CALIFORNIA ENERGY COMMISSION

SCENARIO ANALYSES OF CALIFORNIA'S ELECTRICITY SYSTEM: PRELIMINARY RESULTS FOR THE *2007 INTEGRATED ENERGY POLICY REPORT*

SECOND ADDENDUM APPENDICES

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APPENDIX A

ANALYSIS OF TRANSMISSION IMPLICATIONS OF AGED POWER PLANT RETIREMENT AND REPLACEMENT

Prepared by Navigant Consulting, Inc.

REPORT ON PRELIMINARY ASSESSMENT OF THE IMPACTS OF RETIRING AGED GENERATING FACILITIES IN THE SCE AREA

EXECUTIVE SUMMARY

Background

In the 2005 Integrated Energy Policy Report (2005 IEPR), the Energy Commission adopted a policy that the aging fossil-fueled power plants in California should be retired or repowered by 2012. This study examines the implications of a retirement by 2012 of the majority of such power plants in the Southern California Edison (SCE) service area. Retirement of power plants within the SCE service territory requires that replacement capacity be developed both to provide necessary energy to serve load and to satisfy local capacity requirements for reliability. This study examines how transmission system upgrades might be different under three broad scenarios of future resource development: (1) a build-out satisfying current energy efficiency and renewables policies, (2) these policies plus an expansion of savings from energy efficiency, and (3) the current policy goals plus a much larger emphasis of renewables. These preliminary results indicate that significant transmission upgrades would be required to replace Aged Plants located on the western side of the SCE service area with replacement capacity on the eastern side of the service area, and that there are differences in associated transmission upgrades depending upon the resource build-out strategy. There are also additional transmission upgrades needed beyond 2012 due to load growth; these upgrades might be somewhat different among major retirement and alternative build-out strategies. Power plant development and transmission line upgrades can involve extensive planning and licensing processes with long and uncertain lead-times and results. Therefore, this study suggests that close coordination is needed among the pertinent parties with respect to power plant retirement, the planning and development of replacement resources, and the planning and development of the required transmission line upgrades.

Introduction

At the present time there are seven aged generating plants (with a total of twenty individual units) which are interconnected with the SCE transmission system and which are located along or near the coast in Orange, Los Angeles, and Ventura Counties. Because of their location with respect to the load, other generating resources, and the existing transmission system in the SCE area many of these Aged Plants are necessary to maintain the reliability of the transmission system and, as such, they are currently required to operate even though energy might be available from more efficient resources located elsewhere on the system. These Plants have significantly higher heat rates than new technology combined-cycle generating plants and contribute more to green house gas emissions and criteria pollutants than resources that could replace their output if the transmission system had sufficient capacity to allow such to occur. In addition, many of the Aged Plants use ocean water for once-through cooling which has been targeted by the California State Water Resources Control Board for reduction, if not elimination, out of concern for thermal effects and entrainment of marine organisms.

Further, there are also aged generating plants interconnected with the systems of Pacific Gas & Electric, San Diego Gas & Electric, and the Los Angles Department of Water and Power, most of which continue to operate due to local capacity requirements for reliability purposes. Due to budgetary and schedule limitations the potential impacts associated with retiring some or all of these aged plants were not assessed in this report.

As part of its work related to the 2007 Integrated Energy Policy Report (IEPR), the California Energy Commission (Energy Commission) retained Navigant Consulting, Inc. (NCI) to undertake a preliminary assessment of the impacts that retiring some or all of the units at the Aged Plants in the SCE area could have on the electric system in Southern California. These studies evaluated both the impacts on the transmission system and the requirement for resources to replace the retired generation. As of the date of this report, discussions have been held with both SCE and the California Independent System Operator (California ISO) regarding the Aged Plant retirement studies and the input of both of these parties has been received on a previous draft of this Assessment and on the ratings of the SCE 230-kV lines in the study area.

April 2, 2007 Interim Report

On April 2, 2007 Navigant Consulting, Inc. (NCI) issued an interim report that summarized the results of studies done to identify the transmission system additions/modifications that would be required should certain amounts of Aged Plant generation in the SCE area be retired (a copy of this report is attached as Appendix 1). As discussed in Appendix 1 the Aged Plants evaluated for potential retirement, all of which are gas-fired steam units, included:

- LA Basin plants:
  - Alamitos – Six units with a total installed capacity of 1,930 Megawatts (MW)
  - Etiwanda – Two units with a total installed capacity of 620 MW
  - El Segundo – Two units with a total installed capacity of 660 MW

- Huntington Beach – Two units with a total installed capacity of 400 MW[1]
- Redondo Beach – Four units with a total installed capacity of 1,240 MW

- Ventura County plants:
  - Ormond Beach – Two units with a combined capacity of 1,400 MW
  - Mandalay – Two units with a combined capacity of 400 MW

NCI evaluated retirement opportunities and associated required transmission and assumed new generation capacity additions for projected 1-in-10 peak load conditions for 2012, 2016 and 2020. 2012 was chosen as the initial study year because of the above-mentioned Energy Commission policy that the Aged Plants should be retired or repowered by that year. The years 2016 and 2020 were also studied to assess how load growth and potential changes in the resources mix for the SCE area could impact the need for additional system reinforcements to continue to accommodate the retirement of the Aged Plants.

The studies assessed system impacts for both normal and contingency conditions on the transmission system. The approach used by NCI in this analysis consisted of identifying:

- The amounts of Aged Plant generation that could be retired in 2012 without causing adverse impacts on the transmission system while recognizing that the development of any major transmission upgrades or modifications by 2012 would likely be difficult to achieve unless such projects were already in progress,
- The system impacts due to load growth in 2016 and 2020 when the amounts of retired Aged Plant generation were at the amounts identified in the 2012 case,
- Potential methods of mitigating overloads noted in the 2012, 2016 and 2020 cases, and
- The system impacts that would be expected to occur if all of the Aged Plant generation was retired by 2012.

The resources for the SCE area assumed in these studies are summarized in Table ES-1. The analysis assumed that one San Onofre Nuclear Generating Station (SONGS) unit was out-of-service to stress the system for contingency studies. The renewable resource additions modeled were based on information being developed as part of the California Energy Commission Staff's Integrated Energy Policy Report Analysis Scenarios Project Results Report ("Scenarios Project Results Report"). Major SCE transmission system additions modeled in these studies included:

- The proposed Harquahala-Devers 500-kV line, and

[1] Two of the existing units at Huntington Beach are not considered "aged" and were assumed to remain in service in this analysis (they were repowered in 2003).

- The proposed Tehachapi Renewable Transmission Project.

TABLE ES-1 SCE AREA LOADS AND RESOURCES MODELED IN APRIL 2007 AGED PLANT RETIREMENT STUDIES			
	2012	**2016**	**2020**
SCE Area Loads and Losses (MW)[2]	28,384	29,771	31,261
SCE Area Resources (MW)			
Imports	8,610	9,179	10,879
Aged Plants	2,510	2,510	2,510
New Renewables [3]	683	1,456	1,512
New Thermal Generation [4]	7,774	7,774	7,514
Existing Wind Generation [3]	327	327	327
Other Existing Generation [5]	8,480	8,525	8,519
Total Resources	28,384	29,771	31,261

Summary of Results – April 2007 Interim Report

As discussed in Appendix 1, the studies discussed in the April 2007 Interim Report indicated that for 2012 peak load conditions:

- A total of 4,140 MW of Aged Plant generation (2,340 MW at the LA Basin plants[6] and 1,800 MW at the Ventura County plants[7]) could not be retired unless:
    - The required replacement capacity (approximately 5,400 MW[8]) is developed within the eastern portion of the SCE system.
    - Approximately 0.5 miles of the Chino-Mira Loma #1 230-kV line is reconductored and the wave-traps[9] at Chino are upgraded or removed,

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[2] Includes pumping loads

[3] Assumed dependable capacity

[4] The locations and sizes of the new thermal generation were based on information in the California ISO and SCE generation interconnection queues as of March 1, 2007.

[5] Amount varies due to differences in the output of the SCE area swing generator.

[6] Retired capacity includes 980 MW at Alamitos, 620 MW at Etiwanda. 400 MW at Huntington Beach, and 340 MW at Redondo Beach

[7] Retired capacity includes 400 MW at Mandalay and 1,400 MW at Ormond Beach

[8] Approximately 4,300 MW of capacity would be required to replace the retired Aged Plants and to provide for increased losses while an additional 1,100 MW would be required to replace lost capacity should an outage occur on SONGS Unit #3.

[9] A wave trap is used in power-line carrier applications and serves as an interface between a transmission line and the pertinent communications equipment

- The Antelope-Pardee 230-kV line is in service[10], and
- The limiting elements[11] on the Pardee-Moorpark #2 and #3 230-kV lines are upgraded.

The studies discussed in Appendix 1 also indicated that, if a total of 4,140 MW of Aged Plant capacity was retired in 2012 load growth in the SCE area after 2012 would result in increased or additional overloads and in low voltages on the SCE system. These studies also indicated that the impacts noted on the cases with 2016 and 2020 peak loads could be mitigated if:

- The balance of the Chino-Mira Loma #1 line (approximately 6.5 miles) was reconductored,
- The Chino-Mira Loma #3 and Barre-Ellis 230-kV lines (with a combined length of 19 miles) were reconductored,
- The two Pisgah-Lugo 230-kV lines (with a combined length of 130 miles) were reconductored,
- A short-term emergency rating rather than the long-term emergency rating for the Serrano-Villa Park 230-kV lines was used to determine post-contingency overloads during L-1/L-1 overlapping outage conditions,
- The Antelope-Pardee line was converted to 500-kV operation[12],
- The Vincent-Santa Clara 230-kV line was looped into Pardee and the Vincent-Pardee section was being operated at 500-kV (it is built for 500-kV operation),
- Approximately 500 MVAR of reactive support was installed at various substations in the LA Basin and Ventura County, and
- The series capacitors in the El Dorado-Lugo 500-kV line were upgraded.

Finally, the studies discussed in Appendix 1 indicated that, if all 6,650 MW of Aged Plant generation was retired by 2012:

- Approximately 8,000 MW of replacement capacity would have to be developed within or be deliverable to the eastern portion of the SCE system, and
- A number of additional overloads and low voltage conditions would occur on the

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[10] The Antelope-Pardee line is planned to be in-service by early 2009 and is the first component of the Tehachapi Renewable Transmission Project Plan of Service. It will be designed and constructed for 500-kV operation but will initially be operated at 230-kV.

[11] Information filed with the Energy Commission by SCE in June 1993 indicates that the conductor rating for these lines is greater than the rating modeled in the WECC 2016 summer peak powerflow data set. This leads to the conclusion that another element (such as a wave trap) is presently limiting the capability of the lines.

[12] This would require the development of a 500-kV substation at Pardee

SCE system- requiring the following additional mitigation measures by 2012:

- Reconductoring five 230-kV lines (with a combined length of 30 miles),
- Replacing the limiting elements [10] on three 230-kV lines in the LA Basin,
- Upgrading the series capacitors in the El Dorado-Lugo 500-kV line, and
- Installing approximately 500 MVAR of shunt capacitors at various 230-kV substations in the SCE area.

Due to the costs and lead time required to plan, permit, and develop both the required replacement capacity and the above transmission upgrades retirement of large amounts of the Aged Plant generation in the SCE area by 2012 would be difficult. However a phased retirement plan could likely be developed that would allow sufficient lead time for the development of both the required generation and transmission projects.

Aged Plant Retirement Study Update

After the studies discussed above were completed (and based on discussions with the California ISO) Energy Commission staff and NCI became aware that SCE had, during late-2006 and early-2007, modified the ratings information for most of its 230-kV lines and had begun reporting these new ratings in WECC base cases. Because most of the rating changes resulted in the emergency ratings of the impacted lines being decreased, NCI reran the studies discussed above to reflect the revised ratings.

In addition, since early April 2007, studies of increased energy efficiency and more extensive renewable resource development scenarios (as summarized in Table ES-2) for the SCE area have been postulated as part of the Energy Commission Staff's Scenarios Project Results Report discussed earlier. The effects of higher energy efficiency and higher levels of renewable resource additions were evaluated in combination with the retirement of aged generating plants to determine the relative effects on mitigation requirements to accommodate the retirements.

The numbered cases described in this report (and summarized in Table ES-2) unless explained otherwise, refer to the cases in the Scenarios Project Results Report and are described in detail in the Scenarios Project Results Report.

TABLE ES-2 SCENARIOS PROJECT RESULTS REPORT RENEWABLE RESOURCE AND ENERGY EFFICIENCY CASES (Dependable MW)[13]						
Resource Type	**Case 1 Current Trends**			**Case 1B Compliance With Current Requirements**		
	2012	**2016**	**2020**	**2012**	**2016**	**2020**
Biomass	0	0	0	50	50	50
Wind	57	114	170	265	614	668
Solar (CSP)	0	0	0	305	718	718
Total	57	114	170	620	1,382	1,436
Energy Efficiency	0	0	0	874	1,637	2,269
Solar (PV)	0	0	0	63	139	150
Total	0	0	0	937	1,776	2,419
Resource Type	**Case 3A High Efficiency in California**			**Case 4A High Renewables in California**		
	2012	**2016**	**2020**	**2012**	**2016**	**2020**
Biomass	50	50	50	26	131	235
Wind	265	613	668	207	883	1,516
Solar (CSP)	305	718	718	131	654	1,175
Geothermal	0	0	0	29	147	264
Total	620	1,381	1,436	393	1,815	3,190
Energy Efficiency	1,145	2,292	3,427	874	1,637	2,269
Solar (PV)	63	139	150	303	789	854
Total	1,208	2,431	3,577	1,177	2,426	3,123

Summary of Findings – Updated Studies With 4,140 MW of Retirements

Requirement for New Thermal Capacity

As discussed in Section 2 of this report, the Updated Aged Plant retirement studies indicated that the amounts of new thermal capacity required to meet SCE's net area loads[14] not served by existing conventional and thermal resources and new renewable resources would vary as summarized in Table ES-3.

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[13] Assumed dependable capacity (as a % of installed capacity) as follows: Biomass – 100%; Tehachapi area wind – 22%; other wind – 29%; solar (CSP) – 87%; and solar (PV) – 52%

[14] Total area load less demand side resources (EE and PV)

TABLE ES-3 REQUIREMENT FOR NEW THERMAL CAPACITY (MW)					
Year	Case				
	Reference[15]	UI[16]	1B	3A	4A
2012	3,809	7,182	6,490	6,151	6,445
2016		7,683	6,187	5,445	5,067
2020		8,214	6,832	5,690	4,416

As shown in Table ES-3

- The requirement for new thermal resources in 2012 ranges from about 3,800 MW in the Reference Case (which did not model any Aged Plant retirements or new renewable generation) to about 7,200 MW in the Updated Initial (UI) Case and to about 6,200 MW in Case 3A.
- In the Updated Initial (UI) Case, which did not reflect any new energy efficiency or PV solar demand-side resources, the requirement for new thermal resources increases throughout the study period.
- In Case 1B, which reflects energy efficiency and PV solar levels based on current requirements, the requirement for new thermal resources decreases by about 300 MW between 2012 and 2016 and then increases by about 650 MW between 2016 and 2020.
- In Case 3A, in which further increases in energy efficiency measures were assumed, the requirement for new thermal resources decreases by about 710 MW between 2012 and 2016 and then increases by about 250 MW between 2016 and 2020.
- In Case 4A, which modeled higher renewable resources within California than the other Cases, the requirement for new thermal resources decreases by about 1,380 MW between 2012 and 2016 and by an additional 650 MW by 2020

The above information indicates that in Cases 1B, 3A, and 4A thermal capacity installed to serve load in 2012 might not be fully utilized in subsequent years as the amounts of new renewable and demand-side resources increase and if the available capacity of the intermittent resources is at the levels assumed in these studies.

Sensitivity studies (discussed in Section 6 of this report) examined the effects of extending the assumed retirement schedule for some of the Aged Plants beyond 2012. These

[15] 2012 Case with no Aged Plant retirements or new renewables

[16] The UI or Updated Initial Cases were based on the April 2007 Cases summarized in Table ES-1. Due to changes in assumptions after the April 2007 Cases were prepared, the total amounts of new renewable resources in the SCE area modeled in the UI Cases are approximately 5% lower than the amounts modeled in the April 2007 Cases and are equal to those in Case 1B.

studies indicated that:

- For Case 1B, deferring the retirement of 600 MW by one year mitigates the underutilization concern discussed above (the dispatch requirement for new thermal generation increases by about 290 MW between 2012 and 2016 and by an additional 690 MW between 2016 and 2020).
- For Case 3A, deferring the retirement of 600 MW by one year mitigates a majority of the underutilization concern discussed above (the dispatch requirement for new thermal generation decreases by only 100 MW between 2012 and 2016 and then increases by about 150 MW between 2016 and 2020).
- For Case 4A, limiting the retirements to 2,320 MW in 2012 and to 3,940 MW by 2016 mitigates the underutilization concern during the 2012-2016 (the dispatch requirement for new thermal generation increases by about 180 MW between 2012 and 2016). However, the dispatch requirement for new thermal generation does decrease by about 8% (about 400 MW) between 2016 and 2020.

<u>Required Transmission Upgrades in the LA Basin and Ventura County</u>

As discussed in Sections 3 and 4 of this report, these Aged Plant retirement studies indicated that:

- The following 230-kV lines in the LA Basin and Ventura County would have to be upgraded by 2012 to mitigate post-contingency overloads:
    - The Chino-Mira Loma #1 and #3 lines,
    - The Barre-Ellis line,
    - The Moorpark-Pardee #2 and #3 lines,
    - The La Fresa-Redondo #1 and #2 lines, and
    - The Serrano-Villa Park #1 and #2 lines.
- Approximately 240 MVAR of shunt capacitors would have to be installed on the 230-kV system in the LA Basin and Ventura County by 2016 to mitigate post-contingency voltage problems.
- By 2020:
    - An additional 240 MVAR of shunt capacitors would have to be installed on the 230-kV system in the LA Basin and Ventura County to mitigate post-contingency voltage problems,
    - A 500-kV line termination would have to be added at Vincent to accommodate operation of the Vincent-Pardee section[17] of the existing Vincent-Santa Clara 230-

[17] Information in SCE's "Tehachapi Renewable Transmission Project" document of November 21, 2006 indicates that this line was designed for 500-kV operation

kV line at 500-kV [18]. and

- ○ A 500/230-kV substation would have to be added at Pardee to accommodate operation of the proposed Antelope-Pardee line and the above-mentioned Vincent-Pardee line at 500-kV

These studies also indicated that the Serrano-Villa Park upgrades would be required only in the Updated Initial (UI) Case.

Table ES-4 summarizes the preliminary estimated upgrade costs for the four Cases studied. The information in Table ES-4 shows that:

- The total mitigation cost for the Updated Initial (UI) Case would be approximately $203 million,
- The total mitigation costs for the other three Cases would be approximately $189 million, and
- The mitigation costs for all four Cases would be reduced by approximately $36 million if the Chino-Mira Loma upgrades (which are being proposed as part of the Tehachapi Transmission Project) were not included as an Aged Plant retirement mitigation cost.

TABLE ES-4
SUMMARY OF ESTIMATED MITIGATION COSTS
($Millions – 2007)

	Case			
	UI	**1B**	**3A**	**4A**
2012 Additions				
Chino-Mira Loma Upgrades	36.4	36.4	36.4	36.4
Barre-Ellis Upgrades	28.9	28.9	28.9	28.9
Moorpark-Pardee Upgrades	3.2	3.2	3.2	3.2
La Fresa-Redondo Upgrades	0.1	0.1	0.1	0.1
Serrano-Villa Park Upgrades	14.3	0	0	0
2012 Total	82.9	68.6	68.6	68.6
2016 Additions				
237 MVAR of Capacitors	10.8	10.8	10.8	10.8
2016 Total	10.8	10.8	10.8	10.8

[18] The Pardee-Santa Clara portion of the line would be interconnected with the Pardee 230-kV switchyard.

