Power Center for Utility Explorations

USF
UNIVERSITY OF SOUTH FLORIDA

Capabilities and Operational Interests for Electricity Infrastructure Hardening

Alex Domijan

Power Center for Utility Explorations

The mission of the PCUE is to explore power systems issues comprehensively and develop innovative solutions to the complex challenges in electricity infrastructure, and to train the next generation of power engineering professionals.

Objectives:

- **To instill in students a passion for the electric power engineering field**
- **To invigorate faculty and utility involvement**
- **To assist the power industry by providing value operationally and providing a place for lifelong career development.**

Current Capabilities

1. Unique facilities
2. Faculty expertise
3. Extensive collaborations on infrastructure development
4. An electric utility specific power engineering program with numerous outreach efforts.

1. Unique Facility:
Power and Energy Applied Research Laboratory (PEARL)

- The PEARL facility was the first lab in the world to be able to monitor and replicate field conditions to evaluate performance of power system elements. The lab has been doing applied electric power utility work in power quality, reliability, alternate energy, demand response, and many other areas for 20 years. PEARL is a focal point for power system studies by students, utility engineers, manufacturers, and faculty.

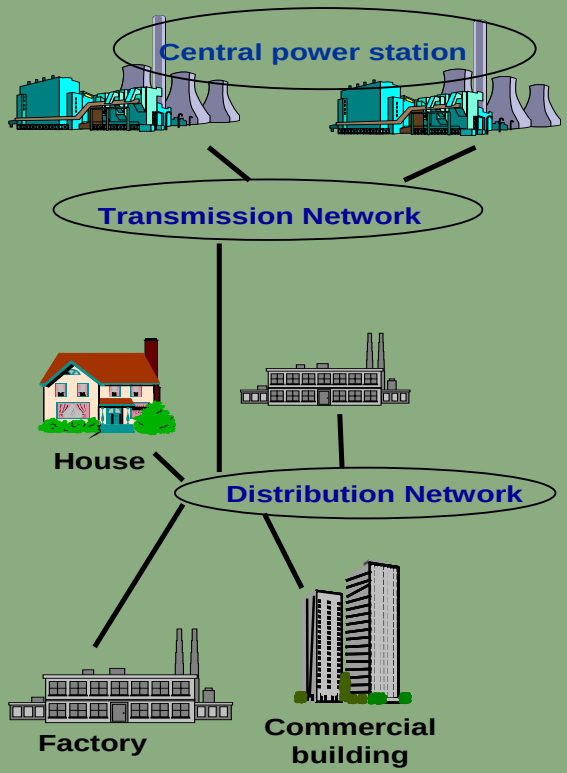
2. Faculty Expertise

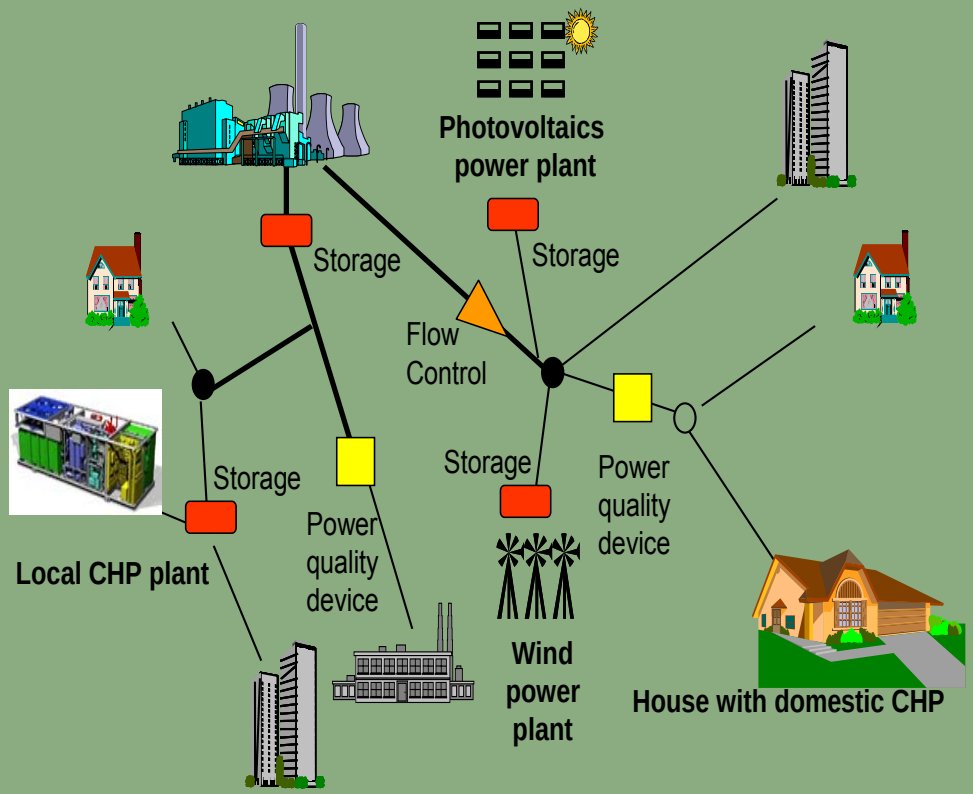
- Dr. Alex Domijan (flexible-reliability-intelligent-energy-delivery-systems, weather and reliability, power quality),
- Dr. Suresh Khator (performance of underground vs. overhead systems, computer data-base management),
- Dr. Ralph Fehr (system planning, power education, distribution systems),
- Dr. Rimas Slavickas (Infrastructure management and cost/benefit analysis, load factor improvement analysis),
- Dr. Carlos Alvarez, affiliated faculty (distributed systems, micro-grids, non-intrusive measurements).
- Additional collaborators include Dr. Lee Stefanakos and Dr. Yogi Goswami in alternate energy systems.
- Approximately 30 faculty from around the world (Spain, Japan, Taiwan, South Korea, Europe) are affiliated via the FRIENDS effort in electrical infrastructure development.

