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S.C. TERMoeLECTRICA S.A.

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Final Report
Emissions Monitoring and Plant
Performance Improvement
Feasibility Study
(Sponsored by US Trade & Development Agency)

PUBLIC VERSION



November 2008



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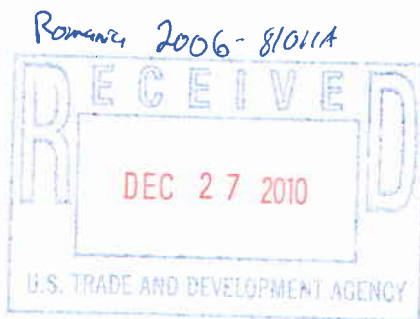
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Termoelectrica CEMS and Performance Improvement

Emissions Monitoring and Plant Performance Improvement Feasibility Study

(Sponsored by US Trade & Development Agency)



Final Report:

November 2008

prepared for



SC Termoelectrica SA

BUCAREST, ROMANIA

prepared by



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The work represented herein is sponsored by the U.S. Trade and Development Agency and prepared by a team under the direction of WorleyParsons Group, Inc. in Reading, PA. The following corporate contact information is presented for the Contractors that contributed to this Project:

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APPENDIX 1 U.S. Sources of Supply

1.0 INTRODUCTION

The U.S. Trade and Development Agency (USTDA) provided grant funds to S.C. Termoelectrica S.A. (Termoelectrica) to evaluate the need for upgrading the controls and monitoring systems at Termoelectrica power plants in Romania in order to face the changes in pollution control regulations and the opening of Romania's power market to competition.

Termoelectrica (the Grantee) selected the team of WorleyParsons and the Romanian company Institute for Studies and Power Engineering (ISPE) to perform a feasibility study entitled "Emission Monitoring and Plant Performance Improvement Feasibility Study Project", under the contract USTDA Appropriation 115/61001, Activity 068111063.

In consultation with Termoelectrica, WorleyParsons and ISPE identified 21 units at six different lignite, coal, oil and gas-fired power plants, located in various locations in Romania, presented in the Exhibit 1: List of analyzed Power Plants.

Exhibit 1: List of analyzed Power Plants

Plant	Number of Units
Thermal Power Plant Borzesti	2
Thermal Power Plant Braila	4
Thermal Power Plant Deva Mintia	6
Thermal Power Plant Doicesti	2
Combined Heat and Power Plant Galati	6
Combined Heat and Power Plant Paroseni	1

The generating units at these plants vary from 60 to 300 MW in size. The oldest was commissioned in 1969 and the newest unit in 1984. The Grantee has been gradually upgrading and modernizing their power plants to replace a legacy of aging and obsolete controls and monitoring equipment with modern computer based distributed control / data acquisition systems (DCS/DAS). However, tight finances due to inadequate revenues have sharply limited their ability to support ambitious modernization programs, and as a result, the plants exhibit a variety of conditions, performance, and controls vintage.

As a condition of Romania's admission to the EU, the country has agreed to limit the levels of pollutants from its power plants to the standards that have been stipulated for all large combustion plants in EU member countries. Thus, Grantee needs to prepare for compliance with EU directives regarding the measurement of sulphur dioxide (SO₂), nitrogen oxides (NO_x), carbon dioxide (CO₂) and particulate matter in the stack emissions.

2.0 STUDY APPROACH

The approach for the feasibility study follows the Termoelectrica Terms of Reference (TOR), and includes the following items:

