DISTRIBUTED ENERGY PEER REVIEW 2005

DECEMBER 13-15, 2005
ARLINGTON, VIRGINIA

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INTRODUCTION

The Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy's Distributed Energy (DE) Program held its third *Distributed Energy Peer Review* December 13 – 15, 2005, at the Doubletree Crystal City Hotel in Arlington, Virginia. The *2005 Distributed Energy Peer Review* examined the four core technology sub-programs: Turbines, Thermal Energy Technologies, Advanced Reciprocating Engines, and End-Use Applications. These programs strive to improve the energy and environmental performance of distributed energy technologies, and to increase the level of technology integration among on-site energy generation alternatives with the ultimate goal of achieving a more flexible, smarter energy system nationwide.

The Peer Review attracted 154 attendees, of whom 21 were reviewers. Peer reviewers were selected after a national search for qualified individuals, representing private industry, consulting, and government organizations, with requisite expertise in related fields and freedom from conflicts of interest.

This year, in addition to formal presentations given in plenary-style format, thirty-eight (38) poster presentations were reviewed; both formal and poster presentations were evaluated according to identical evaluation criteria. Poster presentations were someone shorter and more informal than those delivered in the formal settings, but peer reviewers evaluated the projects in the same manner.

Prior to the peer review, reviewers were provided with project summaries, evaluation forms, and evaluation criteria and guidance. Projects were ranked on a scale of one to ten, with ten representing the highest quality. A final project score was calculated using weighted criteria for relevance to overall program objectives, approach to performing research and development, project management, technical accomplishments, quality, and productivity, and technology transfer, collaboration, and partnerships. Projects within the following programs received the following average project scores:

- **Turbines,** Including Industrial Gas Turbines, Microturbines, Advanced Materials, Low-Emissions and Fuel Combustion – 7.08
- **Thermal Energy Technologies**, Including Thermally Activated Technologies and Micro-Combined Heating and Cooling – 7.03
- **Advanced Reciprocating Engines** – 7.69
- **End-Use Applications, Group 1**, Including Integrated Energy Systems, End-Use Systems, Combined Heat and Power Analysis, Power Electronics, Sensors and Controls – 7.59
- **End-Use Applications, Group 2**, Including Integrated Energy Systems, End-Use Systems, and Combined Heat and Power Education and Technical Assistance – 8.83

The presentations given at the *2005 Distributed Energy Peer Review* are available on the web at http://www.energetics.com/depeerreview05/agenda.html.

THE U.S. DEPARTMENT OF ENERGY DISTRIBUTED ENERGY PROGRAM

The U.S. Department of Energy's Distributed Energy (DE) Program has the led Federal government's efforts to develop a portfolio of advanced on-site, small-scale, and modular energy conversion and delivery components and systems for industrial, commercial, residential, and utility applications. The mission of the DE Program is to strengthen America's energy infrastructure and provide utilities and consumers with a greater choice of energy efficient technologies for on-site generation of electricity and use of thermal energy. The program seeks to develop and deploy, by 2015, a diverse array of integrated distributed generation and thermal energy technologies that are competitively priced and highly efficient. Distributed energy technologies can expand the Nation's aging electricity power infrastructure, relieve congestion on transmission and distribution systems, increase supplies during periods of peak demand, and reduce environmental emissions.

Program activities are organized in two main areas: Distributed Generation Technology Development, and End-Use System Integration and Interface.

Distributed Generation Technology Development

The Distributed Generation Technology Development effort seeks to develop a portfolio of electricity generation and heat utilization technologies with a focus on efficiency, emissions, reliability, availability, maintainability and durability (RAMD) and meeting cost targets. By improving the efficiency of thermally activated systems and advancing the efficiency and emissions characteristics of these power generation technologies, the program provides the building blocks necessary to develop advanced, integrated systems.

Industrial Gas Turbines
The industrial gas turbines program focuses on advanced materials research, such as composite ceramics and thermal barrier coatings that will improve performance and durability. Research tests cost effective, low emissions technologies, and continues efforts to lower manufacturing costs and increase durability of ceramics, combustion systems, and combustor designs for gas turbines.

Microturbines
Microturbines are a new type of combustion turbine for use in distributed energy generation applications. About the size of a refrigerator, microturbines produce 25 to 500 kilowatts of energy and can be located on sites with limited space for power production. Waste heat recovery can be used in combined cooling, heating, and power (CHP) systems with the potential to achieve energy efficiency levels greater than 80 percent. Activities will include a national effort to design, develop, test, and demonstrate a new generation of microturbines for DER applications that are cleaner, more affordable, reliable, and efficient than products currently available.

Advanced Reciprocating Engines
Advanced reciprocating engines offer a wide range of power generation at less cost than other technologies. Reciprocating engines can be used for many purposes, such as local power grid and substation support, peak-shaving, remote power, on-site generation, and combined CHP applications. Activities include a national effort to design, develop, test, and demonstrate a new generation of gas-fired reciprocating engines for distributed energy applications that are cleaner, more affordable, reliable, and efficient than products commercially available today.

Advanced Materials and Sensors
Advanced materials and sensors, such as ceramics and environmental barrier coatings, are some of the key enabling technologies that improve the efficiency of stationary industrial gas turbines, microturbines and reciprocating engines. Engineered ceramics offer all the advantages of ceramics -- resistance to heat, corrosion, erosion, and chemical activity -- while adding strength and thermal shock resistance that conventional ceramics do not demonstrate.

Fuel Combustion (Formerly Fuel Flexibility)
Fuel Combustion evaluates long-term combustion technologies for low emissions, focusing on next-generation dual fuels (gaseous or liquids). Research focuses on the evaluation of fuel characteristics and effects of fuel variations on distributed generation equipment for long-term availability and durability.

Thermal Energy Technologies (Formerly Thermally-Activated Technologies)
Thermal energy technologies convert natural gas, exhaust, or rejected heat into heating, cooling, humidity control, or bottoming cycles. Utilizing thermal energy is an essential building block for combined heat and power (CHP) integrated systems, widely recognized as the next wave of energy efficient power generation devices that will compliment central power station electric power generation into discrete, economical, reliable, and secure distributed power generation.

End-Use System Integration and Interface

The focus of the End-Use System Integration and Interface subprogram is to develop highly efficient integrated energy systems that can be replicated across end-use sectors that will help demonstrate a research and development (R&D) objective or address a technical barrier.

Distributed Energy Systems Application Integration facilitates acceptance of distributed energy resources by partnering with industry consortia in commercial buildings, light industrial, supermarkets, hotels, healthcare and education end-use sectors. Projects quantify the energy and emissions benefits and installation and retrofit costs; research integration issues and recommend improvements; and correlate data to analytical models and tools for end use customers. Research includes activities on electronics and supervisory control strategies to better optimize electrical and thermal needs and to synchronize with the grid.

Cooling, Heating, and Power Integration (CHP) reduces energy costs and emissions by using energy resources more efficiently. In conventional conversion of fuel to electricity, over two-thirds of the energy input is discarded as heat to the environment and not used for productive purposes. CHP makes greater use of fuel inputs by utilizing the discarded heat with system potential efficiencies from 60 to 80 percent. Research and development are focused on integration of prime movers such as turbines, microturbines, and reciprocating engines with thermally activated technologies (chillers, dehumidification, etc.) for plug-and-play, high efficiency, integrated CHP systems. The program also continues support to the Regional Application Centers (RACs) and educational programs under the State Energy Program (special projects) activity.

For more information about the specific goals of each of these programs and subprograms, please visit the Distributed Energy website at http://www.eere.energy.gov/de.

Evaluation Criteria and Peer Reviewer Ratings

Each project lead or team provided advance information, in the form of a *Project Summary Form*, as to how they had satisfied the review criteria. The *Project Summary Form* included the following:

Overall Project Purpose and Objectives: Provide a brief project description. Identify specific project goals and objectives. Outline the major milestones that have been set for the entire timeframe of your project. List

major partners, including subcontractors, with whom you are participating in this project, and the role they play in its completion. Explain how this project contributes to the achievement of the U.S. Department of Energy's Distributed Energy Program goals. Describe the expected benefits of your project for the U.S. DOE and the nation.

FY 2004 and FY 2005 Results and Accomplishments: Describe specific technical results achieved, milestones reached, publications released, and any other accomplishments since the previous Peer Review in December 2003.

FY 2006 Plans and Expectations: Identify and describe your FY 2006 plans and expected FY 2006 milestones. Explain any key technical barriers that you foresee and your strategy to overcome these barriers. If applicable, please provide 2007, 2008, and 2009 milestones.

Public/Private Partnerships: Identify cooperative efforts and technology transfer/outreach activities related to this and related projects. When answering, consider work with private industry, state and local government, federal government, national laboratories, academia, and trade associations.

During the three-day peer review, three concurrent tracks of both formal and poster presentations, allowed principal investigators to share the results of their work with peer reviewers. Formal presentations followed a sample template and allowed a set amount of time for the presentation, followed by a question and answer period. Poster presentations were more informal, and allowed principal investigators to "show and tell" their projects as peer reviewers gathered around. General attendees had the opportunity, following peer reviewer questions and answers, to ask questions as well.

Each project was reviewed by a Peer Review Panel, composed of individuals, or peer reviewers, representing both private and public sector interests in distributed energy. These individuals were invited to participate after an exhaustive solicitation and national search for well-qualified experts who had requisite background experience and expertise as well as freedom from conflicts of interest. The five panels are identified below:

TURBINE PEER REVIEW PANEL

Name	Affiliation
Roy Allen	Consultant
Ed Kraft	EHK Technologies
Timothy Lieuwen	Georgia Institute of Technology
Ajay Misra	NASA
George Touchton	GLT Energy Consultancy

THERMAL ENERGY TECHNOLOGIES PEER REVIEW PANEL

Name	Affiliation
Frank Biancardi	UTRC Retired
Rob Brandon	Natural Resources Canada
Thomas Clemens	SG America

ADVANCED RECIPROCATING ENGINE PEER REVIEW PANEL

Name	Affiliation
Avtar Bining	California Energy Commission
Nabil Hakim	Consultant
Dan Kincaid	Distributed Power Consulting
Clark Midkiff	University of Alabama
David Thimsen	EPRI

END-USE APPLICATIONS #1 PEER REVIEW PANEL

Name	Affiliation
Wei-Jen Lee	University of Texas at Arlington
Mike Muller	Rutgers University
Robert Webster	Webster Ventures
Cherif Youssef	SEMPRA

END-USE APPLICATIONS #2 PEER REVIEW PANEL

Name	Affiliation
Susan Davis	Questar
Jack Kazmar	Comfort Air Solutions
Deepak Perti	DuPont
Agami Reddy	Drexel University

Peer reviewers were required to evaluate each project on the basis of the following rating scale.

9-10	7-8	5-6	3-4	1-2
Outstanding/ Excellent	Very Good/Few Areas to Improve	Good/Modest/ Some Areas to Improve	Fair/Significant Weaknesses	Poor/Not Adequate

Each project was then scored according to the following weighted criteria to determine its ranking as compared to other projects within the program area:

- Relevance to overall program objectives – 5%
- Approach to performing the research and development and project management – 35%
- Technical accomplishments, quality, and productivity – 40%
- Technology transfer, collaboration, and partnerships – 20%

Peer reviewers evaluated each project independently; consensus was not required. The scores were averaged to illustrate comparative ratings among projects, as shown in the summary table for each program. The reviewers' individual responses were not disclosed to DOE.

OVERALL DISTRIBUTED ENERGY PROGRAM EVALUATION

Upon completion of the full DE Peer Review, reviewers were asked to evaluate the overall DE Program. This allowed them to assess the program from a "big picture" perspective and to suggest new directions or approaches. Peer reviewers were asked to assess the Department of Energy's Distributed Energy Program on the basis of its relevance to national needs and the agency's mission; program structure and balance; program outcomes; program planning; and implementation. On a rating scale of 1-5, with 5 being excellent, the program was rated very good to excellent in all categories. Results of the *DE Program Management Evaluation* are provided as Appendix C.

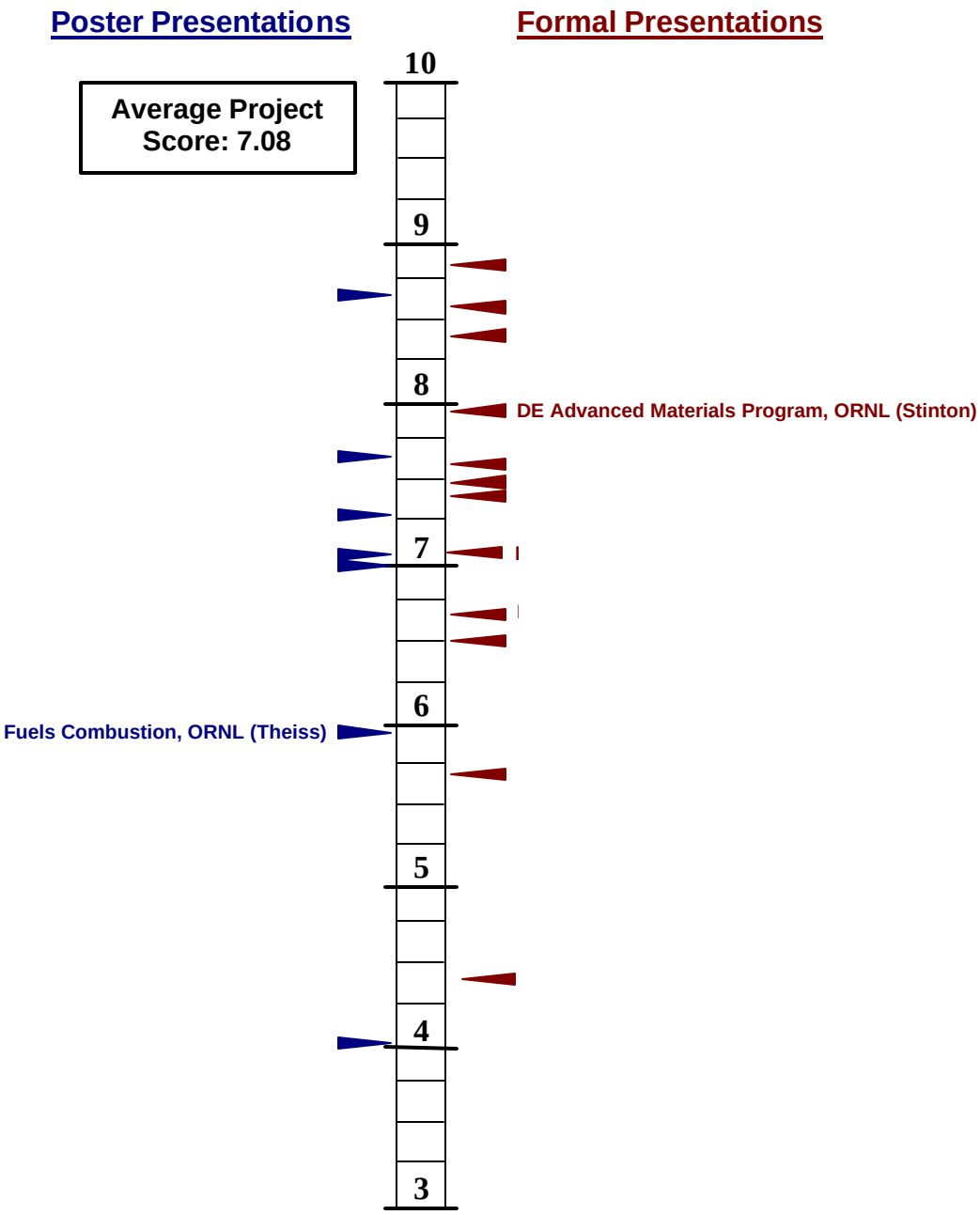
Respondents commended the Department on the manner in which technical and scientific advances have been made to improve the reliability and cost-effectiveness of distributed energy products, components, and systems. The program was noted as being relevant to the needs of our most pressing national energy problems, including grid reliability, diversification of energy sources, and reduction of fossil fuel consumption, reduced greenhouse gas emissions, and improved homeland security.

Some debate exists between those who support the shift in emphasis away from primary research on equipment and systems, to grid security and reliability policy and deployment. Nevertheless, respondents are satisfied with project approaches and goals, and with the work accomplished to date. Some criticisms were leveled at the heavy earmarks attached to financial support for distributed energy, as well as at the unknown strategy and mission for the distributed energy program within the new Office of Electricity Delivery and Energy Reliability.

Program implementation received favorable reviews. Technical progress was seen as excellent, with the taxpayer receiving good value for his/her tax dollar. DOE was encouraged, however, to address commercialization in the future, integrating new technologies with current heating, ventilation, and air conditioning systems and ensuring common integrating platforms so as to alleviate market bias.

TURBINE PROGRAM

A. Turbine Projects - Summary



B. Turbine Program: Advanced Materials Project Evaluations

PROJECT TITLE	**DE ADVANCED MATERIALS PROGRAM**
PRESENTER(S)	**DAVE STINTON, ORNL**
OVERALL SCORE	**7.92**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 9.00

Comments:

- The national labs are a tremendous resource and are relevant to a broad range of RD&D and commercial development programs – including this.
- A broad array of programs with potentially multiple benefits.
- Highly relevant to overall DOE goals.
- Materials have always been and remain key enablers of energy systems. ORNL remains an essential resource for these issues and has done a very credible job of managing these programs.
- Well aligned.

2. Approach to performing the research and development and project management:

Rating: 7.40

Comments:

- Programs are well managed, but could use some market realities to prioritize. Technical work, particularly in materials, is top rate. Future efforts should focus on the key issues – not all 25 programs.
- The project has too many tasks for the budget. Might need to eliminate a few tasks to create a better focus. The project should consider alternate solutions for the technical problem. Example: the project is developing new stainless steel for recuperators – there might be alternate solutions, such as using an existing high temperature alloy. The technical solution proposed in various tasks is based on the interests of ORNL researchers, which may not necessarily be the best solutions.
- ORNL takes a very critical, yet supportive, approach to managing external development contracts. Periodic reports and reviews are conducted to address progress and keep records on track.
- Solid, diversified team oriented towards developing real progress. Not clear that current technical partners represent best available expertise-should consider broadening partners to others outside Tennessee; e.g. ceramics program could benefit by engaging other universities with expertise in this area (e.g. University of Connecticut).

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 8.00

Comments:

- The national labs are a tremendous resource and their efforts and contributions underpin much of the work accomplished by this program, and many other RD&D and commercial developments.

- Good work on 347SS improvement. Good job on ceramics exposure to moisture problem, but some economic input is needed to determine the future course.
- Excellent technical progress toward understanding the problem. The project must be complemented for developing cost-effective EBC coating techniques.
- Have made very valuable contributions to materials progress for both gas turbine and reciprocating engines, as evidenced by the strong collaboration with OEM's
- Clear demonstration of solid progress across a broad front.

4. Technology transfer, collaborations, and partnerships:

Rating: 8.40

Comments:

- Very good.
- Excellent collaboration with industries and end users. The collaboration with end users is exemplary and will ensure that technologies developed by ORNL are adopted by the end user. However, it was not clear if collaboration with material suppliers is producing worthwhile results.
- Have always, and continue to involve OEM's as key participants in programs.
- Good tech transfer focus.
- Concern regarding the choice of partners. Team should move outside Tennessee as needed to engage more qualified partners.

