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ENVIRONMENTAL HEALTH PROJECT

ACTIVITY REPORT

No. 20

Summary of Phase I:
Restructuring and Environmental Improvement
Assistance to RAS Kiviter
Kohtla-Järve, Estonia
1994-1995

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EHP/ESTONIA TEAM MEMBER DESCRIPTIONS

Activity Manager

Fred Rosensweig is a Vice President and Senior Consultant/Trainer with Training Resources Group, Inc. He has managed numerous large, international projects and is experienced in organizing and managing large teams of consultants with varied backgrounds. Mr. Rosensweig is permanently staffed on the Environmental Health Project (EHP) and serves as the activity manager for the Estonia activity. He is responsible for managing the overall progress of the effort, including staffing, scope of work, and budget management.

Team Leader

Don Jackson is a Senior Program Manager with Radian International LLC. He has 25 years of management, technical, and environmental experience in the oil refining manufacturing and processing industries and has developed environmental and technical solutions for a broad range of process industry problems. Mr. Jackson was previously associated with a major U.S. developer of oil shale deposits and worked with an engineering firm on the start-up of the largest operating U.S. shale oil facility. As team leader, he is responsible for overall management of the technical work on the Estonia activity.

Technical/Environmental Specialist

Graham Harris is a chemical engineer with Radian International LLC and has over 25 years of experience in process engineering. Mr. Harris concentrates on process analysis, emission measurement, and emission control technology evaluation in his specialty areas of petroleum refining and organic chemicals. He has worked extensively in the international arena and has performed process analysis for various large industrial facilities in Eastern Europe, including the former East Germany and the Czech Republic. Mr. Harris leads the technical team of EHP staff and local engineers who work with the RAS-Kiviter process management staff.

Technical/Environmental Specialist

Ed Andrechak is a chemical engineer and project manager with Radian International LLC. Prior to joining Radian, Mr. Andrechak worked as a process and environmental project engineer at one of the largest U.S. refineries. He has led numerous process/design optimization projects for various oil refineries, working directly with plant operators to implement process changes. Mr. Andrechak's areas of technical expertise include air issues/permitting, wastewater evaluations, subsurface investigations and remediations, and hazardous waste site evaluations. He leads the EHP team's efforts to locate markets for many of RAS Kiviter's products, identify dephenolization plant improvements, and institute the fuses recycling system at the retorts.

Technical Process Systems Specialist

Doug Swenson was employed by Radian International LLC until May 1995 and served as a member of the EHP team until that time. Mr. Swenson specializes in various refinery and petrochemical processes, and has provided technical assistance on detailed process design and during construction,

pre-commissioning, and start-up of facilities throughout Asia and in Italy, Holland, and Nigeria. As process systems specialist, Mr. Swenson worked closely with the EHP team environmental specialists to assess the feasibility of cogeneration at RAS Kiviter.

Technical Process Systems Specialist

Frank Mansfield joined the EHP team as an independent consultant in August 1995 to assist with the cogeneration project. Mr. Mansfield has over twenty years of experience in operation, maintenance, inspection, and risk analysis reviews of power generation equipment in the United States and overseas. He has been responsible for technical evaluations of the used turbine generator purchased by RAS Kiviter and has worked closely with both RAS Kiviter staff and the local Estonian engineers to manage the installation and start-up of the turbine.

Oil Shale Industry Specialist

Robert Parrish is a chemical engineer with over 22 years of experience in technical program and operations management in the oil shale, petroleum, petrochemical, and mining industries. His areas of expertise include new technology planning and implementation, process development, problem-solving, hazard analysis, and project management. As an independent consultant on the EHP team, Mr. Parrish is providing input on several of the RAS Kiviter activity technical tasks.

Oil Shale Industry Specialist

Jerry Sinor is an internationally recognized technical consultant to the U.S. and overseas oil shale industrial facilities, with 30 years of experience in economic analysis, marketing assessments, environmental planning, energy forecasting, retorting technology, alternative fuels, and chemical process development. As an independent consultant on the EHP team, Dr. Sinor has provided expertise to both the technical and marketing tasks of the activity, assisting in the evaluation and development of marketable products from oil shale.

Financial Specialist

Joseph Murrie specializes in international finance and is an expert in investment analysis, capital markets, and corporate financial reorganization and restructuring. An independent consultant, he has over twenty years of experience in corporate financial consulting and has worked in Asia, Africa, South America, Europe, and the former Soviet Union, including a recent assignment in Lithuania evaluating proposed industrial privatizations. As the team's financial specialist, Mr. Murrie leads the efforts to improve financial management practices at RAS Kiviter.

Management Specialist

Edward Salt is a Vice President and Senior Consultant/Trainer with Training Resources Group, Inc. He has more than 20 years of experience in organizational assessment, management improvement, analysis, and consulting. He specializes in institution building, management systems and skills development, strategic planning, training design, presentation and evaluation, and productivity and quality improvement. As management specialist, Mr. Salt works with RAS Kiviter managers to develop strategies for improving management at the facility.

Marketing Specialist

Art Rowley has over 15 years of experience in providing market assessment for the petroleum production industry worldwide. An independent consultant, he is an expert in developing marketing plans and marketing teams to address the demands of the world market for petroleum products. Mr. Rowley has worked closely with the EHP technical team to assess market potential for RAS Kiviter's oil shale products on the world market and has assisted the RAS Kiviter management team to develop a focused marketing strategy.

Industrial Hygienist

Nancy Orr is a Certified Industrial Hygienist and an independent consultant who specializes in comprehensive environmental health and safety hazard assessment and program development. Ms. Orr was previously responsible for ITT Corporation's worldwide environmental protection efforts, industrial hygiene and safety compliance audit program, and for supporting compliance programs for ITT's diverse operations. As industrial hygienist on the EHP team, Ms. Orr is responsible for improving worker health and safety at RAS Kiviter.

Program Planner

Leslie Wilkinson is an International Specialist with Radian International LLC and serves as a program planner on the EHP team. She has worked on numerous overseas environmental projects, coordinating technical team staffing and facilitating communication between team members and the client. Ms. Wilkinson is also experienced with purchasing and exporting requirements. Her role on the EHP team is to facilitate communication and cohesiveness between the many team members, including the Estonian subcontractors and the RAS Kiviter staff, and to coordinate logistics, compile reports, and procure commodities according to USAID procedures.

Program Planner

David Fernandes is an employee of Camp, Dresser & McKee International who is permanently staffed to the Environmental Health Project. As a program planner on the EHP team, he is responsible for controlling the overall activity budget, managing the editing and final production of all reports, contracting with local consultants in Estonia, purchasing commodities, and organizing all travel arrangements for the team members in conjunction with USAID guidelines.

ACRONYMS

EAP	Environmental Action Program
EHP	Environmental Health Project
ENI	Bureau for Europe and the New Independent States (USAID)
LLC	Limited Liability Company
PPE	Personal Protective Equipment
USAID	United States Agency for International Development

EXECUTIVE SUMMARY

RAS Kiviter, located in Kohtla-Järve (northeast Estonia), is an oil shale retorting and related chemical producing complex that has caused severe environmental impacts and is now struggling to remain viable in the Estonian economy. The U.S. Agency for International Development (USAID) agreed to assist RAS Kiviter to reduce the environmental impacts of its processes and to improve the plant's financial, managerial, and technical viability. USAID requested the Environmental Health Project (EHP) to carry out this work. Phase I of the activity was implemented beginning in October 1994 and ending in February 1996. The activity was budgeted at approximately $900,000, of which approximately $220,000 was targeted for commodities. Phase II will consolidate the progress made in Phase I and firmly establish the process improvements. Phase II will be underway until September 1996.

The EHP team for this activity began work in late October 1994. A five-person team that included four members of the EHP team and the USAID Washington project officer traveled to Estonia from November 14 to 22 to develop an overall activity work plan, which was finalized in December 1994.

The overall objective of this activity was to assist RAS Kiviter to mitigate specific environmental impacts to the Kohtla-Järve region and to help the plant become more economically viable by increasing revenue and decreasing overall production costs.

Objectives were also outlined in the Phase I work plan for each of the eight tasks identified for this activity.

Task 1
Identify product application markets for the phenol-based compounds that RAS Kiviter has demonstrated an ability to produce. A second objective, where feasible and if resources permit, was to identify and develop new phenol-based products that can be derived from the shale oil processed at RAS Kiviter.

Task 2
Gather sufficient information from RAS Kiviter to evaluate the technical and economic feasibility and the environmental benefits of electrical cogeneration at the plant site, specify and locate the cogeneration equipment required, and prepare an investment-grade proposal for funding.

Task 3
Improve the operation of the sulfur recovery process at RAS Kiviter in terms of hydrogen sulfide removal from the retort gas and in terms of quality/marketability of the product sulfur and thiosulfate.

Task 4
Optimize the fuses recycling operation at RAS Kiviter to maximize the amount of fuse material which can be recycled without impacting retort gas quality or causing unacceptable accumulation of material in the retorts.

Task 5
Design a complete system for collection and treatment of storm water runoff from the spent shale piles and implement Phase I and part of Phase II of that design.

Phase I: Design the complete facility and install a pumping station to concentrate spent shale runoff into two existing collection basins.

Phase II: Increase residence time in the basins by creating a long flow path using curtain walls.

Task 6
Reduce worker exposure to toxic chemicals, reduce worker accident rates, and increase worker awareness of health and safety issues.

Task 7
Provide specific accounting and financial/investment analysis support to the technical engineering tasks on this project; introduce cost accounting concepts and methodology to the Accounting Department at RAS Kiviter; improve financial accounting practices, particularly where the financial accounting system interfaces with the cost accounting methods being introduced; and provide technical assistance to establish a basic methodology and format for the preparation of capital investment proposals.

Task 8
Improve the implementation and acceptance of the management restructuring at RAS Kiviter.

Several major goals were realized under Phase I of this activity, as detailed below.