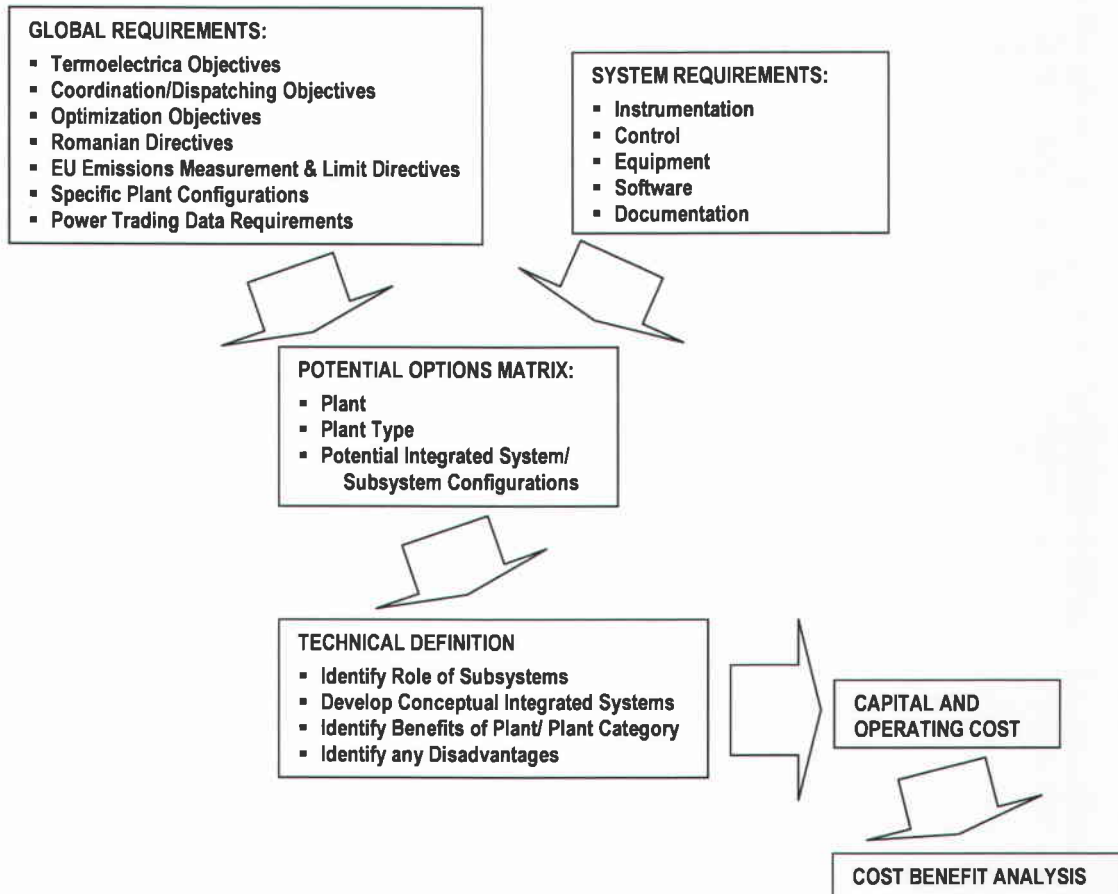
- ▶ Data gathering – kick-off Meeting – Site Visits. (Task 1).
- ▶ Baseline Data for the Units. (Task 2)
- ▶ Develop Optimization Methodology. (Task 3)
- ▶ Compatibility of existing European Union Standards and Environmental Impact assessment. (Task 4)
- ▶ Developmental Impact Assessment. (Task 5)
- ▶ Define the Project Scope Packages. (Task 6)
- ▶ Determine the Least Cost Option. (Task 7)
- ▶ Develop Implementation Plan. (Task 8)
- ▶ Develop Detailed Cost Estimate. (Task 9)
- ▶ Prepare Performance-based Engineer, Procure, and Construct (EPC) Bidding Documents. (Task 10)
- ▶ Final Report. (Task 11)

WorleyParsons and ISPE developed a set of questionnaires for each unit designed to provide a written record and a supporting basis for the evaluation. Some of the data was obtained prior to any plant visits, but visits were performed to obtain a complete picture of the situation. The team visited all of the subject plants, to verify data, observe actual plant condition, and to speak with operating personnel.

WorleyParsons and ISPE reviewed relevant Romanian and EU legislations, directives, and standards in the areas of control and communication, electricity market, electricity generation, transmission and distribution and environmental impact.

WorleyParsons developed the overall methodology for achieving the appropriate solution to the Termoelectrica objectives, presented in Exhibit 2: Optimization Methodology.

Exhibit 3 Optimization Analysis Logic Flow Diagram



The methodology is divided into two major parts:

- ▶ Implementing CEMS equipment to comply with EU directives and standards; and
- ▶ Implement a performance monitoring/ improvement system that will facilitate TE participation in the electricity market, according to EU directives and standards.

The methodology to evaluate and optimize CEMS implementation is straightforward and consists of the following steps:

- Determine/ Verify existing and anticipated EU and Romanian requirements regarding CEMS, as well as individual plant/ unit requirements/ needs;
- Develop technical approach, cost estimate, and schedule for CEMS implementation; and
- Develop recommendations to TE.

Exhibit 5: Characteristics of Various Levels of Performance Optimization

Characteristic	Level 1: Minimum	Level 2: Partial Upgrade	Level 3: Full Upgrade
Signals Used for New Dedicated DAS	Basic existing plant signals and/ or some manual inputs	Automated, but with some limitations	Full DAS automated
Plant Controls	Analog Boiler and Steam Turbine	Likely Digital Boiler Controls, but Analog Steam Turbine Controls	Full Integrated DCS with Soft Controls
Compliance with EU Requirements	May have difficulty to meet all requirements	Likely Compliance	Full Compliance
Performance Monitoring Programs	Minimum or None	Basic Software	Consider Menu of Possible Programs
Available Performance Benefits	Minimum or None	Some Potential Benefits	Full Potential Benefits

Based on the existing situation at each plant site and each operating unit, a matrix was developed to indicate the required investment components at each TE generating unit to be studied.

