FINAL TECHNICAL REPORT

INDUSTRIAL ASSESSMENT CENTER PROGRAM
AWARD NUMBER: DE-FC36-02GO12097
CENTER LOCATION: The University of Texas at Arlington
PI: Professor Dereje Agonafer

1.0 EXECUTIVE SUMMARY

The work described in this report was performed under the direction of the *Industrial Assessment Center (IAC)* at University of Texas at Arlington. The *IAC* at The University of Texas at Arlington is managed by Rutgers University under agreement with the United States Department of Energy Office of Industrial Technology, which financially supports the program.

The objective of the *IAC* is to identify, evaluate, and recommend, through analysis of an industrial plant's operations, opportunities to conserve energy and prevent pollution, thereby reducing the associated costs. *IAC* team members visit and survey the plant. Based upon observations made in the plant, preventive/corrective actions are recommended. At all times we try to offer specific and quantitative recommendations of cost savings, energy conservation, and pollution prevention to the plants we serve.

2.0 GOALS OF THE PROGRAM:

1. Industrial Assessments
2. Promoting adoption of assessment recommendations
3. Promoting IAC program
4. Student Participation

2.1 Industrial Assessments

Assessments were conducted at small and medium size local manufactures to help them to manage energy requirements, reduce waste and increase productivity associated with manufacturing processes, materials, facilities and support functions. Each assessment was carried out in four phases which are described below.

- The Pre Assessment Analysis: The purpose of this analysis is to collect some preliminary information about the facility and give the IAC team some background data regarding utility bills and usage. This analysis must be completed prior to arranging an assessment date.
- The Site Visit: The IAC team will conduct a one day site visit to study the manufacturing process and to make energy, material waste and productivity related measurements using diagnostic equipment.
- The Report: Within 60 days of the assessment, the IAC team will submit a confidential report to the plant manager detailing the team's analysis and money saving recommendations, along with estimates of related costs, performance, and payback periods.
- The Follow Up: In two to six months after the assessment, the IAC team will contact the plant manager to determine which, if any, of the recommended measures have been implemented. The implementation rate helps to measure the IAC program's success.

The IAC at UTA performed 88 such assessments over the period of 2003-2007. The summary of these assessments is provided in table 1.

Year	1ST QUARTER			2ND QUARTER			3RD QUARTER			4TH QUARTER			TOTAL
	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	
FY03	1	0	3	3	2	3	3	1	2	1	1	3	23
FY04	1	2	1	1	0	3	0	1	1	4	6	3	23
FY05	0	1	0	1	1	2	0	4	1	3	5	3	21
FY06	1	1	1	1	0	1	1	2	0	1	6	6	21

2.2 Promoting adoption of assessment recommendations

UTA-IAC used a wide variety of resources to aid in the implementation of assessment recommendations. We continued to recommend the use of the Texas Manufactures Assistance Center (TMAC) whenever the assessment recommendations to clients warrant. TMAC has a wide array of staff engineers, which are able to assist clients with implementation of recommendations on sliding scale basis. Additionally, assessment follow-up telephone communication aided with answering client questions regarding implementation of specific recommendations.

Client name	Initial audit date	Follow-up date
Conveyors,Inc	2004-10-15	2006-03-21
Turbocare	2004-12-21	2006-03-21
Delfasco Forge	2004-01-21	2006-03-23
Horizon Milling	2005-02-04	2006-03-23
Morrison Products	2005-04-01	2006-03-23
Southern Champion Tray	2005-02-25	2006-03-23
Inca Metal Products	2005-04-15	2006-03-23
Associated Truss and Lumber	2005-04-22	2006-03-23
Rehrig Pacific	2005-04-08	2006-03-23
FMC Technologies	2005-05-26	2006-06-26
Flexible Foam Products	2005-06-10	2006-06-26
GranuTech Saturn Systems	2005-06-24	2006-06-27
GTM Plastics,Inc	2005-06-30	2006-06-27
Texstars, Inc	2005-07-08	2006-08-28
Hampson	2005-07-14	2006-08-28
Progressive	2005-07-15	2006-08-29
Osteomed	2005-07-22	2006-08-29

2.3 Promoting IAC Program

We continuously promoted the program through promotional mailings and also we made further efforts to enhance our coordination with the Texas Manufacturers Assistance Center which serves over 400 clients within the Dallas/Fort Worth (DFW) Metroplex. As a result of the information of “Save Energy Now Initiative” to over 100 clients by email, 2 companies- Coca Cola Syrup Company at Dallas and Atlas Copco BMH at Grand Prairie replied requesting energy assessments.