- **Phenol waste reduction through sales contracts.** In January 1996, RAS Kiviter and Georgia Pacific signed a US $750,000 contract, under which the U.S. firm agreed to purchase one quarter of RAS Kiviter's yearly production of alkylresorcinol. Once the delivery schedule has been met to its satisfaction, Georgia Pacific may purchase the entire lot of RAS Kiviter's alkylresorcinol production, a potential yearly contract of US $3 million. This company is also considering a joint venture arrangement with RAS Kiviter to purchase and market all of Kiviter's epoxy resins. These developments represent a major step forward on this task. In addition, four other prospective phenols buyers have been identified, and substantive negotiations for product testing and sales of phenols, including joint venture arrangements, are ongoing and will continue in Phase II. Producing phenols could increase revenues for RAS Kiviter and eliminate these phenol contaminants from the wastewaters.
- **Upgrading power production.** RAS Kiviter purchased a used turbine generator for independent power production at the facility. The EHP team helped Kiviter develop a project team and schedule for refurbishing and installing the generator and identified the equipment needed for installation. This project will continue in Phase II, with startup and final performance testing concluding in September 1996. RAS Kiviter will generate its own power, saving millions of dollars annually in electricity costs. The cogeneration unit is expected to pay for itself during its second year of operation.
- **Testing equipment to improve sulfur recovery.** To improve the sulfur recovery process operation, the EHP team pilot tested an auto-filtration unit to solve the problem of nozzle pluggage which causes the plant to shut down once every three to four months. Tests will determine whether this task will be pursued.
- **Improvement of fuses recycling.** EHP successfully demonstrated a fuses recycling pump at one of the four retorts. As a result, four additional fuses recycling pumps were purchased for installation at the other retorts. Work on this task will continue under Phase II to assist Kiviter to upgrade its other two large retorts, which are not now equipped for recycling. Eight hydraulic cylinders have been purchased and shipped with Phase I funds. Installation of the additional pumps and cylinders will be completed in Phase II, and technical assistance will be provided to Kiviter to design and specify any additional equipment required to outfit the retorts for recycling. Once the recycling equipment is installed and operating effectively, fuse waste should be eliminated, thus avoiding the negative environmental impact of the fuses and recovering more usable shale oil product.
- **Improvement of collection and treatment of spent shale runoff.** Spent

shale wastewater runoff was addressed initially by development of a runoff collection/treatment system. Once the system design was developed, USAID and EHP approached the Finnish Ministry of Environment about their interest in this task, based on previous interest they had expressed. After a joint site visit to Kiviter, the Finns agreed to implement the EHP-designed runoff collection/treatment system in order to reduce the pollution load on the Gulf of Finland. EHP will coordinate with the Finns, and their designated contractor, as they implement this system during 1996. The Finnish support of the runoff collection/treatment system is an excellent example of donor coordination, and allowed EHP to redirect scarce USAID resources to other tasks on the project.

- **Reduction of worker exposure.** Worker exposure to pollutants was reduced through the provision of personal protective equipment (PPE). After the equipment was delivered to Kiviter, the EHP team conducted a one-week worker health and safety training session to improve worker awareness. EHP also identified the worst sites of worker exposure to pollutants.
- **Advanced management restructuring.** Kiviter staff agreed on key actions to move forward with management restructuring. Interviews with Kiviter management indicated problems in such key areas as the interrelationship between the units and the central operations, communication, money flow, and managers' rights and obligations, particularly with respect to finance issues. A two-day offsite management seminar for twenty top managers was held in June 1995 that focused on analyzing and discussing a case study and making agreements about actions that should be taken to move forward with management restructuring. Following the workshop, it was recommended that another be organized in mid-1996 to address issues identified in the first workshop.

In general, the work planned under Phase II will continue progress made under Phase I. With the additional commodities funding available in Phase II, significant process improvements can be accomplished by the conclusion of Phase II, improvements that will have a positive impact on RAS Kiviter's profitability by helping it to increase revenue from phenol products sales and cut costs by producing its own electricity. In addition, completion of tasks under Phase II will significantly reduce RAS Kiviter's negative environmental impact on the region.

1 INTRODUCTION

RAS Kiviter, located in Kohtla-Järve (northeast Estonia), is an oil shale retorting and related chemical producing complex that has caused severe environmental impacts and is now struggling to remain viable in the Estonian economy. The U.S. Agency for International Development (USAID) agreed to assist RAS Kiviter to reduce the environmental impacts of its processes and to improve the plant's financial, managerial, and technical viability. USAID requested the Environmental Health Project (EHP) to carry out this work. Phase I of the activity was implemented beginning in October 1994 and ending in February 1996. The activity was budgeted at approximately $900,000, of which approximately $220,000 was targeted for commodities. Phase II will consolidate the progress made in Phase I and firmly establish the process improvements. Phase II will be underway until September 1996.

1.1 Background

In January 1994, USAID conducted a prefeasibility study of RAS Kiviter as a demonstration project under the Environmental Action Program (EAP), which is designed to help central and Eastern European countries focus their resources and those of donor countries on the most critical environmental health threats. The prefeasibility study took into account previous studies by other donor countries, notably those conducted by Sweden and Finland. The USAID team recommended that the Agency proceed with an assistance program under the EAP framework. A five-person team that included four members of the EHP team and the USAID Washington project officer traveled to Estonia from November 14 to 22 to develop an overall activity work plan, which was finalized in December 1994.

Since the study in January 1994, a number of changes have taken place at RAS Kiviter. The plant was restructured into cost centers (including the three production departments), with an accountant assigned to each one. A marketing director was appointed and a marketing department with seven full-time staff established. A planning/economy department was reconstituted, and production planners assigned to each of the three production departments.

By the time the EHP project had commenced in late 1994, the Benzoic Acid Plant had already been privatized and separated from the rest of the RAS Kiviter plant, in venture with a U.S. company. The Nitro-Fert fertilizer plant that was formerly part of the Kiviter complex was also privatized by the Ministry of Economy, and the nearby RAS Kivioli plant was merged with RAS Kiviter.

In addition, plant operation margins were shrinking due to rising costs. The price of mined shale rose, forcing the plant to squeeze out operational efficiencies and to be more aggressive in selling its products in order to pay the increased cost of raw materials.

The long-range future of the plant remains problematic because of the limited economic viability of the oil shale industry, and support from the Ministry of Economy may be necessary. Nonetheless, it is almost certain the plant will remain open because of its key role in the economy of northeast Estonia. As long as the plant remains open, reductions in harmful environmental impacts and

improvements that help operating profitability should be considered worthy objectives.

1.2 Description of RAS Kiviter

The RAS Kiviter Oil Shale Chemical Plant is an oil shale retorting and related chemical producing complex with operations in two locations, Kiviter and Kivioli. All of the RAS Kiviter operations are located in Kohtla-Järve. The first oil shale retorting plant began operating in Kohtla-Järve in December 1924, and the same basic thermal processing technology is still used at RAS Kiviter today. However, the 35 ton/day Pintich-type retorts characterized by considerable use of manual labor were upgraded in the 1960s to the 1,000 ton/day gas generators, which utilize the annular heating space with cross hot gas flow for heating. The operations include oil shale processing (retorting and upgrading), using domestic oil shale to produce two grades of oil used in a variety of products, including boiler fuel oil; and production of phenol formaldehyde resins, using phenol extracted from cooling water and formaldehyde produced at Kivioli.

The plant's many different process units are spread over a large area. The physical site of the plant is in poor condition. There are many pollution sources, ranging from substantial air pollution to the large mounds of waste materials. Most of the process equipment at the plant is antiquated, creating high-risk working conditions. Process efficiency is often lost due to equipment failure and/or down time for prolonged maintenance. The poor plant conditions have a negative effect on financial performance.

Despite the company's poor financial performance and deteriorating capital base, the Estonian Ministry of Economy appears committed to keeping RAS Kiviter open for socio-political reasons. With support from the Ministry of Economy, in January 1994, the management of RAS Kiviter organized their accounting procedures to measure separate revenues and expenses for the following four profit centers:

- Oil shale processing complex
- Production of aromatic hydrocarbons
- Urea resins and phenol formaldehyde resins
- Production of benzoic acid[1]

In the oil shale processing complex, the oil shale is processed in three retorts, with a capacity of 1,000 tons per day per retort, and in over 40 other smaller retorts. One hundred percent capacity utilization is estimated to be 6,220 tons per day, 365 days per year.[2] Total production in 1993 was 326,500 metric tons.[3] This number dropped considerably in 1994 and 1995, as the benzoic acid plant was sold and the production of aromatic hydrocarbons and phenol products ceased. In 1994 and 1995, Kiviter received the bulk of its revenue from the sale of shale oil derived products, used either as end products or intermediates to produce fuel oils and chemicals. Currently, RAS Kiviter has the capability to produce the following marketable products:

- fuel oil, electrode coke, oil for wood impregnation, antiseptic, refined distillate oil, shale road oil, softener for rubber, anticorrosion mastics;
- urcaaldehyde, phenolformaldehyde, styrene-indene resins;
- shale water soluble phenols (total), alkylresorcinol, 5-methyl resorcinol, epoxy resin, plugging compositions; and
- sodium thiosulphate, sulphur (technical grade).

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[1] Zimmerman, Charles; Miller, Craig; and Tarrant, Jim, "Preliminary Assessment of an Environmental Improvement Project for the Estonian Oil Shale Industry," PRIDE/USAID Report, March 1994, pp. II-9-10.

[2] Ibid., p. II-20.

[3] Ibid., p. II-11.

A portion of water soluble phenols is recovered from the shale oil in the condensation system of the retorts on contact with retort liquid. The total phenol water is subjected to solvent extraction and evaporation to recover the total water soluble phenols. Since 1993, when the Russian markets for many of RAS Kiviter's phenolic products were lost, RAS Kiviter management has not been operating the dephenolization plant to produce the various valuable phenolic streams, which are used mainly for their adhesive properties. As a result, the phenolic water was disbursed to local surface waters. This situation will be alleviated during 1996 as the EHP team continues to help identify other Western markets for these products. According to RAS Kiviter management, the production of phenolic compounds could become the facility's most profitable enterprise.

The estimated number of workers at RAS Kiviter in 1993 (including the workers from RAS Kivioli) was 4,640. Approximately 735 of the employees worked in the retorting and chemical processes; the remaining 3,900 people worked in other plant operations.[4] Most of the workers at Kiviter are chemical engineers or skilled operators. Only a very small staff manages the daily operations of the plant and is involved in marketing, accounting, and corporate management. Since 1993, significant internal changes have occurred in the management structure of RAS Kiviter, although these management changes have not always resulted in changes in the way Kiviter works internally.

The senior management of Kiviter essentially includes the general director and the technical director. The general director is in charge of external (mostly government) relations, corporate planning, and financial matters. The technical director is in charge of internal management and achieving production objectives. He supervises managers who are responsible for the various segments of the plant, such as retorting. Although a marketing department was formed in 1994 that includes a marketing director and seven staff, the general director and the technical director continue to be the key persons dealing with product sales.

