

## INTRODUCTION

This report is a summary of comments from the Peer Review Panel at the FY 2006 DOE Hydrogen Program Annual Merit Review, held on May 16-19, 2006, at the Gateway Crystal Marriott in Arlington, Virginia. The work evaluated in this document supports the Department of Energy (DOE), and the results of this merit review and peer evaluation are major inputs utilized by the DOE in making its funding decisions for following fiscal years.

The objectives of this meeting were to:

- Review and evaluate FY 2006 accomplishments and FY 2007 plans for DOE laboratory programs and industry/university cooperative agreements.
- Provide an opportunity for program participants (developers of hydrogen production, delivery, storage, and fuel cell technologies) to shape the DOE sponsored R&D program so that the highest priority technical barriers are addressed. The meeting also serves to facilitate technology transfer.
- Foster interactions among the national laboratories, industry, and universities conducting the R&D.

The Peer Review process followed the guidelines of the Peer Review Guide developed by EERE. The Peer Review Panel members, listed in Table 1, attended the meeting and provided comments on the projects presented. These panel members are peer experts from a variety of hydrogen and fuel cell related backgrounds including national laboratories, developers of hydrogen and fuel cell technologies, universities, and other U.S. Government agencies. Each member was screened from a conflict of interest (COI) perspective per the Peer Review Guide. A complete list of the meeting participants is presented as Appendix A to this report.

**Table 1: Peer Review Panel Members**

No.	Name	Organization
1	Tarek Abdel-Baset	Daimler-Chrysler Corporation
2	Kev Adjemian	consultant
3	Radoslav Adzic	BNL
4	Shabbir Ahmed	ANL
5	James Alkire	GFO
6	Arlene Anderson	U.S. Department of Energy
7	Tim Armstrong	Oak Ridge National Laboratory
8	Radaslov Atanasoski	3M
9	Paulina Atanasova	Cabot Superior Micropowders
10	Balu Balachandran	Argonne National Laboratory
11	Olga Baturina	Naval Research Laboratory
12	Farshad Bavarian	Chevron Texaco
13	Bud Beebe	SMUD
14	Harold Beeson	White Sands Test Facility
15	Thomas Benjamin	Argonne National Laboratory
16	Jeff Bentley	CellTech Power
17	Larry Blair	LANL/Retired
18	Chris Bordeaux	Bordeaux International Energy Consulting, LLC
19	Arun Bose	NETL
20	Lynnae Boyd	National Renewable Energy Laboratory

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21	Eric Carlson	TIAX
22	Joe Carpenter	DOE
23	Daniel Casey	ChevronTexaco
24	Richard Chahine	U. of Quebec
25	Bill Chernicoff	DOT
26	Biswajit Choudhury	DuPont Fuel Cells
27	Deryn Chu	ARL
28	Helena Chum	NREL
29	Whitney Colella	Stanford University
30	Bill Collins	UTC Power/Fuel Cells
31	Mario Conte	Italian National Agency - ENEA
32	James Cross	Nuvera
33	Maria Curry-Nkansah	BP
34	Dennis Curtin	DuPont
35	Mark Debe	3M
36	Lutgard DeJonghe	LBNL
37	Jeff DeLaune	Wisconsin Power
38	Millie Dresselhaus	MIT
39	Anthony Eggert	UC Davis
40	Glenn Eisman	RPI
41	Elam Carolyn	U.S. Department of Energy
42	Mohammad Enayetullah	Protonex Technology Corporation
43	Erich Erdle	DaimlerChrysler
44	William Ernst	Plug Power
45	Linda Eslin	Concurrent Technologies Corporation
46	Dave Farese	Air Products
47	Jim Fenton	UCF
48	Karl Fiegenschuh	Ford Motor Company
49	Constantina Filiou	European Commission
50	Florian Finsterwalder	DaimlerChrysler Corporation
51	Scott Freeman	DaimlerChrysler Corporation
52	Robert Friedland	Proton Energy Systems, Inc.
53	George Froudakis	University of Crete
54	Tom Fuller	GTI
55	Alexi Gabrielov	Shell Hydrogen
56	Jennifer Gangi	Fuel Cells 2000
57	Jason Ganley	Howard University
58	Bob Glass	Lawrence Livermore
59	Raghubir Gupta	RTI
60	David Haberman	IF, LLC
61	Steve Hamrock	3M
62	Jonathan Hardis	NIST
63	Marianne Harmon	GE Global Research
64	Barbara Hennessey	National Highway and Traffic Safety Administration