TABLE ES-4 SUMMARY OF ESTIMATED MITIGATION COSTS ($Millions – 2007)				
	Case			
	UI	1B	3A	4A
2020 Additions				
Pardee 500/230-kV Substation	92.6	92.6	92.6	92.6
Vincent 500-kV Additions	6.3	6.3	6.3	6.3
237 MVAR of Capacitors	10.8	10.8	10.8	10.8
2020 Total	109.7	109.7	109.7	109.7
Total For All Years	203.4	189.1	189.1	189.1

The sensitivity studies discussed in Section 6 indicate that the need to upgrade the Barre-Ellis line is dependent on the status of Huntington Beach Units 1 and 2. Therefore:

- For Case 1B and Case 3A (in which the retirement of these two units is deferred until 2013) the need to upgrade the Barre-Ellis line could be deferred until 2013, and
- For Case 4A (in which these two units are not retired until 2017) the need to upgrade the Barre-Ellis line could be deferred until 2017.

Deferring this expense and the effort required to plan and permit the upgrade to the Barre-Ellis line would likely be of benefit due to the magnitude of the transmission development work planned by SCE during the 2010-2013 period.

<u>Other Impacted Facilities Noted in the Studies</u>

As discussed in Sections 3 and 5 of this report, these Aged Plant retirement studies indicated that the El Dorado-Pisgah and Lugo-Pisgah 230-kV lines and the El Dorado-Lugo and Midpoint-Devers 500-kV lines could experience overloads under some conditions. However, these overloads are due to the interconnection of potential resources with these facilities and are not exacerbated by the retirement of the Aged generation in the SCE area. Therefore, the costs of these transmission upgrades are not included as a cost attributable to Aged generation plant retirement.

Preliminary Assessment of LCR Impacts

During the past two years the California ISO has performed technical studies to identify the amounts of local generation (the Local Capacity Requirement or LCR) within certain load pockets that are required to maximize the reliability of the transmission grid into and within the load pocket. In the case of the SCE system there are two such load pockets (the

LA Basin Area and the Big Creek/Ventura Area) in which the local reliability might be impacted by the retirement of the Aged plants as assessed in this report and the location of the replacement resources. In its ***2008 Local Capacity Technical Analysis – Report and Study Results*** (April 2007) the California ISO noted that the LCR for the LA Basin Area and the Big Creek/Ventura Areas in 2008 would be 10,130 MW and 3,658 MW; respectively.

Section 7 of this report presents a preliminary assessment of the impacts which projected changes in Area loads, the retirement of certain of the Aged Plants, and the assumed resource additions would have on both the local capacity requirement for each Area and the capacity in these Areas to meet the LCR. This preliminary LCR assessment indicated that:

- For the LA Basin Area:
    - The estimated LCR for Case 1B would increase from about 10,700 MW in 2012 to about 11,500 MW in 2020,
    - Due to the higher levels of demand-side resources modeled in Cases 3A and 4A, the LCR for these Cases would be lower than those for Case 1B. Specifically the LCR for Case 3A would remain at about 10,500 MW for all three study years while that for Case 4A would increase from about 10,500 MW in 2012 to about 10,800 MW in 2020
    - There would be ample Available Capacity to meet the LCR for all scenarios studied.
- For the Big Creek/Ventura Area:
    - The estimated LCR for Case 1B would increase from about 3,400 MW in 2012 to about 3,800 MW in 2020[19],
    - Due to the higher levels of demand-side resources modeled in Cases 3A and 4A the LCR for these Cases would be lower than those for Case 1B. Specifically the LCR for Case 3A increased from about 3,300 MW in 2012 to about 3,500 MW in 2020 while that for Case 4A increased from about 3,400 MW in 2012 to about 3,700 MW in 2020
    - There would be ample Available Capacity to meet the LCR for all scenarios studied.

Conclusions

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[19] In the preliminary LCR assessment it is assumed that the import limit into the Big Creek/Ventura Area would increase by 600 MW due to the addition of the Tehachapi Project transmission facilities

These Aged Plant studies indicate that, should 4,140 MW of Aged capacity be retired, significant amounts of replacement thermal resources and significant transmission system upgrades would be required. Developing the required replacement capacity by 2012 could be problematical due to a number of issues including the overall costs of the proposals and the uncertainty associated with the licensing and permitting of both generation and transmission facilities within California. Furthermore, implementing the required transmission upgrades (particularly those involving the rebuilding or reconductoring of existing lines) could be problematical from the perspectives of licensing/permitting, access to the lines to allow these upgrades, and the ability to remove the lines from service while the rebuilding/reconductoring was being performed.

In addition, the higher levels of energy efficiency and renewable energy resource additions that could be achieved by 2016 indicate that the amounts of new thermal generating resources required to enable the Aged generating plant retirements could be decreased by approximately 700 MW to 1,400 MW if some of the retirements could be deferred to 2016. Sensitivity studies indicate that there would likely be benefits in staging the retirement of the Aged capacity starting in 2012 which, in turn, would reduce the amounts of replacement capacity that would have to be installed and would allow the development of the required generation additions and transmission upgrades to be implemented on a more orderly basis. In effect, there are benefits from matching retirements with the development schedule for such preferred resources.

More detailed assessment of the permitting, right-of-way acquisition (in the cases where such is required), construction of transmission upgrades, and the time required to interconnect and install the anticipated new renewable and proposed conventional thermal generation in the SCE service territory would be needed to determine an optimum schedule for the retirements contemplated in this study.

This study has developed a combined plan of energy efficiency, procurement of renewable and new thermal generation resources, and transmission upgrades that would enable the retirement of about 4,140 MW of inefficient, Aged generation located in the SCE service territory. The results of this study indicate that such a plan is electrically feasible, but no analysis has been conducted to assure that it is economically, politically, or institutionally feasible. The timeline required for the transmission upgrades and thermal generation additions could require deferring some of the retirements beyond 2012 A final, optimized plan for combined Aged generation retirements, transmission system upgrades, and new plant additions to replace the retired aged generating plants should consider a more detailed assessment of time required for transmission upgrades and the certainty of completion of both renewable energy resource and inland new thermal generation additions. The development of this plan should involve all of pertinent parties, further address any impacts on Local Capacity Requirements (LCR), and address system operation under the Southern California Import Transmission (SCIT) nomogram.

SECTION 1 - INTRODUCTION

During the Aging Plant Study Update ("Update") discussed in subsequent sections of this report, the impacts of retiring 4,140 MW of Aged Plants and replacing/offsetting the "lost" capacity with new thermal generation, new renewable resources, and new demand reduction measures were assessed. In addition, a series of sensitivity studies were performed in which the amounts of Aged Plant generation assumed to be retired and the timing of these retirements was adjusted such that all were not occurring in 2012.

In assessing the impacts of Aged Plant retirement, powerflow base cases modeling the amounts of renewable resources and energy efficiency measures summarized in Table I-1 were developed. Detailed information on the modeling of the resources summarized in Table 1-1 is presented in Appendix 2 and Appendix 3. In addition, the changes in the ratings of the SCE 230-kV lines discussed above were modeled in each of these base cases; Appendix 4 compares the changed ratings to those in the WECC 2016 case for selected 230-kV lines.

The "Current Trends" case (Case 1) as summarized in Table ES-2 was not used as the basis for any powerflow studies due to the small amounts of new renewable resources assumed within it and the likelihood that all of these resources would be located outside of the Los Angeles Basin or Ventura County.

TABLE I-1
RENEWABLE RESOURCE AND ENERGY EFFICIENCY LEVELS MODELED IN UPDATED AGING PLANT STUDIES (Dependable MW)[1]

Resource Type	Updated Initial Case [2]			Case 1B		
	2012	2016	2020	2012	2016	2020
Biomass	50	50	50	50	50	50
Wind	265	614	668	265	614	668
Solar (CSP)	305	718	718	305	718	718
Total	620	1,382	1,436	620	1,382	1,436
Energy Efficiency	0	0	0	874	1,637	2,269
Solar (PV)	0	0	0	63	139	150
Total	0	0	0	937	1,776	2,419

[1] Assumed dependable capacity (as a % of installed capacity) as follows: Biomass – 100%; Tehachapi area wind – 22%; other wind – 29%; solar (CSP) – 87%; and solar (PV) – 52%.
[2] Cases used in studies summarized in April 2007 Interim Report modified to reflect a slight decrease (60-75 MW) in available renewable resources

TABLE I-1 (Con't) RENEWABLE RESOURCE AND ENERGY EFFICIENCY LEVELS MODELED IN UPDATED AGING PLANT STUDIES (Dependable MW)[3]						
Resource Type	**Case 3A**			**Case 4A**		
	2012	**2016**	**2020**	**2012**	**2016**	**2020**
Biomass	50	50	50	26	131	235
Wind	265	613	668	207	883	1,516
Solar (CSP)	305	718	718	131	654	1,175
Geothermal	0	0	0	29	147	264
Total	620	1,381	1,436	393	1,815	3,190
Energy Efficiency	1,145	2,292	3,427	874	1,637	2,269
Solar (PV)	63	139	150	303	789	854
Total	1,208	2,431	3,577	1,177	2,426	3,123

[3] Assumed dependable capacity (as a % of installed capacity) as follows: Biomass – 100%; Tehachapi area wind – 22%; other wind – 29%; solar (CSP) – 87%; and solar (PV) – 52%.

SECTION 2 – DEVELOPMENT OF BASE CASES WITH 4,140 MW OF RETIREMENTS IN 2012 - RESOURCE ASSUMPTIONS

2.1 Updated Initial (UI) Case

The amounts of renewable resources modeled in this Case are slightly lower than were the amounts modeled in the previous Aged Plant studies summarized in the Executive Summary and as discussed in Appendix 1. Table 2-1 summarizes the dispatched resources modeled in the 2012 Reference Case (without any retirements or new renewable resources) and those modeled in Updated Initial Case for the years 2012, 2016, and 2020 with 4,140 MW of Aged Plant generation retired and replaced by a combination of renewable and thermal resources.

TABLE 2-1
SCE AREA LOADS AND RESOURCES FOR UPDATED INITIAL CASE (MW) [1]

	2012	Initial Studies Case		
	Reference	2012	2016	2020
SCE Area Loads[2] and Losses	28,595	28,701	30,046	31,535
Less, Energy Efficiency	0	0	0	0
Less, PV Solar	0	0	0	0
Net SCE Loads	28,595	28,701	30,046	31,535
SCE Area Resources				
Imports	8,734	8,994	9,079	9,979
Aged Plants	6,650	2,510	2,510	2,510
New Renewables [3]	0	620	1,382	1,436
New Thermal Generation [4]	3,809	7,182	7,683	8,214
Existing Wind Generation [3]	327	327	327	327
Other Existing Generation [5]	9,075	9,068	9,065	9,069
Total Resources	28,595	28,701	30,046	31,535

(The footnotes for Table 2-1 also apply to the other tables in Section 2)

The resultant dispatched resources are depicted in Figure 2-1 while Figure 2-2 depicts the changes in the resource dispatch between the four conditions studied.

[1] The powerflow cases used as the data source for Table 2 (and for Tables 3, 4, and 5) modeled San Onofre Unit #3 off-line so as to stress the cases for contingency analysis.
[2] Includes pumping loads
[3] Dependable capacity
[4] The locations and sizes of the new thermal generation were based on information in the California ISO and SCE generation interconnection queues as of the end of March 2007.
[5] Amount varies because of differences in the output of the SCE area swing generator

As shown in Table 2-1 and as depicted in Figures 2-1 and 2-2 the amounts of new renewable generation increases until 2016 and then remains at about the same level until 2020. As a result, the requirement for new thermal generation continues to increase until 2020. Because the quantities of new renewables and assumed new thermal generation in the SCE area were not sufficient to meet load in 2020, the shortfall was assumed to be met by imports into the SCE area from Arizona which would need to be approximately 900 MW higher in 2020 than was the case in 2016.

2.2 Case 1B – Compliance With Current Requirements (Energy Efficiency and Renewable Energy)

Case 1B models the same amounts of renewable resources as did the Updated Initial (UI) Case but includes significant levels of energy efficiency and customer-installed PV solar in California (both modeled as a reduction in load). Table 2-2 summarizes the dispatched resources modeled in the 2012 Reference Case (without any retirements or new renewable resources) and in the Case 1B studies. The resultant dispatched resources are depicted in Figure 2-3 while Figure 2-4 depicts the changes in the resource dispatch between the four conditions studied.

TABLE 2-2
SCE AREA LOADS AND RESOURCES FOR CASE 1B
(MW)

	2012 Reference	Case 1B		
		2012	2016	2020
SCE Area Loads and Losses	28,595	28,652	29,977	31,403
Less, Energy Efficiency	0	(874)	(1,637)	(2,269)
Less, PV Solar	0	(64)	(139)	(150)
Net SCE Loads (MW)	28,595	27,714	28,201	28,984
SCE Area Resources (MW)				
Imports	8,734	8,734	8,799	8,829
Aged Plants	6,650	2,510	2,510	2,510
New Renewables	0	622	1,382	1,436
New Thermal Generation	3,809	6,488	6,185	6,834
Existing Wind Generation	327	327	327	327
Other Existing Generation	9,075	9,033	8,998	9,048
Total Resources	28,595	27,714	28,201	28,984

As shown in Table 2-2 (and depicted in Figures 2-3 and 2-4) the amounts of new renewable generation increases until 2016 and then remains at about the same level until 2020 while the energy efficiency (EE) and solar PV (PV) load reductions increase throughout the study period. As a result of these increasing amounts of EE and PV relative to the increase in SCE area load, the requirement for dispatching new thermal generation decreases by about 300 MW between 2012 and 2016 and then increases by approximately 650 MW between 2016 and 2020.

2.3 Case 3A – High Energy Efficiency in California

Case 3A models the same amounts of renewable resources and solar PV as did Case 1B but higher levels of EE than was the situation for Case 1B. Table 2-3 summarizes the dispatched resources modeled in the Reference Case and Case 3A studies. The resultant dispatched resources are depicted in Figure 2-5 while Figure 2-6 depicts the changes in the resource dispatch between the four conditions studied.

TABLE 2-3
SCE AREA LOADS AND RESOURCES FOR CASE 3A
(MW)

	2012	Case 3A		
	Reference	2012	2016	2020
SCE Area Loads and Losses	28,595	28,635	29,970	31,371
Less, Energy Efficiency	0	(1,145)	(2,292)	(3,427)
Less, PV Solar	0	(63)	(139)	(150)
Net SCE Loads (MW)	28,595	27,427	27,539	27,794
SCE Area Resources (MW)				
Imports	8,734	8,754	8,799	8,829
Aged Plants	6,650	2,510	2,510	2,510
New Renewables	0	620	1,381	1,436
New Thermal Generation	3,809	6,150	5,443	5,688
Existing Wind Generation	327	327	327	327
Other Existing Generation	9,075	9,066	9,079	9,004
Total Resources	28,595	27,427	27,539	27,794

As shown in Table 2-3 (and depicted in Figures 2-5 and 2-6) the amounts of new renewable generation increases until 2016 and then remains at about the same level until 2020 while the energy efficiency (EE) and customer-installed solar PV (PV) load reductions increase throughout the study period. As a result of the significant increases in the amounts of EE relative to the increase in SCE area load, the requirement to dispatch new thermal generation decreases by about 700 MW between 2012 and 2016 and then increases by approximately 240 MW between 2016 and 2020.

2.4 Case 4A – High Renewable Energy Resource Additions in California

Case 4A models the same amounts of energy efficiency as did Case 1B and significantly higher levels of renewable resources and customer-installed PV than was the situation for Case 1B. Table 2-4 summarizes the amounts of the various types of dispatched resources modeled in the Case 4A studies. The resultant dispatched resources are depicted in Figure 2-7 while Figure 2-8 depicts the changes in the resource dispatch between the four conditions studied.

TABLE 2-4
SCE AREA LOADS AND RESOURCES FOR CASE 4A
(MW)

	2012	Case 4A		
	Reference	2012	2016	2020
SCE Area Loads and Losses	28,595	28,627	29,965	31,429
Less, Energy Efficiency	0	(874)	(1,637)	(2,269)
Less, PV Solar	0	(303)	(789)	(854)
Net SCE Loads (MW)	28,595	27,450	27,539	28,306
SCE Area Resources (MW)				
Imports	8,734	8,733	8,783	8,829
Aged Plants	6,650	2,510	2,510	2,510
New Renewables	0	393	1,815	3,190
New Thermal Generation	3,809	6,443	5,065	4,414
Existing Wind Generation	327	327	327	327
Other Existing Generation	9,075	9,044	9,039	9,036
Total Resources	28,595	27,450	27,539	28,306

As shown in Table 2-4 (and depicted in Figures 2-7 and 2-8) the amounts of PV solar and renewable generation increases significantly throughout the study period. As a result of the significant increases in renewable resources and solar PV relative to the increase in SCE area load, the dispatch requirement for new thermal generation decreases by about 1,380 MW between 2012 and 2016 and by an additional 650 MW between 2016 and 2020.

Based on the results of the April 2007 studies for 2016 and 2020 all of the above base cases assumed that:

- Approximately 240 MVAR of reactive support was installed at various substations in the LA Basin and Ventura County by 2016,
- By 2020:
    - The Antelope-Pardee line was operating at 500-kV,
    - The Vincent-Santa Clara 230-kV line was looped into Pardee and the Vincent-

Pardee section was operating at 500-kV, and

- An additional 240 MVAR of reactive support was installed at various substations in the LA Basin and Ventura County.

