

SOUTHWEST TRANSMISSION EXPANSION PLANNING (STEP)

Initial Powerflow

Study Results

May 8, 2003

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Grid Planning

California ISO



STUDY ASSUMPTIONS

- Starting case WECC 07HS

Added new generation plants and approved transmission projects:

- Mead 500/230 kV transformer
- Crystal-McCullough series caps upgrade
- Second Miguel-Mission 230 kV line

Removed Mohave Power Plant



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STUDY ASSUMPTIONS

NEW GENERATION PLANTS

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Mexico:

- La Rosita 590 MW
- Imp. Valley 1070MW

Nevada:

- Silverhawk 550 MW
 - Mirant 550 MW
 - Duke 1200 MW
- Total 2300 MW

Hassyampa:

- Red Hawk 1000 MW
 - Arlington 600 MW
 - Harquahala 1170 MW
 - Mesquite 1250 MW
- Total 4020 MW
- Gila River 2080 MW

Total generation additions
case: 3318 MW

compared to the starting



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STUDY ASSUMPTIONS

Compensated additional generation:

Remove **SDG&E** generation

| | |
|----------------|--------|
| Encina 1-3 | 400 MW |
| South Bay1-4 | 650 MW |
| Border peakers | 148 MW |

Remove **SCE** generation

| | |
|------------------|---------|
| Alamitos 1-4 | 1038 MW |
| Montavista 1,2,3 | 375 MW |
| Hntingtn Bch1-5 | 935 MW |
| Mandalay Bay1-3 | 535 MW |
| Redondo Bch 5-6 | 300 MW |
| Alta 1-2 | 140 MW |
| Mtn View | 120 MW |

Add **SCE** generation

- High Desert 325 MW
(total is 850 MW)
- Pastoria 60 MW
(total is 750 MW)

Add lower **Colorado** generation

- Blythe 426 MW
(total is 510 MW)
- Griffith 320 MW
(total is 540 MW)
- South Point 400 MW
(total is 520 MW)

total additions in lower Colorado
1146 MW



BASE CASE

| Area | Load, MW | Generation, MW | Export, MW | Losses, MW |
|---------|----------|----------------|------------|------------|
| PG&E | 25738 | 25458 | -1270 | 990 |
| SCE | 21552 | 12339 | -9820 | 607 |
| SDG&E | 4769 | 2312 | -2672 | 215 |
| Arizona | 16348 | 22389 | 5621 | 420 |
| Nevada | 5801 | 4995 | -892 | 86 |
| WAPA LC | 138 | 4629 | 4365 | 126 |
| Mex CFE | 2293 | 2633 | 283 | 57 |

