Senior Design Exposition Day

May 4, 2012
Thanks to our Sponsors

The design projects and resources required to implement the many engineering and computer science projects in the academic year 2011-2012 were generously provided and supported by the following sponsors:

ACME Concrete
AVISTA
Cedar Mountain Farms
CH2M Hill
Chimfunshi Wildlife Orphanage
City of Reardan
Commuter Cars
Crystalfontz
EPA
GE Healthcare
Gibby Media
Gonzaga University
Goodrich
Haakon Industries

HotStart
Inc Sys
Integrus Architecture
ITRON
LHC 2
Metals Fabrication Company
MSAADA Architects
NIOSH
Parker Aerospace
RANDL
Structural Design Northwest
Taylor Engineering
Varela & Assoc.
Wagstaff
Gonzaga University's Center for Engineering Design was established in 1992 to enhance the design experience for our senior engineering students. The Center obtains projects for the academic year that are defined and provided by sponsors in the private and public sectors. Prospective sponsors are sought throughout the year for projects involving all engineering and computer science programs. Some projects are interdisciplinary. Participating sponsors provide a definition, resources, and funding for the projects. They also commit a liaison(s) from the sponsoring company to guide and support the students throughout the academic year. In turn, this affords the sponsors an opportunity to evaluate students for possible employment.

Throughout the academic year, all projects are periodically reviewed by faculty and the Center's Design Advisory Board (DAB). The DAB is comprised of engineering and computer science professionals among all the disciplines in both the private and public sectors. They are instrumental constituents for the Center and a major factor to guide the students. The review process brings an outside perspective to the projects and is a component required to meet design guidelines established by the Accreditation Board for Engineering and Technology (ABET).
Dean's Message

To Our Seniors and Project Day Attendees:

On behalf of our entire School of Engineering & Applied Science, I would like to welcome all of you to the culmination of another year of hard work for our seniors, their faculty, and numerous others involved with this effort. The Senior Design experience can be demanding, challenging, and, at times, frustrating, but it provides a real-world opportunity for our students to practice their chosen profession—in some cases, for the very first time. What you see today represents the end of something that began as a very sketchy proposal back in September and continued through the many months of this senior year to the presentations that will be given today.

A special note for our seniors. Each year I am amazed at the levels of competence and creativity demonstrated by these project accomplishments. I want to congratulate all of you for the effort and dedication that has brought you to this day, an effort that began not just last September, but when you first entered Gonzaga as freshmen or transfer students. We are proud of you and your achievements, and welcome you to a profession in which you can truly make a difference to the society which you will serve. Go Zags!

Dennis R. Horn
Dean of Engineering & Applied Science

Student Project Teams

Project teams consist of three to five students and a faculty advisor to work with the liaison from the sponsoring company. The students' initial task is to generate a project plan and define strategies required to bring the project to fruition. Students are required to make effective use of available resources to manage their project activities. Specific milestones are identified including written reports and oral presentations. Faculty advisors lend knowledge and experience to the student team by providing guidance in the technical and managerial decisions required by the project. Liaison(s) monitor progress of the project team and assist in making the best use of the sponsor's resources and facilities.

Team ME 5

[Image of Team ME 5]
Gonzaga Senior Design Team Earns $90,000 EPA Award to Improve Health of Zambian Women and Children

A team of five Gonzaga University engineering students captured a $90,000 grant from the U.S. Environmental Protection Agency’s 8th annual People, Prosperity, and the Planet competition April 21—23, 2012 in Washington D.C. The competition encourages college students to design environmental solutions for a sustainable future.

The GU students developed two methods for improving the health of Zambian women and children, and a plan to distribute devices in the African nation. The breakthroughs involve the development of a simple ventilation system for kitchens in rural dwellings and a ceramic water filter made with local material to remove contaminants from drinking water in the home.

The team will use the award money to implement the students’ plan to establish a social enterprise in Zambia to support clean water and air. The team’s bio can be found on page 12 of this brochure.

Director’s Message

Welcome to Design Exposition Day 2012. This year, just as in past years, our seniors have engineered some excellent solutions to real world problems. These solutions span a broad range from experimental studies in budding technologies to solving basic needs in Africa. Though these projects differ widely in focus, all projects seek to make the world a better place for people. Please enjoy the overviews of these projects on the following pages.

Our senior projects are the culmination of the students’ education. Each student works on a small team for their entire year guided by a faculty adviser and a liaison engineer. During this year their adviser and liaison engineering give them practical mentoring in the profession. This sort of learning goes beyond the classroom to integrate theory into real practice.