5. Overall Impressions:

Strengths:

- The materials program provides the underpinnings for much of the progress this program has made.
- Continue recuperater test program. Complete testing of coated ceramics. I did not judge reciprocating work that is not pertinent to micro-turbines.
- Technical expertise of researchers and ability to thoroughly understand the problem and find solutions based on understanding.
- Very strong internal materials expertise combined with subcontractor materials and systems people. Use a strong combination of fundamental understanding and practical application engineering.

Weaknesses:

- It is a challenge for the laboratories to avoid becoming insular from the real development work. The DE Advanced Materials Program has met this challenge and has shown very commendable coordination and cooperation with the projects and PI's throughout the DE Program.
- Too many small programs, success could be enhanced by concentrating on fewer programs.
- Need to eliminate some tasks to put adequate resources into remaining tasks.
- Unfortunately, current budget cuts pose danger of loosing basic capability.

Recommendations:

- The national labs are a tremendous resource and relevant to a broad range of RD&D and commercial development programs.
- The national labs provide continuity. Their staff and programs tend to have more permanence than those of the commercial participants. This should be brought forward and highlighted since it is often underrated or even seen as a fault.
- Soon a decision on the economic and technical viability of ceramics will have to be made.
- Eliminate some tasks to fund high risk/high payoff activities (such as development of cost-effective EBC process).

- Need more materials as well as process cost assessments to help make judgments on what efforts to carry on with reduced budgets.

E. Turbine Program: Combustion Lab Call Poster Evaluations

PROJECT TITLE	**FUELS COMBUSTION: IMPACT OF OPPORTUNITY FUEL COMBUSTION ON DISTRIBUTED ENERGY PLATFORMS**
PRESENTER(S)	**TIM THEISS, ORNL**
OVERALL SCORE	**5.99**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 6.80

Comments:

- This project is rated as an incremental advance that will improve reliability and performance and lower loss of service and maintenance costs.
- This project is most relevant and useful to reciprocating engine technology (see recommendations.)
- Doesn't do anything for major needs of microturbines to better performance and lower cost.
- Relevant to DOE goals and objectives.
- It is not evident how much of these fuels are available as % of total fuels.
- Program approach well aligned with DOE goals.

2. Approach to performing the research and development and project management:

Rating: 4.60

Comments:

- The approach (while correct at the 30.000 foot level) lacks specificity and planning "where the rubber meets the road") – that is in the actual test focus, plan, and goals.
- Running an atmospheric combustor will reveal nothing about potential hot section corrosion.
- Well defined project plan. However, there appears to be no emphasis on impact of various fuels on turbine operation.
- Appears to address key issues.
- The team has put together such a broad program that it is not clear that they will make significant contributions in any area that they are working in. In addition, their plan for turbines is directed at the wrong problems.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 6.50

Comments:

- Too early to evaluate, project was only recently awarded.
- Program just started.
- Besides selecting fuel, there has not been much progress.
- Too early in program.

- Too early to comment on much, but the team appears to be putting together pieces to implement the proposed plan.

4. Technology transfer, collaborations, and partnerships:

Rating: 7.20

Comments:

- Cooperation with, and technology transfer to, OEMs is planned.
- There is good technology transfer, collaborations and partnerships.
- Partnership with Solar Turbines and Brookhaven National Lab.
- Appears to involve relevant players.
- Team has broad and substantive collaborations.

5. Overall Impressions:

Strengths:

- As applied to reciprocating engines: Practical and applied, with high value to OEMs, to maintenance shops, and to owner operators.
- Worthwhile program for reciprocating engines.
- Good test plan and facilities.
- Appears to understand the complex issues and have designed approach to address these.
- A broad and wide ranging program encompassing many key players.

Weaknesses:

- Though laudable in intent, the program plan needs focus and priorities, particularly with regard to the testing regime, fuels to be tested, and the like.
- The project team demonstrates little expertise or understanding of the problems of gas turbines and little knowledge of how the project could benefit gas microturbines.
- No value for microturbines.
- Lack of work to study the impact of various fuels on the turbine performance.
- Not evident from the presentation what the contaminant issues are.
- Not clear that all this work should be performed at this lab, given other DOE centers of excellence in certain areas.
- A major weakness is noted in terms of ability of the program to substantively contribute.

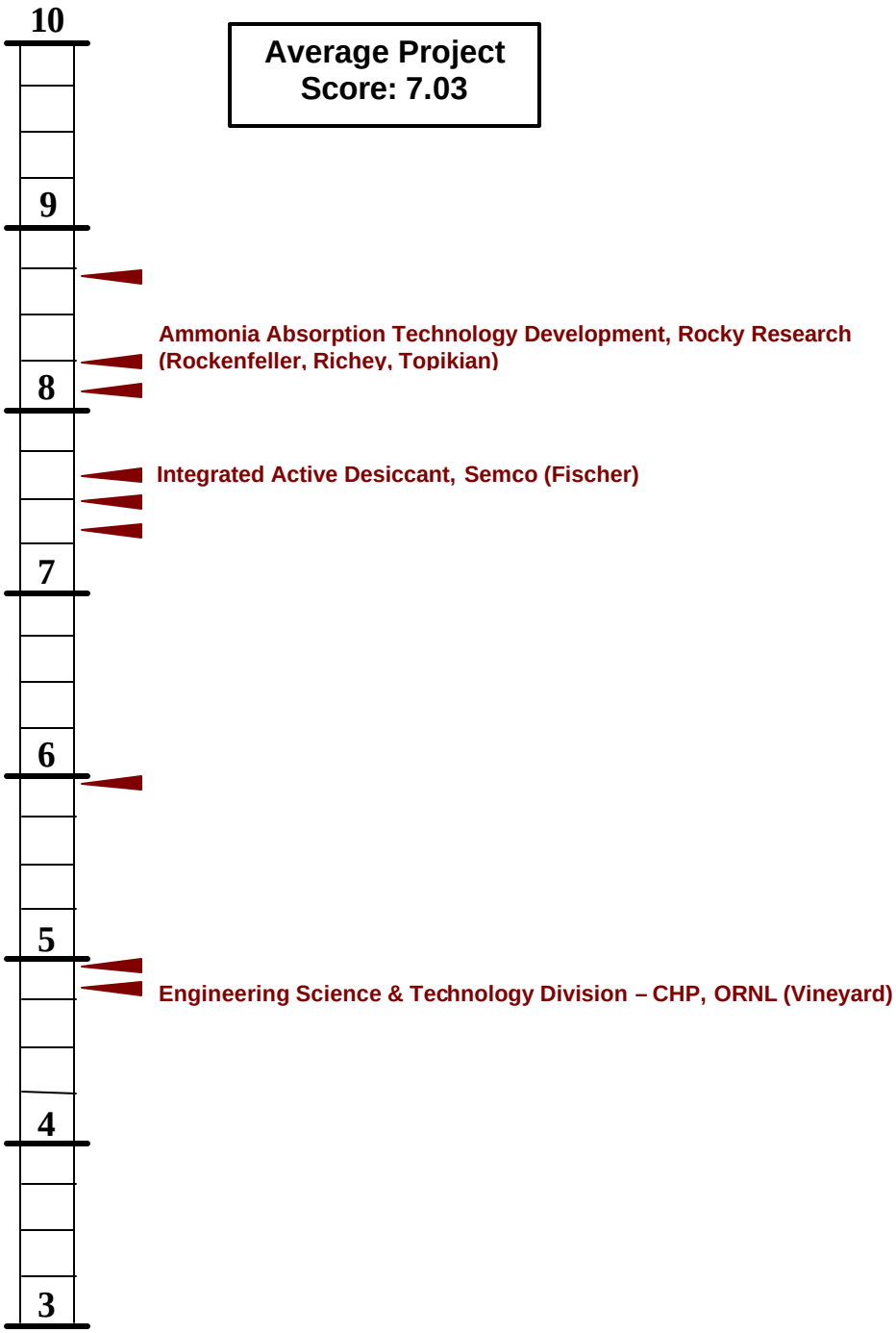
Recommendations:

- Remove microturbines/gas turbine technology and testing from the program, and refocus the resources toward reciprocating engines.
- Tighten up and clearly define the program plan.
- Coordinate with "Toward Predictive Understanding of Low Emission Fuel-Flexible Distributed Energy Turbine Systems" regarding test regimes, fuel mixtures and the like.
- Drop combustor tests and devote program to reciprocating engines.
- Do not duplicate work at other national labs.
- Should likely focus on reciprocating engines, not gas turbine.
- Major program refocusing needed with better articulation of program goals. Focus program around core competencies of Oak Ridge, such as materials and reciprocating engines. Scale back program scope and funding by removing gas turbine component and focus on reciprocating engines.

THERMAL ENERGY TECHNOLOGIES PROGRAM

A. Thermal Energy Technologies Projects - Summary

Formal Presentations



B. Thermally Activated Technology Project Evaluations

PROJECT TITLE	**ENGINEERING SCIENCE AND TECHNOLOGY DIVISION – COOLING, HEATING, AND POWER**
PRESENTER(S)	**EDWARD A. VINEYARD, OAK RIDGE NATIONAL LABORATORY**
OVERALL SCORE	**4.80**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 6.67

Comments:

- Desiccants have been transferred to NREL and the work is being refocused on new heat exchanger concepts, ORC and other projects. This activity is both contract management and in- house R&D and so must be best compared against NREL rather than separate project funded in the main through these national labs. This program suffers at present by being somewhat unfocused.
- Laboratory test facilities very pertinent, useful, and serve as critical DE resource. Attempt to define new areas of expertise, i.e. heat exchangers, advanced power systems, controls, etc; appears weak and may not be sustainable and capable of providing real near term benefits to DE efforts.
- ORNL is the program manager for a number of projects. As such they are relevant.
- It appears that they are undertaking some projects in-house rather then subcontracting. This should not be a long term strategy.

2. Approach to performing the research and development and project management:

Rating: 4.00

Comments:

- The presenter did not discuss program management. This was to be an overview of TAT as managed by ORNL. It was not. Project management was not presented. The basis of continuance of projects was not discussed. Why were some projects determined to be best fit in-house? Why did heat exchanger performance become a project, what is the impact of improving heat exchanges in general? How much energy could be saved? Was it considered that all heat exchanger performance installed in air handling equipment is compromised due to space limitations within the air handler? This limitation is a market constraint as it is related to size (footprint) of the equipment and first cost. I must admit though, that is interesting technology and direction to research a micro-channel non-metallic heat exchanger. The concept of the micro-channel fluid dynamics could relate to improvements in desiccant wheel design. By observation, smaller flutes have lesser pressure drop compared to larger flutes. Micro-channels would allow for the entrained humidity in the air flowing through the wheel flute to be closer to the desiccant and perhaps increase the adsorption rate over the same length compared to the large flutes.
- The research effort of micro-channels may be enhanced by cooperation with a university as a partner.
- There was no discussion of how the project was managed by ORNL. There should be an overview included of who oversees the projects.
- Work on laboratory test facilities, although not emphasized in presentation, is known and key element of DE verification plan for some TAT concepts and systems.

- However, the program effort to establish world class heat exchanger knowledge and a test facility, as well as a resource for Organic Rankine Cycle and other advanced power conversion systems, shows no expertise or awareness of critical issues. Suggest engaging industry experts and extensive literature searches if you continue. Major hurdle to overcome is to establish leading edge skills in low-cost HX manufacture. This need is widespread across TAT technologies but no indication that ORNL can provide sufficient benefits to decrease cost, size and efficiency of critical components. Get outside help to identify specific needs and skills.
- There was little or no comment on how external contracts were managed. A worthwhile objective for ORNL would be to develop a testing facility of high capability for innovative heat exchangers. The ORC material as presented did not seem that innovative and if there was strong connection to industry it was not presented. However waste heat (ORC) and other waste heat initiatives should be pursued

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 5.00

Comments:

- SEMCO work and laboratory facilities are excellent, but no significant indication of ORNL role in Revolution project other than good goals and product objectives. Suggest more technical input from ORNL and highlight that help. Little such help came through in presentation.
- It was not that clear how to make the allocation of technical accomplishments between the lab and the companies involved with the lab. This might have been due to the lack of familiarity of the presenter with some of the work.
- Believe S-O-A in many new technology areas is well ahead and advanced to levels shown in presentation. HX's, ORC's, and Controls, for example, show no leadership.
- This is on an average with the other projects. The SEMCO Revolution project rates 8-9 on its own. The Revolution product looks like it is market ready and meets the goals of the project. The other SEMCO projects are rated much lower. This is because there was no demonstration of why the second SEMCO project did not use equipment for other programs or why the micro-channel research is being conducted. The presenter stated that the heat exchanger fluid flow was not optimum and that seems to be the justification for the research.

4. Technology transfer, collaborations, and partnerships:

Rating: 5.33

Comments:

- The SEMCO project scores high although it seems by these presentations that there was not much technology transfer upfront. SEMCO presents that it did more, and spent more than planned in order to complete the successful design. I am sure that ORNL assisted by evaluation and testing but that was not explained very well.
- The presenter did not discuss technology transfer with industry regarding the carbon filament heat exchanger research. Is there an interested university? Is there an industry interest in this? Is there an industry partner?
- The SEMCO project seems like a success; however there appears to be a lack of a commercialization strategy. Although funding is hard to find it should be on the program's to-do list to avoid premature failure of the SEMCO technology in the market place. It seemed that obtaining the R&D 100 award was enough when really working with SEMCO to get over the commercialization barriers is needed. A demonstration of 20-25 units really needs to supported

- No significant indication of technology transfer. Partnership roles and continuing support of new TAT products introduction into marketplace are essential.

5. Overall Impressions:

Strengths:

- SEMCO Revolution product is good and should be successful as long as SEMCO is successful in regard to establishing sales networks and accounts for the product.
- Has worked with a motivated company to assist in the development of a significant project. The program has links with ORNL materials group that has value.
- Clearly a program searching for new direction. Build upon strengths in TAT test facilities and absorption technology acquired over past decades striving to keep absorption technology alive, in spite of vapor compression dominance.

Weaknesses:

- The second SEMCO project involving the engine generator seems like starting from scratch. Maybe the DG technology is in place to do so, but probably not. Aren't there packages from other DOE sponsored programs/projects which could have been used here?
- Concerning the in-house projects, while basic research is important, there was no need and justification for the heat exchanger research that was clearly presented. What benefit is this to DG/TAT?
- Program is somewhat unfocussed and both the material presented and answers to the questions suggested a group searching around for significant work to do.
- Unless substantial outside assistance and more skilled staff in new areas are rapidly acquired, or partnerships with other centers of excellence established to show leadership in HX's, ORC's, and controls, consider some deletions.

Recommendations:

- Over the entire TAT platform, there was no discussion of ROI.
- Require that the goals and potential energy conservation be stated for each project.
- The program should look at NREL's model and if funds permit build up an excellent test center at ORNL capable of testing heat exchanger and recuperator technology including novel concepts from small innovative companies. The program should not try to develop concepts internally and needs to make sure it has the right human resource base to perform the independent HX testing capability.
- Very hard look at future areas in light of reduced DE (DOE) budgets may be necessary.

PROJECT TITLE	**INTEGRATED ACTIVE DESICCANT – VAPOR COMPRESSION HYBRID ROOFTOP WITH CHP CAPABILITY**
PRESENTER(S)	**JOHN FISCHER, SEMCO**
OVERALL SCORE	**7.63**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 7.33

Comments:

- The presenter should have explained more clearly how this project relates to TAT. The Revolution does use gas as the heat source. It was only during the Q&As that it was stated that heat from DG sources could also be used. The second project does include this but was not clearly stated that it was intended to meet TAT objectives. That needs to be stated.
- This product is relevant to the TAT and DE goals.
- Revolution product is an excellent first step in providing a viable DE TAT desiccant system. Need to show actual high efficiency recovery of waste heat from IC engine and MT prime movers for direct DE program relevancy.

2. Approach to performing the research and development and project management:

Rating: 8.00

Comments:

- The presenter did relate that there were cost overruns on their side. That is not surprising; perhaps the upfront budgeting should consider that. If the uncertainty factor was a bit higher in the budget, perhaps the funding from ORNL would have been higher and the risks to SEMCO lower.
- This project appears to be well managed both from a product development viewpoint and from a demonstration aspect. As indicated elsewhere may need some more limited support to assist in market penetration.
- Team displayed an excellent program plan, project management and execution. Milestones appear to have been met and technical, packaging and market barriers to product introduction addressed and overcome.
- Project 2 and 3 appear on track and logical steps. Only analysis and limited test data displayed but efforts look extremely promising.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 7.67

Comments:

- The first project is clearly moving to commercialization.
- The second project is re-inventing the wheel. Another DG package already funded should have been implemented. This would have eliminated double funding for DG equipment. The real project here should have been to install a package from another program as a demonstration of the other program as well. Low leverage points here!

- The technical execution of the project appears to be excellent with the project manager knowledgeable of the hurdles that face the company in getting the project to market.
- Project 1 shows several major and impressive technical accomplishments.
- Use of variable speed drive good effort and should promote more usage in standard HVAC product. Capability and performance of desiccant very significant and key. Test results and ORNL verification excellent.
- Projects 2 and 3 results will come later, but important to demonstrate integrated desiccant and IC engine waste heat recovery soon, perhaps
- Before school installation. Benefits of desiccant in Walgreen's are impressive!

4. Technology transfer, collaborations, and partnerships:

Rating: 7.00

Comments:

- There was only brief discussion of technology transfer for project 1. The presenter did relate that when something did not go as expected that they did hold discussions with the component manufacturer.
- There was no discussion of technology transfer for the second project. There is much in DG that could have been utilized here.
- The project has 3 varied field trials; the cinema appears to be good application. The DE project with the reciprocating engine raises some questions as exhaust heat recovery is not used and the seasonal efficiency is not that high.
- Hopefully, successful effort will be communicated to regional DOE CHP centers. ORNL should actively promote and disseminate product development with HVAC industry and designers and specifying engineers.

5. Overall Impressions:

Strengths:

- The "Revolution" product.
- A good technical solution with a good idea of how to get the unit to market (focusing on key accounts). Noted that 75% of the funding came from SEMCO, good government leveraging
- Good project team, major accomplishments, and product that meet market requirements and provide packaged system approach.

Weaknesses:

- Not utilizing other DOE funded DG programs/projects for the engine generator for second project. As the project manager, ORNL should have insisted on reducing funding and distributing to other programs.
- The inclusion of the reciprocating CHP project may have been promised during the bidding process but may be distracting SEMCO from going after their main market which might be non-CHP projects, just straight TAT applications

Recommendations:

- Over the entire TAT platform, there was no discussion of ROI (return on investment). This seems to be a comment on all TAT projects.
- Require that the goals and potential energy conservation be stated for each project.
- Regarding the first project, the IAQ issue concerning humidity control seemed to be the driver. However, there are no statistics or metrics. It was assumed that the reviewers are fully aware of this justification for a new design of packaged equipment. Given the reorganization within DOE, any program/projects should include the original merits – metrics – justification and a recap of how they are being met.

- DOE and ORNL need to examine how they can protect their investment in this technology which appears to be addressing a market need for better humidity control. There appears to be a requirement for DOE support even at the monitoring and reporting level with perhaps some very modest funding support to get a reasonable number (35) of units through a 2 year trial to provide market demonstration. Perhaps investment or support of web based monitoring would be the way to go. Having stated that, it is recognized that funding availability is being reduced at the present time.
- Push hard and make sure all risks are reduced or mitigated. Great example of how product development can be successful using government support and willing aggressive company.

