

STEP Screening Study

Potential 500 kV transmission alternatives

DRAFT

May 7, 2003

California ISO

STEP Screening Study

A screening study of eight different transmission configurations has been performed to identify preferred transmission alternatives between the Desert Southwest and California.

Alternatives

Alternative 1:

- Palo Verde – Devers No. 2 (238 miles)
- Hassayampa – Imperial Valley (195 miles)
- Valley – Rainbow (ca. 30 miles)
- Rainbow – Imperial Valley (ca. 188 miles)

Total 651 mi of new 500 kV lines

Alternative 2:

- Palo Verde – Devers No. 2 (238 miles)
- Hassayampa – Imperial Valley (195 miles)
- Escondido – Imperial Valley (ca. 130 miles)

Total 563 mi of new 500 kV lines

Alternative 3:

- Imperial Valley – Devers (ca. 150 miles)
- Hassayampa – Imperial Valley (195 miles)
- Escondido – Imperial Valley (ca. 130 miles)

Total 475 mi of new 500 kV lines

Alternative 4:

- Palo Verde – Devers No. 2 (238 miles)
- Devers – Imperial Valley (ca. 150 miles)
- Valley – Rainbow (ca. 30 miles)
- Miguel – Imperial Valley No. 2 (84 miles)

Total 502 mi of new 500 kV lines

Alternative 5:

- Palo Verde – Devers No. 2 (238 miles)
- Hassayampa – Imperial Valley (195 miles)
- Valley – Rainbow (ca. 30 miles)
- Miguel – Imperial Valley No. 2 (84 miles)

Total 547 mi of new 500 kV lines

Alternative 6: (same as alternative 1, but Harquahala-Parker-Blythe-Devers instead of Palo Verde - Devers No. 2. In addition, Parker-Davis-Mohave)

- Harquahala – Parker – Blythe - Devers No. 2 (ca. 310 miles)

- Parker – Davis - Mohave (ca. 120 miles)
- Hassayampa – Imperial Valley (195 miles)
- Valley – Rainbow (ca. 30 miles)
- Rainbow – Imperial Valley (ca. 188 miles)

Total 843 mi of new 500 kV lines

Alternative 7 (same as alternative 1, Imperial Valley-Miguel-Rainbow instead of Imperial Valley – Rainbow):

- Palo Verde – Devers No. 2 (238 miles)
- Hassayampa – Imperial Valley (195 miles)
- Valley – Rainbow (ca. 30 miles)
- Miguel – Imperial Valley (84 miles)
- Miguel – Rainbow (ca. 100 miles)

Total 647 mi of new 500 kV lines

Alternative 8 (same as alternative 1, in addition Devers – Mira Loma):

- Palo Verde – Devers No. 2 (238 miles)
- Devers – Mira Loma (ca. 60 miles)
- Hassayampa – Imperial Valley (195 miles)
- Valley – Rainbow (ca. 30 miles)
- Rainbow – Imperial Valley (ca. 188 miles)

Total 711 mi of new 500 kV lines

Summary

The studies performed so far indicate that Alternative 1, 2, 3 and 8 have the best performance. Alternative 5 and 7 do not seem to be very good options based on the analysis done so far. However, there are disadvantages and advantages with every alternative. The advantages and disadvantages of each alternative are described below in more detail.

Alternative 1:

Pros:

- High flexibility due to loop configuration
- Additional VAR support needed is low
- Low losses

Cons:

- Miles of new 500 kV lines required is the high (651 miles)
- Higher import level at Miguel than alternative 2,3 and 8

Alternative 2:

Pros:

- Consists of only three lines
- Connects to a major load center in SDG&E
- Low import at Miguel

Cons:

- High uncertainty whether it is possible to bring a 500 kV line into Escondido Substation.
- Does not have closed 500 kV loop and may therefore have lower reliability than alternative 1 in case of common corridor outages (needs to be studied further)

Alternative 3:

Pros:

- Consists of only three lines
- The “shortest” alternative (475 miles of new 500 kV lines)
- Connects to a major load center in SDG&E.
- Has the lowest import level at Miguel

Cons :

- High losses
- High uncertainty whether it is possible to bring a 500 kV line into Escondido Substation.
- Brings only one new import line from Palo Verde/Hassayampa area

Alternative 4:

Pros:

- Fairly short alternative (only 502 miles of new 500 kV lines)
- Uses mostly existing or already established transmission corridors

Cons:

- The alternative with the highest 500 kV losses
- Requires a phase-shifter
- High import at Miguel
- Additional VAR support needed is high

Alternative 5:

Pros:

- Uses mostly existing or already established transmission corridors

Cons:

- The alternative with the highest VAR support needed
- Requires a phase-shifter
- Causes normal overload on Miguel – Mission 2 230 kV line
- The alternative with the highest import level at Miguel

- High losses on the 500 kV system

Alternative 6:

Pros:

- Will provide reliability benefits if built in a different corridor than the existing Palo Verde – Devers line (N-2 of both PV-DE lines will not be a credible outage)
- Provides transmission for Blythe generation
- May provide benefits to the Arizona/Nevada transmission system
- No additional VAR support needed

Cons:

- The longest option (about 843 miles)
- Three additional 500 kV substations are needed as compared to alternative 1.

Alternative 7:

Pros:

- Imperial Valley – Miguel – Rainbow represents an alternative to Imperial Valley - Rainbow

Cons:

- Higher import level at Miguel and higher losses as compared to alternative 1
- A double line outage of Miguel – Imperial Valley No. 1&2 may be very limiting

Alternative 8:

Pros:

- Relieves the loading on the 230 kV system west of Devers and eliminates the contingency overload on San Bernardino – Devers No. 1 230 kV line.
- Reduces South of Lugo flow compared to alternative 1 and provides voltage support to the Mira Loma area.

Cons:

- An additional 500 kV line as compared to alternative 1

Description of study

The screening study followed the outline of the draft “Southwest Transmission Expansion Planning (STEP) Coordination and Study Process” (dated April 21, 2003). All new efficient generation (no peakers) currently under construction in Southern California, Southern Nevada and Arizona were modeled as online in the case used. Generation units with announced retirement before the 2007-08 timeframe and old, units with high heat rate were modeled out of service. The load modeled represents a summer peak day in 2007. (The WECC 2007 Heavy Summer case “07HS1A” was used).

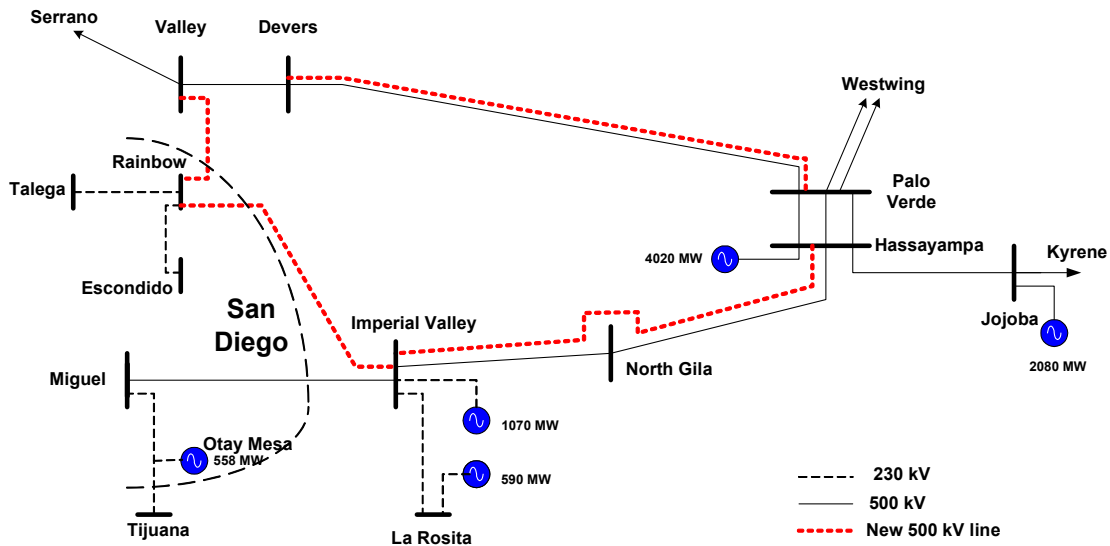
Only the transmission system with voltage 230 kV and above was analyzed in this screening study. Powerflow plots of each alternative with all lines in service are included at the end of the report. Existing overloads that did not change due to the new lines are not reported. Normal overloads and overloads due to single contingency (N-1) of any 500 kV line in the Southwest region were identified. A magnitude of needed VAR support was identified for each alternative by applying a simultaneous loss of both of the SONGS units with no loadshedding. (SCIT was not maximized in the case). No transient stability or contingency analysis of credible N-2 outages have been performed.

All new lines longer than 80 miles were compensated at 50%. Lines longer than 150 miles were compensated equally in both the sending and receiving end (except for Palo Verde – Devers No. 2; same compensation as the No. 1 line). Lines between 50 and 150 miles long were only compensated at the receiving end.

All alternatives have at least one new line going to San Diego (a third connection from San Diego to the outside grid in addition to the two existing; Miguel Substation and South of SONGS). This third connection could be at for instance Rainbow, Escondido, Sycamore Canyon or Ramona. In these studies, only one of these points were evaluated for each alternative. More detailed studies can be performed after other considerations have been taken into account (environmental, land etc.).

