XP Professional deployment. The settings are in line with the National Institute of Standards and Technology (NSIT) recommendations. The current template is for Windows XP with service pack 1 (SP1). Most of the computers running Windows XP Professional at the Berkeley Lab have SP2 already installed. There is a need to update the Berkeley Lab's security settings template. Microsoft introduced a personal firewall as part of the operating system with Windows XP. Microsoft will soon introduce a new desktop operating system known as Microsoft Vista. In Microsoft Vista, the Windows Firewall functionality in SP2 is retained. It is important for Berkeley Lab to undertake an extensive review of the Firewall rules and settings in Microsoft Vista even before an operational version of Vista is released by Microsoft. A good understanding will make Berkeley Lab fully prepared. Remote Assistance provides a way for users to get the help they need when they run into problems with computers. It is a way for Help Desk departments to save on the cost of supporting users. The Computer Support Division at the Berkeley Lab is always looking at ways of improving user support at a reduced cost without compromising security

Engineering

A Matlab® Simulation of the Energy Recovery Linac RF Superconducting Cavity. *RANDALL PLATE (Cedarville University, Cedarville, OH 45314) CARL SCHULTHEISS (Brookhaven National Laboratory, Upton, NY 11973).* Linear particle accelerators (linacs) accelerate ions to near the speed of light in order to conduct experiments on particle collisions. Energy recovery linacs (ERLs) consist of both a linac radio frequency (RF) superconducting cavity and an electron ring which can be used for electron cooling. It is crucial to operate as close to the resonant frequency of this RF cavity as possible in order to maintain a proper accelerating field, but factors such as Lorentz forces and microphonics can detune the cavity. A Matlab simulation of the cavity provides the ability to analyze these affects and develop a digital control system to counteract them and retain the desired electric field gradient. A simulation of the cavities employed in Tesla, Spallation Neutron Source (SNS), and the Rare Isotope Accelerator (RIA) was analyzed and modified to be consistent with the cavity at Brookhaven's linac by changing the quality factors, resonant frequencies, and time constants of the various operating modes. This simulation and control system will be the foundation for the development of another, real-time, simulator which will be applied to the physical cavity. This paper presents the development and implementation of this simulation and discusses the implications of the results obtained.

A New GUI for Global Orbit Correction at the ALS Using MATLAB. *JACOB PACHIKARA (University of Texas at Arlington, Arlington, TX 76019) GREGORY J. PORTMANN (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* Orbit correction is a vital procedure at particle accelerators around the world. It is very important to have a user friendly application. The orbit correction routine currently used at the Advanced Light Source (ALS) is a bit cumbersome and this paper describes a new Graphical User Interface (GUI) developed for global orbit correction using MATLAB. The correction algorithm uses a singular value decomposition method for calculating the required corrector magnet changes for correcting the orbit. The application has been successfully tested at the ALS. The GUI display provided important information regarding the orbit including the orbit errors before and after correction, the amount of corrector magnet strength change and the standard deviation of the orbit error with respect to the number of singular values used. The use of more singular values resulted in better correction of the orbit error but at the expense of enormous corrector magnet strength changes. The results showed an inverse relationship between the peak-to-peak values of the orbit error and the number of singular values used. The plots on the GUI help the ALS physicists and operators in understanding specific behavior of the orbit. It is a convenient application to use and is a substantial improvement over the previous orbit correction routine.

Acoustic Doppler Measurement of High Speed Shearing Flow. *DAVID HUBBLE (University of Tennessee, Knoxville, TN 37916) BRENNAN SMITH (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* The Acoustic Doppler Velocimeter (ADV) is an innovative three-dimensional flow measuring device that relates the phase shift between a transmitted acoustic signal and its reflected counterpart to fluid velocity through pulse-coherent processing. Its low cost and ruggedness make it ideal for measuring in remote locations such as rivers and tidal regions but its ability to measure high speed flow remains in question. After analyzing data from an axisymmetric jet centerline and the exit passage of a hydraulic turbine, it was determined that an experiment was needed to improve understanding of how an ADV responds in shearing turbulent flow and to quantify the bias and errors in measurements from such flow fields. There are several problems that occur when an ADV attempts to measure shearing turbulent flow. First, due to range limitations on the speed settings, high speed flows cannot be unambiguously measured. Second, due to probe geometry, the vertical component of the velocity measurement is biased, exhibiting higher variance than the other two flow directions. To understand how an ADV reacts to shearing turbulent flow, experiments are being conducted on an axisymmetric jet at the TVA's Norris Engineering Lab. The axisymmetric jet was chosen because it creates a well understood, predictable flow field with areas of turbulence strong enough to simulate those found in a hydraulic turbine exit passage. The experimental design was determined by balancing probe resolution against the flow capacity and geometric limitations of the test flume. The geometric limitations caused concern due to the risk of boundary influence. A four inch jet was chosen. This allowed four probes to be located within the jet from 2 to 10 feet downstream with minimal flume boundary interference. There is an inherent bias in the geometry of the ADV that causes vertical measurements to contain less noise. Also, there is considerable noise at high frequencies which indicates an inability to resolve small extremely small scale turbulence. These data should help engineers decide when an ADV is appropriate for flow measurement in prototype settings.

***Addition of Wet Turbine Pod and its Related Heat Exchangers into Realativistic Heavy Ion Collider Cryogenic System.** *CLARENCE DZUBEY, JR. (CUNY–Bronx Community College, Bronx, NY 10453) TOM TALLERICO (Brookhaven National Laboratory, Upton, NY 11973).* The Relativistic Heavy Ion Collider (RHIC) consists of two rings of super-conducting magnets to help guide and focus beams of ions during various scientific experiments. All magnets must be maintained at a temperature of 4.5 degrees Kelvin (K). The basic function of the RHIC Cryogenic System is to maintain the super-conducting magnets in the two rings of the collider at 4.5 K or below. The Cryogenics Group (CG) cycles liquid helium throughout the rings in varying amounts to keep these magnets cold at 4.5 K by removing the heat generated locally due to currents and heat leakage from its surroundings. The Cryogenic System (CS) was originally designed for the Isabelle project, another collider, which required a larger heat load (~25 kW at 3.8 K) however, it was never completed. The RHIC inherited this CS but only needs at most approximately 13 kW at 4.5 K of refrigeration power. The CG has been implementing upgrades over the last three years to achieve greater system efficiency by reducing the power usage. This year's main upgrade consisted of adding a load turbine and its associated heat exchangers that are enclosed in a cold box (CB). A turbine is an enclosed rotary engine that extracts energy from a fluid flow while a CB can be described as a low pressure vessel providing vacuum insulation for cryogenic heat exchangers, which are devices built for efficient heat transfer from one fluid to another. This upgrade would result in a 1 MW power decrease from 6 MW to 5 MW of compressor power. We worked on the planning and implementation that went into incorporating additional control and monitoring instrumentation into the existing CS for the new turbine and CB. The planning stage included engineering and design of digital and analog input and output wiring diagrams, programmable logic card diagrams, and the construction of an additional human machine interface computer screen. The implementation stage involved installation of computer racks and wiring along with analog valves, gauges and sensors.

Advanced Steam Reforming Catalysts for Generating H2 from Natural Gas. *GINA FAZIO (University of Illinois at Urbana Champaign, Urbana-Champaign, IL 61801) DR. MAGALI FERRANDON (Argonne National Laboratory, Argonne, IL 60439).* Reforming of natural gas at the point-of-application is one option being pursued to provide H2 for use with fuel cell systems being developed for distributed power applications. New reforming technologies will be required for these integrated fuel processor-fuel cell systems. A critical component of these fuel processors is the reforming catalyst, which promotes the conversion of the natural gas to H_2. Rhodium supported on an oxide substrate, such as alumina or ceria, is one of the most effective catalysts for reforming natural gas. Unfortunately, Rh is an expensive precious metal and, hence, the cost of a Rh based catalyst is an issue. Optimizing the Rh loading is critical to minimizing catalyst cost. The objective of this project is to investigate the effect of Rh loading on the performance of Rh supported on a lanthana-modified alumina for the steam reforming of methane, the primary component of natural gas. Three different Rh loadings were investigated: 1, 2, and 5-wt%. The catalysts were tested in a microreactor system using either a 3:1 mixture of H_2O:CH_4 or a reformate containing 1% CH_4 at 600-950°C and gas-hourly space velocities (GHSV) of 20,000-70,000 h-1. At a GHSV of 20,000 h-1, similar CH4 conversions and H_2 yields were observed for all three Rh loadings for all conditions investigated. However, at a GHSV of 60,000 h-1, a significant drop-off in performance were observed with the 1 and 2-wt% but not the 5-wt% Rh catalysts.

An Investigation of the Optical Detection of Cellular Metabolic Activity. *KELLY CHRISTIAN (University of Tennessee, Knoxville, TN 37996) JUSTIN BABA (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* The clinical challenge of preventing life-threatening vascular complications after liver and other organ transplants necessitates a means for continual post-operative monitoring for rejection, infection, and normal function assessment. Current methods, which utilize crude systemic measures such as volume of urine output and serum markers for cellular injury, are woefully insufficient. At best, these serve as indirect, time-delayed measures of tissue viability. Additionally, these techniques do not provide continuous, real-time monitoring and thus are inadequate for timely assessment that could enable life saving interventions. To address these inadequacies, the development of a device for continuous real-time tissue metabolic assessment is underway. Currently, an investigation is in progress to determine the appropriate equipment needed to produce a device that can track the ratio of two fluorescent coenzymes that are involved in cellular metabolic activity, NADH and FAD. It is anticipated that the NADH /FAD ratio will stay constant for normal function and increase considerably in the case of abnormal function. Therefore, the detection of a noticeable increase would suggest an early change in tissue viability, i.e., before irreversible organ damage occurs. Before this can be explored, an optical probe must be developed that can appropriately detect and measure the concentrations of NADH and FAD. A device was designed and tested on a spectrophotometer with several different light sources, such as a tungsten halogen, a UV fluorescent lamp, and multiple LEDs (Light-Emitting Diodes), to determine if one of the sources could detect high concentrations of the coenzymes in vitro. A model probe was also constructed, where the samples were tested with the photodiode detector. The results presented show that NADH and FAD fluorescence was visibly observed when the light sources simply illuminated the samples, however the fluorescence was unable to be detected with all but one of the light sources used. This indicates that the samples were fluorescing, but the spectrophotometer and the probe were unable to detect fluorescence due to low sensitivity in UV and near visible range. Future work must be done to determine a proper light source that can detect NADH and FAD suitably. Once the probe is complete, it must be tested for the detection of anticipated physiological concentrations in vitro and for conducting ex vivo studies using excised organs before finally proceeding to live in vivo studies.

Anemometer Standoff. *NICHOLAS JOHNSON (University of Colorado at Denver, Denver, CO 80112) HAL LINK (National Renewable Energy Laboratory, Golden, CO 89401).* Accurate wind speed measurements are critical in the analysis of wind turbine power performance. Common industry practice is to measure wind speed using a cup anemometer that is mounted in a position where the supporting tower distorts the measurement. It is ideal to mount the anemometer on top of the tower. Sometimes this is no practical and must be mounted on a boom, that supports it away from the tower, far enough to limit distortion errors to 1%. A theoretical model has been used to quantify where a distortion will occur with respect to the tower. However, some researchers have recently speculated that the theoretical model inaccurately predicts the distance from the tower where the 1% distortion error occurs. The objective of this project was to experimentally measure and quantify this distortion and thereby validate or disprove the model. To achieve this objective, a test was configured where one anemometer was mounted above a triangular lattice tower to measure the undistorted wind speed. On the same tower a boom-mounted anemometer was mounted below the top of the tower to measure the distorted wind speed. Data were collected by the boom-mounted anemometer at different “standoff” distances. Standoff is the ratio of the separation of the anemometer and the tower to the width of the tower. Data were sorted by wind direction in order to plot where the critical distortion occurs—when the anemometer is directly upwind of the tower. This value was reported. A second tower was requisite to quantify the vertical spacing effects between the top-mounted and the boom-mounted anemometers. This test measured distortion effects for three configurations: at a standoff of 2.31, the model predicts a distortion error of 1.6%, the test indicated 3.2%; at a standoff of 3.47, the model predicts a distortion of 0.9%, the test indicated 2.6%; at a standoff of 4.62, the model predicts a distortion of 0.6%, the test indicated 1.6%. Based on these test results, NREL has concluded that the model inaccurately predicts the distortion. To obtain accurate wind speed measurements with boom-mounted anemometers a larger than predicted standoff is required. Results to date are limited to relatively small amount of standoff distance points, more research is needed to create an acceptable model.

Assessment of Biometrics System. *KWOK WING LEE (Stony Brook University, Stony Brook, NY 11794) UPENDRA S. ROHATGI (Brookhaven National Laboratory, Upton, NY 11973).* Biometric systems are used to authenticate users based on their biological characteristics such as face, voice, fingerprint, and hand geometry. This kind of identification system provides the user with logon convenience and extra protection against theft. The Russian Academy of Sciences Institute of Applied Physics is involved with the project and they are developing a software development kit (SDK), where others can use this product and create their own biometric identification system. To evaluate the quality of their product, a Biologin program was created using C++ programming and other technologies such as Microsoft Graphical Identification and Authentication Dynamic Link Library (MSGINA DLL). Communication with the Russian institute was established daily via internet, to provide them with feedback on their SDK and documentation. The goal of creating a Biologin was to determine if the SDK is useable and if the product can be sold to consumers. Product documentation is very important for a SDK but was lacking in the product and constant communication was required. Testing of the recognition system was very accurate and accounted for only a 3% error rate. It is difficult to work with another country because of language barriers and the time difference. This was a learning experience for the Russian Institute because they must develop software products that can compete with existing ones in the market.

Bipolar Plate Design and Manufacturing for Proton Exchange Membrane Fuel Cells. *RACHEL BACKES (Colorado School of Mines, Golden, CO 80401) JOHN TURNER (National Renewable Energy Laboratory, Golden, CO 89401).* The proton exchange membrane fuel cell (PEMFC) is the preferred candidate for future fuel cell automobiles. Metallic bipolar plates have the ability to improve this type of fuel cell. This project focuses on how stainless steel bipolar plates can be produced and designed for use in PEMFCs. The plate material considered is type 446 stainless steel. Flow patterns are designed to be stamped into the plate through application of rubber pad forming techniques. Dies are designed for the stamping process, and preliminary testing is done with substitute materials. The results of preliminary testing were successful, particularly with the softest backing material used. Seals required for implementation in a fuel cell stack are also designed. The result of this project is a set of preliminary designs for the production and use of stainless steel bipolar plates in a PEMFC.

Building an Atomic Layer Deposition (ALD) System for the Coating of Ceramic Rods. *MATTHEW LEWIS (Iowa State University, Ames, IA 50013) GREGORY KRUMDICK (Argonne National Laboratory, Argonne, IL 60439).* Many new types of technology are being introduced in today’s world, but few of them offer a wider variety of uses than Atomic Layer Deposition (ALD). ALD makes it possible to deposit a layer of film as thin as one atomic layer on a surface and allow maximum control of thickness. With this type of layer control the technological possibilities are virtually endless. The ALD system currently being built in building 362 at Argonne National Laboratory needed to be designed to coat ceramic rods so different materials could be tested on them for strength and thermal efficiency. To accomplish this task we used the existing ALD system as a template and scaled up the new system. Many parts were fabricated by central shops using CAD drawings from Microsoft Visio that were specialized to fit the new system. The design and engineering phase of the new system is nearly complete and the fabrication phase has already begun. The system is scheduled to be finished in late January at which time it will be leak checked and ready to coat materials. The system is also being designed so that it is flexible, in that when ceramic rod testing has been completed, the system will be able to be used for many other types of applications.

Cellulose Breakdown Using a Dry Acid Catalyst. *KEVIN JACKSON (University of Illinois at Chicago, Chicago, IL 60645) CHRISTOPHER MARSHALL (Argonne National Laboratory, Argonne, IL 60439).* With the flux of current gas prices, energy security has become top priority for the United States in recent months. Because of current non-renewable fossil fuels located in unstable regions of the world, America is now looking into renewable alternative sources of energy to fuel our nation’s automotive fleet and provide a means of cheap energy. A successful alternative energy source would allow America to become independent of the unstable regions of the world that currently produce over 80% of the worlds fossil fuels. Ethanol and Hydrogen fuel cells are among the hopefuls that will one day replace gasoline as the fuel that feeds our gas tanks. Between those two, Ethanol production is disputed to be the best option towards supplying our nation's needs. In Brazil, ethanol Production has already replaced 40% of their fueling needs. However, ethanol production is much easier in South America due to climate conditions. They use sugar cane, which is highly made up of sugars like glucose, to produce ethanol. To produce ethanol practically in the U.S. we will need a method of converting the cellulose in corn into ethanol since sugar cane can't be grown in our climate.

Characterization of Superconducting Splices. *MEGAN MALLETTE (Valparaiso University, Valparaiso, IN 46383) CHRISTOPHER REY (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* High temperature superconductors (HTS) are materials that have no resistance to electrical current at temperatures below the transient temperature, Tc, and are therefore able to conduct much higher currents than traditional wire, in a much smaller area. HTS have the potential to greatly increase electrical efficiency in a number of applications, but it is necessary to first fully characterize the behavior of splices (i.e., electrical joints) before incorporating HTS wire into applications in order to minimize joint failure. During this investigation, splices of superconductors to be tested were fabricated by varying the type of solder, surface preparation, joint overlap area, and thermal cycle. Each splice consists of a series of seven lap joints. After fabricating each splice, a range of currents are applied to the splice and voltage measurements across each joint are used to calculate the resistance of each joint for the range of currents tested. While holding all other variables constant, the Sn60-Pb40 solder outperformed the In66.3-Bi33.7 solder in every test. Testing splices with no surface preparation resulted in poor mechanical joints that were unable to handle the stress of testing, showing the importance of surface preparation and oxide removal. Of the two types of fluxes tested, the paste flux outperformed the ruby fluid flux with all other variables constant in every test, except one splice in which the HTS was damaged by the temperature of the soldering iron. Results from varying joint overlap areas showed that larger contact areas decrease the joint resistance, as expected. Surprisingly, there was little difference between successive thermal cycles due to the stress of repeated temperature changes. Further testing on additional types of solders, fluxes, and joint overlap areas would result in a more comprehensive report on splices of HTS. Other variables that need to be considered in further testing of splices are the effects of varying magnetic fields, temperature dependence, and different types of mechanical stress.

