TRIP REPORT #1 ARPECHIM

PITESTI, ROMANIA

WASTE MINIMIZATION PROJECT

MARCH 22 - MARCH 26, 1993

WORLD ENVIRONMENT CENTER
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JUNE 1993

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I. EXECUTIVE SUMMARY

During the week of March 22, 1993, a WEC team consisting of Mr. Garrick J. Solovey, P.E., Malcolm Pirnie, Inc., Mr. Sy Friedman, Consultant, Dr. Raymond L. Feder, WEC Staff Consultant, and Mr. Thomas J. McGrath, WEC Staff (part-time at factory) visited Arpechim to initiate a waste minimization demonstration project.

A summary report containing the experts' findings and recommendations is included with this trip report.

Arpechim is experiencing economic difficulties which has caused interruption in their supply of crude oil. As evidenced by the Malcolm Pirnie, Inc. report, the management enthusiastically embraced the concept of waste minimization. If funding were available, five demonstration projects could be started. However, funding will allow for one and the project jointly selected by the WEC experts and Arpechim management involves minimizing the quantities of hydrocarbons that contaminate the steam condensate which is returned to the power station after process use.

The demonstration project will target for a 20% increase in returned condensate which would result in a yearly savings of $172,000.

Arpechim is currently involved in a joint venture with Coastal Petroleum based in Houston. Mr. Joseph D. Mazzei, Executive Director of Coastal Romanian Petroleum, has kindly offered his assistance to the demonstration project.

II. CONSULTANT'S REPORT

MALCOLM PIRNIE

MALCOLM PIRNIE, INC.
ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

June 11, 1993

Mr. Thomas J. McGrath
Vice President - Technical Programs
World Environmental Center
419 Park Avenue South, Suite 1800
New York, New York 10016

Re: Trip Report - Arpechim S.A. Facility
Pitesti, Romania
March 22 through March 25, 1993

Dear Mr. McGrath:

This trip report summarizes the highlights and findings associated with our recent trip to the Arpechim refinery and petrochemical facility. We have included brief discussions of potential projects that were considered for waste minimization initiatives and general recommendations associated with actions for plant operational/environmental improvements.

Finally, this report describes and defines the scope of work for completion of the Condensate Waste Minimization Project selected for implementation at Arpechim.

This trip report is presented in the following sections:

- Background
- Overview of Arpechim
- Meeting Participants
- General Discussion
- Project Work Scope
- Recommendation and Observations

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BACKGROUND

Arpechim is the major refining and petrochemical facility within Romania. The World Environmental Center has a Cooperative Agreement with the U. S. Agency for International Development (US AID) to provide U. S. expertise for technology and skills transfer to Eastern Europe industry and governments. The objectives are:

- Effective pollution reduction
- Improved worker health and safety
- Efficient energy management
- Increased social awareness

The proposed Condensate Waste Minimization Project is consistent with these objectives and is fully described in later discussions. The World Environmental Center has contracted with Malcolm Pirnie, Inc. to assist with identifying and implementing this project.

OVERVIEW OF ARPECHIM

Arpechim S. A. includes both refinery and petrochemical operations. It is located in the city of Pitesti, which is 110 kilometers west of Bucharest. This facility was built in two phases during the 1970's. It has two atmospheric and vacuum distillation units that can process up to 3.5 million tons of crude per year. It produces a wide range of petroleum products and feedstocks for the petrochemical industry. A detailed discussion of these operations and its products can be found in the recent report prepared by Davy McKee for US AID.

