicals are flammable and toxic, such as hydrocarbons used in foam and aerosol sectors. Thus enterprises are required to adopt fire safety measures to reduce fire risks to acceptable levels, according to local regulations approved by the MPS. MPS and local fire protection bureaus are responsible for supervising fire safety measures and ensuring adequate overall fire protection is maintained.

Performance Indicators and Critical Success Factors

56. The overall success of the project would be a total phaseout in selected ODS sectors. For the halon sector, the performance indicators are: (a) annual halon production phaseout measured at the producers' level—this is *the most important* indicator; (b) annual halon consumption phaseout; (c) halon export and import; (e) halon agent closures, halon extinguisher closures and conversion activities—those enterprises that received grant funds through bidding; (f) other enterprise activities, such as substitute chemical production, halon banking and servicing as defined in the annual programs; (g) implementation of policy instruments; and (h) technical assistance activities. Item (a) is the critical indicator that measures whether the program is successful, whereas items (b) to (h) are critical activities that support the phaseout effort and fire-fighting capability of China. Details of performance indicators and measurable tools are in Annex 9.

Project Benefits, Sustainability and Risks

57. The project would assist the Government in implementing an accelerated ODS phaseout program in selected ODS sectors. The halon sector alone would eliminate 10,700 mt (baseline production) of halon and the ODP reduction would be 37,350 mt. However, as actual production in 1997 would probably be higher than 10,700 mt, actual benefits derived from the ODP reduction would be higher. An acceleration of the phaseout schedule in the halon sector from 2010 to 2006 would generate substantial savings in terms of reduced costs of banking, in addition to a significant ODP reduction. The production sector would account for another 60,000 mt of ODP. Thus the positive environmental impact on the ozone layer is considerable.

58. The project is sustainable because it takes a sectoral approach that considers phaseout activities in any sector in their totality and in the halon sector, MPS has demonstrated capability to manage the sector. China is also committed to the phaseout of ODS as required by its obligations under the Montreal Protocol. This commitment is demonstrated through China's approval of the ODS Country Program, which includes the establishment of a formal framework for implementing phaseout and adoption of a satisfactory policy framework that initially bans expanded ODS use. Subsequent action programs have confirmed that commitment.

59. There is a risk that MLF may not agree (or be able to provide) the funding level indicated by the least-cost analysis. An overall sector funding level would be agreed in principle at the MFEC meeting in mid-November 1997. A substantially reduced funding level would seriously undermine the institutional program that China accepted on conditions that grant funds be made available for "incremental costs" and substitute technologies are accessible. A reduced funding level would also reduce its ability to implement the ODS phaseout efficiently. This is a risk not only specific to China nor to this project, but to the entire global ODS program. Program risk will depend on the level of international funding that is appropriate to generate the intended international benefits.

60. There is also a risk that China may not be able to phase out halon within the agreed time frame, but with a delay. Such a delay would not necessarily connote a failure, but would mean a slower phaseout at China's own cost. Other risks include: (a) limited enforcement capability to support policy initiatives; (b) lack of low-cost and easily available clean substitute technology, such as replacement of halon 1301 since technology is still evolving; (c) lack of low-cost replacement equipment and facilities for the service sector; (d) difficulties in arranging counterpart funding in conversion and replacement investment that are not that financially attractive as not all costs are eligible for MLF financing; and (f) general weakness of local institutions in handling project appraisals, procurement and financing. Except for technology issues, this Project addresses most of these risk factors through the sectoral approach, which would considerably reduce these risks. The release of funds on a fixed percentage basis tied to achievements of phaseout targets provides the framework for supervision and monitoring of the phaseout program. Failure to achieve the phaseout target because of the risks identified above will trigger, both within the Government and the Trustee, a consultative process designed to identify the specific constraints and to design and implement modifications in the policy and enforcement mechanisms to set the program back on track.

61. Finally, there is a risk that China may be able to phase out halon as scheduled, but unable to introduce substitute chemicals quickly enough to maintain overall levels of fire protection. However, MPS is well aware of the potential safety issue this situation creates and has started action on the substitute program to ensure overall, satisfactory fire protection safety levels are maintained.

Agreed Actions

62. At negotiations, assurances from the Government were obtained on the following:

- (a) NEPA would maintain the PMO, with adequate staffing and functions, (para. 35); and
- (b) NEPA would retain at least one domestic implementing agent during the life of the project (para. 36).

63. Conditions of Grant effectiveness will be:

- (a) a first-year annual program for the halon sector approved by both MFEC and the Trustee (para. 24);
- (b) a regulation on the production quota system for halon extinguishing agent, acceptable to the Trustee, to be promulgated and effective (para. 27); and
- (c) a project implementation manual, acceptable to the Trustee, to be adopted by the Recipient (para. 37).

Recommendation

64. I am satisfied that the proposed Grant would comply with the relevant provisions of the Ozone Projects Trust Fund in Resolution 91-5 of the Executive Directors, and I recommend that the Regional Vice President approve it.

Yukon Huang
Country Director, China
East Asia and Pacific Region

Attachments

Beijing, China
December 1997

CHINA

FOURTH ODS PHASEOUT PROJECT

PROJECT COST AND FINANCING
(US\$ MILLION)

Years	Project Cost			Financing Plan		
	Local	Foreign	Total	OTF Grant	Others ^{/a}	Total
ODS reduction activities						
1st year	32	5	37	10	27	37
2nd year	59	10	69	14	55	69
3rd year	42	13	55	17	38	55
4th year	37	13	50	14	36	50
5th year	57	8	65	10	55	65
Subsequent years	70	24	94	29	65	94
Subtotal	297	73	370	94	276	370
Technical assistance	28	2	30	6	24	30
TOTAL	325	75	400	100	300	400

^{/a} Other sources of financing include all other expenditures in ODS phaseout activities, such as government expenditures, enterprises self-financing and commercial loans.

CHINA

FOURTH ODS PHASEOUT PROJECT

**PROPOSED PROCUREMENT ARRANGEMENTS AND
ESTIMATED DISBURSEMENT SCHEDULE**

PROPOSED PROCUREMENT ARRANGEMENTS

1. **ODS Reduction Activities.** There will be no procurement requirements for ODS reduction activities at the enterprise level.
2. **Technical Assistance Activities.** Consultants shall be engaged on the basis of the "Guidelines for the Selection and Employment of Consultants by World Bank Borrowers" dated January 1997. All consultancy contracts in excess of \$100,000 for firms and \$50,000 for individuals would be subject to the Trustee's prior review.

ESTIMATED DISBURSEMENT SCHEDULE
(\$ million)

Bank Fiscal Years	FY1998	FY1999	FY2000	FY2001	FY2002	Subsequent years
Annual	4	12	16	16	16	36
Cumulative	4	16	32	48	64	100

CHINA

FOURTH ODS PHASEOUT PROJECT

TIMETABLE OF KEY PROJECT PROCESSING EVENTS

Preparation (time taken):	24 months
Prepared by:	NEPA and the Bank
First Presentation to the Bank:	November 1995
Departure of Bank Appraisal Mission:	January 1997
Date of Negotiations:	August 1997
Planned date of signing:	November 1997
Planned Date for Effectiveness:	December 1997
List of Relevant PCRs and PPARs:	None
Planned Completion Date:	December 31, 2010

The project was prepared by the following: H. Chan (operations officer, task manager), D. Brown (industrial technical consultant), D. Elsen (lawyer), H. Kim (disbursement), E. Pedersen (halon specialist consultant) R. Pepper (principal economist), and J. Poppele (environmental specialist). The sector manager is Hoon Mok Chung and the country director is Yukon Huang.

ANNEXES

- ANNEX 1: ODS in China and the Montreal Protocol
- ANNEX 2: Summary of China Country Program
- ANNEX 3: Halon Sector Issues
- ANNEX 4: CFC Production Sector Issues
- ANNEX 5: Economic Cost Model
- ANNEX 6: The Proposed Tradable Production Quota and Bidding Systems for the Halon Phaseout Program
- ANNEX 7: Operating Mechanisms of Sector Approach
- ANNEX 8: Halon Sector Phaseout Action Plan, July 1997-2010
- ANNEX 9: Performance and Monitoring Indicators for the Halon Sector

ANNEX 1: ODS IN CHINA AND THE MONTREAL PROTOCOL

1. **China—Largest ODS Producer.** Production and consumption of ozone-depleting substances¹ (ODS) in developed countries were eliminated at the end of 1995, making China the world's largest ODS consumer and producer. With rapid industrialization and urbanization, China's ODS consumption grew at approximately 14 percent a year between 1986 to 1996 and 16 percent between 1991 to 1996. By the end of 1996, China's ODS production was about 85,500 tons² and consumption about 91,300 tons.³ Five industrial sectors account for all ODS use in 1996: foams (23 percent); refrigeration and air conditioning (43 percent); aerosols (5 percent); fire protection (12 percent); solvents (13 percent); and tobacco (4 percent) in 1996. Tables 1 and 2 give the main ODS statistics.

TABLE 1: ODS PRODUCTION, EXPORT, IMPORT AND CONSUMPTION, 1996
(metric tons)

ODS	CFC-11	CFC-12	CFC-113	H-1211	H-1301	CTC ^{/a}	TCE	HCFC-22	Total
Production	23,900	25,980	5,300	11,700	618	291	1,400	16,300	85,489
Import	2,952	863	141	0	0	0	4,669	0	8,625
Export	532	508	23	1,148	270	91	248	25	2,845
Consumption	26,320	26,335	5,418	10,552	348	200	5,821	16,275	91,269
% of ODS	29	29	6	11	0.4	0.6	6	18	100
ODP	26,320	26,335	4,334	31,656	3,480	220	582	895	93,822
% of ODP	28	28	5	33	4	0.2	0.6	1	100

^{/a} Production figure is net of feedstock for CTC and TCE. Both are widely used industrial chemicals. They are used as feedstock in the production of a large number of different substances, including CFCs (regulated under the Montreal Protocol), perchloroethylene (a solvent), pesticides, and other chlorinated products. Although CTC and TCE are ODSs, their use as a feedstock (i.e., raw material) in the production of non-ODS substances (such as perchloroethylene and others, where the CTC is actually converted in another substance) is authorized under the Montreal Protocol and do not count as an ODS production.

¹ Substances that deplete stratospheric ozone leading to increased levels of ultraviolet radiation on the earth's surface.

² Roughly 12 percent in terms of world ODS production.

³ Roughly 17 percent in terms of world ODS consumption.

TABLE 2: ODS AND ODP CONSUMPTION, BY SECTOR, 1996
(metric tons)

	Foam	Refrigeration/ Air Conditioning	Fire Protection	Aerosols	Solvents	Tobacco	Total
ODS	20,870	39,010	10,900	5,000	11,439	4,050	91,269
%	23	43	12	5	13	4	100
ODP	20,870	23,630	35,136	5,000	5,936	4,050	94,622
%	22	25	38	5	6	4	100

2. **China and the Montreal Protocol.** The Government ratified the Montreal Protocol (MP) on Substances that Deplete the Ozone Layer in June 1991, committing to phase out ODS production and consumption by 2010. China is eligible for financing from the Multilateral Fund (MLF) for implementation of the MP, which was created to provide support to eligible developing countries to meet their MP obligations. A Multilateral Fund Executive Committee (MFEC), comprised of representatives from developing and developed countries, manages the MLF. The Bank, the United Nations Development Program (UNDP), the United Nations Environmental Program (UNEP), and the United Nations Industrial Development Organization (UNIDO) are the implementing agencies. The Ozone Projects Trust Fund (OTF) Agreement, between the Bank and MFEC, governs the Bank's MP projects.

3. **Institutional Arrangement.** The Chinese agency responsible for the ODS phaseout program is the National Environmental Protection Agency (NEPA), the head of the Leading Group for Ozone Layer Protection. The Leading Group comprises 18 ministries and agencies and is responsible for the implementation of the Montreal Protocol provisions, the review of implementation options, and strategic decision-making. NEPA has established a Project Management Office (PMO), under the overall guidance of the Leading Group, to manage the ODS phaseout program and is assisted by the China Investment Bank (CIB) and the China Investment and Trust Corporation (CITIC) for ODS I to III projects. Under the ODS IV project, PMO has selected a domestic implementing agency to assist all enterprise-level activities and set up a team in mid-1997 within PMO to take care of all day-to-day halon-related activities.

4. **Phaseout Strategies and Country Program.** A Country Program (CP), setting out strategies, policies and action plans involving external funding and technology support, was prepared in 1992 and presented to MFEC in March 1993. The CP aims to cap ODS consumption by 1996 to the 1991 level of 50,000 tons; it would then reduce that level by 50 percent by 2000 and phase out ODS consumption by 2010. However, with rapid economic growth and a slow start in ODS phaseout due to insufficient MLF funding, the original overall 1996 target was not met. Rapid phaseout of ODS is planned

in sectors where substitute technologies are widely available, such as aerosol, foam and solvent sectors. A more gradual phaseout will be necessary in other sectors, such as refrigeration and air conditioning where substitutes are still expensive, and fire protection where the phaseout must be scheduled to maintain fire protection standards. Sector phaseout strategies were prepared in 1995 for all sectors, including updated information and revised strategies and action plans. The revised overall phaseout schedule calls for an accelerated target of 2005 for substantially complete elimination of ODS, but recognizes slower phaseout in the initial years. The Country Program is currently being updated and will be presented to MFEC in the beginning of 1998.

