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Phase I Powerflow Study Results

Presentation for STEP Group 11/4/2003

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Short Term Upgrades

- Base upgrades
  - Miguel 500/230 kV No. 2 transformer
  - Imperial Valley – Miguel 500 kV series capacitor upgrade
  - Miguel – Mission No. 2 230 kV line
- Phase 1 upgrades
  - Devers 500/230 kV No. 2 transformer
  - West of Devers upgrade
  - Series capacitor upgrades
    - Hassayampa – North Gila – Imperial Valley 500 kV
    - Palo Verde – Devers 500 kV
    - Navajo – Crystal and Moenkopi – Eldorado 500 kV

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Objective

- Develop a "realistic" powerflow case including the Phase I upgrades with high EOR and high dispatch of new generation
- Not a Path Rating Study

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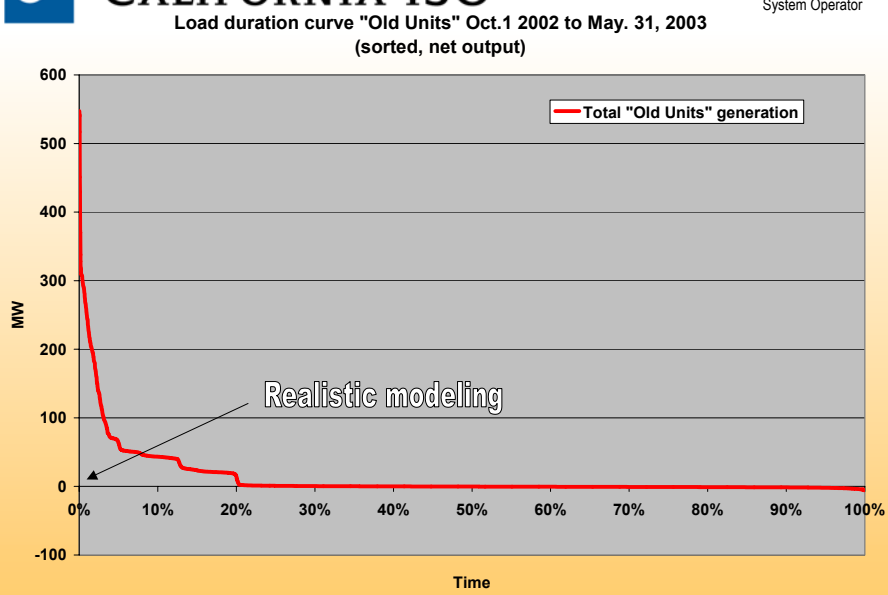

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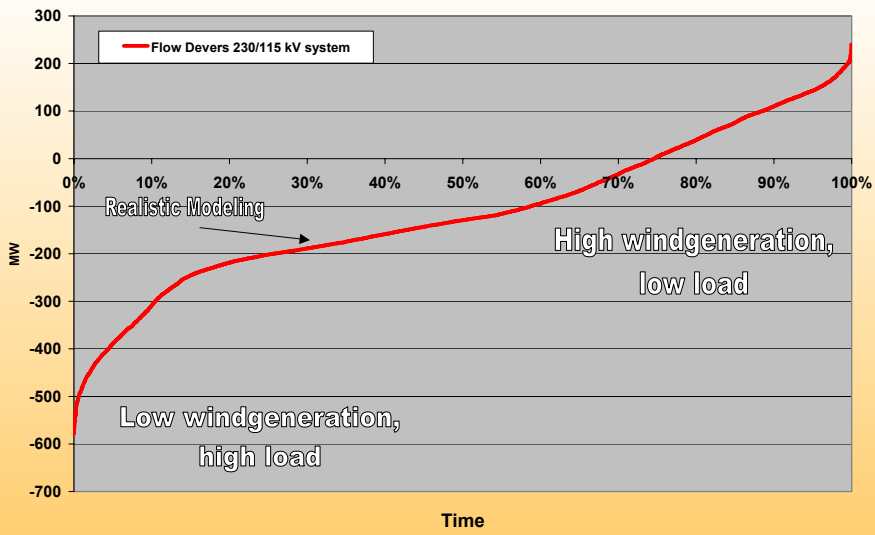
Load duration curve Devers 230/115 kV bank Oct.1 2002 to Sept. 30, 2003
(positive flow is from the 115 kV system to the 230 kV system)