PROJECT TITLE	**AMMONIA ABSORPTION TECHNOLOGY DEVELOPMENT FOR AIR CONDITIONING, HEAT PUMPING, AND REFRIGERATION**
PRESENTER(S)	**UWE ROCKENFELLER, BRUCE RITCHEY, AND HARRY TOPIKIAN, ROCKY RESEARCH**
OVERALL SCORE	**8.28**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 7.67

Comments:

- By using gas as the heat source it fits into the TAT portfolio.
- Project is relevant to DOE goals both from a gas and power conservation objective viewpoint.
- Uwe provided an excellent overview of the efforts to provide NH3-H20 absorption technology for use in DE applications. The focus appears to be on low tonnage systems, similar to that offered by various manufacturers over the past 3-4 decades. The performance features are considerably improved and hopefully so are the first costs and maintenance of the product to market.
- The 3-5 ton capacity may limit the product acceptance for CHP/DE applications, unless multiple units are provided; not always an acceptable solution.

2. Approach to performing the research and development and project management:

Rating: 8.67

Comments:

- Very strong and enthusiastic project leadership. The business plan is well conceived. Technical set-backs are challenges to be solved, not road blocks. The conceptualized manufacturing plan is beyond all other projects as presented.
- This project appeared to have established one of the better attempts to break out from in-house R&D to commercialization. Whether it will succeed is another matter, but the decision to focus on design of key components and establish long term testing is laudable.
- Key fabrication partners have been identified.
- The significance of regulatory and consumer resistance to ammonia systems does not appear to have the attention that might be warranted.
- The program plan appears well thought out with steady technical improvements leading to prototypes for demonstration and proof of concept, etc.
- The ultimate manufacturer and supplier, WFI, may finally have the resources and ability to produce a cost effective product for the intended niche markets, based on their GS HP experience.
- WFI is an experienced system integrator, not low cost component supplier.
- To bring the initial costs of this absorption HP down to acceptable levels may require additional skilled manufacturers interested in supporting this business opportunity.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 8.00

Comments:

- There is an adequate degree of achievement at this time.
- This product appears to be very close to commercialization.
- The identified barriers and risks seem more QA/QC than technical.
- Problems were identified and discussed in the presentation, which was weak on explanations of exactly how the system worked.
- The technical accomplishments indicated are all very positive, i.e., variable speed pump, heat pump feature, and attractive performance over wide operating parameters, -20F ambient, and comfortable heating at low ambient, finally make NH3/H20 absorption a viable product, if attractive, relatively initial costs can be offered.
- The key component, pump and TXV, reliability testing is essential and apparently multiple units are undergoing tests. Other tests of the generator and absorber are progressing, both components needed for efficient systems. Rocky Research is using the many lessons learned from prior NH3/H20 projects by a series of manufacturers.
- The program recognizes the need for developing low cost manufacturing processes for low initial volumes. Rocky Research also recognizes the key market barriers and risks, including stability of its business partner and difficulties of performing in niche markets.

4. Technology transfer, collaborations, and partnerships:

Rating: 8.33

Comments:

- This is a unique situation as some components are so specific that they had to be "invented here" rather than available in the market and adapted to this project. Of course, some components were adapted.
- The partnership with WFI as the manufacturer appears to be a dynamic and comfortable fit. This will provide for market introduction via an in-place distribution and service network.
- The project is now going into the very difficult area of trying to reduce capital cost through manufacturing design. First cost will be a significant market barrier to this technology as well as consumer concerns regarding ammonia systems.
- It is unclear how much WFI will be investing in the project development.
- Good mix of business partnerships being explored. WFI's lack of steel welding/ammonia handling expertise may be difficult hurdle.
- Pool heating/dehumidification market is less known entity/potential.

5. Overall Impressions:

Strengths:

- The strength of this project is that the product is near ready and not years away. Barriers have been overcome.
- The project attitude is good and forward thinking. To devote time to the production-manufacturing methods and demand flow is beyond what others offered.
- High degree of technical understanding of absorption technology. Appears to understand the critical importance of first cost reduction
- Experienced technology company, good leader, and number of potential business partners, solid string of key technical achievements and understanding of product needs.

Weaknesses:

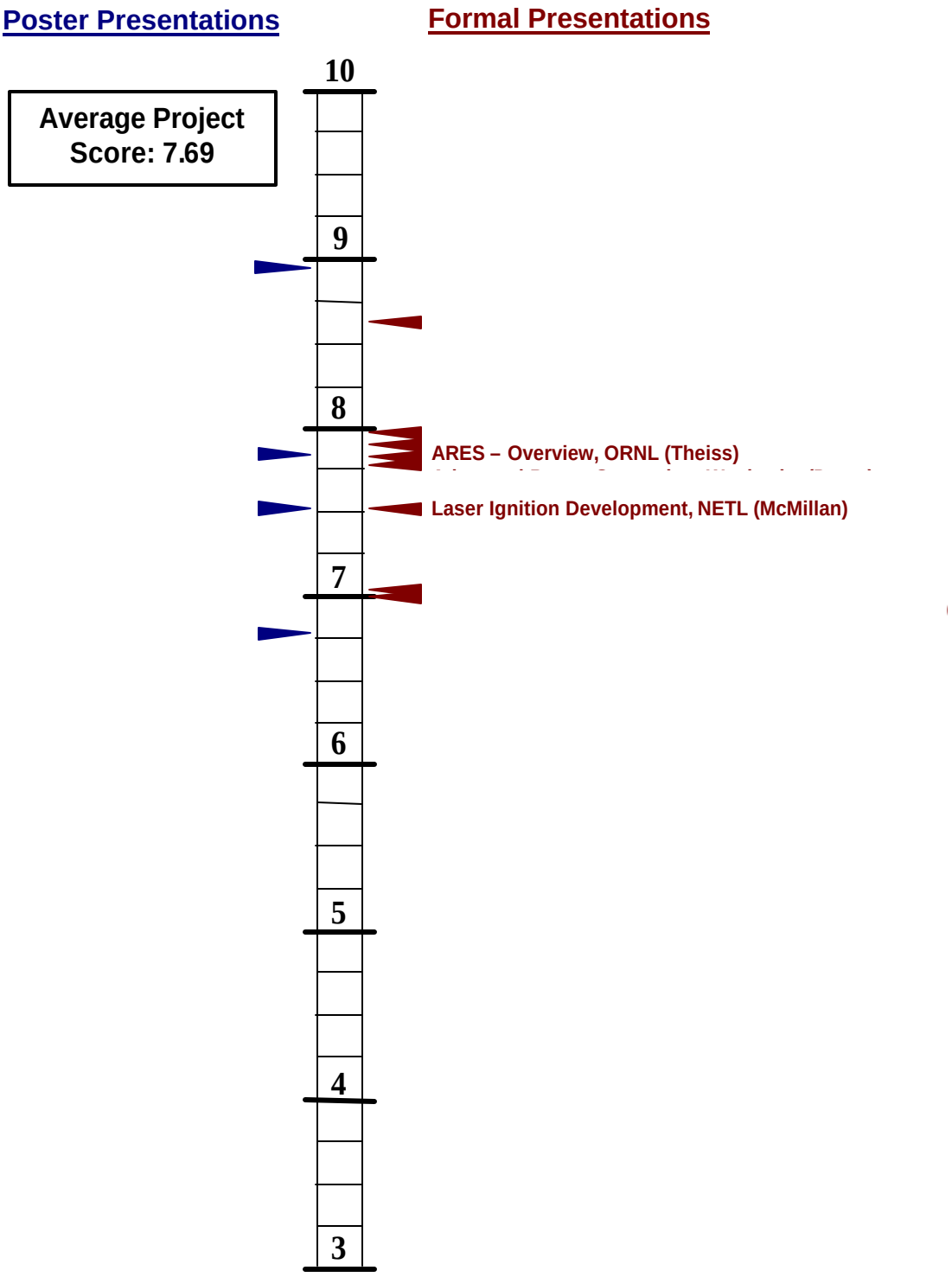
- Concerned that no evidence was presented as to the consumer acceptance of ammonia systems. This issue will only become apparent when the project is well into commercialization; might warrant some evaluation now.
- Uncertainty of product initial costs, and long term commitment and capabilities of business partners

Recommendations:

- Follow through on proof-of-concept and demonstrations. Make sure that sites are lined up and users committed.
- Should be supported through the beta production and manufacturing optimization phase.
- Follow paths defined aggressively with DE/DOE support.

ADVANCED RECIPROCATING ENGINE PROGRAM

A. Reciprocating Engine Projects - Summary



B. Advanced Reciprocating Engine Project Evaluations

PROJECT TITLE	**ADVANCED RECIPROCATING ENGINE SYSTEM OVERVIEW**
PRESENTER(S)	**TIM THEISS, ORNL**
OVERALL SCORE	**7.78**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 7.80

Comments:

- Oak Ridge National Laboratory (ORNL) has shown good relevance to the DOE's Advanced Reciprocating Engine System (ARES) program objectives, mission, goals and strategy.
- ORNL's effort falls within three general areas: ignition controls, emissions, and after-treatment, which have been identified as key areas of focus to achieve ARES goals and objectives.
- The ratings for each of these general areas are as follows: Spark Plug: 7; Adaptive Control: 9; Lean NOx trap: 6
- The sparkplug improvement program is useful but is a general problem and not an ARES-specific program (not a criticism of the work!). Although it was pointed out that the national lab programs are conducted according to the wishes of the participating engine manufacturers, it does seem puzzling that the labs are focusing on SCR, reformate production, lean NOx traps, etc., but this type of technology does not appear to be significant in the engine makers' Phase 3 plans. The active control work is good and directly relevant to the ARES program.
- Spark Plug Erosion – Impacts 10% cost reduction target as spark plug replacement is a significant maintenance cost as well as an availability hit. ORNL is accumulating a public database that should be useful to all.
- Adaptive Control – Impacts on both NOx and efficiency goals.
- NG Lean Trap – Impacts both NOx (in a positive fashion) and efficiency goals (in a negative fashion). This work, however, is particularly applicable to retrofit applications as the reported 2% BTE hit will be difficult to replace in order to achieve DE program BTE goals. Are improving emissions in retrofit applications (at the expense of 2 %age points in BTE) within the DE program goals? None of the engine companies are including lean NOx traps in their plans.
- Doing well in the context of National Labs charter.

2. Approach to performing the research and development and project management:

Rating: 8.20

Comments:

- The quality of project management, including the research plan, program execution, and research team is good.
- The quality of project design is good. However, technical and market barriers have not been addressed.
- Good effort to use results of complementary programs such as FreedomCAR to enhance ARES results.
- Reasonable approach to studying plug life. Is there a "control group" of tested plugs that are exposed to conventional conditions rather than ARES-like conditions? The active control work is

clearly useful and may have implications for HCCI. Good research plan based on previous findings for this work- you do need to work with large-bore engines.

- Spark Plug Erosion – Good start on a spark plug database.
- Adaptive Control – The approach is reasonable. Development of adaptive strategies with the model should probably precede lab work.
- NG Lean Trap – This duplicates other development efforts, but is probably pretty good bang for the buck ($550k in 2004/2005).
- Covering the bases. Can be better off if focused on less topical areas. Controls may require further probing.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 7.40

Comments:

- The degree to which technical accomplishments are being achieved and progress is being made toward overall project goals and milestones is good.
- The degree to which progress compares to performance indicators in terms of effectiveness, efficiency, cost, and benefits is good.
- Results appear to be more qualitative than quantitative. Interesting data, but relationship to ARES goals is not clear.
- Details of spark plug erosion results are well described and potentially valuable. Discovery of intergranular failure mechanism is impressive.
- Good results and track record on active control. Good to test this technology on a variety of engines, fuels, and operating conditions. Lean NOx work could be important to ARES and complements work on truck engines going on at diesel engine manufacturers. It looks like a lot of progress has been made, but not clear that NOx goal and BTE goal could be met simultaneously. Important to perform catalyst cost, life and poisoning issues.
- Spark Plug Erosion – As reported, this effort is primarily diagnostic. It is hoped that it can eventually be prescriptive but past experience with materials scientists is not reassuring.
- Adaptive Control – Single-Cylinder engine modeling accomplishments to date are impressive. The modeling results presented are for heat release rate only. This is useful for BTE estimates and it would have been useful to see some results. Modeling for NOx production should probably also be done but this may require other codes. Commercial-quality strategy is probably a ways off.
- NG Lean Trap – The plan has a reasonable next step.

4. Technology transfer, collaborations, and partnerships:

Rating: 7.80

Comments:

- ORNL has good collaboration with industry, universities, government laboratories, and end-users (utilities).
- ORNL has published and presented its work and results at numerous technical forums. ORNL also organized ARES Catalyst Workshop and has coordinated discussions among engine manufacturers, catalyst suppliers, and universities and labs.
- The ORNL's ARES work is highly leveraged with complimentary work for the Distributed Energy Materials program and with the Office of FreedomCAR and Vehicle Technology. ORNL actively collaborates with the engine manufacturers, the system suppliers, end-users, and universities. ORNL could leverage more resources from states like California.

- Collaboration appears to be good, but no indication of how results will be disseminated. Published results may allow collaborators to incorporate technology into their products.
- Good collaboration with the usual ARES researchers plus several additional corporate collaborators for specific technologies. Good job of information dissemination through publications and presentations.
- Spark Plug Erosion – Collaboration with Champion is a good thing. Is there a way to include others?
- Adaptive Control – No discussion of collaboration with manufacturers.
- NG Lean Trap – The presentation indicated early collaboration with engine manufacturers to establish operating parameters but no explic it discussion of collaboration. Others in industry are doing similar work. What is the path to commercialization?
- Wide interactions and coverage.
- Published results.

5. Overall Impressions:

Strengths:

- Focuses on three key areas of ARES Program - ignition, controls and after-treatment.
- Enthusiasm and apparent analytical skills
- Good job of working with a variety of engines on spark plug life improvement. The adaptive control investigation is potentially very useful and ORNL has a good background to understand the nuances of the problem. Good that more work on large bore engines seems to be in the cards. Impressive work on lean NOx traps. Overall good impression of competence of the research team at ORNL was made.
- Technical diversity.

Weaknesses:

- ORNL could explore technical and market barriers to low-NOx Trap technology and the HCCI technology (coordinated through engine OEMs). Other competing technologies within ignition, advanced controls and exhaust after-treatment could also be analyzed to get a good perspective of their status.
- Lack of quantitatively measured benefits.
- It's important to coordinate with engine manufacturers and regulatory agencies to ensure that LNT technology will be commercially viable.
- Spread too thin?

Recommendations:

- Good technology focus. ORNL should explore technical and market barriers of advanced spark plugs, HCCI and Low-NOx traps.
- Outline an approach that will develop quantitative results
- May want to examine predictive control of HCCI-like combustion now rather than later. Try to identify the viability of LNT technology before going too far down the road with it. You mentioned other potential toxic species emissions- have you found any and how hard are you looking for them? What about formaldehydes?
- Keep the focus.

PROJECT TITLE	**LASER IGNITION DEVELOPMENT**
PRESENTER(S)	**MIKE MCMILLIAN, NETL**
OVERALL SCORE	**7.55**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 8.20

Comments:

- The relevance of this project to the overall Department of Energy (DOE), and the Distributed Energy (DE) program objectives, mission, goals and strategy is good.
- The general objective is to develop laser ignition technology, which in turn enables development of high efficiency (50%), low polluting (<0.1 g/hp-hr NOx) stationary natural gas reciprocating engines for power production and gas compression.
- This is a clear objective supporting the development of ARES products. The approach and collaboration are established.
- This work is potentially highly relevant to the ARES program if it is successful.
- Impacts BTE and BSNOx goals and may be a required development for the manufacturers to achieve these. On the other hand, only Caterpillar listed laser ignition as one of their strategic tools.
- These are disruptive technologies
- Excellent focus areas.

2. Approach to performing the research and development and project management:

Rating: 7.60

Comments:

- The quality of project management, including research plan, program execution, and research team is good.
- The degree to which technical or market barriers are, or have been, addressed, the quality of the project design, and technical feasibility is high.
- The project has effectively planned its future, considered contingencies, and built in optional paths.
- Insufficient data to assess approach and project management. Theoretical issues were presented and may be supported by actual quantitative results. Difficult to assess actual from theoretical.
- Reasonably good job of identifying the overall program goals and milestones.
- The motivations for doing the work were well established.
- The reviewer was uncomfortable evaluating the effort to fabricate the ideal laser based spark plug through appropriate material formulations. It is certainly not a traditional reciprocating engine research project. This is not to say this is not important, but based on this reviewer's experience, it cannot be adequately evaluated. It is assumed that the same is true with most of the panelists. Too much time was spent describing the details of this part of the work.
- Not much discussion of the project team. The approach seems to be OK but they need "gadgeteer" for the multiplexing. The multiplexing scheme doesn't appear to be workable in a field environment.

- Good focus on fundamental developments.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 7.60

Comments:

- Degree to which technical accomplishments are being achieved and progress is being made toward overall project goals and milestones is good.
- The degree to which progress compares to performance indicators in terms of effectiveness, efficiency, cost, and benefits is also good.
- Qualitative results may lead to more rigorous quantitative assessments.
- Good discussion of potential and achievements to date of laser ignition system. Potential benefits of laser ignition in ARES-like high pressure, very lean systems are well identified. The fundamental approach to developing a laser spark plug may be necessary but it seems that similar efforts may have already been made for other applications (military?) and some work can be borrowed. The reviewer did not have expertise in laser development discussion that occupied 10 or 15 minutes of the presentation.
- The contractor is at the fundamental performance stage but has demonstrated impressive BTE and BSNOx results. No sense in doing system cost studies at this stage until they can show something that resembles commercial quality.
- Excellent preliminary results. Gains are being made on a thorough understanding of fundamental requirements for a successful technology breakthrough.

4. Technology transfer, collaborations, and partnerships:

Rating: 7.20

Comments:

- The degree to which collaboration with industry, universities, government laboratories, states, and/or end-users is being, or has been, accomplished is good.
- The effectiveness of technology transfer or dissemination of results is also good. NETL has published and presented its work and results at numerous technical forums.
- The degree to which the project has successfully leveraged other resources or opportunities is good.
- In addition to CRADA collaboration, OEMs are working with NETL to address their specific interests.
- Partners were (finally) identified but details were few.
- Collaborations identified were only with laser equipment vendors.

5. Overall Impressions:

Strengths:

- NETL has a very systematic approach to developing laser ignition
- Good concept with a good understanding of the theoretical benefits.
- Good job of explaining laser ignition advantage at increasing pressure and justifying parasitic energy losses comparable to conventional spark ignition. Competence of the research team to perform their work appears to be well demonstrated.
- Seems to have the core competency to continue.

