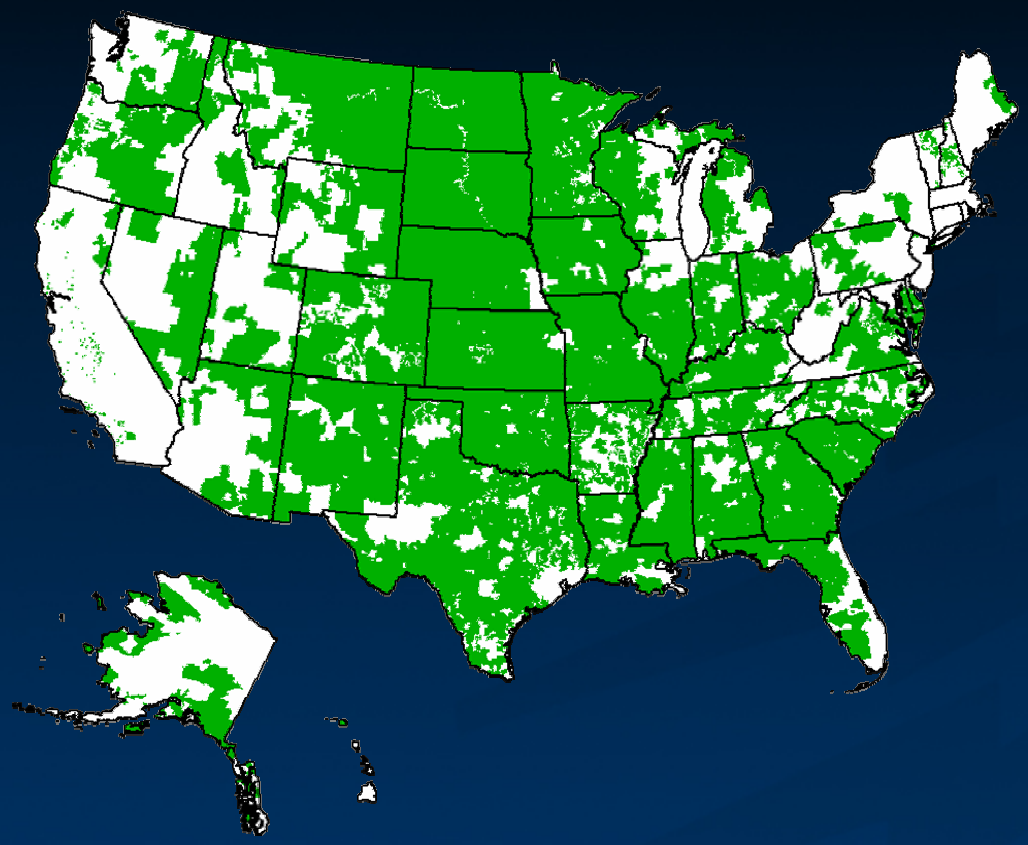
NRECA
Cooperative Research Network

Modern Grid Initiative
Southeast Summit
August 10, 2006
Nashville, TN

NRECA
CRN®
COOPERATIVE RESEARCH NETWORK

Electric Cooperatives . . .



- 864 distribution, 66 G&Ts in 47 states
- 5% of power supply
- 43% of distribution lines, 75% of land mass
- 39 million consumers
- 60% residential, 35% commercial/industrial

NRECA CRN COOPERATIVE RESEARCH NETWORK

NRECA . . .

690 Employees at NRECA Supporting 60,000 Co-op Employees - - -

- Legislative, Policy & Communications
- Retirement, Health & Dental Insurance
- Homestead Mutual Funds
- Education/Training to >20,000 registrants

NRECA CRN COOPERATIVE RESEARCH NETWORK

CRN Website: Primary delivery channel for results

Home | About CRN | Research Areas | Results | News | Resources | Contact Us

NRECA CRN COOPERATIVE RESEARCH NETWORK

BUSINESS AND TECHNOLOGY SOLUTIONS FOR ELECTRIC COOPERATIVES

Log-in to access member content. ID: Password: Log-In

Search Advanced >>

NRECA's Cooperative Research Network monitors, evaluates and applies technologies that help electric co-ops control costs, improve productivity and enhance member/customer service.

RESEARCH AREAS ...