The RAS Kiviter management has operated under government ownership, but is petitioning the government to allow privatization of the entire plant in mid-1996. The EHP team is working with the Kiviter management to manage this change and effect a smooth restructuring transition.

1.3 Activity Objectives

The overall objective of this activity is to assist RAS Kiviter to mitigate specific environmental impacts to the Kohtla-Järve region and to help the plant become more economically viable by increasing revenue and decreasing overall production costs.

The activity is related to the following objectives of the Bureau for Europe and the New Independent States (ENI).

Strategic Objectives

Strategic Assistance Area 1: Economic Restructuring. Foster the emergence of a competitive, market-oriented economy in which the majority of economic resources are privately owned and managed.

Strategic Assistance Area 3: Quality of Life/Social Sector Restructuring. Strengthen the capacity to manage the human dimension of the transition to democracy and a market economy, and help sustain the neediest sectors of the population during the transition period.

Program Objectives

1.1. Increased transfer of state-owned assets to private sector.

1.5. A more economically sound and environmentally sustainable energy system.

[4] Ibid., p. II-20.

3.1. Reduce environmental risks to public health.

Objectives were also outlined in the Phase I work plan for each of the eight tasks identified for this activity.

Task 1
Identify product application markets for the phenol-based compounds that RAS Kiviter has demonstrated an ability to produce. A second objective, where feasible and if resources permit, is to identify and develop new phenol-based products that can be derived from the shale oil processed at RAS Kiviter.

Task 2
Evaluate the technical and economic feasibility and the environmental benefits of cogeneration at the plant site, specify and locate the cogeneration equipment required, and prepare an investment-grade proposal for funding.

Task 3
Improve the operation of the sulfur recovery process at RAS Kiviter to increase hydrogen sulfide removal from the retort gas and improve the quality and thereby increase the marketability of the product sulfur and thiosulfate.

Task 4
Optimize the fuses recycling operation at RAS Kiviter to maximize the amount of fuse material which can be recycled without impacting retort gas quality or causing unacceptable accumulation of material in the retorts.

Task 5
Design a complete system for collection and treatment of storm water runoff from the spent shale piles and implement Phase I and part of Phase II of that design.

Phase I: Design the complete facility and install a pumping station to get the spent shale runoff into two existing collection basins.

Phase II: Increase residence time in the basins by creating a long flow path using curtain walls.

Task 6
Reduce worker exposure to toxic chemicals, reduce worker accident rates, and increase worker awareness of health and safety issues.

Task 7
Provide specific accounting and financial/investment analysis support to the technical engineering tasks on this project; introduce cost accounting concepts and methodology to the Accounting Department at RAS Kiviter; improve financial accounting practices, particularly where the financial accounting system interfaces with the cost accounting methods being introduced; and provide technical assistance to establish a basic methodology and format for the preparation of capital investment proposals.

Task 8
Improve the implementation and acceptance of the management restructuring at RAS Kiviter.

1.4 Purpose and Organization of the Report

The purpose of this report is to summarize the activity, explain how the various tasks have evolved, discuss the progress made toward achieving the indicators set out in the work plan, and lay the framework for Phase II.

The report is organized into five chapters. Chapter 1 is an introductory chapter that provides an explanation of the background to this activity, its objectives, and a description of RAS Kiviter. Chapter 2 provides a comprehensive overview of the activity and includes a discussion of how it was originally scoped and planned, the implementation approach taken by the EHP team, including staffing both in the United States and Estonia, and a description of each task. Chapter 3 discusses the results of the activity, which are

based on their impact on environmental problems at the site, on RAS Kiviter's financial viability, and on the plant's management effectiveness. Chapter 4 addresses the next steps that will be taken under Phase II of the activity and how they relate to the progress made under Phase I. Chapter 4 discusses the long-term sustainability of the progress made at Kiviter. The final chapter of the report discusses the lessons learned during this activity, specifically, how the EHP team has worked with the Kiviter staff, the activity design, the team's technical approach to the work, and collaborations with other donors.

2 OVERVIEW OF THE ACTIVITY

2.1 Initial Assessment and Planning

A five person-team traveled to Estonia from November 14 to 22, 1994 to develop an overall work plan for this activity. The team consisted of four members of the Environmental Health Project activity team and the USAID project officer in Washington. The EHP team members included the team leader, the lead technical consultant, and two members of the EHP core staff.

The team divided its work between Tallinn, the capital of Estonia, and Kohtla-Järve. Discussions in Tallinn focused on the perspective of central ministries and the USAID Mission. The team met with representatives of the Chemical Holding Group at the Ministry of Economy and with staff of the Ministry of Environment. The team also spent time identifying local Estonian firms with which EHP could work to implement this project.

The team members spent three days at RAS Kiviter meeting with managers from various departments within the plant: oil shale processing, chemicals production, environmental protection, health, accounting, finance, and marketing. They met with the managing director, the technical director, the marketing director, and the deputies of the accounting and economy departments. The chief accountant and economy director were in the United States at the time for training. Also participating in some of the discussions were staff from the nearby Oil Shale Research Institute. During the three days, the team members interviewed approximately 25 people.

After the discussions at RAS Kiviter, the team returned to Tallinn to meet with additional local firms and to put together a draft work plan, then returned to Kohtla-Järve to present the draft plan and related schedule to senior staff at RAS Kiviter. RAS Kiviter management agreed without exception and made a commitment to provide active staff participation. The deputy director of the technology department was assigned as the primary RAS Kiviter coordinator for the activity. The EHP team also debriefed the USAID representative in Estonia.

Overall Approach

The overall approach to the work plan was based on the following assertions:

- The technical activities directly contributed to reducing environmental impacts.
- The technical activities tried to integrate financial, marketing, and managerial aspects.
- All commodities directly contributed to the eight tasks selected.
- The activities were results-oriented and directly aimed at fostering change within the plant.
- The activities served to demonstrate environmentally sound industrial restructuring to other Estonian industries.
- The plan of activities was flexible since it was anticipated that during the course of the year circumstances would require some modification to the work plan.
- The plan of activities was based on funding for only one phase (through December 1995), with no assurances of funding for a second phase.

- To enhance sustainability, the tasks made extensive use of local consultant resources, working in cooperation with U.S. experts and RAS Kiviter staff.

The team used two primary criteria to select the eight tasks listed in the work plan: first, to improve the operations of the plant; second, to reduce environmental impacts. The highest priority activities were those that met both of these criteria.

The work plan contained eight tasks:

1. Phenol Products Market Development
2. Cogeneration of Electrical Power from Steam Pressure Reduction and Excess Gas Combustion
3. Optimization of Sulfur Recovery System
4. Optimize Recycling of Fuses to Retort
5. Spent Shale Runoff Treatment
6. Worker Health and Safety Improvement
7. Cost Accounting Practices
8. Management Structuring Review

2.2 Implementation Approach

2.2.1 Technical Assistance Team

While the work plan was being developed, the EHP team was being formed. This was an ongoing process throughout Phase I, as the emphasis on various tasks and the technical work involved shifted, based on the priorities of RAS Kiviter. As a result of the varied nature of the tasks, the EHP team drew upon the expertise of consultants with diverse professional strengths. The current team includes experts in the areas of oil shale processing, oil refining process engineering, industrial health and safety, management training, environmental engineering, wastewater engineering, financial/accounting analysis, and project management. All of the consultants are experienced in performing work in developing countries and many of them have worked in Eastern Europe.

A brief description of the team members and their qualifications is provided at the front of this report .

2.2.2 Local Consultants

During the planning trip in November 1994, the EHP team identified a small engineering company, EnPro Engineers, located in Tallinn, to work as the main local subcontractor on this activity. EnPro Managing Director Heinar Nurste took the lead by assisting the EHP team in communications with the RAS Kiviter staff. When necessary, letters were translated into Estonian or Russian before they were sent to RAS Kiviter. Mr. Nurste coordinated all of the trips to Estonia by the EHP consultants, arranged interpretation services, and set up meetings with key RAS Kiviter contacts. EnPro engineers also located and contracted with other local consultants needed, such as staff from the Oil Shale Research Institute, professors from the University of Tartu to work on the wastewater treatment task, and other private consultants.

2.2.3 RAS Kiviter Team

When the EHP team first began working with RAS Kiviter, appropriate key contacts for each of the tasks were assigned to work with the various team members, under the direction of RAS Kiviter Deputy Technical Director Dr. Juri Zhirjakov. In the early months, it was difficult to obtain full commitment from the Kiviter staff to work closely with the EHP team. However, as the activity developed, and as it began to deliver commodities and valuable technical assistance, RAS Kiviter Managing Director Dr. Yuri Soone and Technical Director Mr. Ivar Rooks became more committed to the project. As a result of this increased senior management attention to the activity, other technical staff at RAS Kiviter became more willing to actively participate.

On Task 1, the phenols marketing task, the EHP team initially expected to work with Mrs.

Bolhovotina, the marketing director. However, it became apparent when Dr. Soone, Dr. Zhirjakov, and Mrs. Bolhovotina visited the United States in June 1995 to discuss product sales that Dr. Soone would be responsible for negotiating sales contracts. Since then, Dr. Soone has been very involved in the phenols marketing task. As managing director at RAS Kiviter, Dr. Soone has also been the key contact for Task 8, the management review task. In addition, he has been directly involved in the turbine generator installation project under Task 2 since summer 1995, when his assistance was needed to expedite the purchase of the used turbine. Dr. Soone committed to moving the project forward quickly and to meeting the deadline of September 1996 for completion of Phase II. The main technical contact on the turbine installation project has been the Director of Electricity Generation at RAS Kiviter, Mr. Yuri Utt.

Ms. Pallady has been the main contact person at Kiviter for both the sulfur recovery and fuses recycling tasks. Mr. Rein Rahe has been the key contact on Task 5, the spent shale runoff task. Deputy Chief for Health and Safety Mr. Henno Sallo has been the key contact person for the worker health and safety task, and Director of Economic Planning Mrs. Lea Kiviima has been the main contact for Task 7, the finance task.

2.3 Task Descriptions

The eight tasks identified in the Phase I work plan are described on the following pages. Each is organized into four sections: Task Description, Objectives, Progress Made under Phase I, and Progress Made toward Indicators. In the last section, the indicators are written as outlined in the original work plan, and the progress toward meeting each of them is discussed.

