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(TF-56008)

ON A

GRANT FROM THE GLOBAL ENVIRONMENT FACILITY (GEF)

IN THE AMOUNT OF USD 18.34 MILLION

TO THE

PEOPLE'S REPUBLIC OF CHINA

FOR A

PCB MANAGEMENT AND DISPOSAL DEMONSTRATION PROJECT

June 24, 2013

China and Mongolia Sustainable Development Unit
Sustainable Development Department
East Asia and Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective December 31, 2012)

Currency Unit = Chinese Yuan Renminbi (CNY)
1.00 = US$ 0.16047
US$ 1.00 = 6.23160

FISCAL YEAR
January 1 – December 31

ABBREVIATIONS AND ACRONYMS

CIO	Convention Implementation Office
CNAO	China National Audit Office
COP	Conference of Parties
CPS	Country Partnership Strategy
CPTF	Canada POPs Trust Fund
CTA	Chief Technical Advisor (International)
DADI	Hangzhou Dadi Environmental Protection Co. Ltd
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPD	Environmental Protection Department
FAO	Food and Agriculture Organization of the United Nations
FECO	Foreign Economic Cooperation Office
GEF	Global Environment Facility
GP	General Policies of the World Bank
MEA	Multilateral Environmental Agreement
MEP	Ministry of Environmental Protection
MIS	Management Information System
MOCom	Ministry of Commerce
MOC	Ministry of Construction
MOF	Ministry of Finance
MOFA	Ministry of Foreign Affairs
MOH	Ministry of Public Health
MOHURD	Ministry of Housing and Urban-Rural Development
MOST	Ministry of Science and Technology
MT	Metric Ton
NDRC	National Development and Reform Commission
NIP	National Implementation Plan
NLG	National Leading Group for Implementation of the Stockholm Convention in China
NRP	National Replication Program
NTA	National Technical Advisor
PCB	Polychlorinated Biphenyls

PCN	Project Concept Note
PIU	Project Implementation Unit
POPs	Persistent Organic Pollutants
RMB	Renminbi (common name for Chinese currency – see also Yuan)
R&D	Research and Development
SEPA	State Environmental Protection Administration
SERC	State Electricity Regulatory Commission
TCG	Technical Cooperation Group
TOR	Terms of Reference
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
UNIDO	United Nations Industrial Development Organization
WB	World Bank
WHO	World Health Organization

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PEOPLE'S REPUBLIC OF CHINA

PCB MANAGEMENT AND DISPOSAL DEMONSTRATION PROJECT

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MAP

1. Project Context, Global Environment Objectives and Design

1.1 Context at Appraisal

The Stockholm Convention on Persistent Organic Pollutants: Persistent organic pollutants (POPs) are a class of toxic chemicals that, as their name suggests, persist in the environment for long periods of time, are able to travel long distances from their points of origin, carried by natural soil, water and air processes, and accumulate in the fatty tissue of living organisms. Exposure to POPs can lead to serious health effects such as reproductive or development disorders, nervous system damage, and immune system diseases.

Given their toxicity, persistence and trans-boundary properties, in 2004 the global community adopted a multilateral environmental agreement to address the challenge. The Stockholm Convention on POPs[1] requires Parties to take measures to eliminate or reduce the release of POPs into the environment. China was actively involved in the development of the Convention, participating in all preparatory meetings and ratifying the agreement on August 13, 2004. At the time of project appraisal, the Stockholm Convention addressed twelve distinct POPs divided across three broad categories: pesticides, unintended by-products and industrial chemicals[2].

Sector and Country Contexts: As a Party to the Stockholm Convention, China's obligations include eliminating the use of polychlorinated biphenyls (PCBs) in equipment by 2025, and pursuing environmentally sound PCB waste management and management of equipment containing PCBs as soon as possible, but no later than 2028. Used in industry as heat exchange fluids, in electric transformers and capacitors, and as additives in paint, carbonless copy paper, and plastics, PCBs are shown to disrupt endocrine and immune systems, cause developmental and behavioral disorders in children, and possess carcinogenic properties.

PCBs were manufactured in China by three production facilities in Xi'an, Suzhou, and Shanghai from 1965 to early 1974. Production of penta-chlorobiphenyl (PCB5) was used in open systems, such as oil paints while that of tri-chlorobiphenyl (PCB3) was principally used in the manufacture of capacitors used in the electric power supply industry.

In the 1980s, it was recognized that China's PCB problems emanated principally from the electric power sector and some large-scale industrial enterprises. The Chinese Government therefore, issued a series of regulations regarding the import, collection, storage, transportation, treatment and disposal of PCBs and PCB-containing electrical equipment, compelled by growing health and environmental concerns. At this stage, the bulk of PCB-containing capacitors were removed from service and stored in a unique system of temporary underground storage facilities, referred to as "concrete coffins", or in caves. And, in this same period, a series of severe PCB contamination incidents occurred in Zhejiang Province.

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[1] The Stockholm Convention entered into force on May 17, 2004. For more information, visit the Convention's website at: http://chm.pops.int/Convention/tabid/54/Default.aspx

[2] PCBs are one group of compounds listed in the Stockholm Convention's initial 'dirty dozen', which also included a range of pesticides, industrial chemicals and by-products. In 2009, the Stockholm Convention amended its Annexes A, B and C to include 9 new POPs, and in 2011 was further expanded to include the insecticide endosulphan.

At the time of project appraisal, investigations supported by bilateral activities (the Italian Persistent Organic Pollutants Trust Fund[3] (Italian POPs TF) and the Canadian POPs Trust Fund (CPTF)[4]) indicated that many 'temporary' disposal sites had exceeded or were approaching their design lifetime and that there were indications that some of the sites were leaking PCBs into the surrounding environment.

Project Background: The project was designed to help China address challenges with respect to PCB management and disposal emanating from incomplete PCB baseline data, weak institutional and policy framework for PCB management, lack of PCB disposal technology and facilities, and insufficient public awareness. Given the vast size of China and the scope of the problem, the project adopted a demonstration approach in order to focus on determining and demonstrating the most cost-effective practices and technologies to address PCB management and disposal issues at the provincial level, through which the foundation would be laid to design and cost a full scale replicable nation-wide PCB management program in future. Zhejiang Province was selected as the demonstration province based on its history with PCB leakage incidents and its overall transformer capacity, data for which had been made available through implementation of activities under the Italian POPs Trust Fund.

At the global level, the project was designed to address China's obligations under the Stockholm Convention, while in tandem contributing indirectly to the objectives of two other chemicals-related multilateral environmental agreements, the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal and the Rotterdam Convention on the Prior Informed Consent Procedures for Certain Hazardous Chemicals. At the national level, the project sought to support implementation of China's 2003 National Program for Construction of Hazardous and Medical Waste Disposal Facilities, as well as the country's ongoing efforts to reduce the risks to human health and the environment from industrial pollution.

Rationale for World Bank Support: The Bank possesses experience in streamlining environmental health considerations into solid and hazardous waste and wastewater management, as well as control of pollution from industry, energy, agriculture and health care activities, which laid the foundations to extend assistance to clients in complying with their obligations under the Stockholm Convention through the Global Environment Facility (GEF), the Convention's interim financial mechanism. In addition, the Bank was assisting China in tackling issues of PCB management through a CPTF-funded grant that supported the development of methodologies and training programs for PCB site assessment and remediation[5], which both co-financed the project's GEF preparation grant and informed the project's design. In tandem, funding from the Italian POPs Fund supported the development of a PCB inventory methodology in Zhejiang and Liaoning provinces and launched preparation of a draft strategy on approaches and options for disposal and reduction of PCBs.

The Bank's technical and policy expertise in waste and chemicals management, complemented by its experience in the design and implementation of GEF projects, made it well placed to extend assistance to China's POPs program in line with the GEF 3 Focal Area Strategy on Persistent Organic Pollutants and consistent with the Bank's 2006-2010 Country Partnership Strategy for China.

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[3] The Italian Grant for an Italian Persistent Organic Pollutants Fund at the World Bank (TF051188) became effective in December 2002. In all, the project carried out 21 activities focused on two provinces – Zhejiang and Liaoning.

[4] The CPTF was established by the established by the Canadian International Development Agency (CIDA). For more information visit: http://siteresources.worldbank.org/INTPOPS/Publications/21314961/CanadaPOPs_brochure_041607_web.pdf

[5] A $175 K CPTF-funded project supported a training program in China that helped: promote awareness of PCB issues; build capacity to gather inventory data for PCBs, inspect storage sites, collect environmental data samples and work safely with potentially contaminated equipment and sites; and, assess PCB destruction technologies.

1.2 Original Global Environment Objectives (GEO) and Key Indicators (*as approved*)

The Project's development objective (PDO), as captured in the project appraisal document (PAD), was to identify and demonstrate environmentally-sound and cost-effective policies, procedures and techniques for safe management and disposal of China's temporarily-stored PCBs, their associated PCB-contaminated wastes and remaining in-use PCBs equipment. The original Grant Agreement[6] synthesized this broad objective to read: assist the Recipient in mitigating the impact of PCB threats to human health and the environment by establishing a cost effective framework for cleaning up PCB.

The Global Environment Objective (GEO), as captured in the PAD, called for the Project to help China eliminate PCBs, one of the 12 POPs covered by the Stockholm Convention, given the potential harm they bring to human health and to the environment.
Two related Outcome Indicators were identified:

1. Lessons from Zhejiang Province's demonstration of the most cost-effective, environmentally-safe policies and methods for identifying, excavating and cleaning-up temporary PCB storage sites documented and disseminated nationally and globally;
2. China's national PCB management program and policy/regulations [are] refined to reflect lessons from Zhejiang's experience.

1.3 Revised GEO (*as approved by original approving authority*) and Key Indicators, and reasons/justification

The GEO and Outcome Indicators remained unchanged throughout the life of the project.

1.4 Main Beneficiaries

The Project's main beneficiaries included Government officials from the Foreign Economic Cooperation Office of the Ministry of Environmental Protection (MEP), which is responsible for overseeing implementation of activities to ensure that China meets its obligations under the Stockholm Convention, and members of the National Leading Group for Implementation of the Stockholm Convention (NLG)[7] composed of central Ministries and state commissions. At the provincial level, the Solid Waste Management and Supervision Center of the Zhejiang Environmental Protection Bureau (EPB), provincial-level employees of the State Electricity Regulatory Commission (SERC), and the dedicated Project contractors, the Hangzhou Dadi Environmental Protection Co. Ltd (DADI) and the Shenyang Hazardous Waste Disposal Technical Center were expected to benefit. Locally, populations living in proximity of PCB storage sites in Zhejiang Province were also seen to be beneficiaries, as was the public at large.

1.5 Original Components (*as approved*)

The Project, as originally approved, included six components, summarized below:

Component 1: Institutional strengthening (US $1,945,000): The objective of the component was to strengthen Chinese institutions for PCB management and disposal in a sustainable manner by supporting,

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[6] Project Grant Agreement, Schedule 2, Description of Project, dated March 16, 2006.

[7] The NLG was established in September 2003 with SEPA (MEP) as the Lead Agency authorized to manage all POPs activities in China. Members include: State Environmental Protection Administration (SEPA), National Development and Reform Commission (NDRC), the Ministries of Foreign Affairs (MOFA), Finance (MOF), Commerce (MOCom), Science and Technology (MOST), Agriculture (MOA), Public Health (MOH), Construction (MOCon), as well as the General Administration of Customs (GAC) and the State Electricity Regulatory Commission (SERC).

inter alia: (a) capacity building at the national level by strengthening the PCB project team and establishment of a national PCB expert group in the CIO under MEP/FECO; (b) establishment o f a local project implementation unit (PIU) in the Zhejiang Province; (c) provision of PCB management training to provincial authorities and technical personnel, as well as project management training for both PIU staff and the PCB project team in the CIO; (d) a study tour on PCB disposal technologies, and (e) public awareness activities.

Component 2: Development of a Policy Framework for PCB management and Disposal (US $810,000): The objective was to support development and improvement of the legal and regulatory framework for safe management of PCBs in Zhejiang Province, including adoption of a PCB pollution prevention/control regulation, development of a technical guideline for PCB management and disposal and elaboration of an emergency response plan for PCB accidents targeted at relevant authorities. At the national level, existing relevant policies and regulations governing PCB management and disposal would be reviewed, revised, and supplemented, as necessary, under the auspices of the development and adoption of a national regulation on PCB management and disposal, while a series of national pollution control and environmental quality standards for PCBs[8] would be designed to facilitate implementation of the demonstration project and support China's broader environmental regulatory framework. To support the sustainability of Project inputs and efforts, a study for a funding mechanism for co-financing PCB management and disposal in China into the future, would be prepared to underpin the effective implementation of the national PCB reduction and disposal strategy to be developed under Component 6.

Component 3: PCB Management in the Zhejiang Province (US $15,016,000): The clean-up of an estimated fifty-six (56) sites would form the basis for the PCB storage site remediation framework in Zhejiang Province, and results would inform the design of the national replication program for PCB elimination (Component 6). A series of feasibility studies[9] would be completed, the exact location of PCB sites would be identified and preliminary quantification of the volume of buried PCBs wastes using Georadar (ground penetrating radar) undertaken, followed by clean-up, according to a specific protocol[10], of sites identified as containing PCBs. Highly-contaminated PCB wastes (>500 ppm) would be transported to a temporary PCB storage facility in Zhejiang, containerized then transported, in accordance with a strict transportation protocol, to Liaoning Province for destruction by incineration. The sub-component also funded establishment of a government-owned suitable storage facility for PCB waste in Zhejiang that would be used in the national replication program. Low-concentration contaminated PCB wastes (between 50ppm to 500 ppm), whose estimated volume was calculated to be in the order of 20,000 tons[11], would be treated in Zhejiang Province. A mobile thermal desorption system (able to treat 50 tons/day), whose selection was based on the evaluation of alternative PCB treatment/disposal technologies prepared during project preparation, would be procured to treat PCB wastes low concentrations. Verification and monitoring of PCBs sites post-clean-up would be undertaken within one year of remediation. This sub-component also sought to compile information on large transformers, test

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8 To include pollution control standard for PCBs in wastewater discharges, gas emissions, solid wastes, surface water, groundwater, soil and air (PAD, Annex 4, p.70)

9 Including: i) pre-treatment of buried PCBs equipment prior to shipment for final disposal; ii) determination of optimum PCB storage (fixed or mobile) for Zhejiang; iii) determination of optimum types of vehicles for inter-provincial transportation of PCB wastes; and iv) determination of fixed or mobile thermal desorption facility for Zhejiang.

10 A comprehensive overview of the procedures to be followed is found in Section B and Annex 4 of the PAD.

11 Analysis within the context of the Italian POPs project had estimated that, on the basis of overall transformer capacity in 1980, Zhejiang province has about 22,500 PCB capacitors and a total of about 247.5 tons of PCB oil. From this, it was estimated that between 1,980 - 2,475 tons (2,000 tons was used as the project indicator) of PCB capacitors and highly-PCB contaminated soils (PCB >5OOppm) would require disposal, while in the order of 19,800 - 24,750 tons (20,000 tons was used as the project indicator) of low-PCB contaminated soils and water (PCB</=5OOppm) were estimated to require clean-up. (PAD, Section B, para. 22 e, p.16)

PCB transformer decontamination technologies, decontaminate up to 10 selected in-service transformers installed prior to 1980.

Component 4: Disposal of Highly-contaminated PCB Wastes in Liaoning Province (US $13,609,000): This component would address the final destruction of highly-contaminated PCB wastes (>500 ppm) collected in Zhejiang Province at an existing, but not fully completed, incineration facility in Shenyang, Liaoning Province. As referenced under Component 3, highly-contaminated PCB wastes recovered in Zhejiang Province would be transported to Liaoning Province for disposal. Specific actions called for under this component would include: provision of support for waste characterization and analysis at an existing laboratory; upgrade the existing Shenyang rotary kiln incinerator to meet Stockholm Convention specifications for disposal of PCBs; training of Shenyang Center technical personnel in the areas of PCB safe storage, safe operation of the PCB incineration facility and dioxin/furan minimization and monitoring; and, successful disposal of highly-contaminated PCB wastes transported from Zhejiang province.

Component 5: Project Monitoring and Evaluation (US $127,000): Project specific monitoring and evaluation activities would focus on tracking results with respect to the number of sites cleaned and the volume of waste treated and disposed of. Results would be introduced into a national POPS management information system (POPS-MIS). To support M&E efforts, a workshop on the monitoring system designed for PCB management in Zhejiang Province would be organized, and three annual workshops would be organized to review and take stock of Project progress.

Component 6: Design of a National Replication Program (US $3,290,000): The results and experiences generated by the demonstration activities in Zhejiang Province would be shared nationally and internationally through workshops. More importantly, they would inform the design of a national replication program to be disseminated throughout China.

1.6 Revised Components

A number of indicators and activities defined under Project Components 2, 3 and 4 were revised as follows:

Component 2, intermediate results indicator in adoption of regulatory frameworks. In December 2010, the technical standards that were to be issued on PCBs in surface water, groundwater, air and soil were dropped since the Government decided to adopt integrated environmental quality standards for all chemicals, including PCBs, outside the timeline of the project. Instead, two new indicators regarding the issuance of National Regulations on PCB management and disposal, and National PCB pollution control standards were introduced.

Component 3, intermediate results indicator on the number of temporary PCB storage sites in Zhejiang Province identified. Given that identification of the actual number of sites requiring clean-up formed part of the Project's activities, and given that in the course of site investigation it became clear that that, in addition to there be fewer sites, not all would require clean-up. In December 2010 the number of PCB storage sites that might require clean-up (estimated at 56) was revised to target identification of 'all' temporary PCB storage sites, without attaching a specific number.

Component 3, intermediate results indicator on in-use large PCB transformers. The results indicator that 10 in-use large PCB transformers installed before 1980 be decontaminated and more transformers tested was dropped in December 2010, given the determination that no such PCB transformers remained in-service. The funds that had been allocated to this activity were transferred to the transportation of highly-contaminated PCB waste from Zhejiang Province to the Shenyang incinerator in Liaoning Province,

which had been identified in the PAD as a project activity but had not explicitly been included in the Project description included in the Grant Agreement.

Component 4, target values for the intermediate results indicators associated with volume of PCB-containing capacitors and volume of PCB oil and contaminated soils to be disposed. Given the decrease in the actual number of sites requiring clean-up, the number of PCB-containing capacitors and the volume of contaminated PCB oil and soils to be disposed of were amended in December 2011 as follows:

a) Incinerator operational records confirm Zhejiang Province's approximately 1,200 T of PCB-containing capacitors and highly-contaminated PCB waste (compared to 22,500 PCB-containing capacitors, as originally estimated) disposed of in an environmentally sound manner; and
b) Incinerator operational records confirm Zhejiang Province's approximately 10,000 T of PCB-contaminated soils (compared to 20,000 T, as originally estimated) disposed of in an environmentally sound manner[12].