5. **MP Operations.** The Bank approved three ODS Phaseout Projects in three successive years, 1993 through 1995. The ODS I and II projects were completed as scheduled on June 30, 1997. Grant fund approved for these two projects, \$6.925 million and \$4.422 million respectively, were fully disbursed in July 1997. ODS III is progressing well. As of October 31, 1997, total committed amount from MFEC amounted to \$68 million and disbursement totaled \$25.7 million. Upon completion of all subprojects, about 23,000 tons of ODP (equivalent to about 25 percent of China ODP consumption) will have been eliminated. This proposed fourth project is a continuation of the phaseout effort. UNDP has been providing: (a) technical assistance through institutional strengthening of PMO; (b) project financing for solvent cleaning and foam sectors; (c) assistance in the revision of fire codes and standards to support halon phaseout; and (d) testing and evaluation of fire extinguisher systems that can be used as halon 1301 alternatives in China. UNIDO assists in financing projects in several sectors. A small number of bilaterally supported projects are also being implemented, of which the United States Environmental Protection Agency (USEPA) has supported several activities in the halon sector.

6. **MP Program and Bank's Country Assistance Strategy.** The ODS phaseout program is part of a larger Bank effort to help China reverse environmental degradation stemming from rapid industrialization based largely on older technologies and underpricing of resources. The Bank has assisted in the development of environmental policies and the regulatory framework, has prepared a comprehensive environmental strategy paper, and has financed a number of environmental protection projects in different provinces of China.⁴

⁴ Including Beijing, Hubei, Jiangsu, Liaoning, Shenyang, Sichuan, Tianjin, Yunnan and Zhejiang.

ANNEX 2: SUMMARY OF CHINA COUNTRY PROGRAM FOR THE PHASEOUT OF OZONE-DEPLETING SUBSTANCES UNDER THE MONTREAL PROTOCOL

1. The Government of China will strictly adhere to the provisions of the Montreal Protocol and undertake necessary measures for the phaseout of ozone depleting substances (ODS) production and consumption in China by the year 2010, provided that sufficient funds are made available and needed technologies are transferred in accordance with the provisions of the Protocol. China will speed up its ODS phaseout once cost-effective substitute technologies and sufficient financial assistance for implementing the technical changeover are obtained.

ODS Situation in China

2. China's ODS consumption in 1991 was 48,239 metric tons (mt), of which 63 percent was produced domestically and 37 percent was imported. Seven types of ODS controlled by the Montreal Protocol are commonly produced and used in China: CFC-11, 12 and 113; halon-1211 and 1301; carbon tetrachloride (CTC); and methyl chloroform (TCE). The four substances accounting for most of the total ODS in 1991 were CFC-12 (48 percent), CFC-11 (34 percent), Halon-1211 (8 percent), and CFC-113 (8 percent).

3. In terms of ODS, the foams sector is the largest user in China, accounting for 37 percent of total consumption, followed by the refrigeration and air conditioning sector with 27 percent, aerosols with 18 percent, solvents with 10 percent, and fire extinguishing (halons) with 8 percent. Although halon usage is relatively small, halons have significant impact due to their greater weighted ozone-depletion potential, and therefore merit special attention.

Forecast of Unconstrained ODS Demand to the Year 2010

4. China's economy is growing rapidly, and ODS consumption is expected to increase at about 11 percent annually. ODS consumption, if not controlled, is expected to reach 84,000 mt by 1996, 116,900 mt by 2000, 173,700 mt by 2005, and 255,600 mt by 2010. Projected ODS consumption in 2010 can be broken down as follows:

- CFC-11:	35,500 mt	- Halon-1211:	19,200 mt
- CFC-12:	138,500 mt	- Halon-1301:	900 mt
- CFC-113:	45,600 mt	- CTC:	3,100 mt
- TCE:	12,900 mt		

5. Projected increases in ODS demand will span all sectors. Demand for rigid polyurethane (PU) foams used in domestic refrigeration is expected to increase at an annual rate of 8 percent until 1995 and at a rate of 3 percent after 1995. Demand for other foams should increase at a rate of 6 percent a year. Industrial refrigeration and air conditioning are expected to increase steadily at 8 percent a year, while commercial refrigeration is projected to grow at 18 percent a year up to the year 2000 and 15 percent a year thereafter. Mobile air conditioning (MAC) demands are expected to grow at an annual rate of 20 percent before 2000 and 10-12 percent after 2000.

6. Demand for Halon-1211 fire extinguisher is expected to grow by 11 percent before 1997 and by 7 percent after 1997, and for extinguishing systems by 14 percent until 1997 and by 12 percent per year thereafter. Demand for Halon 1301 systems is expected to grow by 20 percent before 1997 and by 15 percent after 1997.

7. Demand for aerosols is expected to increase at 30 percent a year until 1995, at 9 percent during 1996-2000, and at 6 percent during 2001-10. Solvents used in electronics cleaning are expected to experience a demand growth rate of 11-16 percent through the year 2010.

Institutional Framework

8. The Government of China has established a formal national institutional framework for ozone layer protection and for implementation of the Montreal Protocol. Within this framework, the **Leading Group for Ozone Layer Protection** is responsible for the implementation of Vienna Convention and Montreal Protocol provisions, the review of various implementation options, and strategic decision-making. The Leading Group comprises 18 government authorities with the National Environmental Protection Agency as the leader.¹

9. Two other entities report to the Leading Group: the **Coordinating Group for Ozone Layer Protection** and the **Project Management Office**. The Coordinating Group has been entrusted with the following tasks:

- (a) concrete implementation of the Convention and the Protocol;
- (b) coordination of the production, import, export and consumption of controlled substances and their products;

¹ Members of the Leading Group on Ozone Layer Protection include NEPA, Ministry of Finance, Ministry of Foreign Affairs, State Economic and Trade Commission, State Planning Commission, State Science and Technology Commission, State Custom Bureau, State Pharmaceutical Administration, Ministry of Public Security, Ministry of Chemical Industry, Ministry of Machinery Industry, Ministry of Agriculture, Ministry of Electronics Industry, Ministry of Internal Trade, National Council of Light Industry, China Tobacco Monopoly Bureau, China Aviation Industry Company and China Aerospace Industry Company.

- (c) financial analysis of the domestic and external funding needed for implementation of the Protocol;
- (d) proposing various options to the Leading Group; and
- (e) handling other affairs related to the Convention and the Protocol.

10. Other institutions involved include the State Administration of Commodity Prices, which manages the prices of controlled substances and substitute technologies, and local environmental protection agencies, which are responsible for the implementation of environmental regulations at the local level.

Policy Framework

11. China's policy framework to phase out ODS and encourage the use of substitute technologies consists of the following 10 specific policies:

- (a) **Production Management.** A permit and quota system will be used to manage ODS production. Government permission will be required for ODS manufacture, based on environmental impact assessments. Enterprises must follow the ODS phaseout schedule in the Country Program.
- (b) **Imports.** Imports of ODS and their products will be restricted in order to promote local production of ODS substitutes.
- (c) **Prices.** Prices of ODS and ODS substitutes will be adjusted when appropriate to ensure a smooth transition.
- (d) **Sales.** Government will be the exclusive supplier for sales of ODS.
- (e) **Taxation.** Tax rates on ODS and their products will be controlled or increased. Tax reductions/exemptions will apply to ODS substitutes and ODS recovery.
- (f) **Investment.** The government will encourage investment policies that promote ozone protection.
- (g) **Incentives.** The government encourages the development of technologies for ozone protection applicable to China, and will establish a fund for outstanding contributors to ODS phaseout.
- (h) **Public Awareness.** Public media resources will be used to raise public awareness of ozone issues. Technical training courses will increase skills of technicians and managers involved with ODS.

- (i) **Green Labels.** "Green labels" will be issued to products made with non-ODS and ODS substitutes.
- (j) **Legal Policy.** Regulations for managing ODS and ODS substitutes will be enhanced and finalized.

Government and Industry Responses to the Protocol

12. China has already issued bans on new ODS-based production facilities in the fire protection and aerosol sectors (1990 and 1991, respectively). Other government and industry responses to the Protocol to date include the establishment of a state-level institutional framework and Ministry-level administrative institutions; the elaboration of industrial management systems for compliance; research into substitution technologies; the mobilization of funding for loans; the establishment of an assessment center for CFC substitution; various activities for the exchange of technical and policy information; and the publishing of various papers to raise public understanding.

ODS Phaseout Implementation

13. The ODS phaseout implementation schedule is shown in the following table:

Sector	Description	Phaseout date
Aerosols	Excludes medical applications	1997
Foams	Excludes use in refrigerators and hard polyurethane boards	2000
Chemical substitutes	Excludes Halons	2010
Industrial/commercial refrigeration		2005
Domestic Refrigeration	Includes use in refrigerators and hard polyurethane boards	2000
Halons		2000/ ^a
Solvents		n.a./ ^b
ODS recovery and recycling	Construction of recovery/recycle networks/sites	2005

^a Not completely phased out. By the year 2000, halons will be phased out for nonessential uses, production of halon and halon extinguishers will be halted, and halon storage and recycling equipment will be reinforced for storage of halons for essential uses.

^b Promotion of non-ODS technologies through entire industry will be started in 1996. It is difficult to predict complete phaseout.

ODS Phaseout Costs

14. The Government's preliminary calculation of least-cost option for phasing out ODS in China by 2010 is estimated to have a direct net incremental cost of about \$1.4 billion (not yet endorsed by MPEC). Other incremental costs have not yet been calculated. The net administrative/management costs for implementation of the Government's Action Plan to implement the proposed strategy is \$500,000 per year.

ANNEX 3: HALON SECTOR ISSUES

1. **Introduction.** The halon sector is one of the larger producers of ODS in China, with production of halon 1211 of 11,700 mt and halon 1301 of 620 mt in 1996. Its significance in overall production of ODS is greater because of its high ODP ratio; 1996 production was equivalent to more than 35,000 tons of ODP. Halon is used exclusively in the fire protection industry in China. The production and consumption of halon in fire protection has produced features that generate a number of issues affecting the strategy and approach for phaseout of halon, and this annex summarizes these features.

2. **Fire Protection Capacity.** Strong economic growth and, in particular, rapid growth of industrial and commercial activities in major urban areas have provided the impetus for the rapid growth of fire protection in the past decade. A number of serious fire accidents have furthermore increased the awareness and enforcement of fire regulations. Since 1990, the fire protection industry has been expanding at 10 to 15 percent a year. The halon segment of the industry has been expanding even more rapidly, based on increased availability of relatively cheap and domestically produced halon 1211 and halon 1301 and the convenience of their use. Compared to other countries, China's fire protection industry has made disproportionate use of halon, an efficient fire extinguishant, albeit unfortunately with high ODP. In 1995, halon extinguishers provided some 30 percent of the overall market, compared to the 15 percent usually found in developed economies before phaseout.

3. Halon is a low-pressure gas and is easily manufactured, with minimum quality-control problems. Only recently, alternatives to halon, such as ABC dry powder, have been introduced into the market. Their substitution for halon in substantial quantities will require active government promotion, sufficient financial assistance and support, the availability of technologies, and market acceptance. Because of the disproportionate use of halon and a strong customer preference for halon-based equipment, rapid phaseout of halon in China has to be carried out carefully to assure maintenance of overall fire protection capacity.

4. **Development of Substitute Agents for Halon 1211.** The speed at which halon can be phased out is not the major issue faced by MPS, the ministry in charge of fire protection. Authorities have already demonstrated a capacity for closing halon chemical plants through regulatory means and direct state intervention in an industry that remains dominated by state enterprises and township and village enterprises. Rather, the major issue is time needed to identify and develop suitable clean alternatives whose production can be expanded to fill the gap created by retirement of halon 1211 and halon 1301. In its phaseout strategy, the MPS has opted to replace halon with mainly ABC dry powder and CO₂, but both face obstacles to their rapid commercialization that must be solved. MPS

technical institutes continue to work on other substitutes for halon, but commercial results are not expected in the near future.

5. **ABC Dry Powder.** As MPS envisages that 50 to 70 percent of the current and future demand for halon would be met by ABC dry powder, the issues facing ABC dry powder manufacture and consumption must be addressed immediately. One important issue relates to quality of the powder. ABC dry powder is manufactured by a number of enterprises, but has been typically of poor quality, exhibiting caking and lumping. Extinguishers using such powder tend to malfunction, and extinguisher manufacturers have been disinclined to pay higher prices for a product that performs badly, and have preferred to manufacture even lower-cost BC powder extinguishers. A healthy market for these extinguishers has developed, because the authorities have frequently permitted use of BC dry powder extinguishers where the fire codes call for ABC dry powder extinguishers. The one factory capable of manufacturing good-quality ABC dry powder has faced significant problems because of high production costs, managerial capability and difficulties in finding a market.

6. **CO₂.** The size of the Chinese chemical industry ensures that there will be no shortage of CO₂. However, because it is used in compressed form, CO₂ use in extinguishers necessitates special high-pressure cylinders. CO₂ cylinders must be thicker and valves must be made to closer tolerances than in the case of halon cylinders. Thicker cylinders translate into greater weight (thus consumer resistance) if the cylinders continue to be made of steel, but at present time China lacks the capacity to make extensive use of aluminum cylinders.

7. **Low Profitability of Substitute Agents.** Enterprises on their own are reluctant to switch away from halon due to high profitability and the strong market acceptance of halon in many fire-fighting applications. The main substitute agents are more difficult to manufacture to the same quality standards as halon and command a lower selling price, thus reducing profit margin of enterprises. These factors are not recognized with the MP eligible funding guidelines. Thus the typical substitution subproject will involve the enterprise undertaking an investment on which it sees a low return. A likely result of the halon phaseout activity will be that a number of halon extinguishers will be closed due to the lower profitability of alternatives.