Task 1
Phenol Products Marketing Development

Task Description

The first task, recovering for sale the phenol compounds contained in the retort quench waters, was identified because of its potential to yield both financial and environmental improvements. Following the shale retorting process at RAS Kiviter, quench waters cool the retort overhead gas. Phenol-based compounds are absorbed in this quench water stream. These phenol compounds are then extracted using a mixture of butyl acetate and isopropyl ether. Historically, this extraction step has been followed by a series of distillations to separate various useful phenol product streams. Products from the distillation section are used as intermediates for the production of various epoxy and phenoxy resins.

Currently, the distillation section of the plant is not being operated due to the lack of markets for these compounds. Previously, they were produced solely for downstream uses in the former Soviet Union. With the dissolution of the Soviet Union and emergence of Estonian independence, these markets were lost. It was strongly believed that by developing new markets for these previously manufactured products, RAS Kiviter could benefit financially from their sale. Furthermore, the shale oil processed at RAS Kiviter is high in "resorcinol," which may warrant a premium price due to its desirable characteristics in adhesives and resins applications. At the same time, successful implementation of dephenolization plant improvements will decrease phenols production costs and reduce the phenols concentration in the plant effluent waters.

Objectives

1. Identify product application markets for the phenol-based compounds that RAS Kiviter has demonstrated an ability to produce.
2. Where feasible and if resources permit, identify and develop new phenol-based products that can be derived from the shale oil processed at RAS Kiviter.

Progress Made under Phase I

In the first few months of the project, the EHP team marketing specialist took an aggressive approach to identifying and evaluating numerous potential buyers of RAS Kiviter's phenol products. The approach later shifted from locating all potential buyers of Kiviter's phenols to a more concentrated effort to qualify the leads and facilitate negotiations between buyer and seller.

Four potential natural phenols customers were identified from screening more than 30 companies worldwide. Specifically, these companies and the phenols streams in which they are interested are the following:

- Coalite in the U.K. - Unfractionated Total Phenols
- Deza in the Czech Republic - 180°-270° C Fraction
- Georgia Pacific Resins in the U.S. - Alkyresorcinols
- Plastics Engineering in the U.S. - 5-Methylresorcinol (very pure grade)

A fifth company, Krems-Chemie in Austria, also expressed interest in working with Kiviter to jointly develop additional markets for phenol-formaldehyde and urea-formaldehyde resins.

In January 1996, the EHP task leader accompanied Georgia Pacific, a U.S. resins manufacturer, to the RAS Kiviter plant. This company had already purchased large test quantities of the alkylresorcinols and were interested in exploring an exclusive purchasing relationship for this compound with RAS Kiviter. Negotiations were held with the senior management of RAS Kiviter, and a US $750,000 contract was signed whereby the U.S. manufacturer agreed to purchase one quarter of RAS Kiviter's yearly production of alkylresorcinol. Once the delivery schedule has been met to its satisfaction, the U.S. manufacturer is interested in purchasing the entire lot of RAS Kiviter's alkylresorcinol production, a potentially yearly contract of US $3 million. The company is also considering a joint venture arrangement to purchase and market all of RAS Kiviter's epoxy resins. These developments represent a major step forward on this task.

Commodities purchased under Task 1 include a specialized distillation column for the production of currently manufactured and new phenols sample materials to support the market development process, and subscriptions to various electronic marketing information services.

The original Phase I scope of work included plans for the optimization and improvement of the dephenolization plant. It was agreed early in Phase I that this work would be deferred until viable phenols customers could be identified. Now that four potential customers have been identified and one large sale has been made, the dephenolization plant improvement work will take place as part of Phase II.

One of the most important issues to arise under Phase I was the subject of cost accounting and the resultant ability to accurately (based on Western accounting principles) calculate production costs for total phenols and the various fractions of phenols. This information is essential to determine the best (most profitable) short- and long-term sales strategy for the phenol products. Under Phase I, the EHP team was not able to determine the process by which these numbers were derived. A cost accounting review for the fractionation operation will be performed in Phase II to determine the most profitable fractions for market development.

Progress toward Indicators

Listed below are the task indicators as described in the work plan and an update on the team's progress toward meeting these indicators.

1. **Sale of initial production lots of phenolic compound products.** As stated above, a US $750,000 contract has been signed under which a U.S. manufacturer will purchase alkylresorcinol, with the potential for purchasing four times the initial amount. Four other potential clients have been identified.
2. **Strengthening Kiviter marketing staff: methods, database of contracts, international network.** The process to assist the RAS Kiviter marketing staff to understand how to negotiate and deal with people and companies from market-oriented economies is ongoing and moving forward. EHP has provided the Kiviter marketing staff with resources such as buyers, world market price guides, and electronic marketing subscriptions.
3. **Lower phenols in dephenolized water by 25% on a weight basis through product recovery.** Facilitating the sale of alkylresorcinol has been the first step toward meeting this indicator. As stated above, the original Phase I scope of work included plans for the optimization and improvement of the dephenolization plant. Now that four potential phenol customers have been identified and one large sale has been made, the dephenolization plant improvement work will take place as part of Phase II. The process improvements in

the dephenolization plant to be implemented in Phase II will achieve a reduction of phenols in the dephenolized water from 0.3 g/L to 0.2-0.25 g/L.

Task 2
Cogeneration of Electrical Power from Steam Pressure Reduction and Excess Gas Combustion

Task Description

This task could potentially bring about both environmental and financial improvements. Currently, the steam created by the operating boilers is dropped in pressure to lower useable levels by using pressure reducing valves. The pressure differentials are sufficient to drive moderate scale cogeneration equipment. In addition, there is a surplus of fuel gas to fire the boilers and excess capacity in the boiler system to utilize this fuel to create more steam for useful purposes (e.g., cogeneration). The price of power from the state utility (Eesti Energia) is expected to increase by a factor of four in the next few years, a strong incentive for the RAS Kiviter facility to become electrically independent and perhaps even a seller of electrical power.

The environmental benefits of cogeneration would stem from the controlled combustion of the surplus fuel gas in the boilers and the reduced emissions from the state utility power plants because of the lessened demand.

Objectives

1. Evaluate the technical and economic feasibility and the environmental benefits of cogeneration at the plant site.
2. Specify and locate the cogeneration equipment required.
3. Prepare an investment grade proposal for funding of cogeneration at the facility.

Progress Made under Phase I

The objectives were completed by mid-June 1995. Late in the second quarter, Kiviter decided, on the recommendation of EHP, to purchase a used turbine generator that the EHP team located in Germany, which would save the facility millions of dollars in electricity costs. The cost of the equipment was very low. In August, RAS Kiviter management staff made several trips to Germany, accompanied by EHP team members, to negotiate the terms of the sale with Siemens and to expedite the dismantlement and shipment of the turbine to Estonia.

The turbine arrived in Estonia in September. Siemens refurbished the rotor in Germany and shipped it to Estonia in November. The EHP team provided project management and technical support to RAS Kiviter to assist them to develop a master plan and schedule for the turbine installation, purchasing project management software for RAS Kiviter and spending several days in Estonia with the plant staff and local subcontractors developing a master schedule.

During the third quarter, USAID and the EHP team determined to continue to provide technical assistance and commodities to assist RAS Kiviter to install the turbine generator, which is scheduled to be completed in September 1996. EHP is also funding the local engineering design work and providing support to guide the project through completion.

Commodities support under this task included payment for the transport of the turbine from Germany to Estonia and electric cable that will feed the cogeneration electric power from the turbine generator site to the main substation.

Progress toward Indicators

Listed below are the task indicators as described in the work plan, followed by a brief description of the team's progress toward meeting these indicators.

1. **Feasibility for cogeneration with procurement specifications.** Feasibility for cogeneration at RAS Kiviter was confirmed early on in this project and procurement specifications were written in the first quarter.
2. **Investment grade proposal.** The investment grade proposal was completed in June 1995 and was presented to several possible investors in Scandinavia. Since the team was able to locate a used turbine in Europe that RAS Kiviter could purchase on its own, an investor is no longer necessary.

Task 3
Sulfur Recovery Optimization

Task Description

This task has the potential to provide significant environmental benefits, but it does not directly improve RAS Kiviter's financial situation. The product gas from the oil shale retorts contains from 8 to 10 grams of sulfur compounds per cubic meter. The RAS Kiviter facility includes a sodium arsenate liquid redox sulfur recovery process that typically reduces the product gas sulfur content to around 2 grams per cubic meter. Any residual sulfur compounds remaining in the gas are emitted as sulfur dioxide when the gas is burned. The sulfur that is removed is recovered as elemental sulfur, which was previously used to produce sulfuric acid. However, there is currently no market for the product sulfur, half of which is too contaminated with arsenic to be anything but waste. Even the purer sulfur is being land disposed as a waste. This task aimed to optimize the operations of the existing sulfur recovery unit to reduce sulfur dioxide emissions from gas combustion, improve sulfur product quality to a marketable level, and find markets for the sulfur, resulting in reduced air pollution and hazardous waste and in increased income.

Objectives

Improve the operation of the sulfur recovery process at RAS Kiviter, in terms of hydrogen sulfide removal from the retort gas and in terms of the quality/marketability of the product sulfur and thiosulfate.

Progress Made under Phase I

The team investigated the substitution of a vanadium-chemistry process for the current arsenic-chemistry process. The conclusion was that while technically feasible, the vanadium process would significantly increase chemical make-up costs and that it would be more cost-effective to make small improvements in the arsenic process.

In an effort to improve RAS Kiviter's sulfur recovery process operation by removing hydrogen sulfide from the retort gas, the EHP team purchased and installed an auto-filtration unit at the sulphur recovery plant. The filtration unit was recommended for a pilot test on a slipstream of the solution. The pilot filter was believed to help solve the problem of nozzle pluggage, which causes the plant to shut down once every three to four months so that the output nozzle can be cleaned manually. Debris from the open pit sumps throughout the plant blocks the 3/8" hole and causes additional build-up, eventually plugging the nozzle.

The filter was installed in October 1995 and has been operating for approximately four months. Part of the Phase II effort will be to evaluate the effectiveness of the pilot filter and decide whether or not to fund the installation of commercial-scale filters to reduce plugging. The filters would not be intended to solve all of the problems at the Thylox unit, but would result in a small improvement in the sulfur removal efficiency.

Progress toward Indicators

Listed below are the task indicators as described in the work plan and a description of the team's progress toward meeting these indicators.

1. **Reduction of 20% in H_2S in retort gas to boilers.** Although accomplishment of this goal will need to be confirmed after the pilot test of the in-line filters, it is expected

that this process modification will yield an increased removal efficiency over a longer period of time, which will in turn reduce the sulfur content in the retort gas by at least 20%. Under the current setup, when the nozzles are clear, removal efficiency is at about 77%, but as they get plugged, the removal efficiency drops to about 60%. It is expected that the self-cleaning filters will maintain the removal efficiency at about 77% for the longer term.

