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
Welcome to Design Exposition Day 2010

The Center for Engineering Design is pleased to showcase the design work of our students. Our gratitude is extended to our project sponsors and liaisons.

We encourage you to visit the project exhibits, to attend the formal project presentations, and to join us at the social that concludes these events.

John F. Dacquisto, Director
Center for Engineering Design

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).
Innovators....

LHC2 Antenna

Our team is designing and building an antenna measurement system for use by GU and LHC2 (an antenna design company). We are building a physical antenna positioning system, capable of rotating various sized antennas about two axis; producing a software suite capable of controlling the positioning system while also taking and analyzing data from a network analyzer; and providing calibration and operation procedures for the device. Ultimately, our project will provide antenna designers with the ability to analyze test antenna and view the three-dimensional performance characteristics of the antennas.

ME 1 Team: Advisor: Steven Zemke; Christopher Wendel, Timothy Elder, Patrick Moran, James Wong; Liaison: Dr. Arthur Miller

NIOSH

Many workers in industrial settings are exposed to hazardous airborne particles. Potential health risks associated with this are quantified using particle sampling techniques such as the electrostatic precipitation (ESP), aerodynamic impact, gravitational settling, and vapor deposition. Although there has been some success with this technology, there are application limits: sampling efficiency drops significantly in the particle range of 100nm-200nm. Currently, a portable particle sampling device capable of accurately collecting particles ranging from 1nm-200nm is unavailable. Thermophoretic precipitation has the capacity to fulfill the demand for this sampling range. Our goal is to create a prototype which uses a temperature gradient across an air flow to collect nano-particles.

ME 2 Team: Ryan Davidge, Thomas Jones, John Brownlee, Alex Kinney, Daniel Wiest
Advisor: Steven Zemke
Liaison: John Thorpe

LHC2
Antenna
ME 3 Team: Sergey Moore, Justin Burnett, Clelia Leopold, Nathan Sevigny
Advisor: Steven Zemke
Liaison: Royden Honda

LHC2
Rapid Prototyping

The purpose of this project is to create a way to prototype antennas with complex geometries that cannot be made on standard machining equipment. We are looking at a fused deposition modeling process which would allow us to use a plastic filled with a conductive metal powder to build the prototype layer by layer. We are also designing and machining a special finger for a finger brake that would allow for a specific geometry to be created on standard equipment. Both of these processes will be tested in order to determine the conductivity and other properties of the prototypes.

ME 4 Team: Goodrich Engineer, Mark Wolke; John McDonagh;
Advisor: Mike Keegan; Goodrich Liaison: Lynn Spivey;
Christine Goodrich, Michael Palodichuk, and Stephanie Sabin.
In ME 5 Team: Jeremy Stumetz, Kirsten Poehlman, Taylor Wagemans, Nicholas Niedbalski
Advisor: Mike Keegan
Liaison: Jesse Delanoy

Goodrich Puller

Goodrich Corporation specializes in the manufacture of disk brakes for military and commercial airplanes. In the initial fabrication stage stacks of carbon fiber sheets are combined through a succession of fast actuating needles which fuse them together into a single thick “board.” This requires an operator to manually pull the sheets along the entire length of the conveyor belt (approximately 28 feet) and cut the sheet. During a twelve hour shift, this repetitive motion causes many ergonomic issues.

Our project is to create a machine that will take the place of the operator. We have designed a feeding, cutting, pulling, and driving system that performs the required tasks. The operator's only task is loading the leading edge of the sheet into the feed system. From there, the sheet will automatically be fed to a carriage, pulled down the conveyor, and cut at the desired length, with automatic repetition of the process.

Visionaries....

Goodrich Loop Cooler

At the request of Goodrich Aircraft and Brakes, our task is to design, manufacture, and test a cooling system. The system is capable of recirculating a cooling media (Duratherm HF) at a constant temperature to an external heat source consistently, up to 72 hrs. Our design will incorporate a main cooling system, and a backup system that will prevent possible failures. This system will effectively remove a specified amount of heat energy from the heat source/furnace. The energy will be rejected by pumping the cooling media through a heat exchanger, and is cooled by an external water source at approximately 70°F. Also, the said device will be able to control a process heat source by supplying a cooling media at a specified set point temperature of 80-450°F ±10%.