Alternative 1:

Alternative 1:	Palo Verde - Devers No. 2, Hassayampa - Imperial Valley Valley - Rainbow Rainbow - Imperial Valley
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500 kV Lines:

- Second Palo Verde – Devers 500 kV line (including series capacitors in both ends, identical to No. 1 line)
- Hassayampa – Imperial Valley 500 kV line (including series capacitors in both ends, needs to be rated at least 1300 A (normal) and 2000 A (N-1))
- Imperial Valley – Rainbow 500 kV (including series capacitors at Rainbow, needs to be rated at least 1600 A (normal) and 2300 A (N-1))
- Valley – Rainbow 500 kV (no phase shifter)

230 kV lines:

- Loop Talega – Escondido 230 kV into Rainbow 230 kV substation
- Construct new Talega – Rainbow – Escondido 230 kV line

Transformers:

- Second Devers 500/230 kV transformer
- Second Miguel 500/230 kV transformer
- One 500/230 kV transformer at Rainbow

Series Capacitors:

- Upgrade thermal rating on Miguel – Imperial Valley series capacitors with 1900 A (normal) and 2400 A (N-1).
- Upgrade thermal rating on Hassayampa – North Gila series capacitors with 2100 A (N-1).

VAR support:

- About 850 MVAR beyond what is already planned to be in service is needed to sustain a G-2 of SONGS with no load shedding.

Normal overloads:

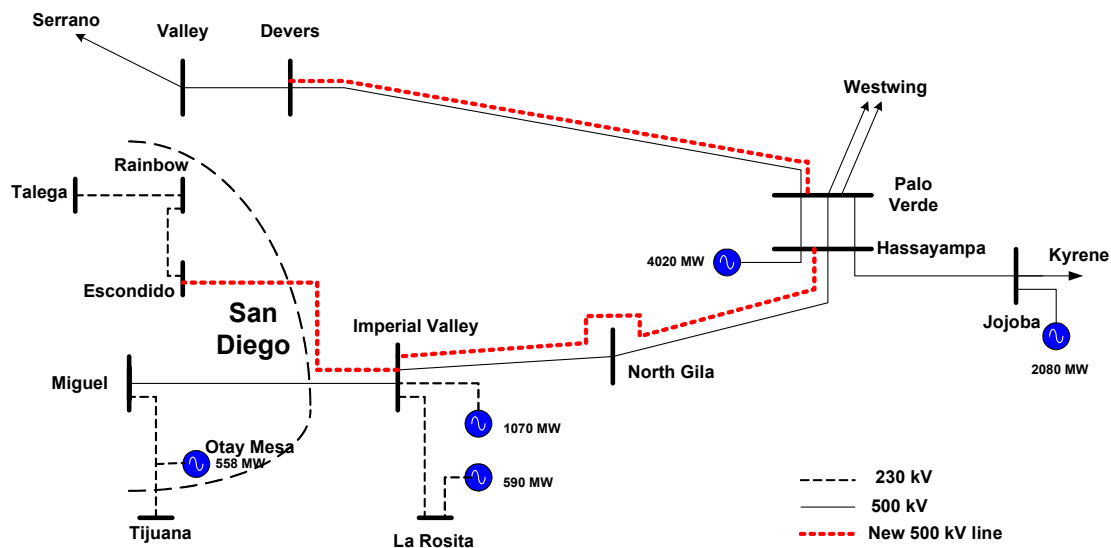
No normal overloads

N-1 overloads:

Contingency	Overloaded element	# of overloads	N-1 rating	Overload (%)	Possible mitigation
Devers – Valley 500 kV line	San Bernardino – Devers 230 kV line No. 1	1	796 A	109	Reconductor
Miguel – Imperial Valley 500 kV line	ROA 230 – HRD 230 230 kV line	1	1080 A	109	(IV Gen. SPS)
Miguel – Imperial Valley 500 kV line	RUM 230 – HRD 230 230 kV line	1	1080 A	104	(IV Gen. SPS)
Miguel – Imperial Valley 500 kV line	RUM 230 – ROA 230 230 kV line	1	1080 A	123	(IV Gen. SPS)
Miguel – Imperial Valley 500 kV line	TJI 230 – Otay Mesa 230 kV line	1	2289 A	102	(IV Gen. SPS)

Alternative 2; (essentially the same as alt. 1, but no Valley - Rainbow line. Connects to Escondido instead of Rainbow)

Alternative 2: Palo Verde - Devers No. 2,
Hassayampa - Imperial Valley
Escondido - Imperial Valley



500 kV Lines:

- Second Palo Verde – Devers 500 kV line (including series capacitors in both ends, identical to No. 1 line)
- Hassayampa – Imperial Valley 500 kV line (including series capacitors in both ends, needs to be rated at least 1200 A (normal) and 2000 A (N-1))
- Imperial Valley – Escondido 500 kV (including series capacitors at Escondido, needs to be rated at least 1600 A (normal) and 2400 A (N-1))

Transformers:

- Second Devers 500/230 kV transformer
- Second Miguel 500/230 kV transformer
- Two 500/230 kV transformer at Escondido

Series Capacitors:

- Upgrade thermal rating on Miguel – Imperial Valley series capacitors with 1600 A (normal) and 2500 A (N-1).

- Upgrade thermal rating on Hassayampa – North Gila series capacitors with 2100 A (N-1).

VAR support:

- About 900 MVAR beyond what is already planned to be in service is needed to sustain a G-2 of SONGS with no load shedding.

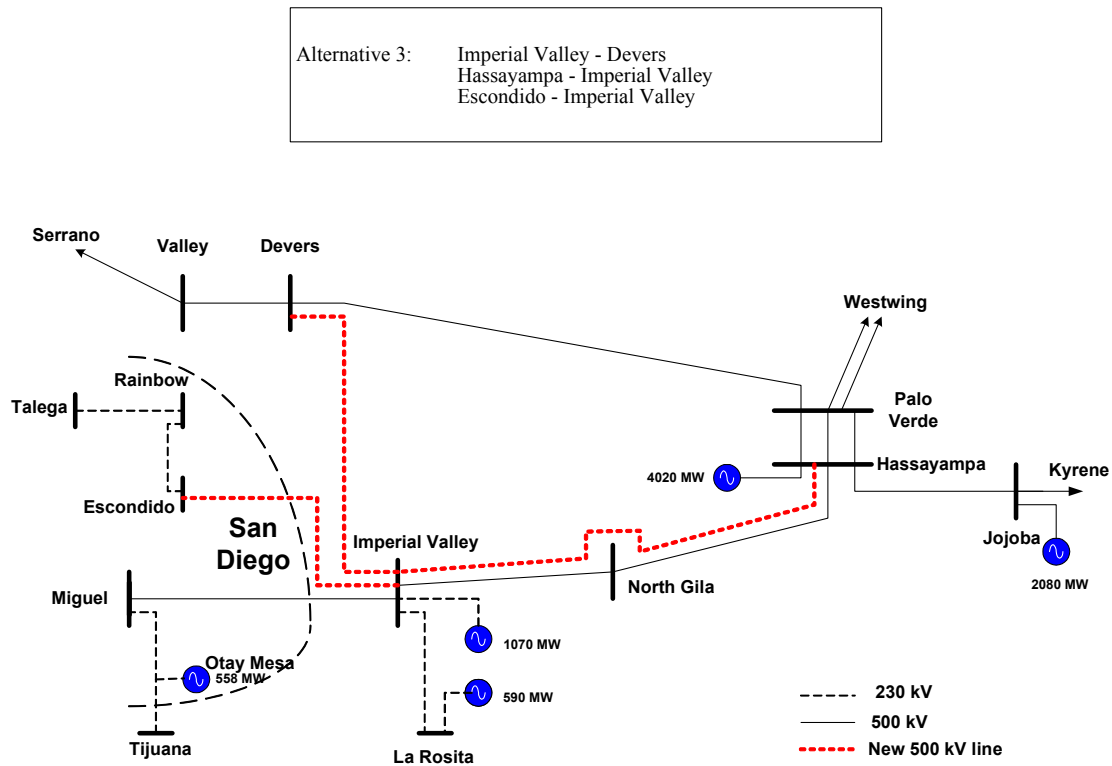
Normal overloads:

No normal overloads

N-1 overloads:

Contingency	Overloaded element	# of overloads	N-1 rating	Overload (%)	Possible mitigation
Devers – Valley 500 kV line	San Bernardino – Devers 230 kV line No. 1	1	796 A	117	Reconductor
Miguel – Imperial Valley 500 kV line	RUM 230 – ROA 230 230 kV line	1	1080 A	103	(IV Gen. SPS)

Alternative 3; (essentially the same as alt. 2, but Imperial Valley – Devers instead of second Palo Verde - Devers line)



500 kV Lines:

- Imperial Valley – Devers 500 kV (including series capacitors at Devers, needs to be rated at least 1200 A (normal) and 2100 A (N-1))
- Hassayampa – Imperial Valley 500 kV line (including series capacitors in both ends, needs to be rated at least 1700 A (normal) and 2300 A (N-1))
- Imperial Valley – Escondido 500 kV (including series capacitors at Escondido, needs to be rated at least 1500 A (normal) and 2200 A (N-1))

Transformers:

- Second Devers 500/230 kV transformer
- Second Miguel 500/230 kV transformer
- Two 500/230 kV transformer at Escondido

Series Capacitors:

- Upgrade thermal rating on Hassayampa – North Gila series capacitors with 1800 A (normal) and 2700 A (N-1).
- Upgrade thermal rating on North Gila – Imperial Valley series capacitors with 1700 A (normal) and 2500 A (N-1).

