

STEP SCWG Presentation

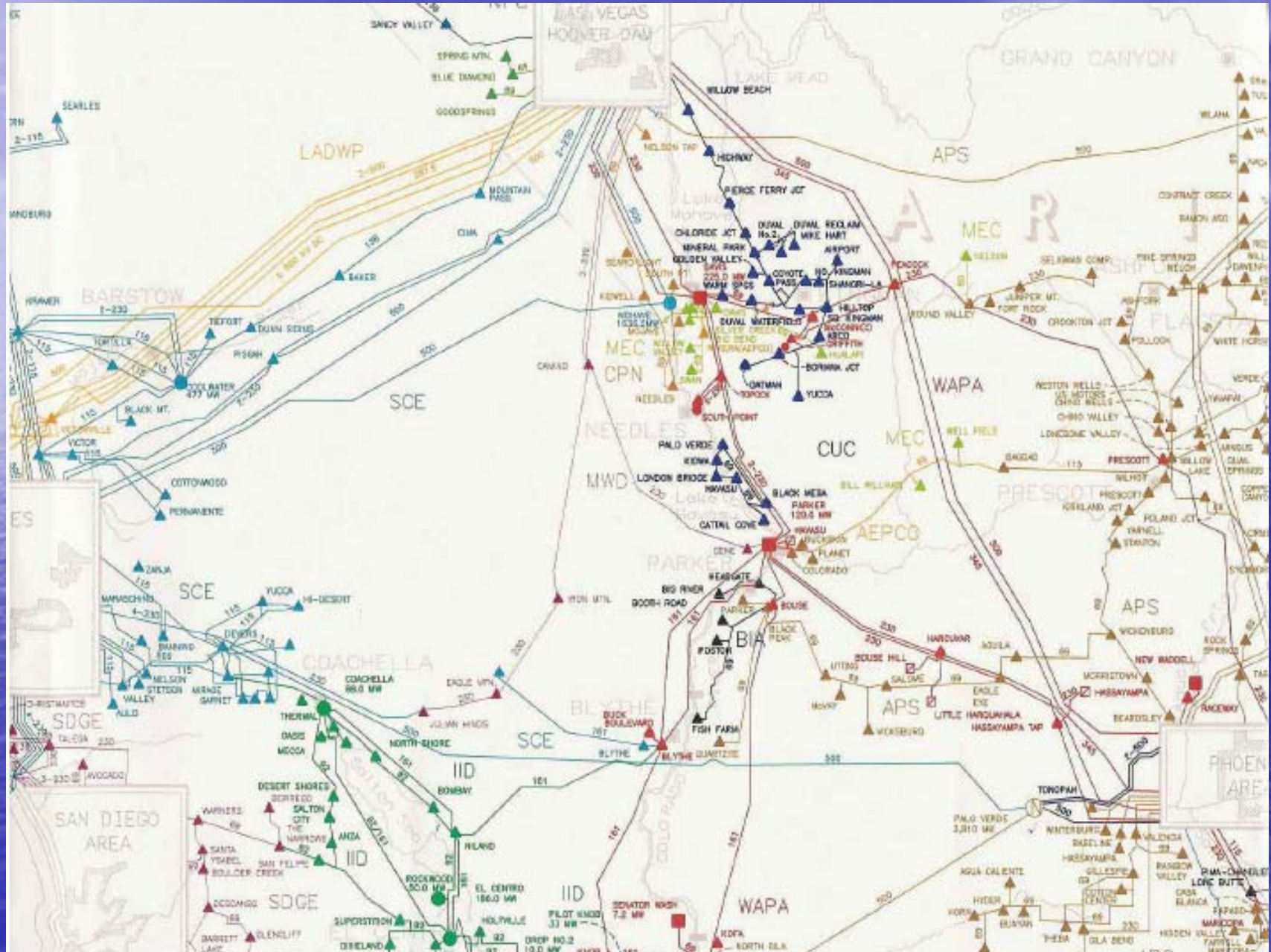
May 5, 2006
San Diego, California

Ron Moulton WAPA – DSW
Industry Restructuring & Transmission Planning

Power System Reliability

- Correct Relay Operation
- Correct Breaker Ratings
- Reliability Depends on Accurate Fault Current Calculations