ME 6 Team: Brian Smits, Sean Moran, David Champoux, Joseph O’Connell
Advisor: Mike Keegan
Liaison: John Finley
Boeing Debris Collector

The project group, ME-07, has been contracted by Boeing Company to design, build, and test a prototype that will be able to dispose of small space debris in Low Earth Orbit space (LEO). The LEO space environment contains a large amount of debris that can impact current and future spacecraft operations. The team will formulate design specifications from customer requirements, develop concepts, design and test the prototype. The criteria in which the debris capture mechanism is being designed includes capture of debris ranging in size from 1 to 20 centimeters, fitting into an ESPA ring and attaching to a satellite, and being able to capture debris that comes within 2 meters of the satellite. A final report will be turned into Boeing Company detailing the prototype, design process, and suggestions on debris disposal.

Kimball Router

The Kimball Office team’s objective is to design and fabricate a three dimensional programmable router to cut wire-passageway slots into extruded aluminum corner posts that are used in the company’s “Xsite” model of cubicle systems. The current process is labor intensive, and unsafe. The goal is reduction in production time to less than 180 seconds while collecting greater than 90% of machined chips. Through several brainstorming sessions, the team, with the help of engineers and machinists from Kimball, developed a final concept. Three ball screw assemblies are used to achieve the linear motion while a unique clamping system allows the work piece to be rotated while being machined. This machine will enable the aluminum posts to be produce quickly, efficiently, and most important, safely.

ME 7 Team: Chad Chaffin, Joseph Goelz, Stefan Lauderback, Edgar Poza
Advisor: Mike Keegan
Liaison: Kimberly Hicks

ME 8 Team: Advisor: Jeff Nolting;
Liaison: Ken Lambie;
Alex Wollin, Jonathan Chrisman, Julian Johnson, Keith Mowell
Problem Solvers....

**Mobius Robotic Head**

Our project is to create a physical representation of a working human brain. The head will be an interactive exhibit in the Mobius Science Center to educate visitors on the neuro-anatomy of the brain as well as basic sensory input and response. The model consists of a wire-frame head, a rotating base, and a mechanical-electrical brain. It is a multi-year project where user input will activate head rotation, vision activation, hearing, speech, and basic brain function. We will build and assemble the physical and electrical parts in order for next year's team to automate the movements and responses of the head and brain.

**ME 10 Team:** Taylor Bechtold, Julia Marshall, Nicholas Vigo, Sean Finerty  
**Advisor:** Debra Offill  
**Liaison:** Dr. Ward Merkeley

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**Alliance Tamper**

Our project focused on designing a device that would properly index corrugated sheets that drop off a conveyor belt prior to printing. Alliance Machine Systems International, LLC (AMSI) has an existing device that performs poorly with smaller sheets, and the pneumatic cylinders used have a life cycle of 6-12 months. Our goals were to improve cycle time for alignment from 1200ms to 200ms; improve stacking reliability with smaller sheets; and increase the overall product life cycle. Our concept uses a vibratory motor attached to a hopper to shake and guide the sheets to within a ±1/16” tolerance. The cycle time is decreased because the device is constantly guiding the sheets into their proper alignment for indexing. The stacking reliability has been improved by reducing the drop height of the sheet off the conveyor. The overall product life cycle has been improved by reducing the system part count.
**Energy @ GU**

The goal of the project is to look at Gonzaga’s current energy infrastructure and see how it could be improved. Currently the campus steam system includes minimal monitoring equipment, making accurate efficiency calculations impossible. Our group researched steam systems and provided recommendations for setting up a robust monitoring system to track energy being produced and used at the facilities as well as the losses occurring. Another major part of our project was performing comprehensive energy audits of both Jepson and Herak. We looked at electrical and heating/cooling loads to find major areas where energy efficiency could be improved. Our final report includes our findings and estimated potential energy and cost savings.

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**Boeing Fan Nozzle**

Our team is developing a concept for a variable area fan nozzle (VAFN) suited for application on large commercial aircraft engines, specifically the Boeing 737-800. Variable area fan nozzles have been widely used in aerospace applications to adjust the operating point of the propulsion system to better align with various flight conditions that the vehicle will encounter. A turbofan jet engine’s thrust consists of two parts: the primary, or fan, flow and the secondary, or core, flow. Currently, commercial jet engines have a fixed area fan nozzle optimized for a balance between climb and cruise. This fixed area limits the efficiency of the engine’s thrust. A variable area fan nozzle would allow the primary, or fan, flow to be optimized for every flight condition, thus increasing engine performance and decreasing fuel consumption.