- Upgrade thermal rating on Miguel – Imperial Valley series capacitors with 1600 A (normal) and 2400 A (N-1).

VAR support:

- About 1150 MVAR beyond what is already planned to be in service is needed to sustain a G-2 of SONGS with no load shedding.

Normal overloads:

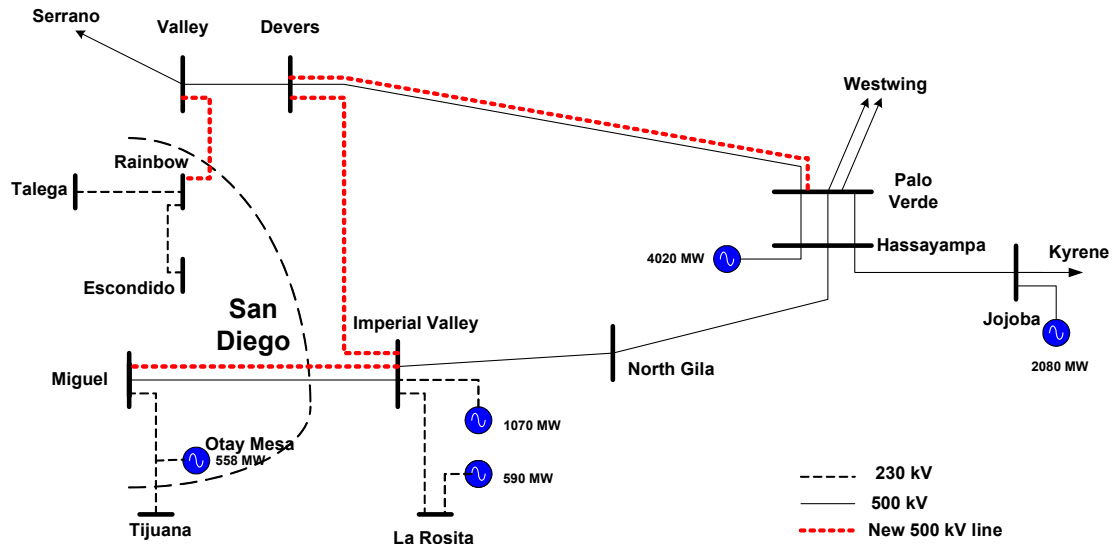
No normal overloads

N-1 overloads:

Contingency	Overloaded element	# of overloads	N-1 rating	Overload (%)	Possible mitigation
Devers – Valley 500 kV line	San Bernardino – Devers 230 kV line No. 1	1	796 A	108	Reconductor

Alternative 4;

Alternative 4: Imperial Valley - Devers
Miguel - Imperial Valley No. 2
Valley - Rainbow
Palo Verde - Devers No. 2



500 kV Lines:

- Second Palo Verde – Devers 500 kV line (including series capacitors in both ends, identical to No. 1 line)
- Valley – Rainbow 500 kV
- Imperial Valley – Devers 500 kV
- Imperial Valley – Miguel No. 2 500 kV line

230 kV Lines:

- Loop Talega – Escondido 230 kV into Rainbow 230 kV substation
- Construct new Talega – Rainbow – Escondido 230 kV line

Transformers:

- Second Devers 500/230 kV transformer
- Second Miguel 500/230 kV transformer
- One 500/230 kV transformer at Rainbow
- Phase shifter at Rainbow

Series Capacitors:

- Upgrade thermal rating on Hassayampa – North Gila series capacitors with 1900 A (normal) and 2400 A (N-1).

- Upgrade thermal rating on North Gila – Imperial Valley series capacitors with 1800 A (normal) and 2300 A (N-1).

VAR support:

- About 1350 MVAR beyond what is already planned to be in service is needed to sustain a G-2 of SONGS with no load shedding.

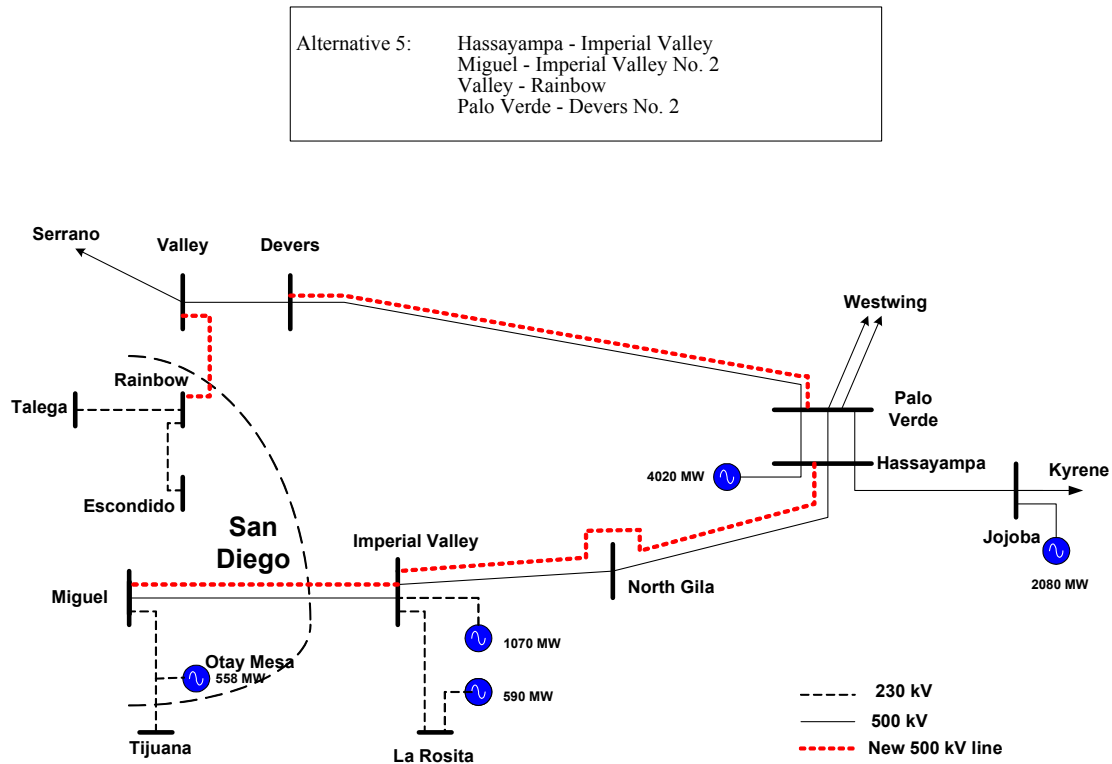
Normal overloads:

No normal overloads

N-1 overloads:

Contingency	Overloaded element	# of overloads	N-1 rating	Overload (%)	Possible mitigation
Devers – Valley 500 kV line	San Bernardino – Devers 230 kV line No. 1	1	796 A	135	Reconductor

Alternative 5; (Second SWPL and second Palo Verde Devers, Valley - Rainbow)



500 kV Lines:

- Second Palo Verde – Devers 500 kV line (including series capacitors in both ends). Normal rating needs to be 1800 A and N-1 rating needs to be 2500 A.
- Second SWPL:
 - Hassayampa – Imperial Valley 500 kV line (including series capacitors in both ends). Normal rating needs to be 800 A and N-1 rating needs to be 1400 A.
 - Miguel – Imperial Valley 500 kV line (including series capacitors at Miguel). Normal rating needs to be 1200 A and N-1 rating needs to be 2200 A.
- Valley – Rainbow 500 kV

230 kV Lines:

- Loop Talega – Escondido 230 kV into Rainbow 230 kV substation
- Construct new Talega – Rainbow – Escondido 230 kV line

Transformers:

- Second Devers 500/230 kV transformer
- Second Miguel 500/230 kV transformer

- One 500/230 kV transformer at Rainbow
- Phase shifter at Rainbow (Needs to be +/- 25 degrees to hold 960 MVA)

Series Capacitors:

- Upgrade N-1 thermal rating on existing Palo Verde – Devers No. 1 series capacitors to 2500 A.
- Upgrade N-1 thermal rating on existing Miguel – Imperial Valley series capacitors to 2200 A.

VAR support:

- About 1600 MVAR beyond what is already planned to be in service is needed to sustain a G-2 of SONGS with no load shedding.