8. **Essential Uses of Halon.** In November 1994, the Government promulgated a regulation limiting new halon extinguishers and systems to only essential uses, as a way of reducing market demand for halon-based equipment. This regulation was effective in October 1995. The authorities have indicated that this regulation has already had a significant effect on the demand for halon-based equipment, but this judgment has yet to be confirmed by interviews with extinguisher producers. The government has also not yet indicated clearly what "essential uses" translate into in practice, nor has it designed inspection and monitoring systems that would allow enforcement of the regulation. After

years of rapid growth, the 1996 halon 1211 production had declined from the 1995¹ level, representing a 4 percent decrease and 1997 is expected to decline further as a result of the regulation.

9. **Fire Codes, Monitoring and Enforcement.** In general, fire codes in China have to be modified to promote the phaseout of halon. This will involve not only revisions of fire codes aimed at removing or restricting the possibility of halon use, but also improved enforcement of the codes and monitoring of premises. Improved information and monitoring systems will also be required to enable China to document to the Bank and MP that phaseout targets are being met. Initial work supported by MLF has already begun to modify various parts of the fire codes, but substantial work is needed to improve the information and monitoring systems.

10. **Phaseout of Halon 1301.** Halon 1301 is produced in one factory in China and is used primarily by manufacturers of custom-designed fire protection systems. Growth of this segment of the market has been very rapid in recent years, and China has been importing halon 1301 to supplement domestic production. In principle, phaseout of halon 1301 is relatively straightforward because only one factory has to be phased out; but in practice it is complicated by the fact that substitutes for halon 1301 are few and are extremely expensive. China has identified a substitute—FM200—which has a current market price four to five times more than halon 1301 and for which China has not obtained the technology to produce. The patent of FM200 is currently available only from one supplier in the United States, and it is not yet clear whether China will be able to obtain the rights to produce the chemical (HFC 227ea). As a result, MPS anticipates that the phaseout of halon 1301, whose impact on ODP is disproportionately large, will not start until 2000. MPS is developing a program to limit growth of halon 1301 systems and assessing other alternatives.

11. **Servicing Requirements, Recycling and Banking.** The service sector is a difficult area to address since it involves more than 2,000 service units scattered throughout China. The two main issues to address will be limiting emission and recovering of halons and handling of new alternatives such as ABC powder and CO₂. It will require a large technical assistance program, including training of servicemen at service units (such as handling of new substitute agents and minimizing losses during servicing) and provisions for recycling equipment and facilities. Policies will be required to promote refilling extinguishers with substitute chemicals and giving financial incentives to service units to recycle halon. MPS has started a small pilot program for recycling under USEPA's support. The fact that each year's production of new extinguishers and systems adds to a stock that requires a percentage of refilling and

¹ The latest production figure for halon are:

	<u>halon 1211</u>	<u>halon 1301</u>
1995	12,189 mt	599 mt
1996	11,700 mt	620 mt

servicing each year means that phaseout of halon production on a given schedule must be accompanied by a more rapid phaseout of new halon extinguisher production. The costs of premature retirement of halon-based equipment also suggest the need for a halon banking scheme that can recover and recycle halon. The program for the service sector is still under development and the main actions are not expected to start until the year 2000. Immediate actions needed include continued development of the recycling system, minimization of the halon stock by promoting a rapid halon phaseout program and technical assistance to improve the servicing system.

ANNEX 4: PRODUCTION SECTOR ISSUES

1. **Introduction.** The next sector to be included in the sector approach is the production sector. CFC production increased sharply during the early 1990s as part of a self-sufficiency program. CFC demand has recently decreased overall as a result of phaseout efforts in the CFC user industry. By 1996 China has become substantially self-sufficient in CFC production, and the strategy is to maintain this self-sufficiency, both in CFCs and the CFC substitutes (which in this case constitutes several high-purity hydrocarbons and a smaller number and volume of chemicals that are similar to CFCs in properties but have no or very little ODP). As the CFC user industries shift away from CFCs, including many hydrocarbon applications, CFC production will be reduced annually to match local demand. To achieve this reduction, many CFC producers will simply have to exit the chemical business, while most will face outright closure. Currently, China does not plan to export significant amounts of CFC, but exports to other developing countries could be a means of providing financial resources to the industry during the phaseout period. (Indian CFC producers have adopted this approach.)

2. **Characteristics.** CFCs are produced in about 40 factories in China. Many are small rural enterprises, similar to the halon sector, with few prospects for switching to alternate products. Several larger enterprises are multiproduct chemical factories that are more financially viable and more capable of restructuring to a different product mix. About 35 of the CFC producers will close or convert to nonchemical businesses. For rural enterprises, this closure will result in localized hardship, since these enterprises and their townships have limited financial resources and management skills required to diversify, alternative businesses will be difficult to find. The few chemical substitutes needed, such as HFC 134a (and an associated lubricant required for its special use), HCFC 22, and HFC 123, are very capital-intensive and are likely to receive little or possibly no funding from MLF. The size of funding required will present a major issue even for the larger enterprises. To partially solve this issue, China has decided to rely partly on HCFC 22, a chemical with very low ODP, that can be used in the interim until a permanent solution is developed. HCFC 22 will be used in commercial refrigeration and some foam applications, and under the MP this chemical can be used in developing countries until about 2015, at which time its use will be substantially limited. Less capital-intensive than other substitutes, it can likely be developed by the larger existing CFC producers as part of their restructuring plans.

3. A **preliminary estimate** in the production sector indicated that ODS phaseout costs will be three to four times the size of costs in the halon sector. The main cost components for the production sector are: (a) costs of replacement chemicals and (b) closure costs. The principal demand for replacement chemicals is for much higher value and more technically sophisticated products that require substantial investment

resources. These products present major costs, as well as technical and marketing issues that will have to be addressed specifically in a proposed project preparation activity for the production sector. The absence of eligibility guidelines from MFEC for the production sector with the likelihood of little or no funding for these substitutes will compound this issue. Closures and/or annual reductions in CFC production level will be handled through a quantitative production license system similar to the halon sector.

4. Since MFEC guidelines for funding for CFC production have not been finalized, the anticipated funding level cannot be determined at this time, but could conceivably be as high as about \$100 million, if funding for substitute chemicals is permitted. A notional amount of about \$40-50 million has been provisionally allocated in the proposed ODS IV grant to cover this sector. The proposed funding would be adjusted when more accurate data are available.

ANNEX 5: ECONOMIC COST MODEL

1. In order to evaluate options for China's phaseout of production and consumption of halon 1211 and halon 1301 in a cost-effective and economically efficient way, while meeting the rapidly growing demand for fire protection in China, an economic cost model has been built to measure the costs to China of phasing out halon under various scenarios and to establish the phaseout costs that are eligible for MLF financing under its current eligibility rules.

2. **Market Demand.** The computer-based cost model starts from projections of market demand for fire protection for the period 1996-2010. The projection (shown in Table 4) was based on extrapolation of data for 1991-95 of production and consumption of fire protection agents that was available at the beginning of 1996. At that time, production and consumption trends in China could be established only in approximate terms, because comprehensive data had not collected from enterprises in the past. Thus, the demand projection presented in Table 4 was based on an official estimate that production of halon 1211 had grown from 4,000 tons in 1991 to 9,950 tons in 1995, and that domestic consumption had reached 8,550 tons in 1995. Subsequent surveys conducted by MPS and analysis of information during the development of the phaseout plan have improved the coverage and quality of available information, and the data presented in Tables 1, 2 and 3 represent the most recent estimates of production and consumption of fire protection agents. In particular, the survey conducted in 1997 of halon agent producers demonstrated that the halon-based extinguisher industry was already beginning to respond to the policies restricting use of halon-based extinguishers and systems, since domestic consumption of halon fell in 1995. The "Sector Plan for Halon Phaseout in China," dated October 20, 1997, provides the best available data on production and consumption of agents, disaggregated into: (a) domestic market use and exports/imports, (b) use for extinguishers and systems, and (c) use for refilling the current stock of extinguishers and for new extinguishers (see Tables 1, 2 and 3 below). Total consumption of agents is estimated to have grown at 18 percent a year between 1991 and 1995 (when GDP growth averaged 12 percent), with consumption of halon growing somewhat faster than other major agents, reflecting consumer preferences for a relatively low-cost, high-quality and convenient product.

TABLE 1: PAST PRODUCTION AND CONSUMPTION OF AGENTS
(tons)

	1991	1992	1993	1994	1995	Number of Producers (1995)
Halon 1211						
Production	4,144	7,767	10,848	14,294	12,338	14
Import	0	0	0	0	0	
Export	0	0	0	0	1,400	
Domestic Consumption, of which use for	4,144	7,767	10,848	14,294	10,938	
new extinguishers	4,051	7,043	9,581	12,540	9,350	
new systems	0	432	626	689	705	
servicing	93	291	641	965	883	
ABC Powder						
Production	0	0	800	1,500	2,000	5
Domestic Consumption, of which use for	0	0	800	1,500	2,000	
new extinguishers	0	0	800	1,500	2,000	
servicing	0	0				
CO₂						
Domestic Consumption			200	500	500	
AFFF						
Domestic Consumption	0	0	500	1,000	1,000	3
BC Powder						
Domestic Consumption	21,691	23,421	26,619	33,433	39,727	50
Foam						
Production	10,737	11,594	13,176	16,550	19,665	36
Domestic Consumption, of which use for	10,737	11,594	13,176	16,550	19,665	
new extinguishers	1,627	1,757	1,996	2,508	2,980	
new systems	9,110	9,837	11,180	14,042	16,685	
Halon 1301						
Production	50	68	120	540	750	1
Import	40	50	0	0	0	
Export	0	0	0	240	450	
Domestic Consumption, of which use in	90	118	120	300	300	
new extinguishers	0	0	0	0	0	
new systems	82	110	110	280	277	
service	8	8	10	20	23	

Note: Domestic consumption = Production + Import - Export. Domestic consumption includes consumption of agent for extinguishers, extinguishing systems and servicing (retirement and refilling). Data are based on a 1995 survey of nonhalon agent producers and consumers and a 1997 survey of halon agent producers and users.

TABLE 2: AGENTS USED IN EXTINGUISHERS (TONS) AND EXTINGUISHERS PRODUCED ('000)

Extinguisher Type	1991	1992	1993	1994	1995	Number of manufacturers (1995)
Halon 1211						72
agent consumed	4,051	7,043	9,581	12,540	9,350	
extinguishers produced	2,025	4,321	5,630	7,449	5,390	
ABC powder						
agent consumed	0	0	800	1,500	2,000	
extinguishers produced			267	500	667	
CO₂						
agent consumed	0	0	200	500	500	
extinguishers produced			33	83	83	
AFFF						
agent consumed	0	0	500	1,000	1,000	
extinguishers produced			63	125	125	
BC powder						
agent consumed	21,691	23,421	26,619	33,433	39,727	
extinguishers produced	7,230	7,807	8,873	11,144	13,242	
Foam						
agent consumed	1,627	1,757	1,996	2,508	2,980	
extinguishers produced	542	586	665	836	993	
Total Agents:						
agent consumed	27,368	32,221	39,696	51,481	52,776	
extinguishers produced	11,424	12,714	16,056	20,947	20,500	

Note: Data are indicative: calculations are based on the 1995 survey for nonhalon agents and the 1997 survey for halon agent.

TABLE 3: AGENTS CONSUMED IN EXTINGUISHING SYSTEMS (tons)

	1991	1992	1993	1994	1995
Halon 1211	0	432	626	689	705
Halon 1301	82	110	110	280	277
Foam	9,110	9,837	11,180	14,042	16,685
Total	9,192	10,379	11,916	15,011	17,667

Note: Figures on halon 1301 systems do not include the amount of agent in imported systems. A large number of systems have been imported as part of joint-venture projects, especially in special risk uses, such as oil and gas, power and telecommunications.

3. **Demand Projection.** The demand projection for 1996-2005 relating to extinguishers was made by considering: (a) common relationships between economic growth and fire protection in other countries for which reliable data are available; and (b) past and current developments in China as they were known in 1996. It is expected that, over time, the growth rate of fire protection in China will increasingly be determined by the rate of growth of the economy itself, but for the time being, it will continue at a higher level. The demand projection, shown in Table 4, estimates that the market for overall fire protection (measured in terms of agent) will increase by an annual rate of 15 percent until 2000 and by 10 percent a year thereafter. The projection has been based on a number of considerations: (a) the probability that the economy will grow at approximately 10 percent a year until 2000 and maintain a growth rate of 8-10 percent thereafter;¹ (b) continuing healthy growth of commercial construction in urban areas and special economic zones;² and (c) increasing demands for agent for servicing and retirement of a growing stock of fire protection equipment.³ These projections indicate also that, given the existing capacity in China for halon agent production (estimated to be approximately 19,000 tons), unconstrained demand for halon could be met from existing facilities until approximately 2000.

