

## Quarterly Report

FY - 2008

Quarterly Period Starting 1 April 2008 through 30 June 2008

Third Quarter

### Highlights From the Director's Desk

#### CAES research facility construction in finishing stages

Completion of the 55,000 square foot high-performance CAES research facility is on schedule for August, 2008. The CAES facility, which is sited north of University Place in Idaho Falls along the east bank

of the Snake River, will provide infrastructure for the CAES public/private partnership that includes Boise State University (BSU), Idaho State University (ISU), the University of Idaho (UI), and the Idaho National Laboratory (INL). Labs and offices will house CAES

programs focused on advanced energy research and education including university faculty and students, national lab researchers, and industry. The photo below right shows the inside view from the first floor with ISU architect Cheryl Hanson in the foreground. The photo below

left shows a view of the second floor looking towards the third story atrium windows. The CAES web site, [www.caesenergy.org](http://www.caesenergy.org), features a time-lapsed video of the entire construction project updated every Friday.

#### CAES Building in Progress



#### Idaho Governor provides additional funds for CAES

On June 9, 2008, Gov. C.L. "Butch" Otter announced that the state of Idaho will provide an additional \$2 million to help complete the CAES research facility.

The \$2 million, drawn from the state's 1995 Settlement Agreement fund, will help complete laboratories in the building, finish information technology systems and purchase furnishings. According to Governor Otter, "This is

a sound investment in our future, both in terms of jobs and economic activity and in terms of developing cleaner, more efficient energy." In response, Dennis Spurgeon, DOE assistant secretary for Nuclear Energy, said "The

Department of Energy greatly appreciates the support the state of Idaho has shown for this critical energy research mission." CAES Interim Director Harold Blackman adds, "Governor Otter has clearly demonstrated the importance

he sees in CAES' potential to address national and international energy issues, while enhancing education and work-force training opportunities in Idaho. We really appreciate the state support in making CAES a reality."

### **Idaho State Board of Education Approves CAES Funding**

On June 19, 2008, the Idaho State Board of Education (SBOE) gave its final approval to invest \$1.6 million in the state universities on behalf of CAES. The request, which originated with the CAES university partners (BSU, ISU, UI), was brought to the SBOE as part of the annual budget for the state universities with the approval of the legislature and Governor Otter. The universities will use these funds to support faculty who engage in the CAES research and education mission.

### **CAES supports Governor's 25x'25 Renewable Energy Council**

Governor Otter established the 25x'25 Renewable Energy Council to promote the production and transmission of renewable energy in Idaho with a special focus

on agricultural and forestry resources. CAES is supporting the Council with both personnel and technology. Michael Louis (BSU), Assistant Director of the CAES Energy Policy Institute serves on the 25x'25 board; CAES affiliate Melinda Hamilton (INL) chairs the 25x'25 Biogas Task Force; Robert Smith (UI), CAES Associate Director, Travis McLing (INL) and Sian Mooney (BSU) serve on the Carbon Task Force. CAES has also set up and manages a web-based communication center based on Oracle/BEA AquaLogic User Interaction software. The 25x'25 communication center provides secure communications, task management, and document sharing for the nine 25x'25 task forces: Biofuels, Biogas, Carbon Issues, Conservation and Energy Efficiency, Economic-Financial Development, Forestry, Geothermal, Hydropower, and Wind.

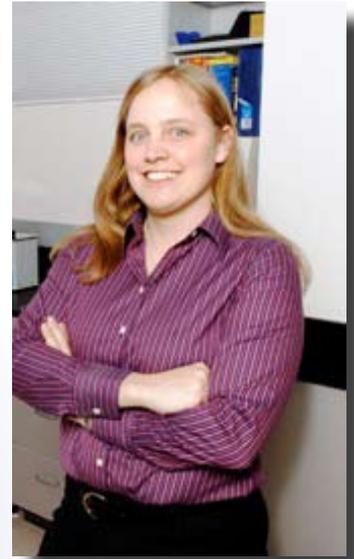
### **CAES Sponsorship Highlights University Collaboration**

On May 5 – 7, 2008, CAES sponsored the Idaho Academic Center of Excellence Workshop on High-Level