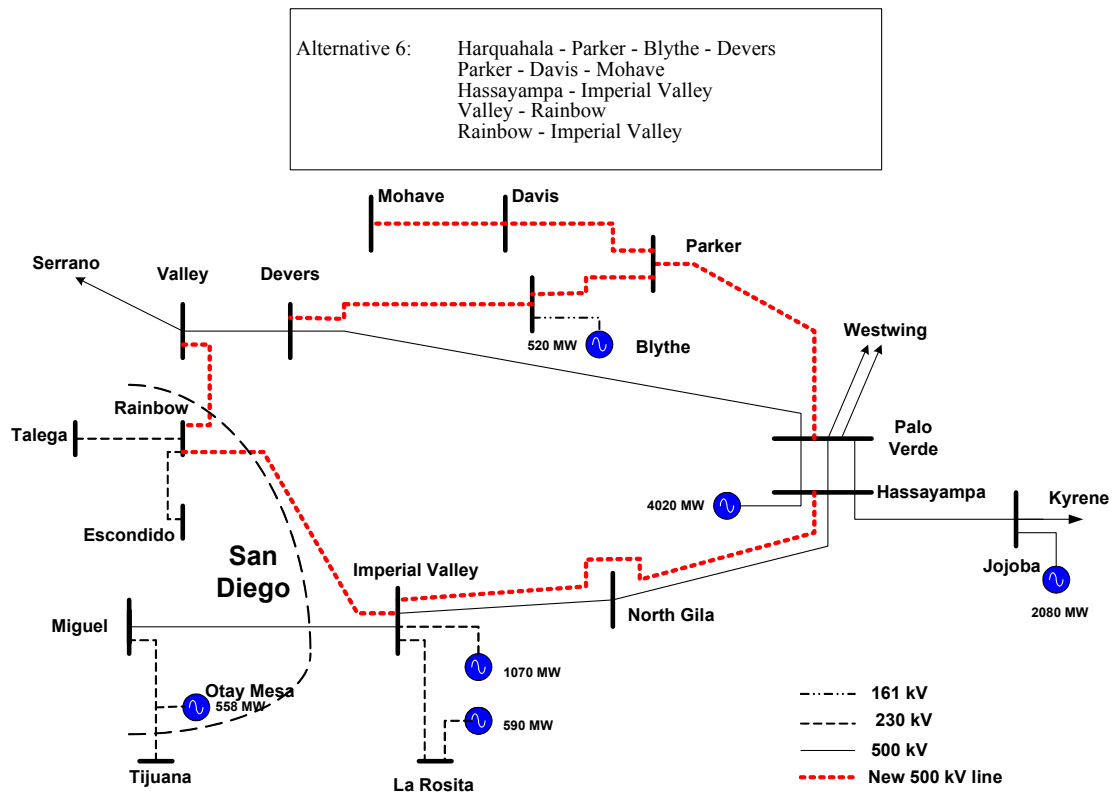
Normal overloads (N-0):

Overloaded element	N-0 rating	Overload (%)	Possible mitigation
Miguel – Mission No. 2 230 kV line	2002	113	??

N-1 overloads:

Contingency	Overloaded element	# of overloads	N-1 rating	Overload (%)	Possible mitigation
Devers – Valley 500 kV line	San Bernardino – Devers 230 kV line No. 1	1	796 A	131	Reconductor

Alternative 6; (same as alt. 1, but Harquahala – Parker – Blythe – Devers instead of second Palo Verde - Devers. Also Parker – Davis - Mohave)



500 kV Lines:

- Harquahala – Parker – Blythe - Devers 500 kV line (including series capacitors at Harquahala and Devers)
- Parker – Davis - Mohave
- Hassayampa – Imperial Valley 500 kV line (including series capacitors in both ends, needs to be rated at least 1300 A (normal) and 2000 A (N-1))
- Imperial Valley – Rainbow 500 kV (including series capacitors at Rainbow, needs to be rated at least 1600 A (normal) and 2300 A (N-1))
- Valley – Rainbow 500 kV (no phase shifter)

230 kV lines:

- Loop Talega – Escondido 230 kV into Rainbow 230 kV substation
- Construct new Talega – Rainbow – Escondido 230 kV line

Transformers:

- Second Devers 500/230 kV transformer
- Second Miguel 500/230 kV transformer
- One 500/230 kV transformer at Rainbow
- One 500/230 kV transformer at Blythe

- One 500/230 kV transformer at Parker
- One 500/230 kV transformer at Davis

Series Capacitors:

- Upgrade thermal rating on Miguel – Imperial Valley series capacitors with 1900 A (normal) and 2400 A (N-1).
- Upgrade thermal rating on Hassayampa – North Gila series capacitors with 1500 A (normal) and 2200 A (N-1).

VAR support:

- No VAR support is needed to sustain a G-2 of SONGS with no load shedding.

Normal overloads:

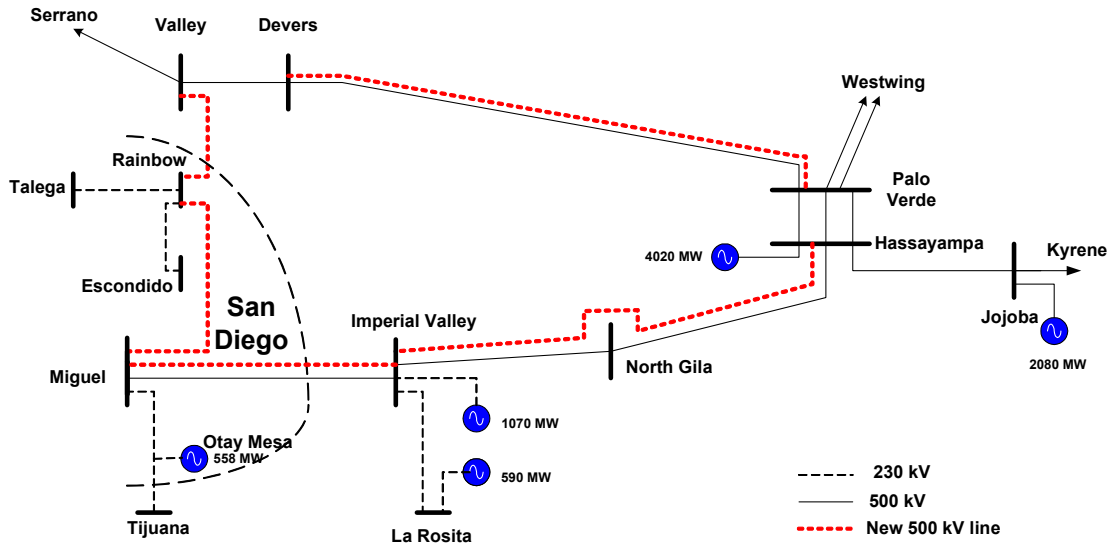
No normal overloads

N-1 overloads:

Contingency	Overloaded element	# of overloads	N-1 rating	Overload (%)	Possible mitigation
Devers – Valley 500 kV line	San Bernardino – Devers 230 kV line No. 1	1	796 A	107	Reconductor
Miguel – Imperial Valley 500 kV line	ROA 230 – HRD 230 230 kV line	1	1080 A	109	(IV Gen. SPS)
Miguel – Imperial Valley 500 kV line	RUM 230 – HRD 230 230 kV line	1	1080 A	104	(IV Gen. SPS)
Miguel – Imperial Valley 500 kV line	RUM 230 – ROA 230 230 kV line	1	1080 A	123	(IV Gen. SPS)
Miguel – Imperial Valley 500 kV line	TJI 230 – Otay Mesa 230 kV line	1	2289 A	102	(IV Gen. SPS)

Alternative 7

Alternative 7:
 Palo Verde - Devers No. 2,
 Hassayampa - Imperial Valley
 Valley - Rainbow
 Miguel - Imperial Valley
 Rainbow - Miguel



500 kV Lines:

- Second Palo Verde – Devers 500 kV line (including series capacitors in both ends, identical to No. 1 line)
- Hassayampa – Imperial Valley 500 kV line (including series capacitors in both ends, needs to be rated at least 1200 A (normal) and 1800 A (N-1))
- Valley – Rainbow 500 kV (no phase shifter)
- Imperial Valley – Miguel 500 kV (including series capacitors at Miguel, needs to be rated at least 1600 A (normal) and 2900A (N-1))
- Miguel – Rainbow 500 kV (including series capacitors at Rainbow, needs to be rated at least 1200 A (normal) and 1600 A (N-1))

230 kV Lines:

- Loop Talega – Escondido 230 kV into Rainbow 230 kV substation
- Construct new Talega – Rainbow – Escondido 230 kV line

Transformers:

- Second Devers 500/230 kV transformer
- Second Miguel 500/230 kV transformer

- One 500/230 kV transformer at Rainbow

Series Capacitors:

- Upgrade thermal rating on Miguel – Imperial Valley series capacitors with 1600 A (normal) and 2900 A (N-1).
- Upgrade thermal rating on Hassayampa – North Gila series capacitors with 2100 A (N-1).

VAR support:

- About 800 MVAR beyond what is already planned to be in service is needed to sustain a G-2 of SONGS with no load shedding.

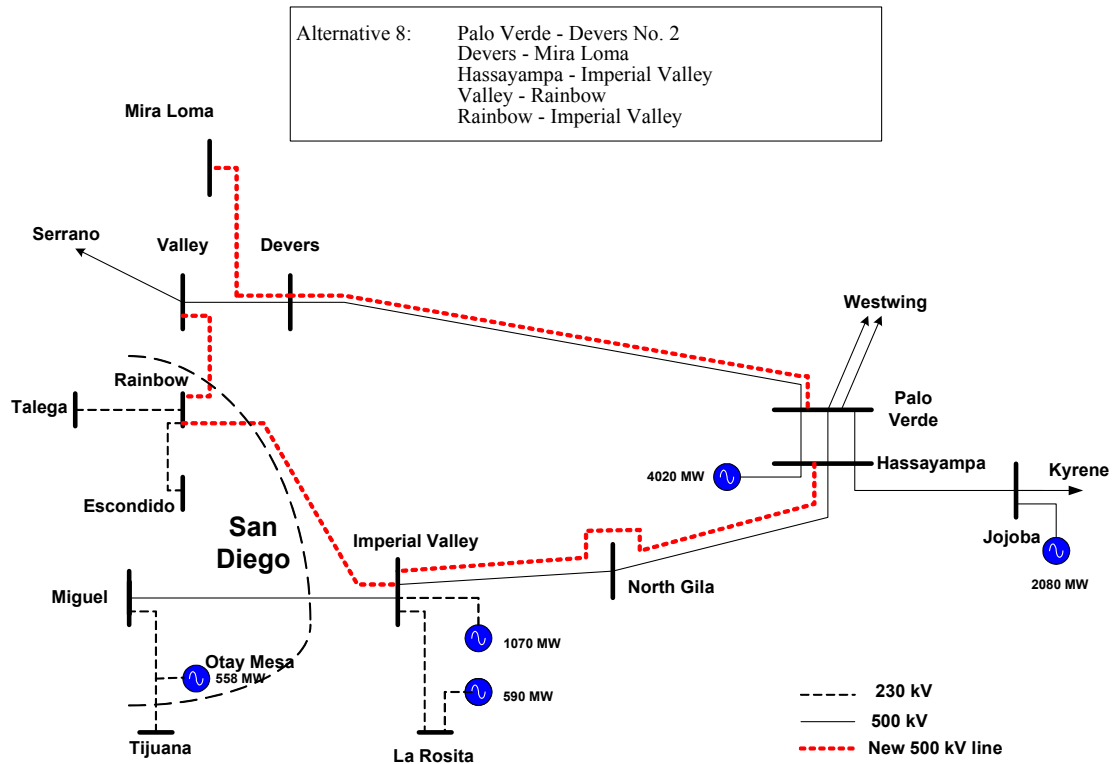
Normal overloads:

