Particulate Emission Abatement for Krakow Boilerhouses

Technical Progress Report #11

Period: October 1, 1996, to December 31, 1996

January 20, 1997

Prepared for:

Federal Energy Technology Center
U.S. Department of Energy
P.O. Box 10940
Pittsburgh, PA 15236

DOE Project Manager

Richard E. Hucko

Prepared by:

LSR Technologies, Inc.
898 Main Street
Acton, MA 01720
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Abstract

Environmental clean-up and pollution control are considered the foremost national priorities in Poland. The target of this cleanup is the Polish coal industry, which supplies the fuel to generate over 78% of Poland’s primary energy production. This project addresses the problem of airborne dust and uncontrolled particulate emissions from boilerhouses, which represent a large fraction of the total in Poland. In Kraków alone, there are more than 2,000 uncontrolled boilers accounting for about half the total fuel use. The large number of low-capacity boilers poses both technical and economic challenges, since the cost of control equipment is a significant factor in the reduction of emissions.

A new concept in dust collection, called a Core Separator, is proposed for this important application. The Core Separator is an advanced technology developed through research sponsored by the Department of Energy. It utilizes a highly efficient collector, which functions on the principle of inertial separation. The system is able to control fine particulate matter, as in the PM10 regulations, which limit the emission of dust particles below 10 microns in diameter. Its dust removal performance has been shown to be comparable to that of a medium-efficiency electrostatic precipitator (ESP). Yet, its cost is substantially lower than that of either an ESP or fabric filter. While the Core Separator achieves high efficiency, its power consumption is just slightly higher than that of a cyclone. It functions dry and without the aid of energy-consuming enhancements. It is simple, reliable, and unlike the ESP and fabric filter, easy to maintain. This combination of features make it ideal for the small boiler market in the City of Kraków.

A highly qualified team has been assembled to execute this project. LSR Technologies, Inc., a technology-based company located in Acton, Massachusetts, is the developer of the Core Separator and holder of its patent rights. LSR has sold several of these units in the U.S. and Europe. EcoInstal, a leading supplier of environmental equipment in Poland, is licensed to sell the Core Separator, and will support LSR as a subcontractor. The Polish Foundation for Energy Efficiency (FEWE), located in Katowice, is a consulting organization with extensive expertise in the Polish economy and natural environment. FEWE is also a subcontractor to LSR.

This project will be divided into three major phases. Phase 1 is called "Infrastructure Studies" and will includes business planning, and site-selection of a full-scale Core Separator Demonstration Unit. Phase 2, called "Commercial Development," includes the first Demonstration Unit in a local boilerhouse, followed by several Core Separator installations collecting flyash from different Polish coals. Also, a manufacturing facility is to be equipped to accommodate the projected sales volume. If the goals of this project are met and the Core Separator can be successfully marketed, there is a potential to significantly reduce particulate emissions in Kraków.
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*Core Separator* Manufacture by EcoInstal  
Figures 1 and 2

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Exhibit of EcoInstal at 1996 Environmental Fair - Poznan  
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Introduction

This project involves the implementation of a new particulate control technology called a “Core Separator” for low-emission sources (LES) in Kraków. With several hundred boiler sites in the city burning low-grade coal, existing pollution control equipment consists primarily of low-efficiency cyclones. Such equipment cannot meet the emission standards of most industrial nations. More importantly, these conditions have been the cause of low ambient air quality in Kraków from suspended particles. The CoreSeparator can be retrofitted onto these boilerhouses to substantially reduce particulate emissions, particularly those consisting of the fraction classified as PM10.

In this project, CoreSeparator technology is being demonstrated for boilerhouse applications in the Kraków region of Poland. Phase I entailed business planning and infrastructure studies to determine the market for this equipment. In the second phase, the technology is being demonstrated in several boilers of different capacity and firing various grades of coal. Later, a joint venture company (JV) was to be established with the capability of manufacturing and supplying this equipment in Kraków and throughout Poland.

The contract between DOE and LSR began April 1, 1994, although DOE permitted some work to commence prior to that time. This report documents work completed during the eleventh quarter, i.e., October 1-December 31, 1996.

Results and Discussion

Several important accomplishments occurred during the past quarter. A number of significant milestones have been reached that will enable LSR to complete all of its obligations under this project by mid-1997. The following is a summary of those accomplishments:

1. A License Agreement was signed by LSR and EcoInstal on November 22, 1996. The agreement gives EcoInstal the exclusive right to market and sell Core Separator dust collectors in Poland for an initial period of three years with an option to renew the license through the life of the patent. The license also allows EcoInstal to market LSR’s technology in other neighboring countries. A copy of the Patent and Trademark License are attached to this report. A copy of the complete agreement between LSR and EcoInstal can also be provided to DOE if requested. This document is considered "proprietary" and it
should not be used outside of DOE.

(2) As of this writing, EcoInstal has commissioned twenty-two Core Separator units in Poland, and two units have been exported to other countries. Eleven other CoreSeparator dust collectors are under construction as shown in the attached Installation List. Even if no future units were to be sold, the existing Core Separator installations are collectively treating about 350,000 ACFM of dust-laden flue gas, or the equivalent of 300 MWt of boiler output. These units are removing about 5,000 tons of dust emissions annually throughout Poland.