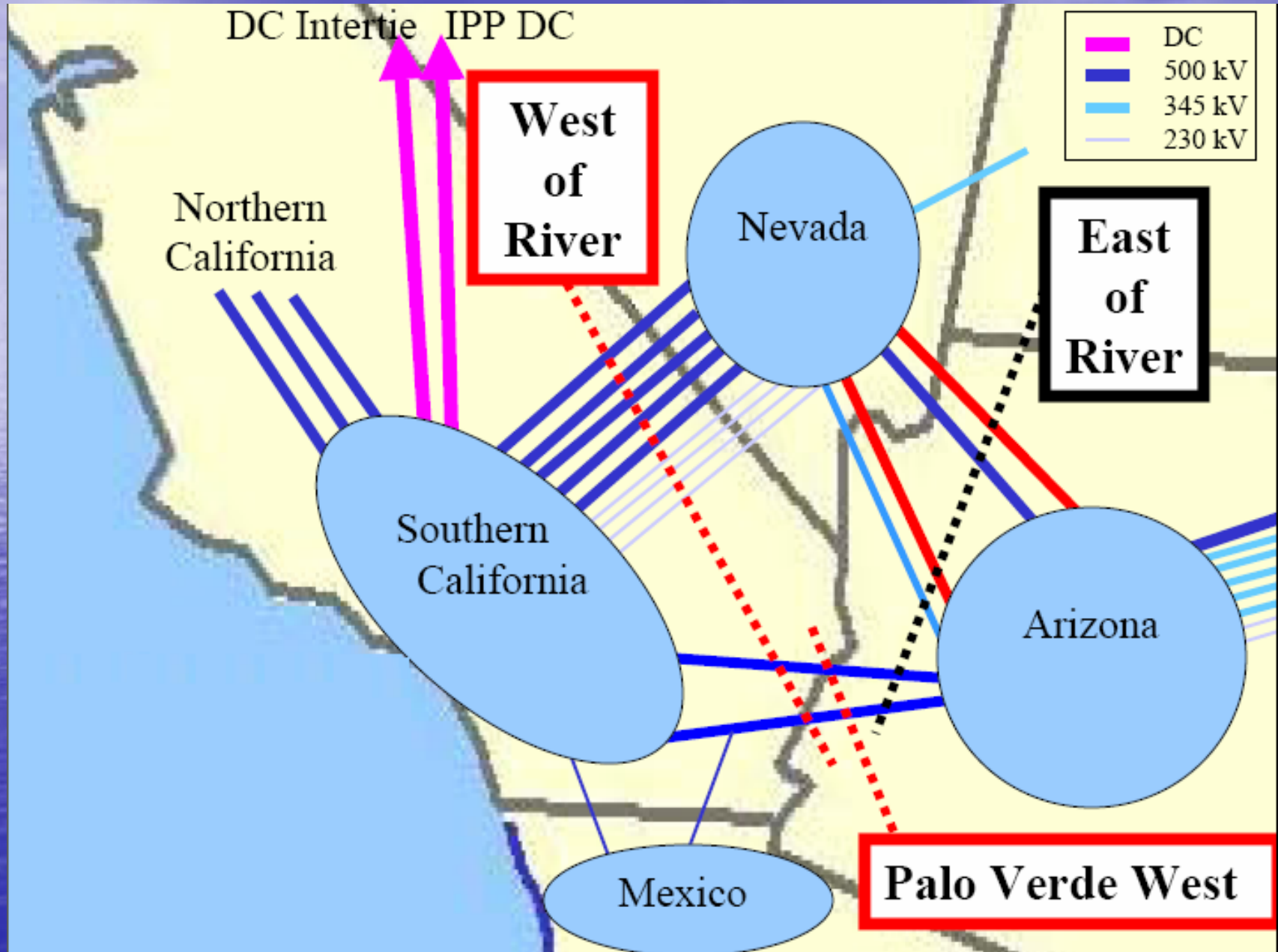
Interconnected System



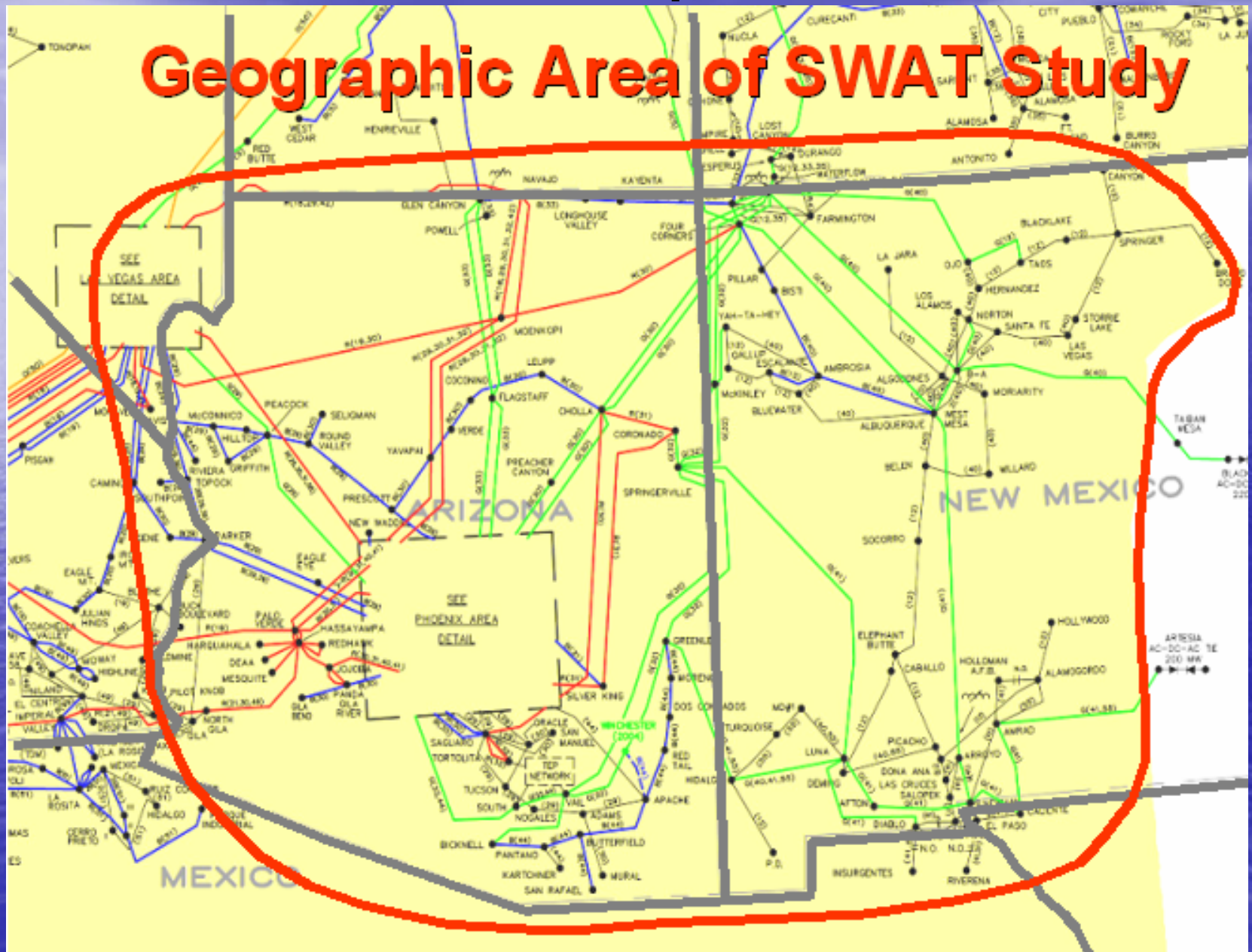
Reasons to Form Regional Short Circuit Working Group

- The interconnected system requires cooperation between everyone for accurate short circuit data.
- SWAT and CCPG recently formed regional Short Circuit Working Groups
- Regional groups combining cases to eliminate equivalents and increase accuracy