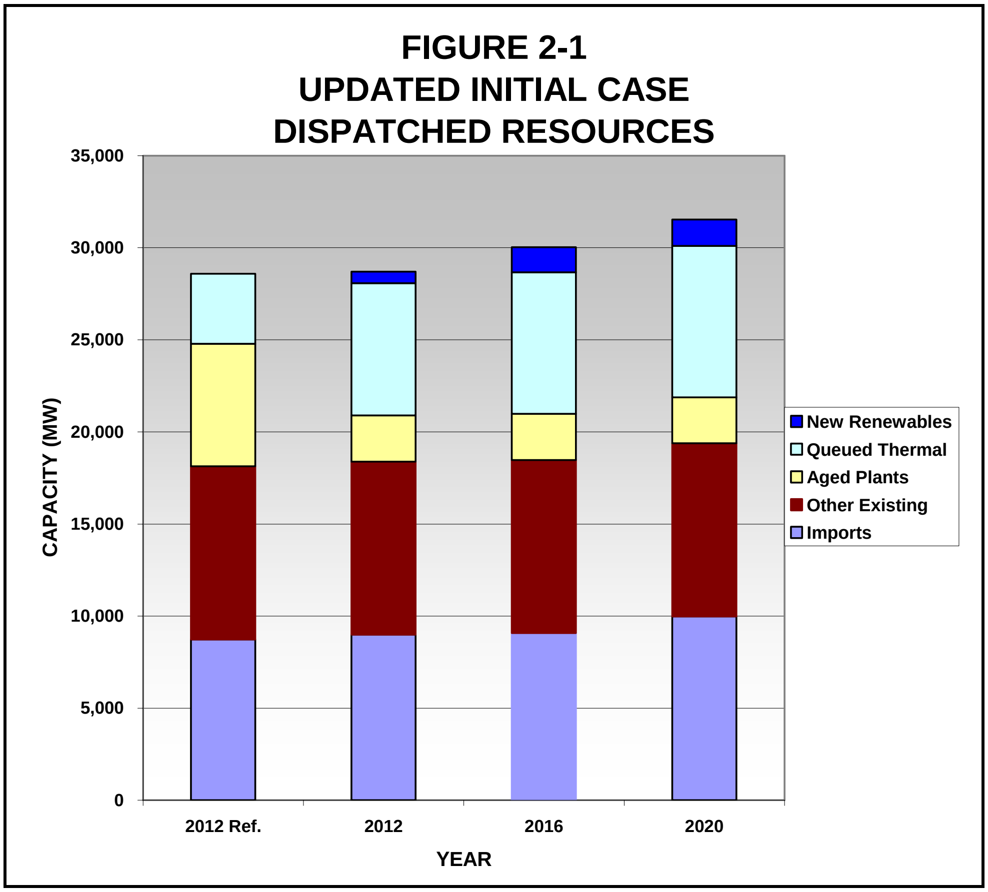


FIGURE 2-1
UPDATED INITIAL CASE
DISPATCHED RESOURCES
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
CAPACITY (MW)
2012 Ref.
2012
2016
2020
YEAR
New Renewables
Queued Thermal
Aged Plants
Other Existing
Imports

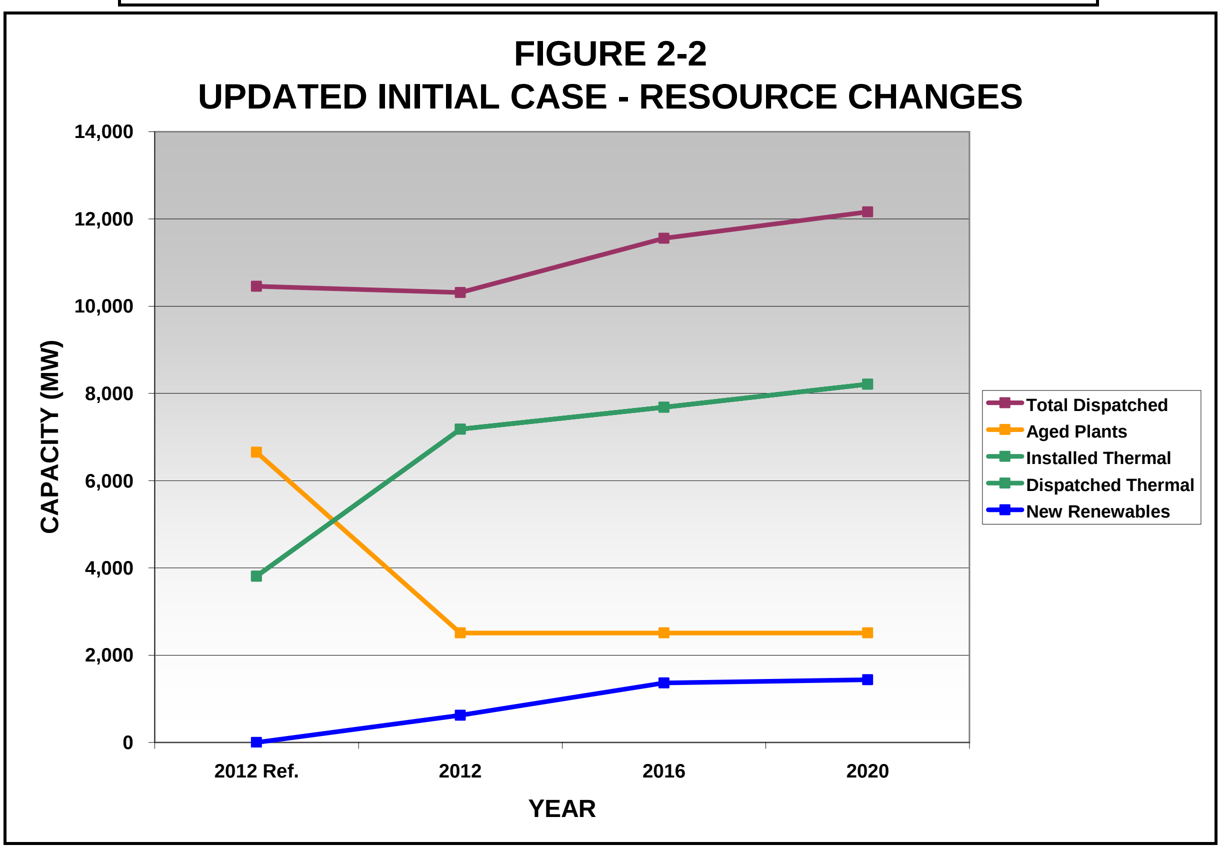


FIGURE 2-2
UPDATED INITIAL CASE - RESOURCE CHANGES
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
CAPACITY (MW)
2012 Ref.
2012
2016
2020
YEAR
Total Dispatched
Aged Plants
Installed Thermal
Dispatched Thermal
New Renewables

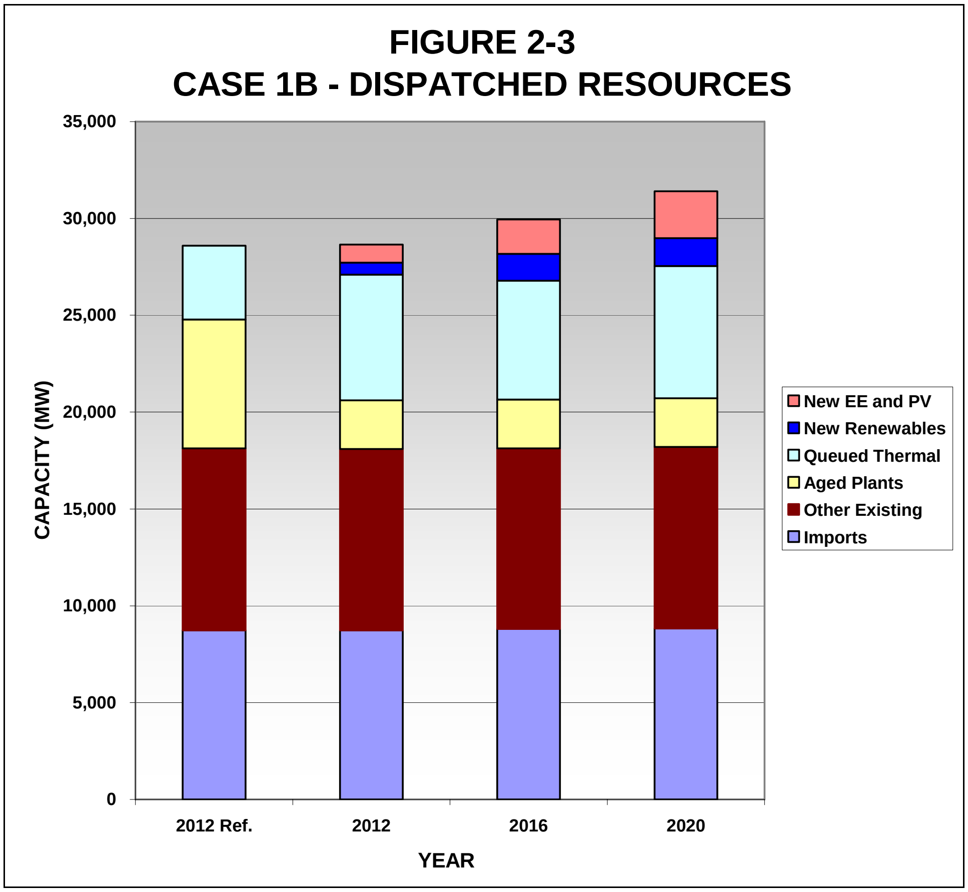


FIGURE 2-3
CASE 1B - DISPATCHED RESOURCES
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
CAPACITY (MW)
2012 Ref.
2012
2016
2020
YEAR
New EE and PV
New Renewables
Queued Thermal
Aged Plants
Other Existing
Imports

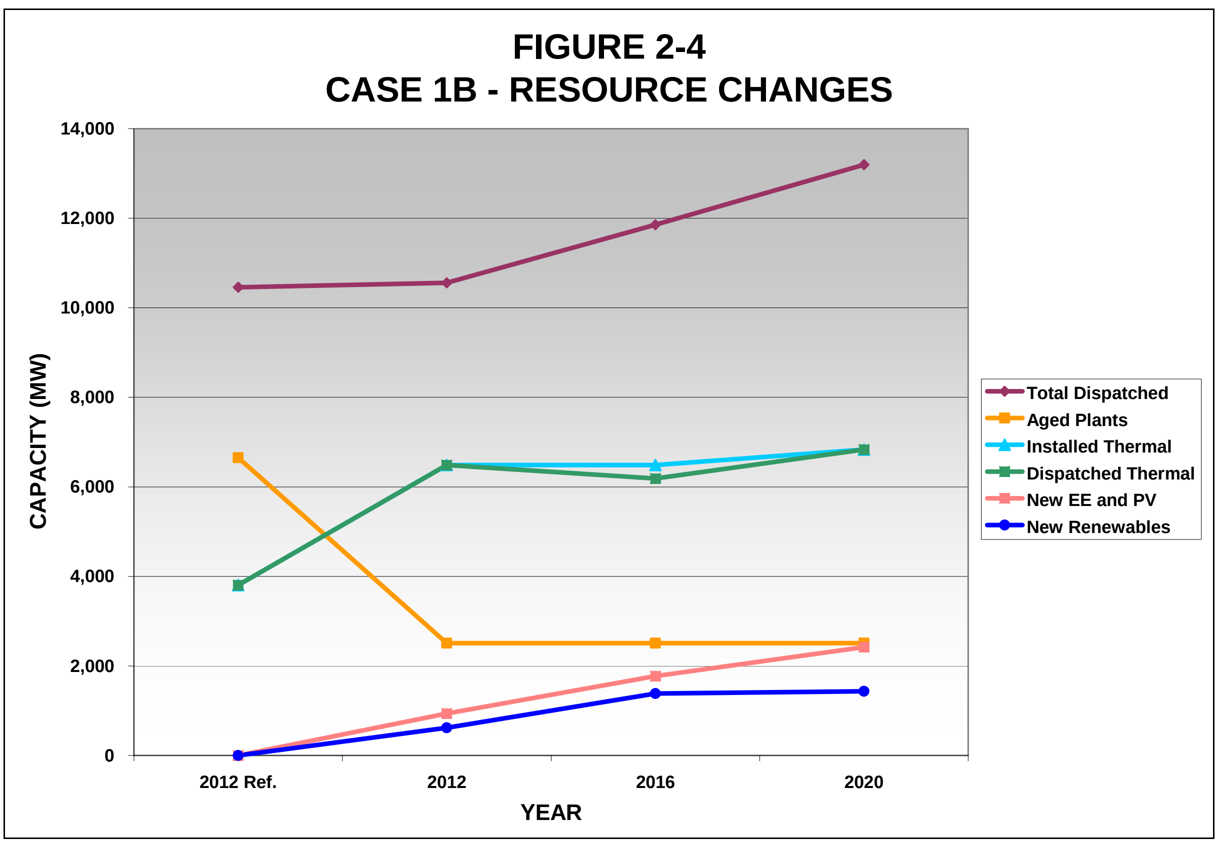


FIGURE 2-4
CASE 1B - RESOURCE CHANGES
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
CAPACITY (MW)
2012 Ref.
2012
2016
2020
YEAR
Total Dispatched
Aged Plants
Installed Thermal
Dispatched Thermal
New EE and PV
New Renewables

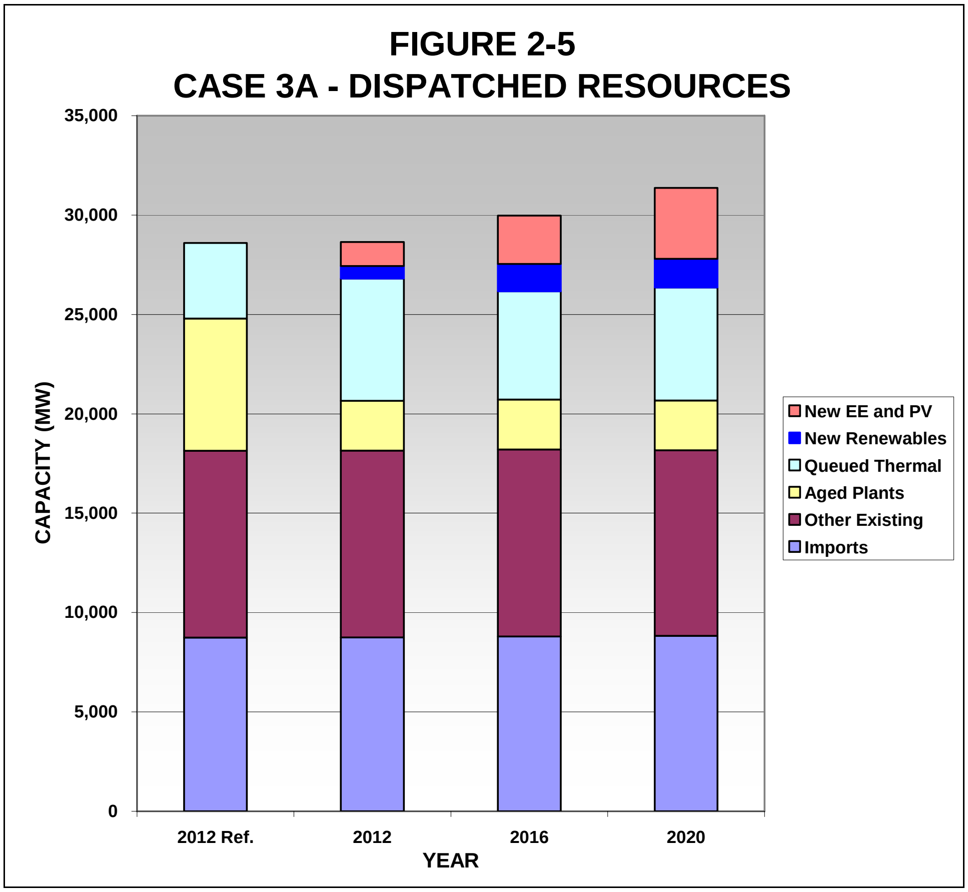


FIGURE 2-5
CASE 3A - DISPATCHED RESOURCES
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
CAPACITY (MW)
2012 Ref.
2012
2016
2020
YEAR
New EE and PV
New Renewables
Queued Thermal
Aged Plants
Other Existing
Imports

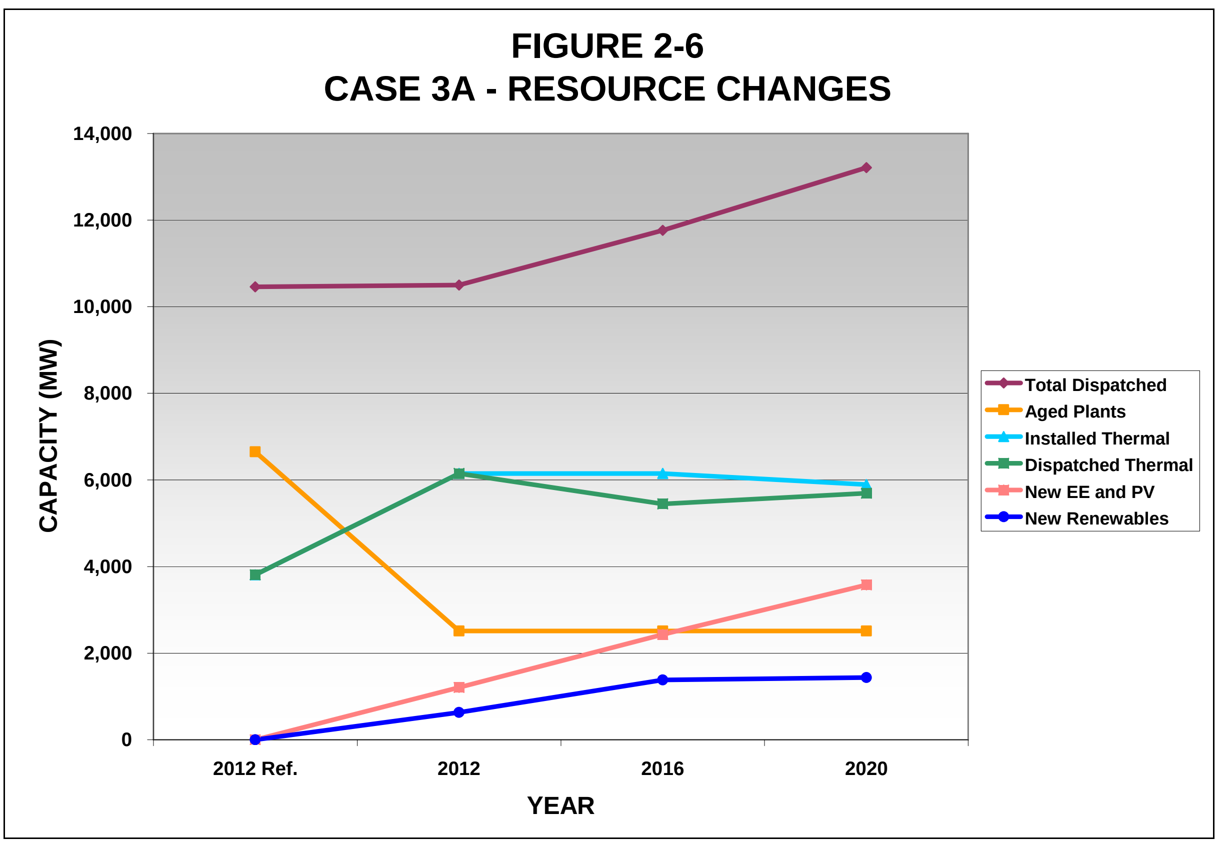


FIGURE 2-6
CASE 3A - RESOURCE CHANGES
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
CAPACITY (MW)
2012 Ref.
2012
2016
2020
YEAR
Total Dispatched
Aged Plants
Installed Thermal
Dispatched Thermal
New EE and PV
New Renewables