Weaknesses:

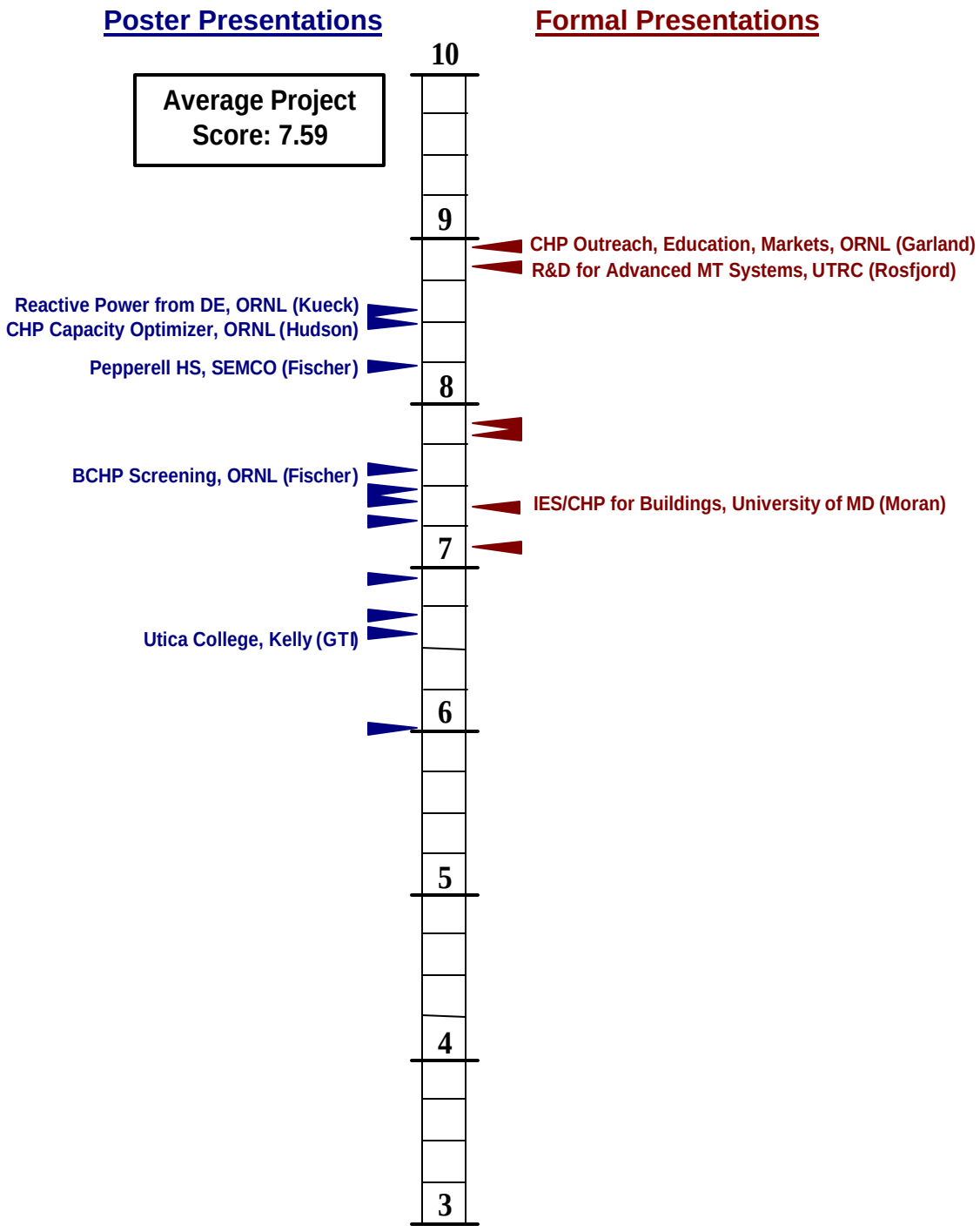
- Significant risks exist in this cutting edge research. High cost and extended durability could be a significant challenge. These issues need to be fully explored.
- Lacks preliminary cost/benefit assessment.
- Too much time was spent on the details of lasing material design and not enough on the big picture issues. Need to mention how this ties in with ARES issues more clearly.
- Lacks a laser ignition system and functional specification.

Recommendations:

- Work with collaborators to develop a preliminary cost/benefit assessment.
- Look at using optical information derived through laser port as a tool for engine feedback control.
- Look around at other laser applications to see if some of your particular challenges have already been identified and addressed.
- Invest efforts and resources in laser ignition system developments instead of expending it on engine "validation" testing.

END-USE APPLICATIONS PROGRAM GROUP 1

A. End-Use Applications – Group 1 Projects - Summary



B. Integrated Energy Systems Project Evaluations

PROJECT TITLE	**RESEARCH, DEVELOPMENT, AND DEMONSTRATION OF PACKAGED COOLING, HEATING, AND POWER SYSTEMS FOR BUILDINGS**
PRESENTER(S)	**TOM ROSFJORD, UTRC**
OVERALL SCORE	**8.88**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 9.50

Comments:

- This project performs research, development, and demonstration of packaged cooling, heating, and power systems for buildings. They are very important topics for future DE deployment.
- Packaged systems are an important way to improve implementation of CHP in buildings and this set of tasks is critical.
- Project is on task with major DOE and DE program vision and goals
- UTRC has done a great job in demonstrating the benefits of the project. It is obvious from the results accomplished so far.

2. Approach to performing the research and development and project management:

Rating: 9.00

Comments:

- This project applies "Stage Gate" approach to evaluate, reduce, and mitigate possible risks during the process.
- Program is managed well – perhaps overly managed. There is concern that some of the areas they have abandoned were mistakes.
- Management of technology objectives in 8 areas and prioritizing the research effort for maximum accomplishment of goals is commendable. Starting with the opportunity/application and working upstream towards technology development is also an extremely valuable approach.
- UTRC was ranked very high because they have done a good job. Their Stage Gate process seems to work well. The reviewer supports the suspension of any research work that will not produce real results and UTRC has done that.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 9.25

Comments:

- The project has accomplished its goals well by establishing multiple testing and evaluation sites. The project investigators have managed technology in 8 areas – stopping 3 and completing 2 through "System Technology Readiness."
- Hybrid chiller project is very exciting. Packaged systems should really be modular systems with simple integration.

- Technology has broad market application and United Technologies has the market reach to implement on a national level.
- UTRC has completed the development and demonstration of the Capstone/Carrier CHP system (good job). They also working on the engine/CHP package and the ORC work.

4. Technology transfer, collaborations, and partnerships:

Rating: 7.75

Comments:

- Partner with ORNL on absorption and adsorption technologies
- UTC is doing this pretty much by themselves and ORNL; broader collaboration would help.
- Public private partnerships are in place to leverage existing knowledge base and implement lessons learned.
- Great partnership with Capstone and the engine manufacturer to develop the CHP systems. UTRC is urged to involve other partners such as Universities, RACs, etc. to better disseminate the results.

5. Overall Impressions:

Strengths:

- Well organized presentation with good accomplishments.
- Excellent project producing important results. Use of HVAC people to develop ORC systems is very good. Developments in technology will have large leveraging potential
- Conducting research on parallel paths allows for important comparisons of relative technical feasibility and value.
- Very impressive presentation and research results. It is very important to develop packaged/integrated CHP systems then just packaging few pieces of equipment and hoping they will work together in the field.

Weaknesses:

- Hard to discern difference between commercial development for UTC and appropriate research funded by DOE. It seemed like most of the projects were directly related to their business plan and when it did not meet thresholds it was discontinued. DOE type programs would continue if they were producing interesting results
- Conducting research on parallel paths can be distracting. However, UT is managing this potential downside well.
- How much of this work is co-funded by UTC? As the commercial partner for these CHP systems, their cost share is expected to be significant. Will UTRC fund this development without DOE funding?

Recommendations:

- Broaden participation – include universities, for example. Develop more inclusive method of deciding which programs to continue and which to suspend.
- The commoditization of reciprocating engines is valuable and the same approach towards other components would be an enhancement.
- Continue funding this work and various associated developments.

PROJECT TITLE	**INTEGRATED ENERGY SYSTEMS/COOLING, HEATING AND POWER SYSTEMS FOR BUILDINGS**
PRESENTER(S)	**DENNIS MORAN, UNIVERSITY OF MARYLAND**
OVERALL SCORE	**7.36**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 7.50

Comments:

- Linkage of CHP project with curriculum and research in the university is a good idea.
- This is a mature program which serves as a unique test bed for 3rd party reviews of new technologies – it is very useful and clearly meets DOE goals.
- Development of more efficient technologies for medium-sized office buildings is good approach.
- It is clear that installing various pieces of equipment in the field created technical operational problems. University of Maryland tested the full (integrated) package in the lab before installing these systems in the field.

2. Approach to performing the research and development and project management:

Rating: 7.25

Comments:

- Several projects are being carried out at the same time. However, the main theme of the overall activities should be clearly defined.
- This is a good team; the students add energy and enthusiasm to the program.
- Some unavoidable problems have slowed some things.
- Technical barriers, such as equipment failures, have been encountered and successfully mitigated while staying on course with the program. The database of operational information provides a good basis for student research and mining activities.
- It is not clear how the students and other faculty members are involved in the design, operation, and performance measurements of these systems. If this is the main objective, it should have been clearly articulated.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 7.00

Comments:

- This is a very active center. They have carried out several projects with good visibility.
- Data gathered during their operations is invaluable. Need better public access to it.
- Program has become an excellent training ground for students that will take the "lessons learned" to the marketplace
- It is not clear from the presentation what the new research activities are.
- Too much equipment has been replaced.

4. Technology transfer, collaborations, and partnerships:

Rating: 8.25

Comments:

- This is more of a demonstration and proof-of-concept project.
- The center does collaborate with many organizations.
- Large numbers of partners, students, etc. Very good work with DOE to promote technologies and DG in general.
- Leveraging through their consortium is very valuable.
- Public-private partnerships are strongly leveraged and are an integral part of the program
- These types of university programs are important to develop new energy engineers.

5. Overall Impressions:

Strengths:

- They have high visibility. They have visitors from different countries.
- Excellent infrastructure for doing testing. Top people are very good.
- Great opportunity to train new energy engineers.
- Student /academic connection is one of a kind.
- Excellent participation by a dynamic group of industry experts with a wide range of backgrounds.

Weaknesses:

- Less focus.
- Direction is not clear. Top people are overcommitted.
- The program is more designed as a testing center than as a technology development center.
- Too late to comment, because the project is almost completed.

Recommendations:

- Focus on certain activities.
- Develop long range plans (without funding sitting there) so that the role of the center and test bed are easy to see.
- Follow through with graduating students to continue to technology transfer into the private sector.
- Continue funding these types of programs.

PROJECT TITLE	**CHP OUTREACH, EDUCATION, AND MARKETS**
PRESENTER(S)	**PATTI GARLAND, ORNL**
OVERALL SCORE	**8.95**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 9.00

Comments:

- A well managed program that is important for CHP Outreach, Education, and Market Development
- CHP is an OLD technology and has continued to be underutilized because of ignorance. This function is very important to meeting DOE implementation goals.
- The work that is being performed at ORNL through the CHP outreach program is directly tied to DOE & DE vision and mission.
- This outreach program is vital to the success of any R&D efforts.

2. Approach to performing the research and development and project management:

Rating: 9.00

Comments:

- This is a 3-year plan. 14 subcontracts were awarded in February 2003. At present, 11 out of the 14 subcontracts have been completed.
- Good use of DOE funds – short time horizons with lots of achievements.
- This group manages a large knowledge base of information that is collected from a broad network of relationships. This network is well managed and the information collected and redistributed is up to date and relevant.
- Great efforts by the project team to develop and implement the various outreach and educational programs.
- Very impressive list of partners, stakeholders and active participants.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 8.75

Comments:

- The CHP Installation Database has been updated.
- Created Regulatory Requirements Database for Small Electric Generators.
- Model for Sustainable Urban Design Blueprint for Urban Sustainability: Integrating Sustainable Energy Practices into Metropolitan Planning.
- Created DG Operational Reliability and Availability Database.
- Monitored market trends in CHP technologies, applications, and regions.
- Provided users and policy makers with understanding of CHP market opportunities and current applications.

- Many accomplishments – lots of activities – great use of leveraging resources.
- Rapid changes in technology and pricing make some documents out of date.
- The group has significant accomplishments in all three task areas assigned to it.
- The list of technical achievements is excellent.
- The quality of brochures, publications and reports is first class. The reviewer receives many of these documents and finds them very easy to use and helpful.

4. Technology transfer, collaborations, and partnerships:

Rating: 9.25

Comments:

- This program is entirely about technology transfer – the principal investigator and her sub-contractors have successfully raised awareness throughout the country.
- Project team is a nice public/private partnership. Funding is leveraged through matching from partners.
- Great work.

5. Overall Impressions:

Strengths:

- Well managed team with good accomplishments.
- Good program, good use of funds.
- The network of relationships brings a broad capability to collect and distribute "fresh" market information.
- The outreach and training activities is a "must task" for the DOE-DE program to claim any market success in the development of various technologies and tools.

Weaknesses:

- Scattered approach (being inclusive) gives a scattered message. Perhaps reducing the variety of projects would focus more attention on fewer projects.
- Funding constraints may threaten the viability of this network.

Recommendations:

- Create sense of urgency with current natural gas crisis.
- As gas price increases affect the market for CHP, a shift in focus towards opportunity fuels may be appropriate as a supplement.
- It is surprising that the funding for this program has been reduced by 60%. I would strongly recommend reversing this trend and continue to maintain the same level of funding for this very important program.

C. End Use System Poster Evaluations

PROJECT TITLE	**UTICA COLLEGE**
PRESENTER(S)	**JOHN KELLY, GTI**
OVERALL SCORE	**6.61**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 6.75

Comments:

- This demonstration program is very important for CHP technology dissemination.
- It is important to consider impact of environmental controls on CHP systems as rules change. This is the first project I am aware of which is looking at this.
- This package would also be appropriate for other small "campus" applications other than colleges.
- The presenter was not familiar with the project at all and could not answer many basic questions.

2. Approach to performing the research and development and project management:

Rating: 6.50

Comments:

- The approach of the project seems reasonable. However, the substitute presenter does not have enough knowledge to answer some of the questions.
- There seems to have been some trouble in finding a site for this project. It also appears that use of this high temperature catalyst is being considered without comparing it to other competing types of technologies (NSCR, for example)
- Fuel prices have likely increased dramatically since the 2004 project inception and alternative fuel contingencies should be explored.
- The presenter was not familiar with the project at all and could not answer many basic questions.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 7.00

Comments:

- The project was funded in Sept. 1, 2005. The team has made good progress.
- Hardware will be put in place in March – so accomplishments to date are procedural.
- Most 2004-2005 accomplishments are non-technical.
- It is not clear if the project will test both SCR & NSCR and compare performance. If this is the case, then they are of real value, otherwise, the benefits are not evident.

4. Technology transfer, collaborations, and partnerships:

Rating: 6.00

Comments:

- This project brings together GTI, Cummins Engine and Utica College for CHP project demonstration.
- The idea of this demonstration project is to develop a pre-engineered package providing cooling and power that can easily be applied at small colleges. There is no specific plan(s) for technology transfer.
- Requires higher level of college involvement to include this equipment in "engineering curriculum".
- No real information has yet to be generated. It is expected that when results are available this will take place
- Students and other significant collaboration opportunities have not been fully leveraged yet.
- The presenter did not address this area at all and was not familiar with the details related to Tech Transfer, Collaborations and Partnership.

5. Overall Impressions:

Strengths:

- Demonstration program is very important for CHP technology dissemination.
- This project brings together GTI, Cummins Engine and Utica College for CHP project demonstration.
- Important area – need to develop data on environmental controls for engines.
- The project will provide an excellent comparison of emissions and performance with and without SCR
- Unable to find any strengths of this project.

Weaknesses:

- The idea of this demonstration project is to develop a pre-engineered package providing cooling and power that can easily be applied at small colleges. There is no specific plan(s) for technology transfer.
- GTI should have been better prepared to explain this project.
- Presenter was not familiar with many aspects of the project.
- Location would be better at a school with engineering students
- Other emission reduction alternatives could also be tested along side hot side SCR in this demonstration.

Recommendations:

- Principal investigator should develop technology transfer plan to disseminate the results of the demonstration project.
- Require higher level of college involvement in order to include this equipment in "engineering curriculum".
- Would have liked to see other NOx mitigation systems compared to the high temp SCR
- Other opportunities to expand collaboration efforts and side by side technology comparisons should be explored.
- Without knowing more about this project, it is hard to make any recommendations.

PROJECT TITLE	**PEPPERELL HIGH SCHOOL**
PRESENTER(S)	**JOHN FISCHER, SEMCO**
OVERALL SCORE	**8.23**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 8.75

Comments:

- Since this is a brand new building, it is an ideal location to demonstrate and test CHP technologies.
- Good demonstration project.
- Very good approach to meeting DOE program overall vision
- Good job in presenting the objectives and the benefits of this project. The use of desiccant technology to control humidity is critical to the success of many cooling systems.

2. Approach to performing the research and development and project management:

Rating: 8.25

Comments:

- Though the calculation on paper looks OK, deciding not to recover the energy from the waste heat may cost the overall system efficiency.
- Good team assembled – contractor has every reason to make this work well.
- Major challenges have been identified and are being systematically addressed. Market feedback is being actively pursued and considered.
- Good overall project management and progress in overcoming technical difficulties in the field.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 8.00

Comments:

- The project is being carried out as planned.
- Hardware has yet to be installed – much of the accomplishments of this program will involve measuring actual performance.
- Success is being made in the integration of numerous technologies.
- The installation of the CHP/desiccant package seems to progress well.

4. Technology transfer, collaborations, and partnerships:

Rating: 8.50

Comments:

- No specific technology transfer plan has been established.
- The more visibility the better for this application of an important technology – winning the R&D 100 award is big.
- The inclusion of national labs, universities and a big box chain can lead to rapid deployment of this technology.
- Too early to evaluate. But it looks like a good team is in place to transfer this technology to the market.

5. Overall Impressions:

Strengths:

- Since this is a brand new building, it is an ideal location to demonstrate and test CHP technologies.
- The project is being carried out as planned.
- Use of "low quality" waste heat has always been a challenge – this is the best technology to use it. The hybrid approach, and its small size are both important factors.
- Good integration of several technologies in an atmosphere of broad institutional and market participation.
- Excellent presentation.

Weaknesses:

- No specific technology transfer plan has been established.
- Though the calculation on paper looks OK, deciding not to recover the energy from the waste heat may cost the overall system in efficiency.
- There are doubts whether they will reach the 70% goal in efficiency without using stack waste heat from the engines.
- Terms were used without explanation that (probably for marketing) end up being confusing. For instance, what is an active desiccant wheel? It is not easily found in their materials.
- Many technical challenges to be overcome in this technology integration.
- The economic analysis may be too optimistic.

Recommendations:

- Project team should take a closer look at their decision not to recover the energy from the waste heat.
- Since the system is operated in a grid independent design scheme, an automatic and/or manual switchover scheme has to be established.
- As part of the demonstration project, utilize the waste heat from the stack and get maximum efficiency. This would perhaps not be cost effective in commercial accounts, but would be important in showing what the top performance of this technology could be.
- Listen closely to market based feedback.
- Verify the performance of the system after it is installed and compare to the proposed data used to justify the project economics.

PROJECT TITLE	**CHP CAPACITY OPTIMIZER**
PRESENTER(S)	**RANDY HUDSON, ORNL**
OVERALL SCORE	**8.48**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 9.00

Comments:

- This project has developed a user friendly software package for CHP capacity optimization. It is a very useful tool for a DE planner.
- Attacking a very important problem – and much more challenging than would appear with a quick look.
- It will be difficult to standardize this tool since CHP developers use a wide range of independently developed tools. Having said that, a relatively simple-to-use standard tool such as ORNL has developed is required for the CHP technologies to become widely accepted.
- Excellent presentation. This tool is badly needed to optimize CHP systems.