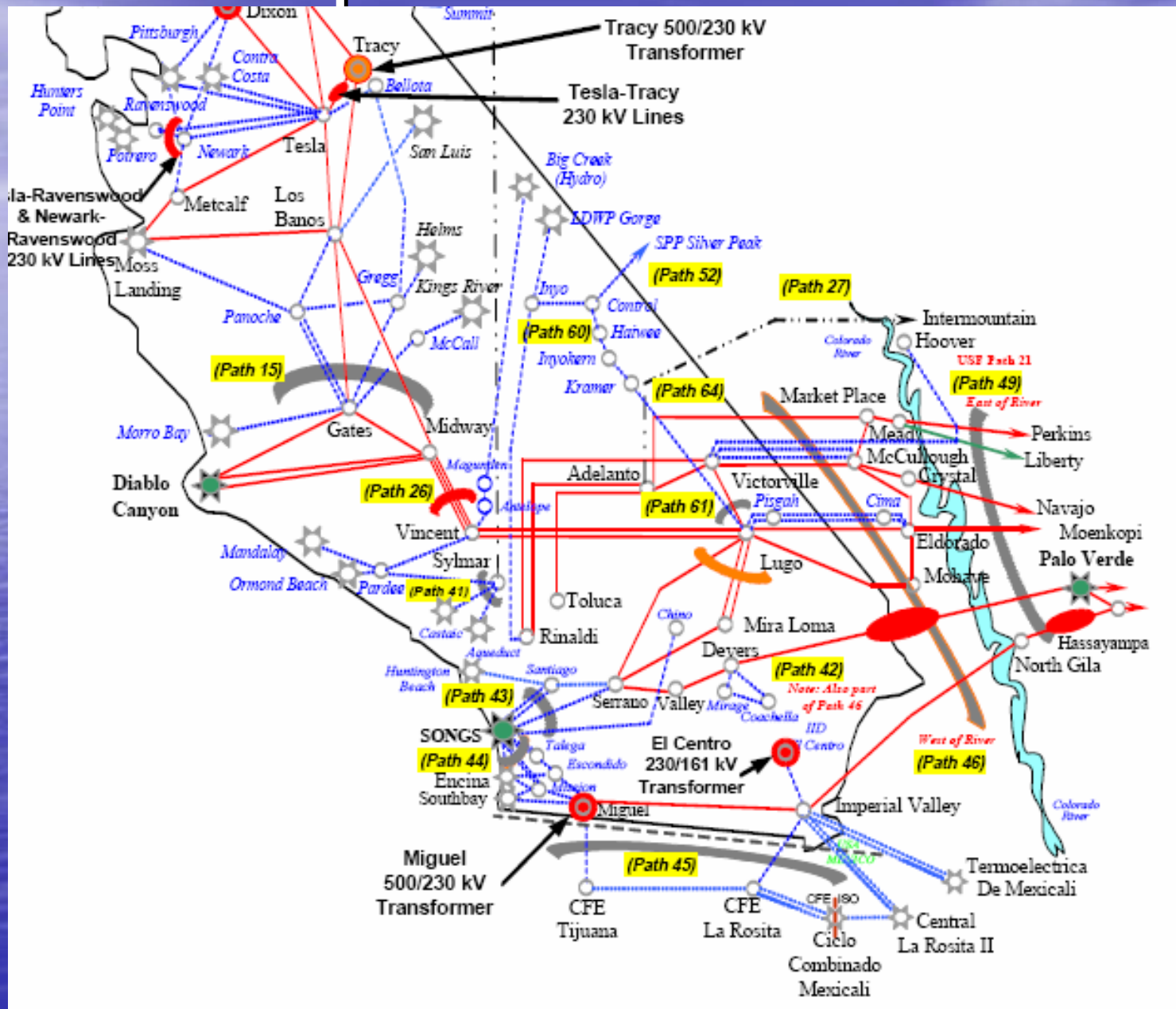
Interconnected System



SWAT SCWG Footprint



STEP Footprint



Regional SCWG Liaisons

SWAT SCWG Members

[Tom Field](#) WAPA

[Don Bryce](#) USBR

[Mark Etherton](#) SWRTA Class Two Consultant

[Steve Phegley](#) APS

[Maria Ramirez](#) SRP

[Gary Trent](#) TEP/Unisource

[Tom Spence](#) SWTC

[Steve Conrad](#) PNM

[David Barajas](#) IID


[Jorge Barrientos](#) IID alternate

[David Gutierrez](#) EPE

[Joe Trantino](#) - NPC/SPPC

[Bill Middaugh](#) - [CCPG](#) Liaison

SWAT SCWG Webpage

Address  <http://www.azpower.org/swat/>



AZ POWER

Planning for Arizona's future

PV-PW

PW-SEV/BRG

SWAT

CATS STUDY

ABOUT SRP

NEWS UPDATES

- **Subgroups**
- **Meetings**
- **Maps**
- **Reports**
- **Members**
- **Related links**

Southwest Area Transmission

Purpose and vision statement

Southwest Area Transmission (SWAT) is comprised of transmission regulators/governmental entities, transmission users, transmission owners, transmission operators and environmental entities. The goal of SWAT is to promote regional planning in the Desert Southwest. The SWAT regional planning group includes four main subcommittees, which are overseen by the SWAT Oversight Committee.



