



IAB News

Newsletter of the Industrial Advisory Board, Power Systems Engineering Research Center

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May 2002, Vol. 2, Issue 2

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Thoughts from the Chair

Dale Bradshaw, TVA

Transmission Technology Issues and Resulting Transmission Technology Gaps for PSERC R&D

Generation reserve shortfalls resulted in the electricity price spikes of the late 1990s. These high prices created a stampede to install new generation, particularly by Independent Power Producers (IPPs). Over 98% of the announced new generation was natural gas-fired peaking and combined cycle facilities which are quick to install and easy to permit.

Terry Boston, TVA's Transmission and Power Supply Executive Vice President, cites this IPP "gold rush" as the source of the exponential increase in transmission transactions with transmission system loadings increasing significantly to levels not anticipated and with power flows from unexpected directions.

Within a few years, transmission reserve margins disappeared and transmission congestion created winners and losers among generation providers, depending on the location of their generating assets.

Merchant Plant Locations Aggravate Congestion

IPPs tend to build their merchant generation where gas lines and power lines intersect, apparently with little

knowledge or concern of whether the transmission system has spare capacity. Generation assets near load centers could easily be worth an order of magnitude more than those on the far side of a point of transmission congestion relative to the load center. To make matters worse, IPPs often build in states where permitting time is short and certain, but not necessarily near load centers, thereby further aggravating transmission line congestion.

Very few merchant plant builders requested firm transmission rights; instead they planned on using less expensive, low tariff transmission services utilizing excess capacity. Unfortunately for the builders of merchant plants hoping to capitalize on the power price surges, the spikes generally occur when system overloads force transmission providers to use TLRs to cut non-firm transactions.

Is New Transmission Investment Too Risky?

In 1996 FERC Orders 888 and 889 supported the advent of competition in generation markets; however, unfortunately they appeared to create uncertainty for return on investment (ROI) for transmission investments. For the investment community, investment in new transmission lines seems to be too risky and long term (5 to 10 years).

Investment in new transmission lines and assets plunged, allowing reserves to drop to dangerous levels which could result in unreliable service, outages, poor power quality and economic losses. EPRI has estimated these losses to be currently 120 to 180 billion dollars per year. Generally, only lower cost, short term and low risk transmission upgrade investments are being pursued to keep transmission systems hanging on.

Because the electricity and the power traders don't follow the same set of rules, the transmission system path used by the flowing electrons and the path paid for by the traders don't always match. This can result in overloaded lines and inadequate compensation for the transmission provider. Without necessary revenues, the transmission company is unable to upgrade the transmission system.

The numbers of voltage sags and collapses and blackouts have been increasing with 90% of the problems caused by a lack of transmission capabilities rather than a shortage of generation.

R&D Needed to Bridge Gaps in Transmission Networks

Research and development (R&D) to support advancements in flexible, low-cost, mobile voltage support and power flow control devices is clearly needed to bridge the gaps in transmission networks. Continued improvements are desperately needed in advanced conductors, distributed dynamic voltage support devices, dynamic thermal circuit rating systems, improved power system communications and distributed T&D energy storage systems.

Merchant generation, sited considering only local transmission system impacts, can result in overloaded conditions on long distance Extra High Voltage (EHV) transmission lines. As the FERC vision for increased competition is realized and more merchant generation is built, power flows will need to be rescheduled to minimize losses and contract paths will likely be shorter. Thus, if new long distance EHV transmission is built, it may be useful for only a few years. This situation leads to the conclusion that flexible, mobile solutions, such as distributed voltage source converters or energy

storage devices, should be included in the set of solutions to transmission problems.

Many transmission lines have been loaded beyond the line surge impedance loading (SIL) causing an exponential increase in the need for reactive compensation (capacitors) to maintain voltage. With loads increasing at 3% per year, the need for reactive compensation will grow at 9% per year. However, the addition of static, slow-switched capacitors has reduced the voltage stability margins for all transmission systems. This requires that additional capacitors be added to the system for stability. Overall, as loads increase at 3% per year, the total need for capacitors could be greater than 27% per year to maintain voltage stability!