Collection and Transmission Systems Cost and Performance Model for the Baseline Offshore Wind Farm. *AMY BOWEN (Baylor University, Waco, TX 76798) JIM GREEN (National Renewable Energy Laboratory, Golden, CO 89401).* The National Wind Technology Center (NWTC) of the National Renewable Energy Laboratory (NREL) has undertaken a series of concept studies to evaluate the cost and performance of offshore wind farms. One of these studies will evaluate the power losses experienced throughout the electrical power collection and transmission systems as well as the cost of the system components and their installation. A hypothetical system was designed based loosely on the Horns Rev offshore wind farm. This system was then sent out to manufacturers with requests for electrical and cost data on the submarine cables and transformers. Upon discovering that the electrical data available for submarine cables is scarce, a very basic method of loss analysis was developed using three parameters: conductor resistance, ampacity, and power loss at capacity. The total losses are divided into two groups: losses that are modeled as a quadratic term which varies with current, and a base loss that is assumed to vary little with current, and is thus modeled as constant. In the model, both costs and losses are listed in per meter values to account for parameter variability. Power losses varied between cables from different manufacturers and also between different wind farm layouts. The cost of cables varied widely between different manufacturers as well, with one manufacturer's cable more than two times higher than another's. The results obtained in this study will be applied to the overall concept study.

Collection, Analysis, and Archiving Heavy Truck Driving Characteristics and Duty Cycles to Support the Evaluation of Benefits of Energy Efficiency Technologies. *JOSEPH MASSIMINI (Purdue University, West Lafayette, IN 47906) GARY CAPPS (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* Despite common beliefs, commercial vehicle energy performance on highways is not well known. Ever changing hours of operation, anti-idling regulations, traffic situations and construction work make it difficult for drivers to have a true situational awareness of driving characteristics on highways. Understanding of these characteristics is often obtained through qualitative means. A quantitative profile of driving behavior of heavy trucks does not exist. Generation of duty cycles that reflect real world driving would aide in creating such a profile. Sensors, autonomous to the driver, mounted on active fleet tractor trailers collecting kinetic, kinematics, human factor and environmental information will provide the data necessary to generate these duty cycles. Additionally, half the tractor-trailers will be fitted with Next Generation Single Tires (NGSTs) as opposed to standard dual tires to observe any improvements in fuel efficiency. This project involved extracting and analyzing the duty cycle data collected during the Pilot Test and creating and testing a prototype sensor suite for the Field Test that includes both Controller Area Network (CAN) and RS-232 type connections, requiring not only specific programming in the Data Acquisition System (DAQ), but also special CAN cables, RS-232 connectors and signal conditioning modules. ORNL worked with the DAQ vendor to specify and create the necessary software and hardware needed for integration into the prototype. This project also had to consider the fact that active fleet tractor trailers with a single driver typically operate 11 hours a day. Each channel collected and stored in the DAQ is collected at 16 bits per Hertz, thus a very large amount of data will be collected in a very short period of time. Methods were developed for formatting, organizing and archiving this large amount of data using custom Visual Basic software. At vehicle launch duty cycle data will be collected with the custom sensor suite, and will be archived and stored in an accessible location using the created software and can be used for validation, research and development of energy efficient technologies.

Compact Nanosecond High Current Pulser Design. *MICHAEL MALLO (University of Oklahoma, Norman, OK 73019) SOREN PRESTEMON (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* A pulser is an electronic circuit which generates a high voltage or current pulse with a very short pulse-width. Pulsers can be implemented using various topologies, such as Marx Generators, capacitor banks, coaxial transmission lines, helical lines, striplines, and Blumleins. The goal of this project was to review basic pulser theory and to design, test, and compare several pulsers using various topologies. The final design should deliver a repeatable pulse greater than 1 kA with 10 ns or less pulse-width to a 1 Ohm inductive load (high field microcoil) and be small enough to allow for insertion into an ultra high vacuum accelerator environment. The pulser topologies tested were capacitor bank, coaxial transmission line, stripline, and parallel plate Blumlein. The capacitor bank produced an output voltage of 289 V with a ringing frequency of 17.9 MHz, corresponding to a positive voltage pulse-width of 28 ns. The load impedance of this circuit is unknown. The coaxial transmission line was expected to produce an output voltage pulse of 500 V with a pulse-width of 13.2 ns; the actual output was 500 V, but with a pulse-width of 11.8 ns. The stripline was expected to produce a 1 kV 4 ns voltage pulse through a 1 O inductive load. The parallel plate Blumlein was expected to produce a 1 kV 1.2 ns voltage pulse through a 1 O inductive load. However, the stripline and Blumlein both produced far less voltage than anticipated and voltage pulse-widths of just over 10 ns. Three factors may have lead to this inconsistency in predicted versus measured pulse-widths. First, the diagnostic tool used to measure the stripline and Blumlein voltage pulses was a Tektronix P5102 1 kVRMS 100 MHz 10x high voltage probe. The 100 MHz bandwidth prevents the probe from accurately measuring pulse-widths shorter than 10 ns. Second, the short lengths of these lines may have lead to a greater prominence of end effects, or variations in the electric and magnetic fields at the ends of the transmission lines, in the output pulses. Third, the low 1 O load impedances combined with the stray inductances may have caused longer than expected pulse rise times. The latter two factors warrant further investigation to better understand what electrical and geometric properties lead to end effects and long rise times, and to what extent they affect the output pulse.

Comparison of Intrabeam Scattering High Energy Approximations, and Equilibrium. *ALLEN OWENS, II, ROBERT OWENS (North Carolina A&T State University, Greensboro, NC 27411) MIGUEL FURAN, SEKAZI MTINGWA (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* The International Linear Collider (ILC) is a particle accelerator being designed with the hopes of exploring higher energy particles in the universe that have never previously been accessible. Two of the major components of the ILC are the electron and positron damping rings, which serve the purpose of shrinking the emittances of the beams. There are several competing processes that affect the beam emittances. Synchrotron radiation damping serves to decrease the emittances. A major contributor to emittance growth is a phenomenon called Intrabeam Scattering (IBS), wherein particles within a single bunch Coulomb scatter off one another, thereby causing the beam emittance to increase.. The IBS emittance growth rates are calculated using computer codes, and often it is too time consuming to use the full theory of IBS. In order to calculate IBS growth rates in the most efficient manner, several high-energy approximations to the full theory have been developed for the energy regime of the ILC. It is important to find the most accurate approximation. We analyzed three approximations of IBS using the software package, Mathematica; Bane's approximation, a new Diagonal Matrices approximation, and a recent CIMP one-log approximation, while attempting to develop a better two-log approximation to the CIMP formulas. We also analyzed the equilibrium emittances of the beams at different charges to determine if the transverse emittances, bunch length, and energy spread would meet the necessary requirements for the ILC. After comparing the various approximations, the Diagonal Matrices approximation proved to be the closest approximation to the full theory of IBS.

Comparison of Three-phase AC/DC Converters in a Wind to Hydrogen System. JOSHUA PRICE (University of Colorado at Boulder, Boulder, CO 80303) CHRISTOPHER PINK (National Renewable Energy Laboratory, Golden, CO 89401). Efficient production of hydrogen from wind power can be achieved by direct coupling of a variable-speed three-phase wind turbine to an electrolyzer with a high quality three-phase ac/dc rectifier interface. This paper compares three different topologies of three-phase high-quality rectifiers for use in a wind to hydrogen system. A six-pulse phase-controlled rectifier, a single-switch unidirectional ac/dc buck converter, and a single-switch ac/dc single-ended primary inductance converter (SEPIC) are developed and simulated using software-modeling techniques to calculate power output and efficiencies determined by wind turbine and electrolyzer operational characteristics. Software simulations indicate that the single-switch ac/dc SEPIC exhibits an increase in power production of 25% in the lower 25% of usable wind speeds over the single-switch ac/dc buck converter, and an increase in power production of 5% in the lower 10% of usable wind speeds over a modified six-pulse phase-controlled rectifier, with less cost and comparable efficiency. This work is part of a larger project that investigates a methodology to maximize off-grid wind to hydrogen production with a power electronics interface.

***Completing Phase III of Chipmunk Electrical Packaging Upgrade.** *JULIAN DIAZ (Bronx Community College, Bronx, NY 10453) VINCENT CASTILLO (Brookhaven National Laboratory, Upton, NY 11973).* Chipmunks are radiation monitoring devices used by the Collider Accelerator Department (C-AD) at Brookhaven National Laboratory (BNL) that detect radiation by means of an ionization chamber which generates a current that is proportional to the radiation. The current is converted to a frequency which is also proportional to the radiation. Different levels of radiation are used to create interlocks on the C-A machines. Chipmunks were developed at Fermi National Laboratory (FNAL) in the early 1980s and for the past 26 years have been effective as the detectors in the radiation monitoring system for the C-AD at BNL. They were designed with 1980s technology which included extensive hand-wiring and some of the components are actually obsolete. An engineering upgrade was started three years ago with the help of Community College students from the Community College Institutes (CCI) summer student program at BNL. A backplane was designed to replace hand-wiring and printed circuit boards (PCBs) were redesigned with readily available components. This project is focused on the design of circuits that will complete the upgrading process. Such circuits include a PCB for the indicators lights; a PCB for the front panel indicators; a PCB for the interlock circuits and completion of the backplane wiring. With all this circuitry in place the upgraded chipmunk will be ready for testing.

Computer Aided Engineering in the Development of the Electron Beam Ion Source Electrostatic Components in the Low Energy Beam Transport Region. *GAVIN MCINTYRE (Rensselaer Polytechnic Institute, Troy, NY 12180) LOUIS SNYDSTRUP (Brookhaven National Laboratory, Upton, NY 11973).* The Electron Beam Ion Source (EBIS) is the new pre-injector system for the Relativistic Heavy Ion Collider (RHIC) and will outperform the Tandem van de Graff which is the current ion source for RHIC. The EBIS is more versatile, with the ability to produce myriad stable ion species from the noble gases to uranium. Deflectors (steering/minor focusing) and quadrupoles (focusing/defocusing) ensure the beam quality and are developed using computer aided drafting and engineering software. The analysis is crucial to the success of the deflector and quadrupole designs; thus simulations constructed in analytical software (Kobra) are developed to ensure design integrity. The Adaptor Deflector is the initial steering/focus device that is mounted concentrically to the upstream ion lens. The deflector consists of electrode pairs with equivalent potentials that are mounted either parallel or alternating. Various designs were modeled using Pro/Engineer and were comprised of two to eight electrode pairs. The investigated designs included: the split cylinder, the dual dipole (two dipoles offset from one another), and 8/16 congruent, electrode arrangements in order to ascertain the design that produces the least aberrations to the ion beam. The functionality of the deflector designs were simulated with a theoretical beam in the electrostatic analysis software, Kobra, and the 16 electrode deflector produced the most desirable qualities. Three quadrupoles are located in the Low Energy Beam Transport (LEBT) region of EBIS; the two simulated designs were a basic quadrupole triple and a Helical Electrostatic Quadrupole (HESQ). The triplet is composed of three inline quadrupoles, with electrode pairs of equivalent electric potential which focuses/defocuses the ion beam in two axial directions. The electrodes are oriented by a stainless steel framework and ceramic standoffs that act as insulators for the grounded vacuum vessel. The quadrupoles are offset from the vacuum chamber using swivel bolts that aid in mounting. The design incorporates two spring-loaded feedthroughs per quadrupole, which supply the voltages to a divided contact pad that is directly connected to the electrodes by solid wire. The HESQ has four helical electrodes held concentric in a grounded vacuum vessel and offer more locations for focusing/defocusing than the triplet while spanning a shorter length. The electric fields the quadrupoles produced were tested using the electrostatic capabilities of Kobra by applying various potentials to the electrodes; both resultant fields were adequate for focusing/defocusing the EBIS but the HESQ was superior to the triplet.

Controls Engineering for a Compact Crystal Positioning System. *PRISHANTHA DUNSTAN (Columbia University, New York, NY 10027) CHRISTINA HOFFMANN (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* The ability to manipulate a sample for research and development has always been a basic essential. When sample size shrinks to the micro-scale and the environment for analysis proves unsuitable for direct human interference, the ability to carefully and accurately control the sample becomes much more difficult. In this case a positioning system for aligning and moving the samples remotely is desired. Such a device was constructed by Square One Systems in collaboration with the Spallation Neutron Source at Oak Ridge National Laboratory. Based on a tri-sphere approach, a series of linear actuators are employed to perform linear and spherical motions around a center point. The scope of this project was multifold: The individual motors of the instrument were calibrated and aligned. Once completed, the instrument was hardwired into a computer for control through LabVIEW software. The controls software was designed to mimic the operation of a goniometer, such that the sample could be rotated through two angles, the second angle being dependent upon the first. The equations of motion used enable sample rotation such that the crystal's position remains fixed while the motors move around it. Since the samples will be subject to neutron beam exposure with dimensions as small as 100μm x 100μm, ensuring that the crystal does not leave the beam when rotating will be essential to collect meaningful data. The controls also provide numerous calibration functions, enabling re-centering and adjustment of the sample after loading. The software calculates limits of rotation, preventing over rotation and possible dropping of the sample. Virtual images of the sample plate provide a visual for the scientist, due to the fact that the sample chamber will prevent direct view of the sample. This new instrument provides several advantages over the current sample positioner on the market (the hexapod). Using innovative Piezo motors, the instrument can manipulate the sample with zero backlash, ensuring accurate manipulation. The instrument also allows for easy sample changing, since the sample plate is not permanently fixed to the instrument. Because the software allows for repositioning of the sample, it provides much room for time-saving methods. For example, if a sample pin were used, such that 3 samples were loaded (one at the tip, one 1/3 from the tip, one 2/3 from the tip), the instrument could manipulate 3 samples sequentially without the need to reload.

Design and Construction of an RF Plasma Source. *JOHN CARR (University of Illinois at Chicago, Chicago, IL 60601) RICHARD VONDRASEK (Argonne National Laboratory, Argonne, IL 60439).* An RF plasma source is being developed to provide a 1+ ion beam for the Californium Rare Ion Breeder Upgrade. The 1+ beam will be injected into the Electron Cyclotron Resonance ion source, at the Argonne Tandem Linear Accelerator System, and charge bred to n+. An existing plasma source, no longer being used, was redesigned and modified to conform to new specifications. The RF plasma source consists of a 29 ml high-temperature quartz ion bottle. Gas is admitted to the plasma chamber through the ion bottle using an insulated tip and sealed with an o-ring. The bottle is mounted to a 5 inch round base, also sealed with an o-ring. Beam extraction is provided by a 30 kV puller mounted to the base opposite of the ion bottle. The source is designed to use up to a 500 MHz RF signal to ignite the plasma and create the ion beam. Redesigning and retrofitting a currently available unit was a time and cost effective way to construct a suitable plasma source.

Design and Implementation of a High Availability Distribution Layer In a Campus Environment. *MANGAL TYAGI JR. (Prairie State College, Chicago Heights, IL 60411) AJ TEMPROSA (Brookhaven National Laboratory, Upton, NY 11973).* The implementation of a robust, scalable, and fault tolerant network is dependent on logical and physical segmentation of workgroups to provide compartmentalization in event of network failure. The Cisco hierarchical model simplifies the task of building a reliable, scalable, and cost-efficient hierarchical internetwork by introducing a modular approach to the design and functionality of each network component. A distribution layer provides policy-based connectivity for workgroup access without having to route local data through the core or backbone of the network. By determining the fastest or best path to transmit data, the distribution layer will also send non-local requests to the high-end core, which will then transport the request at high data transfer rates to the correct service. Several policies provided at the distribution layer include packet filtering, quality of service (QoS), virtual LANs (VLAN), and manipulation of network traffic, which altogether contribute to exerting control over network transmissions and what goes in and out of the network. In order to improve Brookhaven National Laboratory's (BNL) network, a third distribution layer (DL-3) will be configured and deployed which will be attached to the core at high transfer rates and redistribute network data across a portion of the BNL campus. DL-3 will have redundant chassis consisting of the Cisco 6500 series, multi-layer switches, and dedicated power distribution unit (PDU) feeds. In addition, port aggregation is a technology that is implemented to provide higher bandwidth, and will also serve as a backup if a link fails. Before the deployment of DL-3, the components, such as the supervisor engines and multi-layer switches, have to be properly configured. The configuration process includes conversion of the Cisco supervisor engines from hybrid to native mode, assigning VLANs and network addresses, and establishing the spanning tree root. Once DL-3 is configured, it is connected to the network to start servicing the BNL campus similar to the other two distribution layers. The deployment of DL-3 will provide more reliable connectivity at the BNL campus by reducing the amount of hosts exposed to network failure. The work being performed is part of an ongoing effort to BNL's network reliability and performance.

Design Assistance for Renovation and New Construction at Red Rock Canyon National Conservation Area Using Building Energy Simulation. *BENJAMIN BARNES (University of Illinois at Urbana Champaign, Urbana-Champaign, ILLINOIS 61801) ROBI ROBICHAUD (National Renewable Energy Laboratory, Golden, CO 89401).* The Federal Energy Management Program Technical Assistance team at NREL used eQUEST software to help the Bureau of Land Management in their attempt to reach and exceed the goals of the 2005 Energy Policy Act in their new visitor center and renovated offices at Red Rock Canyon National Conservation Area. EQUEST was chosen for its intelligent defaults and its DOE-2 engine, which has been well validated against real buildings. Weather data collected on site was used for simulating external loads and visitation data from the current visitor center was used to generate internal occupancy loads while other internal loads were largely eQUEST defaults, except infiltration, which was adjusted to account for the door use patterns of a visitor center. The heating, ventilating and air conditioning (HVAC) equipment in the design involves a dedicated outdoor air system (DOAS) serving all zones and several recirculating, terminal units. The outdoor air load was simulated by assigning the DOAS to a few central zones and giving it the entire building outdoor air requirement while the recirculating units served the zones they were specified to with no OA load. Evaporative cooling (EC), on-off, two step and continuous daylighting, moveable insulation, dual speed compressors and a deeper Western overhang were all simulated. The EC and daylighting achieved the majority of the savings (21% and 8% of total building energy, respectively) while the results for the other measures suggested that they can likely be ignored. It is recommended that water conservation issues with EC be seriously investigated. Two step daylighting controls should be implemented and, if it proves feasible, combined with EC. The moveable insulation should be avoided as it would introduce maintenance issues and actually has a net detriment to energy use. The model, in the future, should be further validated concerning its HVAC approximations and used to assist in peak load management. Also, to be of greatest benefit, it must be kept up to date with current design development.