2. **Increase of 20% purity in sulfur recovered.** The EHP team reviewed RAS Kiviter's plans to install a sulfuric acid wash system and concluded that Kiviter will be able to increase the purity in sulfur recovered, probably by more than 20%.
3. **Sale of sulfur product at 50% over current prices.** The EHP team concluded that increasing the sale prices by 50% is not practical. The 60 EEK (approximately US $5) price that Kiviter last received in the Amsterdam spot market is similar to that for liquid redox sulfur in the United States and is probably the best price it will be able to receive for this product.

Task 4
Optimize Recycling of Fuses to Retorts

Task Description

This task could yield both environmental and financial improvements. Recycling the fuses to the retorts eliminates them as a waste product. An average of 1.125% fuses are produced from the average plant rate of 5,480 tons/day (TPD). Historically, the fuses have been disposed in a nearby waste shale pile, runoff from which has potentially contaminated the groundwater in the subsurface beneath the pile as well as other water collection systems. The financial benefits of recycling the fuses are increased product yields resulting from a greater utilization of the shale material.

Objectives

Optimize the fuses recycling operation to maximize the amount of fuse material that can be recycled without impacting retort gas quality and or causing unacceptable accumulation of material in the retorts.

Progress Made under Phase I

Early in the activity, EHP determined that new fuses recycling pumps were needed at each of the three 1,000-ton/day retorts to more efficiently recycle the fuses back to the retorts. A test pump was purchased and installed by June 1995 and the EHP team determined that the pump design was sufficiently sized to handle the entire daily production of fuses to be recycled to the retorts.

As a result, four additional pumps were purchased, two for installation at the other two 1,000-ton/day retorts, one to serve a collection of smaller retorts, and one spare, in lieu of purchasing key replacement parts for the other pumps.

The EHP team was also tasked with putting together a more focused test plan to validate RAS Kiviter's ability to increase its fuses recycle rate and to determine what percentage of the total feed stock can be recycled as fuses. This was originally scheduled to take place in the third quarter of 1995, but was postponed until February 1996, due to the unforseen prolonged shutdown of the 1,000 ton retort where the fuses pump was installed in June. The EHP team oil shale industry process expert conducted the test with Dr. Yefimov and RAS Kiviter staff after the retort was back on line in February.

During the fourth quarter of 1995, it was also determined that technical assistance and commodities assistance to help RAS Kiviter upgrade the other two 1,000-ton retorts would allow them to move forward quickly to install the recycle pumps. The EHP team purchased eight hydraulic cylinders (four per retort) for the fuses injection system. The cylinders are the driving mechanisms to "spray" the fuses back into the retort once they have been pumped back up to the feed system. The hydraulic cylinder depresses a plunger that is filled with the fuses, which are then spread across the top of the bed in the retort. Other commodities purchases and additional technical assistance to help RAS Kiviter upgrade the retorts will be provided under Phase II funding.

Progress toward Indicators

Listed below are the task indicators as described in the work plan and a brief report on the team's progress toward meeting these indicators.

1. **Achieve recycle of fuses to substantial extent.** This was not achieved due to shut

down of the plant, but tests conclude that this goal will be met. After RAS Kiviter staff install the four recycle pumps on all of retorts as planned, Kiviter will be able to recycle the bulk of its fuses.

2. **Determine maximum recycle with regard to product.** It is expected that the EHP team will assist the Kiviter staff to double the maximum recycle of fuses from 1% to 2% (the appropriate amount generated in the retorting process). By increasing the fuses injection rate to 2% on the three 1,000 TPD retorts, almost the entire plant production of fuses (60 TPD of fuses) will be recycled. This will almost eliminate the fuses as a waste product.

Task 5
Spent Shale Runoff Collection and Treatment

Task Description

This task has the potential to produce significant environmental improvements, but, other than through reducing emission fees, does not directly improve Kiviter's financial situation. Currently, spent shale from the retorts is conveyed to disposal piles on the Kiviter property that have reached heights of over 100 meters. The spent shale contains residual organic compounds, including water soluble phenols. Rainwater runoff from the shale piles is therefore contaminated with phenols. The problem is worsened by the use of phenolic quench water to sluice the spent shale and make it easier to handle, which increases the phenol loadings and the water runoff rates. The disposal of fuses on the shale pile is an additional source of phenols. The runoff collects in a wide ditch on the down-gradient side of the shale piles and drains to the Kohtla River, then to the Purtse River, to the Gulf of Finland, and eventually to the Baltic Sea. The phenols cause major environmental problems, contaminating drinking water along the watershed of the two rivers, devastating marine life in the Kohtla and Purtse Rivers, and damaging marine life and the fishing industry throughout the Baltic area. Implementation of this task could significantly reduce these negative impacts.

The scope of this task was to design a collection and treatment system for the spent shale runoff.

Objectives

1. Design a complete system for collection and treatment of storm water runoff from the spent shale piles.
2. Implement Phase I and part of Phase II of that design.

- Phase I: Design the complete facility and install a pumping station to get the spent shale runoff into two existing collection basins; and
- Phase II: Increase residence time in the basins by creating a long flow path using curtain walls.

Progress Made under Phase I

Under the direction of the EHP technical/environmental specialist, most of the technical work on this task was allocated to local Estonian consultants who had already been working on this issue for some time. It was agreed that the Enno Projeckt Ltd. (Mr. Enno Kirt and Dr. Aleksander Maastik) would work on the treatment plant design (both simple and more sophisticated versions) and Professor Toomas Tenno of the University of Tartu would conduct treatability studies to predict the phenol reduction that could be achieved by various configurations of the biological treatment of the runoff water from the spent shale piles at RAS Kiviter.

In early April 1995, the EHP team received technical specifications from Mr. Kirt and Dr. Maastik for the electric water pumps and curtain walls for the collection basins, which were to be the commodities purchased under this task. The EHP team then explored the possibility of finding U.S. vendors for these items.

During the second quarter, it became apparent that additional technical assistance would be required to implement the turbine generator task (in light of the purchase of the turbine generator equipment by RAS Kiviter). In order to have sufficient resources necessary for the cogeneration task, it was necessary to reallocate funds from this task, making it impossible to complete all of the task goals.

However, the EHP team prepared a grant funding proposal and completed the technical design of the proposed spent shale runoff collection and treatment system to present to other donors.

The proposal was presented to several Scandinavian donors, including the Finnish Ministry of Environment in August 1995. In October, a follow-up meeting was scheduled in Estonia with the Finns to conduct a site inspection at RAS Kiviter. Subsequently, the Finns decided to fund the project and purchase the required curtain walls and pumping systems for the collection basins. To assist the Finns, USAID agreed that Mr. Kirt, Dr. Maastik, and Professor Tenno would complete their work on the treatment plant design in conjunction with the Finns. The EHP team agreed to coordinate with the Finns as they implement the shale pile runoff project.

Progress toward Indicators

Listed below are the task indicators as described in the work plan and a brief report on the team's progress toward meeting these indicators.

1. **Design, procure, and install pumping station for spent shale runoff.** Local consultants completed the design for the pumping stations but did not purchase commodities or install any equipment.
2. **Design, procure, and install internal curtain walls in spent shale runoff basins.** Local consultants completed the designs for the curtain walls. Since the project effort will be implemented by the Finns, EHP did not procure or install the curtain walls.
3. **Lower phenol content of runoff effluent by additional 30%.** This indicator should be realized by the implementation of the project by the Finns.
4. **Proposal for completion of spent shale runoff treatment system.** This was successfully completed and the project was undertaken by the Finnish Ministry of Environment.

Task 6
Worker Health & Safety Improvements

Task Description

This task was designed to improve the health and safety of RAS-Kiviter's workers by reducing worker exposure to toxic chemicals, lowering worker accident rates, and increasing worker awareness of health and safety issues. From previous visits to the facility, it was evident to the EHP team that hazards exist in virtually all aspects of worker activities. The challenge in this task was to identify which hazards posed the greatest risks and determine how these hazards could be addressed through the purchase of personal protective equipment (PPE) and/or management and worker health and safety training.

In this task, the EHP team assessed hazards and identified PPE needed to protect workers from these hazards through a two-step process; identification of and assessment of hazards, and selection of PPE that is effective at protecting workers.

Objectives

Reduce worker exposure to toxic chemicals, lower worker accident rates, and increase worker awareness of health and safety issues.

Progress Made under Phase I

A hazards assessment of the Kiviter plant was completed in June 1995. After an overview by the Safety Department, the EHP industrial hygienist participated in a walk-through survey. She visited most functional units and observed workers performing their tasks. She also interviewed unit technical directors and workers to learn more about the type and frequency of their tasks. The consultant visited the infirmary to examine the accident and injury log and discuss injury trends. She collected a limited number of point-in-time (grab) air samples using colormetric detector tubes.

The remainder of the first visit was spent understanding the existing health and safety programs and procedures and discussing the current inventory of health and safety equipment. Discussions were held regarding which strategies would be most likely to motivate workers to use the personal protective equipment in preparation for the health and safety training scheduled for year-end.

Many of the health and safety risks facing the Kiviter workers are well understood and have been identified by the Safety Department. Appropriate personal protective equipment for each task has been identified and, at some time in the past, supplied. The current inventory, however, is extremely low and comprises a limited number and type of older items that are not as effective as equipment that has been developed in the past 15 years. Some of the equipment is completely ineffective for the exposure level for which it is now being used.

In addition to upgrading and updating the personal protective equipment in the high hazard areas already identified in the plant (coke, aromatic, resin, and desulfurization units), high quality protective devices for maintenance and cleanup crews was highly recommended.

Additional measures are necessary to develop confined-space entry procedures and provide appropriate safety equipment. There are numerous vessels, pits, boilers, and other confined spaces that are entered for routine and nonroutine tasks without benefit of atmospheric testing, ventilation, supplied breathing air, or rescue apparatus.

The Kiviter operations present unique risks to maintenance and cleanup crews in most oil

shale processing and chemical plant areas. Because the equipment is old and generally in a poor state of repair, maintenance workers are frequently required to perform many emergency and nonroutine procedures and repairs which result in chemical, thermal, and mechanical exposures and accidents. Cleanup procedures conducted at least daily include manual sweeping and shoveling in the retort buildings, resin plant, and shale processing areas, activities which release potentially high dust and chemical exposures.