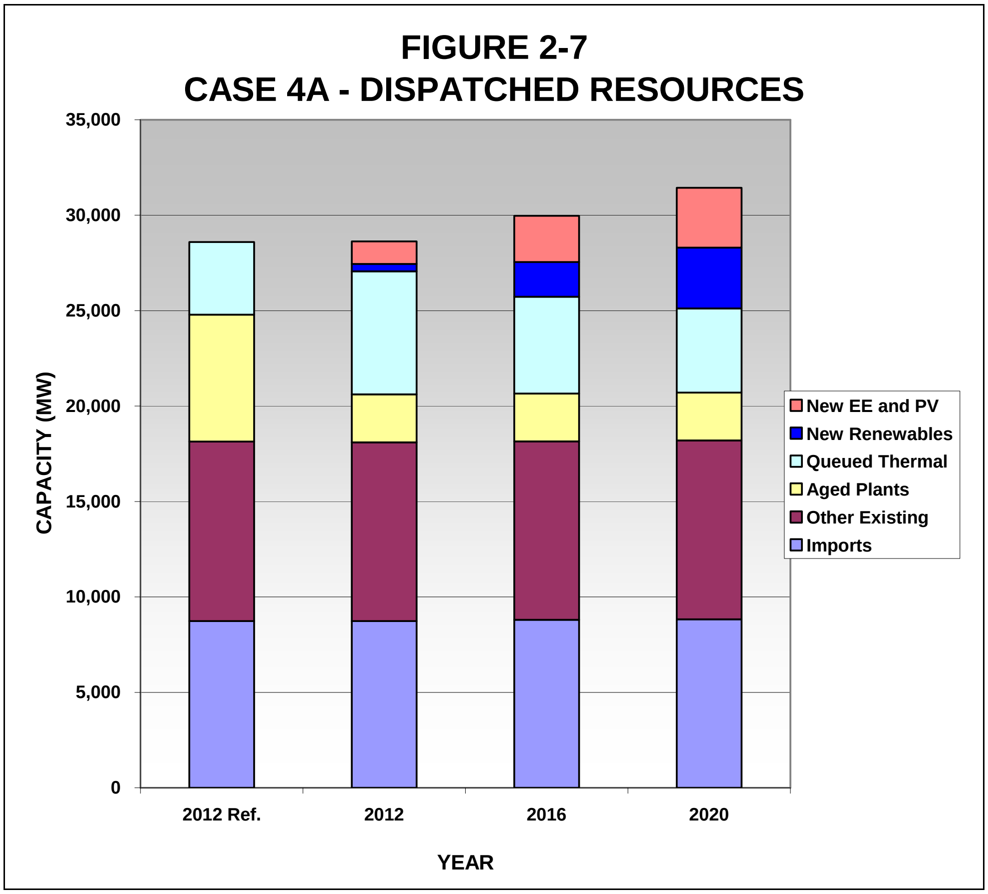


FIGURE 2-7
CASE 4A - DISPATCHED RESOURCES
CAPACITY (MW)
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2012 Ref.
2012
2016
2020
YEAR
New EE and PV
New Renewables
Queued Thermal
Aged Plants
Other Existing
Imports

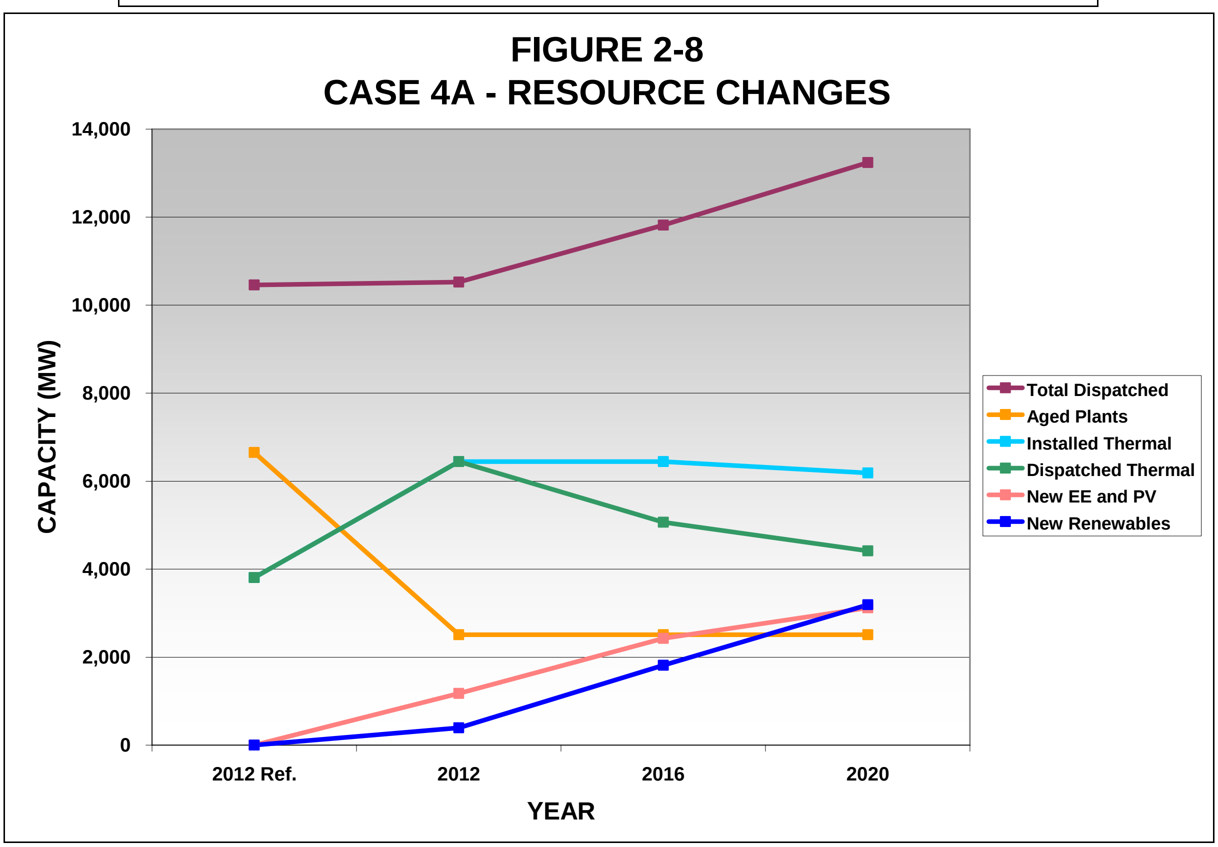


FIGURE 2-8
CASE 4A - RESOURCE CHANGES
CAPACITY (MW)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
2012 Ref.
2012
2016
2020
YEAR
Total Dispatched
Aged Plants
Installed Thermal
Dispatched Thermal
New EE and PV
New Renewables

SECTION 3 - RESULTS OF CONTINGENCY ANALYSIS WITH 4,140 MW OF RETIREMENTS IN 2012

Once the powerflow base cases discussed in Section 2 were developed numerous contingencies were simulated on each case to see if any overloads would occur on the transmission system in the SCE area. The contingencies simulated on the cases included:

- Approximately 200 Category B (N-1) contingencies involving 230-kV and 500-kV lines in the SCE area,
- Approximately 240 credible Category C (N-2) contingencies involving 230-kV and 500-kV lines in the SCE area, and
- Overlapping (N-1/N-1) contingencies involving most of the 500-kV lines in the SCE area and approximately 30 of the most critical 230-kV lines in the LA Basin and Ventura County.

As discussed in Section 2, NCI also developed base cases with the San Onofre #3 unit off-line and simulated the N-1 and N-2 contingencies on these base cases. Appendix 5 contains lists of the Category B, Category C, and overlapping outages simulated in these studies. These contingency lists were developed, in part, from contingency lists used in various SCE planning documents.

The following reliability criteria were applied during these studies:

- Transmission lines:
  - Category A (base case) conditions – Normal rating of limiting component
  - Category B (N-1) contingencies and overlapping outages – Normal rating[1] of limiting component
  - Category C (N-2) contingencies – Emergency (short-term) rating of limiting component
- Transformers:
  - Category A (base case) conditions – Normal loading rating
  - Category B (N-1) and Category C (N-2) contingencies – Emergency rating of bank

These studies indicated that, with the most recent rating information for the SCE 230-kV lines applied, the following lines within the LA Basin and Ventura County could experience overloads under certain conditions:

- Chino-Mira Loma #1 and #3 230-kV lines

[1] Long-term emergency ratings would normally be applied for these types of outages; however such data was not provided by SCE or the California ISO

- Barre-Ellis 230-kV line
- Moorpark-Pardee #1 and #2 230-kV lines
- Pardee-Santa Clara 230-kV line
- La Fresa-Redondo #1 and #2 230-kV lines
- Serrano-Villa Park #1 and #2 230-kV lines

The studies also indicated that the following lines, which are located in the eastern-most portion of the SCE system and whose ratings have not changed, could experience overloads under certain conditions:

- Lugo-Pisgah #1 and #2 230-kV lines
- El Dorado-Pisgah #1 and #2 230-kV lines
- El Dorado-Lugo 500-kV line
- Midpoint-Devers 500-kV line

This section of the report presents information on:

- The length and conductor used on each of the above 230-kV lines as specified in information supplied by SCE to the Energy Commission in June 1993 (refer to Appendix 6),
- The ratings of each of the LA Basin 230-kV lines and the factors impacting these ratings as specified in information supplied to the Energy Commission by SCE in June 2007 (refer to Appendix 7),
- The ratings of the lines in the eastern portion of the SCE system, and
- The worst case overloads noted on the above impacted lines (information regarding the contingencies causing these overloads is contained in Appendix 8).

3.1 Chino-Mira Loma #1 230-kV Line

The Chino-Mira Loma #1 230-kV line is approximately 7 miles in length and utilizes two 605 ACSR conductors per phase for approximately 0.5 miles of its length (information as to the size of the conductors used on the balance of the line is not publicly available). The normal and emergency ratings for this line are 1,790 amps and 2,200 amps; respectively and, according to information in SCE's *CAISO Controlled SCE Transmission Expansion Plan 2007-2016* (December 2006), are limited by the 605 MCM conductors and a wave trap at Chino.

The worst case overloads noted on this line are summarized in Table 3-1. The information in Table 3-1 shows that the highest overloads on the Chino-Mira Loma #1 line occur in the Updated Initial (UI) Case studies which did not model any load reductions due to new energy efficiency or customer-installed solar PV. On the other hand, the lowest overloads are noted in Case 3A which models significant amounts of load reductions due to additional energy efficiency program impacts (about 4.5% in 2012 and about 12% in 2020). However, even with the load reductions in Case 3A, the worst case loadings on the line in 2016 and 2020 are significantly higher than the line's present ratings.

TABLE 3-1
WORST CASE OVERLOADS ON CHINO-MIRA LOMA #1 LINE

	Rating	Loading (PU) in Case			
	(Amps)	UI	1B	3A	4A
2012 Studies					
Overlapping Outage	1,790	112	101	-----	101
Category C (SONGS 3 Out)	2,200	112	105	104	105
2016 Studies					
Category C (SONGS 3 In)	2,200	111	102	-----	-----
Overlapping Outage	1,790	136	126	122	122
Category C (SONGS 3 Out)	2,200	134	126	123	124
2020 Studies					
Category C (SONGS 3 In)	2,200	123	112	104	107
Overlapping Outage	1,790	152	138	128	132
Category B (SONGS 3 Out)	1,790	108	100	-----	-----
Category C (SONGS 3 Out)	2,200	146	136	128	130

3.2 Chino-Mira Loma #3 230-kV Line

The Chino-Mira Loma #3 230-kV line is approximately 6 miles long and utilizes two 1033 MCM ACSR conductors per phase. The normal and emergency ratings for this line are both 2,480 amps and are limited by line clearances.

The worst case overloads noted on the Chino-Mira Loma #3 line are summarized in Table 3-2.

TABLE 3-2
WORST CASE OVERLOADS ON CHINO-MIRA LOMA #3 LINE

	Rating	Loading (PU) in Case			
	(Amps)	UI	1B	3A	4A
2012 Studies					
Category C (SONGS 3 In)	2,480	135	126	126	128
Overlapping Outage	2,480	107	-----	100	103
Category B (SONGS 3 Out)	2,480	114	107	105	105

Category C (SONGS 3 Out)	2,480	156	147	143	142

TABLE 3-2 (Con't)
WORST CASE OVERLOADS ON CHINO-MIRA LOMA #3 LINE

	Rating (Amps)	Loading (PU) in Case			
		UI	1B	3A	4A
2016 Studies					
Category B (SONGS 3 In)	2,480	107	-----	-----	-----
Category C (SONGS 3 In)	2,480	148	134	130	131
Overlapping Outage	2,480	118	-----	-----	-----
Category B (SONGS 3 Out)	2,480	121	111	107	109
Category C (SONGS 3 Out)	2,480	164	154	148	150
2020 Studies					
Category A	2,480	104	-----	-----	-----
Category B (SONGS 3 In)	2,480	111	104	-----	-----
Category C (SONGS 3 In)	2,480	153	142	132	135
Overlapping Outage	2,480	123	117	108	101
Category B (SONGS 3 Out)	2,480	124	115	112	109
Category C (SONGS 3 Out)	2,480	168	154	152	153

As was the situation with the Chino-Mira Loma #1 line the highest overloads on the Chino-Mira Loma #3 line occur in the Updated Initial (UI) Case studies while the lowest overloads are noted in Case 3A. However, even with the load reductions from energy efficiency program impacts in Case 3A, the worst case loadings on the line in 2016 and 2020 are significantly higher than the line's present ratings.

3.3. Barre-Ellis 230-kV Line

The Barre-Ellis line is approximately 13 miles long and utilizes two 1033 MCM ACSR conductors per phase. The normal and emergency ratings for this line are both 2,480 amps and are limited by line clearances.

The worst case overloads noted on the Barre-Ellis line are summarized in Table 3-3. As was the situation with the Chino-Mira Loma lines, the highest overloads on the Barre-Ellis line occur in the Updated Initial (UI) Case studies while the lowest overloads are noted in Case 3A. However, even with the load reductions in Case 3A, the worst case loadings on the line are higher than the line's present ratings.

TABLE 3-3 WORST CASE OVERLOADS ON BARRE-ELLIS LINE					
	Rating	Loading (PU) in Case			
	(Amps)	UI	1B	3A	4A
2012 Studies					
Category C (SONGS 3 In)	2,480	114	108	106	107
Overlapping Outage	2,480	114	108	106	107
Category C (SONGS 3 Out)	2,480	112	106	103	103
2016 Studies					
Category C (SONGS 3 In)	2,480	123	110	106	107
Overlapping Outage	2,480	123	110	106	107
Category B (SONGS 3 Out)	2,480	105	-----	-----	-----
Category C (SONGS 3 Out)	2,480	119	109	105	105
2020 Studies					
Category C (SONGS 3 In)	2,480	135	118	111	114
Overlapping Outage	2,480	135	118	111	114
Category B (SONGS 3 Out)	2,480	108	105	-----	102
Category C (SONGS 3 Out)	2,480	133	117	112	112

3.4 Moorpark-Pardee #2 and #3 230-kV Lines

Each of these lines is approximately 26 miles long and both utilize two 1590 MCM ACSR conductors per phase. The normal and emergency ratings for both lines are 1,800 amps and 2,280 amps; respectively. The limiting element with respect to both ratings are the ratings of the disconnect switches on the lines.

The worst case overloads noted on the Moorpark-Pardee #2 and #3 lines are summarized in Table 3-4.

TABLE 3-4 WORST CASE OVERLOADS ON MOORPARK-PARDEE #2 AND #3 LINES					
	Rating	Loading (PU) in Case			
	(Amps)	UI	1B	3A	4A
2012 Studies					
Category C (SONGS 3 In)	2,280	108	106	104	105
Overlapping Outage	1,800	137	134	131	133
Category C (SONGS 3 Out)	2,280	109	106	104	105

TABLE 3-4 (Con't) WORST CASE OVERLOADS ON MOORPARK-PARDEE #2 AND #3 LINES					
	Rating (Amps)	Loading (PU) in Case			
		UI	1B	3A	4A
2016 Studies					
Category C (SONGS 3 In)	2,280	119	107	102	106
Overlapping Outage	1,800	150	135	130	135
Category C (SONGS 3 Out)	2,280	119	107	103	106
2020 Studies					
Category C (SONGS 3 In)	2,280	122	112	105	112
Overlapping Outage	1,800	155	142	133	141
Category C (SONGS 3 Out)	2,280	123	113	105	112

As was the situation with the Chino-Mira Loma lines and the Barre-Ellis line, the highest overloads on the Moorpark-Pardee #2 and #3 lines occur in the Updated Initial (UI) Case studies while the lowest overloads are noted in Case 3A. However, even with the load reductions from energy efficiency program impacts in Case 3A, the worst case loadings on the line are significantly higher than the lines' present ratings.

3.5 Pardee-Santa Clara 230-kV Line

The Pardee-Santa Clara line is approximately 40 miles long and utilizes a single 1033 MCM ACSR conductor per phase. The normal and emergency ratings for the line are both 1,240 amps. The line's ratings are limited by line clearances.

The worst case overloads noted on the Pardee-Santa Clara line are summarized in Table 3-5. As shown in Table 3-5 the overloads on this line are relatively small and occur only for 2020 load conditions for the Updated Initial (UI) Case studies.

TABLE 3-5 WORST CASE OVERLOADS ON PARDEE-SANTA CLARA LINE					
	Rating (Amps)	Loading (PU) in Case			
		UI	1B	3A	4A
2020 Studies					
Category C (SONGS 3 In)	1,240	101	-----	-----	-----
Overlapping Outage	1,240	101	-----	-----	-----
Category C (SONGS 3 Out)	1,240	102	-----	-----	-----

3.6 La Fresa-Redondo #1 and #2 230-kV Lines

The La Fresa-Redondo lines are each approximately 5 miles in length and both utilize two 1590 MCM ACSR conductors per phase. The normal and emergency ratings of both lines are 2,400 amps and 2,640 amps; respectively. According to information in SCE's *CAISO Controlled SCE Transmission Expansion Plan 2007-2016* (December 2006), the limiting factors for these lines are wave traps at Redondo.

The worst case overloads noted on these lines are summarized in Table 3-6. As shown in Table 3-6, the only significant overloads on them occur in the Updated Initial (UI) Case studies.

TABLE 3-6
WORST CASE OVERLOADS ON LA FRESA-REDONDO LINES

	Rating (Amps)	Loading (PU) in Case			
		UI	1B	3A	4A
2012 Studies					
Overlapping Outage	2,400	105	-----	-----	-----
2016 Studies					
Overlapping Outage	2,400	106	-----	-----	-----
2020 Studies					
Overlapping Outage	2,400	114	103	-----	-----

3.7 Serrano-Villa Park 230-kV Lines

The Serrano-Villa Park lines are each approximately 3 miles in length and both utilize two 1590 MCM ACSR conductors per phase. The normal rating for both lines is 3,230 amps; the emergency rating for the #1 line is 3,810 amps while that for the #2 line is 4,050 amps.

The worst case overloads noted on these lines are summarized in Table 3-7. As shown in Table 3-7, the only significant overloads on these lines occur in the Updated Initial (UI) Case studies.

TABLE 3-7
WORST CASE OVERLOADS ON SERRANO-VILLA PARK LINES

	Rating (Amps)	Loading (PU) in Case			
		UI	1B	3A	4A
2012 Studies					
Overlapping Outage	3,230	106	-----	-----	-----

TABLE 3-7 (Con't) WORST CASE OVERLOADS ON SERRANO-VILLA PARK LINES					
	Rating (Amps)	Loading (PU) in Case			
		UI	1B	3A	4A
2016 Studies					
Overlapping Outage	3,230	106	-----	-----	-----
2020 Studies					
Overlapping Outage	3,230	115	101	-----	-----
Category C (SONGS 3 Out) [2]	3,810	102	-----	-----	-----

3.8 Lugo-Pisgah #1 and #2 230-kV Lines

The Lugo-Pisgah lines are each approximately 65 miles long and utilize a single 605 MCM ACSR conductor per phase. The normal and emergency ratings for both lines, per the WECC powerflow data set, are 725 amps. It is likely that the line conductors and associated terminal equipment are the limiting factors with respect to the ratings of these lines.

The worst case overloads noted on these lines are summarized in Table 3-8.

TABLE 3-8 WORST CASE OVERLOADS ON LUGO-PISGAH LINES					
	Rating (Amps)	Loading (PU) in Case			
		UI	1B	3A	4A
2016 Studies					
Category C (SONGS 3 Out)	725	101	-----	-----	-----
2020 Studies					
Category B (SONGS 3 In)	725	-----	----	-----	120
Category C (SONGS 3 In)	725	109	-----	-----	132
Category B (SONGS 3 Out)	725	-----	-----	-----	119
Category C (SONGS 3 Out)	725	111	-----	-----	131

Review of the information in Table 3-8 shows that the only significant overloads on the Lugo-Pisgah #1 and #2 lines occur in the Updated Initial (UI) Case and in the Case 4A studies for the year 2020. The overloads in the UI Case are due to the amounts of new CSP solar generation modeled at Pisgah (approximately 480 MW) and the amount of new

[2] Only the Serrano-Villa Park #1 line is overloaded

combined cycle generation (1,140 MW[3]) modeled at Mohave and El Dorado. The overloads in Case 4A are due primarily to the amounts of new CSP solar and wind generation modeled at Pisgah (a total of approximately 690 MW). Sensitivity studies for Case 4A indicate that overloads of a similar magnitude would occur even if the Aged Plants were not retired and the assumed new thermal generation in the Los Angeles Basin was not developed.