(3) One of the units installed this summer is at Budostal 5 for a rotary drier processing asphalt in Kraków. This unit is not on a coal-fired system and, therefore, was not subsidized by our project.

(4) The largest CoreSeparator to date is being constructed for Fiat Auto Poland in Bielsko Biala, about 60 km from Kraków. This unit will be treating 140,000 M³/h of flue gas from a WR-25 boiler, and is scheduled for startup in early 1997.

(5) A contract was also received for four new CoreSeparator units at the Zorza Cooperative Heating Plant in Myslenice (a suburb of Kraków). When complete, there will be nine Core Separator installations in Kraków. Of course, there are many other nearby operating units which are in close proximity to the voivodeship of Kraków.

(6) A large environmental fair and trade show, called POLEKO, took place November 19-22 in Poznan. More than 1000 companies from 90 countries participated. EcoInstal displayed an excellent exhibit at this fair and was one of seven companies selected for a special show award. Both EcoInstal and LSR appeared on a local television broadcast in which the companies and Core Separator technology were highlighted.

(7) During the environmental fair, both LSR and EcoInstal met with Mr. Charles Bliss of U.S. AID to review the progress of our project. Mr. Bliss seemed to be very pleased with the number of Core Separator unit sales in our project, and was quite impressed with EcoInstal's exhibit. During the trade show, one new Core Separator sale was completed.
Following the signing of our License Agreement, EcoInstal presented a summary of technology transfer costs associated with the Core Separator through May 1996. Based on the combined cost sharing of LSR, EcoInstal, and early users of the technology in Kraków, LSR’s cost-share commitment will be exceeded in this Cooperative Agreement.

Conclusion

The major milestone for this quarter will be executing a contract with Zorza for the installation of four new dust collectors. The engineering for these units has already been completed. The final installation should be finished during the first quarter of 1997.

The Zorza units when operational will fulfill LSR’s obligations under our Cooperative Agreement for number of installations. Following this milestone, LSR intends to make preparations to close out our contract. Full documentation of all costs and cost sharing will be prepared.

LSR fully intends to continue doing business in all regions of Poland in the near and distant future.
LSR Technologies, Inc.

Environmental and Energy-Related Systems

January 2, 1997

Ms. Linda Weightman
Reports Receipt Coordinator
Federal Energy Technology Center
U.S. Department of Energy
P.O. Box 10940
Pittsburgh, PA 15236-0940

Ref: Foreign Travel Report, “Particulate Emission Abatement in Krakow boilerhouses,”
DE-FC22-94PC94111

Dear Ms. Weightman:

There was one foreign trip made during the 4th quarter 1996 in conjunction with this Cooperative Agreement. This travel took place on November 17-24 and was made by the undersigned in the Republic of Poland. If you require additional information, please let me know.

Sincerely,

S. Ronald Wysk
Managing Director
## Core Separator Installations in Central Europe
(as of 12/31/96)

<table>
<thead>
<tr>
<th>Installation</th>
<th>No. of Units</th>
<th>Initial Operation</th>
<th>Capacity (M³/h)</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PEC Oborniki</td>
<td>1</td>
<td>4/95</td>
<td>10,000</td>
<td>WR-2.5 Stoker Boiler</td>
</tr>
<tr>
<td>2. EXBUD Tarnow</td>
<td>2</td>
<td>5/95, 6/96</td>
<td>5,300</td>
<td>Fluidized Bed Boilers</td>
</tr>
<tr>
<td>3. Kombinat RSP Czempin</td>
<td>3</td>
<td>8/95</td>
<td>5,600</td>
<td>WCO-80 Stoker Boilers</td>
</tr>
<tr>
<td>4. PEC Knurow</td>
<td>1</td>
<td>10/95</td>
<td>50,000</td>
<td>WR-10 Stoker Boiler</td>
</tr>
<tr>
<td>5. Czech Technical University</td>
<td>1</td>
<td>10/95</td>
<td>2,500</td>
<td>Fluidized Bed Boiler</td>
</tr>
<tr>
<td>6. MPK Krakow</td>
<td>3</td>
<td>1/96</td>
<td>5,600</td>
<td>WCO-80 Stoker Boiler</td>
</tr>
<tr>
<td>7. Armatura Krakow</td>
<td>1</td>
<td>1/96</td>
<td>24,500</td>
<td>WR-5 Stoker Boiler</td>
</tr>
<tr>
<td>8. Institute of Non Ferrous Metals</td>
<td>1</td>
<td>6/96</td>
<td>12,000</td>
<td>Copper Smelter</td>
</tr>
<tr>
<td>9. Matizol Gorlice</td>
<td>2</td>
<td>3/96</td>
<td>10,000</td>
<td>Asphalt Plant Drier</td>
</tr>
<tr>
<td>10. Odelwnia Zeliwa</td>
<td>1</td>
<td>3/96</td>
<td>25,000</td>
<td>OKR-5 Stoker Boiler</td>
</tr>
<tr>
<td>11. Argentchem Opalenica</td>
<td>1</td>
<td>6/96</td>
<td>800</td>
<td>Smelting Furnace</td>
</tr>
<tr>
<td>12. Klimawentex Rzeszow</td>
<td>3</td>
<td>6/96</td>
<td>3,000</td>
<td>Glassmelting/Sanderdust</td>
</tr>
<tr>
<td>13. Budostal Krakow</td>
<td>1</td>
<td>6/96</td>
<td>21,600</td>
<td>Rotary Drier/Asphalt</td>
</tr>
<tr>
<td>14. Farbiarski Warsaw</td>
<td>1</td>
<td>6/96</td>
<td>9,000</td>
<td>PCO-60 Heating Boilers</td>
</tr>
</tbody>
</table>