END USE SOLUTIONS »
Evaluate consumer services and technologies that can improve energy efficiency, increase comfort and satisfaction, and lower costs.

RENEWABLE ENERGY & DISTRIBUTED GENERATION »
Increase knowledge of emerging renewable and alternative energy technologies to ensure innovative use based on sound business decisions.

INFORMATION & DIGITAL COMMUNICATIONS TECHNOLOGY »
Evaluate emerging technologies for consumer use and utility value.

TRANSMISSION RELIABILITY & SECURITY »
Address capacity demands and mitigate security vulnerabilities and risks.

DISTRIBUTION OPERATIONS BEST PRACTICES »
Balance operational effectiveness and cost control in all aspects of engineering and operations.

GENERATION, FUELS & ENVIRONMENT »
Help ensure the continued use of abundant coal resources as a cost-effective power supply in compliance with environmental regulations.

WHAT'S NEW ...

Attend CRN's first Member Summit, August 15, 2006, in Minneapolis, MN. More >>

CRN uncovers short-term solutions to coping with transmission congestion. More >>

What are the costs and benefits of Regional Transmission Organizations? More >>

Catch up with CRN activities through **E Update**, CRN's biweekly email. »

TechSurveillance Magazine

A Journal for CRN Members May 2006

Utilities Share Concerns, Successes with Bird Diverters | Story >>

Demand Controllers Help Small Commercial Customers | Story >>

The Virtual Power Plant: A Concept Worth Exploring | Story >>

How Can Cooperatives Fight Rising Copper Thefts?| Story >>

CRN R&D Process

- MAG meetings provide guidance, suggestions for new project ideas with deliverables in one to two years.
- These projects are then presented to CRC (Cooperative Research Council) for funding decision.
- Between meetings, the MAG works with CRN staff providing feedback on each project's progress and deliverables

NRECA CRN COOPERATIVE RESEARCH NETWORK

CRN R&D Process

- High priority projects that bubble up between meetings can be approved in a fast track process.
- TechSurveillance is continuously used to flesh out ideas and develop white papers like:
  - New distributed reactive power source may reduce grid congestion
  - California tests flywheel matrix for

Transmission Reliability and Security

Membership Advisory Group (MAG)

Alabama Electric Cooperative
Arkansas Electric Cooperative Corporation
Associated Electric Cooperative
Basin Electric Power Cooperative
East River Electric Cooperative
East Kentucky Power Cooperative
Georgia Transmission Corporation
Great River Electric
Hoosier Energy REC
Tri-State G&T Association

Tennessee Valley Authority (Invited Guest)

NRECA CRN COOPERATIVE RESEARCH NETWORK

Research Portfolio Priority and Projects

- Enhance performance of new & existing assets
  - Investigate and demonstrate software to prevent system collapse
  - Outline short term solutions to transmission congestion
  - Address transmission line siting barriers including cost analysis of overhead vs. underground transmission lines

NRECA CRN COOPERATIVE RESEARCH NETWORK

Mission

- Provide technology solutions to Electric G&T's and co-ops that optimize the existing and evolving transmission system, enhance reliability, and mitigate security risks

NRECA CRN COOPERATIVE RESEARCH NETWORK

CRN TRAS Website

Home | About CRN | Research Areas | Results | News | Resources | Contact Us

NRECA CRN COOPERATIVE RESEARCH NETWORK

RESEARCH AREAS

Welcome, Dale Bradshaw [Logout] Search Advanced >>

Home > Research Areas > Transmission Reliability and Security

- Distribution Operations Best Practices
- End Use Solutions
- Generation, Fuels & Environment
- Information & Digital Communications Technology
- Renewable Energy & Distributed Generation
- Transmission Reliability & Security

Transmission Reliability & Security

Provide technology solutions to electric cooperatives that optimize the existing and evolving transmission system, enhance reliability, and mitigate security risks.

About

Our Research Agenda | Advisory Group Members | How To Get Involved

Recently Completed

04-20 Short-Term Solutions to Transmission Congestion

05-13 RTO Costs and Benefits

Resources

NEETRAC: Research reports and component failure analysis

- What is CEATI?
- Tri-State G&T Transmission Research Projects
- TVA Research & Development Program
- Power Flow Control Using Distributed Series Impedances
- IPIC Distributed Series Impedance
- IPIC Solid State Transformer
- Intelligent Power Infrastructure Consortium Briefing
- Navigating The Futureof Supply
- Power Systems Engineering Research Center
- Short Term Solutions Transmission Congestion
- Status of Current Markets and Energy Policy

WHAT WE'RE WORKING ON ...

