



April 25-27, 2006
Manhattan Beach Marriott
Manhattan Beach, CA

Tuesday, April 25

7:15 Reception / Continental Breakfast

8:00 Keynote Speaker

*Brig. Gen. William N. McCasland,
Vice Commander, Space and Missile Systems Center*

8:40 Invited Plenary Session Speakers

Dr. Carla Signorini
Head, Power and Energy Conversion Division
European Space Agency
Power Subsystems Technical Monitoring in ESA Contracts

Koichi Shinozaki
Deputy Manager, Safety and Mission Assurance
Japan Aerospace Exploration Agency
An Overview of the JAXA's Inspection Concept for Spacecraft Acquisition

William F. Tosney
Assoc. Principal Director of Risk Assessment and Management Subdivision
The Aerospace Corporation
The Satellite Acquisition Process: A Process Control and Accountability Perspective

10:15 Program Experience

Interconnect Weld Joint Interface Implications to Mission Capability

Robert W. Francis and C. Sve, The Aerospace Corporation

Lithium Ion Battery System Qualification for GEO Satellites

John C. Hall, J. D. Soldi, Jr., G. M. Brown, and L. Marcoux
Boeing Satellite Systems

Battery Electronics Unit (BEU) for Lithium Ion Battery Cell Balancing

Winnie Choy, Boeing Satellite Systems

Results from 10 Year Low Energy Proton Radiation Testing of GPS Coverglass

Simone M. Missirian, M. Ciofalo, D. Coleman, A. Garcia, H. Graziano, S. Liu, and M. Meshishnek, The Aerospace Corporation

JPL Power Systems for Current Planned Missions

Paul Timmerman, D. Karmon, and M. Underwood, Jet Propulsion Laboratory

12:00 Lunch on own



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Tuesday, April 25 (cont)

**1:15 Energy Generation I – Multijunction Solar Cells and Arrays
On-Orbit Performance of Solar Arrays Utilizing Emcore Multijunction Solar Cells**

Navid S. Fatemi, Emcore Photovoltaics, B. Neff and B. Hoang, Space Systems Loral

Do Cell Cracks Really Matter? – Quality Assurance Procedures and Reliability Predictions for Solar Cells on EADS Astrium Solar Arrays

Claus G. Zimmerman, EADS Astrium GmbH

Modeling of Multi-Junction Solar Cells to Compare Illumination and Forward Bias Current Loading as Array Qualification Techniques

Joseph R. Srour, A. O. Sosa, J. R. Scarpulla, J W. Palko, R. W. Francis, and D. C. Mayer, The Aerospace Corporation

Frontiers in III-V Space Photovoltaic Cells and Panels

Chris M. Fetzer, H, Yoon, D. Law, R. King, J. Hanley, R. Bardfield, and P. Hebert, Spectrolab, Inc.

On the Need for Low Energy Proton Testing of Shielded Space Solar Cells

Robert J. Walters and J. Warner, Naval Research Laboratory, S. Messenger and J. Lorentzen, SFA, Inc., and G. Summers, University of Maryland, Baltimore County

[Back-up Presentation: Thin Germanium Wafers for High Efficiency Space Solar Cells: Status and Challenges

Wim Geens and Paul Mijlemans, Umicore, G. Flamand, IMEC, W. Kostler, M. Meusel, and G. Strobl, RWE Space Solar Power GmbH, G. Timo and C. Flores, CESI, and S. Taylor, ESA/ESTEC]

**3:15 Energy Storage I – Flight Performance, Failures and Lessons Learned
Range Safety Considerations for Small-Cell Lithium-Ion Batteries**

Chris Pearson, C. Thwaite, and R. Spurrett, ABSL Space Products and D. Strub, Vandenberg Air Force Base

Development of Capacity Fade Model for Lithium Ion Batteries under LEO Conditions

Branko N. Popov, J. Lee, Y. K. Anguchamy, and B. McKissock, Center for Electrochemical Engineering, University of South Carolina



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Tuesday, April 25, 3:15 (cont)

Life Test and DPA Correlation for the Aging of Lithium Ion Cells in GEO Orbit

John C. Hall, A. Schoen, and D. Wong, The Boeing Company, P. Liu and K. Kirby, HRL Limited, and P. Biensan and F. Bonhomme, SAFT

Lithium-Ion Satellite Battery Reliability Projections

Mark Issacson, Lockheed Martin Space Systems

Comparison of Real Time and Accelerated Lithium-Ion Cell GEO Cycling

Chuck Lurie, Northrop Grumman Space Technology Systems

5:00 Adjourn

Wednesday, April 26

7:15 Reception / Continental Breakfast

8:00 Energy Generation II – Thin Film Solar Arrays

End of Life Performance Predictions for Unshielded Solar Cells in Space

Robert J. Walters and J. Warner, Naval Research Laboratory, S. Messenger and J. Lorentzen, SFA, Inc.