65	Andy Herring	Colorado School of Mines
66	Steve Herring	INEL
67	Mike Hicks	3M
68	Shinichi Hirano	Ford Motor Company
69	Katsuhiko Hirose	Toyota
70	Raymond Hobbs	APS
71	Doug Hooker	DOE
72	Mark Janney	Porvair Advanced Materials
73	Craig Jensen	U. Hawaii
74	Scott Jorgensen	GM
75	Erik Kallio	TACOM
76	Junji Katamura	
77	Richard Kelley	DOE
78	John Kerr	LBNL
79	Merrill King	NASA
80	John Kopasz	Argonne National Laboratory
81	Curt Krause	ChevronTexaco
82	Theodore Krause	ANL
83	Romesh Kumar	Argonne National Laboratory
84	Nobuhiko Kuriyama	AIST
85	Pete Langlois	Ernst & Young
86	Stephen Lasher	TIAX
87	Jay Laskin	Consultant
88	Michele Lewis	ANL
89	Ludwig Lipp	FuelCell Energy
90	Melissa Lott	Alliance Technical Services
91	William Lueckel	Renewable Fuels Association
92	Andy Lutz	Sandia National Laboratory
93	Stanislav Malysenko	Russian Academy of Sciences
94	Robert Mantz	ARO
95	Len Marianowski	Consultant (retired from GTI)
96	Nenad Markovic	ANL
97	Victor Maroni	ANL
98	David Masten	GM
99	Tony Mazza	Hydrogenics Corporation
100	Jim McGetrick	BP
101	William McLeod	Consultant
102	Shawna Mcqueen	Energetics
103	Stephon Melancon	Entergy Nuclear
104	James Miller	ANL
105	Rana Mohtadi	Toyota Technical Center
106	Henk Mooiweer	Shell
107	Graham Moore	ChevronTexaco
108	Tom Moore	Consultant

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109	Ted Motyka	Savannah River National Laboratory
110	Deborah Myers	Argonne National Laboratory
111	Gene Nemanich	Consultant
112	Cathy Padro	Los Alamos National Lab
113	George Parks	Conoco Phillips
114	Pinakin Patel	FuelCell Energy, Inc.
115	Dilo Paul	NETL
116	Mike Pero	Hydrogen Safety, LLC
117	Mike Perry	UTC Fuel Cells, LLC
118	John Peters	Montana State University
119	John Petrovic	DOE/Retired
120	Guido Pez	Air Products & Chemicals
121	Peter Pintauro	Case Western
122	Bryan Pivovar	LANL
123	Walter Podolski	ANL
124	Joseph Poindexter	Teledyne Energy Systems, Inc.
125	Michael Quah	NextEnergy/CTC
126	Venki Raman	Protium Energy
127	Dan Rastler	EPRI
128	Robert Remick	Colorado Fuel Cell Center
129	Vernon Roan	University of Florida
130	John Robbins	ExxonMobil
131	Mark Roelofs	DuPont
132	Jerry Rogers	General Motors Corporation
133	Phillip Ross	Lawrence Berkeley National Laboratory
134	Leon Rubinstein	Shell Hydrogen
135	Gary Sandrock	Retired
136	Dave Schiraldi	Case Western
137	Steve Schlasner	ConocoPhillips
138	Jesse Schneider	DaimlerChrysler RTNA
139	Patrick Serfass	National Hydrogen Association
140	John Shen	DOE
141	Dave Sjoding	Washington State University
142	Ed Skolnik	Energetics, Inc.
143	Ken Stroh	Los Alamos National Lab
144	Karen Swider-Lyons	NRL
145	Hazem Tawfik	State University of New York & BNL
146	George Thomas	DOE
147	John Titchen	Hydro Tasmania
148	Doanh Tran	DaimlerChrysler Corporation
149	John Turner	NREL
150	Nicholas Vanderbogh	Consultant
151	Henry Voss	PolyFuel
152	Fred Wagner	Energetics

153	Fred Wagner	General Motors Corporation
154	Jim Waldecker	Ford Motor Company
155	Sharlene Weatherwax	DOE
156	Alan Weimer	University of Colorado
157	Steve Weiner	PNNL
158	Cory Welch	National Renewable Energy Laboratory
159	Ed Wenzinger	MPR Associates
160	Rose Wesson	NSF
161	Doug Wheeler	consultant
162	Robert Wichert	USFCC
163	Mahlon Wilson	LANL
164	Chris Wolverton	Ford Motor Company
165	Chao Wu	Southern Company
166	Jung Yi	Arkema Inc
167	Tom Zawodzinski	Case Western
168	Piotr Zelenay	LANL
169	Richard Ziegler	Sentech, Inc.