SWAT subgroups

View a [draft description of SWAT subgroups](#).

SWAT Short Circuit Working Group (SWAT- SCWG)

The SWAT-SCWG meets every third Thursday of each month.

Contact Thomas Field at Field@wapa.gov for more information or visit the

Click Here

[SWAT-SCWG Web site.](#)

SWAT SCWG

AZ POWER *Planning for Arizona's future*

PV-PW

PW-SEV/BRG

SWAT

CATS STUDY

ABOUT SRP

NEWS UPDATES

Southwest Area Transmission Short Circuit Working Group

Purpose and vision statement

The Southwest Area Transmission (SWAT) Short Circuit (SC) Working Group is comprised of transmission owners, transmission operators, and other interested WECC stakeholders. The goal of the SWAT SC Working Group is to promote regional short circuit studies and common methodologies for individually and jointly owned/operated transmission systems in the Desert Southwest.

[Jointly Owned Transmission System Map](#)

SWAT SC Working Group Charter

Click the link below to download the SWAT SC Working Group charter.

[SWAT SC Working Group Charter](#)

- [Meetings](#)
- [Documents](#)
- [Cases](#)
- [Maps](#)
- [Task Forces](#)
- [Members](#)

Scope of Work - Charter

- Annual Short Circuit Operating Case
- Common Methodologies
- Annual Standards Review
- Common Impedance Maps
- Boundary Equivalents
- Joint Planning SC Task Forces
- STEP Reporting

Annual Short Circuit Operating Case

- Improved Short Circuit Data for Relay Settings
- Improved Short Circuit Data for Breaker Duty Evaluations
- Improved Short Circuit Data for Safety Grounding and Arc Flash Evaluation
- Improved Reliability of System Operation and Maintenance Personnel Safety

Annual Short Circuit Operating Case

- Combining with adjacent Regional SCWG Cases annually improves data not in STEP region
- Improved data can be imported into Planning cases

Common Methodologies

- The lowest reliability breaker in a station determines the breaker reliability design criteria of the station.
- Different Programs and different people have different methods of breaker duty evaluations
- One methodology chosen for the jointly owned stations

Annual Standards Review

- Breaker Duty Studies, TRV Studies, Switching Studies, and Safety Grounding Studies based on standards
- Standards can change without a change in study methodologies
- Annual review of standards changes to determine if study methodology changes required

Example of Standards Change

TRV Issues

TRV Peak Decreased by 15% in C37.06-2000, C37.04-1999, and C37.09-1999

- 1. CB cannot interrupt 3 phase ungrounded fault**
 - a. NESC changed to cause this**
 - b. First-Pole-to-Clear factor decreased**

- 2. 170 kV and above no option**

Example of Standards Change – NESC Changes

NESC Changes

1990 NESC Section 171

Circuit breakers, reclosers and fuses shall be capable of safely interrupting the maximum short circuit current available from the system at the point of application.

2002 NESC Section 171

Devices that are intended to interrupt fault current shall be capable of safely interrupting the maximum short circuit current they are intended to interrupt, and for the circumstances under which they are designed to operate.

Example of Standards Change – IEEE Changes

First-Pole-to-Clear Factor

Section 5.9.1.2 C37.04-1999

$$E_2 = K_a \times K_f \times \left(\frac{\sqrt{2}}{\sqrt{3}} \right) \times V$$

E_2 = **Peak TRV voltage**

K_a = **Amplitude factor (1.4 above 100 kV)**

K_f = **First-Pole-to-Clear Factor**

V = **Rated Voltage in rms line-line**

Example of Standards Change – IEEE Changes

First-Pole-to-Clear Factor

K_f in 1979 C37.04 and C37.09

1.5 for three phase ungrounded faults (note: K_a was 1.44)

K_f in 1999 C37.04 and C37.09

1.3 for three phase ungrounded faults

cannot interrupt 3 phase grounded faults at rated interrupting current now because of this decrease in the first-pole to clear factor

There is an option of 1.5 for breakers between 100 kV and 145 kV

Example of Standards Change – IEEE Changes

First-Pole-to-Clear Factor

Note 6 for Tables 1,2, and 3 of C37.06-1997

$E_2 = 1.76$ times rated maximum voltage.