During the third quarter, the EHP team developed a list of appropriate personal protective equipment for purchase and supply to Kiviter workers that included respirators, gloves, goggles, face shields, fall protection harnesses, hearing protectors, splash aprons, and jackets.

Worker health and safety training was conducted at Kiviter during the first week of December 1995 to address the care of personal protective equipment and safe work practices. Key workers, supervisors, and unit heads were identified for participation in the training. Twenty-five staff members attended the workshop, most of them managers representing various areas of the facility. The intent was to extend the benefits to a wider audience by training supervisors. Topics covered included:

1. A review of the hazard assessment results
2. A review of the types of hazards identified
3. A discussion of the role of work practices, engineering, and administrative controls
4. A discussion of the role of PPE
5. A review of the selection, care, maintenance, useful life, and disposal of PPE

Although EHP was initially told that workers would be reluctant to use PPE, this proved not to be the case. Kiviter workers found the U.S. equipment to be comfortable and high quality and were very willing to use it. The cooperation of Kiviter's Safety Department has also led to encouragement of workers to use the PPE.

Progress toward Indicators

Listed below are the task indicators as described in the work plan and a brief report on progress toward meeting these indicators.

1. **Reduce worker exposure in high-risk operating facility sites.** Through the hazard assessment performed in June 1995, the EHP consultant determined the areas within the plant where worker exposure can be classified as high risk. EHP purchased personal protective equipment that will help achieve reduced exposures in these high-risk areas.
   - All 26 coke oven workers in the coke departments are now wearing heat proximity suits that protect them from excessive radiant heat exposures; aluminized gloves that protect their skin from direct contact with hot surfaces; ear muffs, which protect them from high noise levels associated with resurfacing the coke oven walls; safety glasses, which protect them from eye contact with hot metal particles and dust; and chemical resistant gloves, which protect them from dermatitis and skin cancer as a result of skin contact with petroleum products. Seventy-five percent of the remaining coke department workers now have ear plugs and safety glasses.
   - All 30 workers in the styrene department are now wearing air-purifying respirators that provide protection against this suspected carcinogen and known skin sensitizer.
   - All of the sulfur plant workers involved in soda ash handling are now provided with an ambient air source of breathing air and a full-face respirator.
   - All 6 maintenance workers who work at dangerous heights are now equipped

with state-of-the-art fall protection systems.

- All 224 aromatic hydrocarbon department workers now have half-face air-purifying respirators to prevent them from inhaling carcinogens.
- Forty percent of the laboratory workers are now equipped with chemical splash gloves and chemically resistant gloves.

2. **Implement PPE and production training in those high-risk areas.** PPE purchases will continue under Phase II funding. Training in the larger issues of management commitment to worker health and safety at RAS Kiviter will also be addressed in Phase II.

Task 7
Financial and Accounting Technical Assistance

Task Description

This task was originally intended to focus on strengthening several key financial systems, including cost accounting, financial accounting, financial planning, and capital investment analysis. However, after a detailed review, EHP determined that the focus of the task should be more limited, concentrating instead on specific issues such as the development of the cogeneration investment proposal.

Objectives

The objectives of this task are:

1. Provide specific accounting and financial/investment analysis support to the technical engineering projects considered and/or implemented by EHP.
2. Introduce cost accounting concepts and methodology to the RAS Kiviter Accounting Department.
3. Improve financial accounting practices, particularly where the financial accounting system interfaces with the cost accounting methods being introduced.
4. Provide technical assistance to establish a basic methodology and format for the preparation of capital investment proposals.

Progress Made under Phase I

The EHP financial specialist made two visits to Estonia, in December 1994 and February 1995. He conducted an in-depth review of financial accounts and reports and discussed and reached agreement with RAS Kiviter personnel on a preliminary finance and accounting scope of work. He held meetings with the head of the Accounting Department and it became apparent that through the management reorganization at Kiviter, an entire revision of the accounting and financial systems had been accomplished.

Thus the focus of this task shifted to providing capital investment analysis to the technical tasks. Financial analysis was provided in April 1995 to the cogeneration investment proposal.

Upon request from Kiviter, the EHP team purchased 10 new 486 computers, monitors, network hardware, and a laser printer for senior Accounting and Economic Planning Department staff. This hardware upgrade was necessary because Kiviter is in the process of installing an Estonian-written financial accounting and reporting software system.

Progress toward Indicators

Listed below are the task indicators as described in the work plan and a brief report on progress toward meeting these indicators.

1. **Implement cost accounting system.** An accounting workshop at RAS Kiviter had been considered to convey cost accounting concepts and methodologies to the accounting department heads at the plant. Under Phase II, a review of existing cost accounting practices will be undertaken in conjunction with Task 1, the phenols marketing task.
2. **Kiviter able to prepare investment grade proposal (project finance and capital investment analysis).** Under this task, investment grade proposals were not performed directly with the RAS Kiviter staff, but in conjunction with the other consultants on this project for specific technical tasks (i.e., cogeneration, phenols).

3. **Kiviter able to prepare 1995 statutory financial reports.** Kiviter has the accounting systems and skills in place in order to generate financial reports.

Task 8
Management Restructuring Review

Task Description

The eighth task focused on assessing the status and progress of the major reorganization that is taking place at RAS Kiviter. New organizational, functional, and operational concepts have been introduced and need to be embraced, continued, and supported. This task reviewed what occurred in the restructuring process and identified a number of problems. A workshop was held to begin to address those problems.

Objectives

Improve the implementation and acceptance of the management restructuring at RAS Kiviter.

Progress Made under Phase I

In January 1995, the EHP team interviewed key management staff at RAS Kiviter. The interviews explored the staff members' perspectives on the intent of the restructuring, asked for their views on the impact of the restructuring on various units, and examined problems that were hindering the effective implementation of the restructuring process. The interviews identified a number of problem areas, including lack of clarity about intra-department money flow and the need to develop better relationships between production units and centralized functions. Six months later, another series of interviews were conducted. Data from the interviews indicated that most managers had seen significant progress in restructuring, but that problems continued in such key areas as the relationships between the units and central operations, communication, money flow, and managers' rights and obligations, particularly regarding finance issues.

Based on the data from both rounds of interviews, a two-day offsite management seminar for twenty top RAS Kiviter managers was held in June 1995. The seminar focused on analyzing and discussing a case study and making agreements about actions that should be taken to move forward with management restructuring. The case study was based on a Hungarian petrochemical plant that had been through a major restructuring, and was written by a Hungarian consultant who participated in the seminar. Following the workshop, a number of recommendations were discussed regarding how the EHP activity could continue to assist RAS Kiviter in management restructuring.

In October 1995, the managing director of RAS Kiviter said that the management seminar had made an important contribution to restructuring the facility and that there was still a need for additional assistance in Phase II. The objective of this task would remain the same—to improve the implementation and acceptance of the management restructuring underway at RAS Kiviter. Changes of the type being implemented at Kiviter require time. EHP believes that another seminar which brings together the top managers will be an important step in continuing to gain acceptance of a new way of doing business. The primary efforts in the Phase II scope of work are to carry out a follow-up series of interviews assessing the status of restructuring and problems that impede it and to design and conduct a management seminar to address the issues identified. A second workshop would provide an open, participative opportunity for managers to discuss important issues and identify possible courses of action.

Progress toward Indicators

Kiviter staff have developed an action plan that addresses those key issues that are inhibiting progress toward management restructuring. This action plan was developed during the June management seminar, and progress will be made toward addressing these issues in the subsequent training provided by the management specialists in Phase II.

3 RESULTS

3.1 Summary of Key Results

Several major goals were realized under Phase I of this activity, as detailed below.

- EHP's efforts to identify purchasers of Kiviter's products resulted in a US $750,000 contract, signed in January 1996. Georgia Pacific agreed to purchase one quarter of RAS Kiviter's yearly production of alkylresorcinol. Once the delivery schedule has been met to its satisfaction, the U.S. manufacturer may purchase the entire lot of RAS Kiviter's alkylresorcinol production, a potential yearly contract of US $3 million. Georgia Pacific is also considering a joint venture arrangement with RAS Kiviter to purchase and market all of Kiviter's epoxy resins. These developments represent a major step forward on this task. In addition, four other prospective phenols buyers have been developed and explored, and substantive negotiations for product testing and sales of phenols, including joint venture arrangements, are ongoing and will continue in Phase II. Producing phenols could increase revenues for RAS Kiviter and eliminate these phenol contaminants from the wastewaters.
- RAS Kiviter purchased a used turbine generator for independent power production at the facility. The EHP team located the turbine and helped Kiviter develop a project team and schedule for refurbishing and installing the equipment. This project will continue in Phase II, with startup and final performance testing concluding in September 1996. RAS Kiviter will generate its own power, saving millions of dollars annually in electricity costs. The cogeneration unit is expected to pay for itself during its second year of operation.
- To improve the sulfur recovery process operation, the EHP team pilot tested an auto-filtration unit to solve the problem of nozzle pluggage, which causes the plant to shut down once every three to four months. Tests will determine whether this task is to be pursued in Phase II.
- EHP successfully demonstrated a fuses recycle pump at one of the four retorts. As a result, four additional fuses recycling pumps were purchased for installation at the other retorts. Work on this task will continue under Phase II to assist Kiviter to upgrade its other two large retorts, which are not now equipped for recycling. Eight hydraulic cylinders have been purchased and shipped with Phase I funds. Installation of the additional pumps and cylinders will be completed in Phase II, and technical assistance will be provided to Kiviter to design and specify any additional equipment required to outfit the retorts for recycling. Once the recycling equipment is installed and operating effectively, fuse waste should be eliminated, thus avoiding the negative environmental impact of the fuses and recovering more usable shale oil product.
- Spent shale wastewater runoff was addressed initially by development of a runoff collection/treatment system. Once the system design was developed, USAID and EHP approached the Finnish Ministry of Environment about their interest in this task, based on previous interest they had

expressed. After a joint site visit to Kiviter, the Finns agreed to implement the EHP-designed runoff collection/treatment system in order to reduce the pollution load on the Gulf of Finland. EHP will coordinate with the Finns, and their designated contractor, as they implement this system during 1996. The Finnish support of the runoff collection/treatment system is an excellent example of donor coordination, and allowed EHP to redirect scarce USAID resources to other tasks on the project.