- 06-04 Evaluation of Voltage Stabilizing Technologies
- 06-03 Real Time Reliability Technologies
- 03-25 Siting Barriers
- 05-14 Underground vs. Overhead Transmission: Tools and Analysis to Help Quantify and Compare Design Costs

TECHSURVEILLANCE MAGAZINE ...

Utilities Share Concerns, Successes with Bird Diverters
(May 2006)

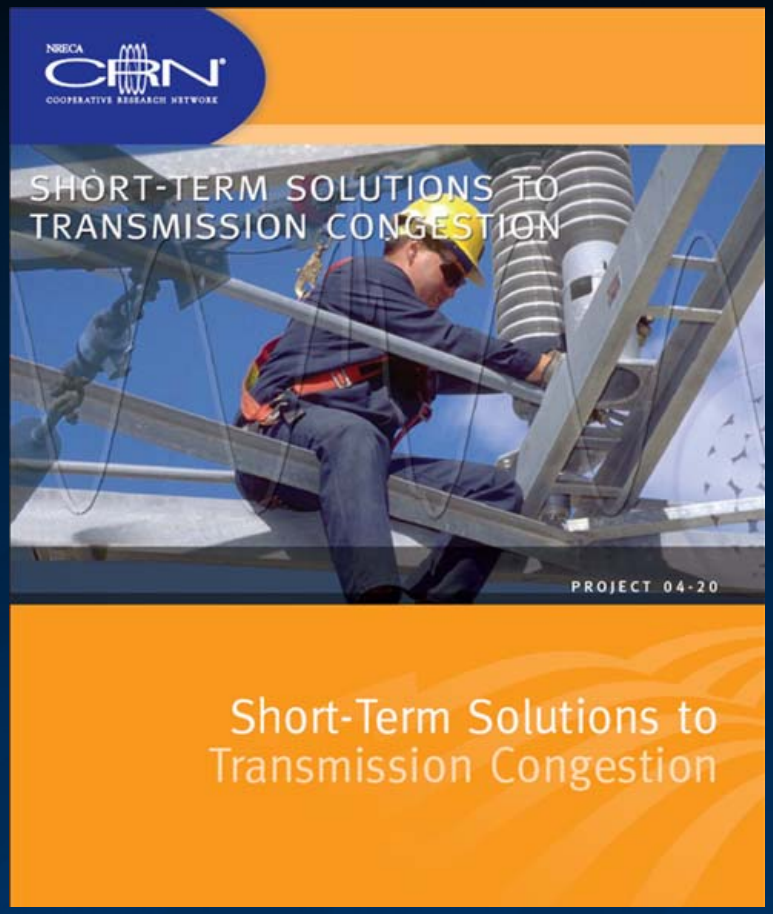
Both the U.S. Fish and Wildlife Service and the nation's utilities seek to reduce bird collisions with power lines that result in outages and bird deaths.

New Distributed Reactive Power Source May Reduce Grid Congestion
(February 2006)

California Tests Flywheel Matrix for Frequency Regulation
(February 2006)

Completed Short-Term Solutions to Transmission Congestion

- Priority of Fixing Transmission Congestion:
  - Implement transmission optimization software
  - Examine and implement dynamic rating of lines
  - Improve EMS (or install EMS if not in place)
  - Install Advanced Conductors and upgrade transformers
  - Install distributed dynamic flow control devices
  - Install FACTS devices