Design of Blade Rotation System for a Large Wind Turbine Blade Test Stand. *MICHAEL SMITH (Portland State University, Portland, OR 97201) JASON COTRELL (National Renewable Energy Laboratory, Golden, CO 89401).* Wind turbine blade testing is a key element in the development and success of the blade manufacturing industry. Testing is necessary to achieve higher reliability and meet international certification requirements. NREL (National Renewable Energy Laborotories) tests blades on both faces by mounting the blade on a test stand and applying static loads. The blades must be rotated between tests to apply loads to a second face. The objective of this study is to create and evaluate design options for a blade rotation system. Project deliverables include design specifications, graphic models, and cost estimates. The primary components of the rotational system include large adaptor plates, a rotational guide, and a drive. The focus of the study is on the design and selection of the rotational guide. Two main concepts were developed for comparison; one in which the blade is mounted to a heavy duty slewing bearing and one that uses calipers with rollers to support and guide blade during rotation. The results of this study indicate that the caliper design is likely to be a more expensive and complicated choice. However, the caliper design offers options for scalability and modularity that may make it more cost effective in the long term.

***Design Study of Temperature Stabilization of the Analyzer Array of the High Energy Resolution Inelastic X-Ray Spectrometer of the Advanced Photon Source.** *JUSTIN BUELL (Montgomery College, Rockville, MD 20850) BRANISLAV BRAJUSKOVIC (Argonne National Laboratory, Argonne, IL 60439).* Through the use of the high energy resolution inelastic x-ray (HERIX) spectrometer at the Advanced Photon Source (APS), vibrations in the lattice structure of various materials can be studied. The instrument consists of nine detector-analyzer pairs, a vacuum chamber, and a support structure for the entire instrument. X-rays from the APS beamline, scattered by a specimen through the vacuum chamber, are reflected and focused by the analyzers through a collimator and into a series of corresponding detectors which measure the properties of the photons. Due to the high cost of vacuum compatible components, it is more economical to place the analyzers outside of the chamber than inside it. Because thermal expansion due to temperature fluctuations in the hatch in which the spectrometer is located will compromise the geometric alignment between the optical components of the spectrometer, it is necessary to stabilize the temperature of the analyzers before the instrument can be calibrated. Using SolidWorks, a model of an enclosure and cooling channels for the analyzer array was developed. Expanded Polystyrene, a type of Styrofoam, was the selected material for the enclosure because of its optimal thermal properties. The enclosure was designed to eliminate heat transfer by free convection and minimize conduction to the analyzers. The cooling channels will consist of a copper tube through which water at a controlled temperature will flow and a series of copper pads, onto which the tube will be brazed, that will be mounted onto the support plate of the analyzers to improve thermal conduction between the analyzers and the cooling water. Finite element analysis of transient heat transfer was performed on the model assuming the hatch temperature to be a sinusoidal function of time based on measurements from a similar hatch. The results of the analysis indicated that the enclosure alone would not sufficiently stabilize the temperature of the analyzers, but that the enclosure and cooling infrastructure would maintain an acceptable degree of stability in the temperature.

Determination of the Effect of Interlayer Porosity on the Performance of Oxygen Electrodes for Solid Oxide Electrolysis Cells. *PATRICK DRIEMEYER (University of Missouri–Rolla, Rolla, MO 65401) JENNIFER MAWDSLEY (Argonne National Laboratory, Argonne, IL 60439).* Currently work is being done on the thermochemical cycle known as the "Westinghouse Process" in which hydrogen is produced. The step of interest in the Westinghouse Process is the decomposition of SO_3 to SO_2 using electrolysis to lower the temperature at which this reaction occurs. This step is considered a hybrid of thermochemical and electrochemcical processes and reduces the highest temperature of any step to 500–600°C from 850°C. The lower temperature range opens the door for a wider array of materials to be used in construction of a hydrogen production plant. The development of an oxygen ion conducting cathode for the electrolyzer cell which exhibits low resistance is desired since it would allow free exchange of oxygen and electrons, thereby improving the performance and output of the electrolyzer cell. The production and testing of various cathode compositions along with an examination into the effect of porosity in the doped-ceria interlayer will be examined and reported on. The compositions that will be tested include $La_{0.5}Sr_{0.5}CoO_3$-d; $Nd_{0.5}Sr_{0.5}CoO_3$-d; $Ba_{0.5}Sr_{0.5}CoO_3$-d. These compositions will be produced on site and tested in air within the temperature range of 900°C to 500°C. Their performance will be measured using electrochemical impedance spectroscopy (EIS) in which the area specific resistance (ASR) will be calculated and compared to determine the most appropriate design path. We have found that the incorporation of porosity in the doped-ceria interlayer between the oxygen electrode and the stabilized-zirconia electrolyte improves performance.

Determining the Effect of Aerosol Composition on the Accuracy of Aethalometer Real-Time Measurements of Black Carbon. *SRYAN RANGANATH (University of California–Berkeley, Berkeley, CA 94709) THOMAS W. KIRCHSTETTER (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* Black carbon (BC), a main component of soot, is studied for its associated climatic and health effects. Filter-based light-transmission instruments are commonly used for measuring properties of black carbon. The aethalometer performs real-time measurements of black carbon concentration. Previous studies indicate that measurements produced by light transmission instruments, and the aethalometer specifically, are affected by the enhancement in particle light absorption due to the light scattering within the filters used to collect the particles. While the extent of this enhancement varies with particle loading and particle composition, the aethalometer algorithm does not consider these effects. This result could jeopardize the quality of measurements of BC concentration made with the aethalometer. This behavior was studied in the laboratory using controlled generation of BC and light scattering aerosols. An inverted diffusion flame produced BC aerosols with steady physical characteristics. A nebulizer produced salt particles which were mixed with BC from the flame. These particles were diluted with filtered air prior to sampling. The aethalometer sampled pure BC aerosols and BC + NaCl in individual experiments. In both cases, the aethalometer reported a decreasing concentration despite sampling a constant BC concentration. However, different decreasing trends in concentration were observed, depending on the composition of the aerosols sampled. This difference in instrument response means that different empirical corrections are required, which is not a practical solution to the problem. Continued investigation with aerosols of different composition is the next expected step. These results may be first steps in showing an empirical correction for the aethalometer is not practical.

Development of a Long Ion Chamber Electrometer for Particle Accelerator Beam Containment. *NICHOLAS PATE (Tennessee Technological University, Cookeville, TN 38505) PAUL WRIGHT (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* A common problem in cavity-coupled linear particle accelerators is misalignment of cavity phases resulting in particle beam loss over a short distance; when an intense beam is lost in this manner, high levels of ionizing radiation are developed that can pose a danger to both personnel and the machine itself. Long Ion Chambers (LIONs) provide a low-cost and -complexity method of monitoring radiation levels along a length such as an accelerator, potentially allowing a control system to take beam containment measures if a radiation threshold is exceeded. LION implementation in machine protection systems at the Spallation Neutron Source (SNS) requires that a standard electrometer design be developed, validated, and calibrated against other beam-loss and radiation detector systems. Circuit analysis of an existing prototype electrometer was performed to determine ideal characteristics of the design, and an experimental frequency analysis was performed to verify suitability for use under the expected measurement conditions. Because a vital piece of measurement equipment was unavailable, it was not possible to conduct a more detailed characterization of the circuit. It was determined that the maximum input signal before output clipping occurs is an order of magnitude higher than necessary, that gain drops off significantly for signals above 10KHz, and that the circuit operates as expected for relatively high input and offset currents. Further work will include a more detailed spectrum analysis, especially for small signals, determination of signal-to-noise ratio, and investigation of a small interference source that was observed during testing. This work is part of an ongoing effort to evaluate and implement LION-based radiation monitoring and beam containment in the SNS accelerator system.

Development of a Multi-Pollutant Personal Sampler (MPPS). *MARIA MINJARES (Our Lady of the Lake University, San Antonio, TX 78207) LARA GUNDEL (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* The effects of indoor and outdoor air pollutants on human health have long been a concern to health care workers, environmental scientists, and citizens alike. Previous work has consisted of developing methods for separating and trapping particulate matter (PM) and gaseous pollutants. Currently, the multi-pollutant personal sampler (MPPS) consists of denuder with polyurethane foam coated with a ground sorbent, XAD-4, followed by a filter to collect PM < 2.5 μm diameters (PM2.5). Indoor and outdoor air sampling was conducted at Lawrence Berkeley National Laboratory to determine how much PM2.5 the polyurethane foam would retain. The results obtained from sampling indoor ambient air proves our hypothesis that the PM2.5 will pass through the 80 pores per linear inch (ppi) XAD-4 coated PUF. However, the 80 ppi XAD-coated PUF retained 30% of PM2.5 in its structure during outdoor air sampling. Further experimentation is needed to improve the MPPS geometry so that > 95% of PM2.5 passes through the XAD-coated PUF to the filter.

Development of a One-Dimensional Coal Gasifier Model Using Fortran and UNIX. *ANDREW ELDER (Gonzaga University, Spokane, WA 99258) KEN JOHNSON (Pacific Northwest National Laboratory, Richland, WA 99352).* Coal gasification is a technique that is gaining attention as a clean fuel source for highly efficient power plants that are also environmentally friendly. In this process, coal is mixed with steam and a controlled amount of oxygen while under high temperatures and pressures. This environment causes the coal to break down into a synthesis gas (i.e., syngas) of hydrogen and carbon monoxide with lesser amounts of other gaseous compounds. The syngas can be used for fuel, while the waste gases can be removed easily. The goal of this project was to develop a one-dimensional computer model that would predict the heat transfer through the outer wall of the gasifier. (A one-dimensional model is one that deals with heat transfer solely in a linear fashion). Using the Fortran programming language on a UNIX machine, knowledge of conductive heat transfer and an explicit forward difference numerical method, two such one-dimensional models were developed. These models determined the heat loss through the gasifier wall and the temperature at various points through the wall. These models will serve as the foundation for future work in coal gasification modeling.

Effect of Acid Agitation on Buffered Chemical Polishing of Niobium for Radiofrequency Cavities. *SARA MOHON (The College of William and Mary, Williamsburg, VA 23186) ANDY WU (Thomas Jefferson National Accelerator Facility, Newport News, VA 23606).* The performance of niobium superconducting radiofrequency (SRF) cavities can be affected by the smoothness of their inner surfaces. Smoother inner surfaces tend to result in better performance. Normally, smooth niobium surfaces are obtained by buffered chemical polish (BCP). BCP is necessary to remove the damaged layer created during fabrication and machining of the cavities. Previous experiments conducted in the Surface Science Lab at Thomas Jefferson National Accelerator Facility have shown that the morphology of niobium surfaces may be altered via different agitation constraints during BCP. The focus of this research is a systematic study of the effect of agitation on the BCP treatment of niobium. Six samples of niobium, each one square centimeter in size, were prepared using a 1:1:2 BCP mixture for 75 minutes. A control sample was also analyzed with no BCP treatment. Each BCP treated sample was agitated after a certain amount of time, varying from 0 to 75 minutes. After this treatment, the samples were examined by a 3D profilometer, where quantitative information about surface morphology was extracted. Qualitative inspection of the surface of each sample was performed a metallographic optical microscope (MOM). It was found that the surface roughness increased up to a certain asymptotic limit as the time interval between agitations increased, and that a green unidentified cloud-like material appeared above the inner surface area of niobium samples when there was no agitation. The MOM photographs show evidence that the BCP mixture attacked the grain boundaries and defect locations more than it did elsewhere, making a BCP treated surface rougher in comparison to some other polishing methods. The treated samples became smoother as the time interval between agitations decreased although they never become as smooth as the control sample. Smoother surfaces were also found in areas where the green cloud formed than in areas where it was absent. A model is proposed to qualitatively explain the experimental results. Further investigation is warranted for different BCP ratios to see if a smoother surface finish is possible and what agitation it requires. In addition, a BCP study of how larger grain samples affect niobium surface morphology is promising to the improvement of SRF cavities. These endeavors and the experimental results are useful for the BCP treatment of niobium SRF cavities to be used in particle accelerators.

Effect of Neodymium Oxide on Thermal and Mechanical Properties of Alkaline Earth Sealing Glass for Solid Oxide Fuel Cells. *BRIAN BISKIE (Northern Illinois University, DeKalb, IL 60115) YEONG-SHYUNG CHOU (Pacific Northwest National Laboratory, Richland, WA 99352).* Earlier work on glass seals for solid oxide fuel cells (SOFCs) has shown that when fuel cells are operated over long periods, glass seals tend to react with the ferritic stainless steel interconnects at the metal/glass interfaces, and form undesirable phases. An approach for this problem was to make sealing glasses more refractory such that the glass would be sealed at higher temperatures (i.e., 950°C) and thus be less reactive at operational temperatures of (750–800°C). In this study, a novel glass series containing Sr-CaO-Nd_2O3-B_2O_3-SiO_2 was developed to determine the effect of Nd_2O_3 on the thermal and mechanical properties of the glass. Properties such as coefficient of thermal expansion (CTE), glass transition temperature, softening temperature, and elastic modulus were determined as the neodymium content was varied throughout the glass series. The results showed CTE increased with increasing Nd_2O_3 content up to 5 mole percent which had a CTE of 11.97 ppm/ C for as-cast glass, while the glass transition and softening points showed different behaviors. A similar alkaline earth silicate glass was used for interfacial strength testing. In addition to as-sealed coupons, samples were also aged in either air or a reducing environment to study the environmental effect on interfacial strength. The results showed the tensile strength decreased ~53% when aged in air at 850°C for 250 hours, and increased ~38% when aged 250 hours at 850°C in moist, dilute hydrogen fuel. Possible causes for the strength change were discussed.

Effect of Reactant Gases Humidification on Hydrogen Fuel Cell Performance. *FIDA ABDULLAH (State University of New York at Farmingdale, Farmingdale, NY 11706) DR. DEVINDER MAHAJAN (Brookhaven National Laboratory, Upton, NY 11973).* Recent experimental investigations on polymer electrolyte membranes (PEM) fuel cells emphasize water management as being a critical factor in the design of an efficient cell. The current research project aims to explore the influence of humidified air and hydrogen on the fuel cell's performance. The first part of this experimental work was conducted on a five graphite bipolar plates fuel cell power stack, while operated under various loads, and involved the measurement of dry reactant gases (hydrogen and oxygen/air) humidity and temperature entering and exiting the fuel cell. The results, obtained at room temperature, indicated a substantial increase in the exiting humidity of oxygen (25.26%) despite the humidity entering the cell being relatively constant at 50% RH. The air exiting the cell plateaus at 75.15% RH (relative humidity). A comparison of the effect of both hydrogen and oxygen/air gases, under similar conditions, on the power stack performance was made. The oxygen's substantial increase in humidity was matched by a smaller increase (14.3%) from the exiting hydrogen side. when dry gases were used the power stack yielded a maximum power density of 19.43 mW/cm² and a maximum current density of 41.33 mA/cm². The second part of the experiment involved conventional methods of external-humidification of the oxygen gas/air and the humidified air entering the cell was changed in a range from 85.63% to 78.42% RH. As a result, the humidified air exiting the cell yielded a slight increase in humidity to 2.11%. Comparing humidified air versus non-humidified air a 72.77% increase in power density was observed. Since the results in the dry cell (no humidification) yielded a slight change (14.3%) in the exiting hydrogen humidity, the consequent step was to humidify circulating hydrogen and the results yielded a slighter gain of 12.87% (21.93mW/cm²) in power density. The final part of the experiment was the humidification of both reactant gases. The entering humidification of both gases yielded less improvement in performance than the previous scenarios, when each reactant gas was humidified one at a time. Also, when both entering reactant gases were humidified the exiting hydrogen humidity increased by 2.1% and the exiting air humidity increased by 11%. Initially, the humidification of both reactant gases yielded better performance than solely humidifying hydrogen but fell short of the performance of solely humidifying air. Humidification of air showed a maximum power density increased by 54.24%, and proved to be more influential than humidifying hydrogen or both gases.

Electrical Properties of Materials with a High Dielectric Constant. *CHRISTOPHER DIXON (University of Delaware, Newark, DE 19713) STEVE HULBERT (Brookhaven National Laboratory, Upton, NY 11973).* Silicon integrated circuits are based on the Metal-Oxide Semiconductor Field Effect Transistor (MOSFET). A MOSFET uses a layer of oxide (an insulator) sandwiched between a layer of metal (gate) and a semiconductor to control the flow of electrons between the source and drain. The goal of creating a transistor using high-k dielectrics is to achieve a smaller transistor so that more transistors can be packed into a smaller area. As transistors get small, the leakage current across the dielectric increases leading to problems with battery lifetime and heat dissipation. Thus, new materials are being investigated for use as gate insulators in order to decrease the leakage current. In older electronics the gate electrode is usually a polysilicon semiconductor. Metal gates are desirable to use because they help to limit reaction at the gate/dielectric interface. The energy levels of different metals relative to the energy levels of the high k dielectrics determines the leakage current through the dielectric. Samples of the dielectric,$(HfO_2)_x(SiO_2)_{1-x}$ were analyzed by using ultraviolet photoelectron spectroscopy(UPS). UPS is a technique for measuring the energy spectrum of electrons emitted during the absorption of ultraviolet radiation. The relative alignment of the energy levels of the Si substrate, the dielectric film, and the gate electrode will determine the electrical properties of the transistor. This spectrum reveals the characteristic ionization energies of the component atoms and facilitates study of their chemical nature. Utilizing UPS it is possible to see the Fermi level and energy levels of the materials that are being considered. Analyses were run on the samples with different amounts of Ag and Alevaporated onto the surface of the dielectric samples. Data was recorded as a function of metal thickness for both Ag and Al depositions.The Secondary Electron Cutoff (SEC) made it possible to determine the work function of the samples being tested, and to discover whether any electric charge was transferred at the metal/insulator interface. The threshold voltage (and consequently the drain to source on-current) is determined by the work function difference between the gate material and channel material. Measurements we are undertaking will help determine which metal and dielectric are used in future generations of very highly integrated circuits.

Enhancement of Airside Heat Transfer in Air-Cooled Condensers for Binary Cycle Geothermal Power Production. *CHRISTOPHER HANNEMANN (University of California–Berkeley, Berkeley, CA 94720) CHUCK KUTSCHER (National Renewable Energy Laboratory, Golden, CO 89401).* Binary cycle geothermal power production requires a majority of the thermal energy in the working fluid to be rejected after exiting the turbine. Because abundant sources of cool water are not available near many of these geothermal wells, air-cooled condensers must be used instead of the preferred water-cooled systems. The capital cost for these condenser arrays, as well as the parasitic power consumed to run the required fans, contributes significantly to the total cost of geothermal power. To improve the airside heat transfer in these condensers, enhanced fins are being tested at the National Renewable Energy Laboratory; slit and bent annular fins are examined in the present study. Transient testing is performed on small tube sections to determine performance improvements based on heat transfer coefficients and pressure drops as well as to select an optimum bending angle. Using the results from the transient tests, a steady-state test using a 17 tube, single pass cross flow heat exchanger is performed. The slit fins are tested unbent and bent at 12° in two different configurations, using water as the working fluid and testing each sample at four different air flow rates. The "staggered" arrangement is shown to perform the best, and the 12° bent fins are shown to outperform the unbent fins by 3–5% heat transfer per unit hydraulic power. Both the unbent and bent fins underperform model predictions, possibly due to corrosion within the tubes. Further work will focus on retesting the bent slit fins with the corrosion removed as well as examining the effects of twisting the slit fins.

