Post-Transient Stability Analysis

Imperial Valley Study Group

SDG&E Transmission Planning

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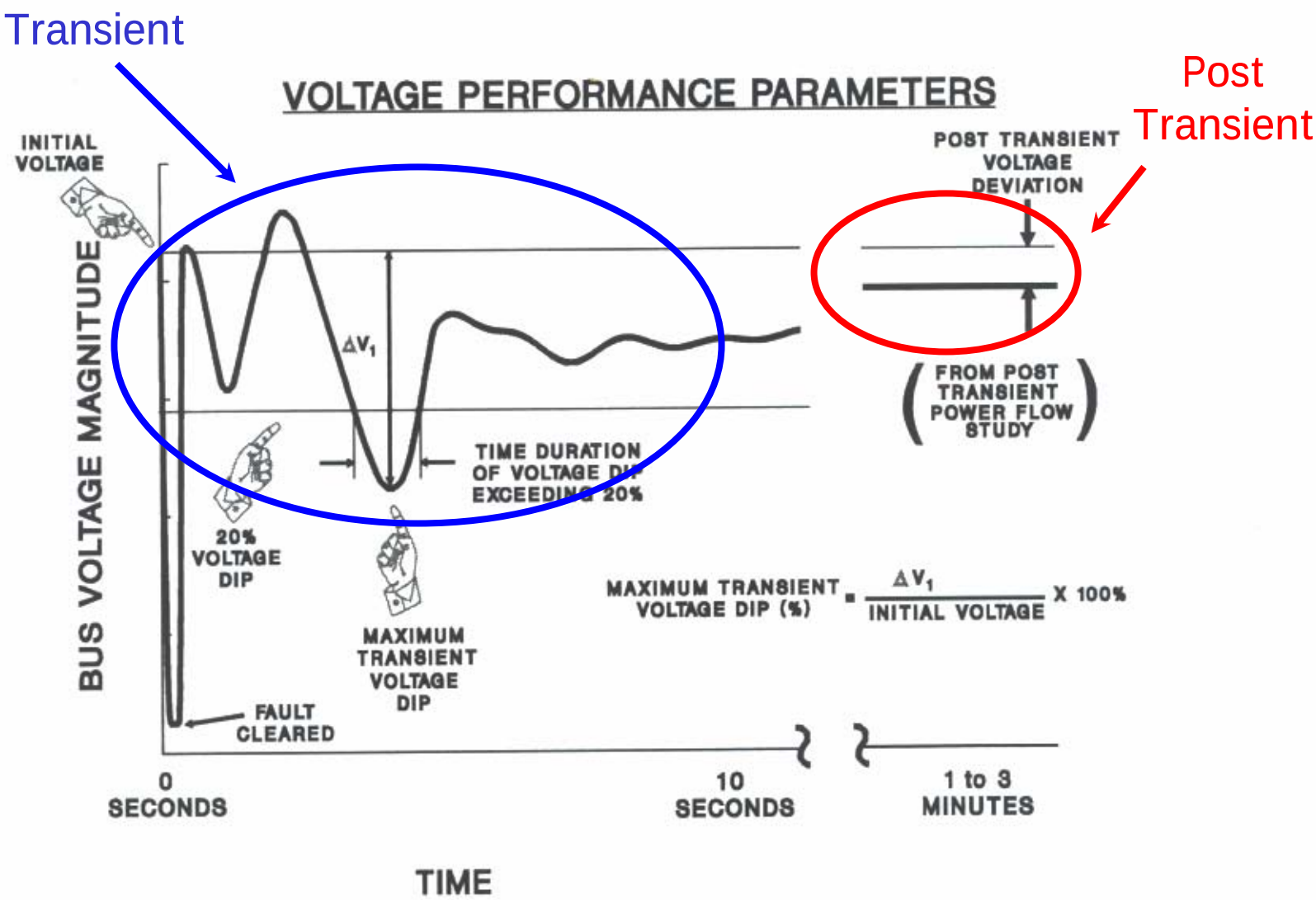
Two Types of Dynamic Stability

