# Continuously Variable Series Reactor (CVSR)

Team:

Oak Ridge National Laboratory
Managed by UT-Battelle for the US Department of Energy
SPX Transformer Solutions, Inc.
Waukesha Electric Systems, an SPX Company
The University of Tennessee Knoxville


Contact info:

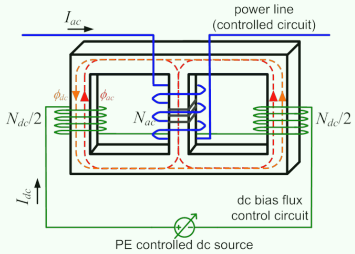
**Aleksandar Dimitrovski, PhD**
One Bethel Valley Rd.
P.O. Box 2008, MS-6070
Oak Ridge, TN 37831-6070
(865) 574-3610, (865) 574-9329 fax
dimitrovskia@ornl.gov


## Objective

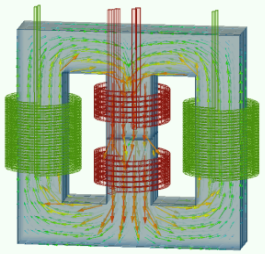
**Simple, reliable, and efficient power flow control device that is cost- effective for system-wide deployment and full control of the power grid.**

## Approach

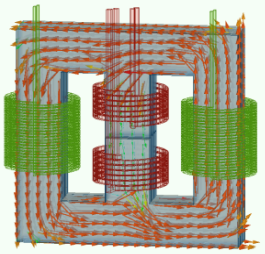
**CVSR is based on the concept of magnetic amplifier, a saturable reactor where the saturation of the magnetic core is controlled by a dc circuit that is magnetically coupled with the main ac circuit.**




**A small current in the control circuit produces bias flux that changes the reactance of the main circuit and controls much larger current in the power line.**

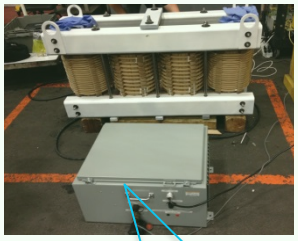


**Unsaturated core without bias flux allows for unimpeded ac flux development and full reactance.**

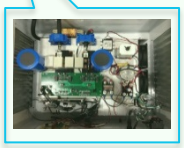


**Saturated core with bias flux impedes the ac flux and limits the reactance.**

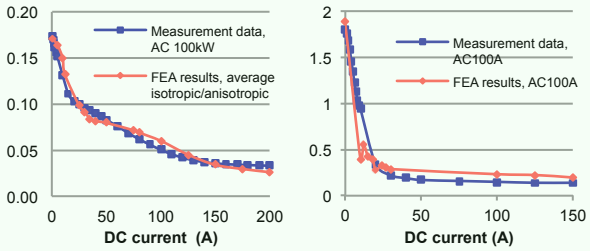
## Laboratory demonstration unit



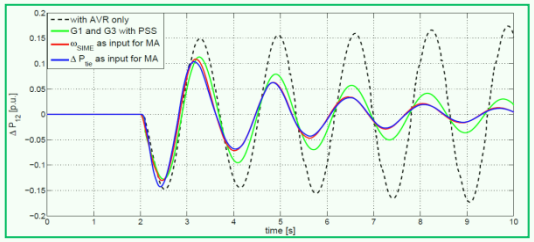
**480 V, 200 A demonstration units for proof of concept, research, and testing.**



Reactance (Ω)




Transient response (simulation results)




## Field demonstration unit

**- A 115 kV, 1500 A single-phase CVSR unit has been built and under testing.**

**- Designed regulation range has been validated by preliminary tests.**

**- Three-phase field demonstration is planned for early 2015 in a utility substation.**

## Characteristics

**A special magnetic amplifier design that:**

- **isolates sensitive power electronics from the high voltage and current power flow**
- **uses a low power dc source and eliminates the need for superconductive winding and cryogenic equipment**
- **enables smooth reactance regulation**
- **minimizes harmonics**

## Applications

**Potentially a versatile control tool to:**

- **relieve power flow congestion**
- **damp slower speed electro-mechanical and inter-area oscillations to improve power system stability**
- **limit fault currents and decrease the required rating of power system devices**
- **balance phase asymmetry**

**An effective way for full control of the power grid and making the grid part in "smart grid" smart.**

Oct. 2014