TABLE 4: DOMESTIC CONSUMPTION FORECAST OF HALON EXTINGUISHING AGENT AND ITS SUBSTITUTES UNDER UNCONSTRAINED CONDITIONS
(tons)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Halon 1211	8,550	9,833	11,307	13,003	14,954	17,197	18,917	20,809	22,889	25,178	27,696
Halon 1301	300	345	397	456	525	603	664	730	803	883	972
BC	39,727										
ABC	2,000	2,300	2,645	3,042	3,498	4,023	4,425	4,867	5,354	5,890	6,479
CO ₂	500	575	662	760	875	1,006	1,106	1,217	1,339	1,472	1,620
AFFF	1,000	1,150	1,323	1,521	1,749	2,011	2,212	2,434	2,677	2,945	3,239
Total	12,350	14,203	16,333	18,783	21,600	24,840	27,324	30,057	33,062	36,369	40,005

¹ According to the "Ninth Five-Year Plan and Outline Objective of 2010 for the Chinese Economy," the government target for GDP growth between 1996 and 2000 is 8 percent a year, but 1996 growth was 10 percent.

² According to the "Chinese Statistical Yearbook," building area grew by 14 percent a year between 1991 and 1995, propelled by rapid growth of office accommodation in major urban areas and special economic zones. Although recent data suggest that overcapacity in the major urban areas is leading to a slowdown in new office starts, secondary urban areas appear to be expanding office construction more rapidly, so that the overall growth rate is likely to remain high.

³ In the past, agent consumption for servicing and retirement of the existing stock of extinguishers appears to have been small. However, demand is likely to increase both as stocks increase and as regulations governing servicing are applied more consistently. In the demand projections, it is assumed that servicing of 3 percent of the stock of extinguishers is carried out each year, and that annual retirement rates for the stock will be 3 percent before 2000, 4 percent from 2001 to 2005, 5 percent from 2006 to 2010 and 7 percent thereafter.

4. The demand projection for 1996-2005 was constructed on the assumption that halon would remain in the market. It has been termed the “unconstrained case,” reflecting the fact that, in the absence of the Montreal Protocol and a Chinese government decision to phase out use of halon, there would be no constraint on the supply and use of halon. It thus provides a baseline for demonstrating the amount of halon substitutes that will be necessary to satisfy market demand under various phaseout scenarios. The demand projection also assumes that the structure of the market would continue to resemble that prevailing today; in other words, the future growth rates of all forms of fire protection are assumed to be identical, although the historical data indicates that growth of halon use has tended to outpace the overall market, because of the advantages of halon-based fire protection perceived by consumers. The figures indicate that consumption of agents in the domestic market in 1995 was split 85 percent dry powder and 15 percent clean agent, which meant that extinguisher consumption was split approximately 70 percent dry powder and 30 percent clean agent.

5. **Phaseout Scenarios.** At the beginning of the modeling exercise, the Chinese Government stipulated that it would seek MLF financing to offset the incremental costs of phasing out 9,950 tons of halon production and consumption. In other words, it agreed to seek funding for the amount of 1995 production that it had reported to the Montreal Protocol, and implicitly agreed to finance itself the costs of closing any production above that level.

6. To select a specific phaseout program for halon 1211, a number of phaseout scenarios were developed for analysis through the cost model. The scenarios, each of which was defined in terms of tonnage of halon agent to be removed from the market each year, provide variations in three parameters: phaseout speed and profile, alternative technologies and substitutes for halon 1211, and use of halon banking. The model: (a) calculates the number of extinguishers that the tonnage of halon 1211 to be phased out could produce;⁴ (b) allocates this number to substitute extinguishers (using CO₂, ABC powder and AFFF) on the basis of the “conversion ratio” of 65 percent, 31 percent and 4 percent respectively; and (c) calculates the additional tonnage of these agents required.⁵ The conversion ratio given above is used until the structure of the extinguisher market attains a 85/15 dry powder/clean ratio, after which the model selects a conversion ratio necessary to preserve this market structure. Given the conversion ratios used, it should be recognized that, even if the market for new extinguishers were to grow at the same pace

⁴ In 1995, approximately 4 million extinguishers were produced from the 7,309 tons of halon 1211 available for new production, indicating that the average extinguisher required just under 2.0 kg of halon.

⁵ To produce a substitute extinguisher capable of producing the same fire protection as the halon extinguisher being phased out, it is assumed that 1 kg of halon is replaced by 1.5 kg of ABC powder, 3 kg of CO₂ or 4 kg of AFFF. Although the usual ratio for replacement of halon by ABC powder is 1:1, the above ratio is being used in the case of these projections, since a significant share of the halon extinguisher market in China consists of 1 kg cylinders, which must be replaced by the minimum size of ABC powder extinguisher, which is a 2 kg cylinder.

as GDP, the growth of agent output will be somewhat greater. It should also be noted that the incorporation into the demand projections of a need to allocate some of future halon production to refilling and maintaining the current stock of extinguishers means that, under any of the scenarios, production of new extinguishers will have to be phased out more quickly than halon production.

7. **Design of Phaseout Scenarios.** Six scenarios for phasing out halon 1211 on a sector basis and a single scenario for halon 1301 were developed for intensive analysis. The six phaseout scenarios for halon 1211 (Table 5) provide variations in three parameters: phaseout profile, alternative technologies and substitutes, and halon banking.

TABLE 5: SCENARIOS FOR HALON 1211 PHASEOUT

	1998-2000	2001-2003	2004-2006	Alternate Agent for Extinguishers	Halon bank
Scenario A	60%	20%	20%	HCFC	yes
Scenario B	60%	20%	20%	ABC, CO ₂ , AFFF	yes
Scenario C	60%	20%	20%	ABC, CO ₂ , AFFF	no
Scenario D	36.7%	40%	0%	ABC, CO ₂ , AFFF	yes
Scenario E	20%	40%	40%	ABC, CO ₂ , AFFF	yes
Scenario F			Baseline scenario		

8. **Scenario F.** It is defined here as the baseline scenario. It assumes that China phases out halon 1211 in conformity with the London Amendment of the Montreal Protocol, with no further steps being taken to accelerate the phaseout beyond China's existing obligations. Under existing obligations, China: (a) could increase halon production to meet basic domestic needs—15 percent annually until 2000, then 10 percent until 2002; (b) would reduce production in 2002 to the average production level of 1995-97; (c) would keep production in 2005 to be 50 percent of the 2002 level; and (d) would phase out all production by 2010. Such a scenario would generate large phaseout costs to China, and eligible incremental costs from the MLF would also be high. An additional reference scenario for comparisons to project-by-project approach has also been developed.

9. **Scenario B—The Least-Cost Solution.** Scenarios A, B, and C estimate costs by adopting the same phaseout profile but different approaches to phasing out halon 1211 by 2006. Scenario A models the costs of converting halon extinguishers to HCFC; C assumes that halon banking schemes would be provided through import of agent rather than domestic production; and B assumes some domestic production for halon banking. While all three scenarios front-load the phaseout, B has the least phaseout costs; thus the choice is between scenarios B, D and E. D and E have different phaseout profiles. While B front loads the phaseout costs; E back loads the phaseout; and D lies between these two scenarios. The more frontend-loaded the profile, the lower the costs of dealing with the stock of extinguishers after production of agent ends, but the higher the costs of

premature retirement of production facilities and the earlier replacement investments are incurred. In addition, the more frontend-loaded the phaseout, the lower would be the halon production. In short, scenario B is the obvious choice with the lowest cost to China and MLF and the lowest halon stock by 2006.

10. **Scenario for 1301** (Table 6). A single scenario was defined for phaseout of halon 1301 with a baseline production of 750 mt. It is assumed that newly produced halon will mainly be used for servicing and refilling installed systems; and beginning 2006, all new systems will use halon 1301 substitutes. In order to limit costs of premature retirement for existing systems, the phaseout is rearend-loaded with 60 percent of the production phaseout occurring in 2006 because most 1301 is for essential uses and because the few alternatives are very expensive. By itself, the proposed phaseout does not meet the provisions of the London Amendment, but is acceptable because an accelerated phaseout of halon 1211 is anticipated.

TABLE 6: HALON 1301 PHASEOUT SCENARIO

	1998-2000	2002	2006	2010	Substitute	Halon bank
Phaseout %	0	20	60	20	FM 200 ^{/a}	Yes

^{/a} The model uses FM200 as a proxy for substitute system costs. According to HTOC members, the incremental installed cost of halon substitute systems such as Inergen and CO₂ is either more expensive or roughly equivalent to FM200.

11. **Technical Assistance Activities.** The costs of technical assistance required to achieve halon phaseout are considered to be independent of the scenarios being evaluated. Technical assistance includes policy development and implementation of policy measures, fire codes revisions, promotion of tradable production quota, public awareness, development of alternative technologies, technical assistance to beneficiary enterprises and service stations, testing facilities, training for all involved agencies, and development of a management information system as a monitoring tool for the entire halon sector phaseout.

12. **Total Phaseout Costs.** Based on the results of the modeling exercise and considering the risk of higher costs of halon banking that China may incur if halon phaseout were delayed, the Chinese government has developed its “Sector Plan for Halon Phaseout” based on scenario B. Together with the phaseout of halon 1301 and technical assistance activities, total phaseout costs are summarized in Table 7.

13. **Cost Model.** Calculation of the economic costs to China of halon phaseout and of the incremental costs eligible for MLF financing according to the current rules has been made through a cost model that has a number of submodels, calculating the economic costs of:

TABLE 7: TOTAL PHASEOUT COSTS OF THE HALON SECTOR

	Total cost to China (\$ million)	MLF funding request (\$ million)
Costs incurred to date (as of 9/96)	11.6	4.4
Phaseout costs for halon 1211	171.0	48.6
Phaseout costs for halon 1301	17.7	8.1
Technical assistance activities	6.0	6.0
Total	206.3	67.1
Minus costs incurred to date	-11.6	-4.4
Net Incremental Costs	194.7	62.7

- (a) incremental closing costs for halon 1211 agent plants;
- (b) incremental conversion costs for halon 1211 fire extinguisher plants, fixed fire systems and servicing stations for halon extinguishers;
- (c) incremental costs for halon 1211 and 1301 recycling, destruction and banking;
- (d) incremental costs for halon 1301 closure plant and substitute plants; and
- (e) incremental costs for supporting activities related to the phaseout.

14. Information fed into the model for the calculations was based upon surveys of halon producing and consuming enterprises in China designed to determine actual plant conditions. This enterprise level information was blended with MLF project funding experiences in China and other countries and expert judgments to establish unit phaseout costs: for example, for extinguisher conversion projects, the 72 factories were grouped into three size categories, for which average conversion costs were developed. The model established the costs of phaseout under each scenario examined on a year-by-year basis, and through discounting at 10 percent the costs were expressed as a net present value (in 1997 dollars) for the purpose of selecting the least-cost option. In addition, the phaseout costs were compared to the halon production under each scenario in order to calculate cost per ODP.

15. Detailed breakdowns of the costs to China and costs eligible for reimbursement from the MLF are provided in chapter 3 of the "Sector Plan for Halon Phaseout in China." The following paragraphs briefly explain the economic cost calculations of halon agents (1211 and 1301) closures, substitute chemical production, conversion of extinguisher production, halon recycling and recovery, halon reclamation and banking, and conversion of servicing centers.

16. **Closure of Agent Production.** The model calculates the economic cost to China of phasing out production of halon agent on the basis of costs incurred through premature retirement of the plant, and measure the value-added given up by closure.

17. In real life, closures will take place within the framework of a tradable production quota system to be introduced in late 1997 for the remaining plants. The quota system will establish a national quota for each year consistent with the phaseout profile and an individual quota for each enterprise that will decline annually until the end of production. Although the initial quota schedule assumes that all enterprises can stay in business until phaseout is completed, it is expected that trading of quotas between enterprises and the sale back to government of quotas in return for MLF funds under the proposed bidding system will result in smaller and older enterprises exiting the industry relatively quickly.

18. The incremental costs for closure of halon production (ICHC) can be expressed as follows:

$$\text{ICHC} = (\text{TP} \times \text{P} \times \text{PR} \times \text{Y}) + (\text{W} \times 2)$$

where TP = total production in each year
P = price of halon
PR = profit rate
Y = remaining years of life of plant
W = wages of halon workers

19. On the basis of survey data on the halon agent plants collected in 1995, the plants were separated into two groups basing on their remaining life-time and technology. Two large enterprises, each currently producing more than 2,000 tons, have been making a profit of 13.5 percent (based on data for 1993, 1994 and nine months in 1995) and are considered to be able to produce until 2010. The remaining, smaller enterprises are considered to be able to produce only until the end of 2004;⁶ the survey data on their financial performance indicated an average profit rate of 9 percent (on the same basis as above). In the calculation of closure costs, it was assumed that the smaller and less profitable plants would be closed first, and that lost profit would be calculated on the basis of the number of years that closure occurred before 2005. Once the less profitable plants have been closed, closure costs are based on the circumstances of the two large plants; thus lost profit is calculated on the basis of a plant life until 2010.

20. The survey data on the halon agent enterprises also included information on workers (including retirees for whose pension payments the enterprises are responsible) and their wages, for both the total enterprise and the halon plant. An average salary for all

⁶ Because of previous maintenance practices, which involve periodic closures to rehabilitate plant, it is assumed that the remaining lifetime of these plants enables them to maintain production to the end of 2004.

enterprises was calculated as the basis for calculation of the labor compensation element of overall phaseout costs. The salary cost is computed at \$250 per ton per year.