3.9 El Dorado-Pisgah #1 and #2 230-kV Lines

The El Dorado-Pisgah lines are each approximately 49 miles long and utilize a single 605 MCM ACSR conductor per phase. The normal and emergency ratings for both lines, per the WECC powerflow data set, are 725 amps. It is likely that the line conductors and associated terminal equipment are the limiting factors with respect to the ratings of these lines.

The worst case overloads noted on these lines are summarized in Table 3-9. As shown in Table 3-9 the only significant overloads on the El Dorado-Pisgah #1 and #2 lines occur in the Case 4A studies for the year 2020. These overloads are due to the amounts of new CSP solar and wind generation modeled at Pisgah (a total of approximately 690 MW). As was the situation for the Pisgah-Lugo lines, sensitivity studies for Case 4A indicate that overloads of a similar magnitude would occur even if the Aged Plants were not retired and the assumed new thermal generation in the Los Angeles Basin was not developed.

TABLE 3-9
WORST CASE OVERLOADS ON EL DORADO-PISGAH LINES

	Rating	Loading (PU) in Case			
	(Amps)	UI	1B	3A	4A
2020 Studies					
Category C (SONGS 3 In)	725	-----	-----	-----	118
Category C (SONGS 3 Out)	725	-----	-----	-----	118

3.10 El Dorado-Lugo 500-kV Line

The El Dorado-Lugo 500-kV line conductors have a normal rating of 3,700 amps (per the WECC data sets). However, the series capacitors installed in the line to reduce its reactive impedance are rated at 1,600 amps (normal) and 2,400 amps (emergency).

[3] The California ISO generation interconnection queue includes a 550 MW combined-cycle unit proposed for interconnection at the Mohave 500-kV switchyard (queue # 118) and a 591 MW combined-cycle unit proposed for interconnection at the El Dorado 500-kV switchyard (queue # 145)

The worst case overloads noted on this line are summarized in Table 3-10. Review of the information in Table 3-10 shows that the most significant overloads occur on the El Dorado-Lugo 500-kV line in the UI Case and are due to the amounts of new thermal generation modeled at Mohave and El Dorado (approximately 1,140 MW) and to the amounts of new CSP solar generation modeled at Mohave (which increases from 220 MW in 2016 to approximately 390 MW in 2020). Again, sensitivity studies for Case 4A indicate that overloads of a similar magnitude would likely occur even if the Aged Plants were not retired and the assumed new thermal generation in the Los Angeles Basin was not developed.

TABLE 3-10
WORST CASE OVERLOADS ON EL DORADO-LUGO LINE

	Rating	Loading (PU) in Case			
	(Amps)	UI	1B	3A	4A
2012 Studies					
Overlapping Outage	1,600	114	109	-----	-----
Category B (SONGS 3 Out)	1,600	102	-----	-----	-----
2016 Studies					
Overlapping Outage	1,600	112	110	-----	102
Category B (SONGS 3 Out)	1,600	102	-----	-----	-----
2020 Studies					
Category B (SONGS 3 In)	1,600	118	-----	-----	-----
Overlapping Outage	1,600	150	102	104	117
Category B (SONGS 3 Out)	1,600	124	-----	-----	-----

3.11 Midpoint-Devers 500-kV Line

The conductors on the existing Palo Verde-Devers 500-kV line (with which the proposed Midpoint Substation would be interconnected) have a normal rating of 3,950 amps (per the WECC data sets). However, the series capacitors installed in the line are rated at 2,700 amps (normal) and 3,450 amps (emergency).

This line experienced an overload of 17% as the result of the most critical Category B outage for the Updated Initial Case for 2020 (in which a 700 MW combined cycle project (California ISO queue #167)) was assumed to be interconnected at the Midpoint substation. A sensitivity case was developed in which only 200 MW of Aged Plant generation was retired and approximately 4,000 MW of queued thermal generation was not developed and the critical Category B contingency was simulated on it. This study indicated that the resultant overload on the Midpoint-Devers line would be approximately 22%; in other words, overloads on this line are due to the amounts of generation interconnected at Midpoint and imports into Southern California and not to the retirement of Aged generation.

SECTION 4 - MITIGATION OF OVERLOADS WITH 4,140 MW OF RETIREMENTS IN 2012 – LINES IN LA BASIN AND VENTURA COUNTY

This Section discusses methods which could potentially be used to mitigate the overloads on the 230-kV lines in the LA Basin and Ventura County noted above and presents preliminary estimated costs for these mitigation measures. It also presents preliminary estimated costs associated with:

- Initiating 500-kV operation of the Antelope-Pardee line,
- Looping the Vincent-Santa Clara 230-kV line into Pardee and initiating operation of the Vincent-Pardee section at 500-kV, and
- The approximately 480 MVAR of reactive support installed at various substations in the LA Basin and Ventura County.

Mitigation of the overloads on the lines in the eastern-most portion of the SCE system is discussed in Section 5.

The overloaded lines in the LA Basin and Ventura County are built using one of four different conductor size/bundling configurations. These configurations and the maximum allowable normal and emergency line ratings for each are summarized in Table 4-1.

TABLE 4-1
MAXIMUM CONDUCTOR RATINGS - IMPACTED LA BASIN/VENTURA COUNTY LINES

Configuration		Maximum Ratings (Amps) [1]	
Conductor Size	Number per Phase	Normal	Emergency [2]
605	2	1,790	2.200
1033	1	1,240	1,462
1033	2	2,480	2,852
1590	2	3,230	3,715

4.1 Chino-Mira Loma #1 230-kV Line

<u>Required Ratings</u>

As discussed in Section 3.1, the normal and emergency ratings of this line are 1,790 amps

[1] Maximum ratings for two bundled 605 conductor based on ratings of Chino-Mira Loma #1 line; maximum ratings for other configurations based on information in Appendix 6.
[2] Short-term emergency ratings

and 2,200 amps; respectively. To mitigate the overloads presented in Section 3.1 the normal and emergency ratings for this line would have to be increased to the values summarized in Table 4-2. Comparing the information for the year 2020 in Table 4-2 to that in Table 4-1 indicates that:

- For the UI Case and Cases 1B and 4A the upgraded line should be built utilizing two 1590 MCM conductors per phase.
- For Case 3 the line could be rebuilt using two 1033 MCM ACSR conductors per phase. However, doing so would not provide any margin for future system changes.

TABLE 4-2
REQUIRED RATINGS FOR CHINO-MIRA LOMA #1 LINE
(Amps)

	Case			
	UI	**1B**	**3A**	**4A**
2012 Studies				
Normal Rating	2,010	1,820	1,790	1,810
Emergency Rating	2,470	2,320	2,290	2,310
2016 Studies				
Normal Rating	2,440	2,260	2,190	2,190
Emergency Rating	2,960	2,780	2,700	2,720
2020 Studies				
Normal Rating	2,720	2,470	2,300	2,360
Emergency Rating	3,210	3,000	2,810	2,870

Proposed Mitigation

SCE's *CAISO Controlled SCE Transmission Expansion Plan 2007-2016* (December 2006) states that the Chino-Mira Loma line will be upgraded during 2011 as part of the Vincent-Mira Loma 500-kV Project (Segment 8 of the Tehachapi Project). In addition, SCE's *Tehachapi Renewable Transmission Project* presentation at a CPUC workshop on November 21, 2006 states that one of the Chino area to Mira Loma area 230-kV lines will be rebuilt as a double-circuit line (the presentation does not specify which of the three Chino-Mira Loma lines will be involved). In any event, the information presented above indicates that, at a minimum, the Chino-Mira Loma #1 line should be rebuilt using two 1590 MCM conductors per phase.

4.2 Chino-Mira Loma #3 230-kV Line

Required Ratings

As discussed in Section 3.2 the normal and emergency ratings of the Chino-Mira Loma #3 line are 2,480 amps and are due to clearance limitations. To avoid overloads for the various Cases discussed above the normal and emergency ratings for this line would have to be increased to the values summarized in Table 4-3.

Comparing the information in Table 4-3 to that in Table 4-1 indicates that by 2012 and for all four Cases the line would have to be rebuilt with or be replaced by a line utilizing, as a minimum, two 1590 MCM conductors per phase. However, by 2016, this configuration would provide enough capability for only Case 3A and, by 2020, it would not provide enough capability for even Case 3A.

TABLE 4-3
REQUIRED RATINGS FOR CHINO-MIRA LOMA #3 LINE
(Amps)

	Case			
	UI	**1B**	**3A**	**4A**
2012 Studies				
Normal Rating	2,840	2,660	2,620	2,600
Emergency Rating	3,890	3,650	3,550	3,510
2016 Studies				
Normal Rating	3,000	2,770	2,660	2,720
Emergency Rating	4,060	3,820	3,680	3,730
2020 Studies				
Normal Rating	3,080	2,910	2,790	2,720
Emergency Rating	4,170	3,820	3,760	3,790

Proposed Mitigation

At present there are three 230-kV lines between the Chino and Mira Loma substations. The Chino-Mira Loma #1 and #2 lines interconnect Chino and the West 230-kV bus at Mira Loma while the Chino-Mira Loma #3 line interconnects Chino and the East 230-kV bus at Mira Loma. The bus tie between the West and East busses at Mira Loma is operated in a normally open fashion. The Chino-Mira Loma #2 line has the same normal and emergency ratings (2,480 amps) as does the #3 line.

As discussed in Section 4.1, SCE's current plans call for removing one of the Chino-Mira

Loma lines and replacing it with a double circuit line. As a result, a modified powerflow Updated Initial (UI) case for 2020 was developed in which:

- The Chino-Mira Loma #1 line was removed and replaced with a double-circuit 230-kV line with both circuits utilizing two 1590 MCM conductors per phase,
- Both circuits of this new line were interconnected with the East Bus at Mira Loma, and
- The interconnection point for the existing Chino-Mira Loma #3 line was moved from the East bus to the West bus at Mira Loma.

Studies conducted on the resultant base case indicated that modifying the system between Chino and Mira Loma as discussed above would mitigate all overloads on the 230-kV lines between these two substations.

Preliminary Estimated Mitigation Cost [3]

Table 4-4 summarizes the estimated cost (in $1000 of 2007 dollars) for the facilities identified above as being required to mitigate overloads on the 230-kV lines between Chino and Mira Loma.

TABLE 4-4
CHINO-MIRA LOMA LINES
ESTIMATED UPGRADE COSTS
($Millions – 2007)

Facility	Estimated Cost
Rebuild Chino-Mira Loma #1 Line	27.6
Add Line and Transformer Terminations at Chino	5.3
Add Line Termination at Mira Loma	3.5
Total Estimated Cost	36.4

4.3 Barre-Ellis 230-kV Line

Required Ratings

As discussed in Section 3.3 the normal and emergency ratings of the Barre-Ellis line are 2,480 amps and are due to clearance limitations. To avoid overloads for the various Cases discussed above the normal and emergency ratings for this line would have to be

[3] The estimated costs for all proposed mitigation steps in this Section 4 were derived from information in the System Impact Studies performed by SCE for the Sun Valley and Victorville 2 Projects

increased to the values summarized in Table 4-5.

Comparing the information in Table 4-5 to that in Table 4-1 indicates that by 2012 and for all four Cases the Barre-Ellis line would have to be rebuilt with or be replaced by a line utilizing, as a minimum, two 1590 MCM conductors per phase.

TABLE 4-5
REQUIRED RATINGS FOR BARRE-ELLIS LINE
(Amps)

	Case			
	UI	**1B**	**3A**	**4A**
2012 Studies				
Normal Rating	2,820	2,680	2,640	2,650
Emergency Rating	2,820	2,680	2,640	2,650
2016 Studies				
Normal Rating	3,050	2,740	2,630	2,650
Emergency Rating	3,050	2,740	2,630	2,650
2020 Studies				
Normal Rating	3,350	2,930	2,760	2,830
Emergency Rating	3,350	2,930	2,760	2,830

Proposed Mitigation

The proposed method of mitigating the overloads on the Barre-Ellis line is to reconductor the line using two 1590 MCM conductors per phase and to modify existing structures as necessary to mitigate any clearance issues. To test the effectiveness of this proposed mitigation, the modified Updated Initial (UI) case for 2020 discussed in Section 4.2 was modified to reflect the reconductoring of the Barre-Ellis line. Studies conducted on the resultant base case indicated that reconductoring the line using two 1590 MCM conductors per phase would mitigate any overloads on the line.

Preliminary Estimated Mitigation Cost

Table 4-6 summarizes the estimated cost (in $1000 of 2007 dollars) for the facilities identified above as being required to mitigate overloads on the Barre-Ellis 230-kV line. As discussed previously the rating of the existing facility is limited by line clearances. For the purposes of this preliminary estimate it was assumed that:

- One-half of the existing line would be rebuilt to mitigate the clearance limitations and the remaining half would be reconductored, and
- The switches and wave traps at both the Barre and Ellis terminals of this line would

be replaced by 4,000 amp units.

TABLE 4-6 ESTIMATED COST FOR BARRE-ELLIS LINE UPGRADES ($Millions – 2007)	
Component	**Estimated Cost**
Rebuilt Section of Line	15.2
Reconductored Section of Line	11.8
Replace Switches at Barre and Ellis	1.6
Replace Wave Traps at Barre and Ellis	0.3
Total Estimated Cost	28.9

4.4 Moorpark-Pardee #2 and #3 230-kV Lines

<u>Required Ratings</u>

As noted in Section 3.4 the normal and emergency ratings for the Moorpark-Pardee #2 and #3 lines are 1,800 amps and 2,279 amps; respectively and are limited by the disconnect switches on the lines. To avoid the overloads on these lines as presented in Section 3.4, the normal and emergency ratings for these two lines would have to be increased to the values summarized in Table 4-7.

TABLE 4-7 REQUIRED RATINGS FOR MOORPARK-PARDEE #2 AND #3 LINES (Amps)				
	Case			
	UI	**1B**	**3A**	**4A**
2012 Studies				
Normal Rating	2,470	2,420	2,370	2,400
Emergency Rating	2,480	2,420	2,370	2,400
2016 Studies				
Normal Rating	2,710	2,440	2,340	2,430
Emergency Rating	2,720	2,440	2,350	2,430
2020 Studies				
Normal Rating	2,790	2,560	2,390	2,540
Emergency Rating	2,810	2,570	2,390	2,550

Proposed Mitigation

The information in Table 4-7 indicates that all of the overloads noted on the Moorpark-Pardee #2 and #3 lines would be mitigated if the switches on the lines were upgraded so that their normal and emergency ratings were as least 2,810 amps. As a point of reference, the normal and emergency ratings for the Moorpark-Pardee #1 line (which uses the same conductor as do the #2 and #3 lines) are 3,000 amps and 3,300 amps; respectively and are limited by a wave trap on the line.

Preliminary Estimated Mitigation Cost

Table 4-8 summarizes the estimated cost (in $1000 of 2007 dollars) for the facilities identified above as being required to mitigate overloads on the Moorpark-Pardee #2 and #3 lines. In addition to replacing the switches on both lines as discussed above, it was assumed that the wave traps on both lines would be replaced. Both the replacement switches and wave traps were assumed to be rated at 3,000 amps.

TABLE 4-8
ESTIMATED COST FOR UPGRADES TO MOORPARK-PARDEE #2 AND #3 LINES
($Millions – 2007)

Component	Estimated Cost
Replace Switches at Moorpark and Pardee	2.8
Replace Wave Traps at Moorpark and Pardee	0.4
Total Estimated Cost	3.2

4.5 La Fresa-Redondo #1 and #2 230-kV Lines

Required Ratings

As discussed in Section 3.6 the normal and emergency ratings of these lines (both of which utilize two 1590 MCM conductors per phase) are 2,400 amps and 2,640 amps respectively. To avoid the overloads on these lines as discussed in Section 3.6, the normal rating of these two lines would have to be increased to 2,740 amps (a value well under the normal maximum rating for this conductor configuration as presented in Table 4-1).

Proposed Mitigation

In its *CAISO Controlled SCE Transmission Expansion Plan 2007-2016* (December 2006), SCE has proposed to increase the rating of these lines by removing the wave traps on them at Redondo.

Preliminary Estimated Mitigation Cost

The estimated cost (in 2007 dollars) for removing the wave traps on the La Fresa-Redondo lines is $140,000.

4.6 Serrano-Villa Park #1 and #2 230-kV Lines

Required Ratings

As discussed in Section 3.7 the normal and emergency ratings of these two lines (both of which utilize two 1590 MCM conductors per phase) are as follows:

- Serrano-Villa Park #1 line – 3,230 amps (normal) and 3,810 amps (emergency)
- Serrano-Villa Park #2 line – 3,230 amps (normal) and 4,050 amps (emergency)

To avoid the overloads on these lines as discussed in Section 3.7, their ratings would have to be increased to the following levels to avoid overloads for only the Updated Initial (UI) Case:

- Serrano-Villa Park #1 line – 3,720 amps (normal) and 3,890 amps (emergency).
- Serrano-Villa Park #2 line – 3,720 amps (normal).

Proposed Mitigation

Comparing the above required ratings to the rating information for a two conductor, 1590 MCM configuration in Table 4-1, indicates that these lines would have to be reconductored by 2012 for the Updated Initial (UI) Case.

Preliminary Estimated Mitigation Cost

Table 4-9 summarizes the estimated cost (in $1000 of 2007 dollars) for the facilities identified above as being required to mitigate overloads on the Serrano-Villa Park 230-kV lines.

TABLE 4-9
ESTIMATED COST FOR SERRANO-VILLA PARK #1 AND #2 LINE UPGRADES
($Millions – 2007)

Component	Estimated Cost
Reconductor Both Lines	10.9
Replace Switches at Serrano and Villa Park	3.1
Replace Wave Traps at Serrano and Villa Park	0.3
Total Estimated Cost	14.3

For the purposes of this preliminary estimate it was assumed that:

- Both lines would be reconductored with two 1590 MCM SSAC conductors per phase, and
- The switches and wave traps at both the Serrano and Villa Park would be replaced by 4,000 amp units.

4.7 Initiation of 500-kV Operation on the Antelope-Pardee and Vincent-Pardee Lines

The estimated costs for initiating 500-kV operation of the Antelope-Pardee line and the Vincent-Pardee line in 2020 are summarized in Table 4-10.

TABLE 4-10
ESTIMATED COST FOR INITIATING OPERATION OF ANTELOPE-PARDEE AND VINCENT-PARDEE LINES AT 500-KV
($Millions – 2007)

Component	Estimated Cost
Develop 500/230-kV Substation at Pardee [4]	92.6
Add 500-kV Line Termination at Vincent	6.3
Total Estimated Cost	98.9

4.8 Addition of Shunt Capacitors on 230-kV System

The estimated costs for installing approximately 480 MVAR (six 79 MVAR banks with breakers) of shunt capacitors on the SCE 230-kV grid are summarized in Table 4-10.