Thin Film Triple-Junction Amorphous Silicon Solar Cells and Modules on Polymer Substrates

Arindam Banerjee, K. Beernink, F. Liu, K. Lord, B. Yan, G. DeMaggio, J. Yang, and S. Guha, United Solar Ovonic Corporation

Environmental Tests of Thin-Film CIGS Solar Cells and Coupons

Martin Kroon, Dutch Space BV, F. Kessler, ZSW, and C. Kaufmann, HMI

Design, Build, and Testing of TacSat Thin Film Solar Arrays

Bill Zuckerman, S. Enger, and N. Gupta, Microsat Systems, Inc.

Boeing Thin Film High Power Solar Array

Ray Stribling, Boeing Satellite Systems

[Back-up Presentation: Poss[®] Coatings as Replacements for Solar Cell Cover Glasses

Henry Brandhorst, T. Issacs-Smith and Brian Wells, Space Research Institute, Auburn University, J. Lichtenhan and B. Fu, Hybrid Plastics, Inc.]



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10:15 Energy Storage II – Recent Improvements for Spacecraft and Launch Vehicle Batteries

Composite Structure $\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$ with Excess Lithium as a Suitable Cathode for Satellite Applications

K. Amine, W. Lu, and D. Vissers, Argonne National Laboratory

Developments in High Energy and High Power Lithium-Ion Cell Designs for Military and Aerospace Applications

Rob Gitzendanner, F. Puglia, and J. DiCarlo, Yardney Technical Products/Lithion, Inc.

Evaluation of QL015KA Cell for the Aerospace Application

Hiroshi Nakahara and H. Tsukamoto, Quallion LLC and J. Stockel, National Reconnaissance Office

A Variable Temperature Shut-down Separator for Safer Lithium-Ion Cells

Judith A. Jeevarajan, NASA Johnson Space Center, and L.Y. Sun, Policell Technologies, Inc.

New Low-Temperature Failure Mode for Nickel Hydrogen Cells

Albert H. Zimmerman, The Aerospace Corporation

[Back-up Presentation: Self-Discharge and Convergence in Small-Cell Lithium-Ion Batteries, Phil Cowles, COM DEV Space]

12:00 Complimentary Lunch

1:15 Energy Generation III and PMAD I – (Parallel Sessions)

**Energy Generation III - Innovative Solar Cells and Concepts
Goals and Initiatives for Space PV Power Research in the Advanced Systems and Technology Office of the NRO**

Richard D. Ridgley, National Reconnaissance Office, and D. Straw, The Aerospace Corporation

Theoretical and Experimental Investigation of Approaches to >50% Efficient Solar Cells

Christiana Honsberg, University of Delaware

Towards Polycrystalline Thin Film III-V Photovoltaics

David Wilt, NASA Glenn Research Center, and M. Smith and P. Jenkins, OAI



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Nanocomposite Organic Solar Cells – Towards Low Cost Flexible Power

David S. Ginley, D. Olson, W. Mitchell, M. White, M. van Hest, and S. Shaheen, National Renewable Energy Laboratory, D. Olson, and R. Collins, Colorado School of Mines, M. White, University of Colorado

Radioisotope MicroPower Generation

Ryne Raffaele and C. Cress, Rochester Institute of Technology, D. Wilt and S. Bailey, NASA Glenn Research Center, C. Murray and R. Kouldeika, Sandia National Laboratories

[Back-up Presentation: Surpassing the 30% Efficiency Level for Multi-Junction Space Solar Cells

Paul Sharps, I. Aeby, D. Aiken, B. Clevenger, A. Cornfeld, J. Hills, G. Johnston, F. Newman, M. Stan, and J. Wood, Emcore Photovoltaics]

**1:15 PMAD I – Power Subsystem Analytical Techniques and Applications
Mars Exploration Rover Power Subsystem Modeling with Multi-Mission
Power Analysis Tool**

Eric Wood, Keith Chin, R. Ewell, and A. Adamson, JPL of California Institute of Technology

Multimode Charge Controller for Low Power Space Systems

David Caldwell, P. Carian, and M. Willhoff, The Aerospace Corporation

**Three-Phase Resonant (LCC) Conversion – The Ideal Space Power
Converter**

Geoff Drummond, Colorado Power Electronics, Inc.