21. The closure costs requested from the MLF are calculated on the basis that 9,950 tons of production would be phased out. However, the current capacity of the plants, without further modification or investment, is considerably higher, approximately 17,800 tons. Therefore, future market demand growth for halon (that would occur if halon were not being phased out) could be met to the limit of capacity from existing plants. Thus, the cost to China of phasing out the 9,950 tons of production—costs eligible under MLF rules—also includes the costs of not producing additional amounts that growth in market demand would allow—costs not eligible under MLF rules. Since the figures given in the model for the incremental costs of phaseout for China are based on the cost of phasing out 17,800 tons of production, the cost to China of phasing out agent production is significantly above the eligible costs to be financed through the MLF.

22. **Substitute Chemical Production.** Based on costs incurred under existing projects, the model calculates the cost of investments in new capacity for CO₂, ABC powder and AFFF made necessary by the phaseout of halon, and adds to this capital cost the net change in operating costs to arrive at the incremental costs to China of substituting other chemicals for halon. The capital costs of the substitutes are as follows: \$930,000 for an ABC powder factory with capacity for 3,000 tons a year (based on the previous project implemented in China); \$200,000 for an AFFF factory with capacity for 1,000 tons a year; and \$0 for CO₂.

23. The calculation represents the NPV of the cost of pulling these investments forward before the date when they would be needed in the event that halon capacity remained in the market. (Even if halon capacity were not closed prematurely, it would eventually reach the end of its life, and investments to replace this fully depreciated capacity would be needed. The economic cost to China of the halon phaseout is that this replacement investment has to be made earlier than otherwise.) Only the cost to China is included in the phaseout program, since China is not requesting MLF funds for the incremental costs of substitute chemicals.

24. **Conversion of Extinguisher Production.** The model estimates the incremental costs of closing down halon extinguisher production consistent with the phaseout of halon production and producing substitute extinguishers required to assure equivalent fire protection in China. The key parameters for this calculation are the future market structure of clean and conventional extinguishers, which determines the conversion rate from halon to ABC powder, CO₂ and AFFF extinguishers, the incremental capital and operating costs for conversion projects and the extent of industrial restructuring (i.e., closure of small plants and construction of a smaller number of larger nonhalon extinguisher plants) that is assumed to occur during the phaseout.

25. The model sets as a parameter of the future market for extinguishers that the split between conventional and clean fire protection after phaseout will be 85:15, in line with

MLF guidelines. Since the current structure of the extinguisher market in China is approximately 70:30, removal of halon extinguishers from the market means that replacement is only partly in the form of clean extinguishers;⁷ the conversion rate is calculated as 31 percent ABC powder, 65 percent CO₂ and 4 percent AFFF.

26. In order to calculate the costs of conversion, the model assumes that small (average of 20 tons of halon consumption) and medium (average of 72 tons of halon consumption) plants convert to ABC powder and CO₂ extinguishers in the ratio of 31:65, and large (average consumption of 190 tons of halon consumption) plants convert to ABC powder, CO₂ and AFFF. The ratio for large plants is also 31:65 for ABC powder and CO₂, and they do all the projects necessary for AFFF to replace 4 percent of halon extinguishers. Thus, the base run of the model assumes that the current size structure of enterprises in the halon extinguisher industry is replicated through the conversion projects.

27. Incremental capital costs used in the model for each technology and enterprise size are shown below in Table 8. These costs are taken from the latest guidelines issued by MFEC.

TABLE 8: CAPITAL COSTS FOR EXTINGUISHER CONVERSION

	Small	Medium	Large
ABC Powder			
Capital cost	\$44,000	\$135,000	\$135,000
Cost per kg	\$2.2	\$2.0	\$1.0
CO ₂			
Capital Cost	\$28,500	\$73,500	\$73,500
Cost per kg	\$1.43	\$1.0	\$0.5
AFFF			
Capital cost	n.a.	n.a.	\$78,000
Cost per kg	n.a.	n.a.	\$0.5

28. Incremental operating costs or savings under the conversions have been estimated on the basis of Chinese enterprise information: (a) the operating savings for ABC powder is estimated to be \$1.2 per kg, and (b) incremental costs for CO₂ and AFFF are estimated to be \$2.77 and \$12.0 respectively. The corresponding figures in the draft production guidelines (for an average enterprise of 80 tons) are savings of \$1.5 and \$1.15 per kg for

⁷ If the existing market split was 85 percent conventional and 15 percent clean, then all halon extinguishers removed through the phaseout would have to be replaced by clean extinguishers to maintain a future 85:15 market split. To replace all halon extinguishers by nonhalon extinguishers in the ratio of 85:15 in such a situation would result in a final market split of 98:2.

ABC powder and AFFF respectively and incremental costs of \$2.55 per kg for CO₂. The large difference in the incremental costs of AFFF in the two calculations is explained by the fact that the China sector plan assumes that four units of AFFF is required to replace one unit of halon to give comparable fire protection.⁸ It should also be noted that the lower savings estimated for halon (compared to the guidelines) are the result of the assumption, based on the characteristics of the Chinese fire protection industry, that 1.5 kg of ABC is required to replace 1 kg of halon.⁹

29. **Phaseout of Halon 1301.** The approach to calculating the costs of phasing out halon 1301 is essentially the same as that used for halon 1211. However, the calculation of agent phaseout is relatively simple, because there is only a single producer in China. Costs to China would include the costs of premature retirement of the agent plant and the costs of constructing a plant for MF200, to which must be added the additional operating costs of a MF200 plant. The current price of MF200 is estimated to be \$30,000 per ton, compared to \$8,000 per ton for halon 1301, meaning that incremental operating costs are \$22,000 per ton. The difference between the economic cost to China and the cost borne by MLF is due to the fact that MLF will support only four years of operating costs.

30. It is assumed that there are no incremental economic costs to be borne by producers of halon 1301 fire extinguisher systems, since only minor modifications of components are required for use of MF200. However, these systems manufacturers will face much higher agent costs, as explained above, and these costs increases will be passed on to final consumers. The very large increase in agent cost resulting from phaseout of halon 1301 production and the high cost of replacing components in existing systems so as to use MF200 provide a strong rationale for a halon banking scheme for halon 1301.

31. **Halon Recycling and Recovery.** Demonstration projects for the use of recycling equipment have been implemented in China through bilateral cooperation with USEPA. One hundred sixty-four units of recycling equipment have been provided. Based on these experiences, China will expand this program to cover the service sector, which consists of some 1,000 centers, in general.

32. As indicated earlier, 3 percent of the extinguisher stock is returned for servicing and refilling each year, according to MPS data. Another 3 percent of the stock is retired each year. The recycling equipment in the service shops allows the recovery of halon from retired extinguishers and minimizes emissions during servicing. Capital cost of each unit is \$6,000 installed in the service center, and operating costs are approximately \$1.0 per kg of halon recovered. Therefore, it is estimated that there is an incremental saving using recycling equipment compared to the production cost of halon that would otherwise

⁸ The 4:1 ratio is regarded as necessary for small extinguishers. The 1:1 ratio included in the draft guidelines is regarded as acceptable only for large extinguishers.

⁹ It should also be noted that the figure for savings does not include the incremental costs of larger cylinders and valves that are required for the 3 kg ABC powder extinguisher that would replace a 2 kg halon extinguisher.

need to be produced. Some of the halon recovered is contaminated and cannot be reused. It therefore has to be stored and eventually destroyed. Storage costs are estimated to be \$0.5 per kg, and destruction costs are estimated to be \$5 per kg.

33. The model takes as input data that 3 percent of the extinguisher stock is returned for servicing and that 50 percent of the halon in these extinguishers can be recovered. The same figures are used for retired halon extinguishers. The model therefore calculates the amount of halon saved through the use of recycling equipment, and estimates the cost savings to China. Therefore, the eligible incremental costs in the model include the cost of additional recycling units and the incremental savings from their use.

34. **Halon Reclamation and Banking.** The Chinese government considers that, once production of both halon 1211 and halon 1301 has stopped, supply of halon for essential uses and servicing of existing stock will depend entirely on reclaimed halon from retired extinguishers and also from extinguishers prematurely retired from nonessential uses. The halon available from retired extinguishers (or systems) represents a cost saving to China, as described above. Halon from prematurely retired extinguishers (or systems), however, represents a net cost to China, since they must be replaced by a substitute (such as ABC powder, in the case of nonessential uses).

35. The servicing centers can be used to collect the halon from extinguishers and systems. However, regional centers will be required to clean and store this reclaimed halon. The costs of reclamation equipment for these regional centers is estimated to be \$20,000 for halon 1211 and \$75,000 for halon 1301. It is considered that five centers will be required for halon 1211 and one for 1301. The model includes these costs as eligible incremental costs to be funded by MLF.

36. Currently, the Chinese government considers that the reliability of the above sources of halon may be inadequate to meet the demand for halon at all times. Therefore, it plans to produce, as a buffer stock, approximately 2,000 tons of halon 1211 and 100 tons of 1301 in the final years of production and to store it for future use. It is estimated that the costs of constructing storage is \$0.5 per kg. The cost of constructing 80 tanks with a capacity of 50 cubic meters would be approximately \$4 million, and it would cost approximately \$8 million to produce the halon stock. The model includes the \$4 million for capital construction as an eligible incremental cost to be funded by MLF, while the cost of halon would be borne fully by China.

37. **Conversion of Servicing Centers.** There are approximately 1,000 service centers within China that service halon and BC powder extinguishers. As halon is phased out of the market and as high-quality ABC powder and CO₂ extinguishers increase their market share, these service centers will need to invest in filling equipment and storage for ABC powder to enable them to service ABC powder and CO₂ extinguishers. Insufficient information currently exists on these service centers to allow any precise calculation of the incremental costs that they will face, but a rough estimate would be \$5,000 per center if they were to invest in new servicing equipment. The model includes these costs as eligible incremental costs of phaseout to be funded by MLF.

ANNEX 6: THE PROPOSED TRADABLE PRODUCTION QUOTA AND BIDDING SYSTEMS FOR THE HALON SECTOR PHASEOUT PLAN

1. The halon sector phaseout plan contains a number of activities that are designed to permit production of halon 1211 to be eliminated by the end of 2006 and the production of halon 1301 to be eliminated by the end of 2010. The phaseout plan encompasses:

- (a) reducing and ending production of halon 1211 and 1301;
- (b) developing production of substitute chemicals for use in the fire extinguisher industry;
- (c) converting manufacturing facilities producing halon-based fire extinguishers and extinguishing systems to nonhalon-based extinguishers and systems;
- (d) converting of service centers servicing halon 1211 and 1301 extinguishers and systems to servicing nonhalon-based extinguishers and systems;
- (e) creating halon recycling and banking systems; and
- (f) providing technical assistance to include export and import control, substitute chemical development, management information system, halon management plan, fire codes revisions, revision of standards for alternative agents, promotion, labeling, training, etc.

2. The halon sector phaseout plan and total funding level are expected to be approved by MFEC in principle in November 1997. Funding for the 1998 annual program is expected to be approved at the same time and funds would be released to China in December 1997. If this target date is not met, the phaseout schedule and phaseout tonnage for the initial years would be revised accordingly. The phaseout schedule for halon 1211 is 60 percent reduction over the baseline of 9,950 mt by the end of 2000, and the remaining 40 percent by the end of 2006. With the creation of halon banking, recycling will permit halon 1211 to stay in use for several years after 2005.

3. **Tradable production quota and bidding systems** are the two main policy instruments introduced in the halon phaseout program that would make phaseout activities more market-oriented and cost-effective. Like other new programs, these mechanisms are new to China and new to the ODS program; thus it may take time for them to be operating efficiently. Nonetheless, through close supervision activities, controls on disbursement, and policies that are already in place (and to be promulgated),

the program is expected to achieve phaseout targets at the minimum even if full efficiency may not be attained until later years. Operating procedures will be refined as China gains experience. NEPA and MPS will initiate quota system and bidding process to achieve the phaseout objectives as described in the sector phaseout plan once the MFEC approves the plan, commits to its funding level in principle and approves funding for the first annual program.

Tradable Production Quota for Halon Agents

4. Process in the Establishment of the National and Enterprises' Baseline Quotas:

- (a) MPS and NEPA conducted a full on-site investigation of all halon agent producers in March 1997 examining the actual production levels from 1994 to 1996, sales, exports, raw materials purchase and inventory stock of these factories.
- (b) Consequently, the Trustee contracted an international auditing firm in October 1997 to carry out an independent audit of halon production for years 1995 and 1996 and confirmed that halon 1211 production was 12,189 mt for 1995 and 11,700 mt for 1996 and halon 1301 production was 599 mt and 618 mt for 1995 and 1996.
- (c) Production level for 1997 is uncontrolled, but China has committed to use 9,950 mt for halon 1211 and 618 mt for halon 1301 as the national production level in its funding request and as its baseline quota.
- (d) Based on 1994-96 actual production level of individual enterprises, MPS will determine each enterprise's baseline quotas whose total would be 9,950 mt for halon 1211. The only halon 1301 producer will have a baseline production quota of 618 mt.
- (e) NEPA is expected to announce the national baseline quota and quota for individual enterprises in December 1997.

5. Drafting of the Regulation of Production Quota System for Halon Extinguishing Agent:

- (a) A draft Regulation has been jointly prepared by NEPA and MPS. The Regulation will give NEPA and MPS the authority to establish the overall national baseline quota for each year and gives NEPA the authority to issue quotas to each factory for each year.
- (b) The Regulation gives NEPA, MPS and MCI the authority to enforce the regulatory requirements and establish penalties.

- (c) All halon agent producers were issued *halon production permits* in 1991. The production permit is only a permit to produce and does not have any quantity limitation. A halon factory could produce as much as the market demands and as much as the factory could produce. The quota system will add this quantity limitation.
- (d) The quota system would be able to limit production within the national target.