TABLE 4-10
ESTIMATED COST FOR ADDITION OF 230-KV SHUNT CAPACITORS
($Millions – 2007)

Component	Estimated Cost
2016 Additions (three 79 MVAR banks)	10.8
2020 Additions (three 79 MVAR banks)	10.8
Total Estimated Cost	21.6

[4] Based on information in the Tehachapi Collaborative Study Group report of April 19, 2006

4.7 Summary of Estimated Mitigation Costs

Table 4-11 summarizes and compares the preliminary estimated mitigation costs for the Updated Initial (UI) Case and for Cases 1B, 3A, and 4A. The information in Table 4-11 shows that:

- The total mitigation cost for the Updated Initial (UI) Case would be approximately $203 million,
- The total mitigation costs for the other three Cases would be approximately $189 million, and
- The mitigation costs for all four Cases would be reduced by approximately $36 million if the Chino-Mira Loma upgrades (which are being proposed as part of the Tehachapi Transmission Project) were not included as an Aged Plant retirement mitigation cost.

TABLE 4-11
SUMMARY OF ESTIMATED MITIGATION COSTS
($Millions – 2007)

	Case			
	UI	**1B**	**3A**	**4A**
2012 Additions				
Chino-Mira Loma Upgrades	36.4	36.4	36.4	36.4
Barre-Ellis Upgrades	28.9	28.9	28.9	28.9
Moorpark-Pardee Upgrades	3.2	3.2	3.2	3.2
La Fresa-Redondo Upgrades	0.1	0.1	0.1	0.1
Serrano-Villa Park Upgrades	14.3	0	0	0
2012 Total	82.9	68.6	68.6	68.6
2016 Additions				
237 MVAR of Capacitors	10.8	10.8	10.8	10.8
2016 Total	10.8	10.8	10.8	10.8
2020 Additions				
Pardee 500/230-kV Substation	92.6	92.6	92.6	92.6
Vincent 500-kV Additions	6.3	6.3	6.3	6.3
237 MVAR of Capacitors	10.8	10.8	10.8	10.8
2020 Total	109.7	109.7	109.7	109.7
Total For All Years	203.4	189.1	189.1	189.1

SECTION 5 - MITIGATION OF OVERLOADS WITH 4,140 MW OF RETIREMENTS IN 2012 – LINES IN EASTERN PORTION OF THE SCE AREA

The study results presented in Section 3 indicated that the following lines in the eastern portion of the SCE area could become overloaded under certain conditions:

- Lugo-Pisgah #1 and #2 230-kV lines
- El Dorado-Pisgah #1 and #2 230-kV lines
- El Dorado-Lugo 500-kV line
- Midpoint-Devers 500-kV line

As discussed in Section 3 the overloads on the above lines are driven more by the interconnection of new renewable and/or thermal resources with the Pisgah, El Dorado, Mohave, and Midpoint (proposed) substations than by the retirement of the Aged Plant generation. The following discusses methods whereby the noted overloads could be mitigated. Because the overloads are not due to the retirement of Aged Generation any cost associated with mitigating them are not included in this report.

5.1 Lugo-Pisgah and El Dorado-Pisgah 230-kV Lines and El Dorado-Lugo 500-kV Line

All four of the above 230-kV lines utilize 605 MCM ACSR conductor for which the existing normal and emergency ratings are 725 amps. Because of the age of these lines and the magnitude of the overloads on them reconductoring them might not be feasible. The overloads noted on the El Dorado-Lugo 500-kV line could be mitigated by upgrading the series capacitors in the line to increase their normal rating to 2,400 amps (for the Updated Initial Case) or to 2,000 amps (for Case 4A).

Section 6 in SCE's report entitled ***"Conceptual Transmission Requirements and Costs for Integrating Renewable Resources"*** (November 8, 2006) discusses various new or upgraded transmission facilities that would be required to integrate new resources in the Pisgah area and the El Dorado/Mohave area into the system. These facilities include a new 500-kV line from Pisgah to Lugo and looping the existing El Dorado-Lugo 500-kV line in to Pisgah. These proposed additions would likely mitigate the overloads noted on the four 230-kV lines and on the El Dorado-Lugo 500-kV line.

If additional new resources above the amounts studied herein were developed in the Mohave/El Dorado area it might be necessary to build additional 500-kV facilities between Pisgah and Lugo and between El Dorado/Mohave and Pisgah to integrate the resources into the system (refer to the above mentioned Section 6).

As a point of reference, SCE has estimated that:

- The cost of the transmission upgrades required to deliver up to approximately 2,800 MW from the Pisgah area would be $867 million, and
- The cost of the transmission upgrades required to deliver up to approximately 3,000 MW from the El Dorado/Mohave area would be about $1.8 billion.

5.2 Midpoint-Devers 500-kV Line

The overloads noted on the Midpoint-Devers line (17%) could be mitigated by upgrading the series capacitors in the line to increase their normal rating to 3,200 amps.

SECTION 6 – SENSITIVITY STUDIES

As discussed in Section 2.2 portions of the thermal capacity added in 2012 to replace the retired 4,140 MW of Aged plant generation would be underutilized in subsequent years due to the addition of demand-side resources (EE and PV solar) and supply-side renewable resources. Specifically:

- In Case 1B the requirement for dispatching new thermal generation decreases by about 300 MW between 2012 and 2016,
- In Case 3A the requirement to dispatch new thermal generation decreases by about 700 MW between 2012 and 2016, and
- In Case 4A the dispatch requirement for new thermal generation decreases by about 1,380 MW between 2012 and 2016 and by an additional 650 MW between 2016 and 2020.

Sensitivity cases (the "Mod" cases) were developed in which the assumed Aged plant retirement schedules for each of these three Cases was modified to minimize the amounts of underutilized capacity in each Case. The development of these base cases and the results of contingency studies performed on them are discussed below (detailed loads and resource information for these three Cases is contained in Appendix 9 while Appendix 10 contains detailed information on the results of the contingency studies done on each Case).

6.1 Base Case Development

Case 1B (Mod)

In creating this Case the retirement schedule for Case 1B was modified so that the retirement of 600 MW of generation (400 MW at Huntington Beach and 200 MW at Mandalay) was deferred from 2012 to 2013. Table 6-1 summarizes the resource dispatch modeled in the 2012 Reference Case (without any retirements or new renewable resources) and in the Case 1B (Mod) cases for 2012, 2016, and 2020. Figure 6-1 depicts the changes in the resource dispatch between the four conditions studied.

As shown in Table 6-1 (and depicted in Figure 6-1) deferring the retirement of 600 MW by one year mitigates the underutilization concern discussed above and results in the dispatch requirement for new thermal generation increasing by about 290 MW between 2012 and 2016 (and by an additional 690 MW between 2016 and 2020).

TABLE 6-1
SCE AREA LOADS AND RESOURCES FOR CASE 1B (Mod)
(MW)

	2012	Case 1B (Mod)		
	Reference		2016	2020
SCE Area Loads and Losses	28,595	28,624	29,977	31,400
Less, Energy Efficiency	0	(874)	(1,637)	(2,269)
Less, PV Solar	0	(64)	(139)	(150)
Net SCE Loads (MW)	28,595	27,686	28,201	28,981
SCE Area Resources (MW)				
Imports	8,734	8,735	8,799	8,828
Aged Plants	6,650	3,110	2,510	2,510
New Renewables	0	622	1,382	1,436
New Thermal Generation	3,809	5,847	6,140	6,834
Existing Wind Generation	327	327	327	327
Other Existing Generation	9,075	9045	9,043	9,046
Total Resources	28,595	27,686	28,201	28,981

Case 3A (Mod)

In creating this Case the retirement schedule for Case 3A was modified so that the retirement of 600 MW of generation (400 MW at Huntington Beach and 200 MW at Mandalay) was deferred from 2012 to 2013. Table 6-2 summarizes the dispatched resources modeled in the Reference Case and in the Case 3A (Mod) cases for 2012, 2016, and 2020. Figure 6-2 depicts the changes in the resource dispatch between the four conditions studied.

As shown in Table 6-2 (and depicted in Figure 6-2) deferring the retirement of 600 MW by one year mitigates a majority of the underutilization concern discussed above (the dispatch requirement for new thermal generation does decrease by 100 MW between 2012 and 2016).

TABLE 6-2 SCE AREA LOADS AND RESOURCES FOR CASE 3A (Mod) (MW)				
	2012	Case 3A (Mod)		
	Reference	2012	2016	2020
SCE Area Loads and Losses	28,595	28,602	29,951	31,352
Less, Energy Efficiency	0	(1,145)	(2,292)	(3,427)
Less, PV Solar	0	(63)	(139)	(150)
Net SCE Loads (MW)	28,595	27,394	27,520	27,775
SCE Area Resources (MW)				
Imports	8,734	8,754	8,799	8,829
Aged Plants	6,650	3,110	2,510	2,510
New Renewables	0	620	1,381	1,436
New Thermal Generation	3,809	5,578	5,478	5,623
Existing Wind Generation	327	327	327	327
Other Existing Generation	9,075	9,005	9,025	9,050
Total Resources	28,595	27,394	27,520	27,775

Case 4A (Mod)

Table 6-3 compares the Aged units that were modeled on-line in Case 4A and Case 4A (Mod).

TABLE 6-3 AGED-PLANT GENERATION ON-LINE IN CASES 4A AND 4A (Mod) (MW)						
Aged Unit	Case 4A All Years	Case 4A (Mod)				
		2012	2013-2014	2015	2016-2017	2018-2020
Alamitos 3	0	320	0	0	0	0
Alamitos 5 & 6	950	950	950	950	950	950
El Segundo 3 & 4	660	660	660	660	660	660
Huntington Beach 1 & 2	0	400	400	400	200	0
Mandalay 1 & 2	0	400	400	400	0	0
Ormond Beach 1	0	700	700	0	0	0
Redondo Beach 7 & 8	900	900	900	900	900	900
Total On-Line	2,510	4,330	4,010	3,310	2,710	2,510

Table 6-4 summarizes the dispatched resources modeled in the Reference Case and in the Case 3A (Mod) cases for 2012, 2016, and 2020 while Figure 6-2 depicts the changes in the resource dispatch between the four conditions studied.

As shown in Table 6-4 (and depicted in Figure 6-3) deferring the retirement of certain units as summarized in Table 6-3 mitigates the underutilization concern during the 2012-2016 period discussed above (the dispatch requirement for new thermal generation increases by about 180 MW between 2012 and 2016). However, the dispatch requirement for new thermal generation does decrease by about 400 MW between 2016 and 2020.

TABLE 6-4
SCE AREA LOADS AND RESOURCES FOR CASE 4A (Mod)
(MW)

	2012	**Case 4A (Mod)**		
	Reference	**2012**	**2016**	**2020**
SCE Area Loads and Losses	28,595	28,589	29,960	31,431
Less, Energy Efficiency	0	(874)	(1,637)	(2,269)
Less, PV Solar	0	(303)	(789)	(854)
Net SCE Loads (MW)	28,595	27,412	27,534	28,308
SCE Area Resources (MW)				
Imports	8,734	8,733	8,799	8,829
Aged Plants	6,650	4,330	2,710	2,510
New Renewables	0	393	1,815	3,190
New Thermal Generation	3,809	4,589	4,872	4,420
Existing Wind Generation	327	327	327	327
Other Existing Generation	9,075	9,040	9,011	9,032
Total Resources	28,595	27,412	27,534	28,308

FIGURE 6-1
CASE 1B (Mod) - RESOURCE CHANGES

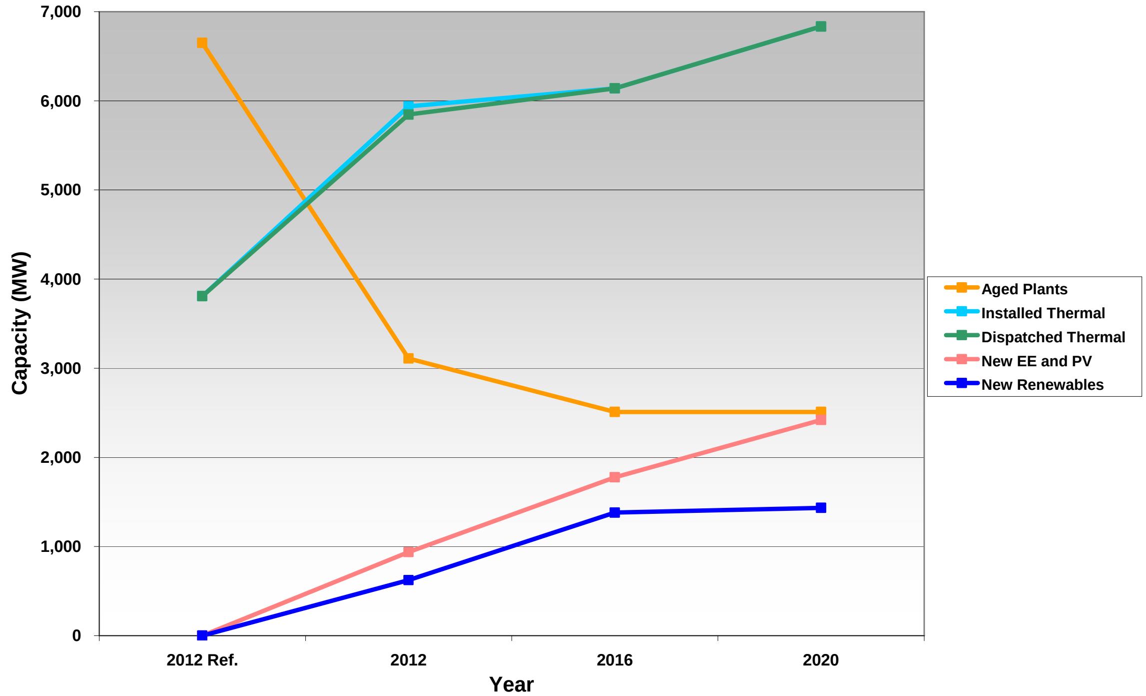
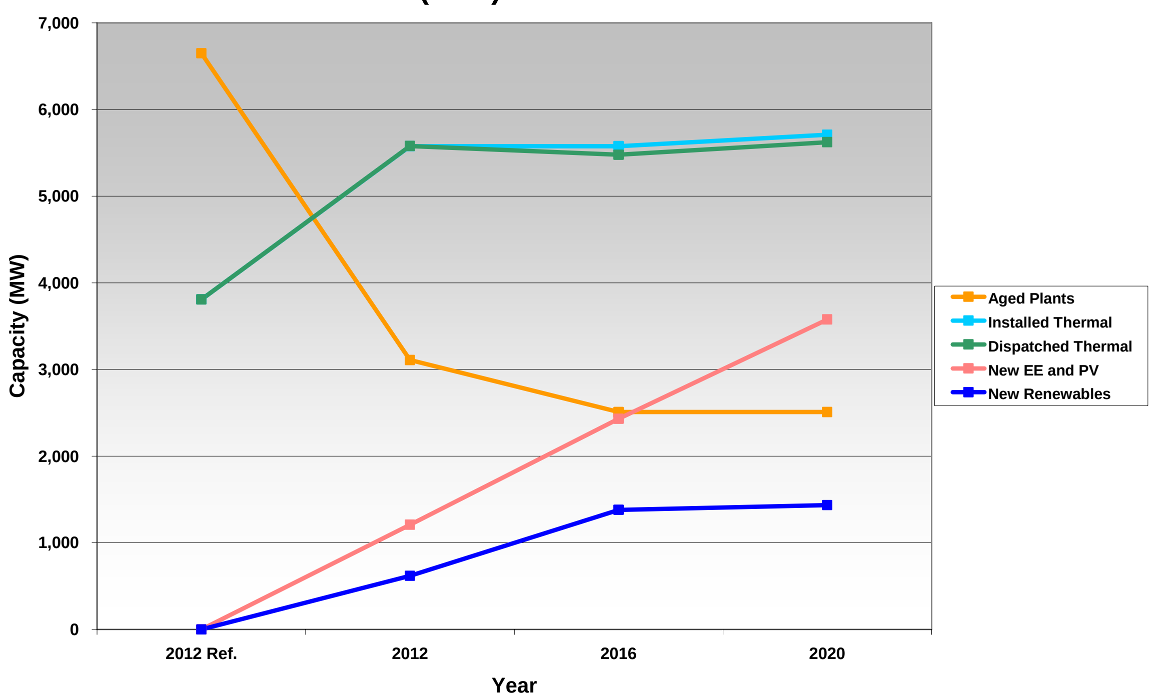
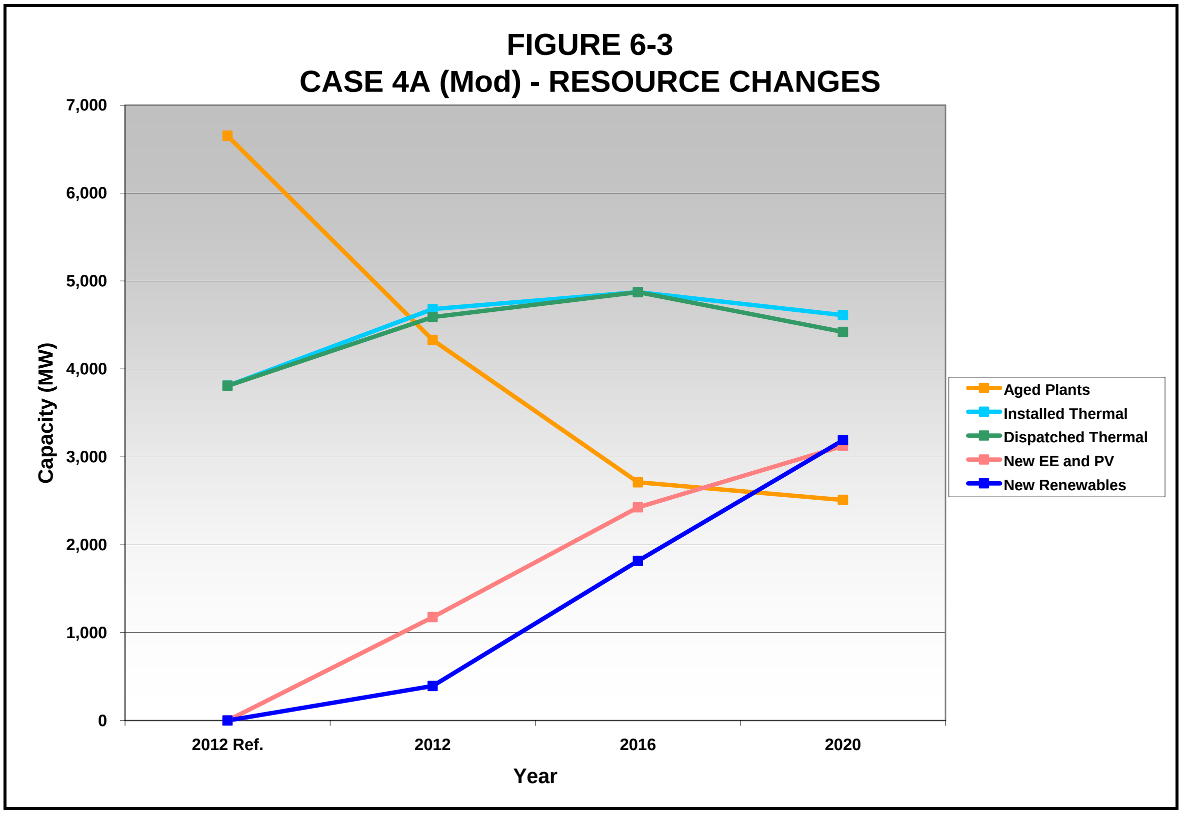


FIGURE 6-2
CASE 3A (Mod) - RESOURCE CHANGES





6.2 Results of Contingency Studies

The study results discussed in Section 3 noted that, with the most recent rating information for the SCE 230-kV lines applied, a number of lines within the LA Basin and Ventura County could experience overloads under certain conditions. Table 6-4 lists these lines and presents information on the worst case overload noted on each of these lines for each study year for Cases 1B, 3A, and 4A.

