

Appendix F

Production and Fixed Cost Modeling

Table of Contents

APPENDIX F.1- KEY ASSUMPTIONS.....	1
TRANSMISSION	1
<i>Transmission Path Ratings & Nomograms</i>	2
<i>Transmission added to the 2008 Base Case</i>	2
<i>Transmission added to the 2013 Scenario</i>	3
<i>Transmission Losses</i>	3
LOAD FORECASTING	6
<i>Planning Margin</i>	6
TREATMENT OF RESOURCES	7
<i>Hydro Conditions</i>	8
<i>Maintenance Outages</i>	8
<i>Heat Rates and VOM costs</i>	9
<i>Resource Additions 2008</i>	9
<i>Resource Additions 2013</i>	11
CAPITAL COSTS.....	14
<i>Resource Capital Costs</i>	14
<i>Transmission Capital Costs</i>	14
GAS PRICES	16
COAL PRICES.....	19
APPENDIX F.2- ABB MARKET SIMULATOR.....	20
PURPOSE AND SCOPE.....	20
MODELING LIMITATIONS AND IMPLICATIONS	21
HYDRO AND WIND MODELING.....	21
ABB MARKET SIMULATOR STRENGTHS	22
ABB MARKET SIMULATOR WEAKNESSES	23
MODEL INPUTS:.....	24
MODEL OUTPUTS:	24
APPENDIX F.3- 2008 BASE CASE	25
BASE CASE RESULTS	25
LOCATIONAL MARGINAL PRICES (LMP)	27
DURATION CURVES	30
NEAR-TERM PROJECTS.....	33
<i>Amps Line Phase Shifter</i>	33
<i>Flaming Gorge Transformers</i>	34
<i>IPP DC Upgrade</i>	36
VALIDATION	37
APPENDIX F.4- 2013 RESOURCE AND TRANSMISSION EXPANSION ALTERNATIVES.....	39
ALTERNATIVE 1	40
ALTERNATIVE 2.....	46
ALTERNATIVE 3.....	51
ALTERNATIVE 4.....	57
RECOMMENDATIONS.....	62
<i>Recommendation 1</i>	62
REFERENCE CASES	65

APPENDIX F.5- SENSITIVITIES.....	68
SENSITIVITIES – YEAR 2008 ANALYSIS	68
SENSITIVITIES – YEAR 2013 ANALYSIS	68
<i>Gas Prices Sensitivities</i>	68
<i>Hydro Condition Sensitivities</i>	69
DSM.....	70
<i>Expanded Energy Efficiency Scenario for the RMATS Study- Howard Geller, 2/12/04</i>	72
<i>Mohave In</i>	77
<i>Rail versus Wire</i>	77
SENSITIVITY PRODUCTION COST RESULTS	77
ENVIRONMENTAL REGULATIONS	78
<i>Modeling a Carbon Adder as Fuel Price Adder</i>	80
CO2 MODELING	80
APPENDIX F.6- RMATS ECONOMIC COMPARISON TABLES	80
PURPOSE	80
ECONOMIC COMPARISON TABLES	80
<i>Step 1:</i>	80
<i>Step 2:</i>	80
<i>Step 3:</i>	81
DISTRIBUTION OF ECONOMIC GAINS AND LOSSES	82

[Appendix F.1 Key Assumptions](#)

[Appendix F.2 ABB MS](#)

[Appendix F.3 Base Case](#)

[Appendix F.4 Alternatives](#)

[Appendix F.5 Sensitivities](#)

[Appendix F.6 Economic Tables](#)

Table of Figures

Figure F.1. 1: RMATS 33 bubble topology.....	1
Figure F.1. 2: Geographic representation of interface/path locations and line representation	5
Figure F.1. 3: Generation capacity by fuel type (MW)- 2008.....	11
Figure F.2. 1: ABB Market Simulator algorithm process sequence.....	22
Figure F.3. 1: January 2008 average LMP - \$4.00 gas case.....	27
Figure F.3. 2: June 2008 average LMP - \$4.00 gas Case	28
Figure F.3. 3: Hourly system LMP profile for June 12, 2008.....	28
Figure F.3. 4: Idaho to Montana	30
Figure F.3. 5: TOT 2C	30
Figure F.3. 6: Bridger West	31
Figure F.3. 7: IPP DC.....	31
Figure F.3. 8: TOT 3.....	32
Figure F.3. 9: SW Wyoming to Bonanza	32
Figure F.3. 10: Idaho to Montana interface utilization before adding phase shifter	33
Figure F.3. 11: Idaho to Montana interface utilization after adding phase shifter	33
Figure F.3. 12: SW Wyoming to Bonanza interface utilization before adding transformer.....	34
Figure F.3. 13: SW Wyoming to Bonanza interface utilization after adding transformer.....	34
Figure F.3. 14: IPP DC utilization before additional capacity is added.....	36
Figure F.3. 15: IBB DC utilization after additional capacity is added.....	36
Figure F.3. 16: The Idaho to Pacific Northwest path – combination of 500, 230 and 115 kV lines	37
Figure F.3. 17: West of Hatwai path location is in eastern Washington.....	38
Figure F.3. 18: Montana to Pacific Northwest – the lines between Montana and the NW.....	38
Figure F.3. 19: The California Oregon AC Intertie	39
Figure F.3. 20: Path 26 - Between PG&E and Southern California Edison (Midway to Vincent)	39
Figure F.3. 21: East of the Colorado River (EOR) – Western Arizona.....	40
Figure F.3. 22: TOT 2A in Southern CO; TOT 2B – Utah to Arizona; TOT2C – Southern Utah to SE Nevada	40
Figure F.4. 1: Alternative 1 resource additions.....	40
Figure F.4. 2: Alternative 1 top six congested Rocky Mountain Area interfaces without new transmission build	41
Figure F.4. 3: Alternative 1 recommended transmission upgrades	41
Figure F.4. 4: July 2013 average Locational Marginal Prices with Alternative 1 generation included, no new transmission is included.	45
Figure F.4. 5: July 2013 average Locational Marginal Prices after Alternative 1 generation and Transmission is Included.	45
Figure F.4. 6: Alternative 2 resource additions.....	46
Figure F.4. 7: Top 10 congested paths if Alternative 2 generation is added without new transmission	47
Figure F.4. 8: Recommended transmission build for Alternative 2 generation.....	47
Figure F.4. 9: July 2013 average Locational Marginal Prices with Alternative 2 generation included, no new transmission is included.	50
Figure F.4. 10: July 2013 average Locational Marginal Prices with Alternative 2 generation and new transmission is included.	50
Figure F.4. 11: Alternative 3 resource additions.....	51
Figure F.4. 12: Top 10 congested paths if Alternative 3 generation is added without new transmission.....	52
Figure F.4. 13: Recommended transmission build for Alternative 3 generation. Requires two of potentially five export paths to the West Coast.....	53
Figure F.4. 14: July 2013 average Locational Marginal Prices with Alternative 3 generation included, no new transmission is included.	55