6. Issuing the Baseline Quotas:

- (a) Once MPEC approves the funding level for the first annual program, NEPA and MPS will jointly issue the baseline production quota to all halon agent producers, which is expected to be in December 1997. The baseline quotas will be based on their actual production level between 1994 and 1996 and the national baseline quota would not exceed 9,950 mt for halon 1211 and 618 mt for halon 1301.
- (b) Only those factories that have production permits will be issued production quotas.
- (c) No enterprises in China could produce halon agent without a quota.
- (d) No new factories will receive quotas from the Government in subsequent years once the baseline quota are issued.
- (e) In subsequent years, NEPA will issue quotas to each factory by December 15 and quotas will be reduced in accordance with the overall phaseout plan.
- (f) Halon producers will not be allowed to produce exceeding their quota.
- (g) If a factory wishes to get out of the halon sector and be compensated for all quotas in the coming year, the factory could apply grant funds to the Government through a bidding process, or trade their quotas with another factory.

7. Outreach and Training for Halon Agent Producers:

- (a) NEPA and MPS has organize a series of training workshops to educate and reach out to all halon producers on the national phaseout schedule, possible consequence on enterprises' halon production quota in mid-1997. NEPA will repeat these workshops every year for new bidders.
- (b) The workshops will help managers understand how their quotas will be reduced in the future if not participating in trading or bidding.

- (c) In addition, the workshops will explain to all the factories the procedures and requirements for participating in the quota and bidding systems.

8. Trading Quotas:

- (a) Alternatively, the factories could trade their entire quotas to other factories during the year.
- (b) The Regulation allows annual trades and permanent trades.
- (c) Trades are allowed only between existing quota holders only.
- (d) All quota trades must be reported to and approved by NEPA. Trades are effective only after approval by NEPA. NEPA's review of the trade will focus exclusively on whether the factories making the trade has sufficient quotas to sell.
- (e) NEPA will enter the transaction into the MIS and will transmit a copy of the quota status report to both sellers and buyers to show their new quota balance.

9. Monitoring the Quota System:

- (a) The Regulation requires that enterprises must report their current and past years' production, sales volume, halon stock, raw material consumption to local EPBs, fire-fighting bureaus and their sector bureaus semiannually.
- (b) Enterprises are required to report their halon production quarterly to NEPA, copied to MPS, local EPB and FFBS.
- (c) The local bureaus will check from time to time reports received from factories and will visit the factories randomly (but at least once a year) and report to MPS, NEPA and sector ministries on their findings.
- (d) NEPA and MPS are in charge of the implementation of the quota system.

10. Penalties:

- (a) For any factory whose production exceeds its quota, penalties will be imposed. Depending on seriousness of their violations, their production quota may be canceled and they will not be eligible to bid for MLF resources in following years.
- (b) Any factory producing halon without a quota will be fined, its production will be closed by the local government.

- (c) Nonsubmission of required reports by enterprises and delays in reporting also constitute as violation of the Regulation and enterprises will be penalized.
- (d) Any factory whose production exceeds its assigned quota (after quota trade) will be fined. It will be closed if found the second time.
- (e) Any illegal trade of halon or production quota will be fined. Detailed penalties are listed in the proposed Regulation and in the Project Implementation Manual.
- (f) Any factory giving false information, also considered as violation, will be warned and fined.

Bidding System

11. Bidding for Grant Funds:

- (a) For the first annual program, once the baseline production quotas for the country and for individual factories are announced in December 1997, halon agent producers are encouraged to exchange their production quotas with the Government in return for grant funds through a bidding system.
- (b) The annual halon reduction target (as specified in the first annual program and the halon sector phaseout plan) is the bidding target and the annual grant fund available for halon agent reduction is the grant the Government uses to buy back these quotas.
- (c) Halon producers would submit bids—offers to exchange their halon quota—for a specific unit price (Yuan/kg of halon).
- (d) NEPA, MPS and DIA would evaluate bids and awards grants to those bidders with due consideration of bidding prices and the amount of grant available for production closure for that period.
- (e) Provided the government is able to buy back sufficient quota through bidding, the remaining halon producers would retain their quota at the same level in the next year.
- (f) However, if the level of quota purchased through bidding is less than the targeted phaseout amount, quota reduction would be made pro rata among producers that were unsuccessful, or did not participate in the bid with no compensation.
- (g) There will be no regulation on halon extinguisher manufacturers. With the availability of halon agent being reduced, there will be market demand for other fire extinguishers to replace halon extinguishers. Together with other

policy measures (such as ban on halon extinguishers in nonessential areas, fire code revisions, promotion of chemical substitutes, etc.), there are sufficient regulatory restrictions to induce halon extinguisher manufacturers to bid for grant fund either to close or to convert to other nonhalon extinguisher manufacturing.

- (h) A bidding mechanism has been developed by NEPA and MPS for both halon agent producers and extinguisher manufacturers to bid for grant fund on an annual basis.
- (i) Bidding process will not start until available funds for that year has been approved by MFEC. ODS reduction contracts between the Government and the enterprises will not be signed until amount of grant fund has been assured.

12. **The 1998 Annual Program.** Its processing and initial implementation is expected to be as follows:

- (a) funding approval by MFEC in November 1997;
- (b) ODS IV effective in December 1997 after funding approval;
- (c) NEPA and MPS to declare the Regulation of Production Quota System effective following MFEC approval;
- (d) NEPA and MPS to announce baseline national production quota of 9,950 mt for halon 1211 and 618 mt for halon 1301 and baseline production quota for individual factories, expected to be in December;
- (e) NEPA and MPS to announce the halon agent phaseout target (1,990 mt) in 1998 and the national production quota of 7,960 mt for 1998 in accordance with the approved annual program;
- (f) bidding target to be 1,990 mt halon agent reduction and the funding available for halon closures would be the approved grant fund for the first annual program;
- (g) bidding for halon agent producers to start as soon as baseline quotas are announced in November. All preparatory work has been completed;
- (h) no bidding target for halon extinguisher manufacturers, but the available grant fund to provide incentives for bidding;
- (i) bidding awards for halon agent producers to be announced in December 1997;

- (j) signing of ODS reduction contracts between NEPA, MPS and the winning factories. NEPA and MPS will entrust implementation responsibilities to DIA;
- (k) bidding awards for halon extinguisher manufacturers;
- (l) signing of ODS reduction contracts between NEPA and the winning manufacturers; and
- (m) the DIA to be entrusted to supervise contract implementation. Local EPBs and Fire-Fighting Bureaus will also be involved on monitoring policy implementation and supervision.

13. **Proposed Schedule after the First Annual Program.** On an annual basis, NEPA proposes to announce bidding for next year's bid to start around September and complete bid evaluation by around November . The ODS reduction contracts between the Government and the enterprises will be signed in December when next year funding requirements are approved by MFEC.

14. **Bidding Documents.** Bidding documents for halon producers and extinguisher manufacturers have been prepared and near finalization. They are for halon production phaseout and halon consumption phaseout.

15. **Bidding training.** NEPA has started training for all potential bidders and participating institutions. As this is a national program and halon producers and consumers are all over the country, training is very important to familiarize all concerned on halon phaseout strategy, phaseout schedule and annual phaseout targets, bidding procedures and principles, bid compilation, obligations and rights of bidding enterprises. Local EPBs and fire-fighting bureaus will also be trained in the sector strategy, fire protection policies and monitoring and bidding operations. These training will need to be repeated in the first few years. NEPA will be principally responsible for this training. The DIA will also be involved.

ANNEX 7: OPERATING MECHANISMS OF SECTOR APPROACH¹

A. PROJECT MANAGEMENT AND COORDINATION

1. Many organizations are involved in the management and coordination of sector phaseout approaches. In contrast to the ODS I to III projects, local government agencies play a much more active role in day-to-day project activities. The following describes roles and responsibilities of major participants in the project.

2. **China National Leading Group for Ozone Layer Protection (Specialized Sector Working Group).** The National Leading Group for Ozone Layer Protection is the highest authority in China responsible for compliance in the fulfillment of the Montreal Protocol obligations and significant decisions made on the Ozone Layer protection. The Leading Group consists 18 government authorities and sector ministries (list in Annex 2, footnote 1). During implementation of any sector under ODS IV, many problems would relate only to that specific sector; therefore, the Specialized Sector Working Group would be set up within the National Ozone Leading Group consisting of relevant sector ministries and agencies. The Specialized Working Group is responsible for decision-making during sector approach implementation, while the National Leading Group is responsible for decisions on key issues.

3. The responsibilities of the National Ozone Leading Group include:

- (a) establish national policies and regulations related to ODS phaseout;
- (b) review and approve overall phaseout plan of any ODS sector;
- (c) evaluate policy implementation; and
- (d) monitor, guide, coordinate and support PMO's work.

4. The responsibilities of the Specialized Sector Working Group include:

- (a) review first year's annual program of sector phaseout plan;
- (b) examine achievements of previous year's annual program (including technical assistance and their terms of reference), review and approve

¹ With special reference to the halon sector.

following year's annual program, in particular, review progress and achievements of previous year's technical assistance activities;

- (c) review sector phaseout policies and monitor their implementation; and
- (d) review quarterly, semiannual and annual progress reports summarized by PMO.

5. **Ministry of Finance.** Its roles in the project are to:

- (a) sign the ODS IV Grant Agreement on behalf of Chinese government;
- (b) open and manage an ODS phaseout account; and
- (c) review disbursement applications from NEPA and submit applications to the Bank for replenishment.

6. **Sector Ministries.** Their roles in the project are to:

- (a) participate in formulation of the ODS sector phaseout plans and annual programs;
- (b) coordinate with NEPA to formulate policies and regulations related to ODS phaseout;
- (c) formulate technical assistance (TA) projects that are necessary to support sector phaseout and prepare terms of reference (TORs) for substitute technology development and promotion;
- (d) coordinate with NEPA on implementation of technical assistance activities;
- (e) participate in investigation of enterprises' information required in the sector approach;
- (f) coordinate with NEPA PMO and the domestic implementing agent to solve any problems encountered during project implementation; and
- (g) oversee the operation of the MIS substation.

7. **Project Management Office (PMO) of the National Ozone Leading Group.** PMO in NEPA is the administrative body of the Leading Group and the Specialized Sector Working Group. It is responsible for the daily work of the Ozone Layer protection and supervision of project implementation. It reports directly to the Leading Group and Specialized Sector Working Group on key issues. The responsibilities of PMO include:

- (a) **During project preparation:**
 - (i) participate in the formulation of sector ODS phaseout policies and regulations;
 - (ii) organize policy formulation related to ODS phaseout;
 - (iii) participate in preparation of sector phaseout program and annual programs;
 - (iv) participate in preparation of TORs on TA activities; and
 - (v) select and appoint domestic implementing agents (DIA) and procurement agents.

- (b) **During the bidding process:**
 - (i) organize training activities;
 - (ii) review bid evaluation guidelines formulated by the DIA;
 - (iii) review bid evaluation reports prepared by DIA and jointly define winners' list with DIA and the sector ministry;
 - (iv) based on the annual phaseout target and annual grant, monitor DIA in the bid awards to bid winners;
 - (v) announce winners jointly with the DIA and the sector ministry; and
 - (vi) together with DIA and sector ministry, cosign ODS reduction contracts with winning enterprises.

- (c) **After bid awards and during contract implementation:**
 - (i) organize experts to assist beneficiary enterprises to prepare project implementation plan, as required;
 - (ii) organize experts groups to assist DIA in the review project feasibility studies and the project implementation plans prepared by the beneficiary enterprises; and
 - (iii) review reports on enterprises' financial appraisal status prepared by DIA.

- (d) **Project supervision:**
 - (i) supervise DIA in implementation of enterprise-level activities in annual programs;

- (ii) supervise TA implementation including coordinating with sector ministries in TA activities;
- (iii) set up and operate MIS;
- (iv) monitor policy implementation status;
- (v) monitor annual programs implementation and solve problems in a timely manner;
- (vi) based on annual programs and project implementation plans of enterprises, review payment applications submitted by the DIA;
- (vii) review quarterly production reports submitted by halon agent producers and reports submitted by local Environmental Protection Bureaus and local Fire Fighting Bureaus on halon production;
- (viii) review semiannual and annual progress reports submitted by DIA;
- (ix) summarize progress reports and submit them to the World Bank after the approval of the Specialized Sector Working Group;
- (x) provide the audit agency all information necessary for it to conduct independent performance audits of annual programs and financial audit of the ODS phaseout account, and provide assistance whenever necessary; and submits audit results to the Working Group; and
- (xi) organize project commissioning with the relevant ministries and agencies.

8. **Domestic Implementing Agent (DIA).** The DIA is appointed by NEPA to supervise implementation of enterprise activities in the approved annual programs. It would work under the guidance and direction of PMO. Its responsibilities include:

- (a) **During the bidding process:**
 - (i) define bid evaluation principle and submit to PMO for review and approval;
 - (ii) organize bidding for the sector based on annual programs;
 - (iii) evaluate bids and conduct financial evaluation of beneficiary enterprises;
 - (iv) submit bid evaluation report and winners' list to PMO for review; and

- (v) sign contracts with beneficiary enterprises jointly with PMO and sector ministry.