Many thanks are due to the professionals who make this possible. Thank you project sponsors for providing the engaging projects and sharing your liaison engineers’ time. Thank you also to our Design Advisory Board members for reviewing progress with the teams throughout the year. And of course, many thanks to the administrative staff who make the logistics happen seamlessly.

Steven Zemke
Director of Center for Engineering Design & Entrepreneurship
Due to the scarcity of firewood in many parts of Africa, a large number of families rely on solar reflectors and the power of the sun for their daily cooking needs. The drawback to this is that as the sun sets, their ability to cook meals is drastically diminished.

MENG 1’s goal is to create a solar powered oven utilizing the excellent thermal properties of a molten salt to in essence create a “thermal battery.” The device will be able to receive high input from a solar reflector and in turn allow people to store and utilize this thermal energy for their cooking desires.

The extent of our project is to evaluate the implementation of using a commercial air source heat pump as a supplemental heater to HotStart’s electrical resistance heater to lower electrical energy consumption. HotStart is a Spokane based company that designs and manufactures engine heaters to keep engines at a uniform temperature, allowing them to start quickly. The prototype that we designed will ultimately be tested on the Caterpillar Generator Set used as a backup power source for the McCarthy Athletic Center to determine the cost savings involved with using the waste heat from the engine to heat the coolant in the engine to keep it ready for the start-up in the event of an emergency.
Parker Aerospace Thermal Management Systems designs and manufactures liquid cooled system solutions for high performance electronics in harsh environments. The goal of this project is to design and build a prototype test fixture that simulates cooling silicon microchips used in the field. This test fixture allows Parker to verify theoretical values of heat transfer coefficients. The fixture must be able to accommodate a variety of rectangular heat sink sizes, flow channel geometries, and refrigerant types—all with one fixture, replacing only minimal parts for each test. The system replicates the flow boiling heat removal process in high heat, generally electronics. The test fixture we designed interfaces with an existing closed-loop, recirculating-flow, support system provided by Parker.

The Tango is a 600 kWatt electric supercar capable of traveling over 100 miles at a time on purely electric power. Designer Rick Woodbury has dedicated all of his time to change the future of automobiles with the design of this eco-friendly, zero emission, wicked fast vehicle.

The HVAC system in the Tango unnecessarily restricts airflow causing less than optimum cabin conditions. Our task was to redesign the necessary components to make the Tango experience truly amazing!!
ACME Concrete, based out of Spokane, Washington typically works on projects which include highways, intersections, airport runways, and fueling depots. Concrete pavement constructed in the 1950’s through the 1980’s were constructed without load transfer devices along the transverse joints. After the 1980’s, the Federal Highway Administration insisted on using dowels in new pavements due to joint faulting in existing concrete pavements. ACME creates slots and inserts the dowel bars with a very labor intensive process.

Our group was responsible with designing and building a prototype which semi-automates the dowel bar slot process. The new process reduces labor, decreases time to cut slots, and delivers a better quality slot for bonding of concrete. Due to financial limitations, the prototype was stripped of a few components which ACME hopes to implement in the future, if the prototype process gets approved by the Washington State Department of Transportation.

Goodrich Aircraft Wheels and Brakes manufactures carbon-carbon composite brake disks for use on commercial and military aircraft. ME-6’s primary project focus is in the beginning fabrication of the composite brakes, specifically increasing efficiency and building on the previous projects to implement automation in the textile department. Through the use of a double bobbin fixture over a single bobbin fixture, we aim to increase line efficiency while still maintaining and improving current ergonomics for operators and seamlessly integrating with the current and new systems.
Goodrich Corporation is a company outside of Spokane that manufactures brake disks for commercial airplanes. A residue, requiring removal, accumulates on the disks as a side-effect near the end of the manufacturing process, which has thus far been only removed by hand. Our team was entrusted with designing and building a machine that automatically removes this residue from the disks faster than the manual process. The machine has been designed to clean a wide variety of disk types, diameters and thicknesses. The disks are advanced through fixed, rotating, cylindrical brushes that clean the residue deposits on the disk faces.

LHC2 Inc. is best known in the Inland Northwest for its wireless engineering services. One of its existing horizontally polarized antenna models is popular among Spokane emergency vehicles for its low interference wireless internet. Our task was to assess the current design of the antenna to maximize manufacturability and minimize cost.