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**EE 1 Team:** Liaison: Mike Dillion; Daniel Seymour, John Choma, Mohammad Al-Hayek, Jacob Kubale, Matthew Stockinger
Advisor: Lamont Miles;
Design Advisory Board

The Design Advisory board is composed of individuals and representatives from public and private sector organizations that actively participate in CED to support the engineering and computer science education of our students. The board reviews senior design capstone projects and provides advice to the CED Director and Faculty Advisors in developing plans and policies for the Center. Thanks to this important group of Board Members!

2009—2010 Design Advisory Board Members:

Les Bohush  Electronic Communications  Dave Peden  Coffman Engineers
Bill Choma  Avista Corporation  Mike Perrin  Retired, Monaco Enterprises
Bill Fees  Wash. State Dept. of Ecology  Curt Rettenmier  Avista Utilities
Tim Graybeal  Integrus Architects  Ron Riel  Telvent Utilities Group
Mike Harrington  Alliance Machine  Jim Roleto  David Evans & Associates
Michael Herzog  Itron Corporation  Michael Santora  Alliance Machine
Rudy Lauth  Triumph Composite Systems  Chris Sharman  Soft Dev Systems
Pete Maricich  The Boeing Company  Bob Turner  City of Spokane
Emily Miller, John Olsufka  2009—2010 Design Advisory Board Members:
David Moss  Spokane County Utilities  Gary Weber  The Boeing Company
Ron Oscarson  Spokane County  Una Zeck  Structural Design NW
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          Curt Rettenmier  Avista Utilities
          Ron Riel  Telvent Utilities Group
          Jim Roleto  David Evans & Associates
          Michael Santora  Alliance Machine
          Chris Sharman  Soft Dev Systems
          Bob Turner  City of Spokane
          Gary Weber  The Boeing Company
          Una Zeck  Structural Design NW
          Tom Zysk  The Boeing Company

          Thanks to this important group of Board Members!
Project Sponsors

The design topics and resources required to implement the many engineering and computer science project efforts in the academic year 2009-2010 were provided and supported by the following sponsors:

Alliance Corporation, Spokane, WA
AVISTA Corporation, Spokane, WA
The Boeing Company, Seattle, WA
City of Spokane, Spokane, WA
Coffman Engineers, Spokane, WA
DCI Engineers, Spokane, WA
Department of Transportation, Olympia, WA
Gonzaga University, Spokane, WA
Goodrich Corporation, Spokane WA
IT Lifeline, Spokane, WA
Integrus Architecture, Spokane, WA
Kimball Office Equipment, Post Falls, ID
LHC2, Spokane, WA
Mobius Science Center, Spokane, WA
NIOSH, Spokane, WA
Pend Oreille County, WA
PowerData Corporation, Spokane, WA
Selkirk School District, Metaline Falls, WA
Society of Jesus, Juba, Sudan
Spokane County, Spokane, WA
Schweitzer Engineering Laboratories, Pullman, WA
Drug Reaction Reporting System

The Intelligent Multi-Agent System for Reporting Adverse Drug Reactions is a tool to assist medical professionals evaluate potential adverse drug reactions experienced by patients. Adverse drug reactions are overwhelmingly under-reported for many reasons, including excessive paperwork, uncertainty about the specific drug which caused the reaction, and time concerns. Our system attempts to solve these issues through the use of autonomous software “agents,” which serve as a go-between for medical professionals and a hospital’s computerized database system.

These agents are able to communicate through a simple web-based interface to discover needs, perform data-mining operations on the hospital’s database, assist with form-filling applications, and return results for the medical professional’s review. Our system can submit an official report to the FDA’s Adverse Event Reporting System, where data is aggregated nationwide to support the FDA’s post-marketing safety surveillance program.
The Catholic University of Sudan (CUoS) design team is responsible for the structural and civil site elements of a university to be built in Sudan, Africa. The university will eventually be used by 1000 students and faculty, currently in temporary facilities. The construction documents delivered by the CUoS team will be used to apply for funding. The project was birthed by Fr. Mike Schulteis of Sudan in coordination with MSSADA Architects with hopes to raise up leaders for the upcoming generation in Sudan.