These changes were introduced due to the following three reasons: (i) the PCB-containing capacitors were mostly broken and such poor condition that it would be impossible to ensure proper counting; also size of the capacitors differed from site to site – therefore tons of highly-contaminated waste was deemed to be a more appropriate indicator; (ii) PCB oil was in most cases leaked out of PCB-capacitors and mixed with the surrounding soil, therefore proper measurement of PCB oil was impossible; (iii) the decrease of PCB-contaminated soil was due to decreased number of actual clean-up sites and actual contamination levels that can only be determined once the clean-up is performed.

1.7 Other significant changes

Grant Agreement Amendments and Closing Date Extensions

Over the life of the Project, the GA was amended four times, three with the approval of the World Bank Country Director and one with the approval of the Regional Vice President:

1) *November 13, 2006* - an amendment was introduced to change the GA's disbursement modality from SOE to the use of Financial Monitoring Reports (FMR) as the basis for disbursement and project management.

2) *June 28, 2010* – a level 2 restructuring was approved to allow a 6-month extension of the Project's Closing Date, to December 31, 2010, in order to allow sufficient time to resolve key bottlenecks related to meeting project withdrawal conditions and key short-term project milestones to be achieved[13].

3) *December 27, 2010* – a level 2 restructuring was approved to: 1) extend the Project's Closing Date to December 31, 2011[14]; 2) reallocate Grant proceeds from the Works and Services categories to Goods to

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12 Reflects the final targets adopted following the Project's final restructuring in December 2011.

13 A 2-year extension in Closing Date was originally sought, based on results and recommendations expressed at MTR. The Project had suffered a number of systemic delays that were impeding the actual clean-up of PCB-contaminated sites and the disposal of contaminated wastes and soils. The Project team therefore, argued for an initial 6-month extension that would allow demonstration of clear actions to resolve pending obstacles to implementation and achievement of the agreed milestones by the new deadline, as well as development of a credible action plan, satisfactory to the Bank. Assuming these targets were met, an additional 18-month extension would be considered.

14 Based on progress achieved over the initial 6-month Project extension period, the Recipient requested an additional extension of 18 months to complete clean-up activities in Zhejiang Province, initiate disposal of low-level and highly contaminated PCB soils and wastes, and complete the design of China's National Replication Strategy. According to the action plan developed, it was projected that all activities could be completed within a 12-month period, with the exception of the clean-up and disposal of PCB wastes from the 32 pre-identified contaminated sites. At the time of restructuring, only 16 of the 32 sites were confirmed to have levels of PCB-contamination requiring clean-up, and the action plan indicated that their clean-up and disposal of their PCB wastes could be completed within a six to nine month timeframe. Given the projected timelines, the Project team recommended a 12-month extension, along with the recommendation that pre-monitoring of the remaining 16 sites be

cover increased costs associated with procurement; and, 3) modify Part C of Schedule 2 of the GA to include an additional Project activity, "(g) transportation of highly-contaminated PCB wastes from Zhejiang to Shenyang", and adjust the intermediate results targets to reflect the number of PCB-contaminated sites identified to 35, as well as changes in the process of adopting regulatory frameworks.

4) *December 13, 2011* – a level 2 restructuring was approved to extend the Project's Closing Date to December 31, 2012, and amend the GA to capture the final intermediate results targets agreed upon by the Recipient and the Bank team, based on the actual number of PCB-contaminated sites identified as requiring clean-up.

2. Key Factors Affecting Implementation and Outcomes

2.1 Project Preparation, Design and Quality at Entry

Overall, the design of the Project's components is considered to have been sound. The Project's aims and structure were appropriately responsive to China's interest in addressing the technical, policy, regulatory and information challenges of PCB management and disposal so as to meet Stockholm Convention requirements, as well as to support the government's efforts to reduce environmental pollution and protect human health.

Project Background Analysis that Informed Design: The background analysis that informed Project preparation was comprehensive and commensurate with the technical complexity of the issue to be addressed. The demonstration Project was designed as part of a multi-phase suite of internationally supported POPs and PCB-specific activities aimed at improving China's capacity for PCB management and disposal. Prior CPTF and Italian POPs TF-supported activities helped prioritize Project components related to institutional arrangements, policy options, and available treatment and disposal technology choices. Related GEF-funded POPs-focused activities undertaken in cooperation with the Bank, such as the Demonstration of Alternatives to Chlordane and Mirex in Termite Control Project [P116786], and development of China's National Implementation Plan (NIP) for the Stockholm Convention, prepared by the Convention Implementation Office (CIO) under FECO/SEPA (now MEP) with the assistance of UNIDO, also informed the Project's design.

Government Commitment and Support for Design: The comprehensive management structure adopted for the Project at various levels of government further underlined the country's commitment. The involvement of the 11-Ministry NLG for Implementation of the Stockholm Convention ensured coordination, both with respect to the relevance of the Project's design to the Government's broad pollution management objectives, as well as through the coordinated use of resources, US $14 million of which were provided as counterpart funding. The establishment of a PCB Project Team within the CIO/MEP, as well as one at the provincial level within the Zhejiang Environmental Protection Bureau (EPB), involving EPB staff with environmental monitoring and solid waste management experience, plus staff from the Zhejiang Power Company, drew upon previous experience gained working through the long-standing China-World Bank partnership under the Montreal Protocol on Substances that Deplete the Ozone Layer, that had demonstrated the value of working through a dedicated local project management team. The Project's design adopted this model as part of its capacity-development efforts focused on institutional arrangements.

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fast-tracked in order to determine whether any exceeded acceptable PCB levels. It was agreed that should the pre-monitoring confirm high levels of PCB-contamination at all 16 sites, a further action plan and possible final extension of closing date could be considered.

Analytics used in the Design: Project design was overall, sound. Given that the unique temporary storage system for PCBs and associated PCB-contaminated wastes (e.g., PCB-contaminated soils and water) adopted in China precluded verification of complete baseline data prior to Project implementation, the Project design made use of the best available data to develop rational objectives and indicators to support the identification and demonstration of environmentally-sound and cost-effective policies, procedures and techniques for the safe management and disposal of PCB wastes. Two Environmental Assessments (EAs) were prepared during Project design, one for Zhejiang Province and the other for the Shenyang incineration facility, each of which included an Environmental Management Plan (EMP) that detailed specific PCB mitigation and monitoring measures, institutional coordination and capacity building, as well as thorough implementation and cost schedules.

Possible critical environmental risks and risk mitigation measures were overall, adequately identified and fleshed out during project design.

- The inclusion of focused training and capacity development activities sought to mitigate the risk that limited technical and operational capacity, particularly amongst partners and stakeholders at the provincial levels, might impede implementation.
- In recognition of the inherent environmental risks associated with handling PCBs, due diligence was paid during the preparation phase to gauging projected storage and disposal requirements with the intent of minimizing risk to the environment and surrounding communities.
- On the question of storage, the Project design embedded the requirement for preparation of three additional EAs during implementation: one associated with construction of the PCB storage facility and another for the thermal desorption unit (TDU) for soil decontamination, both in Zhejiang Province; the third would address construction of the PCB storage facility to be erected at Shenyang. Regarding the question of disposal, a total of seven alternative scenarios - ranging from no action, to situ monitoring, to disposal abroad - were considered and rejected in favor of the thermal desorption option ultimately adopted.
- The selection of the TDU, a mature technology used in developed countries, was made based on the fact that China's PCB wastes were principally identified as *low-concentration PCB-contaminated soils*, and on the understanding that thermal extraction was the only in situ process that preserved at least a limited set of the soil's properties, thereby allowing for the return of treated soil to its site of origin (see Annex 2 re: issues regarding selection of a mobile or fixed TDU option).

Based on technical analysis and international experience, high temperature incineration was accepted as the most widespread and proven technology by which to destroy *high concentration PCB wastes* in accordance with Stockholm Convention standards. The decision to have the Project upgrade and use the Shenyang Hazardous Waste Disposal Center in Liaoning Province, which had been designed to meet all applicable Chinese regulations and standards, but not the levels specified under the Convention, versus building a new incineration facility in Zhejiang Province was technically and financially sound given cost considerations regarding new construction versus transportation, the relatively low volume of estimated high concentration PCB wastes in Zhejiang Province that would require incineration, and the projection of large amounts of PCB wastes buried in China's northern provinces that would require incineration under the national replication plan in future.

The extent of legislative reform anticipated at both the national and provincial levels to ensure sustainability of efforts and promote national replication of the demonstration Project's results is also considered to have been reasonable. The existing regulatory frameworks in place at the time of Project design, or baseline scenario, attested to the Government's early legislative responsiveness on the issue,

while also highlighting the limitations they imposed[15], and China's ratification of the Convention assured its commitment to align its policies with the Convention's objectives into the future.

In hindsight however, two related issues are considered to have been deserving of more attention during preparation. One centers on the single sourcing of the Project contractors, Hangzhou Dadi Environmental Protection Co. Ltd. (DADI), identified as the Project partner for site clean-up and treatment of low-concentration PCB wastes, and the Shenyang Center, identified as the Project partner for final disposal through incineration. The other concerns the lack of clarity with respect to the licensing requirements for contractors to handle, treat and dispose of PCB wastes. Both were critical to Project implementation. Indeed, the confidence demonstrated at entry regarding the DADI and the Shenyang Center was so high that their being licensed was included as a withdrawal conditions in the Grant Agreement. When the licensing processes stalled, no sites could be cleaned and no contaminated materials treated, resulting in extensive Project delays (see Annex 2). A more thorough review of the rationale for application of the single source modality for the Project contractors and a more robust dialogue regarding the terms of the regulations governing hazardous waste operations may have avoided the complications that arose and the delays that ensued.

2.2 Implementation

Project implementation took a total of six years, 30 months longer than planned, and the Project closed on December 31, 2012. Project objectives overall, were achieved, as discussed in Section 3.2, despite the fact that implementation faced a number of challenges and delays, particularly in relation to Components 3 and 4.

Components 1, 2 and 5, which respectively sought to address institutional strengthening requirements, develop a policy framework for PCB management and disposal at both the national level and in Zhejiang Province, and ensure effective monitoring and evaluation of Project progress, met their objectives writ large, as outlined below:

- Technical capacity related to PCB management and disposal has been internalized and will underpin China's ongoing work in this sector in future and project management skills were, overall, enhanced.
- Significant progress was made regarding the development of an over-arching policy framework for PCB management and disposal including, technical guidelines, national policy standards and provincial regulations regarding PCB contamination management and control. The decision to integrate PCB management and disposal considerations into a broader national regulatory framework on chemical substances bodes well for the future sustainability of PCB management in China however, the chemical substances regulation had not yet been adopted at the time of Project closure, making it difficult to assess its impact.
- An abstract of a study on financing mechanisms for disposal of PCB wastes in future that was prepared identified three cost scenarios for ongoing PCB management and disposal under the auspices of the national replication program (Component 6). The most cost-effective, least-cost option proposed calls for the ongoing use of Project inputs. While this raises optimism with respect to the potential for ongoing sustainability, the absence of a robust immediate-term replication action pla, precludes the possibility of comprehensively assessing the study's recommendation or the sustained impact of its proposal.
- M&E reporting on activities and results was performed by FECO/CIO and the Zhejiang PIU through semi-annual project progress reports. The Project also generated site specific data which was introduced into the national POPs management information system (POPs-MIS), developed in

[15] PAD, Annex 15.

partnership with the Demonstration of Alternatives to Chlordane and Mirex in Termite Control Project that was under implementation at the same time.

Of the fifty-six (56) sites estimated as requiring clean-up at appraisal, a total of 35 sites were identified as contaminated using geo-radar (ground penetrating radar) technology, but only 16 sites were eventually cleaned, having been deemed contaminated and/or accessible (see Table 2-4, Annex 2).

Implementation of Component 3 generated a number of delays throughout Project implementation. One issue surrounded the question of licensing of the Project contractor, the Hangzhou Dadi Environmental Protection Co. Ltd. (DADI). The firm had been selected as a single source contractor for the recovery of PCB wastes, treatment of contaminated soils and decontamination of PCB-contaminated transformers at design stage based on (i) its experience in waste management under the National Program for the Construction of Hazardous and Medical Waste Disposal issued by the State Council in 2003[16], (ii) its prior experience in cleaning-up PCB sites, and (iii) the expertise it had gained thanks to a decade's worth of Project-relevant technical training its staff had received from the German aid agency, GTZ. MEP confirmed at design stage that DADI would be the only company granted an official license to handle PCB wastes, excluding final disposal of highly-contaminated PCB waste. Yet requirements under the *Measures for Administration of Hazardous Waste (HW) Operation Permits* (2004) that appear to not have fully been understood at preparation, would impede the process and raise a persistent implementation delays, not least because the licensing requirement was one of the withdrawal conditions written into the GA. Extensive inter-ministerial consultations finally allowed for understanding to be shared by all Project proponents and for the licensing issue to be resolved in 2010 (see Annex 2).

Procurement and location of the TDU also created challenges. The initial TDU site location had to be revisited due to local government and civil opposition, the TDU procurement process had to be re-bid, which delayed implementation by many months and, once installed, the TDU experienced a series of persistent technical problems that resulted in delays in the equipment being able to complete the Proof of Performance (POP) Test required. The problems were somewhat compounded by the lack of capacity on the part of FECO/CIO, the Zhejiang PIU and DADI with regard to complex Bank procurement processes. As a result, for example, the warranty period was linked in the contract to equipment delivery as opposed to the hand-over of equipment, which caused additional challenges at the local level. This issue of capacity also affected the design of clean-up plans and cost estimates once the TDU began operation in earnest (see Annex 2). Ultimately, the PCB contaminated sites identified were cleaned and remediated, but the process was at times arduous.

Component 4 - the Shenyang Hazardous Waste Incineration Center was upgraded for PCB waste incineration, including construction pre-treatment and storage facilities, upgrading of the on-line monitoring system and automatic control system, and construction of a hazardous waste characterization/analysis laboratory. The Shenyang Center also faced similar issues with respect to licensing, but the issue was more easily resolved. The facility now meets the Stockholm Convention BAT guidance, which imposes stricter emission standards compared to those imposed by Chinese regulations. Concern exists that the stricter emission standards which the incinerator is designed to reach make the Shenyang facility less cost-competitive compared to other similar incineration facilities (see Annex 2).

In relation to Component 6, the results achieved in Zhejiang Province were expected to inform the development of a national replication plan that, together with the study that would outline a financing

[16] PAD, Section C, Sub-section 2, para 32, sub-para h., p. 24.

mechanism, would allow China to address remaining PCB management and disposal issues into the future. At mid-term review (MTR) it was reported that Beijing Normal University was contracted to prepare the plan, in cooperation with the FECO/CIO team and the CTA. A nationwide PCB inventory/survey has been conducted since 2010. The results of the first two surveys indicate significantly smaller volumes of PCB waste as compared to estimates which, according to FECO/CIO, is the result of deficiencies associated with the surveying process and low awareness among local authorities on PCB contamination. FECO/CIO has continued updating surveys on an annual basis in parallel with provision of in-depth training to local EPBs on the results of the demonstration Project results, and trial site clean-ups in the provinces beyond Zhejiang. During the final stages of the Project's implementation, a national 12th 5-year POPs plan was finalized and approved. This strategic plan covers PCBs and its preparation has been largely informed by the Project's lessons. Project results have been disseminated during international and national workshops. However, no further analysis of the short-term national replication action plan was possible at the time of ICR preparation, given that no indication has been provided to the ICR team that the replication plan, and its associated financing study, had been operationalized.

2.3 Monitoring and Evaluation (M&E) Design, Implementation and Utilization

As per the PAD, the Project developed a M&E strategy by which to track progress toward project objectives and facilitate learning that would support the preparation of the national replication program. Interim outcome indicators were developed to track the sound management and disposal of PCBs wastes from contaminated sites, the development of PCB policies, regulations and standards, and associated capacity building. Achievement of these intermediate outcome indicators would, cumulatively, lay the foundation upon which to reach the Project's desired outcome, adoption of a national replication program for PCB management and disposal, which is key to achieving the long-term sustainability of the investment made.

The Results Framework (PAD, Annex 3) included a comprehensive set of indicators that helped track progress of project implementation. The indicators were generally adequate to track progress under each component, and were clear, measurable and specific. The indicators related to clean-up targets were however, too narrowly defined at appraisal, considering the absence of baseline information available regarding the number of PCB-contaminated sites and therefore, the extent of the clean-up that would ultimately be required.

Overall, monitoring and reporting of the Project's implementation – administrative and technical, and output and intermediate outcome-based - was conducted satisfactorily. M&E reporting on activities and results was performed by FECO/CIO and the Zhejiang PIU through semi-annual project progress reports. While progress reports were submitted on a regular, if sometimes delayed, basis throughout the Project's implementation, in the last year of implementation there was no consolidated report submitted until the very end of the Project. In its stead, *ad hoc* reports detailing key implementation progress aspects and disbursements were submitted regularly. A POPs management information system (POPs-MIS) was to be developed early on during implementation in order to facilitate monitoring, allow for generation of aggregate national level data and demonstrate effectiveness results. Its development, which was undertaken in tandem with that of an MIS system for the Demonstration of Alternatives to Chlordane and Mirex in Termite Control Project, was delayed and hence, it was not put into use until 2010.

2.4 Safeguard and Fiduciary Compliance

Environmental Safeguards

The project was classified as a Category A project. The project triggered Operational Policy 4.01 on Environmental Assessment (EA) and Operational Policy 4.12 on Involuntary Resettlement. Overall, the implementation of the Project's environmental safeguard measures is considered satisfactory. The Environmental impacts associated with the Project included possible PCB leakage resulting in contamination at storage/burial sites and to the surrounding environment during PCB waste excavation, clean-up, containerization, treatment by thermal desorption, temporary storage, transportation, and destruction by incineration. In response, two Environmental Assessments (EAs) were initially prepared, one for Zhejiang Province and the other for the Shenyang incineration facility, followed by three additional EAs during implementation that addressed the construction of PCB storage facilities in Zhejiang Province and at the Shenyang Facility, as well as for the TDU for soil decontamination.. The detailed safeguard measures developed for site clean-up, packaging, transportation, storage, disposal, health and safety etc., further informed the development of a series of formal technical specifications and guidelines for PCBs waste management in China, which lay a solid foundation for implementation of the national replication program into the future, as well as for the national 12th FYP POPs program. Further, in accordance with the Project Grant Agreement requirement, the Zhejiang team and Project contractors, DADI and Shenyang Center, implemented the Project's Environmental Management Plan (EMP) in a satisfactory manner, ensuring that implementation was undertaken in accordance with sound environmental practices and standards.