**Uniform Voltage Distribution Control for Series-Input, Parallel-Output,
Connected Converters**

Kasemsan Siri, M. Willhoff, and K. Conner, The Aerospace Corporation

Graphical Examination of Interface Impedance Stability

Michael Willhoff, The Aerospace Corporation

3:15 Workshops (Concurrent Sessions)

- Energy Generation
- Energy Storage
- PMAD

5:00 Adjourn



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Thursday, April 27

7:15 Reception / Continental Breakfast

8:00 Workshop Summaries

8:15 Power Systems Architecture
JPL Power System Architectures
Gregory Carr, Jet Propulsion Laboratory

Power System Architectures for In-House NASA/GFSC Missions
Diane D. Yun, NASA Goddard Space Flight Center

APL Power System Architectures
George Dakermanji, Johns Hopkins University, Applied Physics Laboratory

UltraFlex –175 Solar Array for NASA NMP ST8
Brian Spence, S. White, M. Eskenazi, J. Wachholz, P. Cronin, T. Gregory, P. Barker, and N. Wilder, ATK Space Systems

10:15 Energy Storage III and PMAD II (Parallel Sessions)

Energy Storage III – New Technology Investment Areas
Regenerative Fuel Cells for Space Power and Energy Conversion
George Miley, and N. Luo, NPL Associates and T. Valdez, Jet Propulsion Laboratory

Fuel Cell Research and Development for Future NASA Missions
Michelle Manzo, D. Bents, K. Burke, M. Hoberecht, L. Kohout, and P. Loyselle, NASA Glenn Research Center

A Fuel Cell Power Source for Unmanned Aerial Vehicle Propulsion
Karen Swider-Lyons, R. Stroman, and J. Kellog, Naval Research Laboratory

Applicability of the Super Capacitors to the Aerospace Missions
Yoshitsugu Sone, M. Uno, Y. Takeda, H. Toyota, H. Saito, K. Hirose, and M. Tajima, Japan Aerospace Exploration Agency

Recent Advances in Li-CFx Battery Technology for High-Rate and Low-Temperature Applications
Ratnakumar Bugga, J. Whitacre, M. Smart, R. Yazami, G. S. Praksh, W. Bennett, and T. Miller, Jet Propulsion Laboratory



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10:15 PMAD II – Power Processing Design and Implementation

Spacecraft Integrated Thermal Energy Management Using Two Phase Flow

Frederick Best and C. Kurwitz, NASA Center for Space Power, Texas A&M University and G. Birur, Jet Propulsion Laboratory

Power Processing for a State of the Art Electric Propulsion System

Michael V. Aulisio, J. Scina, Jr., S. Gerber, and E. Griebeler, Zin Technologies

Summary Evaluation of Power Processing Topologies Utilized for Space Electric Propulsion

Robert Kay, D. Edwards, A. Kristalinski, and B. McCrea, Aerojet Redmond

Power Processor for the Colloid Micro Newton Thrusters for ST7

Bruce Pote and B. Connolly, Busek Company

Emerging Applications and Enabling Technologies for Thermal Management

Kimberly Wrenn, D. Wolf, D. Bugby, J. Baker, and M. Morgan, Swales Aerospace

[Back-up Presentation: Electro-Dynamic Solar Array Capacitance Modelling

Reinhard Roeder, EADS Astrium GmbH]

12:00 Lunch on own

1:15 Energy Generation IV – Nuclear and Non-Photovoltaic Power Generation Overview of NASA Radioisotope Power Technology Program

Ajay Misra, NASA Headquarters

Overview of NASA-JPL's Programs in Advanced Thermoelectrics

Subbarao Surampudi, Jet Propulsion Laboratory

Overview of Advanced Stirling Radioisotope Power Systems Development Programs at NASA Richard Shaltens, NASA Glenn Research Center

Thermophotovoltaic Energy Conversion for Space Applications

Fred D. Newman and P. Sharps, Emcore Photovoltaics

Mass and Performance Correlations of Nuclear Space Power Systems

Ernest Y. Robinson, The Aerospace Corporation

[Back-up Presentation: Advanced Power Sources, Vince L. Teofilo, Lockheed Martin Space Systems]



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3:15 Energy Storage IV – Flywheels

Energy Storage Trade Space Analysis for High Peak-Power

Jerry Fausz and B. Wilson, Air Force Research Laboratory

High Energy Flywheel Technology: Progression from Ground to Space

Matt Polimeno and D. Hockney, Beacon Power Corporation

**MW Flywheel Power Module for Area-Focus Directed Energy Weapon
Pulsed Power Supply**

Dwight W. Swett and J. G. Blanche IV, Optimal Energy Systems, Inc.

**Development of a High Specific Energy, Flywheel Module and Studies to
Quantify Its Mission Applications and Benefits**

Ralph Jansen, University of Toledo, NASA Glenn Research Center and R.
Beach, NASA Glenn Research Center

**Satellite Integrated Power and Attitude Control Via Magnetically Supported,
Flexible Shaft Flywheels including Flexible Structural Appendages**

Junyoung Park and A. Palazzolo, Texas A&M University, and R. Beach, NASA
Glenn Research Center

5:00 *Adjourn*