Enhancing the Target Chamber for the Second Phase of the Neutralized Drift Compression Experiment. *GUILLERMO GARCIA (University of Southern California, Los Angeles, CA 90089) MATTHAEUS LEITNER (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* The objective of a controlled fusion power plant for worldwide energy production has driven the Neutralized Drift Compression Experiment (NDCX) to investigate characteristics of ion-beam manipulation. This report focuses on enhancing the diagnostic target chamber for the second phase of the NDCX project. A target capsule, loading dock, robotic arm and target housing were developed to prepare the diagnostic target chamber for integrated compression and focusing experiments with energy transfer of 1 eV on target with a 500 MW, 1 ns ion beam. Each component was developed to incorporate the design constraints established by the diagnostic target chamber. A LabVIEW program was created to monitor and control movement of the robotic arm. The diagnostic target chamber was assembled and calibration of the robotic arm showed that the system had successful interaction between the LabVIEW program and the newly developed components.

Error Reduction in Polarization Measurement. *DONALD JONES (Acadia University, Wolfville, NS B4P 2R6) ROBERT MICHAELS (Thomas Jefferson National Accelerator Facility, Newport News, VA 23606).* One of the greatest barriers to definitive conclusions in any scientific experiment is the accumulation of errors. Due to the precision required in parity-violation experiments, an effort has been made in Hall A at Jefferson Lab (JLab) to reduce the cumulative error by targeting specific sources. A particular focus has been placed on reduction of error in beam polarization measurements. Compton polarimetry is utilized at JLab because of its unique advantage of allowing polarization to be determined while an experiment is running, without interrupting the beam. Electrical signals produced by scattered photons and electrons are used to determine beam polarization. The helicity of the beam is reversed every 33 milliseconds (ms) and the asymmetry that arises from pulse measurements during consecutive 33 ms intervals, is used to calculate beam polarization. While this asymmetry has been created in the past by counting photons, electrons or electron-photon coincidences, this method gives rise to many systematic errors. New methods are being sought to more accurately calculate polarization. The focus of this research has been to determine whether signal integration can be used to effectively reduce the error to under the 1% level within a feasible time frame. Extensive tests have been done to determine the reliability of signal integration across the full 33ms gate, in order to determine if the background noise is too great to make this technique useful. Because of difficulties encountered, and the lack of beam operation during the time this research was done, a pulse generator was used to simulate the electrical pulses that arise from electron scattering in the Compton polarimeter. The data from the pulse-generated asymmetry indicates that polarization can be accurately determined within three hours of beam operation. Because experiments can last for days, this is a reasonable length of time. To ensure the reliability of this technique, the results were then verified using Monte Carlo simulations. The results of this research show that this method of beam polarization measurement has great promise of being able to reduce the measurement error from the present 3%, to below 1%. This method has yet to be tested during beam operation, but its success would enhance future parity violation experiments.

Evaluation of a 4.5 kW Air-Cooled Lithium Bromide/Water Solar Powered (Hot Water-Fired) Absorption Unit. *DAVID GOODNACK (Pennsylvania State University, University Park, PA 16802) ABDOLREZA ZALTASH (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* During the summer months, air-conditioning (cooling) is the single largest use of electricity in both residential and commercial buildings with the major impact on peak electric demand. Improved air-conditioning technology has by far the greatest potential impact on the electric industry compared to any other technology that uses electricity. Thermally activated absorption air-conditioning (absorption chillers) can provide overall peak load reduction and electric grid relief for summer peak demand. This innovative absorption technology is based on integrated rotating heat exchangers to enhance heat and mass transfer resulting in a potential reduction of size, cost, and weight of the "next generation" absorption units. Rotartica Absorption Chiller (RAC) is a 4.5 kW air-cooled lithium bromide (LiBr)/water unit powered by hot water generated using the solar energy and/or waste heat. Typically LiBr/water absorption chillers are water-cooled units which use a cooling tower to reject heat. Cooling towers require a large amount of space, increase start-up and maintenance costs. However, RAC is an air-cooled absorption chiller (no cooling tower). The purpose of this evaluation is to verify RAC performance by comparing the Coefficient of Performance (COP or ratio of cooling capacity to energy input) and the cooling capacity results with those of the manufacturer. The performance of the RAC was tested at Oak Ridge National Laboratory (ORNL) in a controlled environment at various hot and chilled water flow rates, air handler flow rates, and ambient temperatures. Temperature probes, mass flow meters, rotational speed measuring device, pressure transducers, and a web camera mounted inside the unit were used to monitor the RAC via a web control-based data acquisition system using Automated Logic Controller (ALC). Results showed a COP of approximately 0.58 at 35°C design condition for ambient temperature with 40°C cooling water temperature and approximately 3.7 kW capacity. This is in close agreement with the manufacturer data of 0.60 for COP and 3.9 kW capacity. This study resulted in a complete performance map of RAC which will be used to evaluate the potential benefits of rotating heat exchangers in making the "next-generation" absorption chillers more compact and cost effective without any significant degradation in the performance. In addition, the feasibility of using rotating heat exchangers in other applications will be evaluated.

Evaluation of Long-Term Brake Performance Using Performance-Based Brake Testers (PBBT). *JESSICA JOSEPH (Southern University A&M of Baton Rouge, Baton Rouge, LA 70816) GARY J. CAPPS (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* Performance-Based Brake Testers (PBBTs) are devices that can evaluate the current braking capabilities of a vehicle through the measurement of brake forces developed as a vehicle engages in a braking event while on a PBBT. They are widely used for brake inspection in Europe and Australia and are beginning to emerge as both an enforcement tool and diagnostic aid for private sector maintenance and repair shops. Because of the significant benefits of utilizing PBBT technologies (time/labor savings, error reduction, objective measures, consistency, enhanced fleet safety), Federal Motor Carrier Safety Administration (FMCSA) has an interest in assessing a vehicle's long-term brake performance using PBBT technology over time in a real-world testing environment. This will be done in conjunction with volunteer fleets (including a motor-coach), over a sufficiently long period of time, to measure (for each vehicle in the test fleet) the brake force for the overall vehicle, and for each individual wheel-end. Such an effort would provide experiential data, and would quantitatively assess benefits from long-term brake performance data. A market search was done to find manufactures or sole distributors of PBBT devices that offer artificial axle loading (AAL) capability and research was done to understand the theory of operation of the PBBT. The different types of PBBT (roller, in-ground, portable) were evaluated to decide which PBBT with AAL would be best for research based on meeting FMCSA's Functional Specifications. An evaluation was completed for three possible vendors to determine which vendor would provide the best PBBT for research applications and a training module for use by the Tennessee Department of Safety Personnel. The vendor's PBBT must be certified and meet the FMCSA criteria in order to be a candidate to provide a PBBT. A survey and location matrix was done to compare and decide which one of three possible locations would accommodate the needs for the State of Tennessee and Oak Ridge National Lab.

Evaluation of Various New Anode and Cathode Materials for High Power Li-Ion Battery Applications. *STEPHANIE TRAN (Michigan State University, East Lansing, MI 48823) JUN LIU (Argonne National Laboratory, Argonne, IL 60439).* Since the establishment of the Partnership for a New Generation of Vehicles Program (PNGV) between the U.S. government and the U.S. Council for Automotive Research in 1993, much research has been invested into developing more efficient high power and high energy density hybrid electric vehicles (HEV). The power and performance properties of a Li-ion battery system make it an efficient source of energy for the automobile. However, high production costs of the Li-ion battery make them difficult to be accepted by automobile manufacturers. $LiMn_2O_4$ Spinel and $LiFePO_4$ Olivine active cathode materials are cheaper to produce and may still maintain the performance characteristics of the Li-ion system. Cycling performance tests for these materials have shown a stable battery capacity over many charge-discharge cycles in room temperature and high temperature conditions. Potential hard carbon anode materials also display the prevention of capacity loss at elevated temperatures and long term battery usage. Cost efficient battery components that can still uphold the high power and high energy qualities of a lithium-ion battery system are promising to the new generation of hybrid vehicles.

Examining the River Water and Groundwater Interface in a Hyporheic Zone Mesocosm. *CAROLINE NEWCOMBE (Arizona State University, Tempe, AZ 85287) DR. AMORET BUNN (Pacific Northwest National Laboratory, Richland, WA 99352).* The hyporheic zone of a river or stream is the area of the streambed where groundwater and surface water mix. It is an important area of study because it is an integral part of the river ecosystem with unique physical, chemical, and biological characteristics. This paper will discuss the initial steps in the design and construction of a hyporheic zone mesocosm under development at Pacific Northwest National Laboratory (PNNL). An enclosed experimental ecosystem, called a mesocosm, is well-suited for investigation of the hyporheic zone because it provides control and repeatability in the experiment. A unique feature of the hyporheic zone mesocosm under development at PNNL is that it incorporates both river water and groundwater flows into the sediment profile, whereas previous studies have only examined the effects of influent river water or influent groundwater. Since this mesocosm is using a novel approach in incorporating two types of water, it was necessary to investigate practical designs for sampling ports in the system, as well as to identify appropriate parameters for determining the distribution of groundwater and river water in the system. The hyporheic zone mesocosm consists of a sediment profile contained in a larger, insulated tank. Different configurations of sampling ports were tested by making rectangular or circular cuts in rigid high-density polyethylene tubing. Several water quality parameters of river water and groundwater were also tested in order to determine the best method to characterize the mixing of river water and groundwater within the completed mesocosm. The type of sampling port selected was a series of three 2 mm x 2 mm square cuts spread across a 5 cm length in the center of the tube. Testing several different water quality parameters showed that conductivity is the most reliable way to measure the extent of the river water and groundwater mixing in the hyporheic zone mesocosm, and further testing ensured that conductivity would not increase as a result of salts leaching from the sediment into the water. However, conductivity does not directly relate to uranium speciation or water quality for biological growth, so water quality parameters such as alkalinity, dissolved oxygen, hardness, pH, and ORP will have to be monitored as well.

Exhaust Gas Recirculation Effects on Diesel Engine Soot Formation, Destruction, and Emissions. *EDWIN HUESTIS (University of California–Davis, Davis, CA 95616) MARK P. B. MUSCULUS (Sandia National Laboratory (California), Albuquerque, NM 87185).* Diesel engine manufacturers desire insight into the internal processes that affect emissions in order to design new engines that meet upcoming U.S. pollutant emissions regulations for particulate matter (soot) and nitrogen oxides (NO_x). Exhaust gas recirculation (EGR) is one available tool to reduce pollutant emissions of NO_x, and EGR has also been shown to reduce the formation of soot in fundamental combustion studies. In real engines, however, EGR can increase soot in the engine exhaust by affecting soot destruction processes after combustion. In this study, both exhaust-gas soot emissions and fundamental soot formation/destruction processes inside a diesel engine are measured to understand how these processes affect the ultimate soot emissions. The time-evolution of soot formation and destruction inside an optically accessible diesel engine is measured by analyzing the radiative emission spectrum of the combustion-heated soot. The soot radiative emission intensity is measured within two separate spectral bands, and along with high-speed luminosity movies, the soot temperature and concentration inside the engine are determined using the two-color soot thermometry technique. Gases are also sampled from the exhaust stream and drawn through a filter to collect the soot particles for exhaust-gas measurements. The measurements show that soot formation inside the engine decreased as EGR was added, but soot destruction processes decreased more rapidly, so that exhaust soot emissions increased as EGR was added. Only at very high EGR levels did the exhaust soot emissions decrease, as the soot formation processes became very slow. Finally, soot temperature measurements show that the reaction rates for soot formation and destruction depend on EGR, affecting the soot formation/destruction balance. By combining measurements inside the engine with exhaust-gas measurements, the effects of EGR on the soot formation/destruction balance were quantified in a single experimental facility. The data from this study shows that EGR decreases soot destruction processes more than soot formation processes, so that the balance is tipped toward higher exhaust soot. At very high EGR, however, soot formation processes are so slow that exhaust soot decreases, even with reduced rates of soot production. This study also identifies the tipping points where this balance shifts from increasing exhaust soot to decreasing exhaust soot.

Experimental Test of Relaxational Attenuation for Carbon Dioxide. *ANGEL SANTIAGO (University of Massachusetts–Amherst, Amherst, MA 01003) MORRIS GOOD (Pacific Northwest National Laboratory, Richland, WA 99352).* Attenuation is the reduction of intensity of an ultrasonic wave. Relaxational attenuation occurs when excited molecules do not exchange vibrational or rotational energy infinitely fast with translational waves. The purpose of this research is to determine relaxational attenuation can be shown experimentally. Attenuation is frequency dependent. The study of ultrasonic propagation in CO_2 was studied at 3 atmospheres in varying frequencies. The experiment was carried out using a modified pressure chamber made from a commercial paint can. Data was collected through an oscilloscope for various transducer spacing at increments of a tenth of an inch, in order to facilitate attaining the attenuation of varies frequencies. All data was analyzed using Microsoft Excel and Mat lab software. Plotting the data for attenuation due to frequency I was able to match the CO_2 experimental graph and the theoretical graph. The experiment has shown the ability to obtain the relaxation attenuation of a gas. More experiments are needed with other gases to show working with the relaxation attenuation of a gas would be of practical use as an identifier of specific gases.

Heavy Truck Duty Cycle Study. *MARY LASCURAIN (Pensacola Christian College, Pensacola, FL 32503) GARY CAPPS (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* To date, little real-world scientific data regarding long-haul, Class-8 tractors and their engine and drive train components has been collected for analysis. Of great importance to the study of this class of commercial vehicle is the understanding of how factors such as tire type and vehicle loading influence fuel efficiency. Because many variables cannot be controlled in real-world data collection, simultaneous monitoring of these variables such as weather conditions and road topography can aid in the production of useful data that can be analyzed to isolate controllable variables which influence vehicle efficiency (i.e., tire rolling resistance). Building on efficiency-related data available directly from the truck's J1939 controller area network (CAN), an eDAQ Lite data acquisition system (DAS) was assembled to integrate several external sensors. Data from these sensors augment the duty cycle data by providing not only GPS-based information such as speed and acceleration, but also weather conditions, road topography, and weight information to increase understanding of long-haul operations. In the absence of a Class-8 truck for the earliest stages of testing, several DAS units were placed on passenger cars to collect data in normal operation for up to a week at a time. These tests, which reflected extended periods of real-world driving conditions, more closely simulated the ultimate (long-haul) application of the systems than previous bench-top testing. The results from these tests showed a discrepancy between the tilt sensor data and actual road grade. Preliminary testing also provided readings for speed and wind, which were found to differ significantly from one another. Analysis of the test data revealed that the tilt sensor readings not only were influenced by the natural vibrations of the vehicle, but also responded dramatically to vehicle tilt caused by acceleration and deceleration. Further testing will be conducted to verify that sufficient GPS altitude data can be collected to make the inclusion of a tilt sensor unnecessary. A comparison between wind and speed readings indicated that the weather station provides a sufficient indication of headwind. When a class-8 truck becomes available for instrumentation, the truck database will be integrated into the existing DAS for final testing of the system; these systems will then be installed in five to six trucks in a commercial fleet to gather data for a twelve-month study of heavy truck duty cycles.

Hydrolysis Reaction of the Copper-Chloride Thermochemical Cycle in a Vertical Reactor. *DAVID TAGLER (University of Notre Dame, Notre Dame, IN 46556) MICHELE A. LEWIS (Argonne National Laboratory, Argonne, IL 60439).* Thermochemical cycles have been developed to produce hydrogen at competitive energy efficiency levels while generating low greenhouse gas emissions. The copper-chlorine (Cu-Cl) thermochemical cycle is designed to split water and produce hydrogen at the relatively low peak temperature of 550°C. This cycle consists of three thermal reactions and one electrochemical reaction. This project is concerned with one of the thermal reactions, the thermal hydrolysis reaction of cupric chloride, $CuCl_2$, from 350°C to 400°C at atmospheric pressure. The reaction is $2CuCl_2$ (s) + H_2O (g) → Cu_2OCl_2 (s) + 2HCl (g). The goal of this experiment is to determine the optimum operating conditions (temperature, flowrate, steam ratio, and reaction time) to maximize the desired products, Cu_2OCl_2 and HCl, while minimizing the products of any competing reactions. Argon gas at 100-200 ccm is used to transport steam through a 15 inch vertical reactor containing 150-500 mg of solid $CuCl_2$ in a crucible with a 13 mm ID (inside-diameter) crucible for 15-60 minutes. HCl is collected in a condenser container and water trap. X-ray diffraction (XRD) is used to analyze the solid products of the reaction and determine purity. XRD analysis shows that a competing decomposition reaction of $CuCl_2$ to CuCl increases at temperatures greater than 350°C. The optimum temperature was found to be between 350°C and 375°C for 500 mg, and the optimum reaction time was found to be between 30 and 60 minutes. Greater sample surface area also proved to decrease the amount of CuCl produced. Thus, this experiment was successful in optimizing this reaction. Future studies need to look deeper into the effect of surface area, flowrate, temperature, and reaction time in order to further optimize this reaction.

***Increasing the Durability and Reliability of Radiation Detectors used in Radiopharmaceutical Chemistry.** *SIMARJIT KAUR (Contra Costa College, San Pablo, CA 94806) JAMES P O'NEIL (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* Radiation Detectors are a necessary part of radiopharmaceutical synthesis in order to determine the quantity of radioactivity throughout the synthesis, not only to determine the progress of the chemical reactions and the yield at each step but also to ensure the safety of the personnel involved in this process. Radiation detectors are usually installed in places where the potential of chemical exposure and general physical abuse is quite high. To make the radiation detectors more robust and reliable, a very easy and cost-effective method of "epoxy potting" was devised. The radiation detector is placed in a mold of appropriate dimensions and filled with epoxy (3M Scotch-Weld DP270, black). After the epoxy cures, the radiation detector is protected within a solid light resistant block. This particular epoxy was chosen for this task because it is chemically inert and provides both electrical and mechanical insulation of the detector components from the harsh surroundings of the hot cell.