Bike Lane

In recent years, the need for a larger and improved bicycle infrastructure has become apparent, and municipalities have begun working to update their bicycle networks. The City of Spokane seeks to update and expand its bicycle network, and is looking into an experimental set of pavement markings called Shared Lane Markings or “Sharrows.” These Sharrows can indicate bicycle presence in sections of roadway too narrow to serve as a shared bicycle and automobile lane. Sharrows are currently being tested for durability, recognition and general acceptance by all roadway users. The goal of this project is to collect bicyclist usage data, such as average daily traffic of bicyclists on three different roadways in Spokane. Bicyclist Volumes, placement and economics of Sharrow markings, and Safety, are being studied in addition to efforts to educate drivers and bicyclists about the new markings.
**CE 3 Team:** Thomas Hergenrader, Mac Gills, Andrew Downing, John Ciepiela  
**Advisor:** Melissa Verwest  
**Liaison:** David Giordano

**GU Parking**

Due to tremendous growth in Gonzaga University’s (GU) student body, the need for new facilities is unmistakable. Our design team has taken on the challenge of designing the GU parking structure and retail suits. The two structures will meet the needs for parking and will serve as a temporary location for the GU book store and dining center. The parking structure to be added will be a 214,000+ square foot, open roof, parking structure capable of accommodating over 600 vehicles. The two story retail facility on Hamilton Street will be made to look like the same structure as the GU parking garage. Our design team’s goals include verifying the local code requirements, selecting a structural material that will be most appropriate for the project, designing as many plausible aspects of the structure as we can, delivering AutoCAD drawings, and preparing a final report.

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**Creators....**

**Selkirk School**

The wastewater treatment plant at the Selkirk Junior/Senior High School near Metaline Falls, WA has been unable to consistently meet the present Department of Ecology’s secondary level treatment standards. Ecology recently issued a draft discharge permit that stipulates that Selkirk must prepare an approvable Engineering Report no later than September 1, 2010. This Engineering Report must include an evaluation of and recommendations for operational and capital improvements to the wastewater treatment plant so it will meet, at a minimum, secondary level treatment standards. The client also asked us to investigate the possible alternative of an on-site septic system coupled with a drain field rather than discharging into the Pend Oreille River. In this work, it is important to note that Selkirk is sensitive to operation and maintenance simplicity and inherent costs.

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**CE 4 Team:** Kyle Van Dyk, Brent Robinson, Michael Torres, Mallory Miller  
**Advisor:** Russell Mau  
**Liaison:** Richard Koch
SCC Tech Ed

This project pertained to the design of a technical education building on the campus of Spokane Community College (SCC). As the school’s technical programs have grown, there has been an increasing need for additional classroom and lab facilities. Based on the architectural plans we were provided by Integrus Architecture, the building will be two stories with a clerestory on the roof. The first floor will house classrooms and laboratories, and the second floor will contain offices and more classrooms. The goal of our project is to calculate all internal and external loads and design the structural system necessary to withstand the applied loadings. Additionally, we designed the footings and performed detailing on various connections throughout the structure.

Project Hope

Riverfront Farm is a neighborhood-wide community farm program in Spokane, WA. One aspiration of the farm is to be a demonstration site for alternative “green” technology. The goal of this project is to help Riverfront Farm accomplish this by researching and developing green technologies to create a sustainable building and surrounding farmland.

The focus of the project is retrofitting Riverfront Farm’s “Project HOPE demonstration building” which is a historic building that is not currently a sustainably built structure. The project will put this structure and its surrounding land through a comprehensive “green” remodel in an effort to reduce the building’s environmental impact.
Kootenai Medical Center

The Kootenai Medical Center (KMC) is a 246-bed community-owned hospital in Northern Idaho. It employs over 1,700 people, making it the largest employer in Kootenai County. KMC will expand by creating a separate facility to serve women and children. This building will provide a more comfortable stay for women that are pregnant and in labor as well as newborns and young children by supplying high-quality medical facilities and equipment.

The KMC design team has the responsibility of performing all necessary design calculations to allow the building to withstand all service and environmental loads. The deliverables will be a set of detailed drawings that show the size and location of all structural members. This project gives the Senior Design Team an opportunity to acquire a deeper understanding of the design process and the requirements enforced by the codes and local jurisdictions.

Change Agents....

Department of Transportation

Our project is for the Department of Transportation. We are designing the hydrologic analysis for a new Spokane city arterial, which will run from I-90 to Cheney-Spokane Road. This analysis includes gutter, curb inlet, swale, and dry well design. We are also providing an offsite hydrologic analysis and alternative pavement design.