Our group was able to redesign the antenna to look similar in appearance but differ vastly in assembly construction. The new antenna takes less labor time and uses less material. Also, by eliminating liquid adhesives in multiple steps of the existing design we were able to eliminate the necessity to wait for adhesives to cure. Overall, the new design makes constructing the antenna an easier task and more cost effective.
The National Institute of Occupational Safety and Health (NIOSH) is assessing technologies capable of quantifying the mass of silica in coal dust deposited on filter material. The student team has been tasked with conducting a sensitivity analysis of a few different infrared spectroscopic techniques, choosing the most viable option for silica quantification, and exhaustively testing the chosen technology for silica quantification. The students must also choose a technique that is capable of quantifying silica in coal dust deposited on filters used in a Personal Dust Monitor (PDM) – a NIOSH developed technology to quantify the mass of coal dust in real time. The team has conducted preliminary testing on transmission, attenuated total reflectance, diffuse reflectance, and infrared fiber optics, and concluded that diffuse reflectance is the most viable option and the best suited to handle filters used in the PDM. The team proved that silica mass can be quantified in coal dust using industry standard filter material and pursued the quantification on PDM filters. The findings will be reported to NIOSH in the form of a draft journal article that researchers at NIOSH can then publish.

Wagstaff Inc. specializes in the aluminum casting industry where ingots of around 25 feet long are made. Using a semi-continuous aluminum casting method the ingots are drawn using a mold ring and starting head mounted on a piston the lowers beneath the ground. The focus of our project is the improvement of the alignment system which is altered every time an ingot is removed. Our design should accomplish alignment within 1/2mm tolerance on each side otherwise molten aluminum will escape through gaps between the starting head and the mold ring.
Team ME-11 is working with Randl Industries to redesign a plastic insert for use in electrical boxes. Where the current design is installed by hand, the new insert design is to save time and cost by allowing it to be secured in the box using an automated process. The ultimate goal is to put the new insert design into mass production and to provide a complete insertion machine.

RANDL Industries manufactures square electrical boxes equipped with plastic inserts for handling telecommunication cables. Market demand and cost pressures for this product justify automating the manufacturing process.

ME-12 was tasked with integrating the insert attachment process designed by the ME-11 design team into an efficient automated system. The boxes from the previous stage would be placed onto a conveyor, which takes the boxes to the insert attachment process and then away to the next stage in the overall manufacturing process. The design currently requires some operator involvement and will accommodate future expansions and additional automated processes.
Haakon Industries builds air handling units for use ranging from general, to maintaining cleanrooms and food processing areas. Depending on the size of the unit, heating and cooling coils weighing up to 3,000lbs each must be installed by hand. Currently, these large coils must be pushed into place, which places both the workers and product at risk. Haakon Industries has tasked ME-13 with designing and building a mechanism which will install the heating and cooling coils quickly and safely, eliminating the chance for possible injury to workers, and damage to the product.

In peri-urban Africa, women and children are disproportionately affected by unclean air and water. Our project is funded by the EPA’s P3 Program and focuses on developing technologies that improve drinking water and indoor air quality in the kitchens of Africa and increases sustainability. We use a ceramic water filter requiring less material than current filters with comparable contaminant removal rates. We also developed a thermoelectric-powered ventilation system that removes some airborne particulates created by the cooking fire. Finally the project also proposes an implementation plan using a framework of social entrepreneurship to create a startup filter manufacturer in Africa.
The City of Spokane’s Riverside Park Water Reclamation Facility is nearing capacity in its secondary treatment. Our team has been assigned to reduce this load by adding an additional treatment process to the facility.

Our end goal has been to weigh two treatment options: either add a Chemically Enhanced Primary Treatment (CEPT) system or add additional capacity in the aeration basins. To do this, our team is evaluating the viability of CEPT in comparison to either a new aeration basin or adding upgrades to the existing basins to operate more efficiently. Lastly, we have designed a CEPT system for the plant.