Total in Operation: 22, 184,900

### Under Construction

<table>
<thead>
<tr>
<th>Installation</th>
<th>No. of Units</th>
<th>Initial Operation</th>
<th>Capacity (M³/h)</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. FIAT Auto Poland</td>
<td>1</td>
<td>1/97</td>
<td>140,000</td>
<td>WR-25 Stoker Boiler</td>
</tr>
<tr>
<td>16. Krakodlew-Krakow</td>
<td>1</td>
<td>2/97</td>
<td>8,000</td>
<td>Rotary Drier/Sand</td>
</tr>
<tr>
<td>17. Cementownia Strzelce</td>
<td>1</td>
<td>2/97</td>
<td>10,000</td>
<td>Cement Kiln Drier</td>
</tr>
<tr>
<td>18. Zorza Myslenice</td>
<td>4</td>
<td>3/97</td>
<td>8,000</td>
<td>KRN-1.7 Stoker Boilers</td>
</tr>
<tr>
<td>19. Zembiec Zembcu</td>
<td>1</td>
<td>3/97</td>
<td>35,000</td>
<td>Rotary Drier/Bentonite</td>
</tr>
<tr>
<td>20. PRD Kutnie</td>
<td>1</td>
<td>3/97</td>
<td>45,000</td>
<td>Rotary Drier/Asphalt</td>
</tr>
<tr>
<td>21. PZW Warsaw</td>
<td>2</td>
<td>3/97</td>
<td>100,400</td>
<td>Two Stoker Boilers</td>
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</table>

Total Under Construction: 11, 346,400

Total to Date: 33, 531,300
1. Program/Project Identification No.  
DE-FC22-94PC94111

2. Program/Project Title  
Particulate Emission Abatement for Krakow Boiler Houses

3. Reporting Period  
10/1/96 through 12/31/96

4. Name and Address  
LSR Technologies, Inc.  
898 Main Street  
Action, MA 01720-5808

5. Program/Project Start Date  
April 1, 1994

6. Completion Date  
June 30, 1997 (est.)

7. FY Months or Quarters  

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<tr>
<td>1996</td>
<td>J</td>
<td>P</td>
<td>F</td>
<td>M</td>
<td>A</td>
<td>M</td>
<td>J</td>
<td>A</td>
<td>S</td>
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</table>

8. Cost Status

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<th>Dollars Expressed in Thousands</th>
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</thead>
<tbody>
<tr>
<td>Source</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>DOE</td>
</tr>
<tr>
<td>LSR</td>
</tr>
<tr>
<td>Total P</td>
</tr>
<tr>
<td>Total A</td>
</tr>
</tbody>
</table>

9. Variance

<table>
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<tr>
<th>Planned</th>
<th>Actual</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>121.4</td>
<td>61.1</td>
<td>115.3</td>
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<tr>
<td>121.4</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>121.4</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>121.4</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>121.4</td>
<td>6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>121.4</td>
<td>326.0</td>
<td>326.0</td>
</tr>
<tr>
<td>121.4</td>
<td>326.0</td>
<td>326.0</td>
</tr>
<tr>
<td>(204.6)</td>
<td>(204.6)</td>
<td>(204.6)</td>
</tr>
</tbody>
</table>

10. Major Milestone Status

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Units Planned</th>
<th>Units Complete</th>
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</thead>
<tbody>
<tr>
<td>T2-1 Prototype Demonstration</td>
<td>P</td>
<td>100%</td>
</tr>
<tr>
<td>T2-2 Commercial Units</td>
<td>P</td>
<td>75%</td>
</tr>
<tr>
<td>T2-3 Establish JV</td>
<td>P</td>
<td>100%</td>
</tr>
<tr>
<td>T2-4 Modernize Mfg. Facility</td>
<td>P</td>
<td>80%</td>
</tr>
<tr>
<td>T2-5 Tech. Training</td>
<td>P</td>
<td>80%</td>
</tr>
</tbody>
</table>

11. Remarks

- T2-1 Prototype Demonstration
- T2-2 Commercial Units
- T2-3 Establish JV
- T2-4 Modernize Mfg. Facility
- T2-5 Tech. Training

12. Signature of U.S. Department of Energy (DOE) Reviewing Representative and Date

[Signature]

[Date]
Figure 1

Figure 2

Core Separator Manufacture by Boulnois.
Exhibit of Ecolineal at 1998 Environmental Fair - Poznan