The key factors that have influenced current operations are:

- Inconsistent supply and quality of crude oil
- Limited capital for plant equipment, facilities and spare parts
- Significant infiltration of hydrocarbons into process waters and wastewaters
- High levels of fugitive and vapor losses in its process lines

ATTENDEES

The meetings at the Arpechim facility were held from March 22 through March 25, 1993. The participants included:

Participant	Title	Organization
Thomas J. McGrath*	Vice President	WEC Staff
Raymond L. Feder, D.Ch.E.	Consultant	WEC Staff
Sy Friedman, P.E.	Consultant	WEC (Stouffer Chemical)
Garrick J. Solovey, P.E.	Consultant	WEC (Malcolm Pirnie)
Liviu Ionescu*	In Country Coordinator	WEC Staff
Andrei Gregorescu*	President & CEO	Arpechim
Ion Cojocaru	R&D Director	Arpechim
Gheorghe Florea	Environmental Manager	Arpechim
Alexandru Vasile	Protocol	Arpechim
Vishan Dumitri	Local Representative	Romania EPA
Alexander Tarina*	Technical Representative	Romania Ministry Ecological Dept.

* Part-time.

GENERAL DISCUSSION

The site visit from March 22 to March 25 consisted of the following major activities:

- Informational briefing on Arpechim operations and future directions.
- In-depth discussions of major processes, waste streams and environmental issues.

- Active participation in the initial Arpechim Waste Minimization Team Meeting.
- Tour of plant specific areas and processes, including:
  - Wastewater treatment
  - Control room
  - Laboratories
  - Computer MIS systems
  - Predictive maintenance
  - FCC #2
  - Refinery processes
  - Petrochemical processes
- Identification and preliminary evaluation of potential waste minimization projects to be considered for WEC funding. Some of these projects included:
  - Wastewater monitoring for contaminants associated with the ethylene plant.
  - Conventional clean water from the refinery which becomes contaminated with hydrocarbons resulting from heat exchanger and equipment failures.
  - Refinery wastewater which becomes contaminated with hydrocarbons, phenols and cyanides.
  - Fugitive emissions of organic vapors into the atmosphere from pumps, flanges, valves and other connections. Of particular interest was the ethylene plant.
  - Increase of the percent of acceptable steam condensate to be returned to the Renel steam power station by providing instrumentation to permit diversion of contamination condensate.

Please note that these WEC candidate projects did not include those having significant capital requirements (i.e., SO_2 emissions). The focus was short term fast track efforts that would require a modest investment in analytical equipment. All the above-mentioned projects would demonstrate a return on investment along with environmental/operational improvement in a reasonable or near-term time frame.

PROJECT WORK SCOPE

The proposed project involved the use of steam in the production process. The source of this steam is from both its own power station (six boilers) and the Renel Station (state-owned). The current agreement with Renel Station is to return the steam condensate after process use. For every cubic meter of unreturned steam condensate, Arpechim pays a penalty of 600 Lei (approx. $1 US). Arpechim currently collects steam condensate into two holding tanks prior to release to Renel. This condensate is sampled for the presence of hydrocarbons, salts and other organic compounds. This contamination generally originates from tube failures at column reboilers or in condensers from steam turbines. It is therefore important to Arpechim to identify these system problems as soon as possible.

From previous work documented by an independent U.S. consulting firm, only 40 to 45 percent of all condensate is re-usable. Additionally, based upon information provided by plant staff, total steam flow from Renel is approximately 100 t/hr (needs to be confirmed by Arpechim) or 100t/hr x 1.1 x 2,000 lb = 220,000 #/hr.

Conservatively, we can calculate the potential savings if the percentage of clean condensate can be improved by only 20 percent from current levels of 40 percent re-usable condensate.

$$S = M \times f \times P \times I$$

where:

M = Total steam condensate flow from Renel = 220,000 #/hr
P = Penalty = 600 lei/m^3 = $1/$m^3$
I = Condensate Improvement Factor = 20%
S = Additional Savings ($)/year

$$S = 220{,}000 \frac{lbs}{hr} \times 75\% \times \frac{1\$}{m^3} \times 20\% \times \frac{8760 hrs}{year} \times \frac{m^3}{35.9 ft^3} \times \frac{ft^3}{62.4 lbs}$$

$$S = \$172k/yr$$

To assist Arpechim with the capability to better monitor condensate quality and react to upset conditions, monitoring equipment has been suggested at the condensate effluent from both the refinery and petrochemical facility. This equipment should be capable of continuously monitoring both conductivity and the presence of organics. Arpechim has provided the sampling specifications and process requirements for further evaluation of costs and availability of appropriate monitoring equipment (See Enclosure A). Request for Quotations have been issued to three major U. S. instrument companies having European offices.