(b) During project implementation:

- (i) supervise enterprises' implementation of contracts based on agreed project implementation plans with enterprises and agreed annual programs;
- (ii) visit enterprises to verify production and conversion status;
- (iii) review progress reports prepared by beneficiary enterprises;
- (iv) review procurement done by procurement agency to check whether procurement is carried out in conformity with the agreed procedures;
- (v) review payment applications submitted by beneficiary enterprises, and submit applications to PMO for review and approval; and
- (vi) maintain all financial records and coordinate with PMO to provide all information necessary for performance and financial audits and provide assistance to the audit agency whenever necessary.

(c) Reporting:

- (i) report to PMO any technical, financial, procurement, and management problems occurred during project implementation in a timely manner, and submit reports to PMO with recommendations to solve problems;
- (ii) compile semiannual and annual progress reports;
- (iii) prepare project completion reports and commission document to PMO; and
- (iv) input information on project implementation status into MIS timely.

9. **Local Environmental Protection Bureaus (EPBs).** Local EPBs refer to the local EPBs where halon producers and beneficiary enterprises are located. In the operation of the sector approach, local EPBs are expected to be actively involved in ODS phaseout activities in its locality. The responsibilities of local EPBs include:

- (a) coordinate with local governments to monitor implementation of ODS phaseout policies;

- (b) investigate enterprises' project implementation status and assist to solve problems encountered during project implementation;
- (c) visit halon producers and other project beneficiaries to check production levels and conversion status;
- (d) review quarter, semiannual and annual reports submitted by halon producers and beneficiary enterprises,
- (e) supervise the disposal of the abandoned equipment after commissioning of projects and monitor project operations after commission; and
- (f) review and approve Environmental Impact Assessments prepared by enterprises..

10. Local Fire-Fighting Bureaus (FFBs) for the Halon Sector. Local fire-fighting bureaus refer to local FFBs where the project enterprises are located. They are expected to participate fully in the halon sector phaseout. Responsibilities of the local FFBs include:

- (a) coordinate with local governments and local EPBs in the monitoring of ODS phaseout policies related to fire-fighting (particularly, the ban on nonessential areas), revise fire codes for building, and other halon-related policies;
- (b) visit beneficiary enterprises to check on closure activities, halon production, and conversion projects; and
- (c) review quarterly, semiannual and annual production reports submitted by halon producers.

11. Local Industrial Departments in Charge of Enterprises. Local departments refer to the departments where project enterprises are located. During implementation of the sector approach, local departments will be involved. The responsibilities of Local Departments include:

- (a) implement all sector phaseout policies and review project implementation results;
- (b) provide information of project enterprises to sector ministry timely; and
- (c) investigate project implementation status and assist in solving problems encountered during project implementation.

12. Supporting Body. The Supporting Body is a nonpermanent organization established by PMO to strengthen implementation of the sector phaseout plan. It would provide technical, legal, and economic experts from scientific research institutions or

enterprises recommended by sector ministries and other departments to PMO, DIA and project beneficiaries at the request of PMO and enterprises.

13. **Auditing Agency.** MOF and NEPA will appoint an independent audit agency, acceptable to the World Bank, which will undertake audits for the projects. During negotiations in August 1997, the Bank and China had agreed on a Terms of Reference on the performance audit for the halon sector. Terms of reference would be different for each ODS sector and would be prepared when the sectors are appraised. The audits are to be submitted to the Bank by NEPA no later than June 30 of each year. Its responsibilities are to:

- (a) conduct a financial audit of the ODS phaseout account annually and express its opinion according to generally accepted accounting principles; and
- (b) conduct a production audit for the first annual program and performance audits for subsequent years. For the halon sector, the 1997 production audit (due June 30, 1998) would confirm national production level of 1997). For 1998 and subsequent years, the performance audits would include verification that phaseout targets have been achieved, in particular, that the national halon production is within production target; and implementation of agreed annual programs. The auditing targets include all halon producers and all beneficiary enterprises related to halon reduction, policy instrument implementation (i.e., which policies had been implemented, date implemented) and the implementation of the TA and training activities.

14. **Procurement Agency.** Entrusted by PMO, the procurement agency will undertake equipment procurement for project beneficiaries in conversion projects, based on Chinese regulations. Its responsibilities include to:

- (a) compile bidding document, based on equipment list of enterprises' project implementation plans;
- (b) handle domestic approval process for import equipment;
- (c) organize bid issues and bid opening, and evaluate bids;
- (d) prepare contract (terms of delivery, installation and commission);
- (e) coordinate any claims for discrepancy; and
- (f) supervise any breach of contract.

15. **Beneficiary enterprises.** Beneficiary enterprises are winners in the bidding process and have the responsibilities to phaseout ODS as agreed. Their responsibilities are as follow:

- (a) receive approval from local governments for MLF projects according to local technology renovation or construction project procedures before implementation of MLF projects;
- (b) establish a project implementation office, assign a designated contact person and report routinely to DIA.
- (c) prepare progress reports as requested and submit them to DIA, copied to PMO, local departments of sector ministries, local EPBs and local FFBs, and accept supervision;
- (d) implement the project as indicated in the ODS reduction contracts and according to the agreed implementation schedule,
- (e) obey any laws and regulations related to ODS phaseout;
- (f) (g) send applications to the DIA and PMO if any adjustments to the projects are needed. Changes and adjustment can only be done with the endorsement from PMO;
- (h) prepare project completion reports and submit them to DIA, sector ministries and PMO after the completion of projects; and
- (i) guarantee that the old equipment has been destroyed or otherwise disposed of in such a manner that any further production of ODS with this equipment (for closure projects) or any further use of ODS with this equipment (for conversion projects) is not possible after project completion.

16. The diagram below shows interrelationships among Chinese agencies during implementation. The following page gives a flow chart of major organizations and their reporting and supervision activities.

FIGURE 1: INTERRELATIONSHIP OF CHINESE AGENCIES DURING IMPLEMENTATION IN HALON SECTOR PHASEOUT

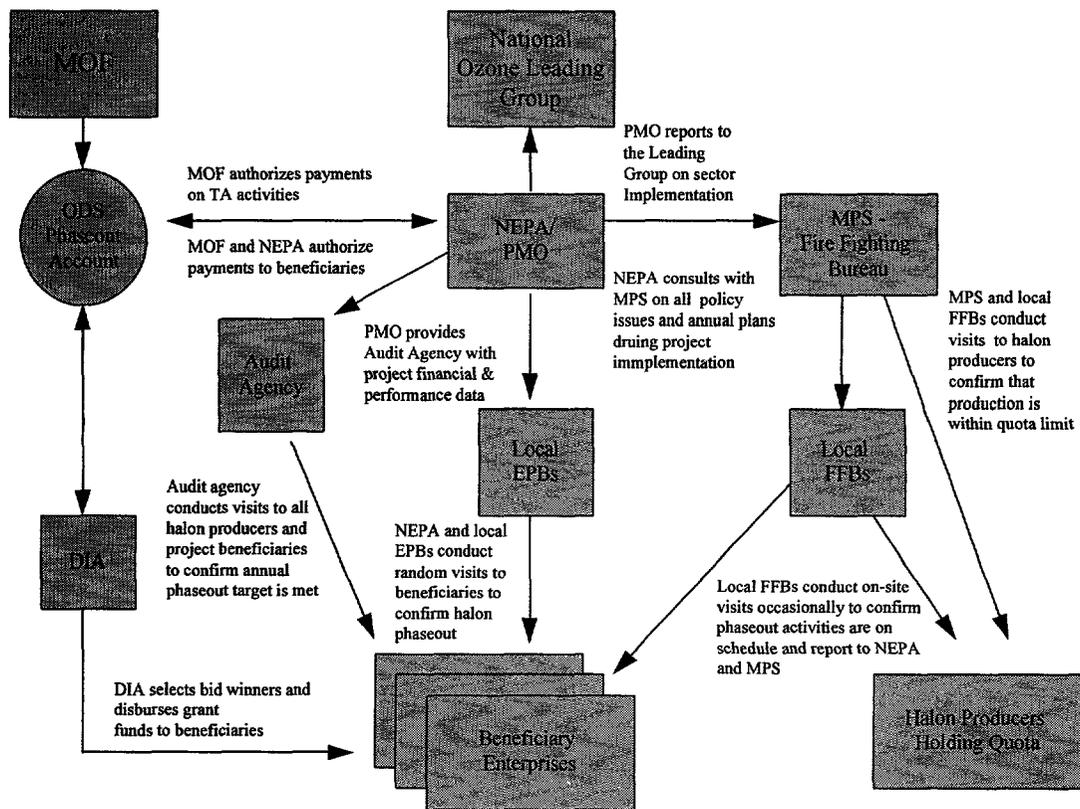
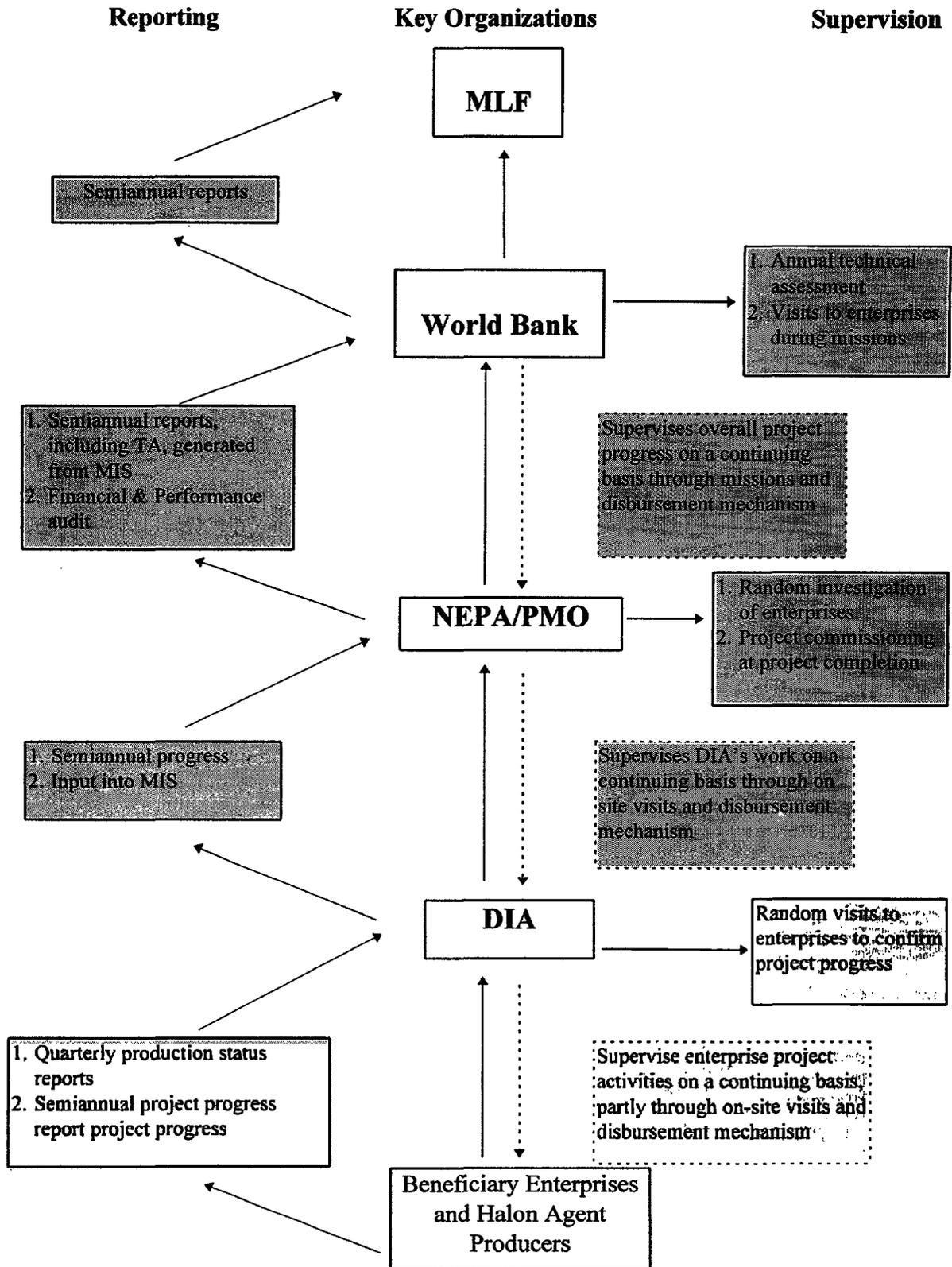


FIGURE 2: INFORMATION FLOWS



B. PREPARATION OF SECTOR PHASEOUT PLANS AND ANNUAL PROGRAMS

17. **Preparation of a Sector Phaseout Plan.** China will choose an ODS sector whose ODP is high and its sector characteristics are more adaptable to a sector phaseout. The halon sector has been chosen as a pilot sector to initiate the sector phaseout approach. Together with the Bank, NEPA has prepared a halon sector phaseout plan covering sector structures and characteristics, policy instruments, total phaseout costs, eligible incremental costs to MLF, phaseout objectives and schedules, and overall phaseout action plan. Other sector phaseout plans would also be prepared once the sectors are identified.

18. **Preparation of Annual Programs.** With the exception of the first annual program, which would be prepared along with the sector phaseout plan, preparation of subsequent annual programs would start in mid-year of every year.

19. For the halon sector, an annual program would include the following:

- (a) sector phaseout schedule;
- (b) performance of activities of previous years and any agreed remedial actions for the current year (not required for the first annual program of any sector);
- (c) performance of activities of current year (not required for the first annual program of any sector);
- (d) description of activities in the following year—ODS phaseout target and national production and consumption level of the year, policies to be implemented, enterprise-level activities, and technical assistance and training activities;
- (e) total annual grant for the following year; and
- (f) performance indicators of the following year.