2. Approach to performing the research and development and project management:

Rating: 8.50

Comments:

- One very important goal of the distributed energy program is to maximize the benefits of DE. To achieve this goal, capacity appropriate DE for specific applications must be installed. This project provides tools to identify the optimal capacity of CHP equipment to maximize the economic benefits.
- Project team seems quite good – clear challenges exist in distributing and then upgrading the software.
- More work needs to be done in the area of strategy development for overcoming market penetration hurdles for the ORNL model.
- Well done.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 8.75

Comments:

- A methodology has been developed to determine the optimal capacities for the CHP prime mover and absorption chiller using nonlinear optimization algorithms and hourly operation simulation of CHP system.
- This could be rated a "ten" depending on the results of the software.
- Based on the demonstration, it has clearly captured a majority of the significant issues in sizing.
- Good progress has been made in the development of the tool.
- Overall accomplishment is very good.

4. Technology transfer, collaborations, and partnerships:

Rating: 7.75

Comments:

- The software and associated documentation will be distributed to the Regional Application Centers and others in the DE/CHP community. Training and user-support will be offered.
- Might benefit from more direct collaborations in development.
- Unless this tool is actively "marketed" widely, national acceptance as a standard will be difficult. Acceptance by major industry participant partners can be useful in achieving this end.
- Not clear if this tool will be widely used, but time will tell.

5. Overall Impressions:

Strengths:

- A user friendly stand-alone CHP capacity optimizer has been developed.
- Important problem, product seems to be right on target, contour map is good way to present complex results.
- Combination with DOE BCHP screening tool is very important.
- Tool is elegantly designed on a widely used Excel platform.
- Excellent presentation and very knowledgeable presenter.

Weaknesses:

- Requires manual update of utility tariff.
- Model uses dispatching as major way to improve efficiency, but does not provide a way to sell excess power.
- The tool may be too complex to use by an average energy engineer.
- Excel spreadsheet seems somewhat clumsy.
- The tool can be viewed as a little "black boxish" unless good documentation and/or training is provided as a supplement to the software.
- Implementation strategy is a key component to broad acceptance as a standard.

Recommendations:

- Lawrence Berkeley National Laboratory has a collection of utility tariff information.
- Continue developing the program; allow design goals to be stated at the start – including one that does not allow operation below certain efficiencies.
- Perhaps start working with partners using the software. It has to get simpler – but this will not be easy.
- Suggest moving to web based system – allows errors to be fixed immediately, tracks users more easily. Users would also have the option to store data on their computers for later use.
- Industry collaboration and communication is a must.
- Need to follow up and develop a software tool to optimize the usage of CHP systems.

PROJECT TITLE	**BCHP SCREENING**
PRESENTER(S)	**STEVE FISCHER, ORNL**
OVERALL SCORE	**7.45**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 7.50

Comments:

- The development of screening and modeling tools was identified as a high priority task in the original *CHP Roadmap.*
- CHP installations are tricky – and do not respond optimally to plug and play.
- A screening program to help vendors and end-users is ESSENTIAL.
- Broad market applications for this technology exist.
- Too complex to assess the value and the relevance of this project.

2. Approach to performing the research and development and project management:

Rating: 7.50

Comments:

- Earlier version of the program was difficult to use, particularly with regard to interpreting results. New release has provided users with a more useful display of results and easier selection of input parameters.
- There is a significant dilemma between simple and therefore trivial to use, and complete, which gives better answers but requires some investment to be able to use – this tool is more toward the latter.
- The new challenges are to get people using this to develop new projects and continue to provide feedback for improvement
- Technical and market barriers are known and are being actively addressed.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 7.50

Comments:

- The BCHP screening tool has been developed to evaluate the economic potential of combined cooling, heating, and power in specific commercial buildings in the US.
- The product is quite useful and this is a significant accomplishment.
- The ability to "drill down" within the program and get to underlying product data is very good.
- Connection to DOE-2 is very important benefit.
- Earlier version was released before sufficient market validation was incorporated. Pilot release and subsequent expansion may increase product confidence and simplify market implementation.
- Again, it is not easy to evaluate the technical accomplishments. It appears like a black box. It is too early to tell if this tool will actually work. It certainly is not ready yet.

4. Technology transfer, collaborations, and partnerships:

Rating: 7.25

Comments:

- The BCHP screening tool has been requested by over 40 individuals from private industry, universities, and government agencies. It is heavily used by the DOE FEMP program.
- Collaborations are new and appropriate, now that the product is working – much greater distribution is needed.
- Good opportunity exists for two way communication from industry/market participants.
- Too early to know. It is a very complex tool, which will minimize its effectiveness.

5. Overall Impressions:

Strengths:

- The BCHP screening tool has been developed to evaluate the economic potential of combined cooling, heating, and power in specific commercial buildings in the US.
- Nice product, sufficiently detailed, should be very useful.
- The need for a product that can perform this type of analysis is growing.

Weaknesses:

- It is difficult to interpret the results.
- Large learning curve to use the software well.
- Not sure who the end-users will be; perhaps third party providers.
- Not clear which of competing products will be the best. Don't want to spend time learning all of them to pick.
- Model is so all encompassing and complex that keeping it up to date as dynamic equipment is developed and market factors interplay is almost impossible. It will therefore be difficult to trust the results of the analysis without significant experience in applying the information produced.
- There are doubts about the value of this software because it seems too complex and not easy to use.
- Don't need to develop tariffs for all utilities, because it is too cumbersome and will never be up-to-date.

Recommendations:

- Develop user friendly Graphical User Interface (GUI) to display and interpret the results.
- Keep working on graphical interfaces. Move toward web based software and develop comparisons with other similar software.
- The maintenance and learning curve involved in this software probably make it too complex for most end-users. There is probably reason to seek consulting groups as intermediaries in product implementation.
- Find a way to make this software tool fool-proof to an average energy engineer.

D. Power Electronics, Sensors/Controls (Posters) Project Evaluation Results

PROJECT TITLE	**REACTIVE POWER FROM DISTRIBUTED ENERGY**
PRESENTER(S)	**JOHN KUECK, ORNL**
OVERALL SCORE	**8.53**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 8.67

Comments:

- The goal of this project is to develop methods to incorporate DE into the distribution system to provide voltage regulation and dynamic reactive reserve.
- Dynamic control of reactive power and using DE in this area are relatively new and important problems.
- This work is necessary to meet DOE goals.
- Important work in a technology area that is not a well understood. There are many potential applications nationwide.

2. Approach to performing the research and development and project management:

Rating: 8.67

Comments:

- This is a newly funded project.
- The approach is reasonable.
- Using ORNL distribution system as a test bed is very good.
- Lots of partners – clearly thought through very well. Nice match of academic and practical tasks.
- Development and testing on the operating ORNL site will provide good real world lessons.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 8.33

Comments:

- This project was initiated in the last quarter of FY05.
- The project team has tested and performed computer simulation and field testing on the synchronous condenser.
- The major milestones, projected results and accomplishment of the project are reasonable.
- They do have some data, and do demonstrate the ability to level voltages. It is pretty early in their cycle. ORNL should be applauded for getting hardware early in a project and not after all the analysis is done
- Good "hands on approach".

4. Technology transfer, collaborations, and partnerships:

Rating: 8.67

Comments:

- Partner with TVA, Lenoir Cities Utilities Board, EPRI-Solutions, University of Tennessee, SCE, Capstone Turbine, Bowman Power, Rolls Royce, SmartSynch, GE, Energetics, and ETAP.
- Partners are many and significant. One of the jobs is to both prove that DG can help with reactive loads and to convince DE manufacturers to embrace them. So this interaction is critical.
- Impressive list of partners and participants.

5. Overall Impressions:

Strengths:

- ORNL has its own distribution system inside the campus to perform field testing.
- Brings attention to dynamic supply of reactive power – establishes a useful lab at ORNL.
- Excellent approach to solving a real world problem with broad industry application.

Weaknesses:

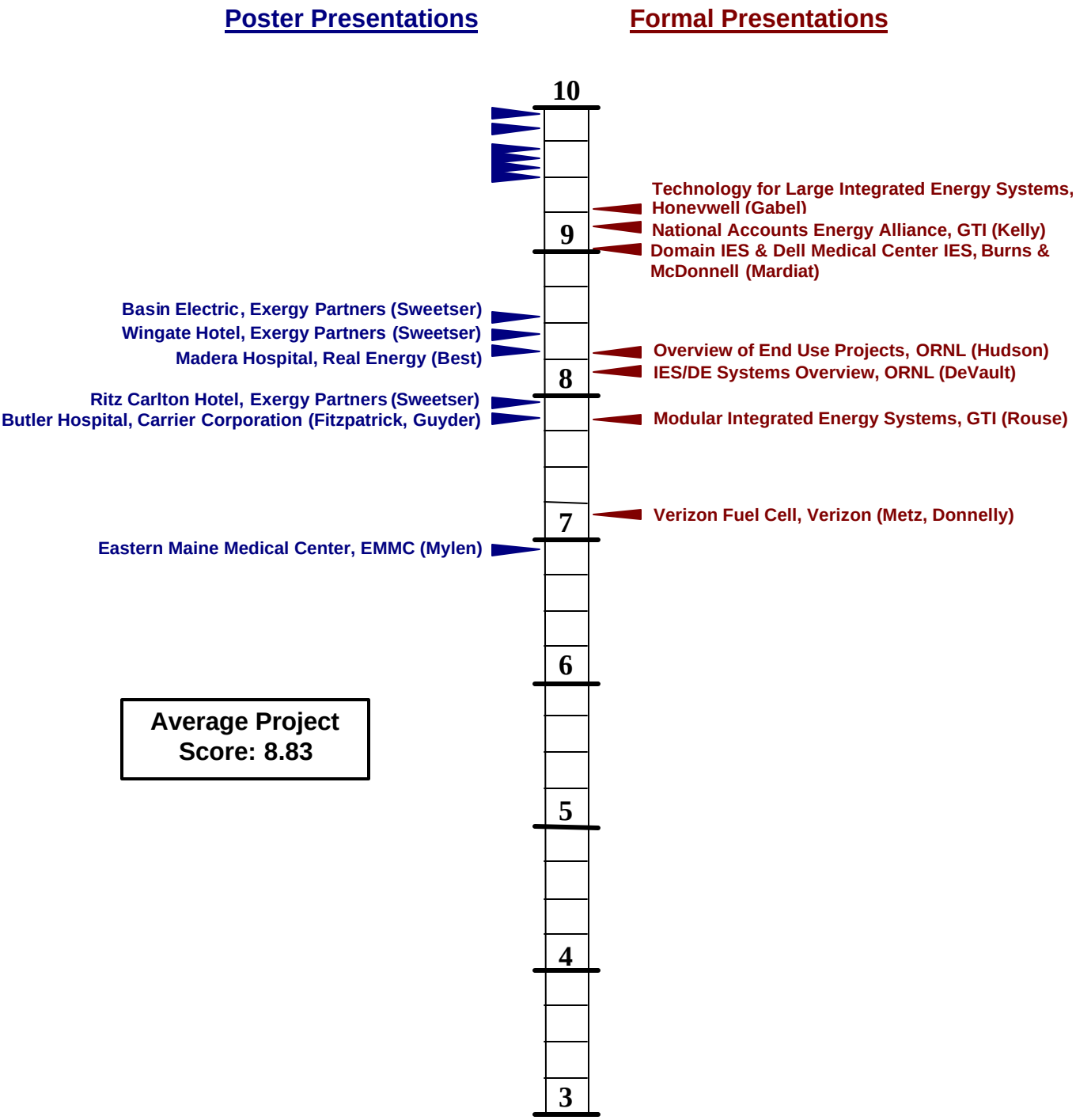
- With current price structure, recovery of investment is questionable. In other words, the market potential of this development is questionable.
- Difficult issue to explain to non-technical people – need to continually improve message.
- Will be difficult to design a "one size fits all" tool in a dynamic marketplace with changing rules.

Recommendations:

- Try to change the utility tariff structure.
- Consider three-phase individual control to balance the voltage.
- Reactive power is power, not voltage, but one of its effects is on voltage. The explanation and terminology could be better.
- Keep a close eye on the various market signals across the country.

END USE APPLICATIONS PROGRAM GROUP 2

A. End Use Applications - Group 2 Projects - Summary



B. Integrated Energy Systems Project Evaluations

PROJECT TITLE	**INTEGRATED ENERGY SYSTEMS – DISTRIBUTED ENERGY SYSTEMS OVERVIEW**
PRESENTER(S)	**BOB DEVAULT, ORNL**
OVERALL SCORE	**8.26**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 10

Comments:

- IES is a stated program objective of DOE/DE.
- Project critical to goal of three integrated energy systems installed through the DE IES/End-Use Application program with over 70% efficiency and payback of 4 years or less. The development of standardized modular designs, with necessary equipment improvements and integration, and installation and successful demonstration of complete modular systems, are the issues which need to be addressed and solved for large scale IES penetration.

2. Approach to performing the research and development and project management:

Rating: 7.75

Comments:

- Good solicitation process. Good to get manufacturers and other research entities involved and build partnerships. Have developed some good successes right away.
- A key project justification is somewhat based on the assumption that future electricity generation will be using natural gas. What if nuclear energy resurfaces again? How would it impact scenario? Did not see any risk/benefits analysis and mitigation plan at portfolio level.
- Excellent objectives and execution on the whole although metrics of selecting the industry teams is unclear. Involves major equipment manufacturers and industry teams. Also, alternative technical options have been selected for R&D, which is an excellent way of hedging bets and reducing risks.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 8.50

Comments:

- Projects met stated goals and showed good technical progress.
- Technical progress was very good overall.
- Though some of the preliminary teaming arrangements had to be reordered, the final seven industry team projects which did result are excellent and met their goals.

4. Technology transfer, collaborations, and partnerships:

Rating: 8.25

Comments:

- Because of the collaboration with manufacturers and other research entities the technology transfer is good. Beyond this, the technology needs to be disseminated to the rest of the engineering field and to customers and utilities. This can be done through the RACs. If the RACs don't continue to receive funding, the technology transfer will stop where it is.
- Good partnerships between various stakeholders on different projects. Did not see any effort at portfolio level to promote the technology or successes via RACs and other avenues, such as ASHRAE, to ensure integration with HVAC industry.
- The industry partners showed a willingness to cost share over 52% of the total project costs. However, technology transfer is an important issue and probably will be done by RACs and market place.

5. Overall Impressions:

Strengths:

- Technology goals/targets met.
- The project successfully achieved its pre-set technical goals (70% efficiency and payback <4 years). Seven projects were successfully completed on time and under budget with several standardized designs at both low and high ends (250 kW- 5 MW). The project teams exhibited extreme professional skill and competence, and are to be commended for their high quality hardware products.

Weaknesses:

- It is critical that this technology is now transferred to larger markets. All benefits of IES (i.e. congested grid, homeland security, back-up power) need to be credited to this technology to improve the competitive position of these technologies.
- Successes of individual projects are tied to equipment made by specific vendors. Should try to promote the technology in a vendor-agnostic manner.
- The described setbacks are part of the learning curve and should not be viewed as weaknesses. Perhaps consideration of HVAC aspects should be expanded.

Recommendations:

- Continue dissemination of information, particularly through the RACs. Continue funding of RACs. Make sure all benefits are accounted for and interconnect problems are solved.
- Exploit the relationship between Austin Energy and the Texas projects to demonstrate success in the terms that utility companies can easily understand. Should tackle interface standardization for larger IES (such as Real Energy is attempting to do for smaller systems). Should promote communication among various projects to ensure that learning is shared all through the project duration rather than at the end. If this were done, I believe the GTI project would not have to wait until Phase 2 to learn some of the lessons on size and design reliability.
- The outcomes of these projects should be made available to CHP centers and others and be highly publicized and widely promoted. Also replication of these projects should be investigated.
- Target the grid overload problems and areas to gain electric utility partnerships and resolve possible substation overload problems. Those are ways to better overcome problems with interconnecting to the grid.

PROJECT TITLE	**TECHNOLOGY FOR LARGE INTEGRATED ENERGY SYSTEMS**
PRESENTER(S)	**STEVE GABEL, HONEYWELL** **NITIN PATHAKJI, BROAD AIR CONDITIONING** **JOHN WINBERLY, I.C. THOMASSON ASSOCIATES**
OVERALL SCORE	**9.26**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 10.00

Comments:

- High relevance to DOE/DE program objectives.
- Project critical to goal of three integrated energy systems installed through the DE IES/End-Use Application program with over 70% efficiency and payback of 4 years or less. The development of standardized modular designs, with necessary equipment improvements and integration, and installation and successful demonstration of complete modular systems, are the issues which need to be addressed and solved for large scale IES penetration.
- Military bases are required to meet specific energy reduction targets. This project is appropriately directed to these targeted requirements.

2. Approach to performing the research and development and project management:

Rating: 8.75

Comments:

- Honeywell selected a good team including I.C. Thomasson, Broad USA and NC State University.
- Good project management. It appears that the best use of Broad's Technology would have been in chiller/heater mode. Did this finding become known after the site was selected? Otherwise, it would have been more appropriate to select a different site that would have allowed chiller/heater to be used.
- Excellent coordination and understanding between three excellent companies with different skill sets made this project a success. Not clear why army base was selected for this project where transparency and visitor access is somewhat limited.
- Military bases represent an excellent way to cross-pollinate and roll out large and small installations.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 10.00

Comments:

- Made good use of exhaust stream with both cooling and steam. Good job with on-line optimization and development of reference designs.
- Technical objectives were met and system is performing as designed. Congratulations to the entire team on a job well done.

- All pre-set technical goals and objectives have been met satisfactorily. Excellent technical choices made; good technical choice and flexibility of exhaust heat. The reference designs developed for large sites (about 5 MW) should be of great value for widespread acceptance. The online supervisory optimization tool should be of great benefit to operate the plant.
- The CAD based reference designs developed for large sites (up to 5 MW) should be of great value for widespread pre-screening of various applications. The online supervisory optimization tool should be of great value as well.

4. Technology transfer, collaborations, and partnerships:

Rating: 8.50

Comments:

- Good participation from partners and great reference designs. For transfer, show and tell is tough on a military base. Other military bases will be more likely to install similar system because it has been done on this base.
- Excellent collaboration between the project partners. The effort to disseminate reference design reports via the web is very commendable. However, siting at military base makes "show-and-tell" difficult.
- The team members have documented energy and economic benefits and disseminated results via technical publications and postings on the web. Constructing this project on a military base limits public access as well as project visibility to the general public.
- Projects on other military bases may be increased following success at this one.

5. Overall Impressions:

Strengths:

- Good and flexible use of exhaust stream heat. Good reference designs. Improved homeland security and ability of base to operate during black-out. Not grid dependant.
- Well-executed project that has met all technical goals. Increased reliability of energy supply impacts homeland security positively.
- Project very well executed and all objectives and tasks completed at a very high level of excellence. All technical targets have been met.
- The tools developed for pre-screening, as well as design, should expand site pre-screening.