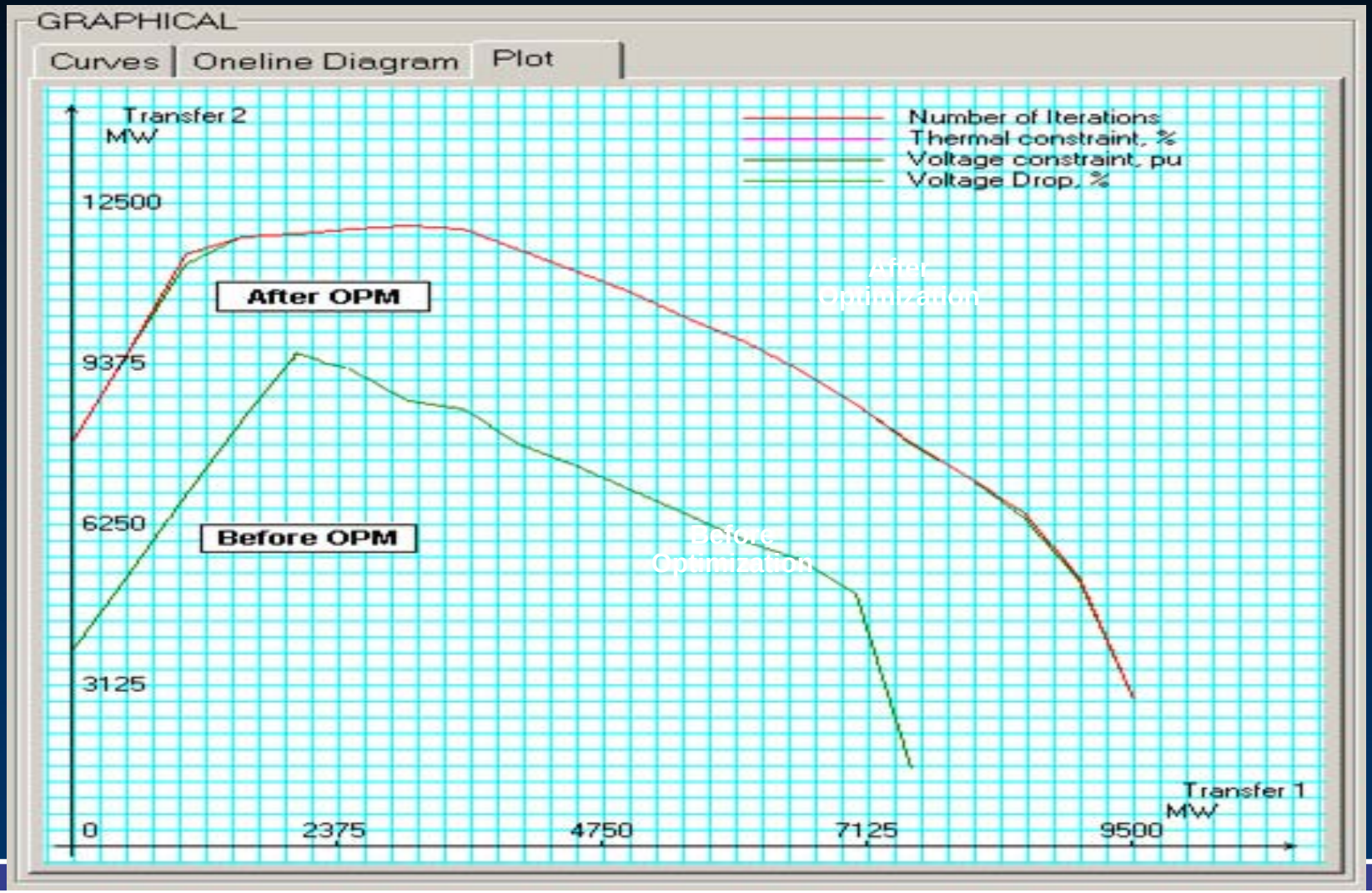
NRECA CRN COOPERATIVE RESEARCH NETWORK

Impact Comparison of OH vs UG Lines

- Visibility
- Environmental
  - Wetlands, water, threatened and endangered species habitat, cultural resources
- Land use
  - Agriculture, airports, roads
- EMF

NRECA CRN COOPERATIVE RESEARCH NETWORK

CRN Project to Evaluate Real Time Reliability (Optimization) Software with HOST EKPC