***Increasing X-Ray Brightness From 3rd Generation Light Sources: Design Study of an Advanced In-Vacuum Magnet Gap Separation Mechanism for Cryogenic Permanent Magnet Undulators and Superconducting Undulators.** *KOBBINA AWUAH (State University of New York at Binghamton, Binghamton, NY 13902) JOHN SKARITKA*

(Brookhaven National Laboratory, Upton, NY 11973). In recent years, superconducting undulators (SCU) and cryogenic permanent magnet undulators (CPMU) have been implemented in synchrotron radiation facilities in order to obtain brighter beams. Due to increasing project costs, there have been recent attempts to improve upon the versatility of the undulator design. Consequently, a chamber that can house either a CPMU or an SCU was designed to help reduce project costs encountered when shifting from a CPMU to an SCU and vice-versa. All models for the project were created using INVENTOR software. Three meter segments of each kind of magnet: superconducting magnet (SCM) and cryogenic permanent magnet (CPM) were created. Since the SCM cannot operate under ultra-high vacuum (UHV) conditions, it was placed in a vacuum-proof box before inserted into the UHV chamber. In order to generate the required magnetic field in an undulator, two magnets of the same kind are aligned to have their poles facing each other and the field is usually controlled by adjusting the gap between the two magnets. Two different gap separation mechanisms (GSM) were studied: one incorporated the use of wedges and rail bearings and the other flexure bearings. The goal was to have a mechanism that could adjust the gap between a 5-50mm range. During the studies, it was found that flexure bearings have no backlash and no friction during operation as compared to wedges and rail bearings. The latter attribute of flexure bearings makes it ideal for use in UHV environments since no oiling is required for the bearings and this reduces outgassing in the UHV chamber. Also, flexure bearings are relatively cheap and readily made. However, flexure bearings tend to be inaccurate at larger gaps mainly because the geometric center of the bearings tend to shift significantly (up to 0.5mm) during large-angle operations. Since the design could only accommodate a misalignment of the magnets in the order of microns, the flexure bearing GSM was not implemented in the final design. Instead, custom ceramic wedges and rail bearing were used in the GSM to reduce friction and springs were used to reduce backlash. Previous GSM models were usually placed on the outside of the vacuum chamber resulting in complexity and increase in project costs. The final design was able to achieve an in-vacuum GSM using less complex components: wedges and rail bearings driven by linear motors. This greatly reduced the overall size of the undulator and also the cost involved.

Indium Zinc Oxide Active Channel Layer in Transparent Thin Film Transistors. *ANDREW CAVENDOR (Colorado School of Mines, Golden, CO 80401) DAVID GINLEY (National Renewable Energy Laboratory, Golden, CO 89401).* Amorphous indium zinc oxide (IZO) shows promise for being the active channel layer in a transparent thin film transistor (TTFT). In the last 2 years, oxide based transistors have begun to be investigated showing the promise to replace amorphous silicon (α-Si) and microcrystalline silicon TFTs to lead to transparent electronics. IZO is a lead candidate because it can be deposited at room temperature and is amorphous, making it suitable for flexible substrates. Also, IZO has higher Hall mobility (μ_h) > 30 $cm^2V^{-1}s^{-1}$ than conventional materials (< 1 $cm^2V^{-1}s^{-1}$), which makes faster TFT switching times possible. We used DC magnetron sputtering with O_2/Ar gas from 0–10% to optimize the active channel layer, for transistors. Addition of O_2 to the sputter gas reduces the carrier concentration (η) while preserving high mobility μ_h. Amorphous IZO films were produced at 70/30 atomic percent In/Zn with μ_h as high as ~55 $cm^2V^{-1}s^{-1}$ and η as low as ~10^{16} cm^{-3}. TFT devices were made in the gate down method through photolithography. The source and drain were produced at 84/16 atomic percent In/Zn, to achieve good conductivity ~2000 S cm^{-1}. Films were incorporated into functional transistors which showed on-to-off current ratios ~10^6.

Inner Reflector Plug Pipe Cutter for the Spallation Neutron Source. *DAVID MACNAIR (Georgia Tech University, Atlanta, GA 30332) CRAIG BRADLEY (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* The Spallation Neutron Source (SNS) drives high velocity protons into liquid mercury which will create the most powerful neutron scattering source in the world. When the protons hit, the neutrons are ejected and the mercury becomes radioactively activated which together with the neutrons irradiate nearby equipment. The Inner Reflector Plug (IRP) serves as a moderator and a heat sink for the mercury target and nearby components. Water fed through pipes running through the IRP absorbs the heat and transfers it to cooling equipment. After about 2 to 5 years, the components of the IRP become damaged due to intense gamma and neutron radiation. Removal must be accomplished by disassembling each layer of shielding, cutting the pipes that ran through that layer, and then repeating for the next and subsequent layers. Methods for removing the shield blocks have already been developed but the SNS needs a pipe cutter. The cutting device must withstand the high radiation environment, cut the pipes inside the IRP without leaving a mess or deforming the pipes so as to make removal of subsequent layers difficult, transport the pipes to a shielded cask, and be used remotely. To reduce costs, not all components of the pipe cutter were designed from scratch. The inner cutter housings, for example, came from commercial tools and had to be analyzed and tested to find the amount of torque required to cut through the IRP pipes. All components were designed or modeled using the solid modeler Pro/Engineer and then analyzed using hand calculations and finite element analysis with Pro/Engineer Mechanica. Results of the calculations were verified by the Remote Systems Group of the Nuclear Science and Technology Division and the SNS Division, and finally the design drawings were completed. Due to the inaccessibility of the irradiated areas by humans during SNS operation, each component inside these environments must be carefully designed, analyzed, and tested before being put into use. Additionally, components must be easily accessible, maintainable, and maneuverable by remote handling equipment so that the SNS can continue its mission of scientific discovery even beyond the length of its original design.

Innovative Analysis and Decision Tools. *MATTHEW SIMON (University of Washington, Seattle, WA 98195) HEATHER DILLON (Pacific Northwest National Laboratory, Richland, WA 99352).* Decision makers in the energy sector rely heavily on modeling and scenario planning when making important decisions. These decisions could be related to initial power plant designs, policies regarding global warming, or new building code regulations, among others. Unfortunately, the future is unpredictable. Uncertainties within the models will undoubtedly cause failures in some real-world applications. Despite the problems associated with these methods, these techniques are heavily relied on to make important decisions in both design and policy. Without the techniques of modeling and scenario planning, making decisions would be extremely difficult, because there would be no efficient way to analyze the different outcomes from making one decision over another. Through several literature reviews, many current modeling software tools and techniques were examined. Each piece of software has its own strengths and weaknesses when looking at robustness. Depending on the application, some software tools are more appropriate than others. Of particular interest was a set of new software tools designed for robust analysis. These tools, developed by Evolving Logic, are the Computer-Assisted Reasoning system (CARs) and the Robust Adaptive Planning (RAP) software. Although they had not been extensively applied to many energy related applications, they are a promising set of software tools allowing for the analysis of problems dealing with deep uncertainty, allowing analysts to make more robust decisions. This paper looks at past and possible future applications of these software tools and how they can improve the decision making process.

Integrating Radiation and Radiofrequency Identification Portal to Monitor the Movement of Radioactive Materials. *NATHAN ROWE (University of Tennessee, Knoxville, TN 37996) CHRIS PICKETT (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* Radio Frequency Identification (RFID) is a fairly new technology that allows for barcode type identification remotely over short distances. There is an interest in using this technology for tracking nuclear materials. One way of doing this is to use RFID portals at access points between materials balance areas. The inclusion of a radiation monitor to this portal would allow for a second level of confirmation of the item being moved. Radiation Portal Monitors are already in use to detect unauthorized movement of nuclear material. In order to demonstrate the integration of an RFID portal with a radiation portal, an RFID portal system was interfaced with an existing radiation portal monitor. The radiation portal monitor was connected to a local PC using a serial interface. Windows services and web services were used to log the data from the radiation portal into a remote database. The RFID web interface is then able to use the database to compare the declared radiation status of the item with its measured radiation level, and alarm if they don't match. The system shows the potential for integrating other security systems with RFID, and shows promise for using RFID for improved nuclear inventory management. Web services make a good communications system to integrate security systems of this type, because of its expandability and modularization. A similar method could be used for combining other types of systems with the RFID software as well.

Investigation of a Rhodium Catalyst in the Reduction of Carbon Dioxide and Pyruvate for Future Use in a Direct Electrochemical Methanol Production Cell. *LINDSAY DIERCKS (University of Iowa, Iowa City, IA 52242) JOHN KERR (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* In a world with dwindling oil reserves and increasing energy demands, reduction of carbon dioxide to methanol using solar generated electricity is a probable and environmentally conscious solution. The part of the carbon dioxide to methanol process that this research is specifically involved in is the reduction of carbon dioxide to formate. The stereo-selectivity of Lactic Dehydrogenase (LDH) was investigated in the reduction of pyruvate to lactic acid as was the reduction of carbon dioxide to formate with only a Rhodium catalyst. Reactions were run in a glass electrochemical cell, and products of the reactions were analyzed on a Capillary Electrophoresis (CE). The pyruvate reaction showed the presence of lactic acid, however it was not certain if pyruvate was also present. The absence of pyruvate on the CE analysis of the pyruvate reaction could mean that there was a one hundred percent conversion of pyruvate to lactic acid, but that result has yet to be reproduced. The carbon dioxide reaction shows the presence of formate, but not oxalate—also a product of carbon dioxide reduction. It has yet to be determined if formate is the sole product of the reduction of carbon dioxide with a Rhodium catalyst.

Measurement of Fair Weather Air Conductivity. *MONROE DALLAS, JR., NATISSA MCCLESTER, (Florence-Darlington Technical College, Florence, SC 29501) JEFFREY GRIFFIN (Pacific Northwest National Laboratory, Richland, WA 99352).* For the past 4 years, staff at the U.S. Department of Energy's Pacific Northwest National Laboratory have been investigating the generation, and transport of radiation-induced ions near the ground. Baseline measurements of fair weather atmospheric conductivity are required in order to estimate ions lifetimes and predict ions detectability downwind of a radioactive source. Using a Gerdien condenser, atmospheric conductivity measurements were made over a two week period, July 10-21, 2006 in the 300 Area of the Hanford Site. Experimental data, during that time period, show some uniformity, with atmospheric conductivity values ranging from 1.4 to1.8 x 10^ -14 S/m. These results are consistent with published values for arid rural desert regions throughout the world. Weather conditions were similar over the two weeks that the experiments were performed. Therefore; to obtain more valid background atmospheric conductivities, future experiments should look into variable weather conditions and evaluate their effects on atmospheric conductivities at the site.

Mechanizing Photoelectron Spectrometer at HERS. *XIORANNY LINARES (University of California–Berkeley, Berkeley, CA 94720) ZAHID HUSSAIN (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* Superconductors have been a main topic of scientific research since their discovery in the 1950s. In the attempt to understand superconductors, researchers later discovered cuprates. The discovery of these "high-Tc" superconductors increased scientists' possibilities of developing room-temperature superconductors. This development would increase the efficiency of electric generation, transmission, distribution, and utilization. This would result in a reduction of generated power requirement, and thus, a decrease in greenhouse emissions to the atmosphere. However, the complexity of high-tc superconductors and their inability to follow the theories of conventional superconductors has thus far prevented the creation of room-temperature superconductors. At the Lawrence Berkeley National Laboratory, the research group under the leadership of Zahid Hussain tests high-Tc superconductors to describe their properties and how they work. They study electron systems using a state-of-the-art High-Energy-Resolution-Spectrometer (HERS) for angle-resolved photoemission experiments. In these tests, x-rays are flashed on a sample, and electrons are then emitted via the photoelectric effect. The emitted electrons are analyzed by a state-of-the-art angle-resolved electron-energy analyzer (Scienta SES-200) that rotates about the sample. The electron analyzer measures the angle and kinetic energy of the electrons, which, through the conservation of energy and momentum, determines their velocity, scattering rates, and energy. The information found is used to create a graph portraying the electron's momentum vs. its kinetic energy. This graph shows the Fermi surface of the material. The Fermi surface is the surface of constant energy in a space that at absolute zero separates the unfilled orbitals from the filled orbitals. Its shape determines the electrical properties of the metal since the current is due to changes in the occupancy of states near Fermi surface. In this way scientists can determine the properties and composition of the material. The research group's testing process is long and time consuming since they have to rotate the analyzer manually to obtain their results. To improve their process, I will make a system that rotates the analyzer automatically and collects data without the need of constant supervision. I will research the most efficient way to rotate the analyzer, make accurate drawings of the system, make the parts needed for the system, assemble it, test it, and integrate it for future use.

MEMS Optical Force Probe. *KEVIN LIN (University of California–Berkeley, Berkeley, CA 94720) JACK KOTOVSKY (Lawrence Livermore National Laboratory, Livermore, CA 94550).* This work seeks to design small and tunable optical force probes to measure compressive loads. As the sensor will be placed between two surfaces, a major goal is to minimize the thickness of the sensor. Optical sensors based on fiber optic and Micro-electro-mechanical systems (MEMS) technology allow for small, versatile, and accurate sensors. These sensors do not use electricity, and offer numerous advantages over traditional sensors. Fiber Bragg Gratings (FBGs) are treated fibers that have a periodically varying index of refraction to give a distinct reflection and transmission spectrum. This spectrum is dependent on strain, caused either by a transducer attached to the fiber or thermal expansion. A challenge of this work is to create a MEMS structure that transduces transverse loads to fiber strain while compensating for thermal expansion. The limitations of silicon and the size of the device introduce many challenges. Finite Element Analysis (FEA) simulates the mechanical and thermal behavior of the MEMS transducer and its micro-beams to determine a suitable geometry (i.e., angle, length, and height). Various metal coatings, solders, and soldering techniques are examined to determine a repeatable and reliable method for sensor assembly. Groove cross-sections are optimized for superior fiber to silicon bonding. Novel schemes assist in the alignment and assembly of the sensor. An optical force sensor using FBGs has been designed with a total thickness of 140um (similar in thickness to a fiber optic cable), insignificant thermal sensitivity, tuneability to different applied pressures, and mass manufacturability. Its fabrication is currently underway.

Minimizing Thermal Fluctuations and Vibration Effects on a High Resolution Beamline. *ALFREDO TUESTA (University of Notre Dame, Notre Dame, IN 46556) NICHOLAS KELEZ (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* Thermal fluctuations from the environment and vibrational impacts from surrounding equipment pose a threat to the performance of high resolution beamlines. An optimal solution is unknown because methods for addressing these issues have never been empirically tested. This research focuses on the support structures, or stands, of MERLIN (meV resolution beamline) but the results can be applied to any beamline. The team measured the ground vibrations at several locations of the Advance Light Source (ALS) where MERLIN will be installed. Two stands, one empty and one filled with Zanite® Polymer Composite (Zanite), were also tested to determine the amplification of vibrations from the ground to the top. The change in the temperature of the top and middle of the empty stand was also recorded along with the change in ambient and floor temperatures for two and a half days. The ground measurements show little change when nearby equipment is turned off. Additionally, the RMS displacement is lower than the team's goal of 0.5-1 micron. The empty stand shows voltage peaks at 40, 60, and 120 Hz, the later two which are damped in the stand filled with Zanite. The air temperature at the ALS changed 1.2 C making the stand temperature fluctuate approximately 0.8 C yielding a 9.8 microns axial deflection. This suggests that the stand must be insulated or filled with a material that will increase its thermal mass in order to decrease its deformation. Zanite should provide this thermal mass, however, more time was necessary to confirm this. Due to experimental error and equipment failure, the results for the ground vibration measurements are sometimes unclear or erroneous. More time was required to rectify these issues and to continue measurements of other methods for solving the thermal fluctuation and vibration effects at the ALS.

National Synchrotron Light Source-II (NSLS-II) Initial Conceptual Design Report. *ERIC CHANG (Carnegie Mellon University, Pittsburgh, PA 15213) ALAN RAPHAEL (Brookhaven National Laboratory, Upton, NY 11973).* The National Synchrotron Light Source II (NSLS-II) is an anticipated $700 million medium energy storage ring designed to deliver constant brightness and flux for hundreds of scientific experiments each year at the Brookhaven National Laboratory (BNL) in Upton, NY. Once operational, NSLS-II will have a diameter of 794 feet and be able to deliver x-rays 10,000 times brighter than the existing National Synchrotron Light Source (NSLS-I) facility. The Department of Energy granted the NSLS-II building proposal "Critical Decision Zero" (CD-0) approving of the facility, allowing site planning to begin (CD-1). The primary project objective was to draft an initial plan for utility placement and an underground emergency tunnel servicing the NSLS-II facility using AutoDesk Architectural Desktop AutoCAD software and a collection of site maps of the entire facility as drafting tools. Among the utilities that were to be supplied are electrical, communication, storm water, fire protection, sanitary, and steam. By analyzing the topography of the site as well as the underground placement of currently operational utilities, the exact depth locations and routing of the various utilities could be completed. Once all the utilities were stemmed from existing lines and drawn on the utility site maps of the facility, an updated map of the facility and in depth depiction of each line was produced. In addition to utilities, an underground tunnel was conceptualized for the use by emergency vehicles. Using the sitemaps, utility investigations, and geotechnical reviews of groundwater history, distance calculations indicated the prime location for the tunnel and later modeled on the computer. The project is a small portion of the much larger planning stages involved for the NSLS-II construction as summarized in a Conceptual Design Report (CDR), which also outlines a budget, scheduling, and environmental/health concerns. With the updated utility maps and models produced, the CDR will be able to better plan the NSLS-II facility accounting for the utilities research and tunnel conceptualization performed. As plans for NSLS-II are finalized and sent for approval, it is expected construction will begin in 2008 and operational in 2012.

Opportunities for Direct Current Power Distribution in Commercial Buildings. *PEARL DONOHOO (Franklin W. Olin College of Engineering, Needham, MA 29492) MICHAEL DERU (National Renewable Energy Laboratory, Golden, CO 89401).* Direct current (DC) systems in commercial buildings have the potential for energy savings through increased motor efficiency, elimination of rectifiers, and use of distributed generation of renewable energy. These potential savings are documented through past studies on power supply efficiency, motor efficiency, and new concepts in DC distribution. Despite alternating current (AC) distribution, components of heating, ventilation, and air conditioning (HVAC) systems, fluorescent ballasts, and plug loads all use DC power. To quantify energy savings, a DC system model of the Pennsylvania Department of Environmental Protection Cambria Office building was completed. The three major building systems, HVAC, interior lighting, and plug-load were modeled, which covered 96% of building energy use. The buildings systems were modeled twice using data from a previous study of the building, first assuming one large rectifier and secondly assuming supplied DC power. The model predicted an annual average savings of $2,700 with a rectifier and $3,200 without.