Weaknesses:

- The fact that it is on an army base restricts access to visitors.
- Would have preferred a site that allowed chiller/heater to be used. While Army site selection demonstrates "reliability" factor of DE, it somewhat dampens the effort to demonstrate the merits of the technology to commercial and utility sectors.
- The project being situated on an army base restricts access to visitors. The developed standardized designs need to be evaluated by a group of independent experts.
- The final report should include a section of lessons learned so that any minor mistakes and delays incurred during projects such as this can be avoided
- Standardized designs need to be evaluated by a group of independent experts to expand credibility.

Recommendations:

- For the future, use the CHP capacity optimizer software and BCHP screening tool to develop gas turbine and chiller size and feed into reference designs that have been developed.
- Based on energy efficiency issues raised by Austin Energy, recalculate system efficiency in terms understood by utilities. Disseminate the case study broadly.
- DOE should strategize on how to best publicize the results of this R&D project to other U.S. military bases and other government facilities.

PROJECT TITLE	**INTEGRATED ENERGY SYSTEMS DOMAIN IES DEMONSTRATION PROJECT & DELL CHILDREN'S MEDICAL CENTER OF CENTRAL TEXAS IES ENERGY PLANT**
PRESENTER(S)	**ED MARDIAT, BURNS & MCDONNELL** **CLIFF BRADDOCK, AUSTIN ENERGY**
OVERALL SCORE	**9.08**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 10.00

Comments:

- High relevance to DOE/DE program objectives.
- Project critical to goal of three integrated energy systems installed through the DE IES/End-Use Application program with over 70% efficiency and payback of 4 years or less. The development of standardized modular designs, with necessary equipment improvements and integration, and installation and successful demonstration of complete modular systems, are the issues which need to be addressed and solved for large scale IES penetration.
- Involving the electric utility as a partner in this project was a great breakthrough. Successful plant operation is a terrific help.

2. Approach to performing the research and development and project management:

Rating: 9.50

Comments:

- It was great to get the electric utility involved as owner and operator. This project has overcome grid interconnect problems and the problem of making sure all benefits of CHP are accounted for. It ensures that this load will be dispatched most economically. Good project team including Solar, Broad, and Austin Energy.
- Excellent project management. However, too many design changes were made between Domain and Dell, which reduces the opportunity to leverage the learning.
- Excellently managed project. Project completed in record time and ahead of schedule.
- Partnering with an electric utility is an extremely astute move and a model which should be followed in other similar projects since a major confrontational issue for practical implementation is thus avoided

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 8.75

Comments:

- The need to define ASERTII definition of efficiency was brought up by this team.
- Met all technical objectives. Use of thermal storage was encouraging.
- All pre-set goals have been met satisfactorily. Quality of product seems to be excellent with the goal of minimum custom engineering accomplished.

- Only issue is the degradation over the day of the chiller due to cycling which needs to be corrected.
- The need to re-evaluate the ASERTI definition of system efficiency is an important issue raised by this R&D team.
- The six standardized reference designs for large installations would be very valuable for future projects involving mixed campus or parks.

4. Technology transfer, collaborations, and partnerships:

Rating: 8.75

Comments:

- Good modularization.
- Engaging Austin Energy was an excellent idea and opportunity to get buy-in from utility companies. Collaboration among the stakeholders was good.
- The project technical objectives have been met.
- Excellent concept to involve the local utility.
- Standardization and modularization seem to have been accomplished satisfactorily.

5. Overall Impressions:

Strengths:

- Got electric utility involved, modularized engineering.
- Collaboration with Austin Energy.
- Project very well executed and all objectives and tasks completed at a very high level of excellence.
- Highly visible location which should serve as an excellent publicity location.
- Electric utility involvement is great and is the future way to succeed.

Weaknesses:

- Absorber degradation due to cycling needs to be solved.
- Too many component changes between the two phases.
- Some work on supervisory control of the system should be undertaken.

Recommendations:

- Disseminate information through DOE and RACs.
- Work with Austin Energy to promote the CHP benefits.
- DOE should strategize on how to best publicize the results of this R&D project.
- Partnering with an electric utility is an extremely astute move and a model which should be followed in other similar projects.

PROJECT TITLE	**MODULAR INTEGRATED ENERGY SYSTEMS**
PRESENTER(S)	**GREG ROUSE, GTI**
OVERALL SCORE	**7.79**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 10.00

Comments:

- High relevance to DOE/DE program objectives.
- Project critical to goal of three integrated energy systems installed through the DE IES/End-Use Application program with over 70% efficiency and payback of 4 years or less. The development of standardized modular designs, with necessary equipment improvements and integration, and installation and successful demonstration of complete modular systems, are the issues which need to be addressed and solved for large scale IES penetration.
- This concept will become the most prevalent system installed in 300 KW to 1 MW because factory skidding up to 10ft. x 50ft. can be transported. Separate penthouses: one for electric generation and the other for HVAC. These are two very different designs. By field servicing separate penthouses and solving both problems at the plants in the field, we will then need two penthouses to be able to handle up to 1 MW.

2. Approach to performing the research and development and project management:

Rating: 7.25

Comments:

- Market analysis was good. FEMA should have been done in the design phases.
- This project involved the most number of partners among the three projects reviewed.
- Management changes seem to have affected the project adversely. Though a number of them seem to have dropped out, the addition of new team members allowed the project to fulfill its stated goals and objectives
- Waukesha's decision to eliminate their engine packing division unfortunately delayed the project. However, the system was installed in June 2004 and has an extended performance assessment. A system of this magnitude must have unveiled many glitches to be resolved (this is a test site). The real question is: do we have enough to know how to go into commercialization?

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 8.00

Comments:

- Built and lab tested. Modularization of small IES is critical accomplishment using less expensive reciprocating engines. Only seven interconnects is a critical accomplishment.
- Project is still not installed. Did not see any lab test results on performance. It appears to have met the cost target.

- All pre-set goals and objectives for Phase I have been met satisfactorily. The reference modular designs of small IES systems developed for commercial buildings should be of great value for widespread acceptance. The contractors looked at different building types so as to determine the size ranges of IES systems are excellent. Laboratory testing lends credibility to entire system performance. The Intelligent Operator module being developed should be of great benefit to operate the plant.

4. Technology transfer, collaborations, and partnerships:

Rating: 7.75

Comments:

- Not yet addressed since project isn't complete.
- Because the research is being done the technology will be picked up by the gas industry.
- Opportunity for transfer technology is big.
- Need to collaborate with HVAC industry.
- Tech transfer issues not yet addressed since project is ongoing.
- The project has yet to install cogeneration and chiller modules, and funding for Phase II is being sought.

5. Overall Impressions:

Strengths:

- This is a real world sized package that can be used by the bulk of commercial customers. Eliminates engineering for every job. Modularity is key. Can help solve grid problems and back-up problems.
- Concept is excellent in terms of potential commercial application.
- Its standardized designs and demonstration are of great value to the success of IES systems in buildings and compartmentalization between power generation and HVAC.

Weaknesses:

- Not yet field tested.
- Needed good system engineering analysis for reliability and risk should have been done up-front.
- Only Phase I has been completed. The entire work done to date may not come to fruition until the system is installed and its operation demonstrated satisfactorily as part of Phase II.

Recommendations:

- DOE should fund Phase II of this project so that this very important project can be completed and its pre-set technical goals, efficiency, payback and modularization achieved.
- DOE should fund Phase II because of its commercial importance.
- Should have technical goals related to system reliability and integration/collaboration with HVAC systems.
- DOE should fund Phase II of this project so that this VERY important project can be completed and its pre-set technical goals (efficiency, payback, modularization, and minimum customization) achieved.
- Several demonstration projects which interface with building HVAC need to be funded.

C. End-Use System Applications Project Evaluations

PROJECT TITLE	**OVERVIEW OF END-USE PROJECTS**
PRESENTER(S)	**RANDY HUDSON, ORNL**
OVERALL SCORE	**8.39**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 10.00

Comments:

- Balanced set of projects using a diverse group of contractors including GTI, NAEA, manufacturers and consultants.
- High relevance.
- Project critical with goal of IES/End-Use Application of DE program of having three integrated systems achieving over 70% efficiency and payback of 4 years or less. The installation and successful demonstration of complete modular systems are the first issues that need to be addressed and solved for large scale IES penetration.
- Developing and testing integrated systems achieving over 70% efficiency and payback of 4 years or less. The installation and successful demonstration of complete modular systems are the first issues which need to be addressed and solved for large scale IES penetration in the 150KW up to 1MW.

2. Approach to performing the research and development and project management:

Rating: 8.25

Comments:

- Projects are operating; they have met efficiency targets and being reported on.
- Most of the projects are well managed.

Did not see any evidence of portfolio management tools being used to track progress, risk mitigation and future funding planning.

- Delineation between End Use Project and IES projects seem to be fuzzy.
- Very good balanced portfolio of projects with diverse applications. The cost share (about 50%) is also a good feature. Good job of selecting competent contractors. The intent of this project was demonstration and not research per se, though certain projects did require unique site-specific adaptations.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 8.25

Comments:

- Most of the projects have met technical milestones except, perhaps, payback.
- Satisfactory to date. Most projects are just coming online.

4. Technology transfer, collaborations, and partnerships:

Rating: 8.50

Comments:

- Excellent collaborations among stakeholders.
- The industry partners showed commitment in willing to cost share over 52% of the total project costs. Exchange of ideas between different DG projects is commendable.

5. Overall Impressions:

Strengths:

- Good balance of projects, consultants, and manufacturers.
- Good portfolio of projects and vertical markets to target.
- The project successfully achieved its preset technical goals (70% efficiency). Construction of eight projects has been completed and operation is just beginning. Diversity of projects is a strong plus.

Weaknesses:

- Use of well-defined portfolio management tools.
- Performance monitoring and equipment reliability issues need more than 6 months or one year of monitoring.

Recommendations:

- Continue funding for energy efficiency, CHP and IES for cost savings, back-up power, homeland security, help with the efficiency of the electric grid.
- Define and use portfolio management tools.
- The outcomes of these projects should be made available to CHP RAC centers and others and be highly publicized and widely promoted. Also replicability of these projects should be investigated.

PROJECT TITLE	**VERIZON FUEL CELL PROJECT – CENTRAL OFFICE OF THE FUTURE**
PRESENTER(S)	**JEREMY METZ AND TOM DONNELLY, VERIZON**
OVERALL SCORE	**7.20**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 10.00

Comments:

- Excellent relevance to not only DOE/DE goals but also for providing green power and reducing GHG.
- Project critical with goal of IES/End-Use Application of DE program of having three integrated systems achieving over 70% efficiency and payback of 4 years or less.
- The installation and successful demonstration of complete modular systems are the first issues that need to be addressed and solved for large scale IES penetration.
- This is a very large powerload as well as an excellent roll-out opportunity through 7 major phone companies.
- Project critical with goal of IES/End-Use Application of DE program of having three integrated systems achieving over 70% efficiency and payback of 4 years or less.

2. Approach to performing the research and development and project management:

Rating: 8.00

Comments:

- Good partnership with LIPA. Also good partnership with DOE, NYSERDA and DOD.
- Working with utility company from the start is a good strategy.
- Choice of PAFC for the technology is somewhat suspect.
- Good partnerships.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 6.75

Comments:

- Very expensive in terms of cost/kwh and haven't reached efficiency targets. However, this is and early installation of commercial fuel cells and costs may come down.
- Good technical progress made to date.
- Need to expand to waste heat recovery and absorption chillers.
- The intent of this project was not just technical but also reliability issues. Fuel cells are very expensive in terms of cost/kwh and haven't reached efficiency targets. However, this is and early installation of commercial fuel cells and costs may come down.

4. Technology transfer, collaborations, and partnerships:

Rating: 6.00

Comments:

- There doesn't seem to be a lot of technology transfer because of the cost of fuel cells. However, Verizon is a leader in the communications business and their competitors may copy them.
- A plan for technology transfer was not evident in the presentation.
- Need to promote the technology among telecoms more aggressively.
- Verizon is a leader in the communications business and this technical option may be replicated in other telecom centers nationwide. The main advantage will be complete technology transfers to the other telecom companies.

5. Overall Impressions:

Strengths:

- Unique application, particularly for fuel cells without reformer in remote locations. No emissions on site.
- Great to see Fuel Cells being commercialized. The impact on GHG reduction and environment should be more widely publicized.
- Rather a unique application using fuel cells without reformer in remote locations.
- Eliminates emissions on site and all relevant documentation redundant.
- Strong point is heightened reliability of the overall system.
- It also uses BioFuel.
- We need their model to negotiate the local utility interconnect and state electric commission.

Weaknesses:

- Not cost effective, doesn't meet efficiency requirements.
- Energy efficiency target was not met.
- Fuel cell technology still being improved upon. It is not cost effective and it doesn't meet efficiency requirements, but that isn't germane to this application since power quality, reliability, and utility interconnect are everything.

Recommendations:

- Too much money has been invested in fuel cells and the "Hydrogen economy."
- Hydrogen usually comes from natural gas. Why not use the natural gas directly?
- Promote more aggressively to telecommunications industry.
- Get heat recovery implemented.
- The contractor should document the process by which he reached the decision to use fuel cells instead of other options.
- The manner in which system reliability was included in the cost benefit analysis is particularly important.
- Set up a Telecom person or department to pursue this opportunity and bring the local RAC in parallel.

PROJECT TITLE	**NATIONAL ACCOUNTS ENERGY ALLIANCE**
PRESENTER(S)	**JOHN KELLY, GTI**
OVERALL SCORE	**9.15**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 10.00

Comments:

- This is a very important project to get end user adoption of CHP.
- Project consistent with the goal of developing three integrated energy systems/end-use systems projects in place and achieving over 70% efficiency. The installation and successful demonstration of complete modular systems is the first issue that needs to be addressed and solved for large scale IES penetration.
- CHP rollout will be best served through large chain store operations.

2. Approach to performing the research and development and project management:

Rating: 9.00

Comments:

- Working with National Accounts is a great way to disseminate CHP widely and create standardized designs that can be used multiple times. You have to sell the technology once on a national level and then to individual locations.
- Excellent approach to address end-user adoption.
- The NAEA activities are well managed.
- As far as individual projects are concerned, a portfolio management approach should be taken to track, assess progress, and make future decisions.
- Working with National Accounts in building applications opens up a very large market segment.
- Pursuing National Account roll out plans will require expanded marketing scope, particularly with the regional CHP regional application offices. This might mean moving the funding for this work and involving local utilities in the effort.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 9.00

Comments:

- Projects on the ground are meeting technical goals.
- Most of the projects have made excellent progress.
- The standards for each vertical market for HVAC and building integration are sorely needed and will be very important.
- Good diverse set of projects. These seem to be meeting technical goals.

4. Technology transfer, collaborations, and partnerships:

Rating: 9.50

Comments:

- This is a very efficient way to collaborate with business and industry. Once you get a foot in the door with a national account, the next location is much easier to sell.
- NAEA concept is great to promote tech transfer, collaborations and partnerships.
- Excellent way of acting as a catalyst for collaboration between business and industry.
- Success of initial projects will go a long way in getting the ball rolling and gaining overall impetus.
- Excellent way of acting as a catalyst for collaboration between business and industry.
- The 300KW to 1 MW separate (power and HVAC) penthouses will become very important.

5. Overall Impressions:

Strengths:

- Several reviewers thought the best strength of this program is to influence national accounts at the planning stages.
- Great effort – sorely needed to accelerate the use of CHP technology to end-users.

Weaknesses:

- Danger of spreading existing resources too thin.
- Should develop a mechanism to transfer expertise and experience to RAC

Recommendations:

- Need a dedicated individual to meet with national accounts.
- Increase funding. Promote standards in ASHRAE and other industry associations.
- Accelerate two (Power and HVAC) penthouse approach 300 KW to 1 MW. It will be needed.

D. End Use Systems (Posters) Project Evaluation Results

PROJECT TITLE	**BUTLER HOSPITAL CHP PROJECT**
PRESENTER(S)	**ROBERT FITZPATRICK AND MICHAEL GUYDER, CARRIER CORPORATION**
OVERALL SCORE	**7.85**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 9.75

Comments:

- High relevance to DOE & DE program objectives.
- Project consistent with IES/End-Use Applications goal of installing three integrated systems with over 70% efficiency and payback of 4 years or less.
- 240 KW is a good sized unit to test.
- Many of the projects will require 120 to 240 KW.
- 12.3 cents per KWH + 30% good electric rate to test.

2. Approach to performing the research and development and project management:

Rating: 7.75

Comments:

- Well managed project. Contingencies and backup options considered.
- Project meant as a demonstration rather than a research project.
- Satisfactorily dealt with existing problems (such as leaking steam piping system).
- No cost overruns and project completed on time.
- Good mix of several personnel.
- No specifics given about monitoring and performance tracking over next year.
- Successful monitoring and performance tracking over next year will be critical, particularly to support the orders for two more similar systems in Rhode Island.
- The ideal mix of partners involved was excellent. It covers all aspects of parties that will be involved in the future project. In addition, harmonious cooperation among the partners is evident.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 7.25

Comments:

- Tracking over the next 12 months will determine accomplishments.
- Primarily a demonstration project with proven technology components.
- System just installed and, hence, benefits are still to be demonstrated.
- System started operation in December 2005 (about one month delay) and accomplishments are satisfactory to date. However, monitoring plan and care in acquiring quality performance data and its proper tracking and analysis is the key to success of such projects.
- Should be very customer-friendly to obtain future orders as well as the two Rhode Island orders.

- It is too early to tell final results.
- The system just started but was operational, which is Step 1; will need to revisit in twelve months of operation.

4. Technology transfer, collaborations, and partnerships:

Rating: 8.75

Comments:

- Carrier and New England Gas will be motivated to sell this concept.
- Good market in the northeast for this concept.
- Carrier-centric project. The experience and learning ought to be made widely available to the industry.
- Very good collaboration between two equipment manufacturers and the local utility personnel.
- Also, project highly leveraged since only about $300k was solicited while total project cost was $875k.
- High potential for success in technology transfer.

5. Overall Impressions:

Strengths:

- Good back-up power for hospital, improved reliability of hospital power, low emissions,
- Good probability of success. Backup/contingency strategy well thought out.
- Project has been successfully executed and implemented to date.
- Strong, complete set of participants worked harmoniously and successfully. Good potential "show and tell" site and right size project.

Weaknesses:

- This technology has high capital costs and therefore is very dependant on low gas costs relative to high electricity costs.
- Not economic outside the east and west coasts. However, that is still a very large market for this technology.
- Return on investment strongly dependent on pricing differential between electricity and gas, as well as cooperation of the electric utility for goodwill rather than retaliation.
- Success of project greatly depends on relative costs of gas and electricity which fluctuate.
- Follow up monitoring and tracking of performance essential.
- Whether expected life and reliability of components is satisfied is yet to be determined.
- High natural gas cost.

Recommendations:

- Finish the project, track results and report to the CHP community through DOE and RACs.
- Finish, document performance versus stated goals, and widely disseminate the learning and experience to the industry.
- Same level of care and attention need to be given for follow-up, i.e., to demonstrate with performance data that expected system efficiencies are being achieved and individual equipment is performing as expected
- Write "Case History" with recommendations from parties involved.

PROJECT TITLE	**EASTERN MAINE MEDICAL CENTER COMBINED HEAT AND POWER PLANT**
PRESENTER(S)	**JEFF MYLEN, EMMC**
OVERALL SCORE	**6.93**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 10.00

Comments:

- Relevance is high to DOE/DE program objectives.
- Project consistent with IES/End-Use Application goal of three integrated systems installed and operating at over 70% efficiency with payback of 4 years or less
- Business model is on the money for involving electric utility partners. Ideal case history for encouraging FRIENDLY support from other electric utility partners due to increasing grid reliability. Projects like this reduce peak demand load on the grid. Hospital operational during blackout; design suitable for other hospitals around the country.