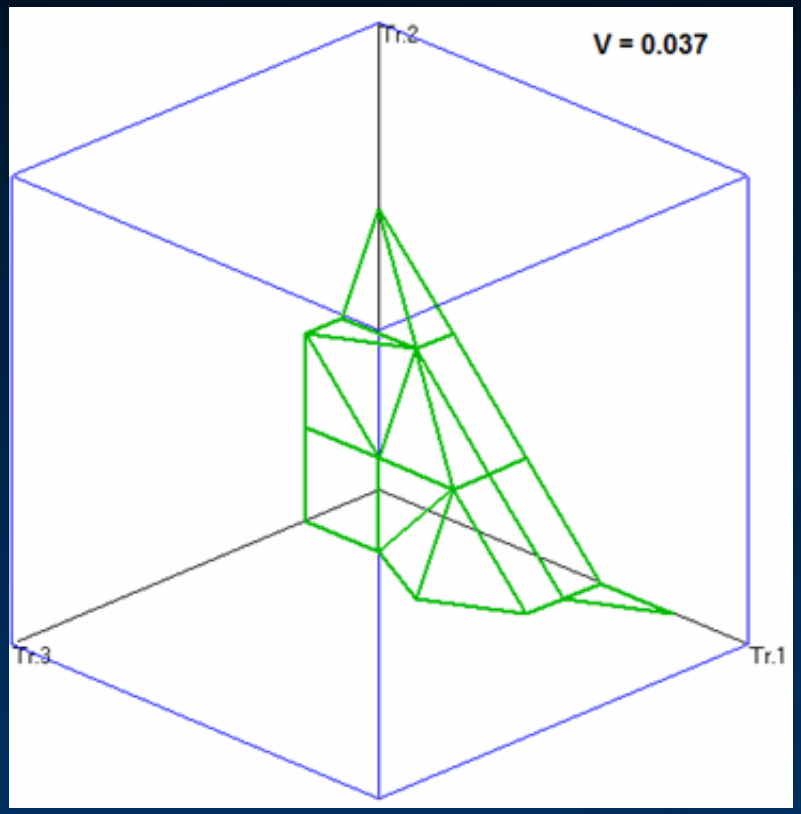


Possible Optimization, Mitigation Measures Used in On-Line Optimal Tools & for Planning

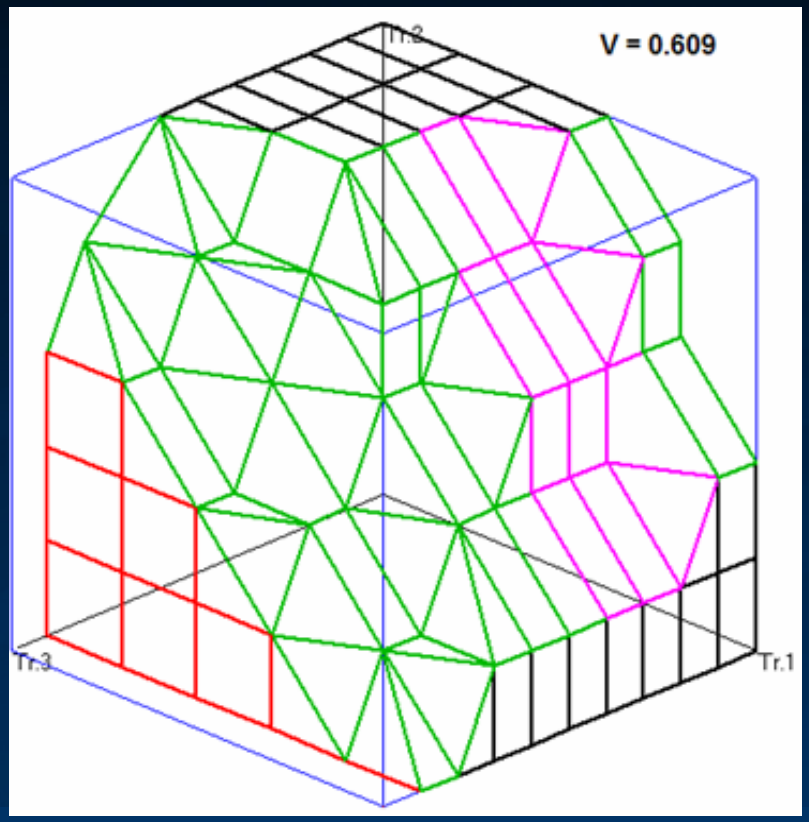
- Applies a minimum number of mitigation measures based on user-defined priority schedule which may include:
  - MW Dispatch
  - MVAr Dispatch
  - Capacitor and Reactor Switching
  - Transformer Tap Change
  - Line Switching (In and Out)
  - Optimal Capacitor, Reactor, FACTS, SuperVAR^{tm} Placement and size
  - Phase Shifter settings
  - Load Curtailment
  - Defined Operating Procedures
  - Switching Not Affected Lines