3. Collaborations on Infrastructure

- The Flexible-Reliable-Intelligent-Electrical-eNergy-Delivery-Systems (FRIENDS) is a decade long international collaborative effort to form a road-map from the grid of today to the future. The future electrical grid may be one that is hardened for various contingencies, including severe weather, but fits within the financial realities of present utility systems. FRIENDS efforts include hardened substation architectures, reliable grid topologies, and quality control centers, among many others. Collaborations with experts involved with systems that are similarly affected by severe weather are desirable and may be shared with Florida utilities to assist in hardening issues.

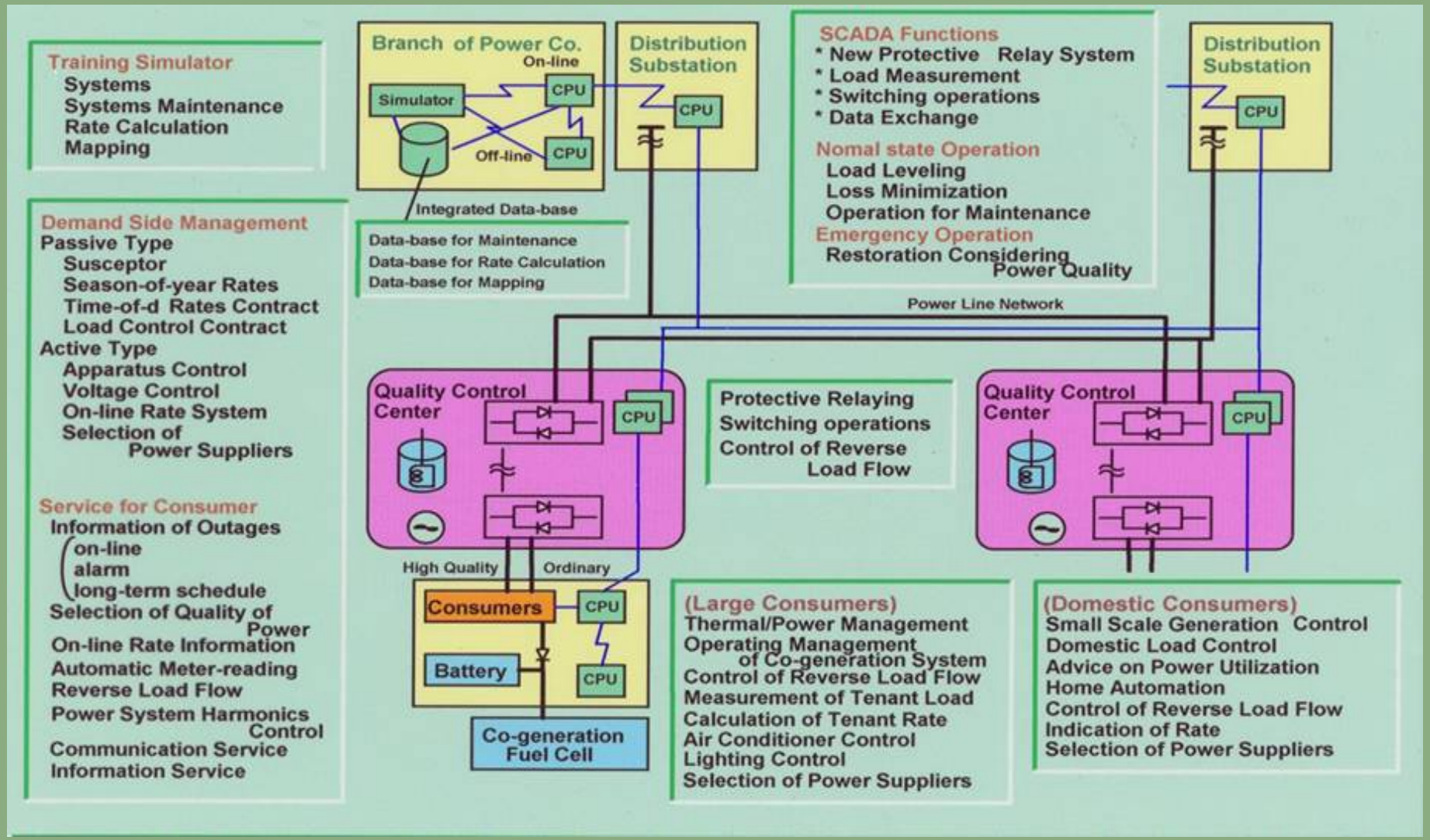
Power Center for Utility Explorations





- Traditional Grid Structure
- Evolution to Central Station plus Distributed/On-Site Generation with Integrated Real-Time Network Management & Demand Response

FRIENDS and Advanced Substation Designs (Quality Control Centers)



Working with State University Partners

- The Florida Coastal Monitoring Program at UF working in collaboration with PCUE at USF would enhance hurricane information during the event in a weather and reliability database.
- The Center for Advanced Power Systems at FSU is a collaborator on electricity infrastructure and their lab facility has substantial capabilities for real-time analysis.

4. Electric Utility Power Engineering Program and Outreach