Social Safeguards

The project was expected to generate significant social benefits by reducing public health risks associated with the release of PCBs through enhanced management, site clean-up and disposal of PCBs and contaminated materials. Possible social risks assessed at design included the threat of public exposure to contaminated sites, buildings and/or water supplies during site clean-up in Zhejiang Province and transportation processes, as well as on location at the disposal facility in Shenyang. Overall, these risks were considered minor in comparison to the expected local and global benefits. They were nevertheless, carefully considered during design and addressed through application of high technical standards, establishment of effective communication with local residents, and involvement of stakeholders in all potentially controversial aspects of the project.

Overall, the implementation of the Project's social safeguard measures is considered satisfactory. A Resettlement Policy Framework was developed to address possible land acquisition and resettlement issues, with site-specific resettlement planning to be prepared on a case-by-case basis, involving local governments, affected villages, institutions and households in the inventory of impacts process and development of the compensatory packages. In Zhejiang Province, the fact that PCB site treatment would require temporary land acquisition, as well relocation of structures and PCB 'coffins' raised concerns regarding possible social impacts. Given that the exact location of PCB burial sites was not known and required additional field work, social impacts emanating from site treatment could only be known and addressed as the work progressed. The people affected by the Project's activities were consulted and kept involved in relevant resettlement and response decisions. The cost of land affected was fully remunerated, affected enterprises, infrastructure and public facilities were fully compensated and the livelihoods of those affected were restored. Based on the evaluation of the resettlement monitor, as well as the numerous site visits and mission observations, the Project's resettlement implementation is deemed satisfactory.

Of the 35 PCB-contaminated sites identified, very little adverse social impacts resulted. Of the 16 project sites ultimately cleaned, 5 were located within the compound of power transmission stations, 4 were in warehouses of local companies or public facilities, and 7 were public areas including, a mountain cave and a barren river bank. Only two triggered involuntary resettlement: one village-owned enterprise and 3 households were directly affected. In one case, the project site encroached on approximately 1.5 mu of village land, part of which was rented out to another village for the production of plums. Compensation standard applied to this case was much higher than the local government regulation and the affected village and people were very satisfied with very much sufficient cash and in-kind compensation. At another site, adverse impacts of a limited nature affected three households whose domiciles abutted a project site fence. After consultation and agreement with the affected people, adequate compensation in the form of cash was paid to the households for the impacts of noise and dust, for absenteeism from work on site clean-up days. The local PIU and relevant stakeholders conducted thorough consultations in coordination with of local township governments, the implementation of the social safeguard management in these cases were in compliance with the local government regulations and consistent with the Bank's OP/BP 4.12 on involuntary resettlement.

Fiduciary Safeguards

Financial Management

Overall, financial management was satisfactory. The Project implemented an adequate financial management system in accordance with MOF regulations and requirements outlined in the Grant Agreement. A special project account was created and financial statements regarding the use of funds were prepared in a timely manner, in line with Bank procedures. At Project completion, 98% of the Project funds had been disbursed. A breakdown of the final distribution and division of funds at the national and provincial levels is outlined in Annex 1.

Within less than 6 months of effectiveness, the Project, with the agreement of the client, replaced the Statement of Expenses (SOE) disbursement modality with financial report-based disbursement, Financial Monitoring Report (FMR). This modality was new to both FECO/CIO and the PIU and, as a result, slowed disbursement in the Project's initial stages due to a lack of training. Eventually, the Project teams were able to take advantage of comprehensive training provided by the Bank in March 2008 under the auspices of the sister Demonstration of Alternatives to Chlordane and Mirex in Termite Control Project, also executed by FECO/CIO. Following this training, the FMR process flowed more smoothly though disbursements remained slow into 2010 as a result of implementation delays associated with Components 3 and 4.

The IFRs could be submitted to the Bank as required by legal agreement. All the project annual audit reports were submitted to the Bank with unqualified opinion.

Procurement

Procurement plans were developed and shared with the Bank team for review and no objection in a timely manner and, in accordance with Bank requirements, updated procurement plans were disclosed publicly. Procurement Post Reviews conducted by the Bank found that overall, the procurement of works and goods, as well as the selection of consultants, was carried out in a satisfactory manner in accordance with the Bank's Procurement and Consultants Guidelines. In order to ensure that staff of the Zhejiang PIU, for whom Bank procedures and policies were new, as well as those staff new to the FECO/CIO, were able to manage key procurement processes in a manner that would satisfy project implementation needs,

procurement training, as called for in the PAD[17], was provided by the Bank to ensure that all procurement documents, including payment records, were properly completed and filed.

The overall handling of procurement procedures aside, obstacles were nevertheless encountered in the procurement process, the most important case relating to procurement of the TDU which ultimately, was delayed by over a year. This resulted from the Bank's refusal to accept the results of the first competitive bidding process due to concerns regarding the financial and technical viability of the supplier selected. Given the importance of procuring technology that would indisputably be able to function in accordance with the technical specifications outlined in the Project (and in accordance with the Stockholm Convention), the Bank team requested the Project team to re-bid the TDU. This ultimately delayed implementation and saw the total cost of the equipment rise, which required the Project to reallocate funds in order to meet the costs of the TDU eventually selected. The impacts of the re-bidding process may have been attenuated had the Bank, FECO/CIO and PIU teams worked more closely together to facilitate the process.

2.5 Post-completion Operation/Next Phase

A series of PCB policies, regulations and technical standards developed including, national PCB pollution control and environmental quality specifications are being used to inform the development of a national regulation governing chemical substances. Project results also contributed to the design of China's 12th Five-Year Plan that emphasizes, inter alia, decreasing use of major pollutants and strengthening economic and environmental governance, and have contributed positively to addressing China's commitments under the Stockholm Convention to control POPs in general, and in particular, to pursue environmentally sound PCB waste management and management of equipment containing PCBs by not later than 2028. The results will also continue to support priorities expressed in China's Stockholm Convention NIP with respect to development of effective policies, procedures, capacity and techniques for safely managing and disposing of stored PCBs and associated PCB-contaminated wastes.

Overall, the Project is considered to have contributed positively to the baseline level of national expertise against which future PCB management programs in other provinces will be able to draw. Important lessons have been generated with respect to the challenges and costs associated with the sustainable management and disposal of PCBs, lessons that will be of significant value if and when they are used to effectively inform the strategic planning behind the PCB national replication program and its related financing mechanism. A brief abstract of the anticipated financing mechanism available at Project completion identifies an optimum cost structure under which the Government believes the national replication strategy can be financed and implemented. In order to maximize use of the demonstration Project's inputs, namely the TDU and the upgrade of the Shenyang incineration facility, authorization for their continued use will rely on the adoption of relevant legislation and regulations. At project completion however, both the short-term national replication action plan and its related financing structure remained to be operationalized.

Lastly, Zhejiang Province has developed a Clean Soil Action Plan that seeks to accelerate soil pollution prevention and control. The Plan incorporates the province's 12th Five-Year Plan for POPs Pollution Prevention and Control, and specifically references ongoing PCB management and disposal.

[17] PAD, Annex 8, p.100.

3. Assessment of Outcomes

3.1 Relevance of Objectives, Design and Implementation

Rating: Satisfactory

The Project's results were relevant to the Country Partnership Strategy (CPS) 2006-2010, and remain so under the current CPS 2013-2016, -as well as to both China's country level and global environmental priorities. Under Pillar 3 of the CPS 2006- 2010, which addressed managing resource scarcity and environmental challenges, the Project supported the aim of mitigating the environmental impacts of human activities and, more directly, the Government's desire to observe international environmental conventions by piloting phase-out projects for PCBs. The current CPS 2013-2016 explicitly maintains this focus under outcome 1.6, 'Demonstrating Pollution Management Measures', which seeks to, '[support] efforts to reduce hazardous waste, by continuing to support the reduction of persistent organic pollutants (POPs) - the byproducts of industrial production and the world's most toxic chemicals-from the regulatory level to emissions control and urban site clean-up.' At the national level, the government goal of eliminating POPs and reducing risks to human health and environment from toxic chemicals through the promotion of best environmental practices has remained a high priority (see Section 3.2).

3.2 Achievement of Global Environmental Objectives

Rating: Moderately Satisfactory

Based on assessment of project outputs, weighed against the Project's performance indicators, the Project is considered to have achieved its GEO in spite of the delays that plagued aspects of its implementation. The demonstration of cost-effective, environmentally-safe methods for PCB management and disposal was successful and has contributed to mitigating the impact of PCB threats to human health and the environment. All PCB-contaminated sites in Zhejiang Province that were identified and deemed technically feasible for clean-up were remediated of PCB wastes, while those that could not be cleaned due to inaccessibility of the sites continue to benefit from ongoing monitoring to mitigate risks and ensure safety. A total of 11,428 tons of low- and 1,040.5 tons of high-concentration PCB wastes (Zhejiang + 12 other provinces) have been disposed of using technologically appropriate, environmentally-safe thermal desorption or incineration techniques, in accordance with Stockholm Convention guidelines and standards[18]. The safe removal and disposal of these volumes of low- and high-concentration PCBs and PCB contaminated wastes, and the increased monitoring capacity generated by the Project mean that the potential for future accidental releases of PCBs in Zhejiang Province has been eliminated. In tandem, the potential for the carcinogenic and non-carcinogenic (immune, nervous, reproductive and endocrine systems) effects associated with PCBs to affect human health and the environment in Zhejiang Province, as well as nationally and globally, has been mitigated.

Technical and management skills related to PCB management and disposal have increased and a wide variety of relevant stakeholders, at both the national and provincial levels, have benefited from dissemination of Project results. A series of important PCB policies, regulations and technical standards have been developed and adopted. These have contributed to elaboration of a framework for a National Regulation for PCB Management which will, as a result of experience gained during Project

[18] Of which 8,572t of low-contaminated and 769.4t of high-concentration, by Dec. 31, 2012

implementation, now be integrated into a broad national regulation governing chemical substances as opposed to a stand-alone regulation. This is expected to enhance synergies and facilitate enforcement. Analysis of possible financing scenarios has been undertaken and an optimum cost structure identified which the Government believes could finance the sustainable implementation of the national PCB management and disposal replication strategy. Further, China's 12th Five-Year Plan emphasizes, inter alia, decreasing use of major pollutants and strengthening economic and environmental governance in part as a result of the Project's implementation. At the time of completion, Project results and lessons were being applied to scale-up PCB management activities in 12 other PCB-target provinces, and had served to inform the design of the national 12th Five-Year POPs Plan. Project results also contributed positively to China's commitments under the Stockholm Convention by directly supporting achievement of NIP priorities for development of effective policies, procedures, capacity and techniques for safely managing and disposing of stored PCBs and associated PCB-contaminated wastes.

Overall, the Project generated important lessons learned in terms of managing and disposing of PCBs in a cost-effective and sustainable manner and demonstrates good potential for long-term sustainability of outcomes. Its.. At Project closure however, the short-term national replication action plan was not yet available for review. Given that its completion and effective adoption are key to the ongoing sustainability of PCB management efforts in China, and given the delays in Project implementation outlined above (Section 2.2), this outcome is rated Moderately Satisfactory.

3.3 Efficiency

Rating: Moderately Satisfactory

The demonstration project was designed to contribute both local and global public good by reducing the risk of the release of PCBs into the environment. Due to the lack of reliable baseline data and difficulties associated in measuring the impact of the overall environmental, health and related socio-economic impacts under a 'without project' scenario, it was not possible to conduct a traditional economic or financial cost-benefit analysis for the Project. Nonetheless, benefits to both the local and global environment and human health that would accrue by reducing the potential for PCBs to leach into the environment, though difficult to quantify, were understood to be significant and therefore, considered to exceed the demonstration Project's associated costs.

At the design stage, an estimate was made by FECO/CIO of the cost-effectiveness associated with operation of the TDU system under Project Component 3, with an estimated thermal desorption treatment cost of US $270/ton between end 2006 and mid-2009. The actual TDU treatment cost turned out to be higher than projected for two main reasons: one, the value of the RMB, the currency used for operating cost estimates incurred by the local contractor, dropped against the US dollar by the time the TDU treatment process began in December 2011, raising the cost of treatment/ton[19]; and two, due to the fact that the TDU was unstable and prone to frequent break-downs (see Section 2.2, Annex 2), only lower contaminated soil loads could be treated, while fixed costs did not alter as they were not dependent on actual treatment capacity. As a result, the average treatment cost increased to US $460/ton during December 2011-December 2012 period. For incineration of the highly-contaminated wastes recovered, at appraisal the costs of incineration were estimated to be US $2,000/ton, excluding transportation, based on European/North American data. Actual disposal costs, once again turned out to be higher than projected, totaling US$ 4,123/ton for the first 100 tons incinerated in 2011, and US$3,717/ton for the 669.4 tons incinerated in 2012. The key factors in this case pertain to the amount of soil available for treatment,

[19] In 2011, the RMB dropped to 6.4 against the US dollar. In comparison, its value in 2006 stood at 7.9 RMB to 1 US$, and at appraisal, it had been even higher, at 8.1 RMB for 1 US$.

given that fewer sites than projected required remediation and the volume of high-concentration PCB-contaminated waste was lower than had been estimated, and the high proportion of fixed costs.

The average cost per Project site of US$ 230,000 was also much higher than projected, due to broad variations in costs per site and ton (see Annex 3). These findings are all indicative of the challenges posed by the particularities of China's PCB problem where site characteristics are not uniform but rather, diverse: some sites were easily accessed while others required significant effort and cost to access, and some contained virtually no contaminated materials but nevertheless incurred significant costs to access. Assessing the average cost/ton clean-up is therefore, not a good indicator of efficiency. Comparison with PCB project results in other countries also does not yield useful comparative data. For example, the Moldova POPs Stockpiles Management and Destruction Project reported an average cost/ton eliminated of US $4,183/ton. However, the characterization of the PCB problem was vastly different in Moldova, which allowed clean-up to be addressed in a much more consolidated manner, something which the particularities of China's temporary PCB storage system did not allow. This heralds an important lesson regarding cost considerations that will necessarily have to be taken into account as China rolls out its national replication program.

An incremental cost analysis was conducted at the time of preparation (see Annex 3) and demonstrated, to the satisfaction of the GEF, that the demonstration Project, compared to the "without project" scenario, would be an efficient means by which to assist the government of China to fulfill its obligation under the Stockholm Convention to better manage its PCB baseline data, enhance its institutional and policy framework for PCB management and develop the technical know-how and tools to handle, treat and dispose of PCBs in an environmentally sound manner. Annex 3 examines efficiency with respect to the incremental costs provided in greater detail. The baseline scenario the Project faced invoked the potential for the release of significant quantities of PCBs into the environment and of scattered, ad hoc national capacity with which to address the problem. The positive results generated by the Project at the policy and technical levels are considered transferable within the context of a funded PCB national replication program strategy that promotes use of Project inputs as an efficient way to scale-up national action on PCB management. While the Project is considered overall to have made efficient use of the funds approved, given that the replication program and the financing strategy have not yet been operationalized nationwide, the potential for further efficiency of Project inputs in support of China's national PCB management objectives cannot be assessed. For this reason, the efficiency outcome is rated Moderately Satisfactory.

3.4 Justification of Overall Outcome Rating

Rating: Moderately Satisfactory

The Project achieved its GEO. Environmentally sound and cost-effective policies, procedures and techniques for safely managing and disposing of China's unique temporarily stored PCBs and associated PCB-contaminated wastes were identified and successfully demonstrated. Institutional capacity was strengthened, which enabled the development of targeted policy and regulatory arrangements for the long-term control of PCBs within the context of broader national chemicals management objectives. The Project's concept and design was, and remains, highly relevant to China's obligations under the Stockholm Convention and to its national priorities with respect to pollution and hazardous waste management and environmental protection, as expressed in the 12th FYP. Project results were overall achieved in a cost-effective manner. It is clear that overall, the Project has generated value however, it is not possible to overlook the substantial delays experienced during implementation, which ultimately pushed back Project completion by 2.5 years. Nor is it possible to ignore the fact that the long-term sustainability objectives inherent within the Project's design cannot proceed in the absence of an endorsed

and active short-term PCB national replication action plan supported by a sustainable financing structure. Based on these factors, the overall outcome rating is Moderately Satisfactory.

3.5 Overarching Themes, Other Outcomes and Impacts

(a) Poverty Impacts, Gender Aspects, and Social Development

n/a.

(b) Institutional Change/Strengthening

As a result of Project implementation, capacity was built and strengthened at several levels. At the level of government, capacity within FECO/CIO, the PIU and the Zhejiang EPB was strengthened with respect to technical aspects associated with the development of regulations and legislation in conformity of Stockholm Convention obligations and provincial/national environmental concerns. Implementation of the Project also strengthened FECO/CIO coordination capacity with respect to other ministries within the NLG, with provincial government agencies, and through partnership with various academic and scientific institutions that generated valuable research, all of which can now positively contribute to replication of a PCB management strategy at the national level. The same can be said to be the case for the Zhejiang EPB at the provincial level, which has become a knowledge center that other provinces, in future, can consult. Capacity was also necessarily developed with Project partners at DADI and the Shenyang Center. Overall, results achieved were internalized by Project partners at all levels, such that they can be drawn upon in future, as required.

In addition, from the perspective of administrative management, capacity in both the PIU and FECO/CIO was enhanced with regard to financial management and procurement procedures. It is also clear that public awareness was enhanced during the course of the Project's implementation, and that the general population now understands the health and environmental risks that exposure to PCBs and PCB waste pose. Given the unique temporary storage means adopted in China and the poor record-keeping associated with the temporary storage, such awareness is key.

(c) Other Unintended Outcomes and Impacts (*positive or negative, if any*)

n/a.

3.6 Summary of Findings of Beneficiary Survey and/or Stakeholder Workshops

In December 2012, two National Dissemination and Training Workshops for the PCB Management and Disposal Demonstration Project in China were held in Hangzhou, Zhejiang Province, and in Liaoning at the Shenyang Center. The workshops objective was to disseminate lessons learned and regulatory, technical, and managerial experiences gained through implementation of the Project, and to seek perspectives from a broader audience regarding how PCB management and disposal follow-up actions can best be implemented nationwide. Over 85 individuals from 24 EPBs participated in the workshops and presentations were made by FECO/CIO, Zhejiang PIU, Shenyang Center, DADI, Qinghua University and the Chinese Research Academy of Environmental Sciences.

4. Assessment of Risk to Development Outcome

Rating: Moderate

The risk to development outcomes is rated as moderate. Although Project outputs are considered sustainable in the long-run, the sustainability of outcomes, namely the replication of an effective and sustainable PCB management and disposal program at the national level, may face risks. In particular, scale-up to the national level may be hindered by internal or political issues faced by MEP, the agency tasked with implementation of the Stockholm Convention, and financial considerations.