FLOWS

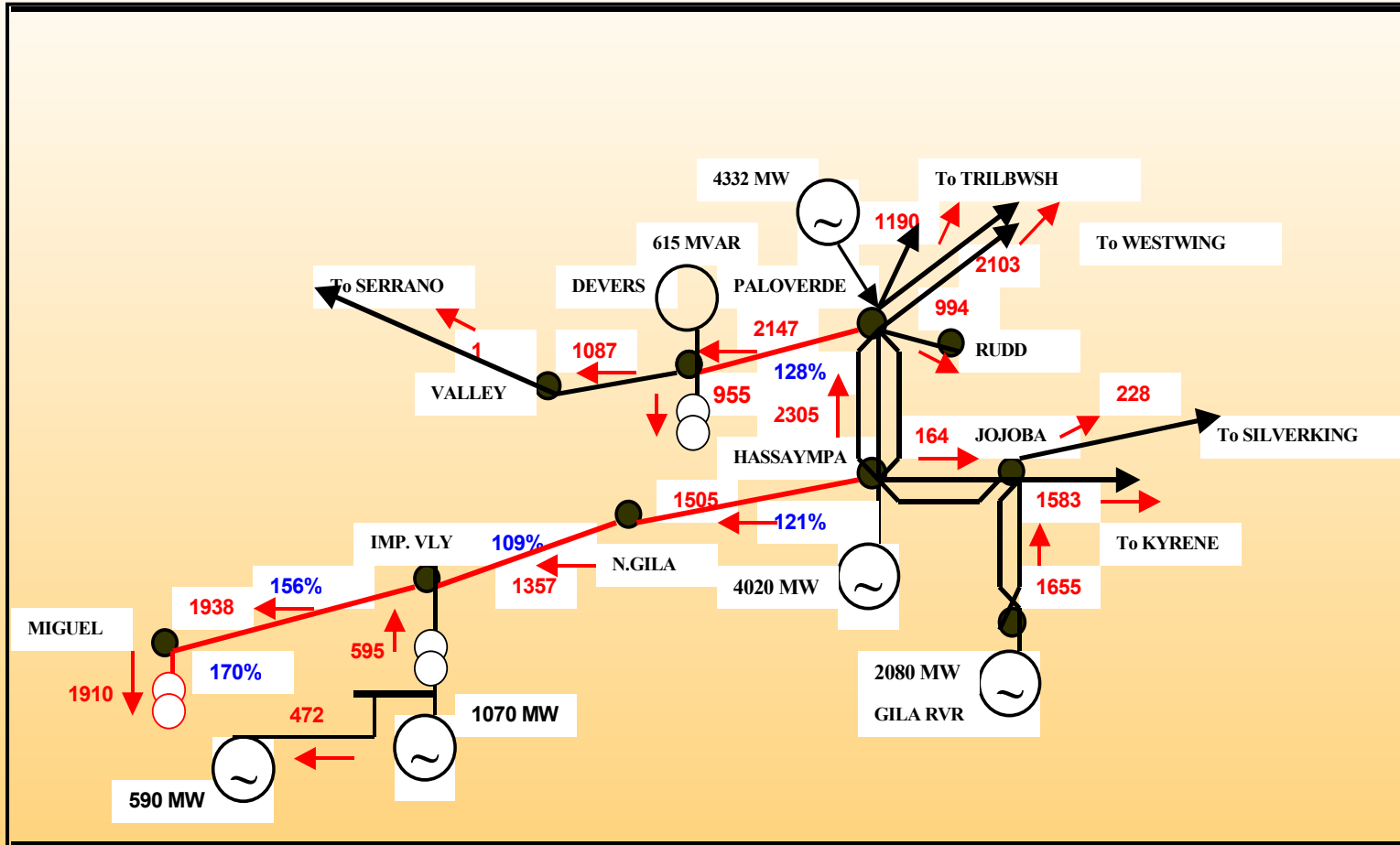
EOR 7079 MW
 WOR 8542 MW
 SCIT 16579 MW

PATH 26
 COI

2748 MW N to S
 3976 MW N to S



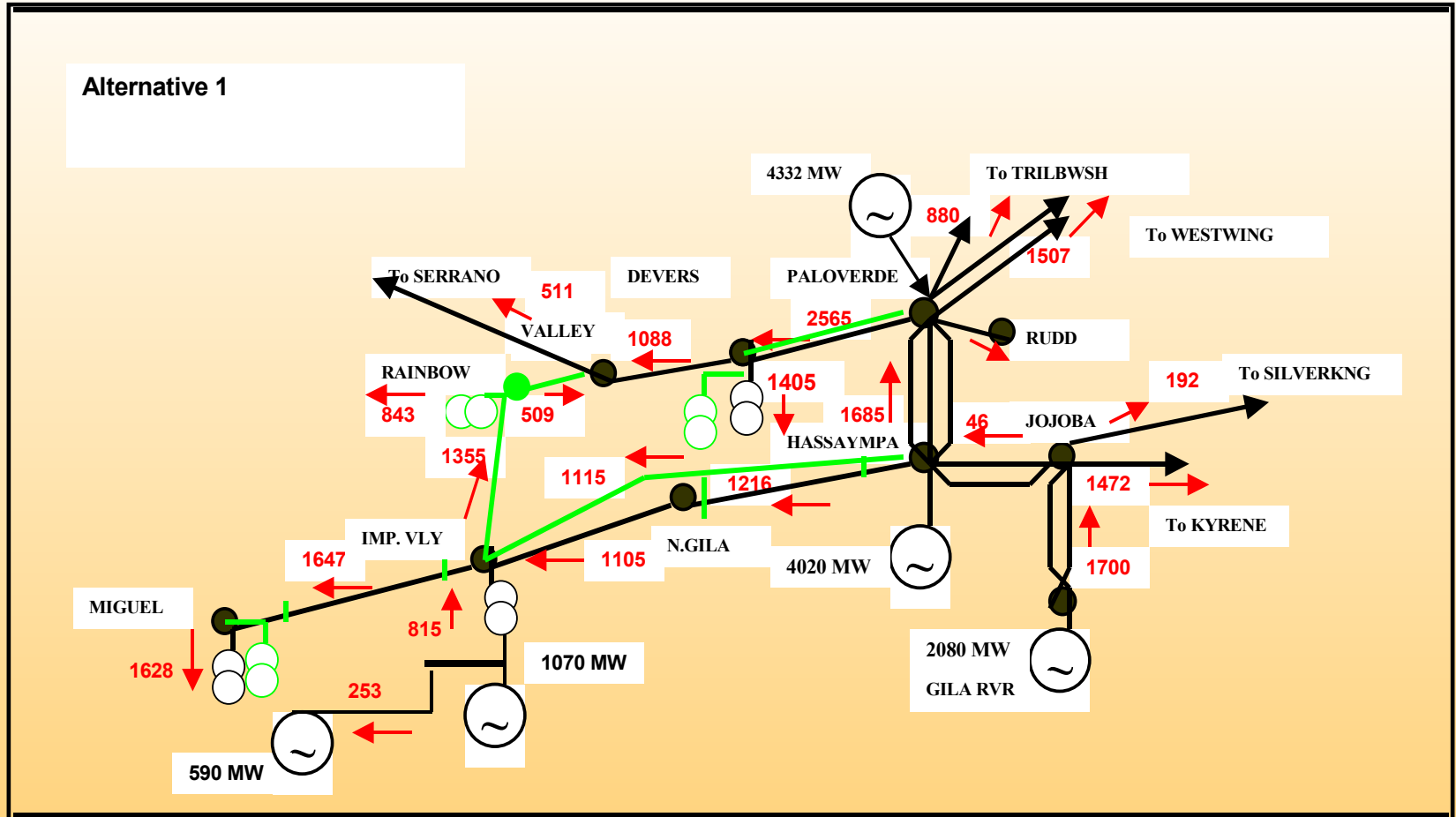
NO UPGRADES





CALIFORNIA ISO ALTERNATIVE 1. FULL LOOP.

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System Operator





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Alternative 1