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Limitations Phase I case

- West of Devers flow, maximum 2200 MW
- Flow on Palo Verde – Devers 500 kV line, maximum 2100-2200 MW
- Normal and N-1 overload on El Centro 230/161 kV transformer
- Miguel Import, maximum 2000 MW
- Voltage support Eastern LA Basin
- EOR, maximum 8300 MW
- SCIT/EOR relationship

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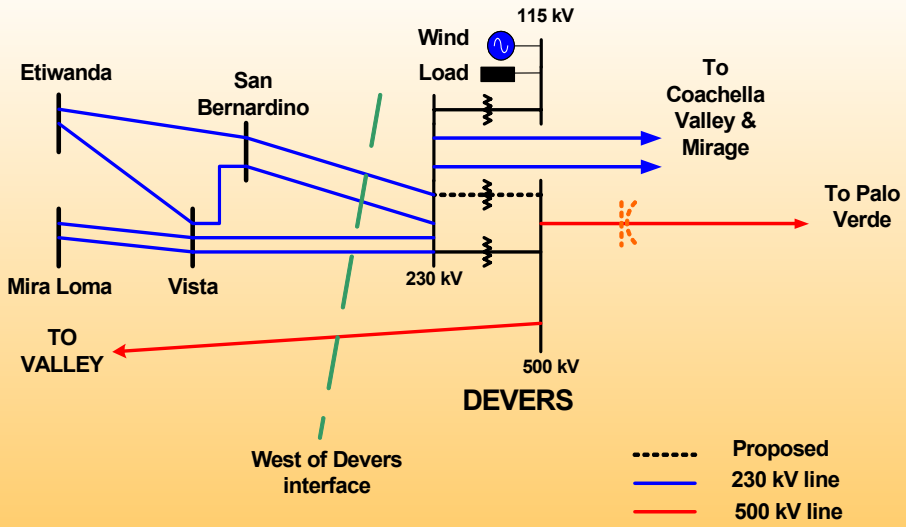
West of Devers



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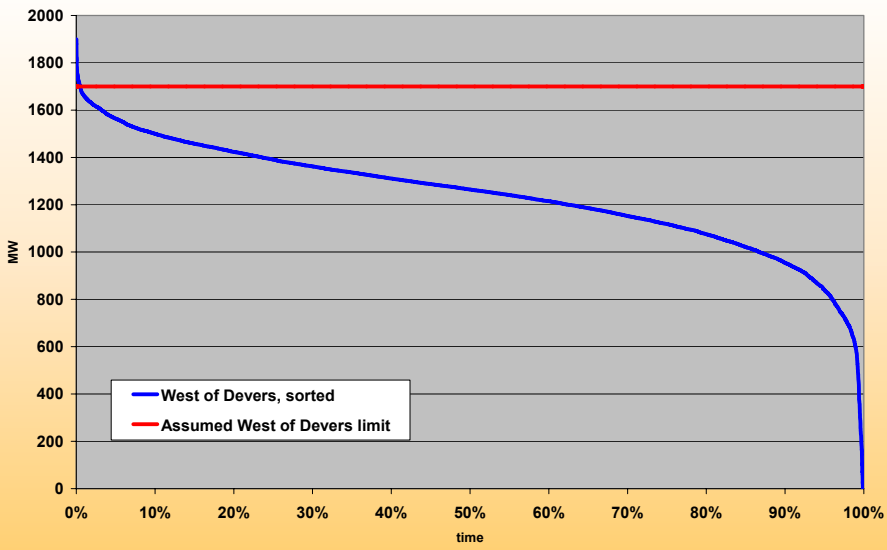
West of Devers flow 10/1/2002 to 9/30/2003, sorted