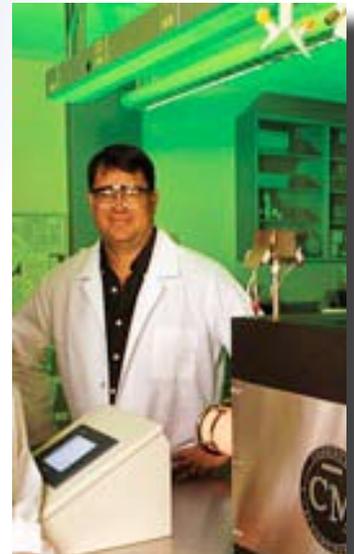
Nuclear Waste at University Place in Idaho Falls, entitled "Idaho: Recent Developments in Nuclear Waste Research and Regulatory Issues." This event was coordinated by CAES affiliate Fred Gunnerson (UI). CAES also co-hosted the National University Consortium / Idaho University Consortium (NUC/IUC) Symposium, May 21 – 22, 2008, which focused on NUC/IUC research that supports the Idaho National Laboratory mission. This event was coordinated by Andy Klein, INL Director of Educational Partnerships. For complete conference details and links to the NUC/IUC symposium papers, please visit the CAES web site, [www.caesenergy.org](http://www.caesenergy.org).

### **Special Recognition**

Two Boise State CAES affiliates were recently recognized for teaching excellence: Darryl Butt received the BSU College of Engineering, Professor of the Year Award while his colleague, Assistant Professor Megan Frary, received the 2008 Bradley Stoughton Award for Young Teachers from ASM International, a materials science professional society.



*Dr. Megan Frary*



*Dr. Darryl Butt*

## **Path Forward**

During the fourth quarter of FY2008, CAES will:

- Co-sponsor a Verification and Validation (V&V) for Nuclear Systems Analysis Workshop on July 21-25, 2008, at the Center for Higher Education in Idaho Falls. During the workshop, international nuclear experts will conduct sessions on V&V and uncer-

tainty quantification for nuclear systems analysis. Nuclear professionals, students, and university faculty will participate in four sessions including: reactor physics, thermal fluids and multiphysics, fuels and materials, and data V&V methods. Workshop cosponsors are the INL, ISU, and North Carolina State University.

Contact Marcy Curr, 208-526-2942, [marcy.curr@inl.gov](mailto:marcy.curr@inl.gov) or visit <https://secure.inl.gov/vvnasaws08/>.

- CAES is sponsoring a Carbon Management workshop to be held at the Boise State University Campus on August 6 and 7, 2008. Stakeholders from academia, industry, and state and federal agencies

will address issues related to carbon management and their impact on legislation, policy, and economics. For more details contact visit <http://secure.inl.gov/carbon-mgmt08/default.aspx>

- Finalize move-in plans with the CAES facility project teams and begin implementing the Occupancy and Facility Management Plans.

# Quarterly Highlights

## Infrastructure Management:

A preview of a project moving into the new CAES research facility was provided by Ron Ballinger (MIT) in his paper "Effects on Crack Growth in High-Temperature Alloys for Advanced Energy Systems." Ballinger described how his team conducts fatigue and static crack growth tests as function of oxygen partial pressure and temperature. Their test apparatus (shown)

provides very accurate measurements of oxygen potential, crack length, and toughness of alloys 617 and 230 in the temperature range 600 -- 750°C. Findings, which include a detailed analysis of the role of oxygen in crack propagation, will play a key role in designing future reactors and other high temperature energy systems. In fall 2008, a comparable test apparatus will be installed in the CAES facility.



## BSU e-Girls Summer Program

On June 14, 2008, Dr. Frary and three of her students participated in Boise State University's e-Girls program, a summer program for high school girls interested in technical careers. In collaboration with Karen Moore (INL), Dr.

Frary and her students demonstrated how to determine the mechanical properties of a material using the MTS load frame in the Boise State mechanical testing lab.