TABLE 6-4
SUMMARY OF OVERLOADS FOR ORIGINAL CASES 1B, 3A, AND 4A
(pu)

Impacted Line	Case 1B			Case 3A			Case 4A		
	2012	2016	2020	2012	2016	2020	2012	2016	2020
Chino-Mira Loma #1	105	126	136	104	123	128	105	124	130
Chino-Mira Loma #3	147	154	154	143	148	152	142	150	153
Barre-Ellis	106	109	117	103	105	112	103	105	112
Moorpark-Pardee #2	134	135	142	131	130	133	133	135	141
Moorpark-Pardee #3	134	135	142	131	130	133	133	135	141

In order to assess the impacts which the changes in on-line generation in the three modified Cases might have on the above study results, the Category B and Category C contingencies listed in Appendix 5 were simulated on the above modified Cases (in which the San Onofre #3 unit was off-line). Table 6-5 presents information on the worst case overload noted on the impacted lines listed in Table 6-4 for each study year for Cases 1B, 3A, and 4A.

TABLE 6-5
SUMMARY OF OVERLOADS FOR MODIFIED CASES 1B, 3A, AND 4A
(pu)

Impacted Line	Case 1B (Mod)			Case 3A (Mod)			Case 4A (Mod)		
	2012	**2016**	**2020**	**2012**	**2016**	**2020**	**2012**	**2016**	**2020**
Chino-Mira Loma #1	100	127	136	-----	123	129	-----	-----	131
Chino-Mira Loma #3	142	154	154	138	150	145	132	145	150
Barre-Ellis	-----	109	117	----	106	111	-----	-----	112
Moorpark-Pardee #2	117	135	142	115	130	133	-----	135	141
Moorpark-Pardee #3	117	135	142	115	130	133	-----	135	141

Comparing the information in Table 6-5 to that in Table 6-4 shows that the timing of the required upgrades for all but the Chino-Mira Loma #3 line are influenced, at least to a degree, by the assumed retirement schedule for the various Aged units. Based on the information in Table 6-5 it appears as though the need to upgrade the Chino-Mira Loma #1 line and/or the Barre-Ellis line could be deferred until the 2020 time frame if Huntington Beach Units 1 and 2 (400 MW) were not retired or if an equivalent amount of re-powered or new generation was added in the proximity of the Huntington Beach facility.

As discussed in Sections 4.1 and 4.2 SCE's plans for developing the Vincent-Mira Loma 500-kV line include rebuilding one of the Chino-Mira Loma as a double-circuit 230-kV line. Therefore, deferment of upgrades to the Chino-Mira Loma #1 because of changes in potential Aged plant retirement schedules may not be significant from a cost-savings perspective. However, as discussed in Section 4.3 the estimated cost of rebuilding the Ellis-Barre 230-kV line is approximately $29 Million. Deferring this expense and the effort required to plan and permit the proposed rebuild would likely be of benefit due to all of the transmission development work planned by SCE during the 2010-2013 period.

SECTION 7 – PRELIMINARY ASSESSMENT OF LCR IMPACTS

During the past two years the California ISO has performed technical studies to identify the amounts of local generation (the Local Capacity Requirement or LCR) within certain load pockets that is required to maximize the reliability of the transmission grid into and within the load pocket. In the case of the SCE system as of spring 2007 there are two such load pockets (the LA Basin Area and the Big Creek/Ventura Area) in which the local reliability might be impacted by the retirement of Aged plants and the location of the replacement resources. The following presents a preliminary assessment of the impacts which projected changes in Area loads and the retirement of certain of the Aged Plants would have on both the LCR for each Area and the capacity in these Areas to meet the LCR.

7.1 CAISO 2008 LCR Report

In April 2007 the California ISO issued its ***2008 Local Capacity Technical Analysis – Report and Study Results*** which presented LCR information for the LA Basin Area and the Big Creek/Ventura Areas. Table 7-1 summarizes information in the California ISO's report relative to the load and LCR for each of these Areas and the generation capacity available in each Area to provide the LCR.

TABLE 7-1
SUMMARY OF California ISO 2008 LCR REPORT
(MW)

	LA Basin Area	BC/Ventura Area
Area Load[1]	19,658	5,011
Local Capacity Requirement	10,130	3,658
Available Capacity		
- QF	780	1,117
- Wind	11	346[2]
- Municipal Owned	508	0
- Nuclear	2,246	0
- Market	8,814[3]	3,933
Total	12,359	5,396

[1] Includes pump loads and losses
[2] Available capacity is equal to the installed capacity of the existing wind farms
[3] The California ISO report of April 2007 shows the capacity available from Market Generation as being equal to 8,548 MW; however, the total output of the Market generators listed on pages 66-68 of the report is 8,814 MW

The information in Table 7-1 indicates that, for the load and resource conditions studied by the California ISO, there would be sufficient capacity in both the LA Basin Area and the Big Creek/Ventura Area to meet the LCR for each Area.

7.2 Assessment of Aged Plant Retirement Impacts

In assessing the potential impacts of the retirement of certain Aged generating facilities it was assumed that:

- The import limit for the LA Basin Area would remain at the 9,528 MW[4] level in the California ISO's April 2007 report,
- The import limit for the Big Creek/Ventura Area would increase by 600 MW due to the addition of the transmission facilities associated with the Tehachapi Transmission Project,
- The loads in each Area would reflect the potential demand-side resources as defined for each Case,
- The LCR for each of these Areas would be equal to the Area load less the Area import limit,
- Approximately 20% of the installed capacity of new wind resources added in the Tehachapi area would be included in the Available Capacity calculation for the Big Creek/Ventura Area.[5] As noted earlier, the California ISO's April 2007 LCR study assumed that 100% of the capacity of the existing wind farms in the Area would be included in the Available Capacity calculation for this Area.

Table 7-2 tabulates estimated LCR-related information for the LA Basin Area and the Big Creek/Ventura Area based on the above assumptions (detailed information used in calculating the information in this table is contained in Appendix 11). Figures 7-1 through 7-3 compare the estimated information on LCR and Available Capacity summarized in Table 7-2 to that developed by the California ISO as described above. The information in Table 7-2 and Figures 7-1 through 7-3 shows that:

- For the LA Basin Area:
  - The estimated LCR for Case 1B increases from about 10,700 MW in 2012 to about 11,500 MW in 2020,
  - Due to the higher levels of demand-side resources modeled in Cases 3A and 4A the LCR for these Cases are lower than those for Case 1B. Specifically the LCR for Case 3A remains at about 10,500 MW for all three study years while that for

[4] The assumed import limit is equal to the Area load less the Area LCR

[5] Scenario Project team analysis of hourly wind performance data for 2003-2005 identified a wide range of production levels during annual peak conditions. 20 percent was selected as an appropriate value from these data.

Case 4A increases from about 10,500 MW in 2012 to about 10,800 MW in 2020

- There is ample Available Capacity to meet the LCR for all scenarios studied.

- For the Big Creek/Ventura Area:
  - The estimated LCR for Case 1B increases from about 3,400 MW in 2012 to about 3,800 MW in 2020,
  - Due to the higher levels of demand-side resources modeled in Cases 3A and 4A the LCR for these Cases are lower than those for Case 1B. Specifically the LCR for Case 3A increases from about 3,300 MW in 2012 to about 3,500 MW in 2020 while that for Case 4A increases from about 3,400 MW in 2012 to about 3,700 MW in 2020
  - There is ample Available Capacity to meet the LCR for all scenarios studied.

TABLE 7-2
ESTIMATED LCR-RELATED INFORMATION
(MW)

Case	Year	Load	Assumed Import Limit	Estimated LCR	Available Capacity	
					Original Cases	Modified Cases
LA Basin Area						
1B	2012	20,194	9,528	10,666	12,633	12,633
	2016	20,444	9,528	10,916	12,633	12,835
	2020	20,983	9,528	11,455	12,979	12,979
3A	2012	19,983	9,528	10,455	12,843	13,295
	2016	19,938	9,528	10,410	12,843	12,843
	2020	20,089	9,528	10,561	12,583	12,583
4A	2012	20,057	9,528	10,529	13,138	13,427
	2016	19,920	9,528	10,392	13,138	13,061
	2020	20,346	9,528	10,818	12,878	12,575
Big Creek\Ventura Area						
1B	2012	5,341	1,953	3,388	4,332	4,547
	2016	5,528	1,953	3,575	4,623	4,623
	2020	5,712	1,953	3,759	4,670	4,670
3A	2012	5,290	1,953	3,337	4,332	4,547
	2016	5,402	1,953	3,449	4,623	4,623
	2020	5,488	1,953	3,535	4,670	4,670
4A	2012	5,312	1,953	3,359	4,274	5,445
	2016	5,450	1,953	3,497	4,623	4,623
	2020	5,606	1,953	3,653	5,117	5,117

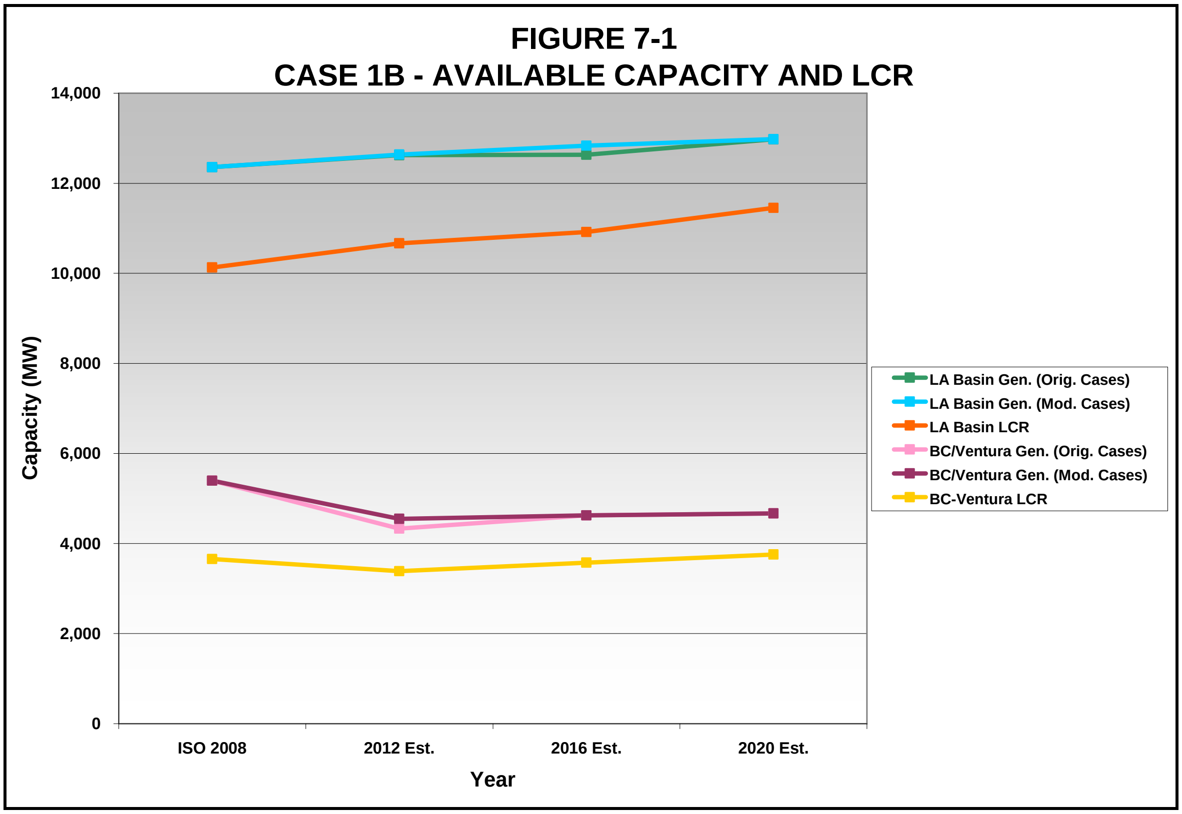


FIGURE 7-1
CASE 1B - AVAILABLE CAPACITY AND LCR
Capacity (MW)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
ISO 2008
2012 Est.
2016 Est.
2020 Est.
Year
LA Basin Gen. (Orig. Cases)
LA Basin Gen. (Mod. Cases)
LA Basin LCR
BC/Ventura Gen. (Orig. Cases)
BC/Ventura Gen. (Mod. Cases)
BC-Ventura LCR

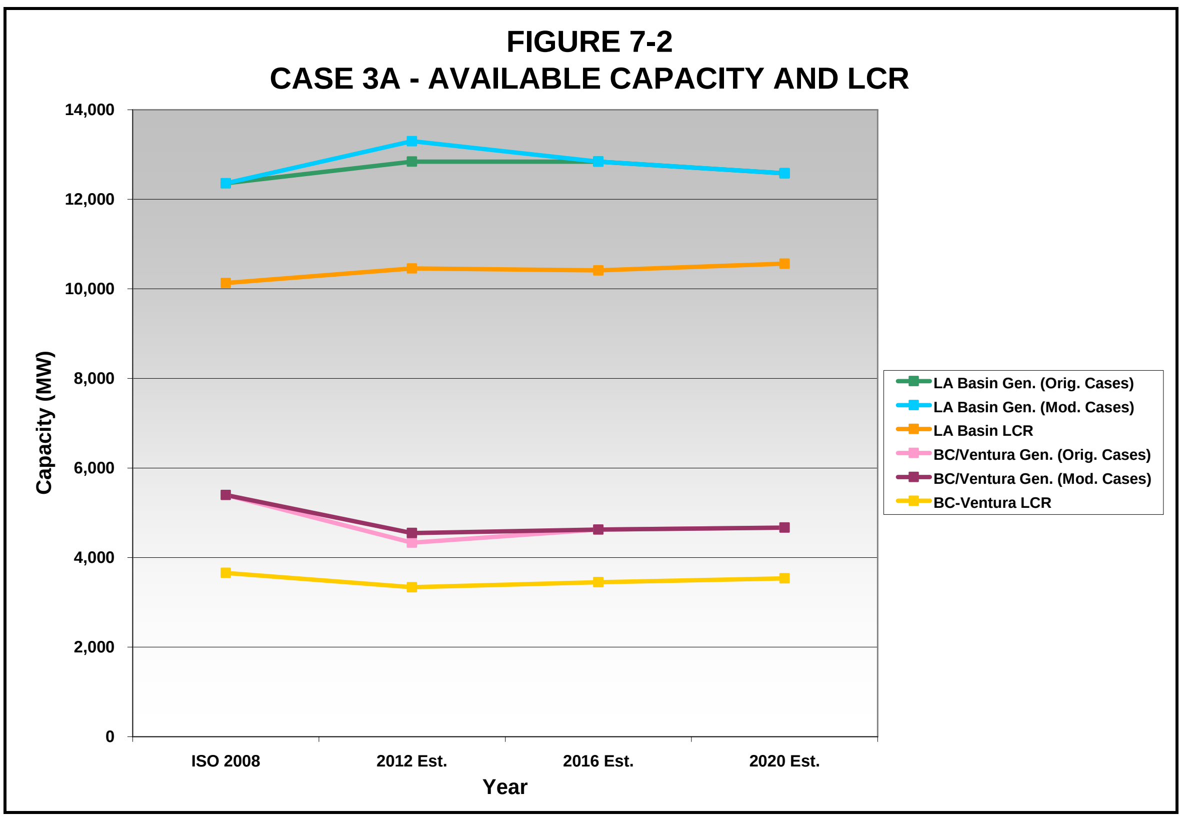


FIGURE 7-2
CASE 3A - AVAILABLE CAPACITY AND LCR
Capacity (MW)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
ISO 2008
2012 Est.
2016 Est.
2020 Est.
Year
LA Basin Gen. (Orig. Cases)
LA Basin Gen. (Mod. Cases)
LA Basin LCR
BC/Ventura Gen. (Orig. Cases)
BC/Ventura Gen. (Mod. Cases)
BC-Ventura LCR

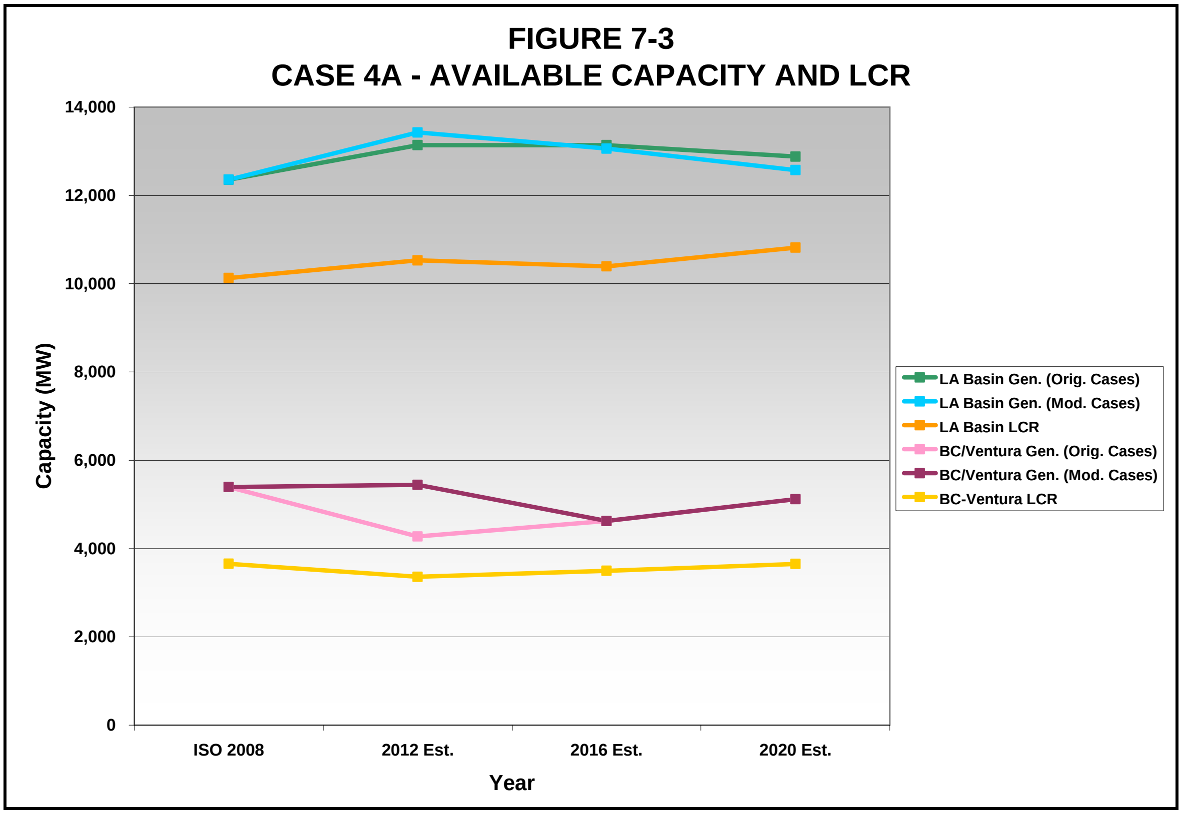


FIGURE 7-3
CASE 4A - AVAILABLE CAPACITY AND LCR
Capacity (MW)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
ISO 2008
2012 Est.
2016 Est.
2020 Est.
Year
LA Basin Gen. (Orig. Cases)
LA Basin Gen. (Mod. Cases)
LA Basin LCR
BC/Ventura Gen. (Orig. Cases)
BC/Ventura Gen. (Mod. Cases)
BC-Ventura LCR

APPENDIX 1

APRIL 2007 AGED PLANT STUDY

INTERIM REPORT

INTERIM REPORT ON
SCE AREA AGED PLANT RETIREMENT STUDIES

EXECUTIVE SUMMARY

At the present time there are several aged generating plants which are interconnected with the Southern California Edison (SCE) transmission and which are located along or near the coast in Orange, Los Angeles, and Ventura Counties. Because of their location with respect to the load and other generating resources the SCE area many of these Aged Plants are relied on to maintain the reliability of the transmission system and, as such, they tend to operate even though energy might be available from more efficient resources located elsewhere on the system. These Plants have significantly higher heat rates than new technology combined-cycle generating plants and contribute more to green house gas emissions and criteria pollutants than resources that could replace their output if the transmission system had sufficient capacity to allow such to occur. In addition, many of the Aged Plants use ocean water for once-through cooling which has been targeted by the California State Water Resources Control Board for reduction, if not elimination, out of concern for thermal effects and entrainment of marine organisms.