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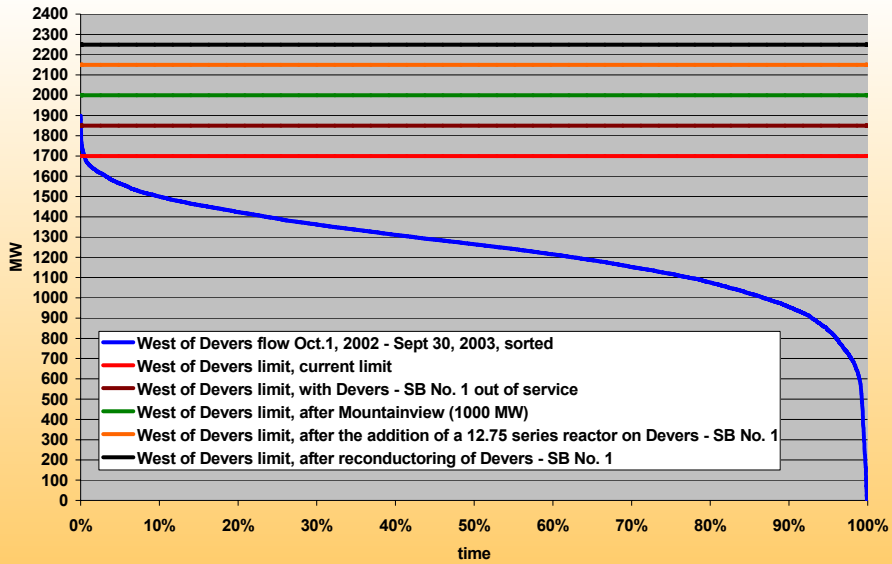
West of Devers flow and limitations



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Flow on Palo Verde - Devers

- Too high flow on the line can overload underlying system if the line trips (N-1)
- Loading on the underlying system depends on generation dispatch, loadlevel and EOR flow
- Potential overloads:
  - Avenue 58 – Banister 161 kV line
  - Gene – Parker 230 kV line
  - Blythe – Eagle Mountain 161 kV line
  - Perkins – Mead (series capacitors and phase shifters, if not bypassed)
- Without SPS, flow cannot exceed 2100-2200 MW under most conditions (at Palo Verde)

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El Centro 230/161 kV transformer

- Loading on the transformer depends on generation from the Imperial Valley and Blythe area, IID load and generation, and EOR flow
- High Imperial Valley generation, low Blythe generation and low IID generation (or high IID load):
  - Potential normal overload on El Centro bank (225 MVA limit)
- High North Gila – Imperial Valley 500 kV line flow:
  - Potential N-1 overload on El Centro bank (258 MVA limit) for loss of North Gila – Imperial Valley 500 kV line

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Miguel Import

- Too high import can overload underlying system (138 and 69 kV) under contingency conditions
- Import level depends on SDG&E generation and load, in particular the generation from the Southbay units
  - Low Southbay generation: N-2 of Miguel – Mission No.1&2 overloads Miguel 230/138 kV transformer and 138 kV lines between Miguel and Southbay
  - High Southbay generation: N-2 of Miguel – Mission No.1&2 overloads Mission – Southbay 138 kV line
- Import limit at about 2000 MW has been identified in previous studies
- Implementation of SPS for double line 230 kV contingencies North of Miguel may allow for an increase in import limit

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Voltage support Eastern LA Basin

- Area with high load and very little generation
- Voltage dip at Devers is a current limitation in the import level into Southern California
- The most critical single line outage is Hassayampa - North Gila 500 kV line
- Higher import to Devers Substation requires additional dynamic voltage support to meet transient stability criteria

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Sensitivities

1) **New Southern California Generation**
   - Otay Mesa (SDG&E, 510 MW)
   - Palomar (SDG&E, 540 MW)
   - Mountainview (SCE, 1000 MW)
- Replaced older Southern California generation:
  - Encina 4&5, Southbay 4, Huntington Beach 2, Alamitos 1, Redondo Beach 6, El Segundo 3
- Replaced 400 MW of generation in PG&E's area
- Mountainview increases the West of Devers rating and reduces the need for voltages support around Devers
- Only local impacts identified

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Sensitivities

2) Mohave units online (1560 MW)

- Replaced older Southern California generation:
  - Encina 4, Huntington Beach 2, Alamitos 4, Redondo Beach 6
- Replaced 650 MW of generation in PG&E's area
- Increase in WOR, both Mohave – Lugo and Eldorado – Lugo 500 kV lines loaded close to normal rating of series capacitors