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PRO

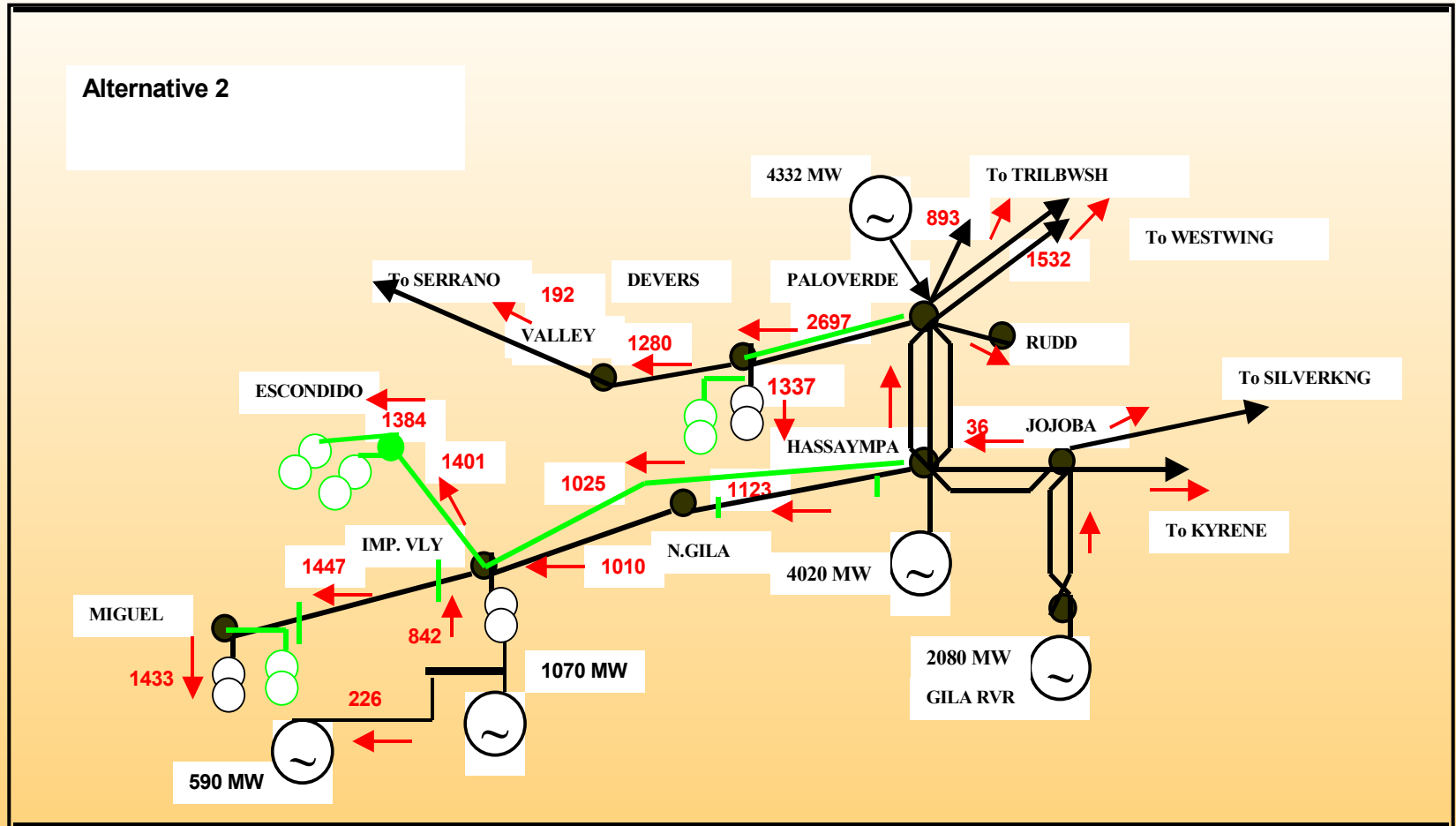
- **High flexibility (loop configuration)**
- **Low additional VAR support (850 MVAR)**
- **Low losses (347 MW)**

CON

- **High length of new 500 kV lines (651)**
- **High import at Miguel (2655 MW)**



ALTERNATIVE 2. FULL LOOP MINUS.