Performance Comparison between Graphite and Metallic Bipolar Plates in Direct Methanol Fuel Cell (DMFC). *RAJA CROWLEY (Farmingdale State University, Farmingdale, NY 11735) DR. DEVINDER MAHAJAN (Brookhaven National Laboratory, Upton, NY 11973).* The use of Direct Methanol Fuel Cell (DMFC) is an electrochemical process without combustion as an alternative source of energy. A DMFC can produce energy constantly, unlike a Lithium battery which stores energy and after all energy is used up, a battery must be recharged for a long period of time. Since methanol is available in a liquid form, it requires minimum storage volume and is easy to transport. DMFCs have been used in different hand held applications such as cell phones and laptop computers. There are many parameters that have an effect on the performance of the DMFC such as the methanol concentrations, fluid and air flow rate, temperature, and the humidity level inside the air side of the cell. In this experiment a performance comparison between graphite and metal treated plates was studied with different methanol concentrations with and without humidification. Membrane Electrode Assembly (MEA) for DMFC with an active area of 2.54cm x 2.54cm, Pt/Ru catalyst in the anode side and Pt. catalyst in the cathode side, were used in two single fuel cells, one with graphite plates and the other with treated metal plates. The liquid methanol was fed to the cell at a rate of 6 ml/min. Methanol concentrations of 3%, 5%, 7%, and 10v% diluted in distilled water were used in both cells, under room temperature, 15psi air pressure, and an air flow rate of 1.0 SCFH. 3% and 5% methanol concentrations showed an optimum performance in graphite and metallic plates respectively. The 3% methanol concentration yielded 29% higher performance in the metallic bipolar plates and the 5% methanol showed 45% higher performance in the metallic plates relative to graphite. Graphite Plates with 3% and 5% methanol concentrations with 40% humidity at the air side resulted in 16% and 21% improvement in performance respectively. While metallic plates with 3% and 5% methanol concentrations, after similar humidification was applied, showed 2%, and 9% improvement in performance respectively. Accordingly, it was concluded that the metallic bipolar plates showed higher performance than the graphite plates, and controlled humidification in the vicinity of 30% to 50% has positive influence on the performance of the cell. Humidification had more effect on the graphite plates than the metallic plates and was attributed to the surface energy of both materials. Future work will focus on optimization of the performance of the single cell and to build a stack of DMFC to power a mobile phone.

Performance of Generation 3 High-power Lithium-ion Trial Cells. *AVERI ESCALONA (University of Illinois at Chicago, Chicago, IL 60606) IRA BLOOM (Argonne National Laboratory, Argonne, IL 60439).* Li-ion batteries have proven to be a successful energy source for many consumer electronic devices. Research is now being done to develop this technology for other applications, particularly as an energy source for hybrid electric vehicles. The Freedom Cooperative Automotive Research (FreedomCAR, formerly known as the Partnership for the Next Generation of Vehicles) has developed certain goals and standards for high-power, Li-ion battery cells for vehicular application. The U.S. Department of Energy's Advanced Technology Development Program addresses issues related to meeting these goals and standards. The program consists of a series of five projects, including the development of a baseline generation of cells (Generation 1) and an evaluation of it, followed by improved iterations (Generations 2 and 3) and finally low-cost packaging for the cells. The Electrochemical Analysis and Diagnostics Laboratory at Argonne National Laboratory evaluated and compared the performance of eight different trial Li-ion cell chemistries to the cell performance of a previous generation (Generation 2, or Gen2) of cells in order to determine an optimal cell composition for the next generation (Generation 3, or Gen3) of cells for a larger study. Good cell performance was evaluated in this particular study in terms of low capacity fade over time and low impedance rise over time. Characterization was done at the beginning of the study to establish a baseline for trial cell performance over time. Calendar-life aging was used as a method of cell degradation, with reference performance tests performed at four week intervals in order to gauge change in cell performance over time. Testing is still in progress, but initial results show that the capacity retention of one of the Gen3 trial chemistries, the 700-series, is better than that of Gen2, and two of the Gen3 trial chemistries, the 600- and 700-series, have a rate of impedance rise similar to that of Gen2. All Gen3 trial chemistries have both lower capacities and higher impedance than the Gen2 chemistry, but it is possible to attribute this to factors such as poor cell composition or physical damage. Based on this initial data, the 700-series cells should be considered for further study.

Performance Testing of Radio Frequency Identification Tags and Evaluation of Russian Radio Frequency-Based Tamper Indication Devices for Nuclear Safeguards. *BEN PETERS (Maryville College, Maryville, TN 37830) CHRIS A. PICKETT (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* Two promising technologies that are being evaluated to help in nuclear material control and accountability are Radio Frequency Identification (RFID) tags and active radiofrequency (RF)–based Tamper Indication Devices (TIDs). There are both active and passive RFID tag systems. Passive RFID systems utilize a reader that induces the passive tag to transmit an RF signal back to the reader in the form of a unique digital identification number. Active tags, on the other hand, are battery powered and continuously transmit an RF signal. Two kinds of active RF-based TIDs supplied by a Russian laboratory were also tested at ORNL. The two TIDs are RF tags that utilize fiber-optic technology to create a loop-type seal, along with bolt seals, which use either a piezoelectric generator or galvanic power cell to provide power to the seals. The active RF TID tags were installed on actual radiological storage containers and evaluated in operation over several weeks. Several RFID tags and readers were characterized to determine read ranges and the effects associated with orientation and placement of the tags on metal storage containers. Ten RFID tags of each type (active and passive) were used in order to determine read range variance. Multiple trials were conducted using tags positioned at four different angles in relationship to the antenna. After multiple trials, the results illustrated that there are both benefits and limitations to using both these technologies for safeguards-related applications. The performance of the passive RFID tag system was primarily affected by the antenna size, as well as with the tag size and type. If these factors are considered during system design, an effective RFID system can be developed to maximize the read range and, therefore, the number of reads. The problems seen with the Russian TIDs were mainly associated with the design of the tag or bolt themselves. More testing and possibly some design changes will be needed before any final recommendations can be made.

Polycrystalline Ceramic Scintillators. *ANDREA NORTH (University of Tennessee, Knoxville, TN 37934) DANNY POWELL (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* Scintillators are a vital component of radiation detection in numerous applications, including medical diagnostics and imaging, nuclear nonproliferation, and scientific research. Due to the demand for these detectors and the limitations of single-crystal scintillators, research of transparent polycrystalline ceramic scintillators has become increasingly attractive. This research has potential advantages for scintillation materials, such as the ease of fabrication and the ability for duplication. Recent studies of ZnO: Ga and Lu_2O_3: Eu have shown promise as potential transparent polycrystalline scintillators. However, additional studies are required to improve the transparency, size, and quality of the densified bodies.

After ensuring the purity of the materials, the powders are combined both manually and chemically to create a homogenous mixture. The powders are densified into a transparent ceramic through hot or cold pressing, vacuum sintering, and pulsed electric current sintering. The first method to be applied on these samples is hot press. The pellets are then tested for the important scintillation properties of decay time, light output, timing resolution, and energy resolution. Because this process is extensive and testing requires a significant amount of time, the project has not yet been completed. However, visual analysis of the ceramic after the hot pressing technique shows promise for these samples. The results from the ZnO: Ga and Lu_2O_3: Eu will enhance the knowledge of their capabilities and could also increase the abilities for radiation detection. Further work will involve different sintering techniques with these samples and also the testing of other samples. This is a very small portion of the research for improved scintillation materials that will mitigate the limitations of single-crystal scintillators.

Power Grid Dynamics: Enhancing Power System Operation through Prony Analysis. *CODY RAY (Oregon State University, Corvallis, OR 97331) ZHENYU HUANG (Pacific Northwest National Laboratory, Richland, WA 99352).* Prony Analysis promises to be an efficient way of recognizing sensitive lines during faults in power systems such as the U.S. Power grid. We use Positive Sequence Load Flow (PSLF) to simulate a simple two-area-four-generator system, and the dynamics the system experiences during a line fault. We then use the Dynamic System Identification (DSI) Toolbox to perform Prony analysis and use modal information to identify key transmission lines for power flow adjustment for improving system damping. We report on the success of the application of Prony analysis methods to the data obtained from PSLF, and the identification of the key transmission line for adjustment. Future work will focus on larger systems, and improving the current algorithms to deal with networks such as large portions of the Western Electricity Coordinating Council (WECC) power grid.

Power Performance Analysis of Wind Turbine Generation Systems. *LAUREN COOPER (Colorado School of Mines, Golden, CO 80401) ARLINDA HUSKEY (National Renewable Energy Laboratory, Golden, CO 89401).* The National Wind Technology Center (NWTC), located approximately 8 km south of Boulder, Colorado, is the premier research facility in the U.S. for wind turbine certification testing and evaluation services. NWTC provides performance, power quality, noise emissions, blade and loads testing in compliance with recognized international standards. Our research involves the power performance tests of wind turbine generation systems, which are used to determine the power performance characteristics of single wind turbines and to compare the performance of groups of turbines. Southwest Windpower, based in Flagstaff, Arizona, has partnered with NWTC to perform power performance analysis measurements of the AIR-X, a three-bladed upwind turbine rated at 400 watts. In 2003, an early version of the AIR-X was tested at NWTC. The results showed that the turbine was not performing at rated power because the shape of the blades was causing the turbine to enter stall mode at wind speeds within the turbine's normal operating range. NWTC is currently testing a version of the AIR-X with a modified blade shape. This new shape is supposed to reduce the aerodynamic fluttering that was previously causing the turbine to enter stall mode. The goal of our research was to write a power performance software program in Visual Basic for Microsoft Excel to analyze the power performance characteristics of wind turbines of all sizes and to use this program to test the performance of the new AIR-X. Our early test results indicate that the new blade shape has improved the power performance of the AIR-X by preventing the turbine from entering stall mode.

Pressure Loss in Cooling Channels Enhanced with Wire-Coil Inserts. *WILLIAM O'BRIEN (Community College of Rhode Island, Warwick, RI 02886) JEFF T. COLLINS (Argonne National Laboratory, Argonne, IL 60439).* Front end high-heat-load components of the insertion devices and bending magnets at the Advanced Photon Source (APS) are cooled with deionized (DI) water flowing through cooling channels that have oxygen free copper (OFC) wire-coils inserted into them to enhance convection heat transfer. The pressure loss across these cooling channels must be studied to optimize the design parameterized friction coefficients of the enhanced cooling channels and bulk fluid velocity of the DI water. One OFC test tube is used, with a 0.375 inch hydraulic diameter, made to accommodate the 13.5 inch long OFC wire-coil inserts. A matrix of OFC wire-coil inserts is fabricated in house with wire diameters ranging from 0.035–0.125 inches and different coil pitches ranging from 0.091–1.00 inches. Water is deionized, sterilized, filtered, and sent through a system of circuits designed to test flow rates across laminar, transitional, and turbulent flow regimes. Pressure loss, flow rate, and temperature readings are collected and reduced to dimensionless quantities used to develop four equations correlating channel size, wire diameter, wire-coil pitch, mechanical fluid properties, and bulk fluid velocity of the DI water throughout laminar and turbulent flow. The correlation established will provide thermal engineers in the synchrotron light source community functions that predict coil pitch and wire size based upon design geometry and pressure loss needs.

Process Engineering for Hydrogen Production Plants Using High Temperature Steam Electrolysis. *ALEJANDRO SAUCEDO, BHARAT THAKKAR, MARIBEL VALDEZ (Illinois Institute of Technology, Chicago, IL 60616) DR. RICHARD DOCTOR (Argonne National Laboratory, Argonne, IL 60439).* Two process simulations for large-scale hydrogen production using High Temperature Steam Electrolysis(HTSE) have been introduced by Argonne National Laboratory (ANL) using ASPEN computer software and Idaho National Laboratory (INL) using HYSYS computer software. The economic feasibility of both processes must be determined thus a cost analysis of fluid transport and heat transfer equipment is conducted, and the energy balance is calculated. From these energy calculations, it is discovered that the optimum energy balance occurs in ANL's feed case of 50% water and 50% hydrogen. From the equipment cost analysis, it is estimated that for ANL the total process equipment cost is $73 million, whereas for INL it is $40 million. For both, ANL and INL systems, the total initial cost of the electrolysis unit and the nuclear reactor is about half a billion dollars. Although a HTSE hydrogen production plant will involve huge upfront investments in resources, this comparative economic analysis provides a basis for HTSE system selection.

Protein Effects on the Microstructure of Doped Silica Aerogels. *BRANDI DOYLE (Texas Tech University, Lubbock, TX 79401) JAN ILAVSKY (Argonne National Laboratory, Argonne, IL 60439).* Silica aerogels (AGs) are inorganic polymers with low density which are used in a wide variety of sensor applications. By doping the silica gel with cadmium sulfide (CdS) and myoglobin, a biocomposite AG used in biosensors is formed. Through better understanding of the microstructure of these porous solids, their properties can be improved and tailored towards specific applications. Silica AGs doped with a myoglobin protein in five different ratios were synthesized and then examined through ultra-small angle X-ray scattering (USAXS). Through the USAXS we expect to see an increase in the size of the protein superstructure with increasing amounts of myoglobin. The log-log plots of the Silica AGs doped with protein consistently show three structural levels, with the first pertaining to the protein superstructure. Through the comparison of the radius of gyration (Rg) which corresponds to the protein size with the percent of myoglobin in the protein mixture, the particle size of the superstructure does not show an increase, or any trend for that matter. Through future investigation we can determine if the percent myoglobin truly has no effect on size of protein superstructure or if there were other factors during sample preparation that affected their growth.

Remote Handling Tooling for the Spallation Neutron Source. *DAVID MACNAIR (Georgia Tech University, Atlanta, GA 30332) CRAIG BRADLEY (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* The Spallation Neutron Source (SNS) will smash accelerated protons into liquid mercury which will create the most powerful neutron scattering facility in the world. When protons hit the mercury, the mercury becomes radioactively activated and the stainless steel housing for the mercury (the target) erodes. Every three months this target will be replaced, requiring the target cart to back into the target cell where manipulators, servo manipulators, and a crane change the target and perform needed maintenance. These operations require special remote handling tools to be designed, fabricated, and tested before the SNS comes online and the target cell becomes inaccessible. One of many tools worked on this semester is the lift compensator, which serves as a backup to the target cart hydraulic drive system. The compensator connects the overhead crane and the target cart backup jacks and will stretch like a spring giving the operator a gage on force applied to the jacks. Since the jacks fail at about 10,000 pounds of force, a break link was added which fails at 5,000 pounds and protects the backup jacks from damage. The spring in the compensator consists of seventy six Belleville washers stacked in series giving the operator 6.5 inches of movement between unloaded and 5,000 pounds. All components were designed using the solid modeler Pro/Engineer and then analyzed using hand calculations and finite element analysis with Pro/Engineer Mechanica. Results of the stress calculations were reviewed by the remote handling group and the SNS division, and finally the drawings were sent for fabrication. Fabrication has not finished, and no final results for the effectiveness of the design are available. Due to the magnitude of the project and the inaccessibility of the target cell by humans during SNS operation, each component inside the target cell must be carefully designed, analyzed, and tested before the SNS starts up. Additionally, components must be easily accessible, maintainable, and maneuverable by remote handling equipment so that the SNS can enjoy scientific discovery even beyond the length of its original design.

Resource Constraint's Role in the Transition to a Closed Self Sufficient Global Nuclear Fuel Option. *TIMOTHY ROGERS (Texas A&M University, College Station, TX 77843) DAVID C WADE (Argonne National Laboratory, Argonne, IL 60439).* With uranium ore deposits estimated at about fifteen million tonnes, it is necessary to determine an optimal ore withdrawal strategy to ensure nuclear energy sustainability. Producing this strategy requires optimization of virgin ore usage so that enough fuel is available to introduce fast breeder reactors as well as secure transportable autonomous reactors. To find an optimal ore withdrawal, a classical mechanics mathematical model is used. State equations of the system form the state matrix, with the control matrix being the ore withdrawal of uranium and the transuranic fuel for each reactor type as a function of time which is simulated over the time interval chosen to find the final conditions. An adjoint solution is then found to construct the Hamiltonian variation with respect to the control matrix. This gradient is then subtracted off to produce a more optimal ore withdrawal control. This process is iterated to minimize the performance index, which is based on the power mismatch between target and actual powers, and then to maximize ore withdrawal to meet power demand. This provides the user with the best possible ore withdrawal strategy to ensure nuclear power growth. Results of this code are dependent on the user input and thus can vary over wide ranges of ore withdrawals. Output from this code shows the implications of introducing reactors that can create fuel. It also shows how early implementation of these types of reactors can help to alleviate the world's future power needs. As for future use of these results, it will be possible to use the optimal ore withdrawal as part of a high fidelity model that accounts for more factors relevant to nuclear power growth.

Rotor Design Optimization for Offshore Wind Turbines. *PAUL KREINER (Stanford University, Stanford, CA 94305) PATRICK MORIARTY (National Renewable Energy Laboratory, Golden, CO 89401).* Modern wind technology is among the most effective and profitable ways to simultaneously address global warming and meet America's growing energy needs. Nevertheless, further advancements, including the optimization of offshore wind turbines, will be necessary for continued success in the United States. This paper describes a MATLAB-based rotor design optimization program called Rotor Optimization for Offshore Turbines (ROOT) that includes both land-based and offshore cost models. The program uses MATLAB's Genetic Algorithm Tool to find the rotor radius, number of blades, chord distribution, and twist distribution that result in a minimum cost of energy (COE) for a given wind regime. To predict aerodynamic performance, ROOT uses a program developed at the National Wind Technology Center called WT_Perf, which relies on blade element momentum theory. ROOT includes a basic structural analysis as well as losses due to soiling, wind farm array effects, availability, and power conversion. Although ROOT requires further development, such as improvements in the structural and cost models, the version discussed in this paper proved to be an effective rotor design tool. ROOT consistently generates blade shapes that closely resemble existing designs, even when the program begins with a random set of geometrically unusual designs. For a wind regime near the Nantucket Sound, ROOT generated a rotor design that would improve COE by 4.6% over the baseline design.

Self-Powered Oil-Fired Heating System Based on Thermophotovoltaic Power Generation. *EVELYN MEJIA, MARTIN NOLAN (The City College of New York, New York, NY 10031) DR. THOMAS BUTCHER (Brookhaven National Laboratory, Upton, NY 11973).* Self-powered appliances, such as a home heating system, have the potential to operate independently from the electric power grid. Thermophotovoltaic (TPV) power generation is well suited for self-powering. This involves generation of electric power by converting radiant heat emitted by a high temperature emitter into electricity using photocells. Since the amount of power generated depends on how much energy is emitted, the radiant emitter becomes an important component of the TPV converter. In this project, a self-powered oil-fired heating system based on thermophotovoltaic power generation was designed and analyzed. For this project, computational and experimental analyses were used to maximize the emitter temperature, measure the emitter temperature distribution, and vary the geometry of the experimental setup in order to reach the desired temperature. The computational fluid dynamics (CFD) model simulated the heat transfer in the combustion chamber. Using the CFD model, possible changes to the shape of the cylinder, placement of the TPV cells, and insulation thickness were explored so as to maximize the emitter temperature and exceed the target of 1300°C. From the CFD, the experimental analysis was designed; this work was part of an iterative process of adjusting the model and the experiments based on their results. The other analysis performed was experimental analysis; two geometrical cases were considered. In the first design case, the experiment was performed using a low Nitrogen Oxides (NO_x) (Blue Flame) burner with an open-end cylindrical Silicon Carbide (SiC) attached as a flame tube. The SiC emitter was selected because it can withstand temperatures above 1300°C, which is ideal for energy conversion. The emitter was wrapped with a refractory blanket to simulate the thermal resistance of the photovoltaic cells. In second design case, the flame tube was simply used to guide the flame toward a flat plate emitter, refractory blanket, and TPV cells that were placed at the open-end of the combustion chamber like a "target wall". The results for the first case showed the maximum temperature along the emitter was 1283°C and the second case, the gas temperature at the target wall reached 1569°C. Therefore, the second case was the ideal approach because it shows promise of being able to heat up the emitter above the desired temperature, 1300°C.