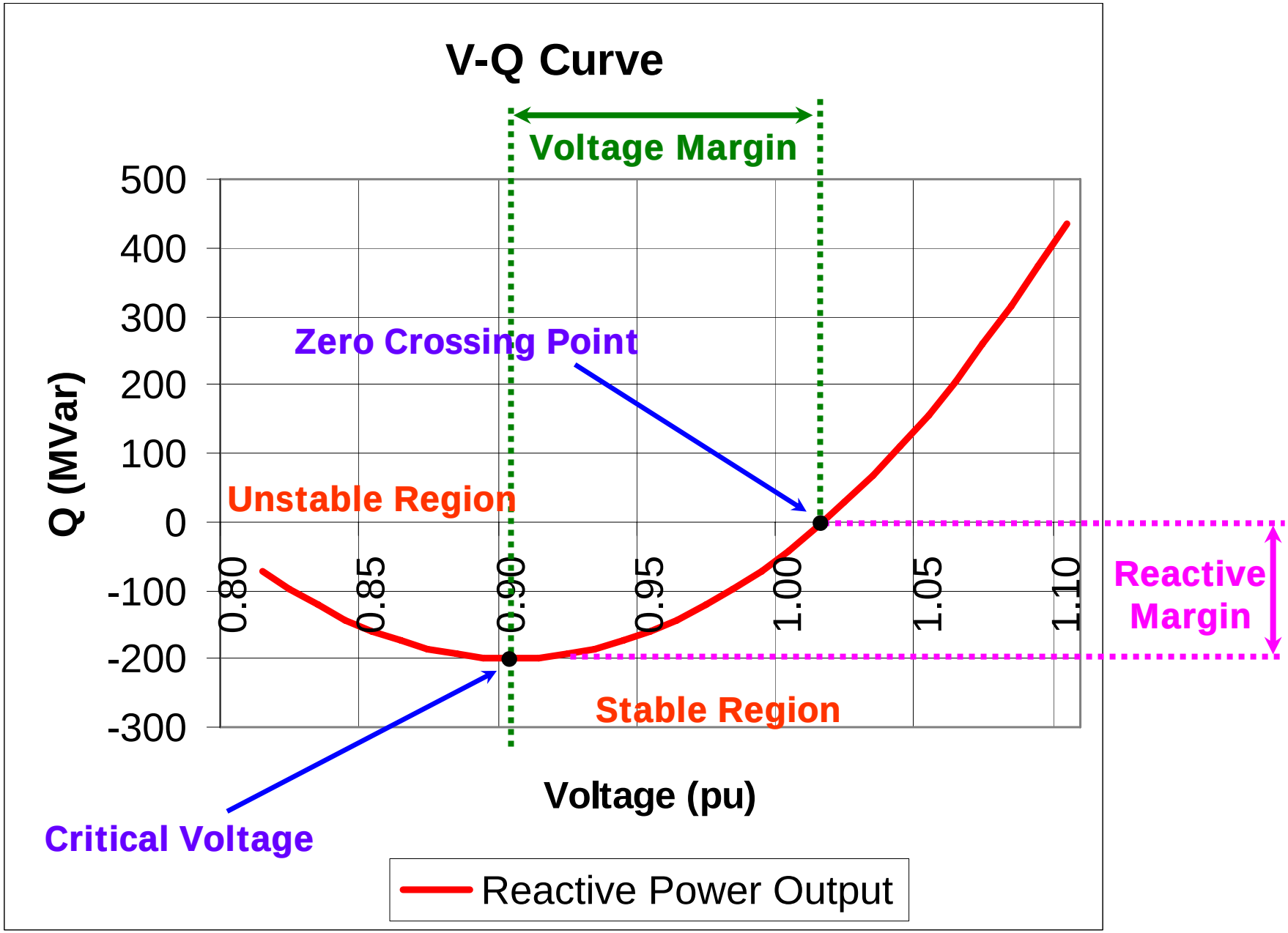
- Transient Stability
  - Synchronization of Generation with Load
- Post-Transient Stability (Var Margin)
  - Voltage Decline and Collapse

- Both cause Blackouts
- Most collapses contain some portion of voltage instability and angular instability


Transient
Post Transient
VOLTAGE PERFORMANCE PARAMETERS
INITIAL VOLTAGE
POST TRANSIENT VOLTAGE DEVIATION
BUS VOLTAGE MAGNITUDE
ΔV1
FROM POST TRANSIENT POWER FLOW STUDY
TIME DURATION OF VOLTAGE DIP EXCEEDING 20%
20% VOLTAGE DIP
MAXIMUM TRANSIENT VOLTAGE DIP (%) = ΔV1 / INITIAL VOLTAGE X 100%
MAXIMUM TRANSIENT VOLTAGE DIP
FAULT CLEARED
0 SECONDS
10 SECONDS
1 to 3 MINUTES
TIME

IEEE Definition of Voltage Stability

- Voltage Stability refers to the ability of a power system to maintain steady voltage at all buses in the system after being subjected to a disturbance from a given initial operating system.