The results achieved by the Project with respect to mitigation of environmental and health concerns associated with PCB wastes are positive, particularly at the level of Zhejiang Province. Public knowledge regarding the environmental and human health risks associated with PCBs, in general, and interference with PCB burial sites has been enhanced. The regulatory and legislative work concluded to date, which supports PCB management and disposal in accordance with Stockholm Convention guidelines lays the foundation for future efforts. Still, it will be important to stay the course in order to ensure that national PCB regulations are effectively captured within the broader chemical substances regulations currently under development. So too does the analysis contained in the financing study that clearly demonstrates the cost-effectiveness that can be gained by building upon the results of the demonstration Project and using its inputs in replicating the strategy nationwide. In addition, the dialogue opened with EPBs from other provinces prior to Project completion is an important step with respect to engaging stakeholders and building consensus and support for replication.

In order to sustain the impact of the PCB management and disposal achieved in China to date, it will be important:

- to secure endorsement of the short-term PCB national replication action plan in a timely manner;
- to act on the recommendations contained in the financing study to solicit support at the government (national and provincial) and private sector enterprise levels to secure the financing necessary;
- to facilitate access to Project results and inputs (i.e. the TDU) more broadly.

5. Assessment of Bank and Borrower Performance

5.1 Bank

(a) Bank Performance in Ensuring Quality at Entry

Rating: Moderately Satisfactory

Bank performance during the Project's design phase is considered to have been moderately satisfactory. The Project's objective supported what was, and what remains, a conviction on the part of the Chinese Government to protect public health and the environment, as well as the global commons, witnessed by China's active participation in the development of the Stockholm Convention. Furthermore, the Project's goals were clearly tied to several of the country's NIP priority components including, strengthening institutional readiness, enhancing POPs inventories, introducing best available and best environmental practice technologies to address waste disposal and contaminated site remediation, and identifying means of financing replication of targeted action plans (see Table 2-3, Annex 2).

Relevant stakeholders including, government at the national and provincial levels, the private sector, academia, international and national technical experts and local communities were involved in the design process. Such dialogue was especially valuable given the particular challenges that were faced in designing a Project that would be able to effectively address China's unique PCB sector particularly given the lack of certainty with respect to the location of contaminated sites and the volume of PCB wastes that would ultimately need to be addressed. In this regard, the internalization of capacity developed, and data generated, by the CPTF and Italian POPs TF projects helped design a robust framework that balanced the difficulty in quantifying impact with certainty.

As aforementioned, two related issues would have benefited from more rigorous attention at entry - the single sourcing of the Project contractors and the issue of licensing for the handling and treatment of PCBs and associated PCB wastes – both of which contributed to delay implementation of Components 3 and 4 and were key to the Project being downgraded to MU in 2010. These potential issues were likely unforeseen within the context of the overall risk analysis that was undertaken at entry, particularly since certification was provided for the Project contractors by the relevant Ministry. Nevertheless, given the vital role these entities were to play in implementation, there should have been greater attention paid to the potential risks associated with the roles, responsibilities and qualifications of such key Project partners. Taking into consideration the significant problems the Project would face as a result of these issues, and weighing the otherwise rigorous preparation process undertaken, Bank performance in ensuring quality at entry is rated Moderately Satisfactory.

(b) Quality of Supervision

Rating: Moderately Satisfactory

For the bulk of the Project's implementation, the Bank team provided Government and other Project counterparts with consistent, timely and best available policy and technical advice, including guidance on financial management, procurement and environmental and social safeguard issues, through fairly regular supervision missions, as evidenced by thorough aide memoires. As the aide memoires demonstrate, the Bank team maintained a constructive dialogue with FECO/CIO and the Zhejiang PIU to address the various complex implementation issues that arose. Specific FM and procurement training was provided for FECO/CIO and PIU staff in order to ensure that the Project's fiduciary and procurement requirements were respected.

Given the risky nature of the clean-up, remediation and disposal work to be undertaken, the active involvement of safeguard specialists ensured that environmental management concerns and stakeholder voices were respected throughout implementation, where required. Site visits were undertaken to ensure compliance with safeguard policies and community and worker safety, and to verify physical works and remediation achievements. This oversight support contributed to the Project closing without any incidents being reported. The quality of supervision over the full implementation period did suffer some difficulties. The quality of supervision is consequently rated Moderately Satisfactory for the reasons cited below:

i) Despite the challenges the Project was facing, in 2009 as noted above, Bank supervision appears to have waned for an 18-month period until mid-2010. Although the MTR was completed by the Project's Chief Technical Advisor (CTA) during this period, no ISR ratings or aide memoires are on file to record supervision of implementation efforts or progress made.

ii) The turning point that brought Bank supervision back on track occurred in 2010 when management proposed the application of a new approach for implementation support. Both Bank supervision and the accuracy of ratings improved, as IP and GEO ratings were downgraded to 'MU' to reflect the magnitude of the concerns that had been raised by past supervision missions, as well as in the MTR.

iii) The importance of the new approach for implementation support cannot be overlooked in terms of the contribution that it made in guiding the Project to a positive conclusion: focused supervision increased, detailed reporting was recorded through aide memoires, ISRs and regular video-conference minutes, and three time-bound restructuring extensions, carefully structured to ensure that milestone goals were being met, were processed. The renewed energy infused into the Bank's supervision efforts from 2010 onwards raised the quality of supervision back up, which justifies the rating of Moderately Satisfactory.

(c) Justification of Rating for Overall Bank Performance

Rating: Moderately Satisfactory

Given the Moderately Satisfactory ratings for both quality at entry and supervision, the overall Bank Performance rating is Moderately Satisfactory.

5.2 Borrower
(a) Government Performance

Rating: Satisfactory

Government performance, rated across the spectrum of the Project's full implementation is considered to have been Satisfactory. The Government was and remains a strong advocate for action in support of the Stockholm Convention, demonstrated by the fact that Project results served to inform the 12th FYP. Agencies involved through the NLG and at the provincial level through the provincial leading group, all played a role, to varying degrees, in ensuring the development of comprehensive policy frameworks at the national and provincial levels, advancing a diverse national capacity base to address the issue into the future, and promoting awareness about the importance of sustainable hazardous waste management.

The Project benefited from political will and commitment, witnessed by total counterpart funding commitments of US $13.7 million, from both the national and provincial Governments, which contributed to national and provincial Project team operations, to the development of a sound framework of policies, regulations and standards, as well as to the design of the national replication program and its initial operationalization efforts. Given the evident support generated for this Project, the one reproach that may be levied with respect to Government performance centers on the lack of clarity that surrounded the issue of licensing for the handling of PCB wastes. It seems clear, in retrospect, that a more open and constructive dialogue, particularly within MEP between the FECO/CIO and the Pollution Control Department (PCD), could have resolved the issue far earlier than was done, which would have eliminated some of the delays experienced. Overall however, performance was Satisfactory.

(b) Implementing Agency or Agencies Performance

Rating: Moderately Satisfactory

The technical complexity of the Project was reflected in the complex management structure adopted to oversee the various aspects of its implementation. The MEP, the agency that oversees implementation of the Stockholm Convention, as well as other multilateral environmental agreements in China, established a PCB Project team in FECO/CIO to manage and monitor all central level Project operations. FECO/CIO was well acquainted with Bank operations and procedures, given previous experience managing Bank-implemented Montreal Protocol Multilateral Fund-funded projects, as well as other GEF-funded initiatives. To address technical issues or concerns, FECO/CIO recruited a CTA, a National Technical Advisor (NTA) and other technical experts who contributed valuable input to Project operations. Overall, the performance of the FECO/CIO team was satisfactory with respect to daily management and partner/stakeholder liaison. However, issues related to the licensing of the project contractors detracted from the team's overall performance, as has the lack of confirmation of uptake of a comprehensive short-term nationwide replication action plan based on Project results and experiences.

Unlike the FECO/CIO Project management team, the Zhejiang PIU had no experience in working with Bank operations or in managing a financially and technically complex Project province-wide. The Zhejiang EPB committed an important level of financing and technically qualified staff to ensure implementation success and the PIU performed a good job in developing the provincial policy, regulations and standards required to sustain the eventual elimination of PCBs, including building Project

results into a Clean Soil Action Plan for Zhejiang Province. However, the PIU struggled at times under the various burdens of Project implementation, particularly as the procurement processes under Component 3 became increasingly complex.

(c) Justification of Rating for Overall Borrower Performance

Rating: Moderately Satisfactory

Overall, Borrower performance is considered to have been moderately satisfactory. Commitment to achieving the GEO, in accordance with obligations under the Stockholm Convention, was manifested throughout Project implementation and FECO/CIO and PIU teams were committed to managing and monitoring for results, despite certain difficulties with respect to management capacity, as noted above. However, persistent issues with regard to intra-ministerial communication during implementation and importantly, the fact that there was no indication that the Project's national replication action plan and its associated financing study, considered the tools by which to replicate and sustain results and experiences nationwide, were officially adopted and in the process of being operationalized at the time of Project closure, results in a rating of Moderately Satisfactory.

6. Lessons Learned

(1) The principle behind the demonstration project modality is that it allows a client to test initiatives or the viability of processes in sectors in which mature technologies have not yet been actively deployed, diffused or transferred, and where lessons learned can be of value for future activities, nationally or globally. Given its nature, the demonstration modality allows for a more flexible, testing approach to guide implementation. Two lessons emerge:

a. At the Project design stage, in situations where baseline data such as the number of sites contaminated, the extent of site specific contamination and the level of clean-up required, is either difficult to determine or simply not known, outcome indicators developed should err towards the conservative, to avoid setting overly ambitious targets that may require down-grading through time-consuming restructuring in future. As the Project learned firsthand, even where site locations were confirmed through interviews and geo-radar testing prior to implementation, it was possible during site remediation to discover that PCB coffins had disappeared (for example, site #43).

b. Inherent within the demonstration concept is the understanding that lessons learned will be applied more broadly and ensure sustainability of the demonstration investment made. It is therefore, key to begin work early on a clear plan for immediate next steps involved in the application of a national PCB replication program, endorsed by relevant government and private sector partners, and ensure the ongoing use of high-value project inputs, such as the TDU. In this respect, roll-out of national replication efforts should figure as a key outcome indicator as opposed to an intermediate outcome indicator.

(2) Effective PCB management in accordance with Stockholm Convention guidelines involves treatment and disposal using technology that meets best available techniques and best environmental practices (BAT/BEP). Access to, or use of such equipment is costly. When investing in such technology, thorough and comprehensive prior assessment must be undertaken on the proposed alternatives. For the purposes of the Project, thorough analysis regarding the use of the TDU was undertaken at preparation however, the costs associated with TDU treatment turned out to be higher than originally planned. Ongoing use of the TDU at a nationwide scale is projected within the context of the financing mechanism study as the most cost efficient option for replication in other provinces and, is likely the best option in countries the size of China, although where faced with small sites in remote locations in different regions, the added costs of

transportation are likely to reduce cost efficiency. Only once the national replication program is fully implemented will this be known.

(3) Retrofitting one national service provider to a level that meets international standards while national standards remain less stringent does not incentivize use of the upgraded facility. These implications need to be considered at the outset of a Project's preparation. The Shenyang Center, having retrofitted its incinerator to meet the Stockholm Convention's stringent BAT/BEP standards is now in a position to dispose of PCB in an environmentally sound manner, in line with international specifications. Yet Chinese regulations remain less stringent. Shenyang's services are now more expensive, placing it in a less competitive position compared to other facilities in the country. The adoption of stricter standards in Beijing, and the fact that the Project has supported the design of improved national environmental quality standards that will serve to inform a national regulation governing chemical substances, including PCBs, can serve to even the playing field. Nevertheless, a sustained effort, ideally through the implementation of a comprehensive, and properly funded national replication plan, will be required to benefit from the investment.

(4) In projects where legal dispensation is required to carry out work (licensing/permitting), it is vital that the relevant legal requirements be clearly understood and the centers of authorization engaged from the outset of a project.

(5) Bank supervision teams must ensure that local project partners possess the knowledge and capacity required to manage complex procurement actions effectively in order to avoid situations such as when modifications were made to contracts in the absence of prior Bank approval, resulting in delayed completion of works at one site and determination of ineligible expenditures at another.

(6) Projects that require extensive technical management on the part of project implementation units and national contractors to allow, for example, for the preparation and review of site specific remediation plans, must include specific training to build such capacity so that smooth and efficient processing ensues.

7. Comments on Issues Raised by Borrower/Implementing Agencies/Partners

(a) Borrower/implementing agencies

FECO/CIO and Zhejiang PIU prepared a draft Project Completion Report dated March 2013. In evaluating Project design and achievements, the report indicates satisfaction with Project outcomes, based on the fact that of the 25 outputs called for under the Project's 6 Components, 23 were fully completed. The two outputs where completion results were rated less than fully completed centered on monitoring and evaluation. The impact that the Project's implementation had with respect to raising consciousness with regard to PCB management issues at all levels of society is considered to be key to the sustainability of efforts. A summary of Recipient's completion report can be found in Annex 7.

The draft ICR was shared with FECO/CIO, their comments incorporated in the final report and concurrence received on June 24, 2013.

(b) Cofinanciers

1) Government of Italy

The Government of Italy did not have the opportunity to provide detailed comments, but a list of the key technical reports prepared by, and under the supervision of, the Chief Technical Advisor (CTA) position it funded were provided, as follows:

1. Technical guideline on identification and labeling of PCB equipment
2. Review of available technologies for PCB decontamination and disposal in China
3. Comparative analysis of thermal desorption processes for PCB contaminated soil
4. Review of available technologies for PCB decontamination and disposal in China
5. Comments and Recommendations on the National Regulation on PCB Management and Disposal;
6. Plan for the trial runs of the PCBs incineration at the Xinmin, Shenyang hazardous waste disposal facility in China, including DE testing and monitoring of dioxin like PCBs.
7. Report on the Trial runs of PCBs incineration at the Xinmin, Shenyang hazardous waste disposal facility in China
8. Report on the Proof of Performance test of the TDU facility in Jiande, Zhejiang.
9. Risk Assessment for the TDU plant in Jiande. Atmospheric emissions of PCBs and PCDD/Fs
10. Technical specifications for the monitoring and cleanup of sites 8 (Shaoxing, Zhuji), 18 (Cixi, Meishang), 22 (Cenling village, Zhongtai county, Hangzhou Yuhang), 28 (Chun'an, Pai Ling Bei Lu, Hangzhou), 37 (Sanmen, Taizhou), 43 (Huzhou, Deqing).

2) United States Environmental Protection Agency (US EPA)

The US EPA also did not have the opportunity to provide detailed comments, but expressed their appreciation for 'the opportunity to work with the World Bank and many of the Chinese agencies on this project,' and congratulated the Government on its completion.

(c) Other partners and stakeholders

N/A

Annex 1. Project Costs and Financing

(a) Project Cost by Component (in USD Million equivalent)

Components	Appraisal Estimate (USD millions)	Actual/Latest Estimate (USD millions)	Percentage of Appraisal
Institutional Strengthening	**1.945**	**1.404**	**72.2%**
Development of a Policy Framework for PCB Management and Disposal	**0.810**	**0.409**	**50.5%**
PCB Management in the Zhejiang Province	**15.016**	**15.735**	**104.8%**
Disposal of Highly Contaminated PCB Wastes in Liaoning Province	**13.609**	**12.455**	**91.5%**
Project Monitoring and Evaluation	**0.127**	**0.034**	**26.7%**
Design of a National Replication Program	**3.29**	**2.80**	**85.1%**
Contingency	**0.300**	**0.00**	
Total Baseline Cost	**35.097**	**32.843**	**93.6%**
Physical Contingencies	0.00	0.00	
Price Contingencies	0.00	0.00	
Total Project Costs	**35.097**	**32.843**	**93.6%**
Project Preparation Facility (PPF)	0.00	0.00	
Front-end fee IBRD	0.00	0.00	
Total Financing Required	**35.097**	**32.843**	**93.6%**

(b) Financing

Source of Funds	Type of Cofinancing	Appraisal Estimate (USD millions)	Actual/Latest Estimate (USD millions)	Percentage of Appraisal
Borrower		14.733	13.838	93.9%
Global Environment Facility (GEF)		18.34	17.65	96.2%
Bilateral Agencies (Government of Italy, US EPA, Government of Japan)		2.024	1.355	66.9%
Total Financing		**35.097**	**32.843**	**93.6%**

Annex 2. Outputs by Component

The Project was consistent with the strategic priorities identified in the GEF 3 (2002-2006) POPs Focal Area Strategy and the objectives of the corresponding draft GEF Operational Program for Reducing and Eliminating Releases of Persistent Organic Pollutants (OP14), which sought to provide assistance, on the basis of incremental costs, to developing countries for:

a) targeted (foundational) capacity building including, awareness-raising among various stakeholders and management and dissemination of information on integrated management of POPs, including best management practices;
b) implementation of policy and regulatory reforms, as well as priority on-the-ground investments; and
c) demonstration of innovative and cost-effective technologies and alternative practices, including the management and phase-out of PCBs.[20]

In ratifying the Stockholm Convention, China officially committed to the obligation under Part II, Annex A, to take measures to manage and dispose of PCBs and PCB-containing materials in accordance with the Convention's requirements. From an over-arching perspective, this commitment laid the foundation for future results generated during the demonstration Project to be applied in the country's remaining provinces in the future, as outlined in Project Component 6, National Replication Program.

Prior CPTF and Italian POPs TF-supported activities helped prioritize Project components related to institutional arrangements, policy options, and available treatment and disposal technology choices. The CPTF funded a series of national and provincial-level awareness-raising workshops, along with a capacity building project that supported the initiation of a PCB management training program covering, inter alia, safe site assessment, establishment of safe storage sites, assessment of PCB destruction technologies, environmental sampling and worker safety, all of which formed the genesis for the development of the more extensive training supported by the Project. The CPTF also funded a toxicity study of POPs on women and children, based on biological and environmental sampling in Zhejiang Province that confirmed moderately high levels of exposure to PCBs. The Italian POPs TF supported the development of the key PCB inventory methodology that was used in Zhejiang and Liaoning Provinces, as well as the preparation of the draft national strategy on PCB reduction and disposal.

Component 1, Institutional strengthening: Activities undertaken under this component helped build the capacity necessary to bring the Project to successful completion and internalize knowledge and skills regarding PCB management and disposal that will serve to underpin China's ongoing work in this sector. Funding supported knowledge-building within FECO/CIO, the arm of MEP that manages all international projects. The FECO/CIO PCB Project Team was responsible for the overall planning and supervision of Project activities. A key role involved liaison within the Ministry of Environmental Protection (MEP), the agency in China tasked with implementation of the Stockholm Convention, as well as with key NLG partners, the Ministry of Finance (MOF) and the State Electricity Regulatory Commission (SERC). Coordination of national–level activities related to the development of regulations and quality standards for PCB management and disposal, development of a funding mechanism for co-financing future PCB management and disposal in China, and public awareness and outreach fell under the FECO/CIO PCB Project Team's purview.

