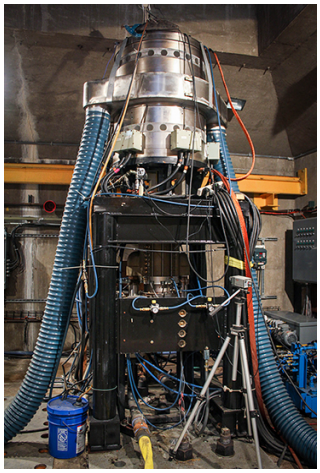
Equipment

Turbine Testing - A 21'x23' gas turbine test cell has been added to the high energy spin bunker to operate turbines as a prime power source for direct drive genera-tors. The Turbine Test Cell includes a rigid mounting system that was installed with consideration given to the need to reconfigure a test setup based on a variety of necessary test equipment.

Pulsed Power Test Bed - Currently the pulsed power testbed is powered by an 18 MJ capacitor bank composed of eighteen 1 MJ bank modules. These modules can be independently charged and triggered to provide a tailored current pulse shape for grid stability testing in the presence of large pulse loads. This power bank supplies the High Energy Medium Caliber Launcher (HEMCL) capable of 2 MJ muzzle energy at an exit velocity in excess of 2 km/s. This test bed is also equipped with a projectile recovery tank designed to capture and stop a high velocity test package with minimal deceleration and little to no damage incurred.



Kahn Water Brake Dynamometer - The 5MW Kahn Series 100 hydraulic dynamometer are designed primarily for testing of high speed turboshaft engines at speeds up to 23,000 rpm and at power absorption levels of up to 7,000 hp. Power is absorbed by vortices generated by the perforated disk rotors and stators; the resulting drag applies a moment to the dynamometer housing which is measured with a strain gage torque reaction sensor. Absorbed power is modulated by controlling the amount of water in the dynamometer with the inlet and outlet control valves. The dynamometer is bi-directional and is capable of both vertical and horizontal orientation; this is critical for testing of vertical axis motor/generators for advanced energy storage flywheels. The electro-pneumatic inlet and outlet control valves control the flow of water to the dynamometer based on commands from the Kahn Series 545 digital dynamometer controller. The hydraulic dynamometer provides a controlled load for a prime mover such as a gas turbine or electric motor..

Digital Real-Time Simulator - The lab features both an RTDS (Real-Time Digital Simulator) Novacor 2.0 and an OPAL-RT real-time simulator, enabling high-fidelity, real-time simulation of complex power systems. These platforms facilitate closed-loop interaction with physical controllers and relays, supporting the development, validation, and de-risking of advanced control systems under realistic operating conditions.

When operated in HIL (Hardware-in-the-Loop) mode, the simulators execute power system models in real time to support rigorous controller design and testing. The system is supported by a suite of power amplifiers for CHIL (Controller Hardware-in-the-Loop) applications, including both Doble F6150 and Omicron 256 plus amplifiers, as well as the GTNET card communication protocol modules for interfacing with controllers and protection relays, such as Woodward genset controllers and the SEL-351 protection relay. These interfaces support both analog I/O and digital communication protocols such as IEC 61850, Modbus, and others.

Power Grid Equipment:

Motors/generators – (1) 2 MVA, 12,000 rpm

Resistive Loads - 1.3 MW Resistive load and 2 MW chopper

Rectifiers - 3.2 MVA (diode), 1.2 MVA (controlled), 1 MVA (Toshiba)

Inverters: 1 MVA (Toshiba), 2 MVA (ARCP)

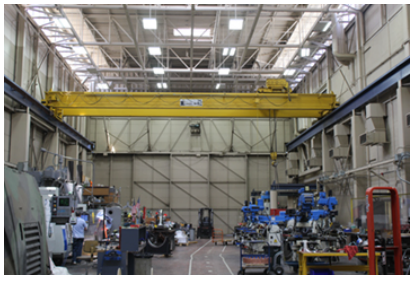
Utility Power: two 480 Vac 3φ utility supplies
Transformers: 490 kVA, 1.2 MVA multi-tap

Equipment

Power Electronic Building Block converters (PEBB) - The PEEB power converter concept is to create a single modular electronic power package that can be easily modified to create a variety of different power converter packages. These power converter types include AC to DC (passive and active rectification), DC to AC (inverter, DC to DC step up (boost), and DC to DC step down (Buck). The Center for Electrome-chanics employs 10 PEBB converter modules. These modules are made up of a Semikron Semistak RE power converter assembly. That feature an IGBT based Skiip 4 intelligent power module (IPM) in a three-phase half-bridge configuration.