This project will assess the plausibility of overland connection between Lake Audubon, a man-made wetland that receives waste-water treatment plant (WWTP) effluent from the City of Reardan, and the headwaters of nearby Crab Creek. Upper Crab Creek is a listed 303d water body for fecal coliform and Lake Audubon is a potential source. To assess contribution, the project team is developing an overland hydrological model of Lake Audubon’s watershed while monitoring several water quality parameters to verify results. Project findings will identify permitting needs for Reardan and become part of the total maximum daily load (TMDL) for Upper Crab Creek.
Hanson Harbor Homeowners Association (HHHOA) and the project sponsor Varela and Associated Inc. have contacted Gonzaga University (GU) asking to help regulate arsenic in Hanson Harbor’s groundwater system. Due to the changes in policy at the Environmental Protection Agency (EPA) and the Washington State Department of Health (DOH), arsenic concentrations in drinking water must be reduced to 10 ppb by June 30, 2013. Hanson Harbor currently has arsenic concentrations of approximately 16-17 ppb in their water. The budget for this remediation project is about $1.3 million and the project site is located north of Wilbur, Washington, along the Columbia River. Our design team researched and evaluated several arsenic removal techniques and created a report to identify the best arsenic treatment option for Hanson Harbor to achieve compliance with the EPA regulations.

The City of Covington Library Expansion Project encompasses the removal of an existing north facing shear wall facilitating the entry into the proposed new addition. The project’s design challenges are to design the gravity framing system for the expansion and to design the lateral resistant systems for the expansion while maintaining architectural integrity between the expansion and the existing structure. The gravity framing design conforms to the constraints with the use of glulam joists and girders with steel columns. The lateral resistance design utilizes a combination of braced frames and masonry shear walls providing stability against wind and seismic forces.
Haiti Children’s Home, CE 6

Jessica Moore  
Craig Mauss  
Angela Weiss  
Brittany Winant

Advisors: Melissa Verwest,  
Jed Druffel  
Sponsor: MSAADA Architects  
Liaison Engineer:  
Kennet Bertelsen  
Kelly Irving

The CEDE 6 Project Team has compiled a Design Study Report for the Lamb Children’s Center in Leogane, Haiti at the request of MSAADA Architecture. The center, which was previously destroyed in the 2010 earthquake, will double as a boarding school and orphanage. The main purpose of this project is to recommend systems for the reconstructed site with special consideration for the natural disasters prevalent in the area. The project compared and analyzed site plan characteristics, rainwater harvesting, greywater reuse, wastewater disposal, energy, materials, and structural systems via a rubric developed to evaluate the products on total cost, durability, safety, sustainability, and system specific concerns. The rubric was used to ultimately recommend the best determined product in each category. The DSR report will be used by MSAADA to apply for funding from charitable organizations to build the project.

Chaplaincy Office Bldg. CE 7

Alex Wong  
Mathew Theisen  
Jacob Blanchette  
Kyle Johnson

Advisor: Tony Stendlund  
Sponsor: Structural Design Northwest  
Liaison: Una Zeck

The Chaplaincy Hospice Building Project involves the structural design of a 13,500 square foot, two story, office building with an elevated mechanical loft and pitched roof, with clerestory windows. Located in Richland, Washington the hospice building will include offices, training rooms, chapel, and auxiliary spaces.

Based on the initial architectural drawings and the local geotechnical report, the team was provided with the task of designing a framing system, which will be able to withstand our calculated gravity and lateral loads. Members within the building will be specifically sized and spaced for their particular load requirements to be evenly distributed through the members and into the ground. Similarly, a roof and flooring system will be designed to minimize noise pollution and vibration for the future tenants. During these processes our group is utilizing different computer programs such as AutoCAD, MathCAD and Microsoft Excel to name a few.
Civil Team #8 has completed design work on two separate projects. The first project includes civil/site improvements for the Associated Painters Hangar at Spokane International Airport. The goal was to design drainage and sitework improvements around the building to minimize dusty conditions near the air handling units as well as create paved access from the adjacent roadway to the units suitable for use by a manlift. The second project is the design of a semi-truck loading bay for Metals Fabrication Company. The goal was to design a trench type loading bay that will fit two semi trailers. This included ramps down into the building and any necessary drainage systems.

This is the second consecutive year that Gonzaga University has partnered with the Chimfunshi Wildlife Orphanage. Chimfunshi is a world renowned orphanage and sanctuary for chimpanzees. This project includes several tasks. Improving the fence and drinking basins for the chimpanzee enclosures, designing brick stoves that will use fuel more efficiently and mitigate smoke away from the user, latrine seals that will water transmission in the rainy season, and hand washing stations. The first group of Gonzaga Engineering students to earn Engineering course credit in Zambia this summer will implement the designs from this project.
The Cedar Mountain Farm Foundation has an existing Bed and Breakfast operating near Athol, Idaho. The foundation wishes to develop a portion of their 440 acre property by constructing a new RV park and campground. Our team developed two alternative property layouts, and a final layout was selected based on the client’s wishes. Once the layout was finalized, our team focused on preliminary design and permitting for the roadways, storm water management, waste water treatment, potable water system, and utility distribution.