Note 6 for Tables 1, 2, and 3 of C37.06-2000

$E_2 = 1.49$ times rated maximum voltage.

Example of Standards Change – OSHA Interpretation

As you noted, Section 171 of the 2002 National Electrical Safety Code contains the following requirement: “Devices that are intended to interrupt fault current shall be capable of safely interrupting the maximum short circuit current they are intended to interrupt, and for the circumstances under which they are designed to operate.” I read this provision as requiring a circuit breaker to be able to interrupt safely any fault on the system. Section 171 also requires the utility to review the interrupting capacity before each significant system change, so clearly interrupting devices have to be suitable for the design of the system. It is the system, after all, that determines what types of faults can occur and what the maximum short circuit current is. For example, if a three-phase grounded-wye system is designed so that the circuit breaker may have to interrupt a three-phase ungrounded fault, then a circuit breaker design with a first pole to clear factor of 1.3 would not meet the requirement.¹ Further, this circuit breaker would not be suitable for installation on an ungrounded three-phase system unless the system design precludes the possibility of a three-phase fault or can somehow otherwise safely interrupt such a fault without damage to the breaker.

Common Impedance Map

- Useful for Short Circuit Case Changes and Planning Cases
- One set of maps reduces duplication of effort
- Easy to make changes for annual operating case by marking drawings

SWAT Impedance Maps

SWAT SCWG Impedance Maps

(All impedance maps are password protected)

2006 Combined Maps

Map Items [List](#) (draft)

APS Impedance [Maps](#)

SRP Impedance [Maps](#)

WAPA DSW Impedance [Maps](#)

TEP/Unisource Impedance [Maps](#)

SWTC Impedance [Maps](#)

IID Impedance Maps

EPE Impedance [Maps](#)

PNM Impedance [Maps](#)

NPC/SPPC Impedance [Maps](#)

Boundary Equivalents

- Utilities with a boundary to non-Step entity generates equivalents for STEP case
- Equivalents eliminated in combined regional planning groups case
- Elimination of equivalents improves short circuit study results

Joint Planning SC Task Forces

- Step input into multi-regional planning group Short Circuit Working Groups
- Unified Step input reduces work by individual step members
- DPV2 SCWVG is a recent example

STEP Reporting

- STEP Website link for SCWG
- Report of work to STEP as needed

STEP SCWG Website Link

▼ Southwest Transmission Expansion Plan (STEP, formerly CARTS)

Dynamic Stability Results

Economic Analysis - Six Preferred Alternatives

Powerflow Results - Six Preferred Alternatives

Updated Powerflow Results - Six preferred Alternatives

Economic Analysis Sensitivities

[Short Circuit Working Group](#)

Northwest/California Subregional Group

ISO Controlled Grid Study

Palo Verde-Devers No. 2

Otay Mesa

Outage Reports

[pdf 142K](#) | [Abstract](#) | 02/01/2006 13:40

Western Congestion Assessment Task Force Update

[pdf 336K](#) | [Abstract](#) | 02/02/2006 14:33

Path 46 (West of River)

[pdf 90K](#) | [Abstract](#) | 02/02/2006 12:24

LEAPS Project

[pdf 560K](#) | [Abstract](#) | 02/02/2006 14:31

October 28, 2005 STEP Meeting

Path 46 (West-of-River) Short-Term Upgrades Path Rating Study Status Update

[pdf 30K](#) | [Abstract](#) | 11/02/2005 15:57

Lake Elsinore 500-MW Advanced Pump Storage Project and Talega-Escondido / Valley-Serrano 500-kV Transmission Line Project (LEAPS and TEMS Interconnect)

[pdf 1500K](#) | [Abstract](#) | 11/02/2005 15:53

SCE Short Term Projects-Status Report

[pdf 64K](#) | [Abstract](#) | 11/02/2005 15:37

Path 49 Short Term Upgrades Update

[pdf 446K](#) | [Abstract](#) | 11/02/2005 15:30

Sunrise Powerlink

[pdf 572K](#) | [Abstract](#) | 11/02/2005 15:25

Green Path Coordinated Projects I ADWP-IID-Citizens

Place Link