

Integration of 75MW Solar PV Plant: Transmission System Design Analysis

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Project Objectives

Design transmission system modifications to:

- Integrate 75 MW solar PV at NEWSOLAR substation
- Provide redundant transmission paths
- Resolve existing system violations
- Maintain stability under N-1 contingency
- Minimize total cost including 5-year loss reduction

Initial System Analysis

Base System Characteristics:

- Total load: 826.3 MW, 275.5 Mvar
- Generation: 837.7 MW from 10 generators
- System losses: 10.7 MW (1.3%)
- Reactive support: -122.5 Mvar from 9 switched shunts

Case Summary for Present

Number of Devices in Case			
Buses	38	Trans. Lines (AC)	42
Generators	10	Series Capacitors	0
Loads	26	LTCs (Control Volt)	12
Switched Shunts	9	Phase Shifters	0
2 Term. DC Lines	0	Mvar Controlling	0
Multi-Term. DC	0		
Breakers	0	Fuses	0
Disconnects	0	Load Break Disc.	0
ZBRs	0	Ground Disconnects	0
Areas	1	Islands	1
Zones	1	Interfaces	0
Substations	0	Injection Groups	0

Case path name: Chapter6_DesignCase1Start.PWB

Case Totals (for in-service devices only)		
	MW	Mvar
Load	826.3	275.5
Generation	837.7	102.0
Shunts	0.6	-122.5
Losses	10.7	-50.8
Dist Gen	0.0	0.0

Generator Spinning Reserves		
	Positive [MW]	Negative [MVar]
	422.3	764.7

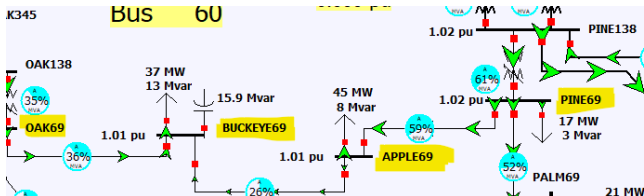
Negative MW Loads and Generators		
	MW	Mvar
Load	0.0	0.0
Generation	0.0	0.0

Slack Buses:

SLACK345 (31); in Area 1 (1)

Existing System Violations

Contingency	Flow	Limit	%
<i>PINE138-PINE69 Xfmr:</i>			
OAK69-BUCKEYE69	760.3	686.1	110.8
BUCKEYE69-APPLE69	454.2	418.4	108.6



Design Approach

- Evaluate all possible connection configurations
- Compare 69 kV vs 138 kV options
- Start with shortest distance solution
- Use least expensive conductors initially
- Upgrade components only as needed
- Consider loss reduction benefits

19 possible configurations evaluated:

- 69 kV options: \$5.94M - \$12.23M
- 138 kV options: \$14.37M - \$19.42M
- Shortest path: NEWSOLAR to BUCKEYE69 & APPLE69 (12 km)
- Required upgrade: OAK69-BUCKEYE69 to Crow conductor

Selected Solution Cost Breakdown

Component	Cost (M\$)
OAK-BUCKEYE Upgrade	3.87
NEWSOLAR-BUCKEYE Line	2.97
NEWSOLAR-APPLE Line	2.97
Loss Savings (0.9 MW)	-2.37
Total	7.44

Loss Reduction Analysis

- Base case losses: 10.7 MW
- New configuration: 9.8 MW
- Savings: 0.9 MW
- 5-year energy savings: 39,420 MWh
- Economic value: \$2.37M at \$60/MWh

Case Summary for Present

Number of Devices in Case			
Buses	38	Trans. Lines (AC)	44
Generators	10	Series Capacitors	0
Loads	26	LTCs (Control Volt)	12
Switched Shunts	9	Phase Shifters	0
2 Term. DC Lines	0	Mvar Controlling	0
Multi-Term. DC	0		
Breakers	0	Fuses	0
Disconnects	0	Load Break Disc.	0
ZBRs	0	Ground Disconnects	0
Areas	1	Islands	1
Zones	1	Interfaces	0
Substations	0	Injection Groups	0

Case path name C:\Users\brent\OneDrive\Documents\UMass ECE\ECE590\termProject\ECE590\PowerWorld_files\case1_finalcheck.PWB

Case Totals (for in-service devices only)		
	MW	Mvar
Load	826.3	275.5
Generation	836.9	87.5
Shunts	0.6	-122.2
Losses	9.8	-65.7
Dist Gen	0.0	0.0

Generator Spinning Reserves		
	Positive [MW]	Negative [MW]
	498.1	763.9

Negative MW Loads and Generators		
	MW	Mvar
Load	0.0	0.0
Generation	0.0	0.0

Slack Buses:

SLACK345 (31); in Area 1 (1)

Conclusions

- Optimal solution: 69 kV connections to BUCKEYE & APPLE
- OAK-BUCKEYE upgrade resolves contingency violations
- Total cost \$7.44M including loss savings
- Meets all reliability and redundancy requirements
- Simple design facilitates implementation

Thank you!!