Deliverables include a report to our client describing the aspects of the development, permitting and preliminary design plan sheets, so that they may continue forward with the development of their property.

Gonzaga University is experiencing increased enrollment and expansion beyond the core campus. With the increased enrollment and expansion comes more pedestrian, bicycle and automobile interaction and conflict. The project goal is to review the current situation, identify areas of concern and safety, study those situations and propose solutions. The final product will be a campus wide analysis and a proposal of suggested solutions. This will include cost estimates and pros and cons of the proposed solutions.
Commuter Cars designs and manufactures electric cars which rely on advanced lithium-ion battery technology. To provide the highest quality product, numerous cell characteristics must be known, including how the discharge rate, temperature, and cycle depth affect the cycle calendar life of the battery. These characteristics are not supplied by battery manufacturers, so independent research must be done to attain them.

Our group was responsible for designing a device which charges and discharges battery cells while simultaneously recording current, voltage, and temperature. The data can then be used to identify trends and ultimately gain a more complete understanding of how different driving characteristics affect the battery cells.

The goal is to replace the expensive, functionally rigid dashboard display of the Tango electric car with a cheaper, functionally flexible, and customizable display. The initial display is a high precision system that shows only a few attributes, like speedometer, odometer, mileage, and RPMs and applies primarily to high-performance, gas-powered cars. The new display is custom tailored to apply to electric cars, providing more information about battery pack voltage, auxiliary power system voltage, and system current levels.
The goal of this project is to provide AVISTA line crews with critical safety information concerning possible arc flash hazards (AFH) at each work location by enabling GoBook Geographic Information System (GIS) displays to show AFH levels. Enabling the GIS display function would benefit the linemen by informing them of potential AFH at their work location so that they can select the appropriate personal protective equipment (PPE).

Our team was assigned to deliver a User’s Manual for implementing a software defined radio (SDR) in Gonzaga University’s Smart Antenna Radio Laboratory (SARL). As a vehicle and example our team programmed, integrated, and tested two SDRs in an end-to-end link. The SDR contains radio frequency hardware and digital signal processing components conducive to radio technology development within the SARL. Our team’s manual covered all aspects of our radio reference design, tools and processes required to duplicate and develop new designs. The output of this project serves as a foundation for future Senior Design projects within the SARL to support local industry.
Gibby Media Group Inc. created a site as conceptual basis to pass on to individual regions around the world for business and of all types. Team Gibby is working on a new website template that allows a region and/or business to add themselves with the capability of uploading multimedia content on paid subscription basis.

Our group is designing, coding, and testing an online application for Itron. This application will be used by Itron’s customer service representatives in order to better communicate with customers. The service reps will have access to an interactive user interface that will allow them to easily and intuitively navigate large amounts of data.
Our team is producing software that will run on, and demonstrate the processing power of Crystalfontz hardware. This software will process machine code for a printable object, and using the processed code and our drivers, control and actively monitor the motors of our "Rep Rap" 3-D printer in order to print 3 dimensional plastic objects. We are also attempting to integrate temperature control and acceleration algorithms that have not been previously used for controlling these types of printers.

The Alchemy Framework is an open source software system created by Eric Mathews at GE Healthcare. The framework gives web developers tools to create powerful medical web applications with ease. The framework also acts as a middleware between the developers and the secure hospital databases.

Our task for this project was to update the framework to implement added functionality. With the added functionality, users are able to navigate different functional areas of the framework easier. We also integrated login functionality of two framework areas to allow single sign in where separate login credentials were previously required.
To the 2012 Seniors, Congratulations and Best Wishes!
Thanks to our Design Advisory Board

The Center for Engineering Design & Entrepreneurship is supported by a dedicated group of volunteers from the engineering community who lend expertise to our students and our program. Thank you!