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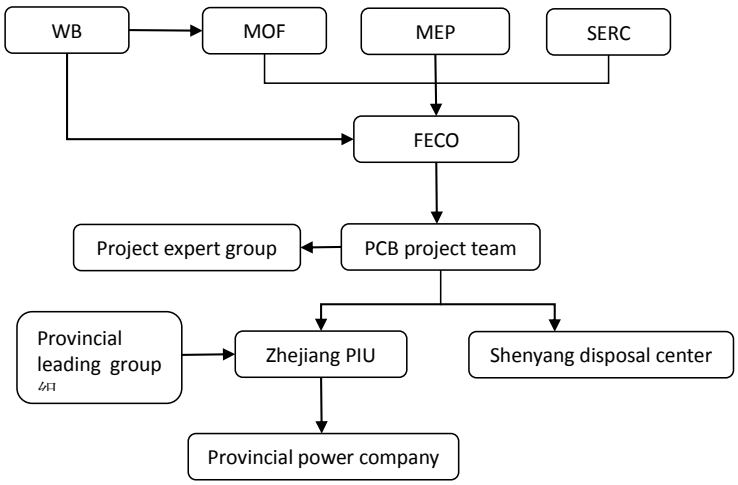
[20] GEF/C.21/Inf.11, April 17, 2003; Strategic Business Planning: Directions and Targets; http://www.thegef.org/gef/sites/thegef.org/files/documents/C21.Inf_.11.pdf

The Project Implementation Unit (PIU) established in Zhejiang Province was staffed by individuals from the Zhejiang EPB, which helped build consensus, cooperation and dialogue amongst provincial-level stakeholders. The PIU was responsible for provincial level Project supervision including, administrative and technical support services, and liaison with the provincial level leading group composed of the government general office, the department of environmental protection, the financial bureau, the development and reform commission and the provincial level power company, as well as with the principal Project contractor, DADI.



Relations between the Project's national and provincial management teams were positive and very constructive. The only perceived drawback involved the number of levels through which information had to pass within the Project's overall management structure. A case in point involved the lack of clarity surrounding the regulatory requirements governing the handling of PCB wastes, an issue controlled by the Pollution Control Department (PCD) in MEP, which caused confusion and delays that, for a time, compromised implementation under Component 3 (see below, overview of Components 3 and 4).

A total of 362 technical and policy staff from national and provincial authorities including, the Zhejiang Solid Waste Management Center and PIU, FECO/CIO, the local EPBs and power companies received technical PCB management training covering site monitoring, risk assessment, PCB storage, treatment and disposal, all of which were key to the successful completion of the Project's other components.

Table 2-1: Training Modules Completed

Training Module No.	Training Describtion	Dates of training workshops	Training Topics	Location	Trainers (Affiliation)	Name of Trainees	Training Method	No. of Participants
1	**PCB management training for PCB managers (Phase I)(organized by PIU)**	19, Jan, 2010	The key objective of this workshop is to strengthen control of PCB pollution risks, and to improve the integrated management knowledge and technical capabilities for administrative staff.	Zhejiang	Zhang Yu, Luo Yu (Zhejiang EPD,ZJPIU)	People from CIO, Zhejiang PIU,Zhejiang Provincial Development and Reform Commission, Zhejiang Provincial Department of Finance, Zhejiang Provincial Department of Land and Resources, Zhejiang Environmental Protection Department, Local Environmental Protection Bureau, Zhejiang Electric Power Company, Local Electric Power Sub-Company.	Discussion	39 people join
2	**Training Workshop on PCBs Monitoring and Risk Assessment (organized by CIO)**	21-25,Aug. 2006	The key objective of this workshop is to invite USEPA Region 9 to provide technical training for local management and technical staff on site characterization, PCBs sampling and analysis, risk assessment, site cleanup planning, and related health and safety issues, for the implementation of the PCB Management and Disposal Demonstration Project.	Zhejiang	Vance Fong, John M. Gilbert,Lida Tan (USEPA)	People from WB, Zhejiang EPB, Zhejiang PIU, Zhejiang Environmental Monitoring Center, Dadi Company, Zhejiang Power Company, Other Provincial Environmental Monitoring Centers (Jiangsu, Anhui, Shanghai, jiangxi, Shandong and Fujian), Environmental Science Research and Design Institute of Zhejiang Province, Other provincial Environmental Science Research and Design Institute (Jiangsu, Anhui, Shanghai, jiangxi, Shandong and Fujian), Liaoning Environmental Monitoring Center, Ningbo Environmental Monitoring Station,	Lectures	54 people join
3	**Thermal Desorption Facility Suppliers Technical Workshop (organized by CIO)**	27-29,Nov.2006	The key objective of this workshop is to survey on and evaluation the main thermal desorption technology and facility and identify the potential facility which is suitable for PCB Demo Project.	Zhejiang	ECC Corporation, Weston Solutions, Inc., RLC Technologies, Inc. and Prantner GmbH Verfahrenstechnik	People from WB,CIO, Zhejiang PIU, Dadi company, ECC Corporation, Weston Solutions, Inc. RLC Technologies, Inc. Prantner GmbH Verfahrenstechnik	Discussion	22 people join
4	**Training on PCB site monitoring (organized by PIU)**	16-18,Apr.2007	Water/Air Sample Collection and Analysis Methods;Cleanup and Examples Site Cleanup Levels,Laboratory and Field Analytical methods,Geophysical Method, Soil Sampling During Cleanup, Confirmation Sampling and Analysis,Thermal desorption and incineration Technic.	Zhejiang	Mr. Vance Fong, Mr.John M. Gilbert (USEPA)	The people from provincial and local power sector and environment monitoring station,solid waste management center, Hangzhou Dadi Co.Ltd, the experts from Vitnam.	Lectures	56 people join
5	**Expert Workshop on PCBs Storage and Disposal (organized by CIO)**	19-21,Apr.2007	Training on PCBs storage and disposal, permitting, inspection and supervision of hazardous waste treatment. Experience sharing by USEPA for the enforcement of permitting system on hazardous waste treatment in China.	Beijing	Mr. Vance Fong, Mr. John M. Gilbert, Mr. Daniel Stralka, Mr. Craig Benson (USEPA)	People from SEPA, 30 provicial EPBs, Shenyang Institute of Environmental Sciences and 20 national enterprises.	Lectures	122 people join
6	**Expert Workshop on PCBs treatment and disposal(organized by CIO)**	26-30,May.2008	This workshop is to revise, improve and define the PCBs site cleanup technical guidance, trial burn plan of Shenyang incinerator, the technical specification of thermal desorption facility with the consultation and assistance from the experts of USEPA Region 9.	Beijing,Zhejiang	Ms.Michelle Rogow, Ms.Lida Tan (USEPA)	The people from provincial and local power sector and environment monitoring station,solid waste management center, Hangzhou Dadi Co.Ltd, CTA,NTA and WB	Discussion	28 people join
7	**Training on PCBs Site Cleanup and remediation of PCB contaminated sites (organized by PIU)**	7-9, Jul, 2010	The key objective of this workshop is to provide comprehensive guidance to PCBs site cleanup and contaminated site remediation work, and to improve the quality of work, awareness of self-protection, and ability of emergency response for technical staff	Zhejiang	Ms.Federica Belloro, Ms.Marina Accornero, Mr.Enrico Moruzzi (Gov't of Italy)	People from WB,CIO, Zhejiang PIU, Dadi company.	Lectures	41 people join
8	**The National Dissemination & Training Workshop for PCB Management and Disposal Demonstration Project in China**	6-7&13-14, Dec, 2012	The major objectives of this workshop are to disseminate regulatory, technical, and managerial experiences obtained in the demonstration project, and also to seek perspectives from broader range of audiences for following PCB management and disposal actions nationwide.	Hangzhou, Shenyang	Wang Kaixiang, Zhang Yu, Chen Hui, Wu Qimo, Wu Changmin, Sheng Shouxiang, Liu Yuqiang (FECO, PIU, Shenyang Center, Dadi, Qinghua Univ., Chinese Research Academy of Environmental Sciences)	24 provicial EPBs	Lectures	88 people joins

As indicated in Table 2-1 above, the training sessions were conducted in collaboration with experts from the United States Environmental Protection Agency (US EPA), as well as other international and national experts. The Project also benefited from the involvement of international and national technical advisors

and experts who assisted in the development of PCB legislation and standards, in the drafting a plan for PCB contaminated site clean-up in the province and, in overall technical direction and guidance, as well as from the involvement of an expert group convened to assist the Zhejiang PIU in drafting a plan for PCB contaminated site clean-up in the province.

Component 2, Development of a Policy Framework for PCB Management and Disposal: The Project successfully advanced the development of an over-arching policy framework for PCB management and disposal at both the provincial and national levels. Effective coordination and partnerships between various government ministries, experts and academia are seen to have facilitated the elaboration of these policy-related Project activities. At the national level, the framework includes a series of regulations made up of eight technical standards/guidelines and six policy regulations that address the various aspects of PCB management including, identification, inventory, risk assessment, emergency response, extraction, handling, transportation, monitoring, disposal and incineration (Table 2-2). During implementation, the decision was taken to not develop stand-alone national PCB control standards but rather, to embed national PCB pollution control and environmental quality standards into a broader national regulatory framework for all chemical substances, now under preparation by MEP. This approach is considered reasonable and likely to yield good long-term synergies. At the provincial level, three PCB contamination management regulations were enacted including, the Zhejiang Province PCB Contamination Environmental Prevention and Control Regulation, the Zhejiang Province Emergency Plan for Sudden PCB Contamination Incidents, and the Zhejiang Province PCB Contaminated Sites Clean-up Project Acceptance Management Regulation.

Table 2-2: National technical standards/guidelines

No.	Title of outputs	Completion date	Sub-contractor
1	”PCBs waste incineration disposal technical guideline”	2008.04	Tsinghua Univ.
2	”PCBs waste long distance transportation technical guideline”	2008.04	
3	”PCBs waste temporary storage technical guideline”	2008.04	
4	”PCBs Contaminated Soil Thermal Desorption Treatment Technical Guideline”	2008.08	
5	“China PCBs Inventory Investigation Guideline”	2005.01	
6	”PCBs Burial Site Environmental Monitoring Technical Guideline”	2008.08	
7	China PCBs Reduction and Disposal Preliminary Strategy”	2006.12	Beijing Normal Univ.
8	“PCBs Emission Standard Prior Research Report”	2010.03	
9	PCBs and Wastes Management and Disposal Regulation	2009.01	North China Electric Power Univ.
10	PCBs Waste Cleanup Technical Guideline	2008.07	Shenyang Academy of Environmental Sciences
11	PCBs Containing Power Equipment Labeling and Management Rules	2008.02	
12	PCBs Incineration Disposal Operation Technical Regulation	2009.03	Environmental Protection Hazardous Waste Disposal Engineering Technology(Shenyang) Center
13	<Framework of Risk-based System for PCB Management and Disposal>	2010.04	CTA
14	<Technical guideline on identification and labeling of PCB equipment>	2008.09	CTA
15	PCBs Equipment and Waste Environmental Management Technical Guidance Manual(First Draft)	2012.12	Chinese Academy of Environmental Sciences

China’s 12th Five Year Plan emphasizes, inter alia, decreasing use of major pollutants and strengthening economic and environmental governance, in part as a result of the Project’s implementation. Project

results also contribute positively to China's commitments under the Stockholm Convention by directly supporting achievement of NIP priorities including, development of effective policies, procedures, capacity and techniques for safely managing and disposing of stored PCBs and associated PCB-contaminated wastes.

Table 2-3: Project component support for NIP objectives

China NIP general objectives	Relevant Project components
(1) Formulate and improve the policies and regulations required for Convention implementation and strengthen institutional building;	Component 1: Institutional Strengthening Component 2: Development of a policy framework for PCB management and disposal;
(2) Introduce and develop alternatives/alternative technologies, give an impetus to their industrialization, and introduce and develop BAT/BEP, waste disposal technologies and contaminated site remediation technologies;	Component 3: PCB Management in the Zhejiang Province Component 4: disposal of highly-contaminated PCB wastes in the Liaoning Province;
(3) Eliminate production, use, import and export of chlordane, mirex and DDT;	n/a
(4) Investigate and update inventories of POPs releases from unintentional production and inventories of electrical equipment containing PCBs and POPs wastes;	Component 6: design of a national replication program
(5) Implement BAT/BEP to control Dioxin releases in key industries;	Component 4: disposal of highly-contaminated PCB wastes in the Liaoning Province
(6) Establish a financial mechanism so as to ensure the implementation of various action plans;	Component 6: design of a national replication program
(7) Carry out demonstration projects and replication programs; and	Project as a whole
(8) Strengthen capacity building and establish a long-term, effective mechanism to control POPs releases.	Component 1: Institutional Strengthening Component 3: PCB Management in the Zhejiang Province Component 4: disposal of highly-contaminated PCB wastes in the Liaoning Province; Component 6: design of a national replication program

The Project also funded the elaboration of a study to ascertain options for developing a funding mechanism to finance PCB management and disposal in China into the future, associated with the national replication program. At Project completion, an abstract of the Study was provided to the ICR team. The abstract indicates that the recommendations proposed, which outline 3 possible future funding scenarios, are based on a nationwide investigation in which 75 PCB equipment storage points housing 7,863 domestic and imported PCB electrical appliances, of which 400 online capacitors were identified in 20 provinces. The provinces are not indicated, nor are the potential sites in need of remediation. It further indicates that results and experiences gained during implementation of the demonstration Project allowed for costs associated the future management and disposal of both low concentration and high concentration PCBs to be assessed. Three management and disposal options are identified, ranging in cost from 1.138 billion Yuan to 610 million Yuan. The least cost option proposes third party use of the thermal desorption technology funded under the Project to dispose of the low concentration PCB wastes in all 20 provinces, and treatment of high concentration wastes at the Shenyang and Tianjin incinerators. Funding, it is explained, will emanate principally from Government and private enterprises according to a 4:6 ratio, with the Government contribution further being divided 6:4 between central and local governments. No background data is presented in the English-language abstract to support the assumptions and recommendations presented. Nor is there any analysis of how the cost considerations associated with the Project's implementation have been weighed and measured. This is worrisome given the diversity of PCB-contaminated sites encountered during the demonstration Project, the expectation that such diverse site characteristics may surface in other provinces, and the wide range of costs that such diversity was shown to engender in Zhejiang. While the abstract's least cost option relies internalizing the positive aspects of the Zhejiang demonstration and speaks to the potential for long-term sustainability of the GEF

investment, in the absence of access to the comprehensive study, it is impossible to gauge how realistic the assumptions presented may be.

The activities to be conducted under *Component 3* were designed to form the basis for the practical technical framework for cleaning-up PCB storage sites in Zhejiang, and would inform the design of the national replication program for further PCB elimination. Of the fifty-six (56) sites estimated as requiring clean-up at appraisal, a total of 35 sites were identified as contaminated using geo-radar (ground penetrating radar) technology, but only 16 sites were eventually cleaned, having been deemed contaminated and/or accessible (see Table 2-4).

Implementation of this component generated a number of delays, throughout the life of the Project. Many centered on the Project contractor, the Hangzhou Dadi Environmental Protection Co. Ltd. (DADI). DADI had been selected as a single source Project contractor for the recovery of PCB wastes, treatment of contaminated soils and decontamination of PCB-contaminated transformers at design stage. At the time of project preparation, a total of 300 hazardous waste disposal facilities were planned in China, but the Government indicated that only two were to be granted the right to handle PCBs, including that operated by DADI, which covered services for the mid-to southern China. This designation was based on the company's experience in waste management under the National Program for the Construction of Hazardous and Medical Waste Disposal issued by the State Council in 2003[21], its prior experience in cleaning-up PCB sites, and the expertise it had gained thanks to a decade's worth of Project-relevant technical training its staff had received from the German aid agency, GTZ. MEP confirmed at design stage that DADI would be granted an official license to handle PCB wastes, excluding final disposal of highly-contaminated PCB waste. The question of licensing would raise issues for much of the Project's implementation, not least of which was their being issued a license was one of the withdrawal conditions written into the GA.

The problem initially centered on the issue of ownership. It was understood at project preparation that the handling of PCB wastes, in accordance with the regulations *on Measures for Administration of Hazardous Waste (HW) Operation Permits* (2004), included collection, storage and disposal. What was not known and what did not surface until later, was that in addition, China's HW regulations stipulate that in order to obtain a license, the licensee must own and operate a PCB disposal facility. Because the TDU was purchased using Project funds, its ownership resided with the Government and could not be transferred to DADI. Therefore, DADI could not be issued a license, nor were they able to collect, transport store or treat PCBs or PCB-contaminated soil.

A number of extensive inter-ministerial consultations were organized to clarify the PCB-contaminated waste permitting process. Eventually, in 2010 the Project received clarification from the Pollution Control Department of MEP, the authority in charge of HW policies and regulations, that HW permitting regulations only require licensing for disposal of HW, and that PCB-contaminated soil was not considered a HW therefore, a license was not required for excavation and temporary storage of PCB wastes (i.e., clean-up of PCB contaminated sites). As such, it became clear that MEP issuing a license was not the solution and so, to satisfy the GA's withdrawal condition, it was proposed to have the provincial EPB approve the PCB clean-up plans, involving collection and storage of soil and capacitors, and that MEP, while not required by law, would issue a national level approval for DADI to operate the TDU for disposal purposes. In July 2010, the Zhejiang EPB reviewed and approved two site clean-up plans prepared by DADI and MEP issued an approval to operate the TDU facility on September 19, 2010, which coincided with the installation of the TDU.

[21] PAD, Section C, Sub-section 2, para 32, sub-para h., p. 24.

Procurement of the TDU and determination of a location for the TDU facility and storage site also faced difficulties. The Project indicated the intent, at design, to have a mobile TDU treat soil in situ, though it was acknowledged that a final decision regarding selection of a mobile or fixed TDU option would require preparation of a feasibility study, pending completion of the site characterization work and consideration of the Project's eventual national replication component needs.[22] Ultimately, the Project opted for a central TDU treatment location. Difficulties arose with the first location selection made due to local government reluctance to accept all PCB waste for the province within the locality, a concern that was supported by the local community. The TDU site and storage facility therefore, had to be changed during implementation. The issue was well-managed by the Zhejiang PIU, but resulted in delays due to the need to engage in new negotiations to identify another suitable location. With respect to the TDU itself, the initial bidding process, which closed in late October 2007, resulted in submission of only one bid. The bid was rejected by the Bank on the grounds that the financial requirement regarding registered capital had not been met, that the bid security provided did not meet the requirements in the bidding document issued, and that the pricing schedule did not tabulate.[23] It was noted at that time, that the bid price for the TDU was nearly twice that at appraisal. In order to attract more potential bidders, the Bank team suggested that the TDU be procured through ICB, with supplementary equipment procured locally. A re-bid by ICB was therefore initiated. The bidding, contracting, delivery and installation process would finally be completed by September 2010.