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Alternative 2

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PRO

- **Only 3 new 500 kV lines (563 mi)**
- **Connects to major load center (Escondido)**
- **Low import at Miguel (2422 MW)**

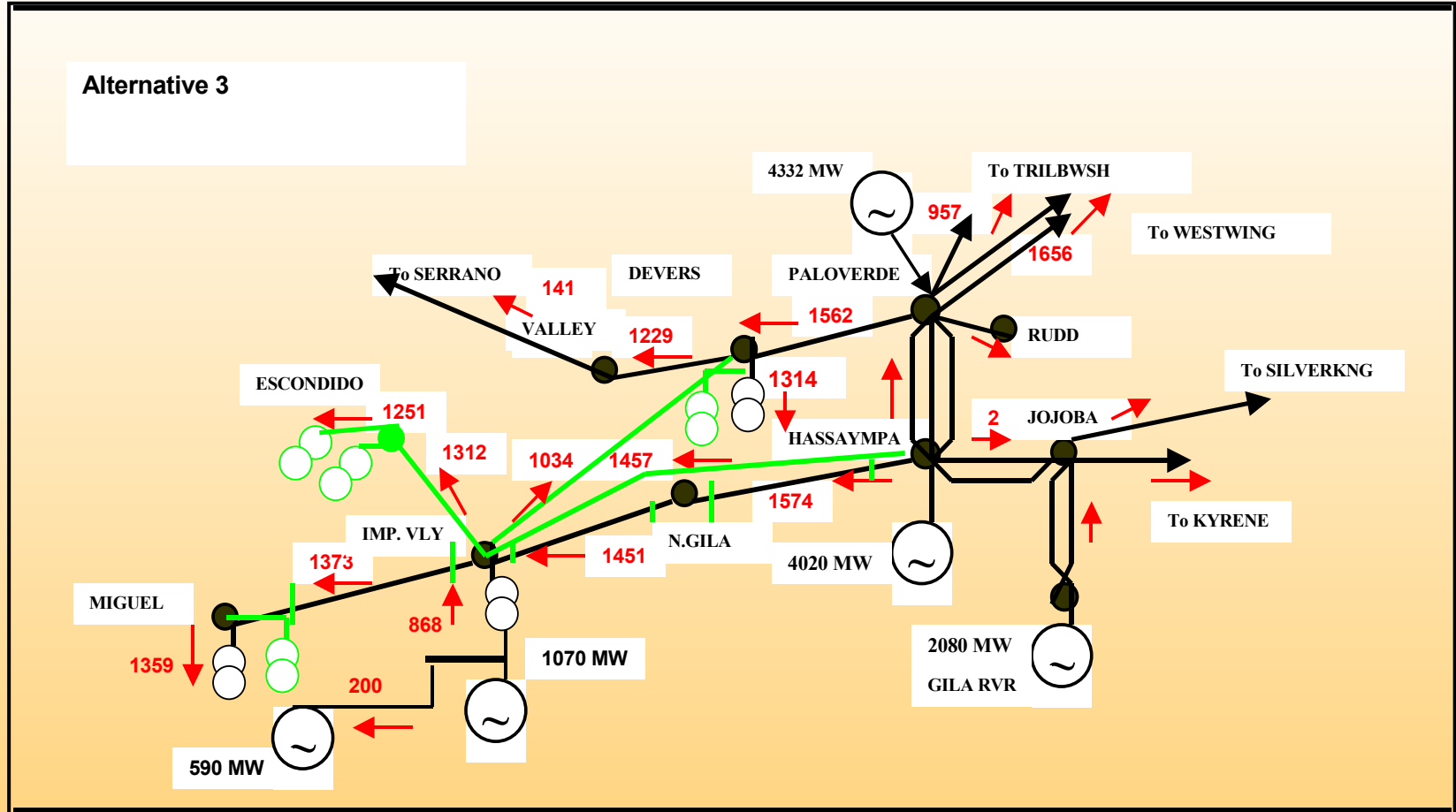
CON

- **Uncertainty about Escondido location**
- **No closed loop-lower reliability**



CALIFORNIA ISO ALTERNATIVE 3. SOUTHERN.