Les Bohush, Gibby Media
Tim Erlandsen, Interlink Advantage
Lindsay Gilbert, Taylor Engineering
Mike Harrington, Alliance Machine
Karl Kolb, Coffman Engineers
Pete Maricich, Boeing
John Oslufka, Telect
Mike Perrin, Retired
Curt Rettenmier, AVISTA Utilities
Paul Robertson, Schweitzer Engineering
Michael Santora, Alliance Machine
Bob Turner, City of Spokane
Una Zeck, Structural Design NW

Bill Choma, AVISTA Corporation
Bill Fees, Wash. Dept. of Ecology
Tim Graybeal, Integris Architecture
Michael Herzog, Itron Corporation
Rudy Lauth, Triumph Composite Systems
David Moss, Spokane County Utilities
Ron Oscarson, Spokane County
Phillip Pintor, Coffman Engineers
Ron Riel, AVISTA Utilities
Jim Roletto, David Evans & Assoc.
Chris Sharman, Soft Dev Systems
Gary Weber, Boeing
Tom Zysk, Boeing
# CEDE Senior Design, Final Project Presentations

**Friday, May 4, 2012**

<table>
<thead>
<tr>
<th>Location</th>
<th>Project</th>
<th>Time</th>
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<tbody>
<tr>
<td>College Hall 245</td>
<td>CPSC 4 Open Source Data Warehousing</td>
<td>2:00 p.m.</td>
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<td></td>
<td>CPSC 3 Crystalfontz Makerbot</td>
<td>2:30 p.m.</td>
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<td>CPSC 2 Commodity Utilization</td>
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<td></td>
<td>CPSC 1 Global Business Broadcasting</td>
<td>3:30 p.m.</td>
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<td></td>
<td>DAB: Curt Rettenmier, Tim Erlandsen, Mike Herzog, Ron Riel, Chris Sharman</td>
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<tr>
<td>PACCAR 215</td>
<td>CE1&amp; ME 14 EPA, P3 Sustainability</td>
<td>2:00 p.m.</td>
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<tr>
<td></td>
<td>ME10 Mold Plate Alignment</td>
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<td></td>
<td>ME 11 Insert Attachment Process</td>
<td>3:00 p.m.</td>
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<td></td>
<td>ME 12 Insert Fixture Automation</td>
<td>3:30 p.m.</td>
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<td>ME 13 HVAC Coil Loading</td>
<td>4:00 p.m.</td>
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<tr>
<td></td>
<td>DAB: Ron Oscarson, ME10 Mold Plate Alignment, Phil Pintor, Tom Zysk</td>
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<tr>
<td>Jepson 126</td>
<td>ME 5 Dowel Bar Retrofit</td>
<td>2:00 p.m.</td>
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<td>ME 6 Double Layer Puller</td>
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<td>ME 7 Residue Removal</td>
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<td>ME 8 Antenna DFM</td>
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<td>DAB: Mike Harrington, John Olsufka, Gary Weber</td>
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<tr>
<td>College Hall 246</td>
<td>EE 1 Programmable Battery Cycler</td>
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<td>EE2 Dashboard Computer Display</td>
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<td>EE3 Arc Flash Analysis</td>
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<td>EE5 &amp; ME 9 Silica Analyzer</td>
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<td>EE4 Zigbee Radio System</td>
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<td>DAB: Bill Choma, Mike Perrin, Michael Santora, Paul Robertson</td>
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<tr>
<td>PACCAR 203</td>
<td>CE4 Arsenic Removal</td>
<td>2:00 p.m.</td>
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<td>CE3 Lake Audubon</td>
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<td>CE2 WWTP Process</td>
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<td>CE 10 Cedar Mountain</td>
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<td>CE 11 Pedestrian Safety</td>
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<td>DAB: Bill Fees, Dave Moss, Karl Kolb, Bob Turner</td>
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<tr>
<td>Jepson 014</td>
<td>CE 9 Chimfunshi/Zambia</td>
<td>2:00 p.m.</td>
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<td>CE 6 Haiti Children’s Home</td>
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<td>CE 7 Hospice Building</td>
<td>3:00 p.m.</td>
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<td>CE 8 Loading Bay &amp; Hangar Drainage</td>
<td>3:30 p.m.</td>
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<td>CE 5 Covington Library</td>
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<td></td>
<td>DAB: Tim Graybeal, Lindsay Gilbert, Jim Roletto, Una Zeck</td>
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<tr>
<td>Jepson 124</td>
<td>ME1 Molten Salt Energy Storage</td>
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<td>ME2 Engine Heater</td>
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<td>ME3 Flow Boiling Test Fixture</td>
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<td>ME 4 Automobile HVAC</td>
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<td></td>
<td>DAB: Les Bobush, Pete Maricich, Rudy Lauth</td>
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