No normal overloads

N-1 overloads:

Contingency	Overloaded element	# of overloads	N-1 rating	Overload (%)	Possible mitigation
Devers – Valley 500 kV line	San Bernardino – Devers 230 kV line No. 1	1	796 A	112	Reconductor

Alternative 8: (Same as alternative 1, but Devers - Mira Loma in addition)



500 kV Lines:

- Second Palo Verde – Devers 500 kV line (including series capacitors in both ends, identical to No. 1 line)
- Devers – Mira Loma 500 kV line
- Hassayampa – Imperial Valley 500 kV line (including series capacitors in both ends, needs to be rated at least 1300 A (normal) and 2000 A (N-1))
- Valley – Rainbow 500 kV (no phase shifter)
- Imperial Valley – Rainbow 500 kV (including series capacitors at Rainbow, needs to be rated at least 1600 A (normal) and 2300 A (N-1))

230 kV Lines:

- Loop Talega – Escondido 230 kV into Rainbow 230 kV substation
- Construct new Talega – Rainbow – Escondido 230 kV line

Transformers:

- Second Devers 500/230 kV transformer
- Second Miguel 500/230 kV transformer
- One 500/230 kV transformer at Rainbow

Series Capacitors:

- Upgrade thermal rating on Miguel – Imperial Valley series capacitors with 1900 A (normal) and 2400 A (N-1).
- Upgrade thermal rating on Hassayampa – North Gila series capacitors with 2100 A (N-1).

VAR support:

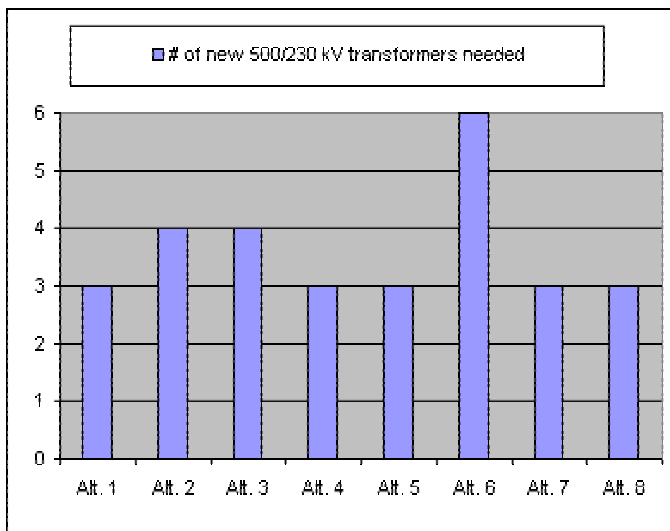
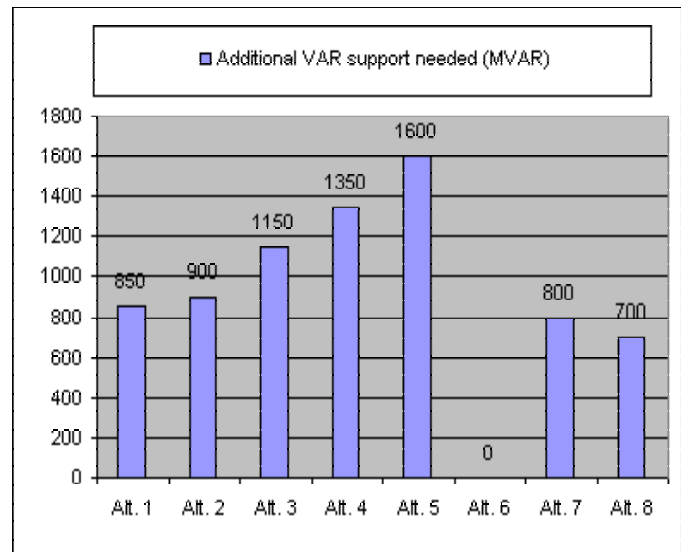
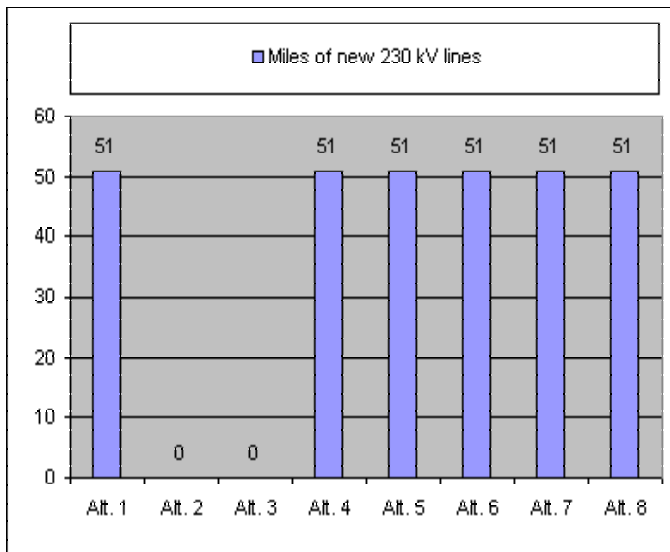
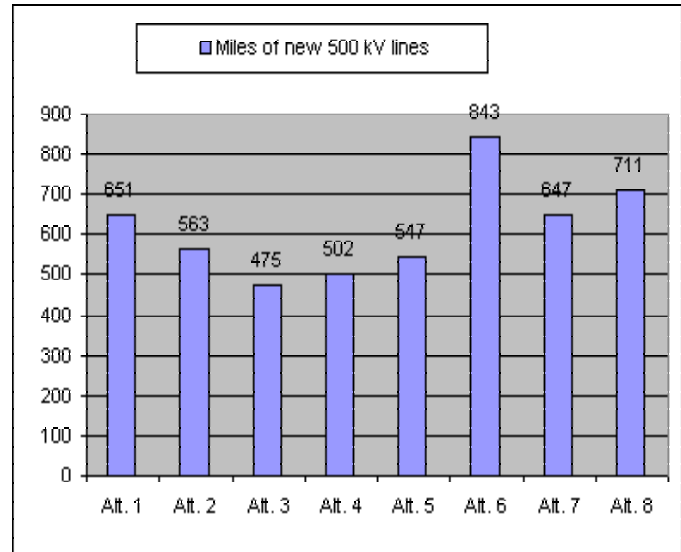
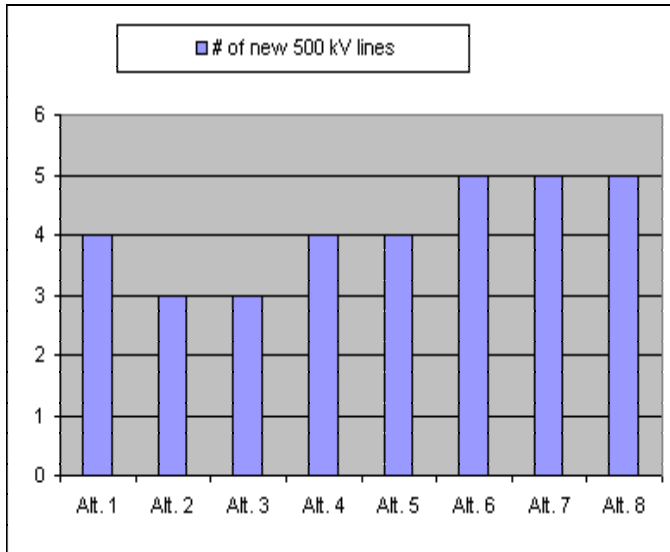
- About 700 MVAR beyond what is already planned to be in service is needed to sustain a G-2 of SONGS with no load shedding.