V-Q Curve
Voltage Margin
500
400
300
200
100
0
-100
-200
-300
Q (MVar)
Zero Crossing Point
Unstable Region
0.80
0.85
0.90
0.95
1.00
1.05
1.10
Reactive Margin
Stable Region
Voltage (pu)
Critical Voltage
Reactive Power Output

Post-transient Criteria

Reliability Criteria, NERC/WECC Planning Standards

I. System Adequacy and Security

D. Voltage Support and Reactive Power

Standards: WECC-S1, WECC-S2

Guides: WECC-G2

NERC/WECC: WECC-G2

- Reactive Power Margin Requirements
  - Based on V-Q methodology
  - Developed by TSS
    - e.g. 150 Mvar margin criteria for Cat B at buses 230 kV and above
  - Proxy for Standards
    - I.D. WECC-S1 through WECC-S3

Reactive Margin Criteria

- SCE
  - Level B (N-1): 300 Mvars
  - Level C (N-2): 150 Mvars
- SDG&E
  - Level B (N-1): 150 Mvars
  - Level C (N-2): 75 Mvars
- CFE
  - Level B 230 kV (N-1): 100 Mvars
  - Level C 230 kV (N-2): 50 Mvars
- IID
  - Level B (N-1): 100 Mvars
  - Level C (N-2): 50 Mvars

Cases to Study

- Heavy Summer Benchmark
- HS, Imperial Valley – Central, Dispatch 1
- HS, Imperial Valley – Northern – Ser/Val, Dispatch 1
- Light Autumn Benchmark
- LA, Imperial Valley – Central, Dispatch 3
- LA, Imperial Valley – Central & Coachella Valley – Indian Hills, Dispatch 3
- LA, Imperial Valley – Northern – Ser/Val, Dispatch 3

Single Contingencies

- Central – San Felipe/Northern – San Felipe 500
- Banister – San Felipe 230 kV
- Devers – Valley 500 kV
- Valley – Serrano or Valley – Ser/Val 500 kV
- Palo Verde – Devers 1 500 kV
- Imperial Valley – North Gila 500 kV
- Imperial Valley – Miguel 500 kV
- Lugo – Mohave 500 kV
- Lugo – Mira Loma 500 kV
- Mira Loma - Serrano 500 kV
- Lugo – Victorville 500 kV
- Otay Mesa – Tijuana 230 kV

Double Contingencies

- Lugo – Victorville & Lugo – Vincent 500 kV
- Lugo – Mira Loma 2 & 3 500 kV
- Palo Verde – Devers 1 & 2 500 kV
- SONGS – Talega 1 & 2 230 kV
- 2 San Onofre units
- 2 Palo Verde units

Buses to Monitor

Monitored Buses		
CFE	**SDG&E**	**SCE**
20238 HRD-230 230.00	22260 ESCNDIDO 230.00	24804 DEVERS 230.00
20017 MEP-230 230.00	22356 IMPRLVLY 230.00	24086 LUGO 500.00
20118 ROA-230 230.00	22464 MIGUEL 230.00	24093 MIRALOMW 230.00
20149 TJI-230 230.00	22504 MISSION 230.00	24131 S.ONOFRE 230.00
IID	22716 SANLUSRY 230.00	24137 SERRANO 230.00
8311 COACHELA 230.00	22768 SOUTHBAY 69.00	24151 VALLEYSC 500.00
8332 ELCENTSW 230.00	22832 SYCAMORE 230.00	24156 VINCENT 500.00
8690 HIGHLINE 230.00	**MWD**	24901 VSTA 230.00
80300 NEWSF230 230.00	25417 IRONMTP1 6.90	24112 PADUA 230.00