## SUMMARY OF PEER REVIEW PANEL'S CROSS-CUTTING COMMENTS AND RECOMMENDATIONS

The Peer Review Panel members provided a number of comments and recommendations that apply to the Annual Merit Review and peer review process, as well as overall management of the DOE Hydrogen Program. These comments are provided in Appendix C of this report. DOE will utilize these comments to improve both the program and future review meetings.

## ANALYSIS METHODOLOGY

As shown above, **169** panel members participated in the merit review process. A total of **167** projects were reviewed at the meeting and a total of **1015** evaluation forms were received from the Peer Review Panel (not every panel member reviewed every project). These panel members were asked to provide numeric scores (on a scale of 1 to 4, with 4 being the highest) for five aspects of the research on their Evaluation Form, a sample of which can be found as Appendix C.

The five criteria and weights were:

- Relevance to overall DOE objectives (20%);
- Approach to performing the research and development (20%);
- Technical accomplishments and progress toward achieving the project and DOE goals (35%);
- Technology transfer and collaborations with industry, universities, and other laboratories (10%); and
- Approach to and relevance of proposed future research (15%).

All the individual criterion scores from various reviewers were averaged together to obtain average scores for each of the five above-mentioned criterion for every project. These average scores were then weighted and combined to produce a final overall score for that project. In this manner, a project's final overall score can be compared to other projects. Following is the formula used to calculate the weighted average overall score:

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$$\text{Final Score} = \text{Score1} * 0.20 + \text{Score2} * 0.20 + \text{Score3} * 0.35 + \text{Score4} * 0.10 + \text{Score5} * 0.15$$

A few new projects were reviewed, where the third criterion (Technical Accomplishments) did not apply because of the project's recent startup. In this case, the other four criteria were scaled proportionally in the weighting calculation and the following formula was used:

*Criterion 3/ Technical Accomplishments weighted at 35% not included; therefore, weighting value for remaining scores = (weight + 35/65 \* weight)*

$$\text{Final Score} = \text{Score1} * (0.20 + (35/65) * 0.20) + \text{Score2} * (0.20 + (35/65) * 0.20) + \text{Score4} * (0.10 + (35/65) * 0.10) + \text{Score5} * (0.15 + (35/65) * 0.15)$$

$$\text{So, Final Score} = \text{Score1} * 0.31 + \text{Score2} * 0.31 + \text{Score4} * 0.15 + \text{Score5} * 0.23$$

A maximum final overall score of 4 signifies that the project satisfied the above mentioned five criteria to the fullest possible extent, while a minimum score of 1 implies that the project did not satisfactorily meet any of the requirements of the five criteria mentioned above.