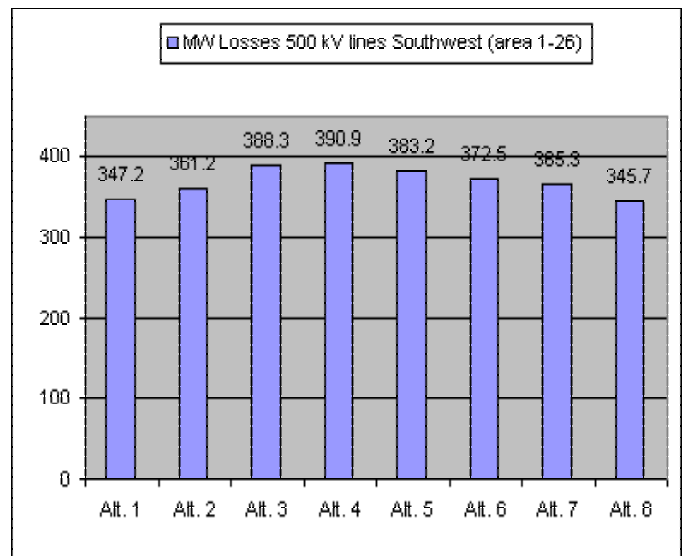
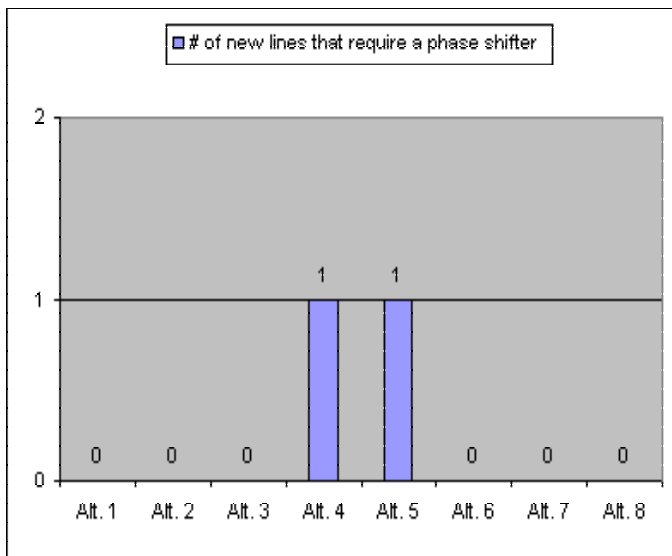
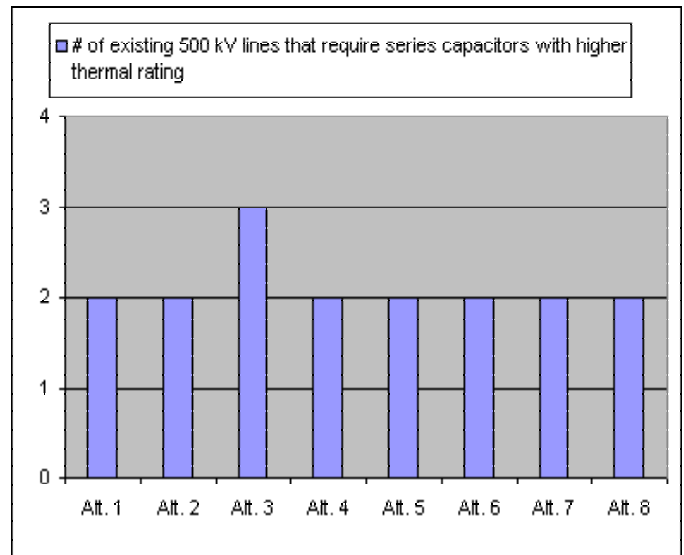
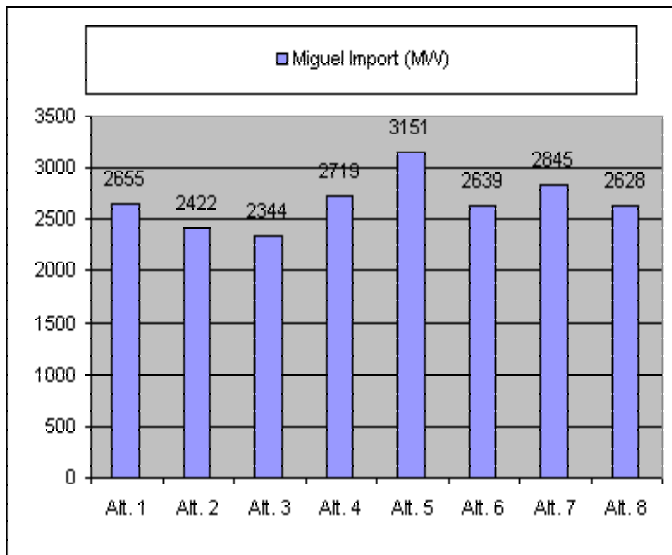
Normal overloads:

No normal overloads

N-1 overloads:

Contingency	Overloaded element	# of overloads	N-1 rating	Overload (%)	Possible mitigation
Miguel – Imperial Valley 500 kV line	ROA 230 – HRD 230 230 kV line	1	1080 A	107	(IV Gen. SPS)
Miguel – Imperial Valley 500 kV line	RUM 230 – HRD 230 230 kV line	1	1080 A	102	(IV Gen. SPS)
Miguel – Imperial Valley 500 kV line	RUM 230 – ROA 230 230 kV line	1	1080 A	121	(IV Gen. SPS)
Miguel – Imperial Valley 500 kV line	TJI 230 – Otay Mesa 230 kV line	1	2289 A	101	(IV Gen. SPS)



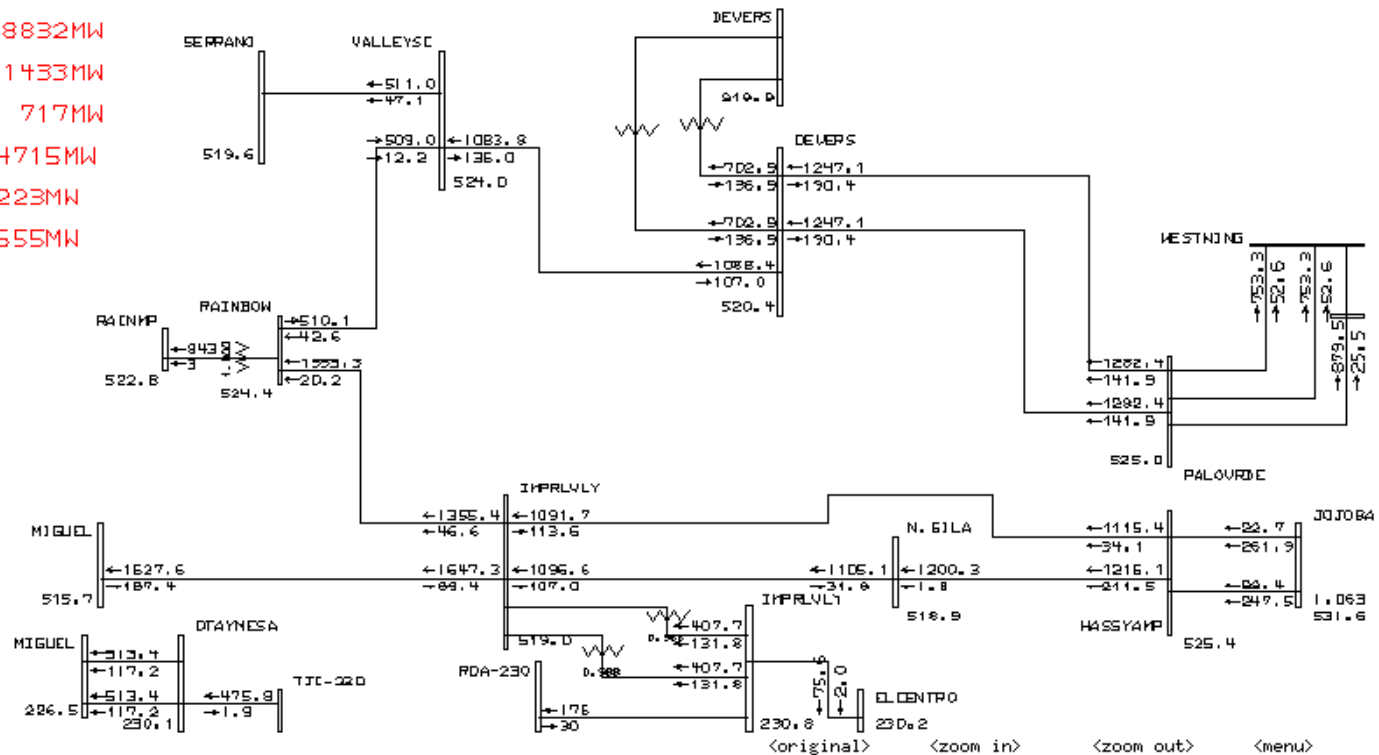


Alternative 1

Southern California/Western Arizona Area Map

COI 3912MW
 PDCI 2339MW
 PATH 15 1640MW
 IPP DC 1561MW
 PATH 26 2367MW
 SCIT 16485MW
 EOR 7392MW
 WOR 8832MW
 N. SONGS 1433MW
 S. SONGS 717MW
 S. of Lugo 4715MW
 SD Imp. 4223MW
 MI Imp. 2655MW

SANDIEGO		SOCALIF		LADWP		ARIZONA	
Gen	2312 MW	Gen	12339 MW	Gen	4597 MW	Gen	22495 MW
Load	4769 MW	Load	21552 MW	Load	6269 MW	Load	16348 MW
Int	-2633 MW	Int	-9727 MW	Int	-2029 MW	Int	5728 MW
Loss	175 MW	Loss	513 MW	Loss	357 MW	Loss	419 MW



WECC 2007 HS1A STARTING CASE
 CHANGED FOR STEP STUDIES
 NEW GENERATION ON AS, MV, CFE ADDED, WITH Vincent & Miraloma 500/230