- Worker exposure to pollutants was reduced through the provision of personal protective equipment (PPE). After the equipment was delivered to Kiviter, the EHP team conducted a one-week worker health and safety training session to improve worker awareness. EHP also identified the worst sites for worker exposure.
- Kiviter staff agreed on key actions to move forward with management restructuring. Interviews with Kiviter management indicated problems in such key areas as the interrelationship between the units and the central operations, communication, money flow, and managers' rights and obligations, particularly with respect to finance issues. A two-day offsite management seminar for twenty top managers was held in June 1995 that focused on analyzing and discussing a case study and making agreements about actions that should be taken to move forward with management restructuring. Following the workshop, it was recommended that another be organized in mid-1996 to address issues identified in the first workshop.

These results can be grouped into three categories: 1) impact on environmental problems; 2) impact on Kiviter's financial viability; and 3) impact on Kiviter's management effectiveness. A discussion of how the project's accomplishments have met these criteria is provided below. The relationship is also presented in Table 3-1.

3.2 Impact on Environmental Problems

Three of the tasks identified under this activity were implemented primarily for their environmental benefits. The optimization of the sulfur recovery system was designed to address inefficiencies in the sulfur removal system at RAS Kiviter, with the objective of reducing sulfur dioxide emissions from gas combustion. Currently, the sulfur is being land disposed for lack of a market. The EHP team has piloted technology at the sulfur recovery unit. This technology was evaluated in the early months of Phase II and it was successful. The result will be increased sulfur removal efficiency over a longer period of time, which will in turn reduce sulfur content in the retort gas by at least 20%.

The task to optimize recycling of fuses to the retorts is another primarily environmental task. By recycling the fuses to the retorts, they are eliminated as a waste product. Historically, the fuses have been disposed in a nearby waste shale pile. Runoff from this pile has potentially contaminated the groundwater in the subsurface beneath the pile as well as other water collection systems. Under Phase I, the EHP team accomplished an increase in the amount of fuses recycled back to the retort at the retort where the new pump is installed. By the conclusion of Phase II in September 1996, after all of the retorts have been outfitted with pumps, the system will have the potential for a near-100% recycle rate of fuses back to the retorts.

The recycling will solve the problem of additional fuses being added to the spent shale pile, but does not address the problem of treating rainwater runoff from the existing shale pile that is contaminated with phenols. This issue was addressed under the spent shale runoff treatment task. The EHP team intended to design a collection and treatment system and

to implement the first phases of this design by purchasing curtain walls and pumping stations. However, the budget under Phase I was reallocated to increase assistance with installation of the turbine generator. The EHP team prepared a project proposal for the shale pile runoff system and presented it to several donors, including the Finnish Ministry of Environment, which decided to undertake the project. The Finns have an interest in completing this task because the resultant pollution eventually empties into the Gulf of Finland and the Baltic Sea and creates a major environmental problem. This accomplishment is an excellent example of donor coordination.

Other tasks also could result in environmental improvements. The development of a market for RAS Kiviter's phenols products will provide the justification for start-up of the dephenolization unit, which extracts the phenol compounds from the quench water stream. The installation of the turbine generator provides environmental benefits that stem from the controlled combustion of the surplus fuel gas in the boilers and the reduction of emissions from the state utility, as demand from its shale-fired power plants is diminished.

3.3 Impact on RAS Kiviter's Financial Viability

The other overall objective of the RAS Kiviter activity was to improve the financial status of the facility. Two of the tasks directly relate to this objective: (1) cogeneration of electrical power from steam pressure reduction and excess gas combustion and (2) phenol products marketing development. RAS Kiviter's purchase of the steam turbine generator shows management's commitment to Kiviter's long-term economic viability. The upfront costs for the purchase, refurbishment, installation, and start-up of the used turbine are minor compared to the long-term savings RAS Kiviter will achieve by not having to purchase power from the grid. After start-up, scheduled for September 1996, it is estimated that the system will pay for itself within one year, saving RAS Kiviter millions of dollars in electricity costs.

The phenols market development task will also affect RAS Kiviter's financial viability over the long term. The EHP team identified five potential customers of RAS Kiviter's phenolic compound streams, and the consultants continue to nurture these relationships to complete another sales agreement in 1996. The agreement with a U.S. resins manufacturer to purchase US $750,000 worth of RAS Kiviter's alkylresorcinol, with an option to purchase the entire production lot, worth about US $3 million annually, will benefit the company financially.

Other tasks also have the potential to produce financial gains. Recycling the fuses back to the retorts should increase product yields by more completely utilizing the shale material. The worker health and safety improvements should lead to decreased worker accident rates, with the financial benefit of more efficient workers and fewer worker days lost to illness and injury. The management restructuring technical assistance should also result in financial gain as management becomes better organized and motivated toward making RAS Kiviter a profitable business.

3.4 Impact on RAS Kiviter's Management Effectiveness

The most obvious task that contributes to RAS Kiviter's management effectiveness is the management training provided under Task 8. It was determined early in the activity that many senior managers resisted the restructuring. The first management training program provided a venue for managers to express their opinions about how restructuring should be organized. Teams were organized to address various issues and a plan was developed that the managers could follow to ease the restructuring transition. This work will continue under Phase II.

Task 1, the phenols marketing task, also contributes to management effectiveness. The EHP team is working with RAS Kiviter to empower its marketing staff with new methods and an international network. Through negotiations with real clients, RAS Kiviter's management is learning how to sell the products on the Western market.

The turbine installation project is a major undertaking in project management. RAS Kiviter management had never taken on this type of large project without the support of the Russians and without being subject to Russian central planning to implement the project. The EHP team is providing on-the-job training to RAS Kiviter management, from the project planning phases through final start-up. This includes technology transfer in the areas of project scheduling, budgeting, contracting with outside sources, and purchasing of commodities. Since the schedule on this project is very tight, the Estonians are learning how to implement a project quickly, and how each task on the project schedule is interdependent to completing the overall project on time. This type of "Western" project management training is invaluable and will serve the RAS Kiviter management well on other projects.

TABLE 3-1
Phase I Activity Results
Environmental, Financial, and Managerial Impacts

Tasks	Environmental Impact	Financial Impact	Managerial Impact
1. Phenols Products Market Development	Lower phenols in dephenolized water by 25% on a weight basis.	Develop phenols sales or joint venture agreements. Reduce dephenolization production costs by 30%.	Empowering RAS Kiviter marketing staff with new methods and an international network.
2. Cogeneration of Electrical Power from Steam Pressure Reduction and Excess Gas Combustion	Controlled combustion of the surplus fuel gas in the boilers. Reduce emissions from the state utility as the demand on its shale-fired power plants is lessened.	Save RAS Kiviter millions of dollars in electricity costs.	RAS Kiviter management learns to manage large systems design and construction projects.
3. Optimization of Sulfur Recovery System	Increase sulfur removal efficiency from an average of about 65% to about 70%.	Possible reduction in emissions fees.	
4. Optimize Recycling of Fuses to Retorts	Increase the recycling rate of fuses back to the retorts from 10% to between 50% and 95%.	Increased product yields due to more complete utilization of the shale material.	
5. Spent Shale Runoff Treatment	Reduce phenol contamination in Estonian waterways.		
6. Worker Health and Safety Improvements	Reduce worker exposure to pollution.	Increase worker productivity.	
7. Financial and Accounting Technical Assistance		Decrease costs through increased awareness of cost managements.	Increased management responsibility for production costs.
8. Management Restructuring Review		Increase profit margins through cost-effective management restructuring.	Develop plan to ease management restructuring.

4 NEXT STEPS

In general, the work planned under Phase II will continue progress made under Phase I. With the additional commodities funding available in Phase II, significant process improvements can be accomplished by the conclusion of Phase II, improvements that will have a positive impact on RAS Kiviter's profitability by helping it to increase revenue from phenol products sales and cut costs by producing its own electricity. In addition, completion of tasks under Phase II will significantly reduce RAS Kiviter's negative environmental impact on the region.

4.1 Priorities for Phase II

The following objectives have been identified for Phase II:

- Identify product application markets for the phenol-based compounds that RAS Kiviter has demonstrated an ability to produce so that the dephenolization unit will be operable, resulting in further reductions of phenols in the dephenolized water (through product recovery).
- Support the installation of a cogeneration unit at RAS Kiviter for independent power production, saving Kiviter millions of dollars in electricity costs.
- Improve the operation of the sulfur recovery process at RAS Kiviter in terms of hydrogen sulfide removal from the retort gas.
- Optimize the fuses recycling operation to maximize the amount of fuse material which can be recycled without impacting retort gas quality or causing unacceptable accumulation of material in the retorts.
- Assist RAS Kiviter in the evaluation of regional wastewater treatment options and provide a coordination point with the Finnish investors in the industrial wastewater treatment system.
- Reduce worker exposure to toxic chemicals, lower worker accident rates, and increase worker awareness of health and safety issues.
- Improve the implementation and acceptance of the management restructuring at RAS Kiviter.

4.2 Key Issues in Phase II

The most significant issue for the EHP team in Phase II is to manage all of the tasks to completion within the schedule of the project (September 30, 1996). On the larger process improvement and infrastructure tasks, such as the turbine generator installation, the upgrading and outfitting of recycling systems on the retorts, and the dephenolization plant improvements, the team has worked quickly within the first month of Phase II to identify exactly what technical process modifications should be made and to develop a schedule. Many of the key commodities that must be purchased for these tasks have manufacturer lead times of several months, and many of these items must be shipped to Estonia via ocean freight due to their large size. Thus it is important that the EHP team move quickly to specify proper equipment, obtain vendor quotations, receive purchase approval from USAID, and place orders with the vendors. As the team learned in Phase I, this process takes time. A goal has been set under Phase II that all

major commodities will be ordered by the end of March 1996.

To assure completion of key tasks by the close of Phase II, it is important to continue motivating and challenging the RAS Kiviter staff to move forward with their responsibilities. The turbine installation involves a large group of local Estonian engineering consultants in addition to the Kiviter staff, and it is critical that the schedule be maintained.

The EHP team will also address various larger issues under Phase II that were identified during Phase I. One issue includes RAS Kiviter's difficulty justifying the logic behind the pricing of their phenolic products. As part of the Phase II Task 1 effort, the EHP team will work with RAS Kiviter management on cost accounting principles to assist them in developing appropriate pricing for the phenols products.

The second larger issue is the lack of management commitment to worker health and safety. Under Phase I, the EHP consultants concentrated mainly on identifying the most hazardous working conditions at RAS Kiviter and providing personal protective equipment to workers to minimize risk. Health and safety training was limited to training in the use and maintenance of the PPE and assigning equipment to specific workers. Under Phase II, the EHP team will address the issue of RAS Kiviter management's lack of commitment to a formal program of health and safety awareness. Issues related to this lack of commitment will be identified and examined, and a strategy developed to improve worker health and safety.