20. **Unit reduction compensation** will be different every year for each sector. It is calculated annually as followed for each sector:

annual grant fund approved/annual phaseout target per unit of ODP,
expressed as \$/kg for each unit of ODP phaseout

For example, for the first annual program, first funding request for enterprise activities would be about \$11.5 million, calculated on the basis of eligible incremental phaseout

costs, and ODS phaseout target is 1,990 mt of halon 1211,² the unit reduction compensation would be:

$$\begin{aligned} & 11,500,000 / (1,990 * 3) / 1,000 \\ & = \$11,500,000 / 5,970 / 1,000 \\ & = \$1.93 \text{ per kg of ODP} \end{aligned}$$

C. APPROVAL PROCEDURES³

21. Funding approval process for the halon sector phaseout plan would be as follows:

- (a) on behalf of the Chinese Government, in October 1997, the Bank has submitted the halon sector phaseout plan and the 1998 annual program to MFEC for its funding agreement in principle for the entire sector over the phaseout period and its fund approval for the 1998 annual program. During the November MFEC meeting, the decision would be made;
- (b) at the end of each subsequent year, the Bank, on behalf of the Chinese Government, would request funding approval from MFEC on the basis of annual programs. MLF would be asked to approve funding at the levels agreed to in the halon sector phaseout plan based on achievement of previous phaseout targets.

22. In general, approval of the annual grants would be based on achievement of halon phaseout targets (production and consumption targets for the previous year not exceeded):

- (a) As the 1998 production and consumption targets would be achieved only at the end of 1998, funding request for the 1999 annual program would be based on the semiannual progress of 1998; and
- (b) Annual program funding requests for years 2000-2009 would be based on achievement of halon phaseout targets of the previous year and the implementation achievements in the first six months of the current year. For example, year 2000 funding request would be based on (i) 1998 halon phaseout results, (ii) implementation status of the 1999 annual program (the first six months), and (iii) year 2000 annual program agreed with the Bank; year 2001 funding request would be based on (i) 1999 phaseout results, (ii) year 2000 implementation progress, and (iii) year 2001 annual program; and so on.

² The ODP for halon 1211 is one unit of halon equals to 3 units of ODP.

³ This approval procedures applies to the halon sector. Funding approval process for other ODS sector might be different as MLF, China and the Trustee gain experience in sector approach.

23. In the unlikely event that China were to fall short of phaseout targets for a given year (halon production exceeds target), the Bank and China would agree on remedial actions. New funding requests to MFEC would go forward only after phaseout targets had been met.

24. **Remedial actions** have been built into the halon production quota regulation and would go into effect should production exceed quota. Quota equal to the national production targets is allocated annually to enterprises. Enterprises exceeding production quota in a given year would be fined according to the quota regulation and their subsequent year's quota would be proportionally reduced. For example, if an enterprise exceeded its halon production quota in 1998 by 100 tons, its quota for 1999 would be reduced by 100 tons. Depending on circumstances that have caused delay in program implementation, other specific remedial actions would be agreed between the Bank and China as the need arises.

25. By the time any overproduction for a previous year is confirmed, the current year's annual program would most likely already be funded and be under way. Thus, the proposed approach to remedial action is to bring the program back on-track by the end of the current year. For example, if over production occurred in 1998, remedial actions would ensure that by the end of 1999, cumulative production for the two years 1998 and 1999 would not exceed the *combined* targets for those years. The remedial actions taken to assure this result would be submitted along with the next year's funding request (2000 annual program using our example). MFEC would then be in a position to either approve funds or condition release of funds for the next year's annual program upon evidence that the remedial actions were successful and that the combined two year production did not exceed combined targets. This approach to remedial action allows the program to maintain momentum and keeps the phaseout schedule on track even if difficulties arise in a particular year.

26. If within two years the program is still not back on-track, continued funding of the program could be based on a reduced level of compensation. For example, future funding eligibility could be reduced based on the slower phaseout schedule. As production phaseout is based on compensation for lost profits and plants have continued to produce reducing the level of profits that would be forgone, grant compensation could be reduced proportionally. Under this plan, grant funds would be approved for annual programs and advanced through the World Bank to China to achieve specific phaseout targets. As such, the Chinese government requests use of these funds to achieve the those targets even in the face of delays. However, if it becomes clear that a delay is persistent and the phaseout targets would not be achieved within schedule of Montreal Protocol controls, funds proportional to phaseout shortfall would be reimbursed to the Multilateral Fund.

ANNEX 8: HALON SECTOR PHASEOUT ACTION PLAN, JANUARY 1, 1998-JANUARY 1, 2010

Year	Baseline production	First Stage			Second Stage					Third Stage					Total Funding Request
		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	
Halon 1211 (mt)															
Production target	9,950	7,960	5,970	3,980	3,317	2,654	1,990	1,990	1,990	0	0	0	0	0	
o.w. Export		800	600	400	200	100	100	100	100	0	0	0	0	0	
Import		0	0	0	0	0	0	0	0	0	0	0	0	0	
Domestic Consumption		7,160	5,370	3,580	3,117	2,654	1,890	1,890	1,890	0	0	0	0	0	
Production phaseout target		1,990	1,990	1,990	663	664	664	0	0	1,990	0	0	0	0	
Consumption phaseout target		1,790	1,790	1790	463	564	764	0	0	1,990	0	0	0	0	
Halon 1301 (mt)															
Production target	618	618	618	618	618	600	600	600	600	150	150	150	150	0	
o.w. Export		318	318	318	318	450	450	450	450	50	50	50	50	0	
Import		0	0	0	0	0	0	0	0	0	0	0	0	0	
Domestic Consumption		300	300	300	300	150	150	150	150	100	100	100	100	0	
Production phaseout target		0	0	0	0	18	0	0	0	450	0	0	0	124	
Consumption phaseout target		0	0	0	0	150	0	0	0	150	0	0	0	74	
Required funding from MLF (\$'000) (NPV in 1997 constant \$)		13,113	9,692	9,645	5,160	3,382	7,157	2,028	1,951	941	523	296	258	116	62,702
Funding request from MLF ('000) (PV of each year, in 1997\$) of which, TA activities		13,113	10,661	11,671	6,868	4,952	11,527	3,592	3,802	20,177	1,234	772	735	363	89,448
		1,550	900	930	980	840	700	560	560	420	420	280	140	140	8,400
Approved Funding ^a from MLF ('000) on Nov. 14, 1997		12,400	9,700	10,600	4,500	3,700	5,900	1,200	1,800	11,400	400	300	100	0	62,000

^a Plus 3 percent annually for local management fee.

ANNEX 8: HALON SECTOR PHASEOUT ACTION PLAN, JANUARY 1, 1998-JANUARY 1, 2010

(Cont'd)

	First Stage			Second Stage	Third Stage
	1998	1999	2000	2001-2005	2006-2010
Phaseout measures	close 7-8 halon 1211 agent producers close about 20 halon 1211 extinguisher producers convert 2 halon fire extinguisher system manufacturers begin construction of an ABC powder plant, if funding is available	close some halon 1211 agent producers close and convert 1211 extinguisher producers continue construction of ABC plant	close halon 1211 agent producers close and convert 1211 extinguisher producers	2001-2002 close H1211 producers convert H1211 extinguisher manufacturers 2003-2005 establish H1211 halon bank modify H1211 extinguisher service stations reclaim H1211 from retired extinguishers close remaining H1211 agent producers by end 2005 convert remaining H1211 extinguisher manufacturers convert H1211 system manufacturers	2006-2009 establish H1301 halon bank close H1301 agent producer in 2009 bank H1211 available in 2006 continue H1211 recycling and reclamation 2010 bank H1301 available
	First Stage			Second Stage	Third Stage
	1998	1999	2000	2001-2005	2006-2010
Policy measures	promote the ban of halon extinguisher uses in nonessential areas promulgate the tradable production quota for halon agent producers in Dec. 1997 and implement in 1998 start bidding for grant funds to start in November 1997 and late 1998 for the 1999 program revise fire fighting building design codes revise fire protection underground engineering design code	continue/complete activities initiated in 1998 adjust the definition of "nonessential use (area)"	adjust further the definition of "nonessential use (area)"	adjust further the definition of "nonessential use (area)"	2006-2009 adjustment the definition of "nonessential use" 2010 enforce bans on halon production enforce bans on halon extinguisher and systems production
	1998	1999-2000		2001-2005	2006-2010
Technical assistance activities	develop MIS—first phase train enterprises for bidding initiate halon import and export management study revise of technical standards for ABC dry powder formulate standard and test methods for spare parts of air fire extinguishing system formulate inert gas design code prepare development of a halon management plan	continue activities introduce techniques for using halon substitutes training local officials in EPB & FFB		publicize halon phaseout plan and educate officials, managers and the public train fire officials and engineers evaluate effect of polices to date	evaluate effects of policies to date publicize halon phaseout plan educate officials, managers and public train fire officials and engineers

ANNEX 9: PERFORMANCE AND MONITORING INDICATORS FOR THE HALON SECTOR

Performance Indicators (based on annual programs of each sector)	Annual program targets	Monitoring Indicators [An MIS system to be set up (incl. 1301 data). Work initiated in 05/97 to include all basic halon sector information, inputted into the MIS framework.]
Halon 1211	1998	<ul style="list-style-type: none"> • 1988 national production level & 1988 quota assigned to each halon producer • quarterly production data from all halon producers to local FFBs, EPBs and NEPA • contracts signed on closures to include details, halon mt to be phaseout, closure schedules, unit reduction compensation, labor compensation, etc. • national level of I <ul style="list-style-type: none"> ⇒ production, ⇒ export sales of halon producers ⇒ imports and ⇒ consumption (production+imports-exports) • details on implementation of closures and conversion projects • NEPA acceptance reports on closures projects • Plant visits by DIA, local government agencies, DIA, MPS and NEPA • In case of quota violation, corrective actions taken including penalties imposed • disbursement status of closure contracts • receipts of reports from beneficiaries to DIA and NEPA • 1997 production audit, dates conducted & comments • Bank—date of supervision missions of annual program & annual technical audit of implementation. Comments & agreed actions.
• production phaseout	1,990 mt	
• halon production	7,960 mt	
• exports	800 mt	
• imports	0 mt	
• consumption	7,160 mt	
• # of 1211 plants at beginning of year	14	
• # of 1211 plants closed during the year	8 estimates, based on bidding	
• # of 1211 plants at end of year	6 estimates, based on bidding	
Halon 1211 extinguisher production closures		<ul style="list-style-type: none"> • contracts signed for closure projects with details on ODS phaseout amount, closure schedules, unit reduction compensation, etc. • disbursement status of closure and conversion projects • NEPA/MPS acceptance reports on closure projects • dates and plant visits conducted by all agencies
• # of manufacturers at beginning of year	72	
• # manufacturers closed during the year	20 based on bidding	
• # of manufacturers at end of year	52 estimates only	
Halon extinguishing system manufacturer conversion		<ul style="list-style-type: none"> contracts signed for conversion projects with details on ODS phaseout amount, implementation schedules, alternative technologies, unit reduction compensation, etc. NEPA/MPS acceptance reports on closure projects dates and plant visits conducted by all agencies
• # manufacturers at beginning of year	22	
• # of conversion	2 depend on bidding	
• # of manufacturers at end of year	20	
Halon 1301		<ul style="list-style-type: none"> • # of 1301 producers at the end of the program year • At end of year, national level of: <ul style="list-style-type: none"> ⇒ production ⇒ export ⇒ import ⇒ consumption (production +export-import)
• # producers at beginning of yr.	1	
• # of producers at end of year	1	
• production phaseout	750 mt	
• export	450 mt	
• import	0 mt	
• consumption phaseout	300 mt	

ANNEX 9: PERFORMANCE AND MONITORING INDICATORS FOR THE HALON SECTOR

(Cont'd)

Performance Indicators (based on annual programs of each sector)	Annual program targets	Monitoring Indicators [An MIS system to be set up (incl. 1301 data). Work initiated in 05/97 to include all basic halon sector information, inputted into the MIS framework.]
Policy Instruments <ul style="list-style-type: none"> • regulation on tradable production quota • bidding system • ban on halon extinguisher uses in nonessential areas • 2 building fire codes revisions 	Start of Program 1998 1998 1998	<ul style="list-style-type: none"> • date of regulation promulgated and effective • operating procedures for trading finalized • quarterly reporting requirements from halon producers finalized • operating procedures for bidding finalized • winners for 1998 selected and awarded • promotional campaigns on the ban undertaken • ban enforcement of the ban by local FFBs and EPBs • codes revision completed • regular plant visits by MPS and fire bureau to check compliance • NEPA/MPS establish penalty for noncompliance and verification process
Technical Assistance <ul style="list-style-type: none"> • MIS • Bidding/quota system • Formulation of export & import polices • Revision of ABC standard • Formulation of design codes of extinguishing systems 	To start: Mid 1997 3rd Q, 1997 1st Q, 1998 1st Q, 1998 1st Q, 1998	<ul style="list-style-type: none"> • dates of TORs agreed by the Bank • dates of no-objection on contracts that require prior review by the Bank • contracts signed with dates, amounts and details on contract implementation • training conducted—dates, participants, contents, trainers, and costs • status of studies • disbursement amounts and dates to contracting parties • progress reports (from consultant firms) received by NEPA • actual formulation of policies and standard as stated in TORs • date of effectiveness of new policies • implementation results of policies, standards and codes