STEP alternatives 2nd PV-Devers 500 HV, 2nd 500/230 Devers, 2nd N3g
 Hassyamp 00 00, 00y-Rainow 000 00 00, 00-0000 0000 00-000000 0000

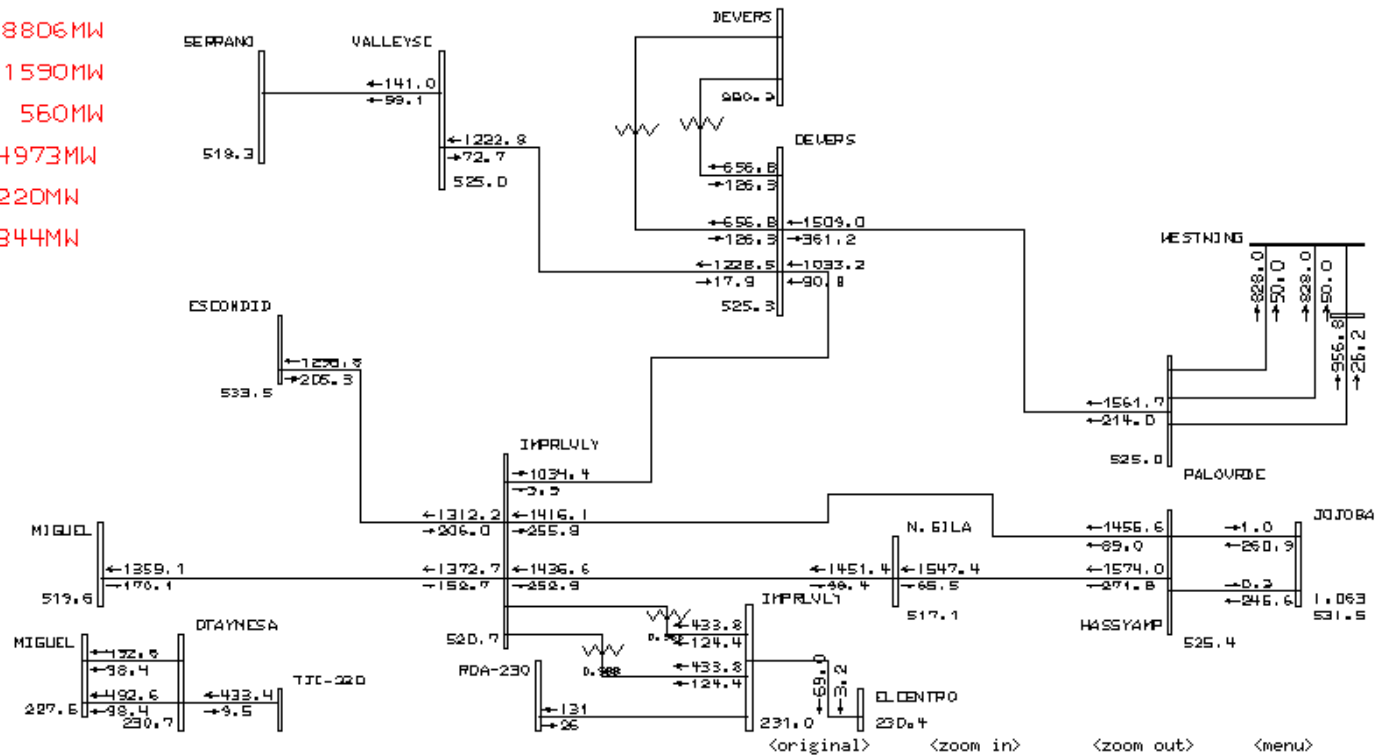
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Alternative 3

Southern California/Western Arizona Area Map

COI 3931MW
 PDCI 2338MW
 PATH 15 1592MW
 IPP DC 1561MW
 PATH 26 2417MW
 SCIT 16510MW
 EOR 7332MW
 WOR 8806MW
 N. SONGS 1590MW
 S. SONGS 560MW
 S. of Lugo 4973MW
 SD Imp. 4220MW
 MI Imp. 2344MW

SANDIEGO		SOCALIF		LADWP		ARIZONA	
Gen	2312 MW	Gen	12339 MW	Gen	4597 MW	Gen	22495 MW
Load	4769 MW	Load	21552 MW	Load	6269 MW	Load	16348 MW
Int	-2635 MW	Int	-9719 MW	Int	-2037 MW	Int	5702 MW
Loss	178 MW	Loss	506 MW	Loss	365 MW	Loss	445 MW



WECC 2007 HS1A STARTING CASE
 CHANGED FOR CTER STUDIES
 NEW GENERATION ON AS, HV, CFE ADDED, With Vincent & Miraloma 900/230

STEP Alternatives: 2nd PV-Devers 900 MW, 2nd 500/230 Devers, 2nd H3g
 Hassayam 10 600, 10g-Palour 600 10 600/230, 10-600 600 10-600/230

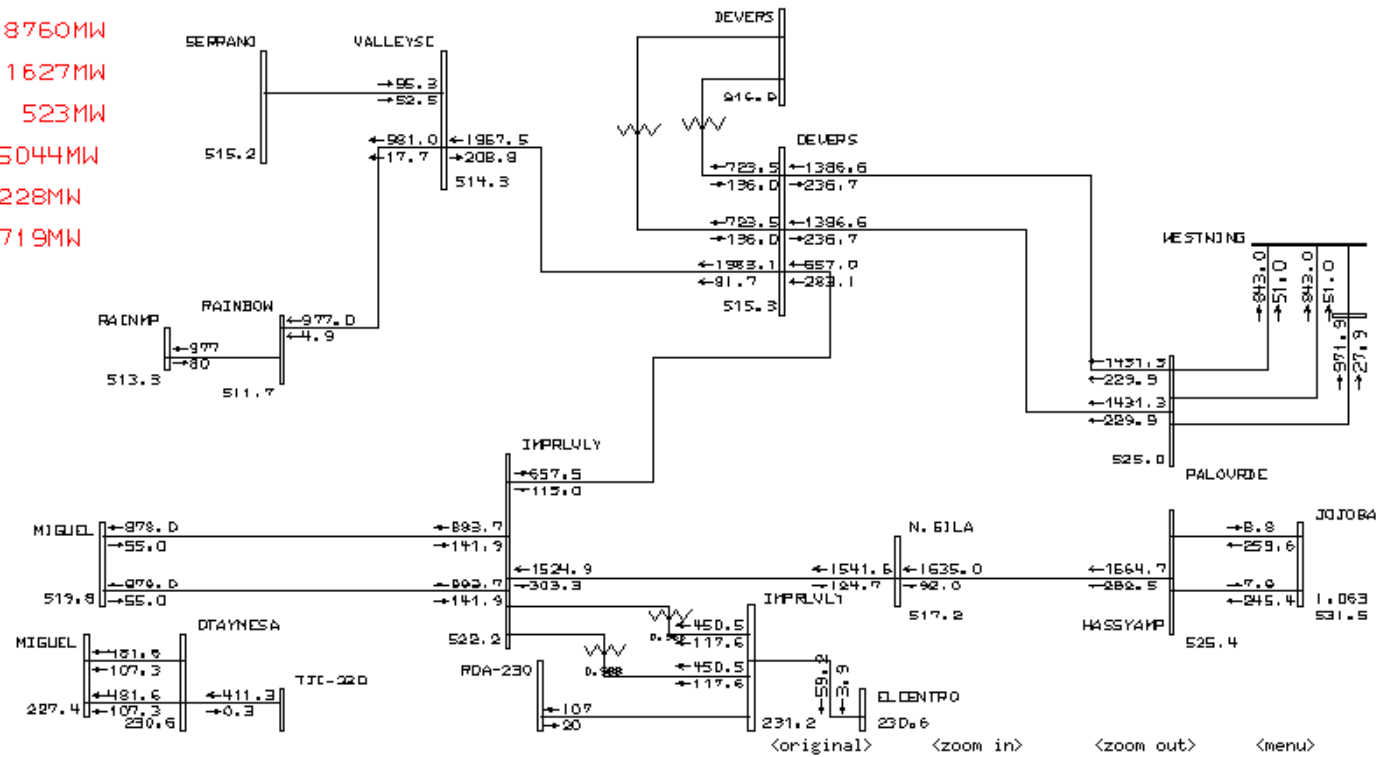
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Alternative 4

Southern California/Western Arizona Area Map

COI 3937MW
 PDCI 2339MW
 PATH 15 1565MW
 IPP DC 1561MW
 PATH 26 2445MW
 SCIT 16492MW
 EOR 7324MW
 WOR 8760MW
 N. SONGS 1627MW
 S. SONGS 523MW
 S. of Lugo 5044MW
 SD Imp. 4228MW
 MI Imp. 2719MW

SANDIEGO	SOCALIF	LADWP	ARIZONA
Gen 2312 MW	Gen 12339 MW	Gen 4597 MW	Gen 22495 MW
Load 4769 MW	Load 21552 MW	Load 6269 MW	Load 16348 MW
Int -2633 MW	Int -9776 MW	Int -2039 MW	Int 5733 MW
Loss 176 MW	Loss 563 MW	Loss 367 MW	Loss 414 MW



WECC 2007 HS1A STARTING CASE
 CHANGED FOR STEP STUDIES
 NEW GENERATION ON AS, NV, CFE ADDED, MH Vincent & Hirston 500/230

STEP Alternatives 2nd PV-Devers 500 HV, 2nd 500/230 Devers, 2nd N3g
 Hassya-00 RD, 03y-RN-01 RD 3U product, 1U-PN-01 COW, CU-Nigual etc