4.3 Ensuring Sustainability

Another of the larger issues EHP plans to address under Phase II is the sustainability of the progress made on each of the eight tasks. Training provided under each task will contribute to sustainability, especially evident under the Management Restructuring task (Task 7) and the Health and Safety Improvement task (Task 6), for which formal training seminars will be conducted. On-the-job training is being provided on all of the technical tasks. In fact, most of the actual new equipment installation and maintenance is currently being performed by the RAS Kiviter staff, such as the self-cleaning filter installed in the sulfur recovery unit and the recycling pumps installed at the retorts. The EHP team provides a peer review function after the systems have been installed to assure their performance, but it is RAS Kiviter staff who have invested the most time.

The turbine purchase, refurbishment, and installation effort truly is a "RAS Kiviter project." Sustainability of this project is assured by virtue of the fact that RAS Kiviter is overseeing the entire program, with technical and management assistance provided by EHP. The type of "Western" project management training they are receiving through this project is invaluable, and will serve the RAS Kiviter management well on other projects.

The use of local consultants, such as EnPro Engineers, the Oil Shale Research Institute, and Tartu University, will also contribute to sustainability. Many of these consultants were working with RAS Kiviter management prior to EHP's arrival, and they will continue to work with them after the EHP activity is completed. Their intimate involvement in the various tasks enhances their ability to encourage the RAS Kiviter staff to continue along the same path. Additionally, the EHP team's relationship with RAS Kiviter management on both the corporate and the operations side has grown substantially in the past several months. The results delivered under Phase I have promoted trust and have encouraged RAS Kiviter's direct participation in all of the tasks.

5 LESSONS LEARNED

5.1 Working with RAS Kiviter

Over the past 15 months, the EHP team has learned much about working with the RAS Kiviter staff. In the early months of the project, EHP consultants faced the doubts of the RAS Kiviter management. Foreign consultants were not new to RAS Kiviter and most of the RAS Kiviter management believed that the money spent to fund outside consultants was a waste. Most consultants would arrive, develop relationships with the RAS Kiviter staff, promise further assistance to RAS Kiviter, then leave and never return. RAS Kiviter management were skeptical about what the EHP program would deliver and they were wary about investing much time with the EHP consultant team.

This attitude changed gradually in the first few months, as the EHP team members continued to visit RAS Kiviter and made progress with their various tasks. By summer 1995, the recycle pump for the fuses recycling at the retort had been delivered and installed, the used turbine generator had been located and purchased by RAS Kiviter, and a management seminar had been held with all of RAS Kiviter management. With these examples of the team's determination to meet commitments and "stay the course," Ras Kiviter's managers became more invested in the successful outcome of the project and began to deal with the U.S. team members directly, as opposed to relying on EnPro.

It has also been important for the EHP consultants to remember that the institutional barriers and preconceived notions of areas of responsibility are still very much in place at RAS Kiviter. The EHP team has had to consider this as a major factor in implementing any task that crosses departmental lines or goes outside RAS Kiviter. Although the Estonians are anxious to "Westernize," the concepts of empowerment, information, entrepreneurship, and marketing are still relatively new to RAS Kiviter. This has been evidenced primarily in the phenols marketing task where the consultants have received resistance from RAS Kiviter when asking for pricing information. It has been important to be persistent in asking for drawings/technical information; however, it is also important to be sensitive to what RAS Kiviter considers "confidential."

The EHP team has also learned that RAS Kiviter General Manager Yuri Soone possesses strong leadership skills. Mr. Soone emerged as a decision-maker on this activity during the critical period of pursuing the steam turbine purchase. Quick decisions and actions were necessary at that time, and Mr. Soone provided the leadership required.

5.2 Design of the Activity

After the EHP made its first trip to RAS Kiviter, it became apparent that the project had to concentrate only on tasks that would have immediate and profound effects on RAS Kiviter's economic and environmental performance. A decision was made to undertake only those tasks that would have the most significant impacts and that could be accomplished within the time frame of the EHP assistance. It was also decided that if a new task emerged that would be more successful than another, changes would be

made in the project to accommodate the new task. Conversely, if a task proved ineffective at making a significant change, it would be cut short and the resources reallocated.

The most significant lesson learned about this activity is that flexibility in staffing, budgeting, scopes of work, levels of effort, and commodities purchases has been vital to the progress made under Phase I. The levels of effort of certain individuals on the team have shifted as scopes of work have been amended to best fit the goals of the tasks. As commodities were identified and exact costs obtained, commodities budgets were traded between tasks to get the most out of the total budget allocation. Some tasks were cut short, such as the finance task and the spent shale runoff task, to make room for other tasks that would provide more significant change, such as the turbine generator installation. Staffing changes have also been made as needs shifted on various tasks and new skills became necessary. As a result of this flexibility and careful attention to the overall budget, USAID and RAS Kiviter are getting the most assistance from limited resources.

The team has also learned the fundamental importance of the commodities purchases as a supplement to the technical assistance on this activity. During one of the first meetings with RAS Kiviter staff, one of the Kiviter senior managers mentioned that consultants had been wasting valuable money trying to "fix" RAS Kiviter for several years and that he wished donor agencies would just give him the money so that RAS Kiviter could buy the plant improvements necessary to make significant changes. It became apparent that the RAS Kiviter staff viewed the commodities purchases as the most valuable aspect of the program. The EHP team has made it apparent, however, that in order to purchase the most appropriate, cost-effective equipment, it is necessary to combine engineering/technical assistance with commodities purchases. Without a budget to purchase equipment, programs and systems to improve RAS Kiviter's economic viability and environmental performance could have been designed and engineered but little would have been done to implement them. The money spent on the activity has in most cases been leveraged with RAS Kiviter's own funds to purchase systems that RAS Kiviter is convinced will be beneficial. This is especially true in the case of the turbine installation task, where EHP and RAS Kiviter will basically split the cost of purchasing circuit breakers for the system under Phase II, and is also true on the spent fuses recycling program. EHP purchased pumps and cylinders to upgrade and facilitate recycling at the retorts; however, Kiviter must also buy some of the equipment and design other equipment to outfit the retorts for the recycling system.

5.3 Technical Assistance Approach

The technical assistance approach to this activity has been based on parameters that were instituted early on. The identification of qualified U.S. consultants to staff this program was the first hurdle. It was necessary to assemble a fairly large team of experts in the technical areas of oil shale processing, cogeneration, industrial health and safety, and environmental engineering, as well as experts in marketing, management training, and finance. The diversity and experience of these team members have been vital to the success of this activity.

An assumption was made that local experts outside of the RAS Kiviter staff should be involved in the activity. The team learned in the first few months that there were Estonian consultants who had been working with RAS Kiviter for quite some time and who understood the situation at the plant. These consultants have been instrumental in assisting the EHP team to move quickly up the learning curve. The team learned that many studies done by various countries had been implemented with little positive effect and gained knowledge from learning about previous work accomplished at RAS Kiviter.

In addition, the team learned that the RAS Kiviter staff is full of very capable personnel who, under proper guidance, can themselves further the progress of the various tasks after USAID assistance has ended. In most cases, RAS Kiviter staff have been responsible for the installation of all the equipment provided under EHP funds.

5.4 Collaborating with Other Donors

The EHP team made every attempt to leverage the resources provided under this project. There have been two instances where donor support has been solicited. A grant funding proposal for the spent shale runoff collection and treatment systems design was developed and presented to the Finnish Ministry of Environment in August 1995, followed by a meeting in October 1995, when the Finns conducted a site inspection at the Kiviter site. The Finnish Ministry of Environment subsequently decided to fund the project and to purchase US $220,000 of the required curtain walls and pumping systems for the collection basins.

Early in the activity, cogeneration at the RAS Kiviter site was deemed feasible. At that time, the EHP team began researching used turbine equipment that RAS Kiviter could purchase on its own. Concurrently, the team developed an investment-grade proposal to fund the purchase of a new turbine system. This investment proposal was presented to several potential investors, many of whom were interested. Fortunately, the EHP team was able to locate a used steam turbine in Germany that could be purchased by RAS Kiviter for a sum of about US $75,000, making an investor unnecessary.

APPENDIX

List of Key Contacts

Detailed below is a list of the key Estonian contacts, both outside consultants and Kiviter staff. They are listed based on their affiliations with the eight key tasks.

Task 1: Phenols Marketing

Dr. Yuri Soone, Managing Director, RAS Kiviter
Dr. Yurij Zhirjakov, Deputy Technical Director, RAS Kiviter
Mrs. Bolhovotina, Marketing Director, RAS Kiviter
Mr. Tiit Purre, Head of Laboratory of Shale Oil Refining, Oil Shale Research Institute

Task 2: Cogeneration

Dr. Yuri Soone, Managing Director, RAS Kiviter
Mr. Ivar Rooks, Technical Director, RAS Kiviter
Mr. Yuri Utt, Head of Electricity Generation, RAS Kiviter
Mr. Vallandi, Engineer, RAS Kiviter
Mr. Heinar Nurste, President, EnPro Engineers

Task 3: Sulfur Recovery

Ms. Pallady, RAS Kiviter
Mr. Nikolai Petrovitsh, Principal of Oil Shale Complex, RAS Kiviter

Task 4: Fuses Recycling

Mr. Ivar Rooks, Technical Director, RAS Kiviter
Ms. Pallady, RAS Kiviter
Dr. Victor Yefimov, Doctor of Technical Sciences, Oil Shale Research Institute

Task 5: Spent Shale Runoff

Mr. Rein Rahe, RAS Kiviter
Dr. Toomas Tenno, Professor, University of Tartu
Dr. Aleksander Maastik, Professor, Estonian Agricultural University, Institute of Water Management
Mr. Enno Kirt, President, AS ENNO PROJEKT

Task 6: Worker Health & Safety

Mr. Henno Sallo, Deputy Chief, Health & Safety, RAS Kiviter

Task 7: Finance

Mrs. Kiivima, Director of Economic Planning, RAS Kiviter
Mrs. Kaiscnova, Chief Accountant, RAS Kiviter
Mr. Kainjukov, Deputy in Economic Planning
Mr. Ivo Sillaste, Independent Consultant

Task 8: Management Review

Dr. Yuri Soone, Managing Director, RAS Kiviter
Ms. Anna Tammerik, Independent Consultant

Overall Assistance

Mr. Heinar Nurste, President, EnPro Engineers
Ms. Riina Reinholm, Interpreter