2. Approach to performing the research and development and project management:

Rating: 6.50

Comments:

- While it is certainly not the fault of the project management team, the certificate of need process mandated by the Maine legislature needs improvement. It was a positive that the EMMC overcame this problem and identified it.
- Issue with utility company should have been anticipated, especially, considering such projects rely heavily on utility company's approval and participation.
- The project incurred a one year delay due to litigation by the local electric utility company based on its view that the project's size (4.4 MWe) would cut into its profits. This contingency should have been considered. Also this may be a recurring issue with other projects.
- Project was delayed by "scorched earth" policy against CHP (should have known earlier in project.) Otherwise, project management for a job of this size and scope is excellent.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 6.75

Comments:

- Primarily a demonstration project with proven technology components. Progress made to date is good but too early to judge.
- Difficult to evaluate technical accomplishments because of one year delay. However, the project is sound and would be a good demo project. The project is under construction at this time. Too early to evaluate how this project will turn out.
- If operational, the project will be a good case history for future rollouts.

4. Technology transfer, collaborations, and partnerships:

Rating: 7.25

Comments:

- Except for the utility company, this project has demonstrated good collaborative effort.
- Partnered with several diverse players such as International District Energy Association and other entities such as ORNL.
- Project highly leveraged: DOE funds were $240k while total project was about $8 million
- Well postured to develop case history and successful story in the future. Good DOE project management: $280,000 invested for $8.8million project.

5. Overall Impressions:

Strengths:

- Great back-up power and security. Good demonstration for a larger project. All components readily available. Good payback and IRR. Good to get natural gas utility involved.
- Will demonstrate a larger CHP application if successful.
- This project demonstrates a large CHP project, offering good diversity as compared to other demonstration projects.
- Good size for enlisting electric utility support and partnership, similar to the Austin, Texas project with Austin Energy.

Weaknesses:

- Dependent on high electric prices relative to natural gas prices. The project is only economic on the east and west coasts, which is still a large market.
- The return on investment is strongly dependent on pricing differential between electricity and gas, as well as cooperation of the electric utility for goodwill rather than retaliation.
- Did not anticipate problems with local utility.
- Delays and electric utility "push-back.".

Recommendations:

- Finish project and distribute results through DOE and RACs.
- Learning from the utility company experience ought to be more widely publicized.
- DOE should consider the above problem from a long-term and global perspective; otherwise this may be a recurring problem with systems of this size.
- Obtain local electric utility support; otherwise there may be a recurring problem with systems of this size.
- Use as a crutch to convince future installations that there is a need for field demonstration of this concept. Involve target electrical utilities.

PROJECT TITLE	**MADERA HOSPITAL**
PRESENTER(S)	**KEVIN BEST, REAL ENERGY**
OVERALL SCORE	**8.38**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 10.00

Comments:

- Relevance to DOE/DE program objective is high.
- Project consistent with goal of IES/End-Use Application program to install three integrated systems with over 70% efficiency and payback of 4 years or less.
- Excellent business model. Size range effective to penetrate much broader commercial market opportunities.

2. Approach to performing the research and development and project management:

Rating: 8.50

Comments:

- The reviewer likes the new business model. If successful, it could be the one to be emulated. However, the objective of establishing an industry-wide standard appears to be too ambitious for the scope of the project.
- This project has the potential to make a big market impact in that a modular CHP design standard can be developed as a result.
- The business model of the contractor in owning and operating the CHP system (thus serving as an ESCO) is very novel and attractive.
- However, long-term success of such a business plan is still uncertain.
- You cannot have this many projects without doing it right. Capital cost and payback scenarios with 7.5% of power cost reduction program will eliminate much of the financial hurdles.
- Product standardization is the key to affordable high-quality sites and off-balance sheet financing of project is a big breakthrough.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 8.00

Comments:

- Contractor appears to have made good progress in installing systems with interchangeable components.
- Did not see enough evidence of standardized interfaces between the modules or within any module.
- Technical accomplishment is in the interfacing and the definition of the standard. Satisfactory to date. However, monitoring and care in acquiring quality performance data and its proper tracking and analysis are key to success of such types of projects.

- On schedule and successful! Successful monitoring of results and satisfied customer backing are the keys to successful rollout plans.

4. Technology transfer, collaborations, and partnerships:

Rating: 8.50

Comments:

- The CHP workshops planned are a great way to communicate. Real Energy should be commended for the effort.
- Real Energy should coordinate with local RAC.
- Excellent and unique collaboration compared to other projects since an energy company is involved as the ESCO. Details of which specific CHP equipment manufacturers were involved have not been clearly spelled out.

5. Overall Impressions:

Strengths:

- Innovative business model.
- Great business model, good niche market. Excellent potential for mass production due to standardization
- Model ability for 500-1500 kW systems standardizes product, enables fast technical solutions for the sales fence. Providing 7.5% reduction on ½ building power load is saleable and fixed. Broad number of vertical market building.

Weaknesses:

- Attempt to establish industry-wide standards for interfacing components and model commendable but may be too ambitious.
- Rather risky, yet to be proven.
- Long-term gas contract costs are too high; will need lower kW (150-250 kW) sizes (required).

Recommendations:

- Seek broader support for standards. Work with DOE and industry associations such as ASHRAE to promote the effort and establish broad based group to attempt creation of standards.
- Same level of care and attention needed for follow-up, i.e., to demonstrate with performance data that expected system efficiencies are being achieved and individual equipment is performing as expected.
- Investigate bio-fuels and contact select electric utilities to embrace this product.

PROJECT TITLE	**BASIN ELECTRIC**
PRESENTER(S)	**RICHARD SWEETSER, EXERGY PARTNERS**
OVERALL SCORE	**8.52**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 10.00

Comments:

- High relevance to DOE & DE program objectives.
- Project consistent with goal of IES/End-Use Application program to install three integrated systems with over 70% efficiency and payback of 4 years or less.
- Broad high capacity market. Concentrated customs (transmission pipe lines). A good roll out plan should be developed.

2. Approach to performing the research and development and project management:

Rating: 9.00

Comments:

- Very creative approach to utilizing waste heat from gas line compressors using ORC.
- Business model is excellent, creating win-win between the vendor and pipe-line utility owners.
- Project is very novel. The fact that Ormat turbines, which supplied the organic turbine, owns and operates the unit, but the rural cooperative is being paid to maintain it, is very novel.
- Equipment is on the ground and operation is in sight.
- This is NOT a small project - it involves overseas vendors. So far, it is well in hand.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 7.67

Comments:

- Even though ORC is a proven technology, system is not yet installed and tested in the fie ld.
- Satisfactory. However, monitoring plan and care in acquiring quality performance data and its proper tracking and analysis are key to success of such types of projects.
- Benefits effectively presented. Well-known old time technology.
- Will need comprehensive monitoring for future sales of the system.

4. Technology transfer, collaborations, and partnerships:

Rating: 9.00

Comments:

- Excellent partnership between stakeholders.

- This is a novel project which should be successful.
- Can be extrapolated to several locations in existing pipeline.

5. Overall Impressions:

Strengths:

- Very creative business model and identification of opportunity for testing ORC technology.
- Project was successfully executed and implemented to date.
- It has the potential of being extrapolated to numerous sites.
- Size of load = big dollars per project.
- Affordable- no fuel costs plus low emissions.
- A well-known technology, very concentrated.
- Well defined market for rollout programs.
- A 4-year payback or less.

Weaknesses:

- Value proposition with ORC is perhaps limited to cold climate. Alternative heat recovery options should be explored for hot climates.
- Though the organic turbines only recover about 10% of the energy, the concept has poor energy efficiency overall.
- 10% efficiency.

Recommendations:

- Identify other opportunities and technologies to address heat recovery from gas pipeline compressing substations.
- Same level of care and attention needs to be given for follow-up, i.e., to demonstrate through performance data that expected system efficiencies are being achieved and individual equipment is performing as expected
- Create a special task force to pursue transmission line owners.

PROJECT TITLE	**RITZ CARLETON HOTEL**
PRESENTER(S)	**RICHARD SWEETSER, EXERGY PARTNERS**
OVERALL SCORE	**7.93**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 9.67

Comments:

- High relevance to DOE/DE objectives. Appears to be a duplicate of Butler Hospital CHP project except for the market segment
- Project consistent with goal of IES/End-Use Application program to install three integrated systems with over 70% efficiency and payback of 4 years or less.
- Equipment size covers a great number of commercial buildings.
- Hotel vertical market is a large opportunity throughout the U.S. Large national accounts control the major share of the market.

2. Approach to performing the research and development and project management:

Rating: 8.33

Comments:

- In spite of the delay caused by a network protection issue, the project team has done well to alleviate unplanned contingency and keep the timeline from slipping significantly.
- Project meant as a demonstration rather than a research project. Satisfactorily dealt with unique situation such as network interconnection
- Application is a hotel and replicating it to other hotels of the same type is appealing.
- Good data acquisition plan.
- Repeats multiple microturbine/absorption projects on previous project.
- Encompasses complete turn key controls, etc. for standby power operations with heat recovery.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 7.00

Comments:

- Project just starting – not enough performance data available to judge the technical success.
- Delay of 3 months due to additional controls and software, however, solved interconnection problem, System commissioned 12/12/05.
- Satisfactory to date. However, development of a monitoring plan and care in acquiring quality performance data, including proper tracking and analysis is key to the success of this type of projects.
- Comprehensive turn key approach. Multiples of standard products (i.e., turbine providence reliability power costs).

- Project is commissioned. Twelve months of effective operation needs to be completed to judge the system a success.

4. Technology transfer, collaborations, and partnerships:

Rating: 8.67

Comments:

- Excellent collaborative effort with the learning shared with the industry widely.
- Very good collaboration between various development equipment manufacturers, hotels and NAEA. .
- Well conceived testing protocol.
- This project has good potential for technology transfer and adoption into similar building marketplace.

5. Overall Impressions:

Strengths:

- Probability of technical success is high. High reliability and back up options
- Successful project to date, several key partners, solved interconnection problem
- Good vertical market within the community. Modules of standard products.
- Good team and good ultimate customer.

Weaknesses:

- Success too dependent on electricity and gas pricing differential and cooperation of electric utility company.
- Success of project greatly depends on relative costs of gas and electricity, which fluctuate.
- Follow up monitoring and tracking of performance is essential.
- Need to determine if actual life of components is as expected.
- High micro-turbine costs as well as high gas prices.

Recommendations:

- Track performance versus objectives and widely disseminate learning and experience widely.
- Same level of care and attention needs to be given for follow-up, i.e., to demonstrate through collection of performance data that expected system efficiencies are being achieved and individual equipment is performing as expected.
- Start formulating hotel/motel rollout model now, pending successful documentation.

PROJECT TITLE	**WINGATE HOTEL**
PRESENTER(S)	**RICH SWEETSER, EXERGY PARTNERS**
OVERALL SCORE	**8.43**

SPECIFIC COMMENTS

1. Relevance to overall DOE and DE program objectives, mission, goals, and strategy:

Rating: 9.33

Comments:

- High relevance versus DOE/DE objectives
- Project consistent with goal of IES/End-Use Application program to install three integrated systems with over 70% efficiency and payback of 4 years or less.
- Achieving over 70% efficiency and payback of 4 years or less.
- 150 KW peak demand reduction will cover 75% of the typical Inns. Plus, blackout backup is a major interest to owners.
- Complete skid-mounted system with limited external connections to the building is critical.

2. Approach to performing the research and development and project management:

Rating: 8.67

Comments:

- Well thought out strategy of evaluating one new technology component – chilled exhaust gas reciprocating generator for optimizing NOx emission reduction.
- Project meant as a demonstration rather than a research project.
- Application is a smaller 96 room hotel (the fastest growing sector in the hotel business).
- Replicating it to other hotels of the same type is appealing.
- Wingate Hotels are well known with a quality, progressive image. Application is a smaller 96 room hotel. The greatest number of perspective prospects will be in the 60 - 150 guest room size. Typically the hotel business targets a 2 1/2 to 3 year payback. However, the blackout ability could possibly overcome the typical shorter paybacks.

3. Technical accomplishments, quality, and progress toward project and DOE goals:

Rating: 8.00

Comments:

- Technology still to be demonstrated.
- Satisfactory. System started operation in December 2005 (about one month delay). Satisfactory to date. However, development of a monitoring plan and care in acquiring quality performance data and proper tracking and analysis is key to success of this project.
- This program is a two-fold program. A demonstration site plus research site in developing fuel emissions through collar exhaust gas treatments.

4. Technology transfer, collaborations, and partnerships:

Rating: 8.67

Comments:

- Multiple stakeholders. Intent to communicate learning widely is clearly evident.
- Great collaboration between numerous partners. Also leverages NAEA.
- Good team.

5. Overall Impressions:

Strengths:

- Good strategy to try out reciprocating generator with potential NOx emission reduction.
- Excellent niche market, great application, good economics.
- Fits the typical market size (60 to 150 rooms), which can be used on existing buildings as well as new construction.
- A year payback may be a problem; however the blackout backup may help considerably.
- Lower emissions, better fuel economy applicable to existing equipment.

Weaknesses:

- Risk is high – no clear mitigation plan (either the technology will work or not).
- Success of project greatly depends on relative costs of gas and electricity which fluctuate.
- Follow up monitoring and tracking of performance essential.
- Success of project greatly depends on relative local utility interconnect issues, and whether the expected life and reliability of components is satisfied has yet to be determined. It will take time to develop this new technology.

Recommendations:

- Better communication of risks. Conduct risk assessment and mitigation plans.
- Same level of care and attention need to be given for follow-up, i.e., to demonstrate with performance data that expected system efficiencies are being achieved and individual equipment is performing as expected.
- This will definitely require a national account program to tackle the four or five chains that control 70% of the Inns. This is a good market to solve the regulatory issues surrounding electric utility interconnect to the grid. Without it the interconnect costs will greatly reduce the potential market size. Pursue and plan for extended time.

APPENDIX A: AGENDA

2005 DISTRIBUTED ENERGY PEER REVIEW

Doubletree Crystal City
Crystal City, Virginia
December 13-15, 2005

TUESDAY, DECEMBER 13TH—DAY ONE

8:00 am	**Registration and Continental Breakfast**
9:30 am	**Keynote and Program Overview** *Kevin Kolevar, Director, Office of Electricity Delivery and Energy Reliability, U.S. DOE* *Patricia Hoffman, Program Manager, Distributed Energy Program, U.S. DOE*
10:00 am	**Distributed Energy Analysis Presentations** ♦ GPRA Analysis – *Chris Marnay, Lawrence Berkeley National Laboratory* ♦ Risk Analysis – *Anne-Marie Borbely-Bartis, Pacific Northwest National Laboratory* ♦ Future Grid—Local Area Analysis of Distributed Energy, Renewable Energy, and Energy Efficiency Impacts – *John Kelly, Gas Technology Institute*
11:30 am	**Luncheon**
1:00 pm	**Begin Concurrent Sessions**

Thermally Activated Technologies	**Reciprocating Engines**	**Posters: Combustion Lab Calls**
Lead: Doug Gyorke, NETL **Review Team: TAT**	Lead: Ron Fiskum, U.S. DOE **Review Team: Recip**	Lead: Don Geiling, NETL **Review Team: Turbine**
Session A	**Session B**	**Poster Session**

Thermally Activated Technologies Lead: Doug Gyorke, NETL Review Team: TAT		Reciprocating Engines Lead: Ron Fiskum, U.S. DOE Review Team: Recip		Posters: Combustion Lab Calls Lead: Don Geiling, NETL Review Team: Turbine	
Session A		**Session B**		**Poster Session**	
1:00 pm	**Engineering Science & Technology Division – Cooling, Heating, and Power *(TAT A1.1)*** *Ed Vineyard, ORNL*	1:00 pm	**Advanced Reciprocating Engine System - ARES *(RE B1.1)*** *Link Brandon, Cummins*	1:00 pm	**Toward Predictive Understanding of Low Emission Fuel-Flexible Distributed Energy Turbine Systems *(TU P1.1)*** *Robert Schefer, SNL* **Fuels Combustion: Impact of Opportunity Fuel Combustion on Distributed Energy Platforms *(TU P1.2)*** *Tim Theiss, ORNL* **Biodiesel Blends in Microturbines *(TU P1.3)*** *C.R. Krishna, BNL* **Development of a Low Swirl Injector for Midsize Gas Turbine and Fuel Flexible Combustors *(TU P1.4)*** *Robert Cheng, LBNL*
Thermally Activated Technologies Lead: Doug Gyorke, NETL Review Team: TAT		**Reciprocating Engines** Lead: Ron Fiskum, U.S. DOE Review Team: Recip		**Posters: Modeling/ Analysis, Microturbines** Lead: Doug Gyorke, NETL Review Team: Turbine	
Session A		**Session B**		**Poster Session**	
1:45 pm	**Integrated Active Desiccant – Vapor Compression Hybrid Rooftop with CHP Capability *(TAT A1.2)*** *John Fischer, Semco*	1:45 pm	**Advanced Power Generation *(RE B1.2)*** *Jim Drees, Waukesha*	2:15 pm	**Distributed Energy Enabling Technologies: Site Energy Simulation (DESS) *(TU P1.5)*** *Chris Marnay, LBNL* **Microturbine, Test & Evaluation *(TU P1.6)*** *Rudy Perez, SCE* **Fuel Composition Effects on Emissions from Microturbine Generators *(TU P1.7)*** *Peter Strakey, NETL*
2:30 pm	**Thermal Conversion R&D Converting Waste Heat into Heating and Cooling Work *(TAT A1.3)*** *Steve Slayzak, NREL*	2:30 pm	**Advanced Reciprocating Engine Systems - ARES *(RE B1.3)*** *Darryl Baldwin, Caterpillar*		
3:15 pm	**Break**	3:15 pm	**Break**	3:15 pm	**Break**
3:45 pm	**Commercial Liquid Desiccant Technology *(TAT A1.4)*** *Andy Lowenstein, AIL Research, Inc.*	3:45 pm	**Advanced Reciprocating Engine System Overview *(RE B1.4)*** *Tim Theiss, ORNL*	**Posters: End Use Systems** Lead: Debbie Haught, U.S. DOE Review Team: End-Use #2	

4:30 pm	**Ammonia Absorption Technology Development for Air Conditioning, Heat Pumping, and Refrigeration *(TAT A1.5)*** *Uwe Rockenfeller, Bruce Ritchey, and Harry Topikian, Rocky Research*	4:30 pm	**In-cylinder NOx Reduction Technologies in Advanced Reciprocating Engine Systems - ARES *(RE B1.5)*** *Sreednath Gupta, ANL*	3:45 pm	**Butler Hospital CHP Project *(EU2 P1.1)*** *Robert Fitzpatrick and Michael Guyder, Carrier Corporation* **Eastern Maine Medical Center Combined Heat & Power Plant *(EU2 P1.2)*** *Jeff Mylen, EMMC* **Madera Hospital *(EU2 P1.3)*** *Kevin Best, Real Energy* **Basin Electric *(EU2 P1.4)*** *Richard Sweetser, Exergy Partners* **Ritz Carlton Hotel *(EU2 P1.5)*** *Richard Sweetser, Exergy Partners* **Wingate Hotel *(EU2 P1.6)*** *Richard Sweetser, Exergy Partners*
5:15 pm	**Adjourn Day One**	5:15 pm	**Laser Ignition Development *(RE B1.6)*** *Mike McMillan, NETL*		
		6:00 pm	**Adjourn Day One**	5:45 pm	**Adjourn Day One**
6:30 pm	**Reception at Hotel**	6:30 pm	**Reception at Hotel**	6:30 pm	**Reception at Hotel**