2.4 Student Participation

IAC at UTA provided numerous students with the opportunity to increase the knowledge base. The participating students during their plant visits encountered various manufacturing environments and due to wide range of possible assessment recommendations, were required to address the issues outside of their area of immediate expertise. The following is a breakdown of major assessment recommendation categories along with some topics IAC students dealt with on a regular basis:

- Energy combustion systems, thermal systems, electrical power, motors, building envelope, HVAC, and lighting.
- Waste Minimization and Pollution Prevention waste stream contamination, equipment, post generation treatment, water use, solid and liquid recycling, waste disposal, and efficient use of raw materials.
- Productivity manufacturing enhancements, purchasing, inventory, labor optimization, space utilization, and reduction of downtime.

The UTA-IAC provided ongoing Software and SEN-Lecture training for its student personnel at least once a month (this training usually takes place during a non-visit week). This training exposed the students to new potential recommendations and the technical background that is required while on the assessment audit. We have aided several students in applying for scholarships with the Association of Energy Engineers.

Every semester at least two students were awarded scholarships. Over the funding period, the UTA-IAC has provided over 50 students with day long training sessions and several short training sessions covering specialized software. The students were also provided with the opportunity to attend various conferences and present the technical papers.

3.0 TECHNOLOGY TRANSFER ACTIVITIES

3.1 Conferences Attended

The IAC-UTA personnel attended various conferences throughout funding period. These conferences are listed below:

- Energy Summit, 2005.
- World Energy Engineering Congress, Austin, Texas, September 2005.
- International Mechanical Engineering Congress and Exposition, Orlando, Florida, November 2005.
- ITherm, San Diego, California, June 2006.
- International Mechanical Engineering Congress and Exposition, Chicago, Illinois, November 2006.
- InterPACK, Vancouver, B.C., Canada, July 2007.

3.2 Publications (Peer Reviewed and Conference Proceedings)

Throughout funding period, the IAC-UTA personnel worked on different problems related to energy consumption and savings and presented their findings in various conferences mentioned above. The list of those papers is presented below.

- Mulay, V.; Karajgikar, S.; Iyengar, M. IBM; Agonafer, D.; Schmidt, R. IBM," Computational study of hybrid cooling solution for thermal management of data centers, " 2007 ASME/JSME Thermal Engineering and Summer Heat Transfer Conferences & InterPACK '07, July 8-12, 2007.
- Bhopte, Siddharth, Madhusudan Iyengar, Bahgat Sammakia, Roger Schmidt and Dereje Agonafer, "Effect of Under Floor Parameters on Data Center Performance", Honorary Symposium for Dr. Suhas V. Patankar, International Mechanical Engineering Congress and Exposition 2006, November 5-10, 2006, Chicago Hilton.
- Bhopte, Siddharth, Bahgat Sammakia, Madhusudan Iyengar, Roger Schmidt and Dereje Agonafer, "Effect of Under-Floor Blockages on Data Center Performance", ITHERM, May 30-June 2, 2006, Sheraton San Diego Hotel and Marina, San Diego, CA.
- Bedekar, Vishwas, Saket Karajgikar, Dereje Agonafer, Madhusudan Iyengar and Roger Schmidt, "Effect of Crac Location on Fixed Rack Layout," ITHERM, May 30-June 2, 2006, Sheraton San Diego Hotel and Marina, San Diego, CA.
- Refai-Ahmed, Gamal and Dereje Agonafer, "Thermal Road map for Telecom Equipment," ASHRAE Transactions, v 111 n 1, 2005, p 913-920

3.3 Invited Talks and Presentations

Professor Agonafer gave numerous talks and presentations outlining the high energy consumption and subsequent thermal management challenges in electronics. These activities are listed below.

- Short Course: Some Thermal and Mechanical Issues That Arise in Three-D Packaging, ITherm Conference, San Diego, CA, 2006.
- Panel Presentation: Challenges in Chip/Processor Level Thermal Engineering, ITherm San Diego, CA, 2006.
- Invited Talk, "Reliability – IAC" to Director and members of the Automation and Robotics Research Institute, UTA, 2006.
- Industrial Efficiency Initiative National Satellite Teleconference, Fort Worth, Texas, 2006.
- Teleconference with Princeton University to discuss Thermal Management issues, August 24, 2006.
- Presentation to Raytheon Co. on microelectronic machines, electronic cooling and energy related issues, August 25, 2006.

- Invited Presenter, HP-Santa Clara Symposium on Thermal Management of Electronics Components through Direct Fluid Cooling, Santa Clara, CA, September 1, 2006.
- Invited Speaker, “Electronic Packaging”, ASME North Texas Section, Plano, Texas, June 2005.