Once installed, the TDU, long-anticipated, immediately faced a host of technical problems including, an initial inability to achieve the environmental performance standards required under the Stockholm Convention which had been clearly specified in the contract, and difficulties in reaching a reasonable operating capacity due to frequent breakdowns. Resolution of these problems would take over a year, which resulted in the contract for the TDU's operation only being authorized in December 2011. In the interim, the TDU underwent more than 25 trial runs, as well as mini tests in order to secure the Proof of Performance (POP) test required to ensure that the process was reaching the specifications outlined in the bidding document and contract, and required under the Convention.[24] This situation affected not only the cost-effectiveness of operations, but also made for additional work on the part of all parties involved due to the need to establish individual contracts dependent on the actual number of tons of PCB waste treated and the associated fixed labor costs.

The issue of fixed costs also raised disagreement between Zhejiang PIU and the Bank team on the cost proposal submitted by DADI. Even once the POP test had been passed, it was clear that the TDU would never run at 100% capacity during the Project's lifetime, yet the clean-up plans and cost estimates submitted by DADI included fixed costs for labor based on a costing for continuous full-capacity TDU operation employing 47 staff. The Bank team considered this to be high given that the available soil was approximately 3-4 times less than could be processed by the TDU per month, and twice less than actual typical monthly processing capacity given the unstable equipment availability rates, yet the number of workers proposed remained the same. Compromise was finally met when DADI, the PIU and the Bank agreed that direct costs were dependent, and would be paid based on the actual amount of soil treated, and that the existing number of workers needed to be maintained in order to respect labor law/contractual implications, and equally importantly, to allow them to benefit from on-site training to ensure availability of trained staff once normal operation of the TDU resumed.

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22 PAD, Section D, para. 65, p.32.

23 See Aide Memoire, March 3-24, 2008 Mission, dated April 22, 2008.

24 The performance requirement specified in the bidding documents and the signed contract indicated the following: daily average of 231 - 531$\mu g/m^3$ vs. 10$\mu g/m^3$ for PCBs, and daily average of 1.58 - 2.34 I-TEQng/m^3 vs. 0.1 I-TEQng/m^3 for dioxin. Treated soil was expected to meet the following standard: 0.64 – 6.02mg/kg vs. 0.25 mg/kg.

Table 2-4: PCB-contaminated sites

No.	Site #	Site Name	Status	Remarks
1	21	Xiaoshan, Hangzhou	Cleanup completed	Capacitors and contaminated soil treated and disposed of.
2	42	Hangzhou, Glass Group Company	Cleanup completed	The capacitors transferred to Shenyang for incineration. No contaminated soil at site.
3	45	Jiaxing Fengzhi Co., Ltd, Jiaxing	Cleanup completed	The capacitors transferred to Shenyang for incineration. No contaminated soil at site.
4	24	Xin'an jiang transformer substation	Cleanup completed	Capacitors and contaminated soil treated and disposed of.
5	47	Formercapacitors pile area in Quzhou Fangcun	Cleanup completed	The contaminated soil treated by TDU. No capacitors found at site.
6	10	Yueqing, Wenzhou	Cleanup completed	The contaminated soil treated by TDU and the cave containing PCB waste closed. No capacitors at site.
7	25	Laoshushan, Jiande	Cleanup completed	The contaminated soil treated by TDU. No capacitors found at site.
8	7	Xinchang, Shaoxing	Cleanup completed	Capacitors and contaminated soil treated and disposed of.
9	36	Nanpu, Huzhou,	Cleanup completed	Capacitors and contaminated soil treated and disposed of.
10	32	Shizikou, Quzhou,	Cleanup completed	Capacitors and contaminated soil treated and disposed of.
11	46	Jiaxing Haiyan（Ganpu）	Cleanup completed	Capacitors and contaminated soil treated and disposed of.
12	18	Meishan, Cixi, Ningbo	Cleanup completed	Capacitors and contaminated soil treated and disposed of.
13	44	Pingyang Former capacitors pile area	Cleanup completed	The contaminated soil treated by TDU. No capacitors found at site.
14	37	Sanmen, Taizhou	Cleanup completed	The contaminated soil treated by TDU. No capacitors found at site.
15	28	Chun'an transformer station	Cleanup completed	Capacitors and contaminated soil treated and disposed of.
16	22	Yuhang, Hangzhou	Cleanup completed	Capacitors and contaminated soil treated and disposed of.
17	8	Zhuji, Shaoxing	No cleanup undertaken	PCB coffin/capacitors could not be found, and the monitoring result showed no pollution.
18	27	Wenchang, Chun'an	No cleanup undertaken	PCB coffin/capacitors could not be found, and the monitoring result showed no pollution.
19	35	Qingtian, Lishui	No cleanup undertaken	PCB coffin/capacitors could not be found, and the monitoring result showed no pollution.
20	6	Shenzhou, Shaoxing	No cleanup undertaken	The capacitors were stolen, and the monitoring result showed no pollution.
21	14	Ninghai, Ningbo	No cleanup undertaken	The capacitors were stolen, and the monitoring result showed no pollution.
22	16	Cixi, Ningbo	No cleanup undertaken	The capacitors were stolen, and the monitoring result showed no pollution.
23	30	Xiaoshun, Jinhua	No cleanup undertaken	The capacitors were removed before project, and the monitoring result showed no pollution.
24	9	Pingyang, Wenzhou	No cleanup undertaken	The capacitors were removed before project, and the monitoring result showed no pollution.
25	1	Eastern part of Shaoxing	No cleanup undertaken	The site had been cleaned up before project. No further monitoring necessary
26	38	Hangzhou Steel Corporation Steel Group	No cleanup undertaken	The site was cleaned before project start-up. Monitoring results showed no pollution and indicated that clean-up had reached the standard of PCB project.
27	11	Wangdian, Jiaxing	No cleanup undertaken	The site was cleaned before project start-up. Monitoring results showed no pollution and indicated that clean-up had reached the standard of PCB project.
28	2	Southern part of Shaoxing	No cleanup undertaken	The site was cleaned before project start-up. Monitoring results showed no pollution and indicated that clean-up had reached the standard of PCB project.
29	3	Former Electric Power Bureau	No cleanup undertaken	The site was cleaned before project start-up. Monitoring results showed no pollution and indicated that clean-up had reached the standard of PCB project.
30	13	Tongxiang, Jiaxing	No cleanup undertaken	Low soil contamination did not environmental risks. Controllable through continuous monitoring.
31	43	Deqing, Huzhou	No cleanup undertaken	Low soil contamination did not environmental risks. Controllable through continuous monitoring.
32	26	Meicheng , Jinhua	Could not be cleaned up.	Under buildings
33	23	Yiwu, Jinhua	Could not be cleaned up.	Under buildings
34	17	Yuyao, Ningbo	Could not be cleaned up.	Under busy roads
35	4	Shangyu, Shaoxing	Could not be cleaned up.	Under busy roads

Component 4 provided funding for the final destruction of highly contaminated PCB wastes collected in Zhejiang Province by incineration at a facility in Shenyang, Liaoning Province that required upgrading in order to be able to dispose of PCBs and PCB wastes in compliance with the Convention's specifications.

The Shenyang Hazardous Waste Incineration Center was upgraded for PCB waste incineration, including construction pre-treatment and storage facilities, upgrading of the on-line monitoring system and automatic control system, and construction of a hazardous waste characterization/analysis laboratory. Initially, the Shenyang Center faced similar issues to those faced by DADI with respect to licensing. In Shenyang's case, FECO was finally able to confirm that the Center was in possession of a license that allowed for the trial operation to proceed in order to demonstrate the safe disposal of PCBs in accordance with Chinese environmental emission standards. The trial run was successfully completed in 2009, with emission results in compliance with agreed standards. A report, outlining the environmental impact parameters of the trial, including minimization of dioxins, and demonstrating that emissions were within the limits agreed for the operation under the EIA, was submitted to the Bank. External monitoring was conducted by third party institute during the incineration process. The facility now meets the Stockholm Convention BAT guidance, which imposes stricter emission standards compared to those imposed by Chinese regulations.

Prior to Project completion, the Bank and the FECO/CIO team discussed the Shenyang incineration facility's future operation prospects. The situation in Shenyang is different from that with the TDU given that the facility can process a large majority of hazardous waste, however concern exists that the stricter emission standards which the incinerator is designed to reach make the Shenyang facility less cost-competitive compared to other similar incineration facilities. On the positive side, discussion on decreasing dioxin and furan emission standards from 0.5ng TEG/Nm3 to 0.1 has been making headway, with Beijing recently adopting the 0.1 standard for solid waste incineration. This may pave the way for the rest of China to follow suit in the near term. Regardless, within the context of the final elaboration of the replication program, it was agreed an incineration plan for the remainder of highly-contaminated wastes from Zhejiang and other provinces, as well as a business plan, would be prepared by early 2013.

Component 5 outlined the means by which the Project would track progress toward project objectives and facilitate learning and capture results that would, in turn, inform preparation of the national replication program goals. A series of comprehensive outcome indicators Results Framework (PAD, Annex 3) were developed to track implementation and results achieved under each Component including, the sound management and disposal of low and high-concentration PCB contaminated wastes, the development of PCB policies, regulations and standards, and associated capacity building and outreach. Achievement of the outcome indicators was expected, cumulatively, to lay the foundation upon which to develop a national replication program for PCB management and disposal, considered a key Project output with respect to the potential for long-term sustainability of the investment made. The indicators were, in general, adequately conceived to track progress under each component, and were clear, measurable and specific. In retrospect however, the indicators associated with clean-up targets, both with respect to number of sites and tons cleaned, are considered to have been too narrowly defined at appraisal, given the absence of reliable baseline information regarding the number of PCB contaminated sites and, by extension, the lack of clear knowledge regarding the extent of the clean-up that would ultimately be required.

Overall, monitoring and reporting of the Project's implementation, including administrative and technical (FM, procurement), as well as against output and intermediate outcome indicators, was conducted in a satisfactory manner by FECO/CIO and the Zhejiang PIU. M&E reporting on activities and results was performed through preparation of semi-annual project progress reports. On the whole, these progress reports were submitted in a timely manner, with the exception of the final year of implementation, an

oversight acknowledged by the FECO/CIO in the Project Completion Report as the reason that one outcome indicator was not fully met (see Annex 7). During the final year, which was also the period during which the bulk of the treatment of low-concentration PCB-contaminated soils was undertaken, the submission of semi-annual progress reports was replaced by submission of a series of ad hoc reports that highlighted implementation progress, disposal achievements and status of disbursements. In addition, the POPs management information system (POPs-MIS) that was expected to facilitate monitoring, allow for generation of aggregate national level data and demonstrate effectiveness results, was developed later than expected and consolidated to include the data management needs of the POPs pesticide Project.

In relation to *Component 6*, the results achieved in Zhejiang Province were expected to inform the development of a national replication plan that, together with the study that would outline a financing mechanism, would allow China to address remaining PCB management and disposal issues into the future. Beijing Normal University was contracted to prepare the plan, in cooperation with the FECO/CIO team and the CTA. Beginning in 2010, a nationwide PCB inventory/survey was conducted. The results of the first two surveys indicated that significantly lower volumes of buried PCB waste were in evidence than estimates projected. FECO/CIO was of the opinion that the results generated during the surveys contained deficiencies associated with both the surveying process itself and low awareness about PCB contamination among local authorities.

During the final stages of implementation, with the Province's PCB contaminated sites remediated and the TDU in operation, FECO/CIO and the Zhejiang PIU initiated provision of in-depth training to local EPBs on Project results. In December 2012, two national workshops ("China PCBs Management and Disposal Demonstration Project Publicity and Training workshop"), involving participants from 24 EPBs, as well as an international workshop, were held to promote achievements and discuss issues associated with Project sustainability. In tandem, a national 12th 5-year POPs plan was finalized and approved with the aim of safely disposing of identified PCB-contaminated equipment waste from the power sector, and cleaning and disposing of high-concentration PCB-contaminated soils by 2015.

Table 2-5: National Replication Program activities initiated

No.	Major activities	Completion status	Related area
1	Burial sites sampling analysis	3 sites	Hebei, Jiangsu
2	Above ground equipment packaging, collection and transportation	2669 sets	Guangdong, Fujian,Liaoning, Heilongjiang, Shanxi, Inner Mongolia, Sichuan, Chongqing, Henan, Hebei, Gansu, Shaanxi
3	Cave stored contaminated soil cleanup	181.5 tons	Gansu Tianshui
4	PCB waste incineration	324.59 tons	Liaoning Shenyang
5	PCBs project National publicity and training workshop	2 times	Beijing, Hebei, Shanxi, Inner Mongolia, Liaoning, Jilin, Heilongjiang, Jiangsu,Shandong,Shaanxi, Gansu,Ningxia, Fujian, Guangdong, Anhui,Hubei,Hainan,Sichuan,Henan, Guizhou,Yunnan, Jiangxi, Hunan,Guangxi

Regrettably, a comprehensive assessment of the short-term national replication action plan was not possible at the time of ICR preparation, given that no indication had been provided to the ICR team that the replication plan, and its associated financing study, had been operationalized and was being systematically applied.

Annex 3. Economic and Financial Analysis

An incremental cost analysis that compared the baseline scenario with the GEF-Alternative scenario was conducted at Project appraisal. The baseline scenario involved the ongoing application of a series of existing ad hoc regulatory, policy and management approaches to the issue of PCB management[25] at the national and provincial levels. In addition, the status quo operation of the Shenyang pilot incineration facility would continue, despite the fact that it was not in compliance with Stockholm Convention requirements due to dated control systems and a lack of online monitoring systems. Effectively, the baseline scenario outlined the continuation of the management practice adopted in the 1990s that had shifted from dismantling to finding and monitoring temporary storage sites, with recovery of PCBs only conducted in the face of serious identified leakages or other accidental releases, or when a site was required for another use, and only on a case-by-case basis. Projections under the baseline scenario were that approximately 5% of the temporary PCB storage sites would be remediated, and that these would be the sites with serious leakages identified, and neither Zhejiang Province, nor the Central Government would develop comprehensive management and policy frameworks to ensure the environmentally sound management and disposal of PCBs.

Nonetheless, under the Baseline Scenario, with GEF support China would prepare and submit to the Conference of the Parties to the Stockholm Convention, a National Implementation Plan (NIP) by August 2006 that would describe China's POPs situation, prioritize actions and outline intended management responses. This action would be undertaken in tandem with implementation of the ongoing Italian POPs TF, that was collecting PCB baseline information in Zhejiang and Liaoning Provinces, and the CPTF, that provided training for PCB management.

Under the GEF Alternative Scenario, and based on an incremental cost calculation of US $32 million, of GEF funding would provide US $18.34 million, the Project would comprehensively identify and demonstrate in Zhejiang province, where a good number of serious accidental PCB leakages had occurred in the past, demonstrate how the PCBs would be safely and most cost-effectively recovered from their temporary storage sites, how those sites could be remediated, and the PCBs transported and disposed of in an environmentally sound manner, all in compliance with the objectives of the Stockholm Convention. This experience was expected to build practical PCB management experience in China and lay the foundations needed to achieve complete disposal of all PCBs in-country by 2028, as specified in the Stockholm Convention. In particular, the GEF-Alternative scenario would support:

1. Identification of all PCB storage sites and PCB transformers still in use[26] in Zhejiang province;
2. Recovery, transportation and disposal of all PCB equipment and PCB wastes from temporary storage sites and PCBs from transformers still in use in Zhejiang Province, following which sites would be restored to their original condition consistent with international environmental practice;
3. Disposal of recovered PCBs in an environmentally-sound manner at China's designated national center for PCB disposal in Shenyang, which would be updated for that purpose by December 2005; and
4. Development of capacity and practical experience in managing PCB elimination at the national level, which would then be translated into preparation of a detailed national PCB management plan.

In the absence of established guidelines on what constitutes incremental costs under the Stockholm Convention, the Project's incremental cost calculation was made based on the general guidelines

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[25] PAD, Annex 15, paragraph 7, sub-paragraphs a-f, p.122.

[26] This component was eventually dropped when it became clear that no PCB transformers remained in service, and was replaced with efforts to ensure the safe and environmentally-sound transportation of high-concentration PCB contaminated waste from Zhejiang province to the Shenyang incinerator.

contained in GEF guidance on Incremental Cost (GEFK.7hnf.5). These guidelines define the principle of "incremental cost" as "a measure of the future economic burden on [a] country that would result from its choosing the GEF-Alternative in preference to the course of action would have been sufficient in the national interest." It did not include a rigorous incremental cost breakdown component by component but rather, adopted a more qualitative assessment by comparing 'without' and 'with' project scenarios, and explaining the incrementality in terms of the fact that actions 'with' project would not have occurred in the absence of obligations under the Stockholm Convention, supported by that body's financial mechanism.

Thus, based on an assessment of the global and national risks/benefits associated with each scenario, the total GEF-Alternative cost was calculated to be US $32.5 million, with incremental costs totaling US $31.5 million. In recognition of the fact that China would realize some national benefits from the incremental expenditures, the Government offered to co-finance the Project by US $11.34 million, plus generated additional co-financing of US $1.84 million from the Governments of Italy, Japan, and the United States. GEF support of US $18.34 million provided the balance of the incremental costs.

Table 3-1. Incremental Cost Matrix at Project Appraisal and Completion

	At appraisal(USD)					At Completion (USD)			
	Baseline Cost	Incremental Cost			Total	Incremental Cost			Total
Component		GEF grant	Co-finance	Other		GEF grant	Co-finance	Other	
Institutional Strengthening		1,283,000.00	299,000.00	363,000.00	1,945,000.00	705,496.72	339,327	360,000	1,404,823.72
Policy Development		72,000.00	668,000.00	70,000.00	810,000.00	213,982.53	125,559	70,000	409,541.53
PCB Management and Disposal in Zhejiang Province		10,030,000.00	3,849,000.00	1,137,000.00	15,016,000.00	11,448,585.83	3,845,344.30	441,477.51	15,735,407.64
PCB waste incineration in Liaoning Province	1,000,000.00	6,238,000.00	6,917,000.00	454,000.00	13,609,000.00	5,029,775.66	6,941,903	483,378	12,455,056.66
Monitoring and Evaluation		127,000.00	-	-	127,000.00	33,862.00	-	-	33,862.00
National Replication Program		290,000.00	3,000,000.00	-	3,290,000.00	218,574.55	2,585,668	-	2,804,242.55
Contingency		300,000.00	-	-	300,000.00	-	-	-	-
TOTAL		**18,340,000.00**	**14,733,000.00**	**2,024,000.00**	**35,097,000.00**	**17,650,277.29**	**13,837,801.30**	**1,354,856.51**	**32,842,935.10**

Overall, the incremental cost analysis estimate was accurate, as the incremental costs incurred as a result of Project activities made almost 100% use of the GEF grant, as well as the co-financing and bilateral contributions received. Given the acknowledgement of the broad Project achievements, from a cost-efficiency perspective, the Project achieved a satisfactory result.