California Independent
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Alternative 3

PRO

- **Only 3 new 500 kV lines**
- **“Shortest” (475 mi)**
- **Connects to major load center (Escondido)**
- **Lowest import at Miguel (2344 MW)**

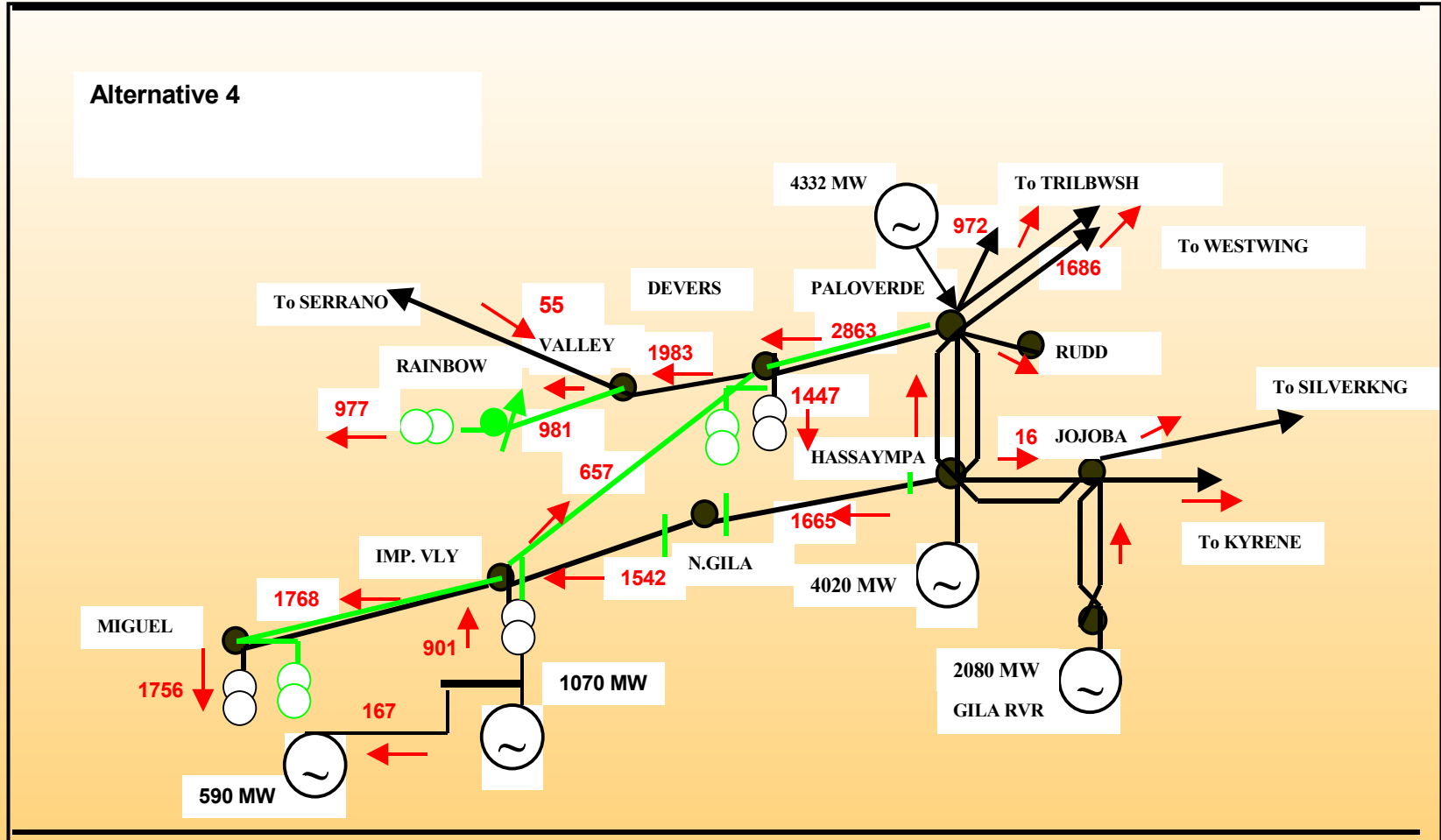
CON

- **Uncertainty about Escondido location**
- **High losses (388 MW)**
- **Only one new 500 kV line from Palo Verde/Hassyampa – lower reliability**



CALIFORNIA ISO ALTERNATIVE 4. NORTHERN

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Alternative 4

PRO

- **Low miles of new 500 kV lines (502)**
- **Uses existing or established corridors**