Power Switching, Filtering and Fault Introduction - To allow for switching and line filtering, there are 8 modular three phase 1600Amp isolation contactor and 130uH inductor sets to be utilized at the optimal point in the test circuit. A large capacitor bank has been added for additional filtering options. The capacitor bank consists of 100 capacitors, each rated for 500uF at 2000Volts. The capacitor bank can be divided into smaller sections for best performance as determined by the desired test parameters. With the capability of switching in different capacitive and inductive values, the test circuit and filtering are easy to modify to meet testing goals. Additional high current and high voltage breakers are utilized to introduce short circuit faults in the test circuits. The three phase breakers consist of two 3000Amp, 4000 Volt units. The breakers combined with different test loads allow for short circuit fault tests from a few to hundreds of amps all depending on the circuit oper-ating voltage and the selected fault load. Control software has been implemented on the control circuits to detect the short circuit faults and interrupt the current flow. Additional standalone circuits have been developed to detect and locate the system faults.

Hardware for performing DC series fault tests includes electrodes, linear motor, and containment system. DC series fault tests can be performed at different bus voltag-es as well as different current levels from a few to hundreds of amps. The ability to perform many different types and levels of tests illustrates the flexibility of the micro-grid system at CEM.



Overhead Cranes - Two 25 ton overhead cranes for main high bay area, additional 25-ton overhead crane for machine shop, smaller 3-ton crane in auxiliary machine shop.

Available Power - In addition to various bench top instrumentation power supplies, CEM also has a 250 Volt 6,000 Amp de power supply located in the main high bay. 4160 V available in the second story transformer vault, with 480 V available throughout the high bay.

Assembly Press - The primary hydraulic composite assembly press in the high bay is 40 ft tall and is capable of generating forces in excess of 500 tons with room for 20 - 25' parts and a 60 in. stroke, one smaller 200-ton H-press with 13 in. stroke, one smaller 200 -ton hydraulic four-column assembly press.

The University of Texas at Austin
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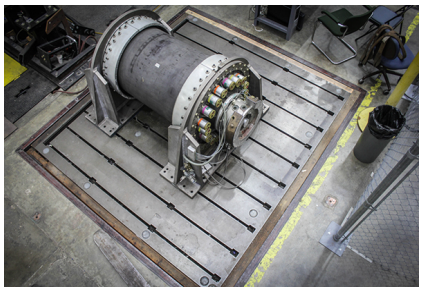
Equipment



Tie Down Pads
Five machine tie-downs throughout the high bay.

Granite Slab
Available for precision assembly.

Drill Presses
- Summit Radial Arm 18" Column 6' Arm
- 2 Miscellaneous Drill Presses

Saws
Tannewitz Band Saw 36" Throat
Kalamazoo Horizontal Band Saw 6"x 12"

Grinders
- K.O Lee Surface Grinder
- 2hp Tool Post Grinders (2x)
- Hammond S"Pedestal Grinder
- Rockwell Disc I Belt Sander

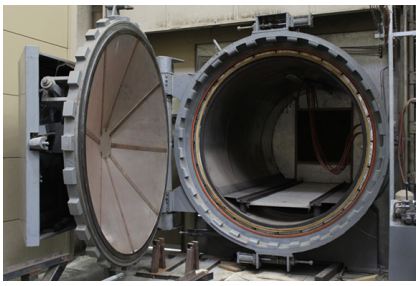
Milling Machines
- Haas Model VF7 Machining
- Hurco CNC Model DMl
- Giddings & Lewis 3• Horizontal Boring Mill
- Summit 350 3 hp 10· x SO" Table (2X)
- SummitSS0S hp 11·xs2·Table(3X)

Lathes
- Victor 20" x 80"
- Sheldon 6" x 24"
- Ryazan 52"x 16"
- Victor 17" x 60"
- Sebastian 13"x 32"
- Hercules 32"x 80"

Welding Shop
- 1200 sq ft external shop used for prototype welding
- Equipped with an ESAB 2-axi oxy-acetylene table, along with both metal/inert gas (MIG) and tungsten/inert gas (TIG) welding machines.

Filament Winding
This dedicated low lab space equipped with environmental controls houses a McClean Anderson 5-axis CNC filament winding machine. The system is capable of processing parts up to 66 in. in diameter and 40 ft long using both wet winding and pre-impregnated fiber tows. The winding machine has been modified with a specially designed fiber payout system to enable processing of high modulus graphite fibers with minimal fiber damage.

Equipment



Autoclave
A dedicated autoclave, manufactured by American Autoclave, is used to cure composite structures. The fully programmable autoclave is rated for 650° F, 250 psig, and can process composite parts up to 7 ft in diameter and 11 ft long. The autoclave can process a range of materials including epoxies, cyanate esters, BMIs, some lower temperature polyimides, and thermoplastics.

Material Characterization
CEM developed a burst test method for characterizing the tensile strength and modulus of filament wound composite rings. The hydroburst test fixture enables a reliable and cost-effective method for assessing material properties of advanced composites (fibers, resins, and fillers including nanoparticles). The fixture can be operated at room or elevated temperature and enables statistically significant generation of critical thermo-mechanical properties, which can be used to establish material design allowables.