Cost-Effectiveness Analysis

The demonstration project was designed to contribute both local and global public good by reducing the risk of the release of PCBs into the environment. Due to the lack of reliable baseline data and difficulties associated in measuring the impact of the overall environmental, health and related socio-economic impacts under a 'without project' scenario, it was not possible to conduct a traditional economic or financial cost-benefit analysis for the Project. Nonetheless, benefits to both the local and global environment and human health that would accrue by reducing the potential for PCBs to leach into the environment, though difficult to quantify, were understood to be significant and therefore, considered to exceed the demonstration Project's associated costs.

At the design stage, an estimate was made by FECO/CIO of the cost-effectiveness associated with operation of the TDU system under Project Component 3, with an estimated thermal desorption treatment cost of US $270/ton between end 2006 and mid-2009. The actual TDU treatment cost turned out to be higher than projected for two main reasons: one, the value of the RMB, the currency used for operating

cost estimates incurred by the local contractor, dropped against the US dollar by the time the TDU treatment process began in December 2011, raising the cost of treatment/ton[27]; and two, due to the fact that the TDU was unstable and prone to frequent break-downs (see Section 2.2, Annex 2), only lower contaminated soil loads could be treated, while fixed costs did not alter as they were not dependent on actual treatment capacity. As a result, the average treatment cost increased to US $460/ton during December 2011-December 2012 period.

For incineration of highly-contaminated waste in Shenyang, appraisal relied on the cost of incineration in European/North American countries, which stood at approximately US $2,000/ton, excluding transportation. As in the case of the TDU, actual disposal costs in Shenyang turned out to be higher than projected, amounting to US$ 4,123/ton for the first 100 tons incinerated in November 2011, and US$3,717/ton for the 669.4 tons incinerated in November-December 2012. The key factors in this case pertain to the amount of soil available for treatment, given that fewer sites than projected required remediation and the volume of high-concentration PCB contaminated waste was lower than had been estimated, and the high proportion of fixed costs.

From a cost per Project site perspective, at appraisal, US$ 4.55 million was allocated for the clean-up of 56 sites, many of which had not yet been identified. The average cost per site would have been US$ 81,232.00. Following Project completion, US $3.68 million had been disbursed to clean-up 16 sites, for an average of US $230,000/site. Clean-up costs ranged from US $10,075 to US $1.069 million per site and the average clean-up cost/ton of soil ranged from US $131/ton at one site to US $14,940/ton at another. The variation in costs per site and ton is indicative of the challenges posed by the particularities of China's PCB problem where site characteristics are not uniform but rather, diverse: some sites were easily accessed while others required significant effort and cost to access, and some contained virtually no contaminated materials but nevertheless incurred significant costs to access. The average cost/ton clean-up is therefore, not a good indicator of efficiency. Comparison with PCB project results in other countries also does not yield useful comparative data. For example, the Moldova POPs Stockpiles Management and Destruction Project reported an average cost/ton eliminated of US $4,183/ton. However, the characterization of the PCB problem was vastly different in Moldova, which allowed clean-up to be addressed in a much more consolidated manner, something which the particularities of China's temporary PCB storage system did not allow. This heralds an important lesson regarding cost considerations that will necessarily have to be taken into account as China rolls out its national replication program.

[27] In 2011, the RMB dropped to 6.4 against the US dollar. In comparison, its value in 2006 stood at 7.9 RMB to 1 US$, and at appraisal, it had been even higher, at 8.1 RMB for 1 US$.

Annex 4. Bank Lending and Implementation Support/Supervision Processes

(a) Task Team members

Names	Title	Unit	Responsibility/ Specialty
Lending			
Helen Chan	Consultant	EASCS	TTL
Yi Dong	Sr Financial Management Specialist	EASFM	FM
Feng Ji	Senior Environmental Specialist	EASCS	Env Safeguards
Agustinus S. Kaber	Program Assistant	EASEN-HIS	
Xiaoping Li	Senior Procurement Specialist	AFTPW	PS
Robert Leonard O'Leary	Senior Finance Officer	CTRLD	Disbursement
Erik Pedersen	Consultant	EASER	PCB Management
Margaret Png	Lead Counsel	LEGLE	Counsel
Yan Wang	Program Assistant	EACCF	
Peishen Wang	Consultant	EASER	Env Safeguards
Qing Wang	Senior Environmental Specialist	EASER	Operations Officer
Chaohua Zhang	Lead Social Development Specialist	SASDS	Social Safeguards
Supervision/ICR			
Evelyn Bautista-Laguidao	Senior Executive Assistant	CROVP	
Carter J. Brandon	Lead Economist	LCSSD	Adviser
Martin Fodor	Senior Environmental Specialist	AFTN3	Env Specialist
Yi Geng	Sr Financial Management Specialist	EASFM	FM
Laurent Granier	Senior Environmental Specialist	CPFIA	Adviser
Xiaowei Guo	Senior Procurement Specialist	EASR2	PS
Feng Ji	Senior Environmental Specialist	EASCS	Env Safeguards
Xiaoping Li	Senior Procurement Specialist	AFTPW	PS
Dominique I. Kayser	Operations Officer	CPFIA	ICR Author
Solvita Klapare	Environmental Economist	EASER	TTL
Steven P. Maber	Senior Environmental Specialist	EASER	TTL
Erik Pedersen	Consultant	EASER	PCB Management
Jiang Ru	Senior Environmental Specialist	EASER	Env Specialist
Sukanya Venkataraman	Customer Service Representative	GSDTR	
Peishen Wang	Consultant	EASER	Env Safeguards
Yan Wang	Program Assistant	EACCF	
Qing Wang	Senior Environmental Specialist	EASER	Co-TTL
Lirong Yang	Sr Environmental Specialist	EASRE - HIS	Env Specialist
Ning Yang	Environmental Specialist	EASCS	Env Specialist
Guoping Yu	Procurement Specialist	EASR2	PS
Chaohua Zhang	Lead Social Development Specia	SASDS	Soc Safeguards

(b) Staff Time and Cost

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	USD Thousands (including travel and consultant costs)
Lending		
FY04	21.35	102.43
FY05	28.38	146.88
FY06	15.10	81.86
FY07	0	0.00
FY08	0	0.00
Total:	64.83	331.17
Supervision/ICR		
FY04	0	0.00
FY05	0	0.00
FY06	3.33	24.88
FY07	22.28	82.57
FY08	13.16	64.64
FY09	10.83	55.27
FY10	13.29	81.53
FY11	14.79	82.84
FY12	17.55	88.12
FY13	15.26	91.83
Total:	110.49	571.68

Annex 5. Beneficiary Survey Results

n/a

Annex 6. Stakeholder Workshop Report and Results

None provided.

Annex 7. Summary of Borrower's ICR and/or Comments on Draft ICR

CHINA PCBS MANAGEMENT AND DISPOSAL DEMONSTRATION PROJECT COMPLETION REPORT : SUMMARY
FECO/CIO, MEP; March 2013

Background/Project Rationale

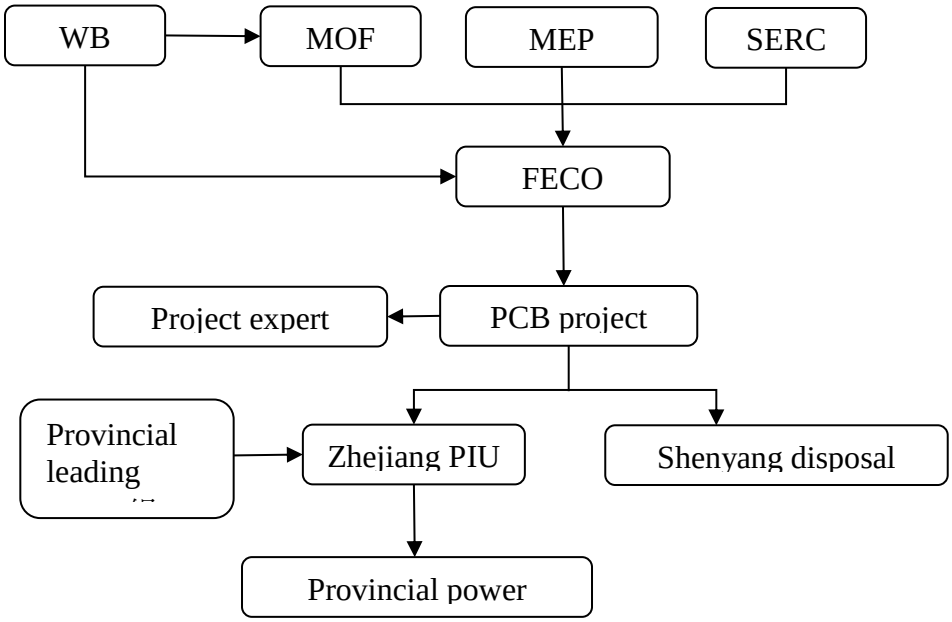
In order to eliminate the hazards of POPs to environment, speed up PCBs power equipment and waste clean-up and disposal, Ministry of Environmental Protection of China(MEP)(formerly SEPA) and World Bank cooperated to develop the "China PCBs Management and Disposal Demonstration Project"(hereafter referred to as PCBs project). Aim to clean-up and dispose PCBs power equipment and waste. Meanwhile, explore and demonstrate environmentally sound and economically effective PCBs equipment management and disposal policy, method and technology. PCB project will replicate safe and effective PCBs management and disposal technology nation-wide through demonstration which will play the lead and promotion role to eliminate PCBs equipment and waste nation-wide. MEP had authorized institution affiliated to MEP-Foreign Economic Cooperation Office (FECO) of MEP to act as PCBs project domestic implementation agency, undertaking project daily management work.

Project implementation and management

National Leading Group(NLG) for implementation of Stockholm Convention in China is consisted of 13 ministries and commissions acting as the national level convention implementation coordination mechanism. It is responsible to lead and organize NIP implementation and all kinds of work related to convention implementation. Among which, (1) MOF acting as the funding management window for international financial organization's donation to China, setup project grant special account, and supervise and manage project grant application and disbursement;(2) MEP as the leading agency for China to implement the Stockholm Convention, is responsible for POPs convention implementation daily coordination and management, and directly guide PCBs project implementation;(3) State Electricity Regulatory Commission is in charge of power sector, cooperate and support MEP to carry out relevant work such as inventory investigation.

FECO as project domestic implementing agency, setup PCBs project team, which is responsible for project activities overall planning and supervision, national level activities organizing and implementation and daily communication and coordination. Project setup expert team, including CTA ,NTA and domestic technical experts to provide technical support for project activities. Meanwhile, relevant technical, financial and policy experts will be recruited based on activity needs to provide consultation and technical support for the project.

Demonstration province setup "Zhejiang PCBs investigation, disposal and management project leading group" which is led by provincial government, and consisted of provincial government general office, provincial dept. of environmental protection, provincial financial bureau, provincial development and reform commission and provincial power company. It is responsible for project coordination within Zhejiang province, supervise project implementation progress in the province, and provide administrative, technical and counterpart funding support to ensure smooth project implementation in the demonstration province. The leading group setup office (Zhejiang PIU), specifically responsible for provincial project implementation and daily routine management work.



Project management

(1)Work plan management

According to the requirement of WB and "project implementation manual", based on project document, FECO coordinated PIU, experts and relevant institution to formulate project overall work plan, clarified each activity content, time frame, responsible party, and funding arrangement, and will adjust periodically during the implementation stage based on actual progress.

(2) Procurement management

Based on WB "WB guideline on selection and recruitment of consultant", "WB procurement guideline ", "Project grant agreement" and "Project implementation manual", with reference to "P.R. China Bidding Law", and "FECO procurement work manual" compile by FECO specifically targeted at foreign grant use management regulation, each year will periodically draft project annual procurement plan, clarify major content of each activity, budget, procurement method, review method, timely update and submission of procurement plan to WB for approval.

(3)Financial management

Based on MOF "International financial organization and foreign government loan and grant management method"(MOF directive 2006 No. 38), and "China PCBs management and disposal demonstration project financial management method"(FMM), from funding claim reimbursement and fund raising, assets management, financial accounting, file management to financial report, all these procedures strictly follow the relevant regulations and rules.

Project special account is setup at MOF, provincial PIU submit quarterly FMR, FECO will summarize and verify, and submit to MOF for funding application. MOF will make advance disbursement of funding based on next quarter budget, to ensure smooth running of all activities. During project implementation, in order to upgrade funding disbursement efficiency, after multi-parties negotiation, reimburse method is changed to "reimburse based on actual expenditure, and MOF will reimburse the cost based on SOE table". Which means FECO submit SOE to MOF for occurred expenditure reimbursement, Zhejiang PIU submit SOE to MOF through provincial financial dept. for expenditure reimbursement. This kind of reimbursement method is kept until project closure which achieved good effect.

MOF as the project grant management window, will exam and verify FECO and PIU's grant use situation, and periodically submit funding application to WB and report funding use details.

Supervision and Evaluation

(1)Daily routine Supervision

Based on project activities requirement, FECO and WB will carry out 1-2 times project progress evaluation annually, and go to demonstration province to have field visit, and timely follow up latest project progress and achievement. Targeted at issues occurred during project implementation in demonstration areas, all parties will timely communicate and coordinate and formulate improvement or adjustment plan.

(2) Annual audit

During project implementation, State Auditing Administration will carry out annual audit during March-April each year, including project performance and financial audit. And fully exam all the activities being carried out during project implementation in detail.

Audit result showed that there is no major audit issues during project implementation period, provincial PIU had cooperated actively for auditing, and timely improve their work based on audit comments, try their best to perfect project outcome.

Project outputs

- Establishment of policy regulation and technical norms

Summarization table of PCBs project research outputs

No.	Title of outputs	Completion date	Sub-contractor
1	”PCBs waste incineration disposal technical guideline”	2008.04	Tsinghua Univ.
2	”PCBs waste long distance transportation technical guideline”	2008.04	
3	”PCBs waste temporary storage technical guideline”	2008.04	
4	”PCBs Contaminated Soil Thermal Desorption Treatment Technical Guideline”	2008.08	
5	“China PCBs Inventory Investigation Guideline”	2005.01	
6	”PCBs Burial Site Environmental Monitoring Technical Guideline”	2008.08	
7	China PCBs Reduction and Disposal Preliminary Strategy”	2006.12	Beijing Normal Univ.
8	“PCBs Emission Standard Prior Research Report”	2010.03	
9	PCBs and Wastes Management and Disposal Regulation	2009.01	North China Electric Power Univ.
10	PCBs Waste Clean-up Technical Guideline	2008.07	Shenyang Academy of Environmental Sciences
11	PCBs Containing Power Equipment Labeling and Management Rules	2008.02	
12	PCBs Incineration Disposal Operation Technical Regulation	2009.03	Environmental Protection Hazardous Waste Disposal Engineering Technology(Shenyang) Center
13	<Framework of Risk-based System for PCB Management and Disposal>	2010.04	CTA
14	<Technical guideline on identification and labeling of PCB equipment>	2008.09	CTA
15	PCBs Equipment and Waste Environmental Management Technical Guidance Manual(First Draft)	2012.12	Chinese Academy of Environmental Sciences

At local level, Zhejiang Dept. of Environmental Protection issued 3 PCBs contamination management and control regulation in Jan. 2009, which are "Zhejiang province PCBs contamination environmental prevention and control regulation(trial implementation), "Zhejiang province emergency plan for sudden PCBs contamination incident "(trial implementation), and "Zhejiang province PCBs contaminated sites clean-up project acceptance management trial regulation" respectively.

Issuance of above-mentioned PCBs management regulation and completion of all kinds of technical outputs provided policy management basis and technical support for demonstration province PCBs burial site management and clean-up. Which will play full demonstration role of the PCBs project. Example had been setup for other province and regions to learn or replicate PCBs waste management and disposal after the project closure.

Establishment of PCBs contaminated site technical and management route

PCBs project carried out 7 times of personnel training and technical workshops, among which 1 time for management capacity strengthening, 6 times for technical training and workshops. Domestic and international experts from relevant institution or fields, project stakeholders and local environmental protection bureaus participated in the training. Total trainees reached 362 person times, which built a solid foundation for PCBs project smooth implementation and advancement.

Based on risk assessment result, Zhejiang PIU determined remediation target of contaminated site according to site future use properties. It is 14mg/kg for industrial/commercial land, 1.5mg/kg for residential land, 0.1mg/kg for agriculture land. During the site clean-up, rapid detection is combined with lab analysis to ensure clean-up reached the remediation target.

PCBs waste treatment and disposal capacity establishment and improvement

（1）TDU's procurement and trial run

Through two times international competitive bidding (ICB), the final review in Dec. 2008 determined the TDU and auxiliary facility supplier. And installation had been completed in Sept. 2009 in Hangzhou Jiande TDU site. This set designed treatment capacity is 3 tons/hour, it can run for 24 hours continuously.

In year 2011, FECO and Hangzhou Dadi Environmental Protection Engineering Co. Ltd (Hereinafter refer to Dadi company) signed Entrustment Agreement and entrusted DADI to be responsible for daily operation and management of TDU and its auxiliary supporting facility.

In May 2012, hosted by Zhejiang PIU, all other stakeholders participated in the TDU environmental acceptance test, the results showed that during the operation of the TDU: all the indicators such as dioxin in flue gas, PCBs emission and PCBs concentration in soil after treatment all meet the local environmental protection standard, which signified PCBs project had setup the PCBs contaminated soil treatment and remediation capacity.

（2）High temperature incineration and upgrade of relevant equipment

Based on the PCBs project arrangement, from 2007 to Nov. 2008, through plan compilation evaluation, engineering design, competitive bidding procedure, by using project grant , for Shenyang PCB incineration facility they add one more component to build pre-disposal hazardous waste characteristic analysis and identification unit. Whole set of instruments include: heat value analyzer, water detector etc. for physical property identification, GC-MS, Atomic absorption spectrophotometer, element analyzer, ultraviolet and visible spectrophotometer etc. for chemical component analysis, and server, storage and database for data analysis and handling. And they had completed all set of lab instrument and equipment installation and tuning including the large scale instruments like GC-MS by June 2009. The setup of hazardous waste characteristic analysis and identification unit realized multiple functions such as basic data collection for PCBs and its waste, entering into warehouse sampling and analysis, distinguish labeling and confirmation, pre-treatment process analysis, relevant technical standard and norms collection and sort out, relevant data collection and research, technical training and exchange, etc.

Meanwhile Shenyang center/Shenyang Academy of Environmental Sciences raised fund on their own to improve flue gas online monitoring system and automatic control system for PCBs incineration facilities:

Automatic control system improvement mainly include centralized display system for working condition, main parameters automatic control for incineration and flue gas treatment, each sub-system data processing component, and major working condition parameter storage upgrading. Compiled specialized software to record and store the system status data, and realized dynamic connection through internet to Shenyang Academy of Environmental Sciences. Data could be transferred and displayed in real time.