NRECA CRN COOPERATIVE RESEARCH NETWORK

Using Optimization Software to Increase Size of Operating Region in an Operating Environment at EKPC

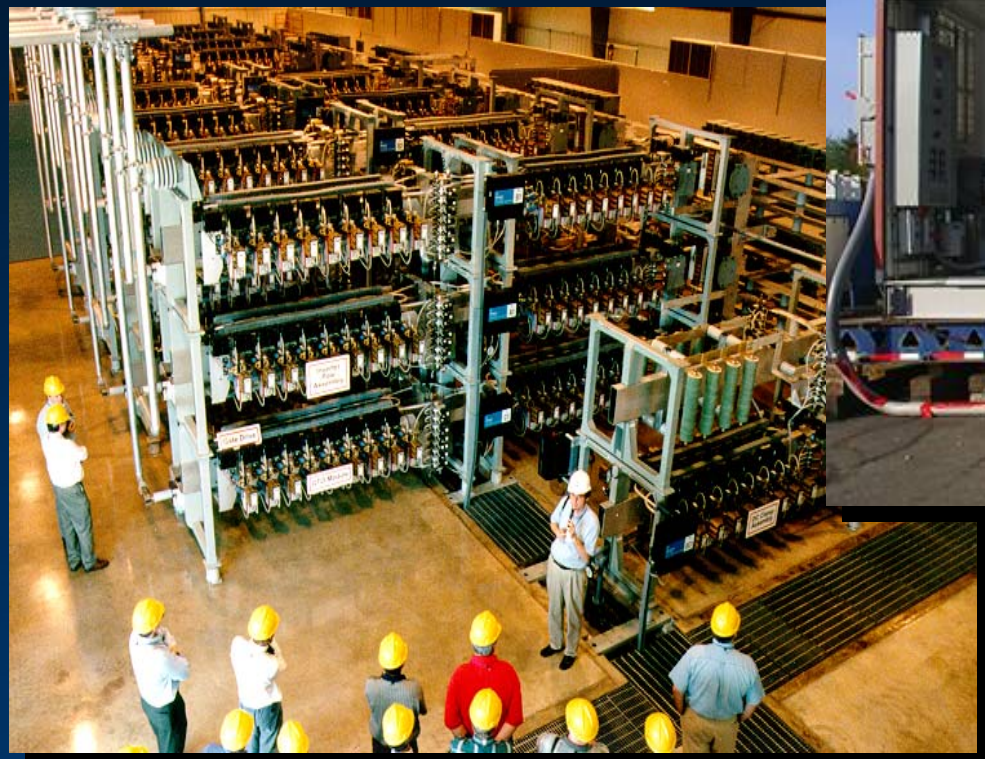


Results prior to using Optimization



Results after using Optimization

CRN Project to Evaluate Voltage Stabilizing Technologies at Tri-State and Basin Electric



NRECA CRN COOPERATIVE RESEARCH NETWORK

“Back to the Future” with a High Temperature Superconducting Synchronous Condenser

- New lower cost option ($50/kVAr) for dynamic reactive compensation.
- Instantly 2X output for transients and 4X output for peaks.
- Low operating, maintenance cost (50% less energy than current options)
- Supports transient stability (inherently stable)
- Commercially available now
- Prototype successfully tested in TVA service area in 2005

CEATI Overhead Line Design Issues & Wind and Ice Storm Mitigation (WISM)

Topics & Issues

Utility approaches to crisis management

De-icing techniques during and following ice storms

Failure containment and load control devices

Prediction and real-time monitoring of loads

Design for High Intensity Winds

Inspection techniques to detect latent damage and aging

Assessment of existing conductor vibration recorders

Simulation of conductor galloping and galloping mitigation device assessment

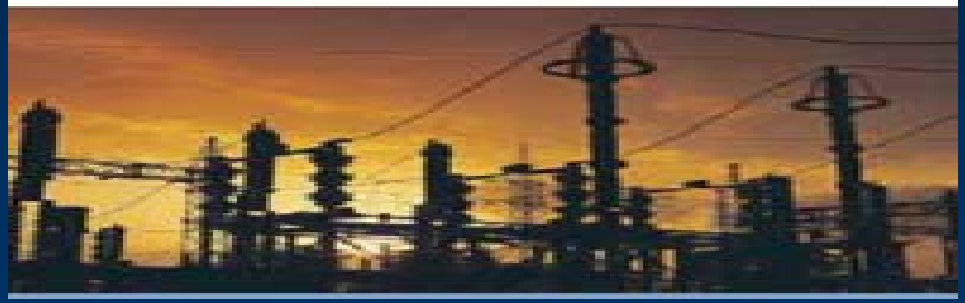
OHL protection against lightning without impairing line strength under ice loads