Figure F.4. 15: July 2013 average Locational Marginal Prices with Alternative 3 generation and option 3 transmission.....	55
Figure F.4. 16: Alternative 4 resource additions.....	57
Figure F.4. 17: Top 10 congested paths if Alternative 4 generation is added without new transmission.....	58
Figure F.4. 18: Recommended transmission build for Alternative 4 generation, requires two of potential five 500kV export lines to the west coast (Alternative 3- option 3 shown here). Also required is one 500kV DC line from NE Wyoming to California.....	58
Figure F.4. 19: July 2013 average Locational Marginal Prices with Alternative 4 generation included, no new transmission is included.	61
Figure F.4. 20: July 2013 average Locational Marginal Prices with Alternative 4 generation and new transmission is included.	61
Figure F.4. 21: Resource and Transmission Additions assumed in Recommendation 1.....	62
Figure F.5. 1: Annual hydro energy (GWh)	69
Figure F.5. 2: DSM Option 2 recommended transmission to be built.....	71

Figures not referenced:

Recommendation 1 & 2 Duration Curves

- [Rec 1 Duration Curves.pdf](#)
- [Rec 2 Duration Curves.pdf](#)

Table of Tables

Table F.1. 1: Transmission interface/path ratings.....	4
Table F.1. 2: Gas prices for 2008 & 2013	9
Table F.1. 3: Coal prices (2004 dollars).....	10
Table F.1. 4: Expected resources to be in service by 2008	11
Table F.1. 5: Resource additions by state and alternative	14
Table F.1. 6: Wind resources added for each alternative	16
Table F.1. 7: Cost curves for thermal plants by type, technology size and vintage.....	17
Table F.1. 8: Transmission line capital cost estimates	19
Table F.3. 1: Western Interconnect production costs for bases cases (2004 dollars).....	26
Table F.3. 2: Top six congested interfaces (paths) for each 2008 base case scenario.....	26
Table F.4. 1: Alternative 1 area production costs (dollars are in millions).....	43
Table F.4. 2: Alternative 1 top six congested interfaces before and after transmission is added	44
Table F.4. 3: Alternative 2 area production costs (dollars are in millions, 2004 nominal terms)	48
Table F.4. 4: Alternative 2 top ten congested interfaces before and after transmission is added	49
Table F.4. 5: Alternative 3 area production costs (dollars are in millions, 2004 nominal terms)	54
Table F.4. 6: Alternative 3 top congested interfaces before and after transmission is added	56
Table F.4. 7: Alternative 4 area production costs (dollars are in millions).....	59
Table F.4. 8: Alternative 4 top congested interfaces before and after transmission is added	60
Table F.4. 9: Recommendation 1 area production costs (dollars in millions)	63
Table F.4. 10: Recommendation 1 interface utilization results	64
Table F.4. 11: Gas Reference Case area production costs (dollars in millions)	66
Table F.4. 12: IRP Based Reference Case area production costs (dollars in millions)	67
Table F.5. 1: Sensitivities study for Alternative 3, Option 3	68
Table F.5. 2: Cost of accelerated DSM for the Rocky Mountain Region	70
Table F.5. 3: Loads levels assumed in DSM case	70
Table F.5. 5: Loads assumed in DSM scenario	76
Table F.5. 6: Cost of accelerated DSM for the Rocky Mountain area.....	77
Table F.5. 7: Annual production costs for each sub-area	78
Table F.5. 8: Incremental CO ₂ adder cost (dollars in millions).....	79
Table F.6. 1: Sample Chart.....	80
Table F.6. 2: Sample Chart.....	81
Table F.6. 3: Economic Gross Gains & Losses Table.....	82
Table F.6. 4: Recommendation 1	83
Table F.6. 5: Recommendation 2	83
Table F.6. 6: IRP Based Reference Case.....	83
Table F.6. 7: All Gas Reference Case	83