*Dr. Megan Frary leads e-Girls demonstration*



## CAES Kicks off Energy Scholars program at INL

"CAES Scholars" are students currently enrolled and pursuing a Bachelor's, Master's or PhD Degree in an accredited science, technology, or engineering program that supports one of the critical areas identified in the Department of Energy's mission for the INL, who meet all eligibility and security requirements of the INL Internship Program. Scholars are selected based on their college grade point average (not less than the equivalent of a cumulative 3.4 on a 4.0 scale) and their intention to pursue a career in some field of science or technology or

engineering that relates to energy production, transmission, or distribution. The 2008 CAES Scholars are:

Edward Read, University of Utah, PhD, Nuclear Engineering;

Avery Bingham, Texas A&M, PhD, Nuclear Engineering;

David Lewis, Idaho State University, BS, Mechanical Engineering;

Dylan Laug, Whitworth University, BS, Biology;

Bryon Curnutt, Idaho State University, BS, Nuclear Engineering;

Matthew Everson, Massachusetts Institute of Technology, MS, Nuclear Engineering;

Alexandra Gertman, College of Idaho, BS, Mathematics;

Eric Johnson, University of Massachusetts Lowell, BS, Nuclear Engineering;

Charles Stratton, University of Cincinnati, BS, Nuclear Engineering;

Spencer Cooley, Brigham Young University Idaho, BS, Mechanical Engineering.



During their internship, CAES Scholars participate in CAES-sponsored activities that include field trips, seminars, and workshops. So far this year, Herschel Smartt (INL) and Corrie Nichol (INL) presented on robotics systems for irradiated environments and Akira Tokuhiko (UI) presented on the University of Idaho nuclear engineering research program. In addition, the CAES Scholars toured Premier Technology's 100,000 square foot manufacturing facility in Blackfoot, ID (shown). Premier provides complete manufacturing services to a variety of industries including: The DOE, the Department of Defense, the nuclear, pharmaceutical, agricultural, food service and chemical industries, and NASA.

The Scholars are planning a team project and will produce a poster presentation that reports on their project to display at the annual INL Internship Poster Session on August 6. This year the Scholars are focusing on the technical challenges associated with hybrid vehicles and renewable fuel sources.

### **Collaborative Relations:**

CAES continues investing INL Laboratory Directed Research and Development (LDRD) dollars to build collaborative research teams. The FY09 LDRD directed call (to \$300K) focuses on two research areas: Bioenergy and Energy-Water-Climate Change. Proposals within these directed research areas are required to establish multi-disciplinary and multi-institutional collaborative teams. The proposal teams are: (1) Bioenergy Proposal Team -- Melinda Hamilton (INL); Greg Bala (INL); Jon Van Gerpen (UI); Tim

Magnuson (ISU); and, Kevin Feris (BSU); (2) Energy-Water-Climate Change Proposal Team -- Jerry Sehlke (INL); Gary Johnson (UI); Daniel Ames (ISU); and, John Freemuth (BSU).

The Bioenergy call seeks a single integrated multidisciplinary research proposal focused on renewable biofuels, with emphasis on the scientific, engineering, economic and social issues associated with Idaho's biofuel industry including the conversion of plant feed stocks and residues, and animal waste to biofuels, including ethanol and biodiesel. The Energy-Water-Climate Change call seeks a single integrated multidisciplinary research proposal focused on energy/ water resources availability and use within the Snake/Columbia River Basin, including potential impacts of changing demands relative to potential pressures from climate change, land use change (e.g., increasing biomass production), urbanization, water resources use changes, and the potential impacts from renegotiation of the Columbia River Treaty. CAES currently has ongoing LDRD research in the following technical areas: Nuclear Fuel Cycle, Materials Science and Engineering, Energy Policy and Carbon Management. For additional information contact the CAES management team at [www.caesenergy.org](http://www.caesenergy.org) via the Contact Information page.

### **University Projects Selected for Nuclear Science and Technology Experiments**

The INL Advanced Test Reactor (ATR) National Scientific User Facility (NSUF) established by the DOE in

2007 to support U.S. leadership in nuclear science and technology announced the selection of four university-let experiments. Through the ATR NSUF program, universities and industry have access to the ATR and the INL Hot Fuel Examination Facility.