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Sensitivities

3) Blythe II online (520 MW)

- Replaced older Southern California generation:
  - Huntington Beach 2 and Alamitos 4
- Blythe II connected radially to Palo Verde – Devers 500 kV line
- About 420 MW increase in West of Devers flow, need for West of Devers upgrades increases substantially

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Sensitivities

4) Navajo South

- Step 1: 500 MW coal plant connected to Four Corners 345 kV. 250 MW scheduled to SCE (250 MW), the rest scheduled to the north and south
- Step 2: Step 1 + 1000 MW coal plant connected to Shiprock 500 kV station. New 500 kV line between Shiprock – Moenkopi - Marketplace. 500 MW scheduled to PG&E and 500 MW scheduled to SCE
- Some local impacts in the Four Corners area

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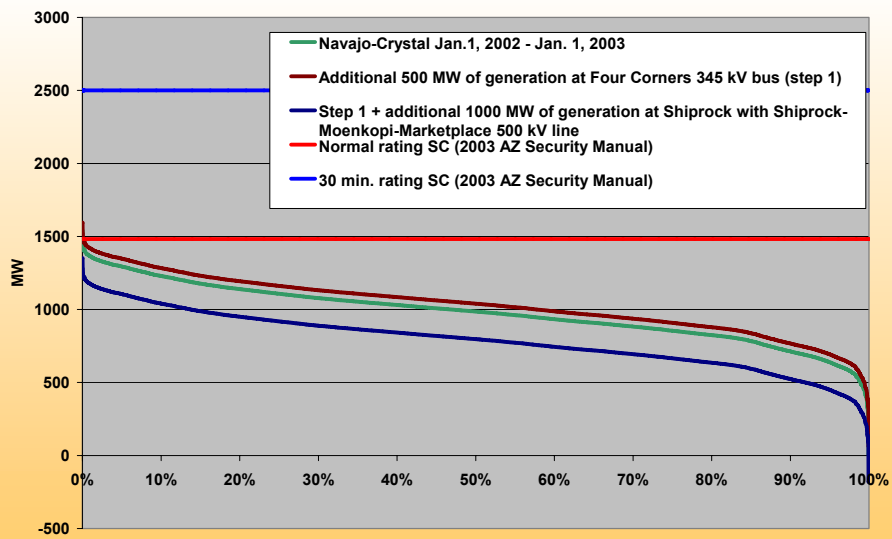
Projected flow on Navajo-Crystal 500 kV line



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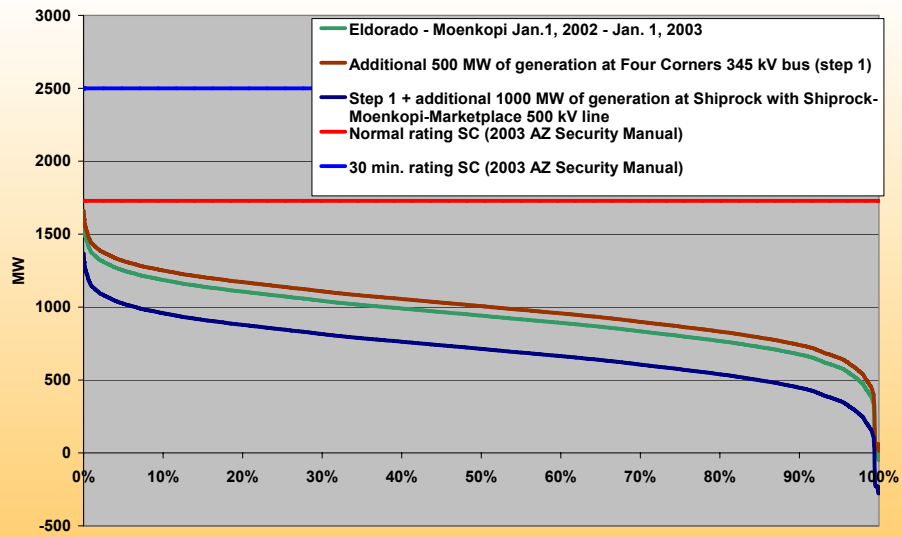
Projected flow on Eldorado - Moenkopi 500 kV line



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