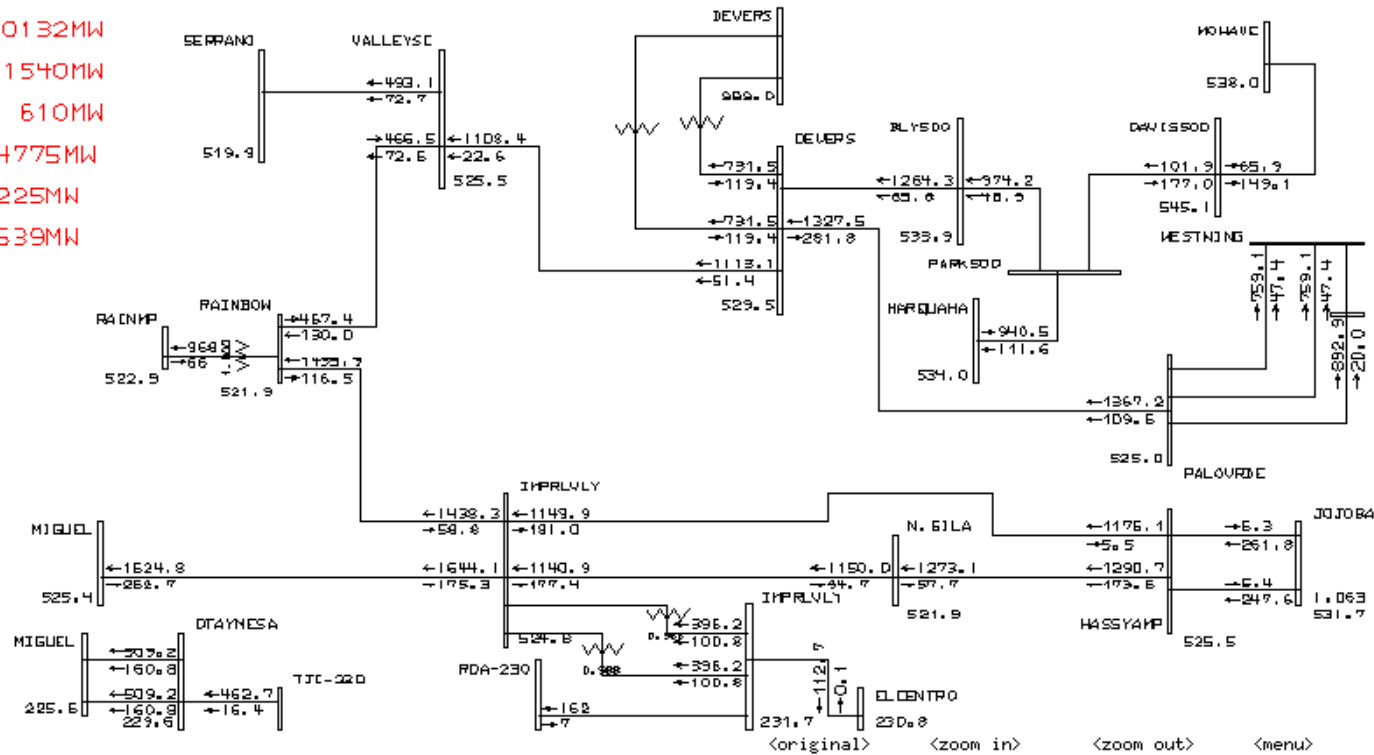
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Alternative 6

Southern California/Western Arizona Area Map

COI 3479MW
 PDCI 2339MW
 PATH 15 2547MW
 IPP DC 1561MW
 PATH 26 1087MW
 SCIT 16504MW
 EOR 8316MW
 WOR 10132MW
 N. SONGS 1540MW
 S. SONGS 610MW
 S. of Lugo 4775MW
 SD Imp. 4225MW
 MI Imp. 2639MW

SANDIEGO	SOCALIF	LADWP	ARIZONA
Gen 2312 MW	Gen 13899 MW	Gen 4597 MW	Gen 22389 MW
Load 4769 MW	Load 21552 MW	Load 6269 MW	Load 16348 MW
Int -2636 MW	Int -8154 MW	Int -2037 MW	Int 5636 MW
Loss 179 MW	Loss 501 MW	Loss 364 MW	Loss 404 MW



WECC 2007 HS16 STARTING CASE
 CHANGED FOR STEP STUDIES
 NEW GENERATION ON AS, NV, CFE ADDED, Nth Vincent & Miraloma 500/230

STEP Alternatives 2nd HV-Devers 500 MV, 2nd 500/230 Devers, 2nd M3g
 Hassayam-00 500, 00y-Phon 500 3U project, 3U-Phon 500, CU-Nigual case

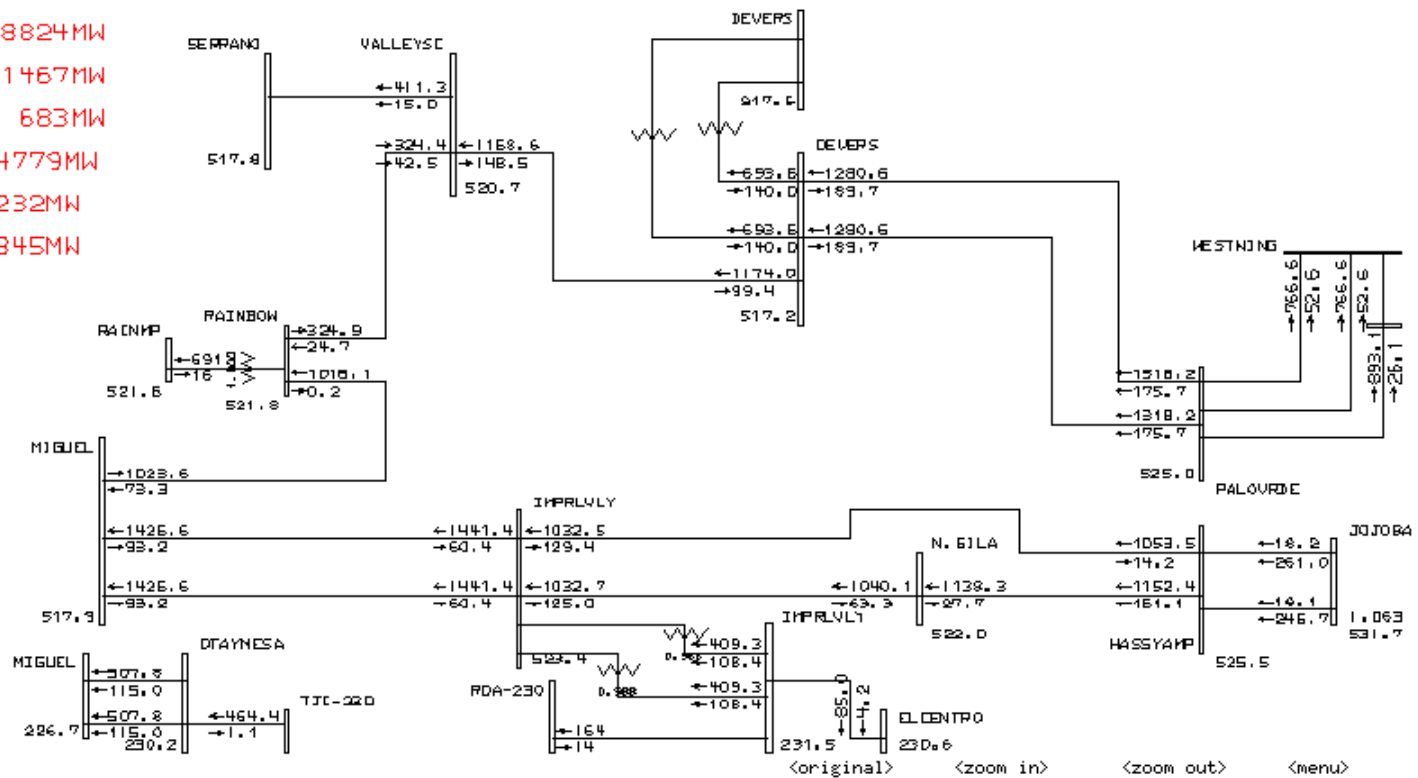
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 Page: 4

Alternative 7

Southern California/Western Arizona Area Map

COI 3914MW
 PDCI 2339MW
 PATH 15 1614MW
 IPP DC 1561MW
 PATH 26 2395MW
 SCIT 16504MW
 EOR 7384MW
 WOR 8824MW
 N. SONGS 1467MW
 S. SONGS 683MW
 S. of Lugo 4779MW
 SD Imp. 4232MW
 MI Imp. 2845MW

SANDIEGO	SOCALIF	LADWP	ARIZONA
Gen 2312 MW	Gen 12339 MW	Gen 4597 MW	Gen 22495 MW
Load 4769 MW	Load 21552 MW	Load 6269 MW	Load 16348 MW
Int -2650 MW	Int -9735 MW	Int -2031 MW	Int 5731 MW
Loss 193 MW	Loss 522 MW	Loss 359 MW	Loss 415 MW



MECC 2007 HS1A STARTING CASE
 CHANGED FOR STEP STUDY
 NEW GENERATION ON AS, HV, CFE ADDED, Rth Vincent & Miraloma 500/230

STEP Alternatives 2nd HV-Devers 500 HV, 2nd 500/230 Devers, 2nd H3B
 Hassayamp HV RD, Miraloma RD HV project, HV-PLM 500, CU-Niguel and
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