The four university experiments include:

University of Florida -- inert matrix ceramic fuel for destruction of plutonium and minor actinides;

University of Illinois -- fundamental investigations of the irradiation behavior of iron-chromium alloys;

North Carolina State University -- irradiation behavior of nanostructured metals and alloys;

University of California-Santa Barbara -- characterization of advanced structural alloys under irradiation.

The INL ATR scientific and technical staff will work closely with each team and will rigorously evaluate each experiment. The test results will be jointly published in open scientific literature. Beginning in the fall of 2008, the ATR NSUF staff will be located in the CAES research facility.

### **Educational Programs:**

During the past quarter, university students completed their spring term and transitioned to internships and assistantships. Students supported by CAES programs and the CAES partners include:

#### **Boise State University:**

*Deborah Allen*, MS, Policy;  
*Adrial Apter*, BS, Materials Science and Engineering (MSE);

*Mark Bathrick*, MS, Policy;  
*Lou Bonfrisco*, MS, MSE;  
*Jatu Burns*, MS, MSE;  
*Patrick Callahan*, MS, MSE;  
*Brandon Christopher*, BS, MSE;  
*Eileen DeShazo*, MS, Policy;  
*Brian Jaques*, MS, MSE;  
*Matt Luke*, MS, MSE;  
*Daniel Osterberg*, BS, MSE;  
*Prakash Periasamy*, MS, MSE;  
*Jeffrey Perkins*, MS, MSE;  
*Patrick Price*, MS, MSE;  
*Russ Slater*, MS, Policy;  
*Chris Stifter*, BS, MSE;  
*David Thompsen*, MS, MSE;  
*Megan Wardwell*, BS, MSE.

#### **Idaho State University:**

*Bryon Curnutt*, BS, MSE;  
*Marya Morrison*, MS, MSE;  
*Daniel Phares*, MS, Nuclear Engineering;  
*Nathan Zohner*, MS, Nuclear Engineering.

#### **University of Idaho:**

*Mohammad Faheem*, PhD, Nuclear Materials;  
*Michael Figueroa*, MS, Nuclear Engineering;  
*Natalie Gese*, MS-MSE, Nuclear Materials;  
*Richard Henderson*, Ph, Chemistry;  
*Robert Hoover*, MS, Nuclear Engineering;  
*Sean McCormick*, MS, Nuclear Materials;  
*Charlotte McMurtrey*, BS, Chemistry;  
*Ramprashad Prabhakaran*, PhD, MSE;  
*Artit Ridluan*, PhD, Mechanical Engineering;  
*Triratna Shrestha*, BS, MSE;  
*Vaibhav Sinha*, PhD, Nuclear Engineering;  
*Pengyu Zhu*, MS, Chemical Engineering.

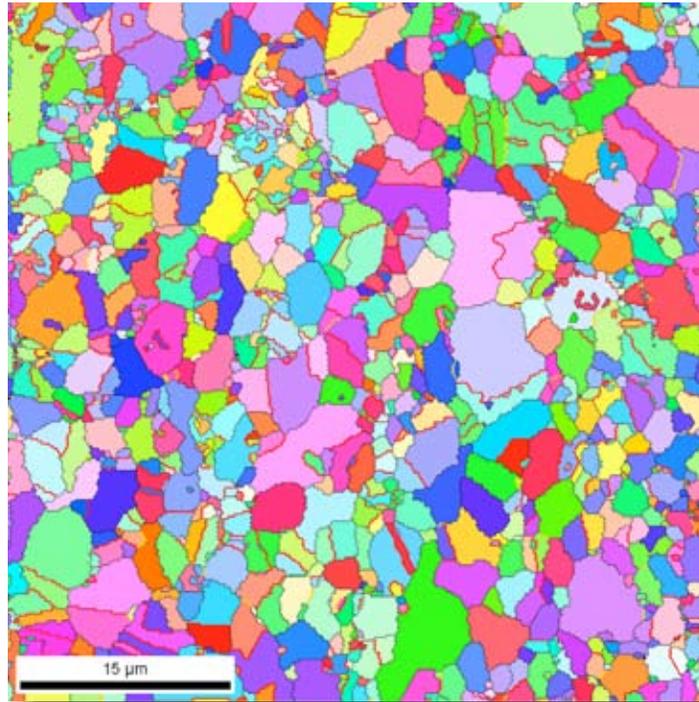
#### **Policy Programs:**

Mike Louis (BSU) and Carole Nemnich (BSU) continue investigating different methods of public