After the upgrading of the equipment, daily disposal capacity is 15 tons/day, annual disposal capacity is 4000 tons. The trial burn result in Sept. 2009 showed that the DRE of PCBs reached over 99.9999%, dioxin emission in the flue gas is below 0.1ngTEQ/Nm^3 which meets the project requirement. All parameter of emission and process data meet the pollution control standard of hazardous waste incineration which possessed the condition of safe, efficient, environmentally sound incineration to dispose PCBs waste.

(3) Construction of Storage Facility

From 2007, through plan formulation and evaluation, engineering design, goods procurement, construction and warehouse equipment procurement and installation, PCBs project built storage facility in Hangzhou, Zhejiang and Shenyang center respectively for the purpose of storage/pretreatment of high concentration PCBs waste and temporary store/transfer low concentration PCBs waste.

The temporary storage facility construction in Shenyang is completed in Nov. 2008, supporting equipment installation, upgrading and sub-system tuning had been completed by July, 2009. The storage unit has passed expert acceptance organized by Shenyang Environmental Protection Bureau. Hangzhou temporary storage facility goods procurement is done by FECO, Zhejiang PIU is responsible for leasing temporary site, selection of construction subcontractor and supervision company. It is finally built in Jan. 2011.

The newly built PCBs waste storage facility capacity reached 1000 tons and 300 tons in Shenyang center and Zhejiang Hangzhou respectively, which provided guarantee for high concentration PCBs waste temporary storage, transportation and disposal.

PCBs contaminated site clean-up and remediation

Based on PCBs inventory investigation result, Zhejiang had identified 35 PCBs equipment burial site and PCBs contaminated sites, distributed into 10 cities except Zhoushan. There are 7 each in Hangzhou and Shaoxing, 4 each in Ningbo, Jiaxing, Jinhua, 3 in Wenzhou, 2 each in Quzhou and Huzhou, 1 each in Taizhou and Lishui. Based on PCBs project overall progress plan, through prior preparation work such as geographical detection, pre-monitoring, social safeguard survey, compensation for occupying famers land, finally clean-up PCBs equipment and contaminants, contaminated soil transportation and site closure for 16 burial sites which possessed the condition for clean-up. By end of 2012, 11,428 tons of low concentration PCBs contaminated soil and 715.91 tons of high concentration PCBs contaminated wastes were cleaned up in Zhejiang in a timely manner, risk was effectively controlled, which achieved the overall objectives for PCBs waste clean-up and contamination control.

PCBs waste treatment and disposal

（1） TDU treatment for low concentration contaminated soil in Hangzhou, Zhejiang

According to the PCBs project arrangement, Hangzhou Dadi Environmental Protection Engineering Co. Ltd undertook the TDU treatment for low concentration contaminated soil from site clean-up. From Sept. 2010 TDU installation and trial run until the project closure on Dec. 31, 2012, total treated

contaminated soil amount to 8572 tons, among which 7400 tons are treated after Dec. 2011 when the TDU is running under stable condition.

In Dec. 2012, DADI optimized soil storage in TDU treatment storage site. They changed ways of storage from simply pile up loose soil to pile soil sacks together. The contaminated soil storage capacity increased from 1200 tons to 3000 tons, which provide guarantee for the large amount of temporary storage and treatment pressure at final stage of project implementation.

（2）High concentration PCBs waste incineration disposal in Shenyang, Liaoning

According to PCBs burial site clean-up work progress in Zhejiang, in accordance with PCBs project arrangement, FECO signed two high concentration PCBs waste incineration disposal contracts through direct procurement method with Environmental Protection Hazardous Waste Disposal Engineering Technology(Shenyang) Center (Hereinafter refer to Shenyang Center) in Oct. 2011 and Nov. 2012 respectively. Since Sept. 2011 Shenyang center received high concentration PCBs waste totaling 1040.5 tons from Zhejiang and 12 provinces in the national replication program. Until Dec. 31, 2012, 769.4 tons of waste had been safely incinerated. The environmental monitoring done by Dalian Institute of Chemical and Physics, CAS and Shenyang Environmental Monitoring center station showed that in the two incineration process, all kinds of emission indicators meet the requirement of "Hazardous waste incineration pollution control standard (GB18484-2001), meanwhile dioxin emission also meet the control standard of 0.1TEQng/Nm^3 required by PCBs project.

National Replication Program

At the final stage of PCBs project implementation, under the circumstances that treatment and disposal technology establishment and rich achievement be made from PCBs contaminated site clean-up and remediation, in order to publicize and promote project achievement, meanwhile consider project sustainability, and "The 12^{th} five year plan for POPs pollution control and prevention in major sectors in China" mentioned should realize the following objectives:

- should safely dispose identified PCBs power equipment and waste, clean-up and disposal of high risk PCBs contaminated soil by 2015, based on the results of national POPs environmental statistic survey led by Dept. of Pollution Control and Prevention of MEP, during the national replication stage, a series of activities including burial site contamination sources detection and analysis, above-ground temporarily stored PCBs equipment collection and disposal, cave stored PCBs contaminated soil clean-up and disposal had been added, and part of counterpart fund is used to support these activities, in order to reach the replication objective of the PCBs project.

The national replication activities completed 3 PCBs equipment burial sites environmental safety status sampling analysis and evaluation in Hebei and Jiangsu provinces. 2669 sets of above ground temporarily stored PCBs power equipment distributed in 29 storage sites in 12 provinces collection and transportation, 1 stone cave stored contaminated soil clean-up in Tianshui, Gansu province. And high temperature incineration disposal for the PCBs power equipment and waste collected in 12 provinces. In Dec. 2012, "China PCBs Management and Disposal Demonstration Project Publicity and Training workshop" had been held in two demonstration provinces: Zhejiang and Liaoning respectively. In order to systematically introduce and publicize all achievements made from the PCBs project. There are total 88 participants including WB, project stakeholders and 24 provincial environmental protection agencies delegates attended these two workshops, which had been approved by WB.

Project Funding Status

Total budget of the project is 35.097 million US dollars, comprised of 18.34 million USD GEF fund, 14.733 million USD co-finance, and 2.024 million USD bilateral funds.

93.58% of total project budget has been disburse, specifically, 77.82% were used to set up and improve PCBs treatment and disposal capability, clean-up PCBs burial sites, and PCBs waste treatment and disposal; 5.42% were used in institutional capacity building, policy system establishment, and project monitoring and evaluation; 7.97% were used in the national replication program. Generally, the project funds were reasonably and effectively spent to complete the designed activities.

Overall evaluation and impact

Evaluation for project design and achievement

(1) The completion status of activities designed by project

There are 25 items in 6 components plan to be completed in the project, 23 items of activities had been completed on time, 2 items: contaminated soil TDU treatment and high concentration PCBs waste incineration had reached 90% and 80% of the expected quantity. It is mainly because during the clean-up process, some unexpected factors such as some sites PCBs leakage is so serious that it exceeds the expectation so clean-up work continued until end of 2012. So part of contaminated soil and high concentration PCBs waste couldn't be treated and disposed before the project closure. Zhejiang PIU had applied for counterpart fund to continue to complete remaining contaminated soil treatment and high concentration PCBs waste disposal. It is expected to complete by end of March.

(2) Project Sustainability

There are three aspects regarding project sustainability: first of all, PCBs project established and strengthened PCBs waste treatment and disposal capacity and technology, TDU is mobile unit, it could be transferred to suitable sites based on PCBs contaminated soil treatment needs. Shenyang center's incineration facility PCBs waste disposal capacity is 4000 tons/year, it could meet disposal demand completely. Secondly, the "PCBs Containing Equipment and Waste Pollution Control Technical Specification" compilation project which had been setup in Dept. of Science, technology and standard of MEP had advanced to comments inquiry stage based on the absorption and adoption of multiple research results of PCBs project; In addition, the first draft of "PCBs equipment and waste environmental management technical guidance manual" targeted at guiding PCBs treatment and disposal for local environmental protection agency manager and PCBs owner had been completed. Thirdly, to carry out national replication activity to publicize and conduct training for PCBs management and disposal in full scale, had upgraded environmental protection worker's consciousness, promoted local environmental protection agency and PCBs waste owner's enthusiasm. Therefore, the strengthening of PCBs management and disposal capacity provided foundation and safeguard for follow-up management and disposal, all level of environmental protection dept. especially PCBs waste owner's consciousness upgrading is the primary power for follow-up management and disposal.

(3) Possible impact made by project outcome

The smooth completion of PCBs project signified that China's convention implementation progress had achieved mile-stone like achievement. There formed one set of effective and feasible measures, technologies and policy system through exploring and target at management and disposal of PCBs equipment and waste buried underground which is special characteristic of China. The elimination of new contamination and hazard of PCBs to China's eco-environment and human health also provided valuable experiences and references for POPs phase-out in China in the future which had made great contribution to China's environmental protection cause.

Evaluation of Project implementation and management

There are three aspects in the project implementation evaluation: project funding use efficiency, project timeliness and project supervision and management level.

(1) Project funding use efficiency

For the project funding use, based on project objectives, all implementation agencies in China had made sufficient project activities and scientific and reasonable budget, after review and approved by WB and project experts, will carry out procurement activities. During the whole process of project implementation, all implementation agencies in China strictly follow WB procurement and financial management rules, for competitive bidding the bid winner is selected based on "lowest price win the bid" principle and negotiated with bid winner regarding unreasonable part. For direct procurement sector experts are engaged to review all cost component rationality, to ensure project funding is used in sufficient, effective, and reasonable manner.

(2) Project supervision and management level

PCBs project had setup effective communication and coordination management mechanism at national and local level. Through irregular scheduled project coordination site visit, progress report, video conference etc. to timely feedback and understand project progress status to ensure project management consistency and efficiency at international, national and local level. Meanwhile timely discover and solve the difficulties and issues emerged during project implementation, adjust project activities in flexible manner, active promotion role is played to ensure smooth and successful project completion.

(3) Timeliness of project management and decision making

For some issues emerged during project implementation, all levels of management agency will report to higher level to timely feedback, and corresponding judgment and decision making will be made by main responsible institutions, activities should suit social environment while ensuring project advance in high efficiency at same time.

During the third extension of project, DADI company is not the sole company which possess PCBs burial sites clean-up work capacity, so WB project management team decide the procurement method of PCBs burial site clean-up sub-contractor will be changed from direct contract to NCB; During the final phase of project implementation, the reduction in numbers of PCBs burial sites to be cleaned-up will cause project fund saving. So FECO suggested to add a series of national replication activities with certain counterpart funding support and had been approved by WB. The above-mentioned not only make the project implementation and management more strict and reasonable, but also enhanced project implementation efficiency, expanded project impact scope, which actually played active role on demonstration and guidance.

Project experiences and lessons

(1) Establish effective project running and coordination mechanism to ensure smooth implementation of project

In order to complete the PCBs waste management and burial site clean-up and disposal in Zhejiang province, multi-level and multi-dept. at national and local level cooperation is needed, including environmental protection dept. , financial dept. and power sector etc. multi-dept. cooperation and coordination. In order to ensure the smooth implementation of project, at national level, under the guidance mechanism of National Stockholm Convention Implementation Coordination Group(NCG), relevant ministries and commissions like MEP, State Electricity Regulatory Commission(SERC) provided effective national administrative support for the smooth implementation of the project. Meanwhile, FECO setup special PCBs project team, mainly responsible for project daily management, communication and coordination. At provincial level, Zhejiang province setup "Zhejiang PCBs investigation, disposal and management project leading group" which is consisted of provincial government general office, provincial dept. of environmental protection, provincial financial bureau,

provincial development and reform commission and provincial power company. It is responsible for project supervision and management to ensure project implementation in orderly manner at local level.

(2) Issuance of corresponding policy and regulation, completion of technical guidance document

In order to meet the need of clean-up work, demonstration province need complete technical support of relevant policies and regulations. So under the management of FECO, multiple technical outputs for PCBs management and disposal had been developed by the project. Under the promotion of Zhejiang EPD and PIU, Zhejiang province issued a series of pollution management and control regulations. The issuance of these regulations and technical outputs provided policy management basis and technical support for PCB-contaminated site management and clean-up in demonstration province. Meanwhile fully utilized project demonstrative role, provided referable or replicable example for PCBs waste management and disposal in other areas and regions.

(3) Introduction of mature foreign technology to provide technical guarantee for PCBs waste environmentally sound management and disposal

The introduction of TDU for PCB-contaminated soil remediation enhanced China's capacity on PCB-contaminated soil treatment and disposal. After training, technical and operational workers mastered the essentials of TDU operation, TDU treatment capacity is fully reflected and expressed. Not only relevant activities in demo project had been completed, but also related fields scientific research topics had been raised. This has played a very active role for promoting and facilitating the environmentally sound disposal capacity enhancement for PCBs and other wastes in China.

(4) National replication program expanded the project impact

A series of activities such as PCBs burial site sampling and detection, above-ground temporarily stored PCBs equipment and contaminated soil clean-up and disposal, international and domestic publicity training workshops at final phase of project, publicized stage-wise achievement from the PCBs project, and popularized the experience of the PCBs management and disposal to benefit other areas in addition to demo province. Moreover, it is in line with the five years objective "to eliminate and dispose identified PCBs equipment and waste" set in "The 12th five-year plan for POPs pollution control and prevention in major sectors in China". While the national replication activities had achieved good replication effects, it is time for PCBs management and disposal to move from demonstration stage to national action after the project closure.

Lessons

PCBs project had been extended for three times, project implementation period was extended for two and half years. Although the factors caused extension couldn't be simply summarized as single aspect reason, for the project implementation in the future the following two points management strengthening is quite necessary:

(1) Strengthen basic information investigation and public awareness raising, leave room for unknown factors

TDU site location had been changed due to the objection of surrounding residents, some burial site clean-up had been delayed due to compensation negotiation. For the project management in the future, basic information investigation for project activity and public awareness raising should be enhanced. For activities arrangement should be more flexible, in order to leave room and time for suitable adjustment in case of unavoidable and unexpected things happen.

(2) Strengthen technical experts support during carrying out activities

TDU procurement had to go through second bidding process due to first ICB failed. During clean-up of some burial site the supplementary clean-up plan had to be prepared and approved by WB again due to insufficient estimation of actual contamination magnitude. The above-mentioned circumstances could be reduced in certain way under the sufficient participation and strengthening of technical experts during the prior preparation process.

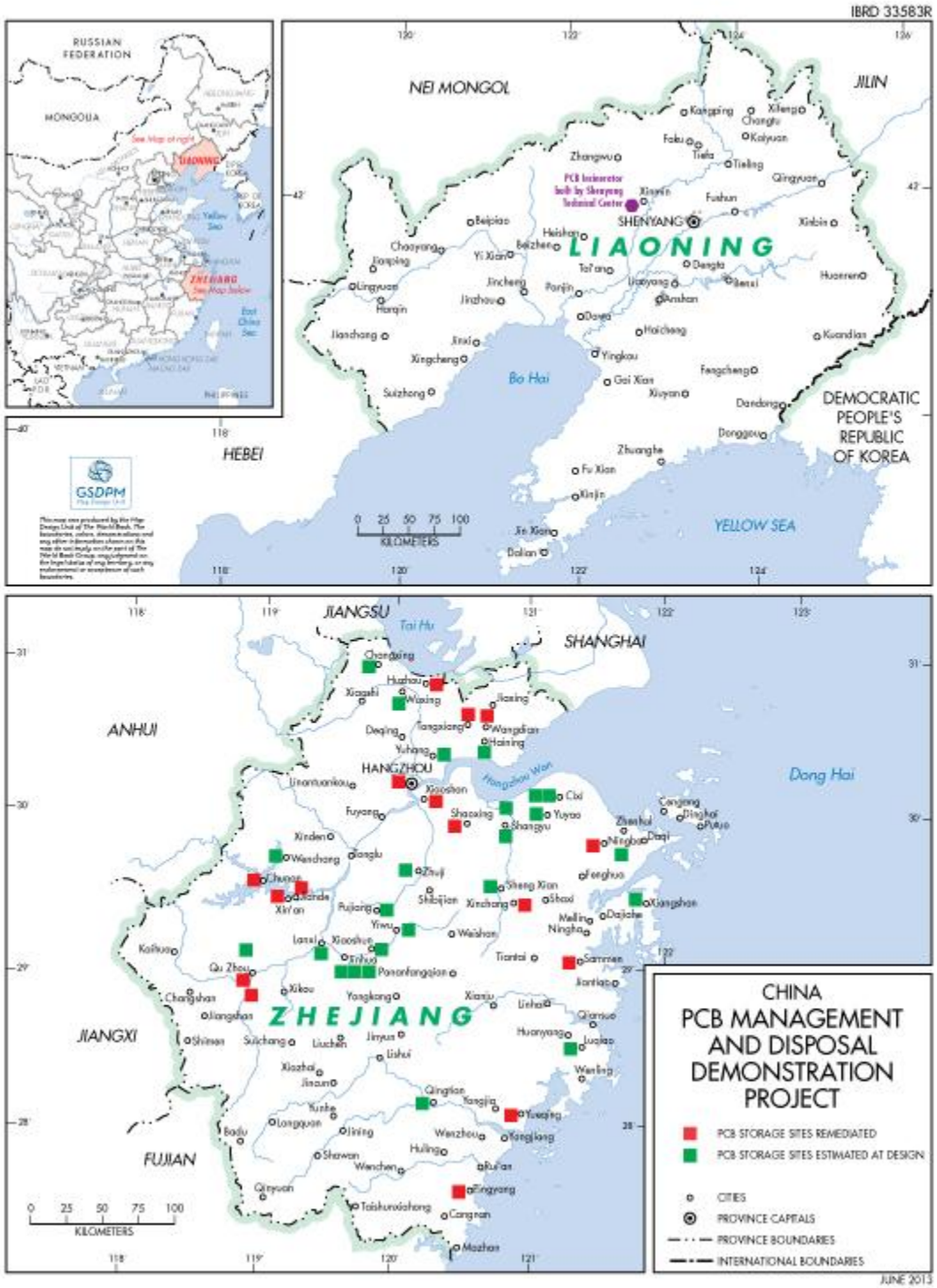
Annex 8. Comments of Cofinanciers and Other Partners/Stakeholders

See section 7.

Annex 9. List of Supporting Documents

1. Project Concept Note
2. Project Appraisal Document, 2005
3. Project Grant Agreement
4. Environmental Impact Assessments (EIAs)
5. Resettlement Policy Framework
6. Country Partnership Strategy (CPS) for China 2006-2010, May 2006
7. Country Partnership Strategy (CPS) for China 2013-2016, November 2012
8. Environmental Assessments
9. Aide Memoires for Supervision Missions, from March 2005
10. Implementation Status Reports (ISRs) from May 2006
11. Mid-Term Review Report, February 2010
12. National Implementation Plan on POPs, Government of China, April 2008
13. Project Restructuring Packages
14. Ministry of Environmental Protection/Foreign Economic Cooperation Office, Project Completion Report, March 2013

MAP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