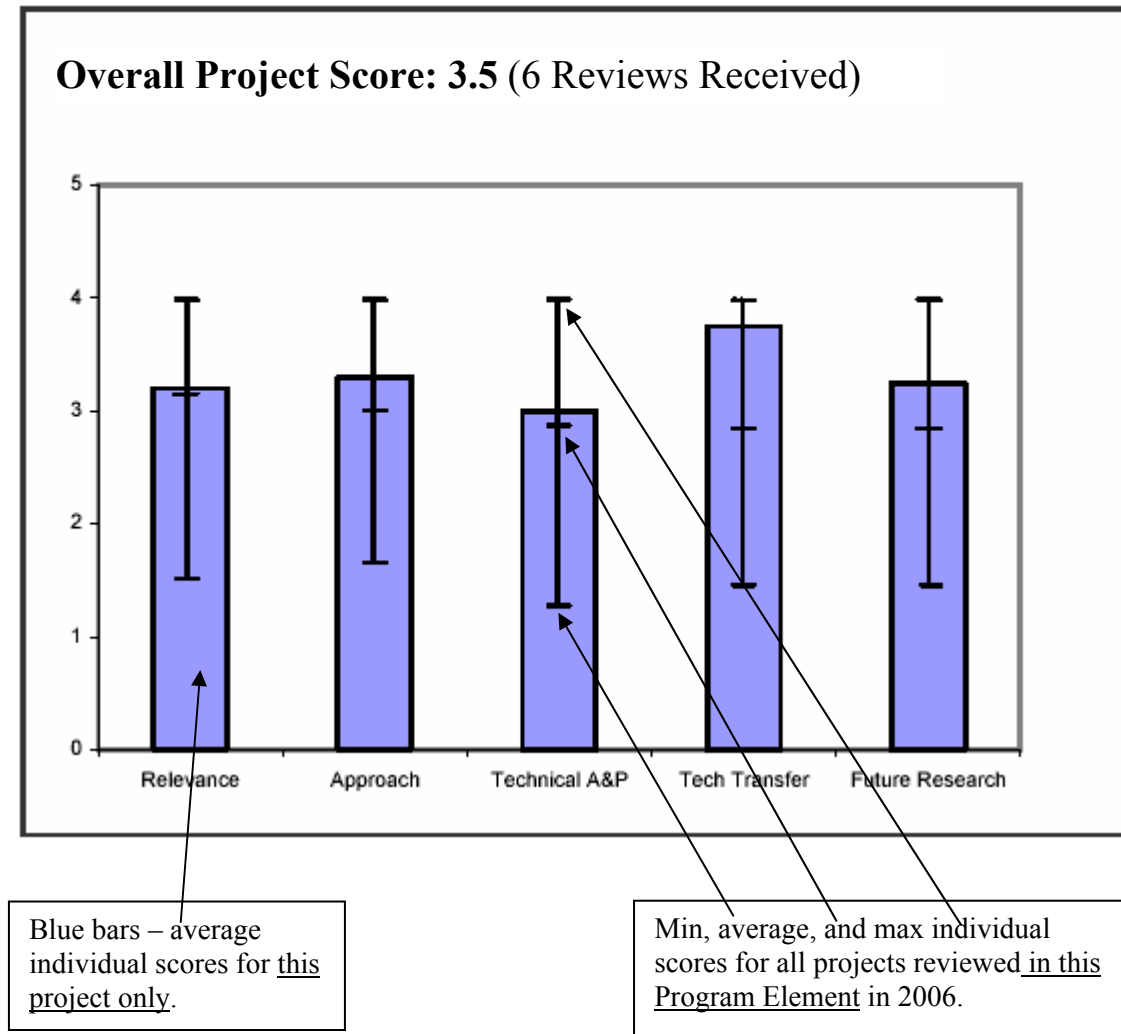
Reviewers were also asked to provide qualitative comments on the five research aspects, as well as the specific strengths and weaknesses of the project, and any recommendations for additions or deletions to the work scope.

These comments, along with the quantitative scores, were placed into a database for easy retrieval and analysis. These comments are summarized in the following sections of this report.

## ORGANIZATION OF THE REPORT

This report is organized in seven sections, in an effort to group projects according to the program elements in which they fall in DOE Hydrogen Program planning. A brief description of the general type of research being performed in each category is presented at the beginning of each major report section.

The remaining pages of each section present the results of the analysis for each of the projects discussed at the merit review. A summary of the qualitative comments is provided, as well as graphs showing overall score and how the particular project compared with all other projects presented within each program category. An example of a graph is provided below:



The project comparisons illustrated in the report are criteria based. Each rectangular blue bar in the chart represents that project's score for that particular criterion of the project. The displayed score for each criterion of a project was obtained by averaging the individual reviewer scores for that particular criterion of the project.

This project's score for each particular criterion (each blue bar) was then compared with the maximum, minimum and average score for that same criterion of all the presented projects (across all sub sections of the Hydrogen program). The maximum, minimum and average scores for a criterion across all the presented projects is graphically displayed by the black line bars which overlay the blue rectangular bars.

For clarification purposes consider that only three projects were presented and reviewed. The hypothetical projects were scored by reviewers as displayed in the table below:

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	Relevance	Approach	Technical A&P	Tech Transfer	Future Research
Project 1	4	2	1	4	3
Project 2	1	4	4	3	2
Project 3	2	3	2	1	4
Max	4	4	4	4	4
Min	1	2	1	1	2
Average	2.3	3.0	2.3	2.6	3.0

In this case, the chart for project 2 would contain a blue rectangular bar with a value of 1 (reflecting the score obtained by project 2 for the relevance criterion) and a black line bar with max, min and average values of 4, 1, and 2.3 respectively for the relevance criteria. Below is a sample calculation for the Project 1 weighted score.

$$\text{Final Score} = 4*0.20 + 2*0.20 + 1*0.35 + 4*0.10 + 3*0.15 = 2.4$$