A potential phenomenon of fast voltage collapse may face the transmission system owners in the future, but the stability models of today are very much out of date. With the widespread use of digital economy devices, the models of customer loads may no longer be conservative and may underestimate the speed of voltage collapse.

The addition of merchant generation that is transient sensitive, unreliable and has little or no reactive compensation reduces the transient stability margin of the associated transmission system. In addition, large existing generators are attempting to reduce their reactive output in order to maximize their energy output.

In addition to stability and voltage issues, some transmission lines are reaching and exceeding their thermal limits. To overload beyond these limits for more than 30 minutes could damage the line conductors with the possibility of permanent line sag increases beyond safety limits. This points to the need for improved dynamic circuit rating devices along with advanced conductors.

R&D Needs Fit PSERC's Capabilities

These are some of the issues and gaps facing transmission providers and the industry. To overcome these and continue to reliably provide high

quality power for consumers will take further technology advancements.

Thus, the time is ripe for targeted, results-driven R&D; the type of R&D that PSERC has shown that it can deliver. The time is also ripe for thinking with PSERC researchers about industry directions along with the associated R&D needs. And the additional benefit that R&D provides in helping our researchers educate our industry's future power engineers is an important bonus! PSERC offers high value in these changing times.

PSERC:

An Asset of Increasing Value

Mike Agee, Duke Energy

PSERC is a collaborative organization of universities, industry, the National Science Foundation, and others. Industry involvement is critical for its success. Certainly value will be obtained at any level of participation. I would like to suggest possible ways to gain even more value for your investment in PSERC.

There is an old analogy that I think is still true. Much like joining a gym to get into shape, you pay your dues, but to get into shape you have to get involved and exercise. I tried just paying dues. Didn't lose a pound! Attending the Industrial Advisory Board meetings and ensuring that PSERC's research results are placed in the hands of the people in our companies that can use them, provides a great deal of value.

There are even more opportunities to gain additional value with limited additional time requirements.

- Participate in Stem Committee meetings/conference calls. Due to PSERC's size and the limited time available at industrial board meetings, much of the preliminary project selection and strategic directions of the Stems is conducted in Stem meetings/conference calls. Additional value can be obtained by actively participating in Stem activities and by expanding involvement of others within your company to cover all three Stem areas. You have the choice to

actively participate in the conference call or to be on the distribution list for information. Either way, you can provide input and value through the discussion or by email.

- Interact with the students during IAB meetings
- Participate in project update meetings and discussions. If you have a particular interest in a project, call and talk with the researchers.
- Submit ideas for new research that would be meaningful to your company
- Publicize and promote the internet seminars and training short courses so those people in your company who have an interest can participate
- Share access to the PSERC website within your company to ensure the research is more broadly available
- Ensure the student resumes are shared within you company and made available to your HR recruitment departments

PSERC is a unique resource that can be tapped a number of ways. These are but a few opportunities for doing so in order to make PSERC an asset of increasing value to your company.

Transmission Grid Study Available

The [National Transmission Grid Study Report](#) has been released. Fernando Alvarado (Wisconsin), George Gross (Illinois), Tom Overbye (Illinois), and Shmuel Oren (Berkeley) contributed to this significant report. As directed by the Administration's National Energy Policy, the report addresses current US transmission issues. A copy can be obtained by going to the website: <http://tis.eh.doe.gov/ntgs/reports.html>.

Calendar of Events

May 30-31, IAB Meeting, Schenectady, NY

August 15-19, Summer Retreat, Near Portland, OR

December 12-13, IAB Meeting, Atlanta, GA

(A [complete calendar](#) is on the PSERC website: www.pserc.wisc.edu).