WEDNESDAY, DECEMBER 14TH—DAY TWO

8:00 am	**Continental Breakfast**	8:00 am	**Continental Breakfast**	8:00 am	**Continental Breakfast**
Advanced Materials Lead: Debbie Haught, U.S. DOE **Review Team: Turbine**		**Reciprocating Engines** Lead: Ron Fiskum, U.S. DOE **Review Team: Recip**		**Posters: End Use Systems** Lead: Merrill Smith, U.S. DOE **Review Team: End-Use #2**	
Session A		**Session B**		**Poster Session**	
9:00 am	**DE Advanced Materials Program *(TU A2.1)*** *Dave Stinton, ORNL*	9:00 am	**Reformer-Enhanced Lean NOx Catalysis for Emission Control of Natural Gas Engines *(RE B2.1)*** *Ken Rappe, PNNL*	9:00 am	**RAC Overview Poster *(EU2 P2.1)*** *Ted Bronson, Power Equipment Associates* **Pacific RAC *(EU2 P2.2)*** *Tim Lipman and Vince McDonell, University of California* **Southeast RAC *(EU2 P2.3)*** *Louay Chamra, Mississippi State University* **Gulf Coast RAC *(EU2 P2.4)*** *Dan Bullock, Houston Advanced Research Center* **Northwest RAC *(EU2 P2.5)*** *David Sjoding, Washington State University*
9:45 am	**Enabling Technologies for Ceramic Hot Section Components *(TU A2.2)*** *Venkata Vedula, UTRC*	9:45 am	**University Research Overview - ARES *(RE B2.2)*** *Cary Smith, NETL*		
10:30 am	**Break**	10:30 am	**Break**	10:30 am	**Break**
11:00 am	**Advanced Materials for *Mercury*™ 50 Gas Turbine Combustion System *(TU A2.3)*** *Jeffery Price, Solar Turbines*	**Micro-CHP** Lead: Mario Sciulli, NETL **Review Team: TAT**		11:00 am	**Mid-Atlantic RAC *(EU2 P2.6)*** *Dennis Moran, University of Maryland* **Northeast RAC *(EU2 P2.7)*** *Larry Ambs, UMass and Tom Bourgeois, Pace University Energy Project* **Intermountain RAC *(EU2 P2.8)*** *Christine Brinker, Intermountain Combined Heat and Power Center* **Midwest RAC *(EU2 P2.9)*** *John Cuttica, UIC Energy Resources Center*
		11:00 am	**Micro-CHP System for Residential Applications that Provide Electrical Power and Heating for the Home *(TAT B2.1)*** *Joe Gerstmann, AMTI*		
11:45 pm	**Melt Infiltrated Ceramic Matrix Composites for Shrouds and Combustor Liners of Advanced Industrial Gas Turbines *(TU A2.4)*** *Krishan Luthra and Gregory Corman, GE*	11:30 am	**Micro-CHP *(TAT B2.2)*** *Benoit Olsommer, UTRC*		
		12:00 pm	**Research, Development, and Demonstration of Micro-CHP Systems for Residential Applications *(TAT B2.3)*** *Bob Zogg, TIAX*		
1:00 pm	**Lunch**	1:00 pm	**Lunch**	1:00 pm	**Lunch**

Integrated Energy Systems Lead: Ron Fiskum, U.S. DOE Review Team: End-Use #2		Micro-CHP Lead: Mario Sciulli, NETL Review Team: TAT		Posters: End Use Systems Lead: Debbie Haught, U.S. DOE Review Team: End-Use #1	
Session A		**Session B**		**Poster Session**	
2:00 pm	**Integrated Energy Systems - Distributed Energy Systems Overview *(EU2 A2.1)*** *Bob Devault, ORNL*	2:00 pm	**Micro-CHP *(TAT B2.4)*** *Karl Mayer, ECR*	2:00 pm	**Utica College *(EU1 P2.1)*** *John Kelly, GTI* **Pepperell HS *(EU1 P2.2)*** *John Fischer, SEMCO* **Neural Net Optimizing *(EU1 P2.3)*** *Darrell Massie, USMA (+Demo)* **Advanced Communication *(EU1 P2.4)*** *Arup Barat, Connected Energy*
2:45 am	**Technology for Large Integrated Energy Systems *(EU2 A2.2)*** *Steve Gabel, Honeywell, Nitin Pathakji, Broad Air Conditioning, and John Wimberly, I.C. Thomasson Associates*		**Microturbines** Lead: Don Geiling, NETL Review Team: Turbine		
		2:45 pm	**Advanced Microturbine System *(TU B2.1)*** *Jeff Willis, Capstone*		
3:30 pm	**Break**	3:30 pm	**Break**	3:30 pm	**Break**
Integrated Energy Systems Lead: Ron Fiskum, U.S. DOE Review Team: End-Use #2		**Microturbines** Lead: Don Geiling, NETL Review Team: Turbine		**Posters: End Use Systems** Lead: Debbie Haught, U.S. DOE Review Team: End-Use #1	
4:00 pm	**Integrated Energy Systems Domain IES Demonstration Project & Dell Children's Medical Center of Central Texas IES Energy Plant *(EU2 A2.3)*** *Ed Mardiat, Burns & McDonnell, and Cliff Braddock, Austin Energy*	4:00 pm	**Cooperative Research and Development for Advanced Microturbine Systems *(TU B2.2)*** *Tom Rosfjord, UTRC*	4:00 pm	**Value of Distributed Energy Resources in Distributed Infrastructure Renewal *(EU1 P2.5)*** *Craig McDonald, Navigant Consulting* **CHP Capacity Optimizer *(EU1 P2.6)*** *Randy Hudson, ORNL (+Demo)* **BCHP Screening *(EU1 P2.7)*** *Steve Fischer, ORNL (+Demo)*
4:45 pm	**Modular Integrated Energy Systems *(EU2 A2.4)*** *Greg Rouse, GTI*	4:45	**Advanced Microturbine System *(TU B2.3)*** *Laura Lindberg, Honeywell*		
5:30 pm	**Adjourn Day Two**	5:30 pm	**Adjourn Day Two**	5:00 pm	**Adjourn Day Two**
	Evening on Your Own		**Evening on Your Own**		**Evening on Your Own**

THURSDAY, DECEMBER 15TH—DAY THREE

8:00 am	**Continental Breakfast**	8:00 am	**Continental Breakfast**	8:00 am	**Continental Breakfast**
Integrated Energy Systems Lead: Ron Fiskum, U.S. DOE Review Team: End-Use #1		**Microturbines** Lead: Don Geiling, NETL Review Team: Turbine		**Posters: Reciprocating Engines** Lead: Cary Smith, NETL Review Team: Recip	
Session A		**Session B**		**Poster Session**	
9:00 am	**Research, Development, and Demonstration of Packaged Cooling, Heating, and Power Systems for Buildings (EU1 A3.1)** ***Tom Rosfjord, UTRC***	9:00 am	**Cooperative Research and Development of Primary Surface Recuperator for Advanced Microturbine Systems *(TU B3.1)*** *George Escola, Solar Turbines*	9:00 am	**Development of Advanced Ignition Using Laser Spark Ignition *(RE P3.1)*** *Azer Yalin, Colorado State* **Low Engine Friction Technology for Advanced Natural Gas Reciprocating Engines *(RE P3.2)*** *Victor Wong, MIT* **Advanced Natural Gas Reciprocating Engine *(RE P3.3)*** *Farshid Sadeghi, Purdue* **Selective NOx Recirculation for Stationary Lean Burn Natural Gas Engines *(RE P3.4)*** *Nigel Clark, WVU* **Two-Stage Catalytic Reduction of NOx *(RE P3.5)*** *Umit Ozkan, Ohio State*
9:45 am	**Integrated Equipment Systems/Cooling, Heating and Power Systems for Buildings *(EU1 A3.2)*** *Dennis Moran, University of Maryland*	9:45 am	**Advanced Integrated Microturbine Systems *(TU B3.2)*** *Mike Bowman and Karl Sheldon, GE Global Research*		
10:30 am	**Break**	10:30 am	**Break**	10:45 am	**Break**
End-Use Systems Applications Leads: Debbie Haught U.S. DOE Review Team: End-Use #2		**Low Emissions** Lead: Merrill Smith, U.S. DOE Review Team: Turbine		**Posters: Power Electronics, Sensors/ Controls** Lead: Mario Sciulli, NETL Review Team: End-Use #1	
11:00 am	**Overview of End-Use Projects *(EU2 A3.1)*** *Randy Hudson, ORNL*	11:00 am	**Industrial Gas Turbine Engine Catalytic Pilot Combustor Prototype Testing *(TU B3.3)*** *Shahrokh Etemad, PCI and Ken Smith, Solar Turbines*	11:15 am	**Advanced DG/CHP Controls Development *(EU1 P3.1)*** *Srinivas Katipamula, PNNL* **DE Enabling Technologies *(EU1 P3.2)*** *Chris Marnay, LBNL* **Reactive Power from Distributed Energy *(EU1 P3.3)*** *John Kueck, ORNL* **DE Advanced Power Electronics *(EU1 P3.4)*** *Ben Kroposki, NREL*
11:30 am	**Verizon Fuel Cell Project - Central Office of the Future *(EU 2 A3.2)*** *Jeremy Metz and Tom Donnelly, Verizon*				
12:00	**National Accounts Energy Alliance *(EU2 A3.3)*** *John Kelly, GTI*	11:45 am	**Industrial Gas Turbine Engine RCL System Development *(TU B3.4)*** *Shahrokh Etemad, PCI and Waseem Nazeer, Solar Turbines*		
12:30 pm	**Lunch**	12:30	**Lunch**	12:30	**Lunch**

Integrated Energy Systems Lead: Merrill Smith, Debbie Haught, U.S. DOE Review Team: End-Use #1		**Low Emissions** Lead: Merrill Smith, U.S. DOE Review Team: Turbine	
Session A		**Session B**	
2:00 pm	**Reactive Power from Distributed Energy *(EU1 A3.3)*** *John Keuck, ORNL*	2:00 pm	**Development of Low-Swirl Injector for Mid-Size Gas Turbines and Fuel Flexible Combustors *(TU B3.5)*** *Robert Cheng and David Littlejohn, LBNL* *Waseem Nazeer and Ken O. Smith, Solar Turbines*
2:30 pm	**DOE's Regional Office Interaction with the DE Program *(EU1 A3.4)*** *Sandy Glatt, DOE Central Regional Office*	2:45 pm	**Benefits of Distributed Energy**
3:00 pm	**CHP Outreach, Education, and Markets *(EU1 A3.5)*** *Patti Garland, ORNL*	3:00 pm	**DE Benefits Studies *(EU1 A3.7)*** *Stan Hadley and Therese Stovall, ORNL*
3:30 pm	**Regional CHP Application Centers Overview *(EU1 A3.6)*** *Ted Bronson, Power Equipment Associates*		
4:00 pm **Closing Remarks** *Patricia Hoffman, U.S. DOE*			
4:30 pm **Reception** Happy Hour (Cash Bar)			

APPENDIX B: LIST OF ATTENDEES

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APPENDIX C: EVALUATION OF OVERALL DE PROGRAM MANAGEMENT

Peer reviewers were asked to assess the Department of Energy's Distributed Energy Program on the basis of its relevance to national needs and the agency's mission; program structure and balance; program outcomes; program planning; and implementation

Respondents commended the Department on the manner in which technical and scientific advances have been made to improve the reliability and cost-effectiveness of distributed energy products, components, and systems. The program was noted as being relevant to the needs of our most pressing national energy problems, including grid reliability, diversification of energy sources, and reduction of fossil fuel consumption, reduced greenhouse gas emissions, and improved homeland security.

Some debate exists between those who support the shift in emphasis away from primary research on equipment and systems, to grid security and reliability policy and deployment. Nevertheless, respondents were satisfied with project approaches and goals, and with the work accomplished to date. Some criticisms were leveled at the heavy earmarks attached to financial support for distributed energy, as well as at the lack of a clear strategy and mission for the distributed energy program within the new Office of Electricity Delivery and Energy Reliability.

Program implementation received favorable reviews. Technical progress was seen as excellent, with the taxpayer receiving good value for his/her tax dollar. DOE was encouraged, however, to address commercialization in the future, integrating new technologies with current heating, ventilation, and air conditioning (HVAC) systems and ensuring common integrating platforms so as to alleviate market bias.

Evaluation Ratings and Comments

Rating Scale: 1-Not Adequate 2-Fair 3-Good 4-Very Good 5-Excellent

Relevance to National Needs and Agency Mission
Rating: 4.50

- Grid congestion, local substations overloads, reduced dependence of oil imports, homeland security and emissions are our country's problems. Distributed energy provides "do able solutions."
- This program is important to saving energy and improving the reliability of the existing grid structure and relieves the need for new power lines. It also reduces greenhouse gases, improves national security, aids in disaster relief and planning.
- The effort is very appropriate for reducing reliance on traditional energy sources, reducing energy consumption, and improving reliability. Significant technical and scientific progress has been made to demonstration of integrated energy systems and components. The progress made will be vital in addressing greenhouse gas reduction efforts that the U.S. will have to make in the future irrespective of the current administration's policy. However, the effort is suffering from gyrations in funding levels. It is important to maintain level funding to sustain development.
- The program has clearly been crafted with a focused eye toward achieving objectives.
- The program is clearly relevant and deserving of additional funding. Distributed energy offers partial solutions of several of our most pressing national problems: grid reliability, diversification

of energy sources, and reduction of fossil fuel consumption, reduced greenhouse gas emissions, and improved homeland security.
- Not convinced that the ceramics program will result in implementation. More work needed in grid integration and increasing overall system efficiency.

Program Structure and Balance
Rating: 4.00

- Current project portfolio is a good start but this effort is just starting. Need to focus more on commercial units between 250 kW to 1 MW to modularize, make them vendor-agnostics. Ensure they are well integrated with HVAC systems. Efforts should be made to lead interface standardization effort to allow plug-and-play capability in future.
- Recommend conducting overall program risk assessment and putting more money in high risk/high payoff areas. There does not appear to be enough money for maturation of ceramics and ceramic matrix composites (CMCs). DOE should have a major role in this key technology.
- I don't have an adequate appreciation of the efforts that were not in my area. However, I am somewhat troubled by a shift in emphasis away from prime movers to only grid issues because the turbines and engines have a lot of potential to improve energy utilization. Maybe DOE should move the prime mover and CHP activity elsewhere, but it needs to be funded adequately.
- Not convinced that the ceramics program will result in implementation. More work needed in grid integration and increasing overall system efficiency.
- Need more on the grid connection issues.

Program Outcomes
(No Numerical Rating)

- Balanced program goals effective.
- Suggest more emphasis on 300 kW to 1MW solutions.
- Well planned research with viable goals. Much of the programs are progressing (not falling by the wayside) and will deliver needed results when completed. This is not an easy thing to accomplish. Congratulations!
- All of the projects demonstrated "on-the-ground" success in meeting stated goals. This is an excellent outcome.
- Most of the projects have well defined approaches and goals and have met technical milestones.
- Concern with the national lab programs form the lab call (i.e., poster sessions) – these were funded with apparently little regard to lab core competencies, or consideration of minimizing duplication of efforts.
- The program with industries is producing excellent results toward meeting overall goals. The industry team is highly focused and market driven, which will ensure successful transition of advanced technology into commercial products. However, the program with national labs can be significantly improved.
- It appears that the national labs are not focused; they are doing what they like to do. There needs to be strong management of research efforts at the national labs. Also, various national lab efforts need to be well coordinated with each other.
- In the reciprocating engine area, one issue that the review panel noted is that there is a lot of work funded on after-treatment strategies but apparently little enthusiasm for these methods among the engine manufacturers themselves. The goals and rate of progress in the RE activity appears to be reasonable. The tax payer is getting a good deal for his/her tax dollar.
- Best results achieved from medium sized companies or consortia. Investment in large companies' research and development, although balanced by funding, has not resulted in success. Solar a possible exception. Performance at national labs mixed.

Program Planning
Rating: 4.13

- It appears the programs will be implemented successfully.
- Too much of the DOE funds are earmarked. Ongoing research is being canceled. Funding needs to continue for both research and the CHP regional application centers. If not, gains to date will be lost. Moving from Energy Efficiency and Renewable Energy (EERE) to the Office of Electricity Delivery and Energy Reliability (OE) will dilute focus on local end-uses. Buildings consume 40% of total energy in the country and 66% of total electricity consumed, so we cannot afford to lose focus on energy use in the buildings sector. The electric utilities must be compelled to participate in the process and to change regulations to be friendlier to more efficient uses of energy, especially where there is grid congestion.
- Program planning appears to be somewhat confused as the DE affiliation is changing from EERE to OE. Clear strategy and mission statement are needed to ensure that DE does not get swamped as just another source of electricity to alleviate grid congestion.
- Difficult to comment given recent changes.
- Good planning process to meet multiple customer needs. It might be nice to have 20-year plan, even though the plan may not be followed due to budgetary changes. The program might want to include high level performance metrics to measure progress every year.
- A shift in emphasis away from prime movers to only grid issues because the turbines and engines have a lot of potential to improve energy utilization is troublesome. Maybe DOE should move the prime mover and CHP activity elsewhere, but it needs to be funded adequately.
- Very hard to plan when program moved around and budget allocations subject to earmarks. DOE is doing a reasonable job under the circumstances.
- The program is well planned. Need long term stability of the program.

Implementation
Rating: 4.14

- Some programs have been delayed due to untouchable problems. But they are still progressing.
- Technical progress is excellent and justifies expenditures. However, DE should also focus on providing clear pathways to ensure that technical successes are converted into commercial successes. This will include integration with HVAC systems and standardization and making the system vendor agnostic.
- Very strong industry component. Management of national lab call component is a disaster. Some labs are working outside of their areas of expertise, their work is overlapping with both other labs and other institutions, and there is essentially no evidence of high level coordination. University component seems disorganized. There is a university program in reciprocating engines, not one in turbines. Little evidence of coordination with other university programs in DOE.
- Does not have adequate university participation. The contribution and impact of national labs is minimal compared to the cost.
- Based on the reciprocating engine presentations, the government is getting good value from all three sectors (industry, national lab), but probably more bang for the buck from the universities. A process should be initiated whereby one or two current university programs are dropped every two years and several more programs are added.
- Need continued implementation.

Other Comments/Recommendations
(No Numerical Rating)

- The number-one target should be grid congestion and substation overloads. Pick the utilities with these problems and target them. In fact, maybe the electric utilities should own the DE sites and retain the revenue.
- Renewable energy is now front and center and many states are legislating renewable power targets for the 2010-2020 time period, another reason for the electric utilities to own the DE sites.
- Think about greenhouse gas reduction and future regulations as you develop your future strategy and mission. Also, think of carbon credits that can be created by technology transfer.
- Overall, DOE and these funded researchers are doing a god job in this program.