RECOMMENDATIONS AND OBSERVATIONS

As part of the site visit, Messrs. Feder, Friedman and Solovey developed several recommendations from the on-going discussions and plant tours. The following suggestions are provided for consideration:

- Finalize the proposal for the Condensate Waste Minimization Project and implement as soon as practical. Include the means to document and demonstrate that the project has fulfilled its objectives for waste minimization and operational improvement. The return trip would probably occur in early September. This will be confirmed based upon equipment availability.

- During the return visit to Arpechim, conduct a 4-hour in-plant waste minimization workshop to include plant staff.

- Evaluate the feasibility of implementing a fugitive emissions program at the ethylene plant at a future date. This could begin with the modest investment in an economically priced OVA. Immediate benefits are expected and pricing to be confirmed ($10-15k).

- Have the Arpechim waste minimization team begin to identify, evaluate and prioritize future waste minimization projects. Help them with this effort during the next visit.

- Suggest the following areas for further evaluation by Arpechim:

    - Complete a heat transfer equipment (condensers and heat exchangers) reliability study (i.e. tube failures)

    - Define in-plant O&M training requirements

    - Perform a plant-wide energy conservation study

    - Prepare spill containment and control plans for petroleum storage and handling

    - Evaluate SO_2 emissions and sulphur recovery potential

- Have the waste minimization team begin to develop a schedule and protocols for a baseline assessment of each process line to include:
  - waste stream characterization
  - review of procedures and practices
  - evaluation of equipment
  - "true cost" evaluations
  - potential options
  - identification of long-term and "fast track" waste minimization projects

In conclusion, we found the Arpechim staff to be totally cooperative and highly competent professionals. It is our belief that they are committed to the concept of pollution prevention and recognize the associated operational improvement potential.

Very truly yours,

MALCOLM PIRNIE, INC.

Garrick J. Solovey, P.E.
Senior Associate

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ENCLOSURE A

DATA SHEET
PITESTI PYROLYSIS #2 (PETROCHEMICAL FACILITY)

PROCESS INFORMATION

▪ Product:	Condensate Return
▪ Temperature, °C:	80 - 90
▪ Pressure, bars:	5
▪ Flow Rate, kg/hr (gal/day):	52,657 (333,000)
▪ Pipe Diameter, mm (inches):	100 (3.9)

CONDENSATE CHARACTERISTICS

▪ Dissolved Oxygen, ppm:	< 0.025
▪ Carbon Dioxide, ppm	< 0.025
▪ Oil, ppm	< 0.01
▪ Iron, ppm	< 0.05
▪ Copper, ppm	< 0.01
▪ pH	> 9.0
▪ Conductivity, μS/cm:	300 to 500

PROPOSED ANALYZER LOCATION

1. Distance from analyzer to tap: 20 feet
2. Hazard Area Classification: Explosion Proof
3. Electrical Supply: 220 Volt, 50 Cycle

PITESTI REFINERY

PROCESS INFORMATION

▪ Product:	Condensate Return
▪ Temperature, °C:	50 - 150
▪ Pressure, bars:	2 - 6
▪ Flow Rate, MT/hr (gal/day):	60 (380,000)
▪ Pipe Diameter, mm (inches):	200 (7.8)

CONDENSATE CHARACTERISTICS

▪ pH:	8.5 - 9.0
▪ Oil, ppm:	< 0.01
▪ Silica, ppm	< 10
▪ Conductivity, μS/cm:	< 500

PROPOSED ANALYZER LOCATION

1. Distance from analyzer to tap: 20 feet
2. Hazard Area Classification: Explosion Proof
3. Electrical Supply: 220 Volt, 50 Cycle