Single and Double Gas Electron Multiplier X-ray Gas Detector. *MARCUS MASON, ELHAG SHABAN (Southern University–Baton Rouge, Baton Rouge, LA 70813) DR. PETER SIDDONS (Brookhaven National Laboratory, Upton, NY 11973).* The purpose of this research is to present results obtained from testing of a single and a double GEM X-ray gaseous detector. The detectors have been designed, assembled, and tested at the National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory (BNL).The single and the double GEM detectors are intended to provide a noise and discharge free amplification to be used for Extended X-ray Absorption Fine Structure (EXAFS) procedure. A voltage of 450 volts across the single GEM provided a maximum gain of 900. A voltage of 350 volts across the double GEMs provided a gain of 9000 without stressing the GEM and creating the possibility of discharges.

SNS Beam Characterization Using Wire Scanner Analysis. *FEDRICK REYNOLDS (Tennessee State University, Nashville, TN 37209) TED WILLIAMS (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* The Spallation Neutron Source (SNS) is the most powerful pulsed source of neutrons in the world. The SNS consists of a Linear Accelerator (Linac) that accelerates negatively charged hydrogen ions (H-) throughout the various regions of the Linac to approximately 88% of the speed of light. These regions include the Medium Energy Beam Transport (MEBT), Drift Tube Linac (DTL), Coupled Cavity Linac (CCL), Super Conducting Linac (SCL), High Energy Beam Transport (HEBT), Accumulator Ring, Ring to Target Beam Transport (RTBT), and finally the Mercury (Hg) target. After the H- beam is accelerated, it is transported to the Accumulator Ring where all of the electrons in the beam are stripped off, thereby converting the beam to only protons. Once released from the Accumulator Ring, the beam then hits the Hg target and knocks out numerous neutrons from the Hg nucleus, which are used for research. Diagnostic equipment throughout the Linac provides data that are used to monitor, correct, and characterize the trajectory and shape of the beam. Some of these devices are wire scanners, which are used to measure the beam's position. Furthermore, the wire scanner data are used to set the magnetic field strengths of the quadrupole magnets; these are used to focus the beam. This is particularly important to the beam-to-target transfer process. Without correct steering, the full benefit of the beam on the target could not be achieved. Using a variety of programs, including Wireanalysis and Graphical Analysis; Gaussian and bi-Gaussian fits are calculated to measure the beam sizes. The measurements of the magnets' parameters are included in the data taken. The beam sizes and the magnets' parameters are fed into the model, and the output generated gives a plot of the sizes of the beam at various positions in the MEBT. The data is also compared on the same graph. The disparity between the two indicates how the beam changes in the MEBT. Adjustments were made to better fit the data. For example, while using wire analysis, the program was only allowed to fit the data that represented a Gaussian profile. This changed some values, but ultimately resulted in a better fit of the data. Although the beam will never be characterized without any error, there is the possibility of characterization with minimal error. Therefore, it is imperative that this research continue.

Structure of Phosphatidylcholine Cholesterol Bilayers Using Grazing Instance Small Angle X-ray Scattering. *CHRISTOPHER LEHMANN (Texas Tech University, Lubbock, TX 79409) JAN ILAVSKY (Argonne National Laboratory, Argonne, IL 60439).* Lipid bilayer membranes isolate and protect cells in the body. The structure of cholesterol/lipid bilayer membranes are studied to understand the manner in which molecules attach and interact at the cell membrane. This research is to determine whether the membrane lipids form ordered structure. The presence of regular lipid structures would affect the manner of drug interaction with the cell membrane and improve the understanding of the progression of many diseases associated with cholesterol. In addition, membrane organization would suggest possible behavior and design of model cell membranes in mircoarray and microfluidic biochips. In this work, cholesterol/palmitoyloleyl phosphatidylcholine (Chol/POPC) bilayers on a glass substrate were studied under grazing instance small angle x-ray scattering (GISAXS). GISAXS was used to measure the diffraction patterns and specular reflectivity. GISAXS is a useful method for lipid membrane research because it probes the area near the interface and data acquisition is fast, minimizing sample exposure to high photon fluxes. Research found the concentration of cholesterol in the bilayer mixture affects the structure of the membrane. Analysis of the collected data shows diffraction in more then one sample. For the samples that showed specular reflectivity the characteristic d-spacing observed is around 40 angstroms. Specular reflectivity suggests that the sample had regions of uniform structure. Future work should examine cholesterol concentrations in the range of 20 to 50-mol%. Membranes with higher mole percent may allow for better imaging because of the larger differences in electron density, also they closely mimic lipid/cholesterol compositions found in mammalian cells. GISAXS will be used in observing the diffraction because it proved an effective way to measure lipid bilayers at high fluxes. In addition, reflectivity data should be taken on the samples. The number of layers present from the reflectivity data would confirm whether a single uniform lipid bilayer is present.

Sulfuric Acid Materials Test Loop. *DANIEL LAMONE (The Ohio State University, Columbus, OH 43210) STEVEN SHERMAN (Idaho National Laboratory, Idaho Falls, ID 83415).* Several hydrogen production processes are currently under investigation by the U.S. Department of Energy (DOE) and several foreign governments, most notably France and Japan, for use in a co-located nuclear plant/hydrogen production facility. One of these processes is the Sulfur-Iodine Thermochemical Process. This process utilizes a series of chemical reactions that are driven by the thermal energy from a Very High Temperature Gas-Cooled Reactor (VHTR) to thermochemically split water into hydrogen and oxygen. The high-temperature chemical step in this process thermally decomposes sulfuric acid (H2SO4) at 850 C, imposing extreme demands on the process materials. To date, little research has been conducted in the U.S. to study the long-term effects of these conditions on structural materials and components, and there are no existing facilities beyond the bench-top for performing such tests. Therefore, there is a need for a closed experimental loop containing sulfuric acid that is capable of exposing samples and integrated components (e.g., heat exchangers, valve designs, etc.) to sulfuric acid decomposition products at high temperatures (750–850°C) for long periods of time. The loop must be capable of long-term, continuous operation (hundreds to thousands of hours) under simulated operational conditions that are to be found in the actual production facility, accommodate different component prototype designs and their respective testing requirements, and operate safely during all periods of operation. This loop will be built and operated at a U.S. Department of Energy (DOE) facility or partner facility under the direction of the DOE Nuclear Hydrogen Initiative (NHI). This project provides a conceptual design for such a materials and component test loop and will serve as a starting point for more the more detailed design and safety analysis work that will be needed once the loop is scheduled for construction and operation.

Synthesis and Electrochemistry of Composite-Structured Lithium Nickel Manganese Oxides for Lithium Batteries. *JENNIFER GATES (Fayetteville State University, Fayetteville, NC 28301) CHRISTOPHER JOHNSON (Argonne National Laboratory, Argonne, IL 60439).* Low weight and volume, high energy and power density, stability over many cycles, a large range of operating temperature, low cost, and safety are desired properties in all secondary batteries, but particularly those that are used in cell phones, laptops, and hybrid vehicles. Lithium's low molecular weight and very negative reduction potential place lithium-ion batteries in a good position towards meeting these goals, but much work must be done towards improving the batteries. In batteries that are currently used in cell phones, a lithium-graphite intercalation solid is the anode and the cathode is $LiMn_2O_4$ or $LiCoO_2$. We investigated $(1-x)LiNi_{0.5}Mn_{0.5}O_2 \bullet xLiNi_{0.5}Mn_{1.5}O_4$ composites, where x is varied from 0 to 1 in increments of 0.1, as a cathode material, in order to try to improve the capabilities of the cathode. The compositions we studied are composites of a layered and a spinel oxide phase. A composite structure may be expected to have a greater stability to lithium insertion/extraction due to synergism between the two phases. Many new lithium metal oxides were synthesized and optimized for phase purity and structure. Electrochemical characteristics are being studied such as current rate, cycle life, stability, and safety in "coin cells". The coin cells were made using lithium metal as the anode; ethylene carbonate (EC) and ethyl methyl carbonate (EMC) in a ratio of 3:7 respectively as the solvent, and LiPF6 as the electrolyte. The current density was 0.10 mA/cm^2, which gives approximately 20 h discharge or charge time.

***Testing and Development of Neutron Bubble Dosimeters for Upgrading Radiation Monitors.** *PHILLIP ZELLNER (Virginia Polytechnic Institute and State University, Blacksburg, VA 24060) ERIK ABKEMEIER (Thomas Jefferson National Accelerator Facility, Newport News, VA 23606).* Jefferson Lab is upgrading its particle accelerator from 6 GeV to 12 GeV to give physicists greater insight in the experiments they run. An unfortunate side effect of the upgrade, is that the experiments performed by Jefferson Lab will generate neutron radiation with much higher energy (up to 20 MeV). The ion chambers that the Lab uses to monitor the radiation dose given to the public, will not be able to detect the higher energy neutrons. In order to solve this problem, neutron bubble dosimeters are being developed to detect the higher energy neutrons. These dosimeters are the first instruments to put superheated bubbles. The ability of the neutron bubble dosimeters to detect 20 MeV neutrons has already been proven. However, this project tested the feasibility of using the neutron bubble dosimeters. The detectors were tested on Jefferson Lab's radiation range and calibrated. Then the neutron bubble dosimeters were tested side-by-side with the ion chamber dosimeters in the existing radiation monitoring stations. It was shown that the neutron bubble dosimeters could detect the higher energy neutrons. The test results from the comparison of the two types of dosimeters showed that the neutron bubble dosimeters were at least as reliable as the ion chambers in detecting the neutrons that are currently produced by the accelerator. This success ensures that a reliable radiation detection system will be in place well before the 12 GeV upgrade is complete, thereby ensuring the safety of Jefferson Lab's employees and the public.

Testing of Beam Position Monitor Calibration Software. *ELI CARREIRO (Rensselaer Polytechnic Institute, Troy, NY 12180) THOMAS RUSSO (Brookhaven National Laboratory, Upton, NY 11973).* New software has been developed for the Relativistic Heavy Ion Collider (RHIC) Beam Position Monitor (BPM) hardware. This software is designed, via calibration, to remove drift within the BPM motherboard, and to make only one initial time—consuming external calibration necessary. The data points from the initial external calibration are saved and utilized in remotely performed internal calibrations. Testing of the software has made use of the following instruments and experimental processes: function generators to simulate the RHIC beam signal to the BPM boards; actual RHIC beam signal; oscilloscopes to monitor electronic activity in board circuitry; resistors soldered onto certain points of the boards in order to introduce artificial drift; and finally, LabVIEW and NX Client software. NX Client software was used to read and to plot calibration data obtained from BPM boards, and LabVIEW virtual instruments were used to vary internal pulser attenuation values of the BPM boards throughout testing. After several tests and modifications to the software, the new version of code proved to be robust in maintaining calibration over a more than acceptable range of internal pulser attenuation values. Furthermore, experimentation revealed the software to be capable of calibrating out simulated drift to well within accepted error ranges. Testing of BPM boards installed in the RHIC showed the software to be operational with real beam signal. The new software is a significant improvement over past systems and, pending further testing and the implementation of a curve smoothing algorithm for calibrations utilizing the RHIC beam data, the software will be employed in all of the RHIC BPM hardware.

***The Solar Hydrogen Home.** *RODRIGO PENA (Nassau Community College, Garden City, NY 11530) DEVINDER MAHAJAN (Brookhaven National Laboratory, Upton, NY 11973).* As oil prices continue to escalate to levels that threaten our economy, alternative energy is starting to play an important role in our society. Hydrogen fuel cells and solar panels are alternatives that promise a non pollutant way of producing energy. A solar cell is a p-n junction, made out of silicon (semiconductor). A p-n junction is the product of two layers of the same semiconductor material that are doped with different materials to leave one free electron in a layer, and a deficit of one electron in the other layer. A photon will move this free electron from one layer to the other, inducing an electrical field at the interface of these two layers, and a current will flow when the circuit is closed. A solar energy arrangement (photovoltaic system) will be used to meet the load of an average household that requires approximately 10,000 kWhr of energy per year. The objective of the current work is to put together a cost effective model house scaled down 1:300 of the energy required for an average residential home to conduct system and energy analysis. The photovoltaic (PV) size facing south required to meet the load of an average household is 9 kW with efficiency of 75% that counts for inverter and wiring losses of the system. In this project, two solar panels measured at 15 watts each will simulate the 9 kW PV system. These two solar panels will be used to feed the total consumption of the model house. In New York, the average sun hours per day are 4.3 hours, during which the PV system will produce the total energy needed to run the house for the whole day. The excess portion of solar energy that is not used during the 4.3 hours will be used to electrolyze water and generate hydrogen and oxygen. The hydrogen is stored in tanks to be used after the sun set to produce energy on demand by hydrogen fuel cells. The current experimental work showed that for 9 kW PV system, the hydrogen production is one fourth the total amount needed to cover the energy demand for the remaining hours of the day after sun set. This is attributed to the efficiencies of the fuel cell and Electrolyzer at the current state of technology.

The Utilization of Thermoelectrics to Capture Excess Waste Heat Produced by an Oil Burner in the Pursuit of Developing a Self-Powered Boiler. *JULIAN TAWFIK (Stony Brook University, Stony Brook, NY 11794) DR. THOMAS BUTCHER (Brookhaven National Laboratory, Upton, NY 11973).* Thermoelectric devices produce electric power when exposed to a ∆T (temperature difference), between the hot and cold junctions. The objective of this project is to conduct theoretical/conceptual feasibility and economic studies on the utilization of thermoelectrics and their ability to produce electricity from temperature gradients generated by an oil boiler to power its electrical components and make it electrically self-sufficient, with no need for a connection to an external power source. The most efficient installation location of the devices on the boiler and its components with the appropriate ∆T was determined (on the boiler wall/exhaust pipe) to produce the 100 watts of electricity needed to power the auxiliary boiler units. The current analysis includes the following factors: maximum temperature the thermoelectric devices could withstand, how many thermoelectrics could be accommodated on the boiler unit or its components, and cost effectiveness with return on investment (ROI). A heat sink, to prevent the overheating of the devices by maintaining the cold side at ambient temperature was designed. Two bismuth-telluride thermoelectric units were tested and an IV curve was obtained (current/voltage) to determine if they would perform under operating conditions of 155°C ∆T between the boiler wall/exhaust pipe (175°C) and ambient air (20°C). 10 units of the #219 model, 5.7-watt generators would need to be purchased at a cost of $419.50. After 20,000hrs the ROI of the units would be $420.00 (a 50¢ gain), which is economically unfeasible. Total burner surface area required was 291.6 cm^2. Results show that making an oil-burning boiler self-sufficient is possible, but uneconomic until more efficient and inexpensive materials are available. Some materials currently being researched are cobalt based and thin film superlattice thermoelectrics. In conclusion, the research here has contributed to the efficiency of oil burning boilers so that less fossil fuels are consumed to maintain a cleaner, healthier tomorrow.

Thermal Management of a PEMFC with Air Cooling. *NEVILLE PERKINS (Farmingdale State University, Farmingdale, NY 11735) DEVINDER MAHAJAN (Brookhaven National Laboratory, Upton, NY 11973).* The use of fossil fuel has become a major problem that has national security implications and environmental concerns. The emission of green house gasses and the need for clean renewable energy has led to the research into alternative energy sources. One of the options to replace fossil fuels is hydrogen fuel that can be utilized in a PEMFC. The PEMFC produces heat energy as a byproduct of the chemical reaction needed to produce electrical energy. The removal of excess heat produced at a rate that keeps the internal temperature constant at about 80°C is a challenge. Monitoring and controlling the external temperature of the active area of the flow field at the bipolar plate or end plate can be an economic way to keep the fuel cell within an ideal temperature range. In this project, an array of 15 thermocouples was dispersed across three bipolar plates in a fuel cell stack to monitor the internal temperature and the rate of heat production. An infrared heat sensing camera was also used to display the external surface temperature of an operating fuel cell. The output from the sixteen 15 thermocouples were connected to data acquisition software. Real-time temperature monitoring was automatically performed at predetermined time intervals. Two fans with variable air flow were used to introduce a steady stream of air to cool the external surface of the fuel cell stack. Two other sensors were used to measure temperatures up and down stream of the air flow used to cool the fuel cell. Data was collected with the fuel cell stack operating at various power levels while establishing the air flow required to keep the internal fuel cell temperature constant at safe operating level. The heat generated by the power stack spikes and causes hot spots during periods of high demand, requiring effective cooling. It is inferred from the collected data that an economical air-cooling system could be designed for a fuel cell stack that would allow it to operate under isothermal conditions. Finding a relationship between active area, heat produced, and air flow required to remove excess heat can supply the design tool needed to configure the cooling system for any fuel cell size.

Three Dimensional Environment Models for Electromagnetic Wave Simulation. *TOMAS TINOCO (Diablo Valley College, Pleasant Hill, CA 94523) JAMES NUTARO (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* Accurate electromagnetic wave simulation demands accurate models of the environment. New techniques that combine ideas proposed by Christiaan Huygens, transmission line theory, and the powerful capabilities of today's computers, could allow fast, accurate and large scale electromagnetic wave simulations. These techniques require three dimensional models with information of the material properties at each point in space to calculate the speed of wave propagation as well as the reflection and transmission coefficients. Therefore, such techniques can not be applied unless models with the necessary information are provided. To address this problem and create the required models, elevation data from the United States Geological Survey (USGS) was used for modeling terrain and Virtual Reality Modeling Language (VRML) was used for modeling buildings. From USGS files, information was extracted to determine the elevation points of a specific region. Subsequently, interpolation techniques were used to obtain the required resolution and a three dimensional array was allocated to store the properties of each point in space. For modeling buildings, VRML files were used as input to a conversion software that stored the physical properties of each location based on the VRML shapes present and their specifications. Using these methods, two models were created; one model using USGS elevation data for Bethel Valley and the other from a VRML model of Oak Ridge National Laboratory courtyard. The terrain model had one meter resolution and contained material properties at each location but was limited to two types of materials. On the other hand, the courtyard model was based on basic shapes but contained the required resolution and a greater variety of material types. This work allowed the creation of the necessary three dimensional models of the environment with the required information and resolution for testing an electromagnetic wave simulator. It was possible to execute the simulation in these models to analyze the time and memory efficiency and to find ways to increase the speed of simulation. Lastly, the courtyard model was used to simulate the path loss of a radio signal and the results were in agreement with measurements taken at different locations of the model. Based on the difference between simulated and measured values, the research team can increase the level of details of the model to improve the results produced by the simulator.