CE 8 Team: Julie Guthrie, Joshua Richards, Jeremiah Woodard
Advisors: Noel Bormann, John Davis
Liaison: Greg Lahti
Pend Oreille Park

The purpose of our project is to design a buildable set of plans for the construction of an RV park within Pend Oreille County Park, which is located approximately 45 minutes north of Spokane on Highway 2. There exists an equestrian trail system around the park, but Pend Oreille County is interested in building a site which will include lots for people with horse trailers and lots for RV parking. Our project includes a complete road design based on topographical survey information of the site, as well as a water system analysis for an extension of the water line from the existing well to meet the new demand. Our project also includes a design for a restroom facility, with an emphasis on sustainability. Our primary concern is ensuring that construction of this park is economically feasible, while also providing an affordable camping destination for families.

B-Hive Test

Our group is working with Boeing to test an API they’ve developed. This software is designed to take large amounts of data, and we are working with the City of Spokane Solid Waste department, and the Gonzaga Sociology department to gather data on fuel usage and human behavior in hopes of increasing the efficiency of the fleet of solid waste removal vehicles.

CPSC 1 Team: Matthew Strohmeyer, Rob Nertney, Scott Pfeifer
Advisor: Christopher Smith
Liaison: Steven Tabacek, IT Lifeline

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IT-Lifeline

Our project is sponsored by ITLifeline. They currently send out salespeople with an excel document to create quotes for people. The aim of this project is to make a website which works from a communal database, allowing for a web frontend. This will clean up the inconsistencies in the creation of quote generation and allow different levels of users to have different levels of access to change pricing for a single quote. The quote generation system is being left open for possible expansion of the company which would allow for multiple sites to be adding their own resources and be sold separately through the same salespeople.

PowerData

The PowerData Corporation makes a product known as the PowerData PowerSimulator. This software is a database with a graphical user interface which simulates power grids. In practice, operators use this technology for training and testing different situations. This senior design project is based around the development of a load-balancing, parallel version of this software using the in-house Linux cluster. The goals for this project are to allow a greater amount of users to operate concurrently, to automate the software to duplicate when overloaded, and to increase overall performance by reducing the amount of updates to the database through a merge and filter scheme.
Congratulations to the Graduating Seniors of 2010!
# Center for Engineering Design Exposition Day

**April 30, 2010**

11 am—5 pm  Project Displays in Herak Building, Main Floor

## Final Project Presentations

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<thead>
<tr>
<th>Location</th>
<th>Project</th>
<th>Time</th>
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<tr>
<td>Foley Teleconference Rm.</td>
<td>EE-1  SEL Comm. Analyzer</td>
<td>2:00 pm</td>
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<td>EE-2  Energy at GU</td>
<td>2:30 pm</td>
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<td>EE-3  Drug Reactions</td>
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<td>CPSC-3 IT Lifeline</td>
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<td></td>
<td>CPSC-1 Boeing B-Hive</td>
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<td></td>
<td>CPSC-2 Power Data</td>
<td>4:30 pm</td>
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<td>College Hall, Room 237</td>
<td>CE-7  Kootenai Medical</td>
<td>2:00 pm</td>
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<td>CE-3  GU Parking</td>
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<td>CE-1  Catholic Univ. of Sudan</td>
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<td>CE-6  Project Hope</td>
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<td>CE-5  SCC Tech Ed Bldg.</td>
<td>4:00 pm</td>
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<tr>
<td>President’s Conference Rm,</td>
<td>CE-2  Bike Lane</td>
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<tr>
<td>College Hall, Room 204</td>
<td>CE-8  DOT</td>
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<td>CE-4  Selkirk School</td>
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<td>CE-9  Pend Oreille Park</td>
<td>4:30 pm</td>
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<td>Wash/Cal Room in COG</td>
<td>ME-11  Boeing Fan Nozzle</td>
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<td>ME-1  NIOSH</td>
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<td>ME-3  LHC2 Prototype</td>
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<td>ME-2  LHC2 antenna</td>
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<td>ME-10  Mobius Robotic Head</td>
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<td>Crosby Road to Utopia Rm</td>
<td>ME-9  Alliance Tamper</td>
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<td>ME-8  Kimball Router</td>
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<td>ME-7  Boeing Debris</td>
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<td></td>
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