- Electromechanical Systems 1 ● Electromechanical Systems 2 ● Energy Conversion Laboratory ● Electric Utility and Energy Systems Seminar Series ● Power System Analysis 1 ● Power System Analysis 2 ● Industrial Power Distribution 1 ● Industrial Power Distribution ● Power Quality ● Power Electronics ● Electronic Converter Systems and Drives ● Utility Distribution Systems ● Power System Protection● Power Markets ● Energy Management Systems ● Power Plant Engineering ● Power System Reliability.

  Special Feature: Joint International Degree Power & Energy Program with FRIENDS partner Spain
- **Numerous Outreach Activities**: Power Cons on Blackouts, New Technologies, PQ, Weather and Reliability

The Next Generation

- The next generation of power engineers, as well as current utility engineers, can be assisted to better prepare themselves to meet the challenges of operating and hardening the electrical grid. The PCUE power program may be used to meet this challenge in collaboration with the utility industry, state universities, and many other international partners.

Interests

- Projects performed related to the electrical infrastructure have included: weather and reliability, grid optimization, demand response, premium power park, FRIENDS, and biomass systems, among many others.

Operational assistance may include topics such as:

- Weather and Reliability studies and monitoring;
- Grid Hot Spots determination and solutions;
- Technology evaluations and forensic analysis;
- Performance of Underground and overhead systems;
- Additional Interests: Power Quality, Micro-grids, distributed systems, system planning, demand response, vegetation management needs determination, crew allocation and manpower needs for fast restoration of service, real time monitoring and non-intrusive measurements.