Transportable Radiation Monitoring Systems. *JULIA MOLINE (Columbia University, New York, NY 10027) PAT HU (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* Malevolent use of radioactive material poses a great threat to U.S. national security. As part of U.S. Department of Homeland Security's initiative to address threats of transporting illicit radioactive materials on the national transportation network, the Oak Ridge National Laboratory (ORNL) is designing and testing a Transportable Radiation Monitoring System (TRMS). TRMS is a set of radionuclide detectors that could be set up at truck stops, rest areas, or on either side of a road to monitor vehicles passing through. The development of the TRMS will allow authorities to deploy radionuclide detectors to any site through which they believe illicit radioactive material may be traveling. It will also facilitate the necessary communication between local, state, and federal law enforcement agencies in the event that something illicit is detected. In May and June, 2006, the TRMS was tested at three sites on the grounds of ORNL. Its accuracy and efficiency were measured by observing its operational efficiency (e.g., recorded down-times) and by comparing the data the system recorded with information on shipments of radioactive material, which were provided by the ORNL Shipping Department. The data were analyzed by a number of variables, including the radionuclides carried by monitored vehicles, speed of vehicles going through the TRMS, and weather conditions at the test sites. Based on conclusions drawn from a series of statistical analyses on the data, the system and the procedures used to operate it will be improved. After the preliminary analysis of the TRMS tests is complete, the system will be tested at various sites on interstates in the Southeast. The challenges of these field tests include not only the technical aspects of the system (accuracy of the alarms, data collection, etc.) but organizational issues having to do with the necessary involvement of various government agencies in any deployment of the TRMS.

Uncertainty of Available Energy and Available Power. *SHAWN ALLRED (University of Wyoming, Laramie, WY 82070) JON CHRISTOPHERSEN (Idaho National Laboratory, Idaho Falls, ID 83415).* Documenting the uncertainty analysis of the derived parameters grouped as Available Energy (AE) and Available Power (AP) for battery cells is a very complex problem. The error is an unknown combination of both linearity and offset; the analysis computes the uncertainty both ways and then the most conservative method is used (which is the worst case scenario). Each method requires the use of over 134 equations, some of which are derived and some are measured values. This includes the measurement device error (calibration error) and bit resolution and analog noise error (standard deviation error). The implementation of these equations to acquire a closed form answer was done using Matlab (an array based programming language). The uncertainty is automatically computed and will become part of the reported results for future battery testing.

Upgrade of Insertion Device Magnetic Measurement System: Motion Control and Position Measurement. *JUSTIN HSU (University of California–Berkeley, Berkeley, CA 94720) STEVE MARKS (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* An Elliptically Polarizing Undulator (EPU) is a storage ring insertion device that generates intense light for use in scientific experiments at synchrotron radiation facilities like the Advanced Light Source (ALS). An EPU has four individual mechanical beams, which are comprised of permanent magnets that have been arranged in a deliberate pattern of alternating pole orientations. By adjusting the position of the beams, one is able to manipulate the trajectory of an electron beam into a sinusoidal or helical path, inducing a desirable phase-coherent superposition that increases the intensity of the produced light by many orders of magnitude. Because the electron beam path depends directly on the EPU's magnetic field, errors in the magnetic field translate into out-of-phase beam trajectories, leading to degradation in brightness. To prevent this, a precision magnetic measurement system is used to measure magnetic field as a function of position. This device assesses optical phase errors and provides a basis for correcting the EPU's magnetic field. Because it had been several years since the magnetic measurement bench at the ALS had been upgraded, many of the components were obsolete. In order to maintain compatibility with newer equipment and software, a complete overhaul of the device was necessary. My task involved upgrading key components of the system. This included replacing laser interferometers with linear encoders, mechanical mounting of the linear encoders, installing an updated motor controller, building a convenient user interface to display all data, planning/implementation of the system's electrical wiring, updating the computer's software/operating system, and writing C/C++ code that facilitated communication within the entire system. Because the project is still ongoing, experimental results have yet to be determined. Future work may involve further investigation and code modification to expand system functionality.

Usability Improvements to Existing Detection Equipment. *FRANKIE PONTILLO (Purdue University, West Lafayette, IN 47906) YOUNG SOO PARK (Argonne National Laboratory, Argonne, IL 60439).* The goal of the project was to develop specific improvements in the method, techniques, and equipment to allow better usability of existing radiation search equipment in the field. A number of hand-held detectors were inspected. The objective was to develop concepts for hands-free operation for each of the detectors These devices include the Indentifinder, a medium weight and sized device that detects radio nuclides, the SAM-935, that is a special nuclear material detector larger in weight and size than the previous, the UDR, a handheld radioactive device that is small in size and weight and often used in the military, and the ORTEC Detective, a gamma-ray detector that is bulky in size and weighs a lot. These devices are very important both inside and outside Argonne National Laboratory. It was important to become familiar with the equipment and with the previous and alternative ideas used. Searching the internet, reviewing books, and visiting manufacturer websites, especially for these devices that we were working with, helped in developing our initial ideas of improving the devices. Looking at devices that were already marketed, but not necessarily ones that served a purpose to the radioactive search devices, shed light on our current situation and gave an idea for designing hands-free devices. Getting contact with companies and putting ideas into visuals that could be presented seemed to get the project moving in the right direction. For the UDR the device design was similar to the iPod neoprene cases, with some slight modifications. For the Identifinder a retractable locking clip device, was used that could be purchased on the open market. For the SAM-935 ideas were taken from a car mounted DVD case, and modified to be part of a pack system that could hold the device. Lastly, for the ORTEC there is a need to come up with an idea for a way to carry the device as a front and back pack, but still be accessible. We are currently having ideas turned into prototypes, with respect to the future of this project; the main goal is that the prototypes be successful to the radioactive search industries. New casing designs were used successfully with the commercial radioactive devices. These new casings with respect to the old ones are more durable, easier to use, and make transportation of the radioactive detectors easier.

Validating Computational Fluid Dynamics Simulations of Thermodynamic Flow in the Very High Temperature Reactor Lower Plenum. *MARY SPROUSE (Kansas State University, Manhattan, KS 66506) W.D. POINTER (Argonne National Laboratory, Argonne, IL 60439).* The Generation IV International Forum (GIF) has been organized to address future energy needs using nuclear energy systems. The Very High Temperature Reactor (VHTR) is an advanced reactor concept undergoing engineering development. The thermohydraulics of the reactor must be modeled to ensure inherent safety in design. Engineering simulations are carried out by using computational fluid dynamics (CFD) software; CFD solves the conservation equations (mass, momentum, and energy) to predict the behavior of fluids in motion through a defined configuration. The software enables a number of turbulence models to be chosen to assess, for instance, the sensitivity of the nuclear system's thermohydraulics to a specific model. The objective of this project was to investigate the capabilities of the CFD package STAR-CD with respect to coarse-to-fine meshing options and turbulence models, with a focus on thermohydraulic flow in the lower plenum of the VHTR. The potential thermal fatigue of the lower plenum structure, as a result of poor thermal mixing, is expected to be the first standard benchmark problem proposed by the GIF VHTR Methods Project Management Board. In order to establish validity of the turbulent flow CFD approach, steady and unsteady simulations were run with various meshing options for a well-documented reference tube bank experiment. The simulation results were compared to experimental data generated by the Idaho National Laboratory's matched index-of-refraction flow experiment to evaluate the capability and packaged options (i.e., turbulence models) of the STAR-CD simulation software. To date the simulations have been found to correctly represent experimental trends. However, differences appear between the coarse-to-fine meshing approach relative to the experiment trends, in particular, between the normalized velocity over distances on the simulated reference tube bank. These differences are now being analyzed. In addition, in order to model the VHTR lower plenum, a script was developed that builds the representative geometry. Future work includes running simulations for this model and comparing the simulated and experimental data. These planned validation exercises using STAR-CD will contribute to the design engineering and safety analysis of advanced nuclear systems.

Validation of CFD Code for Heavy-Vehicle External Aerodynamics Simulation. *EMILY DRINGENBERG (Kansas State University, Manhattan, KS 66502) W.D. POINTER (Argonne National Laboratory, Argonne, IL 60439).* Argonne National Laboratory is using the computational fluid dynamics software STAR-CD and its ES-AERO enhancement (both Adapco) to solve the mass and momentum conservation equations as applied to the generic conventional model of a tractor-trailer vehicle. Preliminary studies show that a reduction in drag as small as 5% translates to fuel savings of about 2.5%, which can be as much as 500-1000 liters/year (~132-264 gal/year) for 150,000 km (~93,206 mi) annual highway driving for a single commercial long-haul tractor-trailer vehicle. The STAR-CD program numerically solves the turbulent flow around a tractor-trailer configuration for different turbulent flow models and under various conditions. By running simulations, information such as the coefficient of drag and pressure distribution around the vehicle is revealed. Both metrics are linked to the aerodynamic performance and hence the fuel-efficiency of the tractor-trailer. Since one defining variable of drag and pressure is the yaw, or the angle at which the flow moving over the vehicle's surface encounters the centerline of the vehicle, simulations are being carried out at yaw angles 0°, 3° (or 2.5° when 3° is problematic), and 6°. Simulations were also conducted to model underhood air flow with a standard radiator (as this is more realistic) and since it influences the overall aerodynamic performance. The information gathered from the simulations is compared to experimental data collected from a scaled tractor-trailer experiment in a wind tunnel. Major results showed an error of only ~12% for the baseline geometry at all tested yaw which confirms the ability of STAR-CD to be used in similar applications to predict fluid flow. The V2F model suggested that for larger yaw angles, a more advanced turbulence model may be needed. The side drag and lift are typically difficult to predict but showed some tendency to follow the trend for small yaw angles. The differences and similarities resulting from this comparison have aided in determining the usefulness and accuracy of the STAR-CD and ES-AERO software as well as potential gains in fuel economy for the tractor-trailer.

Verification and Application of a Thermosiphon Solar Water Heater Model. *JAY JOHNSON (University of Missouri–Rolla, Rolla, MO 65409) JAY BURCH (National Renewable Energy Laboratory, Golden, CO 89401).* Rising energy prices and global warming have sparked added interest in wind, biomass and solar technologies. Solar water heating can reduce domestic water heating costs by more than half and currently new Solar Domestic Hot Water (SDHW) systems are in development and production. Thermosiphon systems are a relatively mature technology, but there are still a number of uncertainties their behavior. Thermosiphon systems use the natural buoyancy of hot water to drive flow during the day, but at night cooler ambient conditions cause reverse thermosiphoning. The National Renewable Energy Laboratory (NREL) has developed a new model using TRNSYS software, which can smoothly transition between forward and reverse flows. Two of the new NREL components in this model were verified by comparing analytical results to the TRNSYS solution. Then using this model, reverse thermosiphoning was studied and quantified in different climates and loop geometries to understand the energy penalty of the typically ignored reverse thermosiphoning phenomenon. New passive solar thermal systems have the tank nearly coincident with the collector, so the penalty from reverse thermosiphoning was of particular interest. All modeling showed some level of reverse thermosiphoning regardless of climate or tank position. Although these systems are highly dependant on hot water draws, the reverse thermosiphon mass was nine times larger in low tank configurations, forward thermosiphon mass was 80% larger with the high tank configuration and hence the high tank configuration was capable of delivering 25% more energy annually than the low tank configuration. This points to using systems with high tank configurations, but attic limitations and the inconvenience of tank mounting may not always make such geometry feasible. This work quantifies the penalty and shows that such configurations, though not optimal, produce reasonable savings.

Environmental Science

A Comparison of Water Chemistry Between Natural, Modified, and Manmade Ponds within Brookhaven National Laboratory. *PRISCILLA RANDOLPH (North Carolina A&T State University, Greensboro, NC 27411) TIM GREEN (Brookhaven National Laboratory, Upton, NY 11973).* Brookhaven National Laboratory (BNL) is located in the center of the Long Island Pine Barrens. Within BNL's 5,265-acre site there are 26 wetlands. Included are coastal plain ponds, vernal ponds, recharge basins, and streams, making it an ideal ecological site to study water chemistry. We tested water samples from seven coastal plain ponds on BNL: four natural (BP1, BP2, BP6, BP9), one man-modified (BP7), and two manmade (BP13a, Meadow Marsh). Five water samples were collected from each pond. An eTrex Vista Cx Global Positioning System (GPS) was used to mark each water sample point. An YSI 659 MDS meter fitted with a multiprobe was utilized to determine temperature, pH, dissolved oxygen, conductivity, and turbidity at each sample point. Water samples were analyzed for sulfate, nitrate, iron, phosphorus, chlorine, calcium, magnesium, copper, tannin-lignin, chromium, molybdenum, aluminum, and suspended solids using Hach DREL/2000 and CEL/890 water test kits. Water samples were also analyzed for eleven different elements using an ICP-AES. The pH in the anthropogenic ponds was found to be more basic than that of natural ponds. Phosphorous, tannin-lignin, and hardness were elevated in the natural ponds when compared to manmade and modified ponds, but only the difference in tannin-lignin content proved statistically significant. The natural ponds were shaded by the canopy of the surrounding forest while the manmade and modified ponds where located directly in the sun. This had a affect on water temperature. The results of this research will give environmental scientists an insight into water chemistry and interrelationships between abiotic and biotic factors and will enable BNL to optimize the management of amphibian and reptile habitats.

A Comparison of Litter Densities in Six Community Types of the Long Island Central Pine Barrens. *DANA TIEVSKY (University of Rochester, Rochester, NY 14627) TIM GREEN (Brookhaven National Laboratory, Upton, NY 11973).* The condition of the Long Island Central Pine Barrens has been an area of ecological concern for the past three decades. In 2003, the Foundation for Ecological Research in the Northeast (FERN) was founded to support scientific research in the Pine Barrens. FERN's groundbreaking project is the Central Pine Barrens Monitoring Program, for which field research began during the summer of 2005 at Brookhaven National Laboratory. The purpose of this 10 year longitudinal study is to determine the current status of forest health in order to promote longevity and conservation in the Pine Barrens, as well as to learn what research should be done in the future. Litter densities from Pitch Pine, Pine-Oak, Oak-Pine, Coastal Oak, Scrub Oak, and Dwarf Pine habitats were compared in order to justify the succession of the Pine Barrens and prepare for future prescribed forest fires. Using Geographic Information System (GIS) and Global Positioning System (GPS) technology, random twenty five by sixteen meter plots of land were selected throughout eastern Long Island and then thoroughly surveyed. Litter and duff depth data were collected at four points along each of the ten line transects in the plot. Pitch Pine forests were found to have the most litter, with an average depth of 6.12 centimeters. Pine-Oak forests have an average litter depth of 6.03. Oak-Pine and Coastal Oak forests have comparable litter depths. Oak-Pine forests have an average litter depth of 5.01 while Coastal Oak forests have an average litter depth of 4.82. Scrub Oak lands have almost no litter with an average depth of 3.63 while Dwarf Pine Forests have an average litter depth of 2.49. A comparison of the vastly different litter densities of the six community types yields results that are consistent with the previously determined succession of the Pine Barrens and shows that litter density plays a key role in aiding forest succession. Data collected under the Central Pine Barrens Monitoring Program was used to determine a threshold for litter density, 4.82 cm. However, this trend is only from the first two years of research. In the future, a more accurate threshold can be determined in order to prescribe forest fires at appropriate times and preserve the Pine Barrens in the most effective manner.

***A Comparison of the Chemistry of Soil Surrounding Natural and Anthropogenic Ponds at Brookhaven National Laboratory.** *SHURRITA DAVIS (North Carolina A & T State University, Greensboro, OR 27411) TIM GREEN (Brookhaven National Laboratory, Upton, NY 11973).* Brookhaven National Laboratory (BNL) is located in the Long Island Pine Barrens, an area formed through decomposition and reworking of glacial materials. BNL has many wetland structures including costal plain ponds, vernal ponds, recharge basins, and streams. Some of these serve as breeding grounds for tiger salamanders (*Ambystoma tigrinum*), a species listed as endangered by the New York Natural Heritage Program. Anthropogenic habitats need to possess suitable characteristics with respect to soil and water chemistry in order to serve as successful breeding habitat for tiger salamanders. Soil is an important factor in controlling vegetation and water chemistry. In this study five ponds were selected for a study of soil chemistry: two natural and three anthropogenic. Nine soil samples were collected from each pond, eight around the perimeter and one from the pond bottom. Global Positioning System (GPS) was used to locate the sample points and ArcGIS was used to map the ponds and sample points. Soil samples were tested for pH, nitrate nitrogen, phosphorus, potassium, aluminum, ferric iron, magnesium, sulfate, calcium, and chloride using LaMotte Combination Soil and LaMotte Soil Micronutrient Kits. Soil moisture content was also determined. Soil color, texture, structure, consistency, and mottling were also observed and recorded. Five of the nine soil samples from each pond were digested using EPA method 3050B for Acid Digestion of sediment, sludge, and soil and then tested for copper, iron, molybdenum, magnesium, cadmium, aluminum, chromium, manganese, potassium and lead using an Inductively Coupled Plasma - Atomic Emission Spectroscope (ICP-AES). The natural ponds were more acidic then the anthropogenic ponds. The soil temperature is higher around the anthropogenic ponds (BP7, BP13, MM) than the natural ponds (BP9, BP6). Nutrient levels were low and consistent across pond types. Though these differences exist, both types of ponds accomplish the goal of providing suitable breeding sites for tiger salamanders (Ambystoma tigrinum). This information will serve as baseline data for BNL's natural resource manager and enable BNL to optimize the management of amphibian and reptile habitats

A Miniature Quartz Crystal-Based Device for Particulate Matter Monitoring with Real-time Data Acquisition. *ZHUO HUANG (Sacramento State University, Sacramento, CA 95819) MICHAEL APTE (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* Exposure to particulate matter (PM) through inhalation has been associated with adverse health problems. Accurately monitoring of the mass concentration and chemical composition of PM are necessary for exposure assessment. Many current instruments in use involve complex operation and labor-intensive work to obtain necessary data