CON

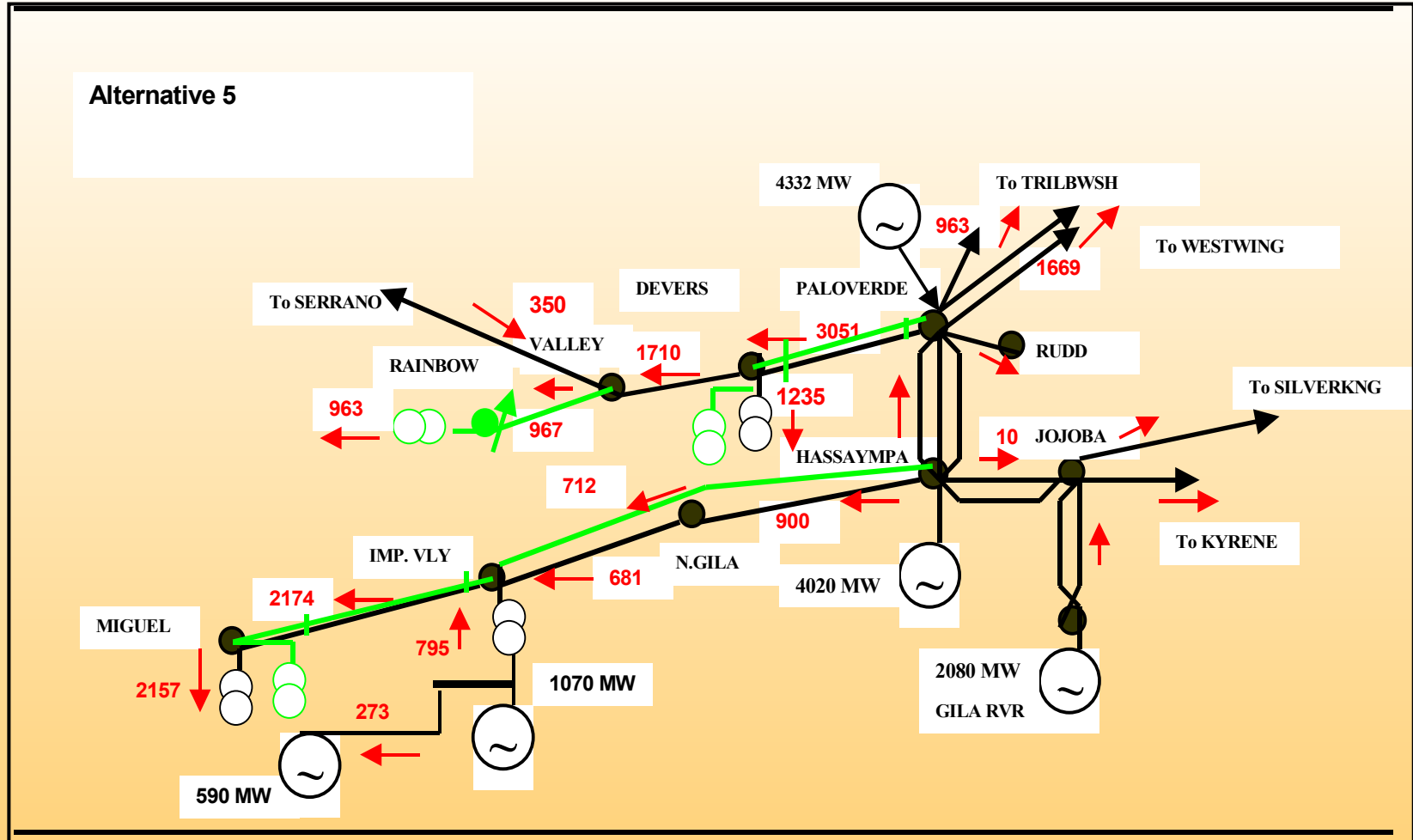
- **Highest losses (391 MW)**
- **Phase shifter**
- **High import at Miguel (2719 MW)**
- **High additional VAR support (1350 MVAR)**

Not worth pursuing?



CALIFORNIA ISO ALTERNATIVE 5. RADIAL.

California Independent
System Operator





Alternative 5

PRO

- **Uses existing or established corridors**

CON

- **Normal overload Miguel-Mission**
- **Phase shifter**
- **Highest import at Miguel (3151 MW)**
- **Highest additional VAR support (1600 MVAR)**

Not worth pursuing?