The options are defined technically and with associated capital and operating costs to facilitate an economically based evaluation of the options.

The following steps were taken to complete the matrix and develop applicable costs of implementation and economic feasibility.

- ▶ Review plant instrumentation and equipment drawings, data, etc. per Unit obtained before and during visit;
- ▶ Review present economic plant data received during plant visit;
- ▶ Develop specific requirements (EU, Romania and TE) to determine each indicated level of monitoring/ optimization, including any specific requirements to participate in the electricity market;
- ▶ Involve vendors/ suppliers in each step of the process to obtain detailed information on available options, requirements, expected performance benefits, and cost;
- ▶ Produce spreadsheets per Unit according to Exhibit 3 to determine the required components/ systems and investment to implement each indicated level of monitoring/ optimization required;
- ▶ Review with Termoelectrica present communication of plant information to their central headquarters, and ways to improve this data transfer; and

for DCS/DAS). As 100% of capital will be raised by debt, there will be no equity capital requirement for this project.

3.0 RESULTS

Three capital investment options under “Minimum”, “Maximum” and “Optimum” Investments have been provided with recommended priority of investment for each unit /plant and three systems [CEMS, Application Server/Software, and DCS/DAS].

A simplified implementation plan and a detailed capital investment requirement under three groups (Purchase Contract, Construction Contract, and Indirect Costs) for optimum investment in each unit/plant and three systems was proposed.

Detailed cost estimate for optimum investment is provided under three groups:

- ▶ Purchase Contracts (Engineering and Material)
- ▶ Construction Contracts (Installation and Commissioning)
- ▶ Indirect Costs (Training, Engineering & Design Management, Financing)

This information will help management of Termoelectrica for appropriate decision in selecting unit/ plant for CEMS and plant performance improvement.

Following three EPC Bidding Documents are introduced for Technical Proposals:

- CEMS – Requirements for Technical Proposal.
- Application Server/ software - Requirements for Technical Proposal.
- DCS/DAS - Requirements for Technical Proposal.

There is provided in Appendix 1 a potential U. S. Supplier’s List.

Potential benefits from the implementation of the recommended addition of CEMS, plant performance improvement, and communication facilities enhancement at the TE head quarter are as follows:

- ▶ Implementation of CEMS will allow power plants to run in compliance with the required laws and regulations. If the plants are not allowed to run, this will have a serious problem in unemployment, a reduction of state revenue due to lack of sale of electricity, increased state expenditure due to buying of electricity in the open market, a high negative factor for present industrial operations and potential future capital investment in the country’s industry due to uncertainty and high cost of electricity.
- ▶ The addition of plant performance improvement will allow to produce electrical power at a more economical and competitive rate. This will make Romania a competitive player to sell electricity in the European markets.





APPENDIX 1

U.S. Sources of Supply

Potential U.S. Sources of Supply

Equipment / Service Area	Supplier	Contact Name	Address	Phone no. Fax no. E-mail address
Plant Application Server/PC w color flat screen/keyboad/mouse	Meiso Automation MAX Controls Inc	Roger Leinbach VP Sales and Marketing	1180 Church Road Lansdale, Pa 19446	(215)393-4035 (215)393-3921 Roger.leimbach@metso.com
	Emerson Process Management Power and Water Solutions	Jeffrey Williams Manager Smart Process Systems	200 Beta Drive Pittsburg, Pa 15238	(412)963-4068 J.Williams@Emerson.com
	Power Solutions ABB, Inc.	Chris Wojnar	29801 Euclid Ave Wickliffe, Ohio, 44092	(440)585-8957 chris.wojnar@us.abb.com
TE Headquarters PC /dual color flat screens	The Foxboro Company/ Weiss Instruments	Robert E Jones Sales Manager	300 Mt Lebanon Blvd Suite 2202, Pittsburg, Pa 15234	(412)344-1500 (412)344-5504 bjones@weissinstruments.com
	Meiso Automation MAX Controls Inc	Roger Leinbach VP Sales and Marketing	1180 Church Road Lansdale, Pa 19446	(215)393-4035 (215)393-3921 Roger.leimbach@metso.com
	Emerson Process Management Power and Water Solutions	Jeffrey Williams Manager Smart Process Systems	200 Beta Drive Pittsburg, Pa 15238	(412)963-4068 J.Williams@Emerson.com
Plant Performance Software Packages	Power Solutions ABB, Inc.	Chris Wojnar	29801 Euclid Ave Wickliffe, Ohio, 44092	(440)585-8957 chris.wojnar@us.abb.com
	The Foxboro Company/ Weiss Instruments	Robert E Jones Sales Manager	300 Mt Lebanon Blvd Suite 2202, Pittsburg, Pa 15234	(412)344-1500 (412)344-5504 bjones@weissinstruments.com
	Meiso Automation MAX Controls Inc	Roger Leinbach VP Sales and Marketing	1180 Church Road Lansdale, Pa 19446	(215)393-4035 (215)393-3921 Roger.leimbach@metso.com