discourse and their effect on the public's perceptions, preferences and attitudes on nuclear energy, funded by the CAES LDRD program. MS students Deborah Allen, Eileen DeShazo, and Mark Bathrick are supporting the project. MS student Russ Slater is developing EPI website functionality to ensure public outreach. Research collaborators include Steve Piet (INL), Jeffrey Joe (INL), Anne Hunter (ISU), and Patrick Wilson (UI).

### Program Development:

Dr. Megan Frary's research team (BSU) continues its CAES-related research activities, including work on spark plasma sintering (SPS) and materials for high temperature heat exchanger applications. The SPS project is funded by a CAES-related LDRD and involves researchers from BSU, UI, ISU and the INL. After examining how SPS processing affects the microstructure and hardness Ni and W, the team is now using electron backscatter diffraction (EBSD) to characterize the crystallographic texture of the samples. The figure below shows an EBSD image of a Ni specimen microstructure processed at 500°C by SPS.



*Inverse pole figure map of SPS Ni. Grains are colored according to the surface normal direction. Grain boundaries are colored according to type: black are high-angle boundaries, yellow are low-angle boundaries, and red are twin boundaries.*

UI reports the following proposal activity:

1. "Characterization of Fluidized Beds via Pressure-Fluctuation Analysis," by D. W. Marshall (INL), D. Drown (UI), and V. Utgikar (UI), to INL LDRD (pre-proposal), for \$600k (pending).
2. "Development of a Dynamic Process Model of a TRU EX Plant for USDoE," by T. J. Tranter (INL), S. Herbst

(INL), Nexia Solutions (UK), V. Utgikar (UI), to DOE Advanced Fuel Cycle R&D, for \$850k (pending).

3. "A Comparative Study of Welded ODS Cladding Materials for AFCI/GNEP Applications," by I. Charit (UI), to DOE 2008 Advanced Fuel Cycle R&D Call, (pending).

for \$1.5M, (pending).

6. "Development of Radiation Resistant Ultrasonic Technologies for Liquid Metal Fast Reactor Development", by GE and A. Tokuhiko (UI), to DOE, for \$2.0M (pending).
7. "Experimental and Computational Study of Irradiation Induced Damage in Advanced

From ISU: faculty have submitted five pre-proposals to the DOE Advanced Fuel Cycle Initiative:

1. Investigation on the Radiolytic Degradation of the TALSPEAK Solvents
2. Synthesis of New Macromolecules for the Selective Extraction of Americium
3. Disposition Path for Recycled Uranium in the U.S.
4. Phase Constitution and Microstructure of Transmutation Fuel Related Systems
5. Wet-Chemical TRU MOX Fabrication by Oxalic Co-Precipitation and In-Situ Determination of Physical Properties

### Scientific Eminence

#### Publications:

Ubic, R., G. Subodh, et al. (2008). "Structure of compounds in the Sr<sub>1-3-x</sub>/2CexTiO<sub>3</sub> Homologous Series." *Chemistry of Materials* 20(9): 3127-3133.

Yeaman, C. B., G. W. S. Silva, et al. (2008). "Oxidative Ammonolysis of Uranium (IV) Fluorides to Uranium (IV) Nitride." *Journal of Nuclear Materials* 374(1-2): 75-78.

#### Professional Contributions:

Brahman, R. K., W. P. Hennessey, et al. (2008). Chemical Interaction Matrix Between Reagents in a Purex Based Process. *ISEC 2008 Conference*. Tucson, Arizona.

Butt, D. (2008). Idaho University Consortium Advanced Fuel Cycle Academic Center of Excellence. IUC/NUC Conference. Idaho Falls, Idaho.

Butt, D. (2008). Nuclear Fuel

4. "Modeling Irradiation Damage in Oxide Dispersion Strengthened Steels for GNEP Applications," by I. Charit (UI), to DOE 2008 Advanced Fuel Cycle R&D (pending).