CEATI Life Cycle Management of Substation Equipment and Apparatus (LCMSEA)

Topics & Issues

Operational Optimization
- On-line Equipment Condition Monitoring to Aid in Predicting Pending In-Service Failures
- Equipment Diagnostics and Maintenance
- Equipment Condition Assessment
- Seek Out, Assess and Implement New Monitoring Technologies.
- Establish "Best Practices" from the Group Expertise

Life Optimization
- Insulation Aging/Deterioration Control
- Validating Tools for Predicting Remaining Life
- Validating Tools for Life Extension of Equipment
- Safety & Environment Preoccupations



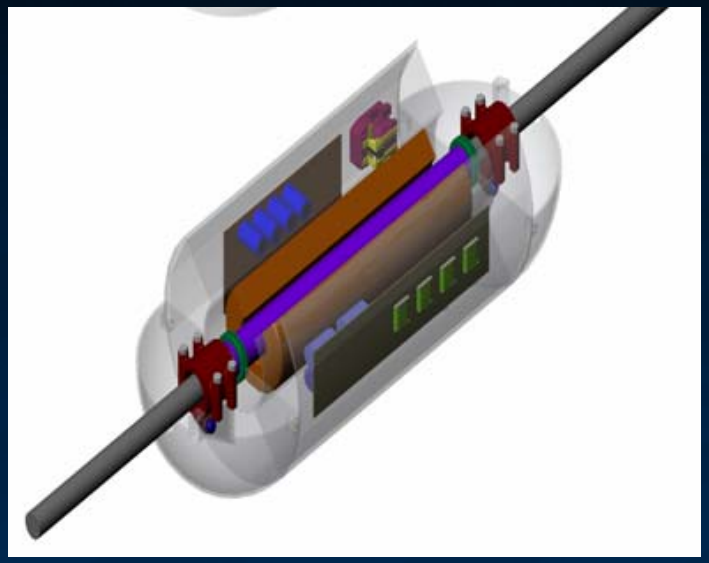
Initiatives Under Development

- "Installing your first Phasor Measurement Unit (PMU)"-- likely partner, TVA
- Evaluate a project to develop soil databases to identify areas with poor grounding (lightning mitigation) and corrosion potential
- Monitor results of the TVA Distributed Series Impedance test of GATECH IPIC's Current Limiting Conductor and evaluate joining the next phase of the project to develop a "Smart Wire" for commercial power flow control

NRECA CRN COOPERATIVE RESEARCH NETWORK

“Smart Wires” Power Flow Control Device

- Defer building of new lines
- Massive redundancy
- Zero footprint solution
- Mass produced modules
- Easy and rapid installation



- Control power flow along contract path
- Maintenance with existing workforce
- Reduced time to deploy and overall cost

NRECA CRN COOPERATIVE RESEARCH NETWORK

Possible Near Term Technology for Low Cost Dynamic Flow Control Device "Smart Wires"

- Couplers that inject VARs in series to change line impedance to enhance system reliability & capacity when considering (N-1) contingencies
- $700 per mile to increase 138 kV line capacity 1%
- 30 mile line, a $216,000 investment could increase power flow by 10% or 12 MW

COOPERATIVE RESEARCH NETWORK

G&T's can potentially benefit from the ENTIRE CRN program – examples:

- Evaluation of Aging Conductors prepared by Dale Douglas
- Communication Infrastructure for Electric System Automation
- VRA-Vulnerability Analysis and Risk Assessment for Electric Cooperatives
- Automating a Distribution Cooperative
- Implementing a SensorNet

NRECA CRN COOPERATIVE RESEARCH NETWORK

Transmission Reliability and Security

RESOURCES TO:

Reduce Cost

Improve Reliability

Minimize Congestion

Avoid Blackouts

NRECA CRN COOPERATIVE RESEARCH NETWORK

Thank you!
Courtesy NASA