Potential U.S. Sources of Supply

Equipment / Service Area	Supplier	Contact Name	Address	Phone no. Fax no. E-mail address
Color Printers	The Foxboro Company/ Weiss Instruments	Robert E Jones Sales Manager	300 Mt Lebanon Blvd Suite 2202, Pittsburgh, Pa 15234	(412)344-1500 (412)344-5504 bjones@weissinstruments.com
	Meiso Automation MAX Controls Inc	Roger Leinbach VP Sales and Marketing	1180 Church Road Lansdale, Pa 19446	(215)393-4035 (215)393-3921 Roger.leimbach@metso.com
	Emerson Process Management Power and Water Solutions	Jeffrey Williams Manager Smart Process Systems	200 Beta Drive Pittsburg, Pa 15238	(412)963-4068 J.Williams@Emerson.com
	Power Solutions ABB, Inc.	Chris Wojnar	29801 Euclid Ave Wickliffe, Ohio, 44092	(440)585-8957 chris.wojnar@us.abb.com
System Engineering and site Interface	The Foxboro Company/ Weiss Instruments	Robert E Jones Sales Manager	300 Mt Lebanon Blvd Suite 2202, Pittsburgh, Pa 15234	(412)344-1500 (412)344-5504 bjones@weissinstruments.com
	Meiso Automation MAX Controls Inc	Roger Leinbach VP Sales and Marketing	1180 Church Road Lansdale, Pa 19446	(215)393-4035 (215)393-3921 Roger.leimbach@metso.com
	Emerson Process Management Power and Water Solutions	Jeffrey Williams Manager Smart Process Systems	200 Beta Drive Pittsburg, Pa 15238	(412)963-4068 J.Williams@Emerson.com
	Power Solutions ABB, Inc.	Chris Wojnar	29801 Euclid Ave Wickliffe, Ohio, 44092	(440)585-8957 chris.wojnar@us.abb.com
	The Foxboro Company/ Weiss Instruments	Robert E Jones Sales Manager	300 Mt Lebanon Blvd Suite 2202, Pittsburgh, Pa 15234	(412)344-1500 (412)344-5504 bjones@weissinstruments.com

LEVEL III U.S. Source of Supply

Potential U.S. Sources of Supply

Equipment / Service Area	Supplier	Contact Name	Address	Phone no. Fax no. E-mail address
Uninterruptible Power Supply	The Foxboro Company/ Weiss Instruments	Robert E Jones Sales Manager	300 Mt Lebanon Blvd Suite 2202, Pittsburgh, Pa 15234	(412)344-1500 (412)344-5504 bjones@weissinstruments.com
	Metso Automation MAX Controls Inc	Roger Leimbach VP Sales and Marketing	1180 Church Road Lansdale, Pa 19446	(215)393-4035 (215)393-3921 Roger.leimbach@metso.com
	Emerson Process Management Power and Water Solutions	Jeffrey Williams Manager Smart Process Systems	200 Beta Drive Pittsburg, Pa 15238	(412)963-4068 J.Williams@Emerson.com
CEMS Cubicle tubed and wired	The Foxboro Company/ Weiss Instruments	Robert E Jones Sales Manager	300 Mt Lebanon Blvd Suite 2202, Pittsburgh, Pa 15234	(412)344-1500 (412)344-5504 bjones@weissinstruments.com
	Forney Corp A UTC Fire abd Security Co	Richard Hovan Markets Manager	3405 Willey Post Road Carrollton, Texas 75006-5185	(972)458-6339 (972)458-6195 Rich.hovan@fs.utc.com
	Forney Corp A UTC Fire abd Security Co	Richard Hovan Markets Manager	3405 Willey Post Road Carrollton, Texas 75006-5185	(972)458-6339 (972)458-6195 Rich.hovan@fs.utc.com
CEMS Analytical Equipment for cubicle	Forney Corp A UTC Fire abd Security Co	Richard Hovan Markets Manager	3405 Willey Post Road Carrollton, Texas 75006-5185	(972)458-6339 (972)458-6195 Rich.hovan@fs.utc.com
	Forney Corp A UTC Fire abd Security Co	Richard Hovan Markets Manager	3405 Willey Post Road Carrollton, Texas 75006-5185	(972)458-6339 (972)458-6195 Rich.hovan@fs.utc.com