5. "Development of Advanced Experimental and Computational Methods for Nuclear Systems Design," by ANL and A. Tokuhiko (UI), to DOE,

Reactor Materials," by A. Tokuhiko (UI), G. Potirniche (UI), and T. Tokuhiko (UI), for \$295k, to DOE (pending).

8. "Assessment of Transferable Technologies in Support of U.S. Fast Reactor Infrastructure", A. Tokuhiko (UI), \$211k, to DOE (pending).

Activities at Boise State University. IUC/NUC Conference. Idaho Falls, Idaho.

Butt, D. P. and B. J. Jaques (2008). Synthesis of Actinide Nitrides. ANS Annual Meeting. Washington D.C.

Butt, D. P. and B. J. Jaques (2008). Synthesis of Uranium Nitride. IUC/NUC Conference. Idaho Falls, Idaho.

Callahan, P. and D. P. Butt (2008). A Novel Transient Liquid Phase Method for Joining Ion Transport Membranes. Fuel Cell 2008. Denver, Colorado, ASME.

Chen, J., et al. (2008). Monte Carlo Analysis of Neutron Slowing-Down-Time Spectrometer for Spent Fuel Assay. IUC/NUC Conference. Idaho Falls, Idaho.

Frary, M., S. Hopkins, et al. (2008). Redistribution of Carbide Precipitates during Creep of Alloy 617. IUC/NUC Conference. Idaho Falls, Idaho.

Gese, N., et al. (2008). Electroreduction of Li<sub>2</sub>O to generate Li for chemical reduction of UO<sub>2</sub>. IUC/

NUC Conference. Idaho Falls, Idaho.

Hartmann, T., F. Poineau, et al. (2008). Synthesis and Properties of Metallic Technetium and Technetium-Zirconium Alloys as Transmutation Target and Radioactive Waste Storage Form in the UREX+1 Process. Atalante 2008. Montpellier, France.

Hoover, R. and S. Phongikaroon (2008). Modeling Anode Process. International Conference on Nuclear Engineering. Orlando, Florida.

Horkley, J., et al. (2008). Enhanced Separation for Nuclear Fuels. IUC/NUC Conference. Idaho Falls, Idaho.

Paviet-Hartmann, P., J. Chapman, et al. (2008). Selective Extraction of Trivalent Actinides by New Macrocyclic Compounds. ISEC 2008 Conference. Tuscon, Arizona.

Paviet-Hartmann, P., J. Horkley, et al. (2008). New Macrocyclic Compounds Synthesis for the Selective Extraction of Technetium. 32nd Annual Actinide Separation Conference. Park City, Utah.

Paviet-Hartmann, P., J. Pak, et al. (2008). Selective Extraction of Perrhenate and Pertechetate by New Macrocyclic Compounds. Atalante 2008. Montpellier, France.

Prabhakaran, R., J. I. Cole, et al. (2008). Small-Scale Specimen Testing of Monolithic Fuels and Structural Materials. American Nuclear Society Meeting. Anaheim, California.

Utgikar, V., T. M. Lillo, et al. (2008). Perovskite-Type Ceramic Oxide Oxygen Permeable Membranes. IUC/NUC Workshop. Idaho Falls, Idaho.

Zhu, P., et al. (2008). Perovskite Type Ceramic Oxide Oxygen Permeable Membranes. IUC/NUC Conference. Idaho Falls, Idaho.

### ***Recognitions, Awards, Officers in Professional Societies, others.***

Akira Tokuhiko (UI) has a research appointment for summer 2008 at the NRC Office of Research to support efforts on modular gas-cooled high-temperature reactor design.

Patrick Price (BSU) received Boise State's Top Ten Scholar Award, which is an award given to the ten best students at the university each year.

Patrick Price (BSU) and Brandon Christopherson (BSU) were both inducted into the University Foundation Scholars program for the academic excellence and community service.

Patrick Price (BSU) received the Student of the Year award by the Materials Science and Engineering Department.

Darryl Butt (BSU) was named Chair of the Department of Materials Science and Engineering in June.

George Imel (ISU) served as an expert evaluator for the European Commission in May.