Interests related to FPSC Initiatives:

Initiative 9 - Collaborative Research on the Effects of Hurricane Winds and Storm Surge;

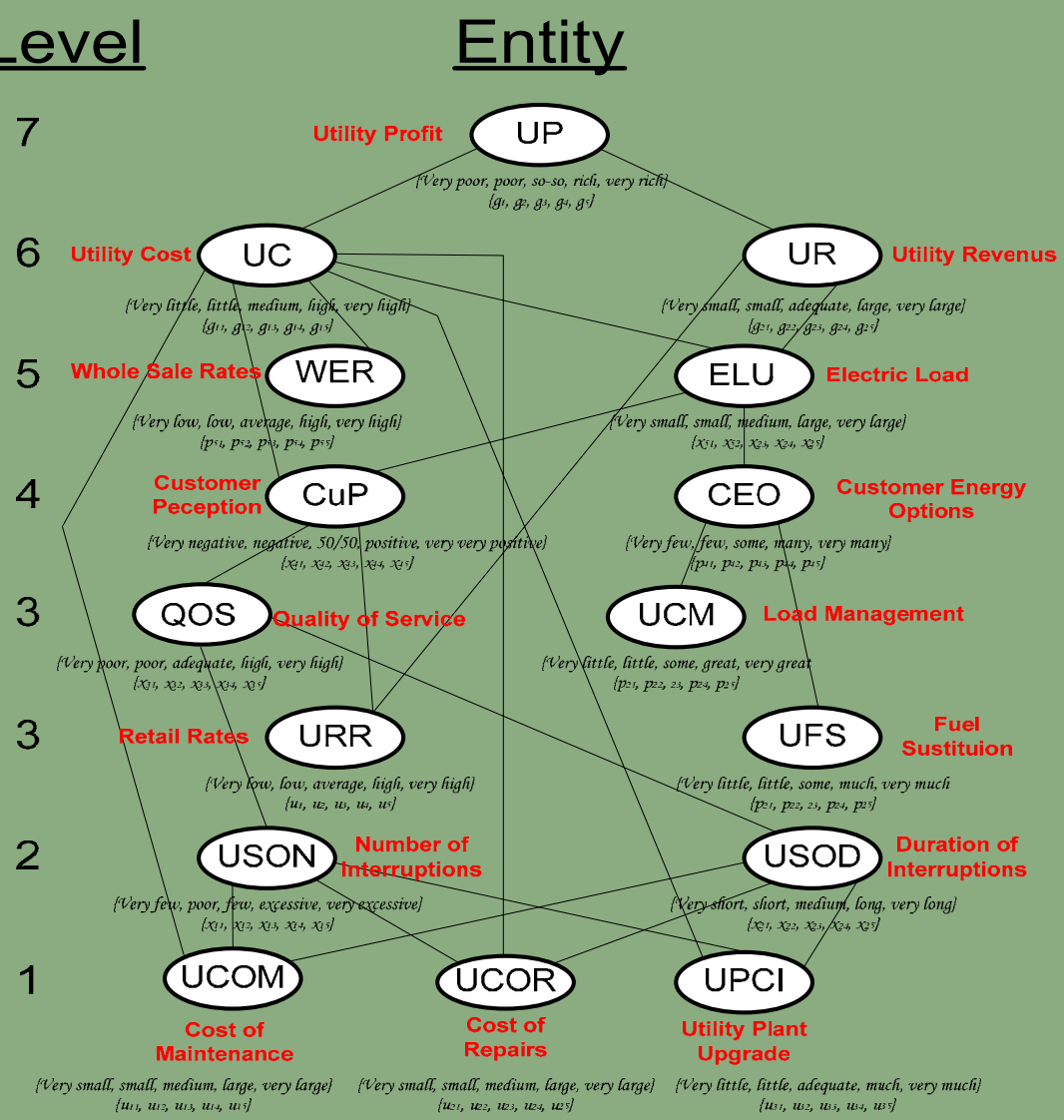
Initiatives 5&6 - T & D GIS, Post-Storm Data Collection and Forensic Analysis;

Initiative 7 - Collection of Detailed Outage Data Differentiating Between Reliability Performance of Overhead and Underground Systems;

Initiatives 8 & 10 - Increased Utility Coordination with Local Governments, and A Natural Disaster Preparedness and Recovery Program.

Dilemmas in Utility Decisions

- **What can be done?**
- **What should be done?**
- **When should it be done?**
  (Before or after the storm?)
- **Where should it be done?**
  i. *Geographically*
  ii. *Circuit location*



Hierarchy of 7 levels of logical entities

Factors that can be Evaluated & Road Maps Developed

Reliability, Revenue, Cost to rate base, Customer interruptions, Restoration time

Thank you