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Alternative 6

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PRO

- **New 500 kV corridor – higher reliability**
- **Transmission for Blythe generation**
- **No additional VAR support**
- **Benefits to AZ/NV**

CON

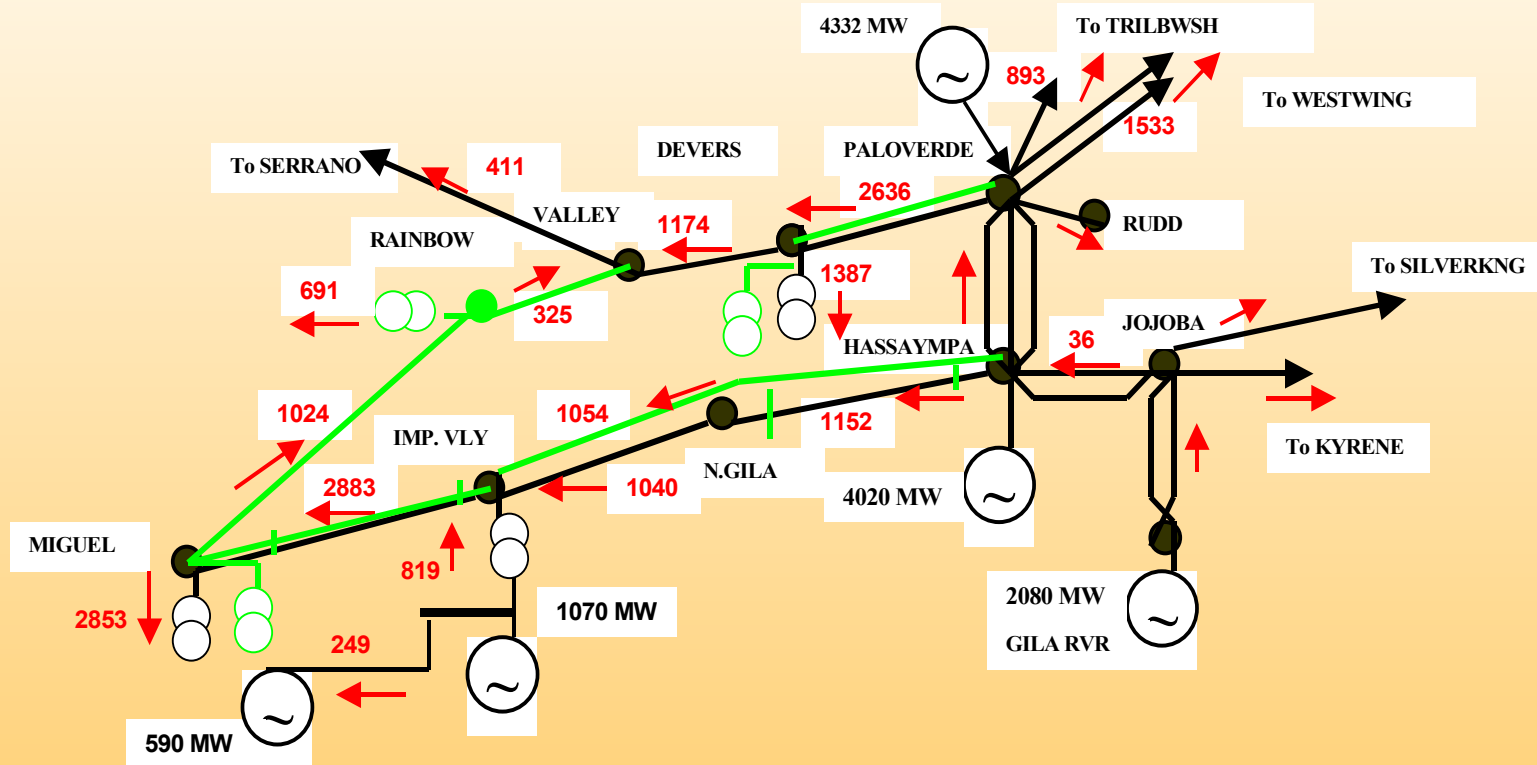
- **Longest 500 kV lines (843 mi)**
- **3 additional 500 kV substations**



CALIFORNIA ISO ALTERNATIVE 7. MIGUEL LOOP.

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Alternative 7





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Alternative 7

California Independent
System Operator

PRO

- **Larger 500 kV loop-
better performance?**
- **Lower additional VAR
support (800 MVAR)**

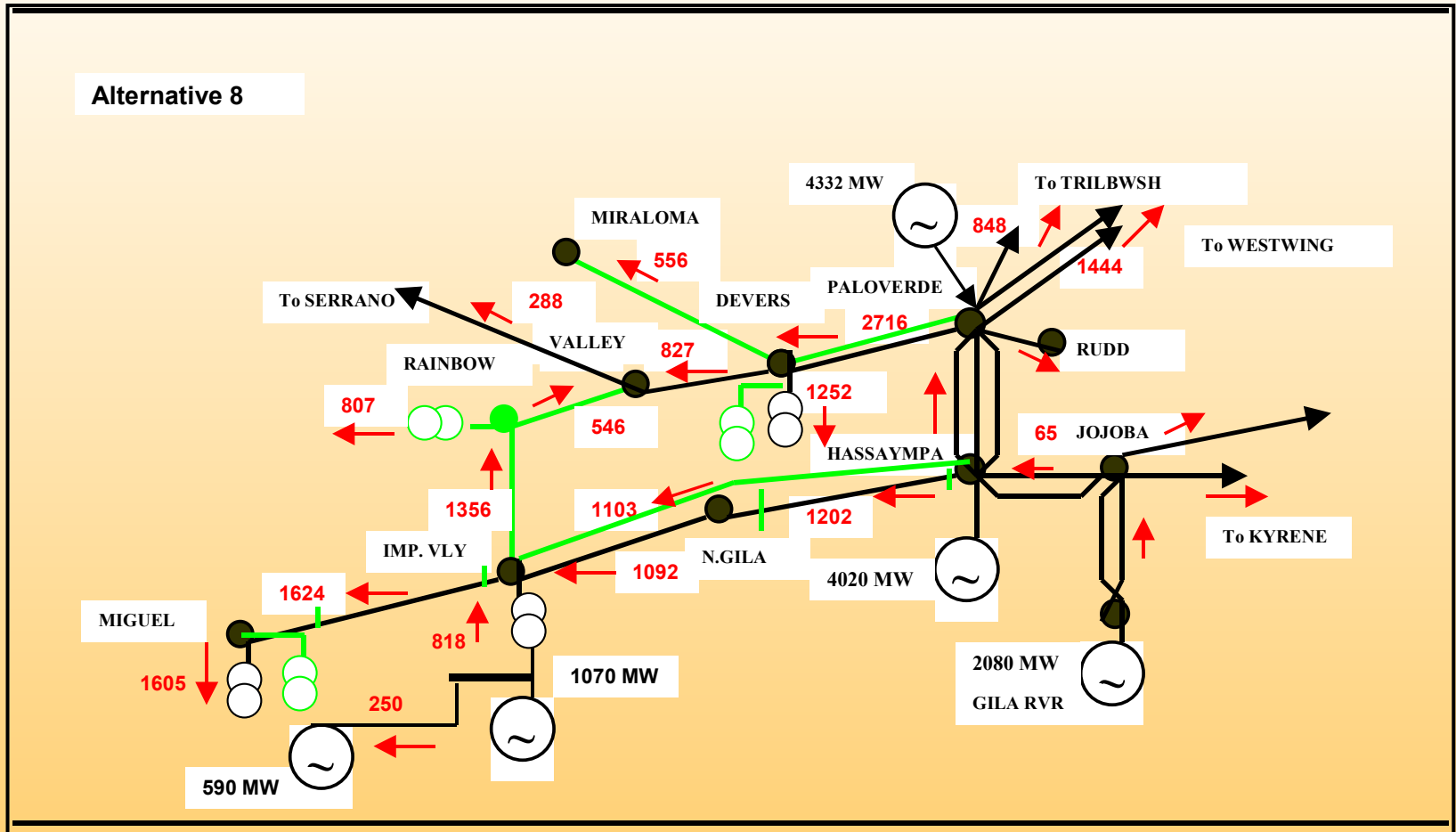
CON

- **High import at
Miguel (2845 MW)**
- **High losses (365
MW)**
- **Double outage
Imp.Vly-Miguel
may be limiting**



CALIFORNIA ISO ALTERNATIVE 8. FULL LOOP AND MIRA LOMA

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Alternative 8

PRO

- **Relieves loading on 230 kV west of Devers**
- **Voltage support to Mira Loma**

CON

- **High length of 500 kV lines (711 mi)**



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SUMMARY OF ALTERNATIVES

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| | Alt. 1 | Alt. 2 | Alt. 3 | Alt. 4 | Alt. 5 | Alt. 6 | Alt. 7 | Alt. 8 |
|---|--------|--------|--------|--------|--------|--------|--------|--------|
| # of new 500 kV lines | 4 | 3 | 3 | 4 | 4 | 5 | 5 | 5 |
| Miles of new 500 kV lines | 651 | 563 | 475 | 502 | 547 | 843 | 647 | 711 |
| Miles of new 230 kV lines | 51 | 0 | 0 | 51 | 51 | 51 | 51 | 51 |
| Additional VAR support needed (MVAR) | 850 | 900 | 1150 | 1350 | 1600 | 0 | 800 | 700 |
| # of new 500/230 kV transformers needed | 3 | 4 | 4 | 3 | 3 | 6 | 3 | 3 |
| # of new 500 kV lines with series capacitors | 3 | 3 | 3 | 3 | 4 | 5 | 4 | 3 |
| # of existing 500 kV lines with series capacitors upgrade | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 |
| Miguel Import (MW) | 2655 | 2422 | 2344 | 2719 | 3151 | 2639 | 2845 | 2628 |
| # of new lines that require a phase shifter | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| MW Losses 500 kV lines Southwest (area 1-26) | 347.2 | 361.2 | 388.3 | 390.9 | 383.2 | 372.5 | 365.3 | 345.7 |



Questions ?