This report summarizes the results of studies done by Navigant Consulting, Inc. (NCI) to identify the transmission system additions/modifications that would be required should certain amounts of Aged Plant generation in the SCE area be retired. The evaluation of required transmission additions and modifications, in combination with proposed or potential generation additions provides important input to the assessment of alternative generation portfolio additions in the SCE area and the associated capital and operating costs, GHG and criteria pollutant emissions, and water use.

The Aged Plants evaluated for potential retirement include:

- LA Basin plants:
  - Alamitos – Six units with a total installed capacity of 1,930 MW
  - Etiwanda – Two units with a total installed capacity of 620 MW
  - El Segundo – Two units with a total installed capacity of 660 MW
  - Huntington Beach – Two units with a total installed capacity of 400 MW[1]
  - Redondo Beach – Four units with a total installed capacity of 1,240 MW
- Ventura County plants:

[1] Two of the existing units at Huntington Beach are not considered “aged” and were assumed to remain in service in this analysis (they were repowered in 2003).

- Ormond Beach – Two units with a combined capacity of 1,400 MW
- Mandalay – Two units with a combined capacity of 400 MW

NCI evaluated retirement opportunities and associated required transmission and assumed new generation capacity additions for projected 1-in-10 peak load conditions for 2012, 2016 and 2020. The studies assessed system impacts for both normal and contingency conditions on the transmission system. The approach used by NCI in this analysis consisted of identifying:

- The amounts of Aged Plant generation that could be retired in 2012 without causing adverse impacts on the transmission system while recognizing that the development of any major transmission upgrades or modifications by 2012 would likely be difficult to achieve unless such projects were already in progress,
- The system impacts due to load growth in 2016 and 2020 when the amounts of retired Aged Plant generation were at the amounts identified in the 2012 case,
- Potential methods of mitigating overloads noted in the 2016 and 2020 cases, and
- The system impacts that would be expected to occur if all of the Aged Plant generation was retired by 2012.

Summary of Results

As discussed in greater detail below, these studies indicated that for 2012 peak load conditions:

- A total of 4,140 MW of Aged Plant generation (2,340 MW at the LA Basin plants[2] and 1,800 MW at the Ventura County plants[3]) could be retired without any adverse impacts on the system if:
  - Approximately 0.5 miles of the Chino-Mira Loma #1 230-kV line was reconductored and the wave-traps[4] at Chino were upgraded or removed, and
  - The Antelope-Pardee 230-kV line is in service[5],
  - The limiting elements[6] on the Pardee-Moorpark #2 and #3 230-kV lines were

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[2] Retired capacity includes 980 MW at Alamitos, 620 MW at Etiwanda. 400 MW at Huntington Beach, and 340 MW at Redondo Beach

[3] Retired capacity includes 400 MW at Mandalay and 1,400 MW at Ormond Beach

[4] A wave trap is used in power-line carrier applications and serves as an interface between a transmission line and the pertinent communications equipment

[5] The Antelope-Pardee line is planned to be in-service by early 2009 and is the first component of the Tehachapi Transmission Project Plan of Service. It will be designed and constructed for 500-kV operation but will initially be operated at 230-kV.

[6] Information filed with the Energy Commission by SCE in June 1993 indicates that the conductor rating for these lines is greater than the rating modeled in the powerflow data sets. This leads to the conclusion that another element (such as a wave trap) is presently limiting the capability of the lines.

upgraded, and

- The required replacement capacity (approximately 5,400 MW[7]) was developed within or was deliverable to the eastern portion of the SCE system.

The studies discussed below also indicated that, if a total of 4,140 MW of Aged Plant capacity was retired as discussed above, load growth in the SCE area after 2012 would result in increased or additional overloads and in low voltages on the SCE system. Specifically:

- The impacts noted on the case with 2016 peak loads could be mitigated by:
  - Reconductoring three 230-kV lines (with a combined length of 28 miles) in the LA Basin,
  - Reconductoring the two Pisgah-Lugo 230-kV lines (with a combined length of 130 miles)
  - Utilizing the short-term emergency (or "B") rating rather than the long-term emergency (or "A") rating[8] for one line in the LA Basin to determine post-contingency overloads during L-1/L-1 overlapping outage conditions.
- Mitigating the impacts noted in the 2020 peak load case would require that:
  - The Antelope-Pardee line be converted to 500-kV operation[9],
  - The Vincent-Santa Clara 230-kV line be looped into Pardee and the Vincent-Pardee section be operated at 500-kV (it is built for 500-kV operation),
  - Approximately 500 MVAR of reactive support be installed at various substations in the LA Basin and Ventura County,
  - The series capacitors in the Eldorado-Lugo 500-kV line be upgraded, and
  - Significant new transmission facilities (such as the LEAPS Project) are extended into the Serrano/SONGS area.

Finally, the studies discussed below indicated that, if all 6,650 MW of Aged Plant generation is retired by 2012 a number of overloads and low voltage conditions would occur on the SCE system. Mitigation of these negative impacts would require that, by 2012:

- Eight 230-kV lines (with a combined length of 56 miles) be reconductored,
- Limiting elements[6] on three 230-kV lines in the LA Basin be replaced,

[7] Approximately 4,300 MW of capacity would be required to replace the retired Aged Plants and to provide for increased losses while an additional 1,100 MW would be required to replace lost capacity should an outage occur on SONGS Unit #3.

[8] The 230-kV line ratings applied in these studies were based on those used in a version of the SCE Transmission Register available to NCI. These ratings are "N" (continuous rating), "A" (long-term emergency rating), and "B" (short-term emergency rating)

[9] This would require the development of a 500-kV substation at Pardee

- The series capacitors in the Eldorado-Lugo 500-kV line be upgraded, and
- Approximately 500 MVAR of shunt capacitors be installed at various 230-kV substations in the SCE area.

In addition to the above system upgrades, approximately 8,000 MW of replacement capacity would have to be developed within or be deliverable to the eastern portion of the SCE system.

Additional Considerations

The information presented above identifies system additions/modifications that would be required if certain quantities of Aged Plant capacity were retired so as to maintain system reliability. Implementing the required additions/modifications (particularly those involving the reconductoring of existing lines) could be problematical from the perspectives of access to the lines to allow such to occur and the ability to remove the lines from service while the reconductoring was being done.

ANALYSIS

The analysis of the impacts of accelerating the retirement of aged generation in the SCE service area involved the development of reference cases of system conditions, status of transmission development, and levels of generation additions assumed with and without the retirement of specific target levels of aged generation retirement. While both normal and constrained contingent operating conditions were evaluated, the ability to sustain reliable system operation under key system conditions and outages is the key test for evaluation of the ability to retire generation located at critical sites within the system.

DEVELOPMENT OF REFERENCE CASES

The initial step in this analysis consisted of developing Reference Case powerflow data sets for the selected study years – 2012, 2016, and 2020. These Reference Case data sets reflected:

- 1-in-10 peak loads for the California system based on the California Energy Commission (Energy Commission) forecast of June, 2006.
- New renewable generation levels in California based on the Case 1b Scenario amounts developed by the Energy Commission. The dependable capacities for both existing and new renewable capacity in California modeled in the data sets were calculated using information on historical dependable/installed capacity ratios as provided by the Energy Commission. Table A-1 in Appendix A provides additional information regarding the amounts and locations of the modeled renewable generation.
- New thermal generation in the Southern California Edison (SCE) area for which SCE has recently signed purchased power agreements.
- Other new thermal generation in the SCE area based on information in the California Independent System Operator (California ISO) generation interconnection queue dated January 26, 2007 and SCE's Wholesale Distribution Access Tariff (WDAT) queue as of September 15, 2006[10]. This generation was added, as required, to accommodate changes in load in the SCE area and any assumed Aged Plant retirements. Detailed information regarding the queue position, capacity, and regulatory status of these various generators is summarized in Table A-2 in Appendix A.
- The retirement of Etiwanda (Mountain View) Units #3 and #4 (a total of 620 MW of capacity) and its replacement by new thermal generation in the eastern portion of

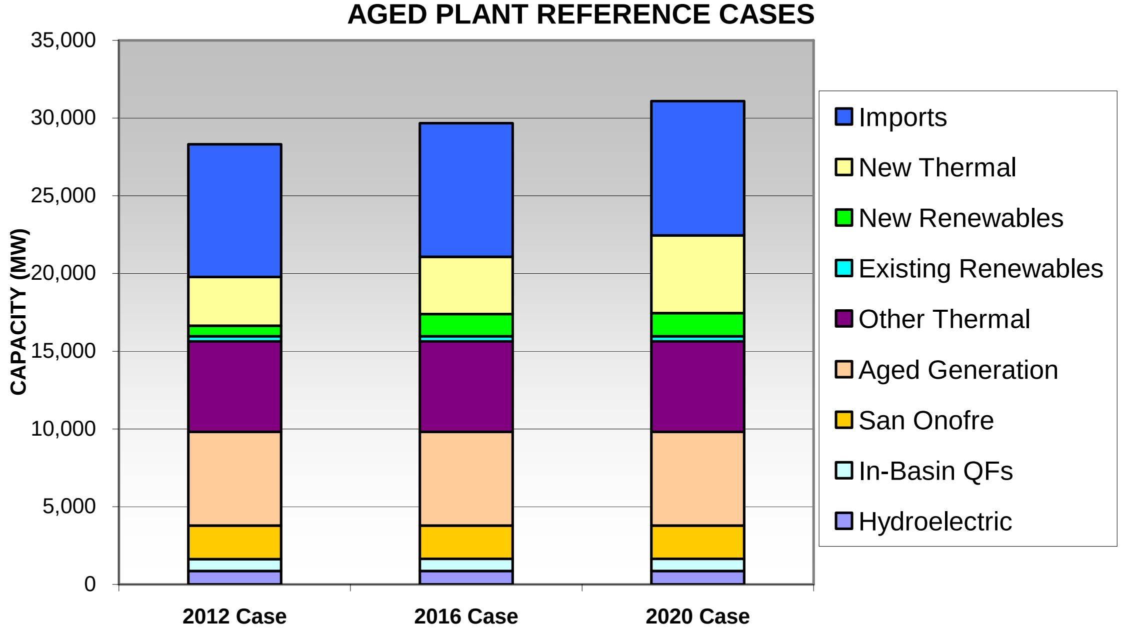
[10] As obtained from the SCE website

the LA Basin.

- The various planned transmission projects in Southern California as follows:
  - The Harquahala-Devers and Devers-Valley 500-kV lines,
  - The Tehachapi Renewable Transmission Project 500-kV lines,
  - The 500-kV SunPath Project between the Imperial Valley and the San Diego area
  - The 500-kV GreenPath Project between the Imperial Valley and the Los Angeles Department of Water and Power (LADWP) system in the Victorville area (this project was modeled in the 2016 and 2020 cases only)

Figure 1 depicts the Reference Case resource stacks for the SCE area for the three study years. Detailed information for these resource stacks is contained in Table A-3 in Appendix A of this report.

FIGURE 1
RESOURCE STACKS FOR SCE AREA
AGED PLANT REFERENCE CASES



ANALYSIS AND RESULTS

The approach used by NCI in this analysis consisted of identifying:

- The amounts of Aged Plant generation that could be retired in 2012 without causing adverse impacts on the transmission system,
- The system impacts due to load growth in 2016 and 2020 when the amounts of

retired Aged Plant generation were at the amounts identified in the 2012 case,

- Potential methods of mitigating overloads noted in the 2016 and 2020 cases, and
- The system impacts that would be expected to occur if all of the Aged Plant generation was retired by 2012.

Studies for 2012 Load Conditions

Retirements of LA Basin Coastal Generation

As noted above, the initial step in NCI's analysis consisted of identifying the amounts of LA Basin coastal Aged Plant generation that could potentially be retired without adversely impacting the existing transmission system. In doing so NCI developed a number of base cases (using the 2012 Reference Case as a starting point) in which varying amounts of aged generation was removed at Alamitos, Huntington Beach, Redondo Beach, and/or El Segundo and the retired capacity was replaced by queued thermal generation in the eastern portion of the SCE system. The replacement capacity in these studies was assumed to come from new generation located within the SCE system because the import paths into Southern California were operating near their limits in the Reference Case.

Once a given base case was developed numerous contingencies were simulated on the case to see if any overloads would occur. The contingencies simulated on the cases included:

- Category B (L-1) contingencies on all of the 230-kV and 500-kV lines in the SCE area,
- Credible Category C (L-2) contingencies involving 230-kV lines in the SCE area, and
- Overlapping (L-1/L-1) contingencies involving most of the 500-kV lines in the SCE area and approximately 40 of the most critical 230-kV lines in the LA Basin and Ventura County.

In addition, NCI also developed base cases with the San Onofre #3 unit off-line and simulated the L-1 and L-2 contingencies on these base cases. During this effort, numerous base cases with varying amounts of Aged Plant generation off-line were developed and subjected to the contingency analysis. As these studies were being performed and documented, NCI reviewed the results to gain insight into the maximum amounts of aged coastal generation that could potentially be retired without resulting in adverse impacts to the existing transmission system.

These studies indicated that 1,720 MW of Aged Plant generation at the LA Basin coastal plants (refer to Table 1) could be retired in 2012 without severely impacting the existing transmission system if:

- Approximately 0.5 miles of the Chino-Mira Loma #1 230-kV line is reconductored and the wave-traps on the Chino end of this line were upgraded or removed, and
- The required replacement capacity was developed in or delivered into the eastern portion of the SCE system. Information on the locations and amounts of this replacement capacity assumed in these studies is summarized in Table 2.

TABLE 1
LA BASIN COASTAL UNITS
EXISTING AND RETIRED CAPACITY

Aged Plant	Number of Units	Existing Capacity (MW)	Retired Capacity (MW)	Units Remaining On-Line	Remaining Capacity (MW)
Alamitos	6	1,930	980	#5 and #6[11]	950
Huntington Beach [12]	2	400	400	None	0
Redondo Beach	4	1,240	340	#7 and #8	900
El Segundo	2	660	0	#3 and #4	660
Totals	14	4,230	1,720	-----	2,510

Retirements of Ventura County Coastal Generation

Once the above studies were completed, additional studies were done to assess impacts on the system if the Ormond Beach and Mandalay plants were also retired. These studies indicated that, for 2012 load conditions, the Ventura County plants could be retired if:

- The Antelope-Pardee 230-kV line planned as part of the Tehachapi Renewable Transmission Project is in-service,
- The limiting elements in the Pardee-Moorpark #2 and #3 230-kV lines were upgraded, and
- An additional 1,840 MW of queued thermal generation was developed to replace the retired generation and to accommodate increased system losses. Information on the locations and amounts of this replacement capacity is summarized in Table 2.

[11] A similar amount of capacity could be provided if Units 1 through 4 were assumed to remain in-service

[12] Units 3 and 4 at Huntington Beach are not considered "aged" and were not considered for potential retirement

Additional, detailed information on the locations and sizes (MW) of the assumed capacity additions summarized in Table 2 is contained in Table A-4 in Appendix A.

TABLE 2
2012 STUDIES
CAPACITY RETIREMENTS AND ADDITIONS
(MW)

	Case		
	Reference	**2012-1**	**2012-2**
Capacity Retirements			
- In LA Basin	620	2,340	2,340
- In Ventura County	0	0	1,800
Total Retirements	620	2,340	4,140
Additions to Replace Retired Capacity			
- Eastern LA Basin Units	91	1,296	1,990
- Victorville/Vincent Area Units	570	1,140	1,140
- Southern Nevada Units	0	0	1,141
Total [13]	661	2,436	4,271
Add'l Capacity to Replace SONGS #3			
- Eastern LA Basin Units	1,110	1,104	505
- Western LA Basin Units	0	0	501
- Imports from Arizona	0	0	76
Total [13]	1,110	1,104	1,082
Total Capacity Requirements	1,771	2,879	5,353

In summary, these studies indicate that for 2012 peak load conditions 4,140 MW of Aged Plant generation in the SCE area could be retired without any adverse impacts on the system if:

- Approximately 0.5 miles of the Chino-Mira Loma #1 230-kV line is reconductored and the wave-traps at the Chino end of the line were upgraded or removed,
- The Antelope-Pardee 230-kV line is in service,
- The limiting elements on the Pardee-Moorpark #2 and #3 230-kV lines were upgraded,
- Approximately 4,270 MW of Aged Plant replacement capacity was developed within or was deliverable to the eastern portion of the SCE system, and
- Approximately 1,080 MW of SONGS #3 outage replacement capacity was developed in or was deliverable to the eastern portion of the SCE system.

[13] Capacity additions are higher than amounts retired or outaged due to increases in SCE area losses and in changes in the output of the SCE area swing machine.

Studies for 2016 and 2020 Load Conditions

Upon the completion of the above studies NCI developed base cases for 2016 and 2020 load conditions which modeled the Aged Plant retirements as described above. Table 3 presents information on the location and amounts of capacity required to accommodate load growth in the SCE area while Table 4 presents information on the location and amounts of Aged Plant replacement capacity assumed in the 2016 and 2020 studies. Additional, detailed information on the locations and sizes (MW) of the assumed capacity additions summarized in Tables 3 and 4 is contained in Tables A-5 and A-6 in Appendix A.

TABLE 3
RESOURCE ADDITIONS TO ACCOMMODATE LOAD GROWTH IN THE SCE AREA
(MW)

	Study Year		
	2012	**2016**	**2020**
Reference Case Load + Losses	27,350	28,696	30,117
Incremental Increase in Load + Losses	-----	1,346	1,421
Incremental Capacity Additions (MW)			
- Renewable Resources		773	56
- Eastern LA Basin Units		507	1,594
- Western LA Basin Units		0	(260) [14]
- Imports from Arizona		66	31
Total Incremental Additions		1,346	1,421

Once the 2016 and 2020 base cases summarized in Tables 3 and 4 were developed, the various types of outages discussed above (L-1, L-2, and L-1/L-1 both with and without SONGS 3 in-service) were simulated on the cases to identify potential overloads. Table 5 summarizes and compares information on the number of impacted lines, the magnitude of such impacts resulting from studies on the cases modeling 2012, 2016, and 2020 load conditions, and potential methods to mitigate overloads. Additional information on these study results is contained in Tables A-7 and A-8 in Appendix A.

[14] Due to assumed termination of purchase power agreement for Long Beach peakers

TABLE 4 2016 AND 2020 STUDIES CAPACITY RETIREMENTS AND ADDITIONS (MW)		
	Study Year	
	2016	**2020**
Capacity Retirements		
- In LA Basin	2,340	2,340
- In Ventura County	1,800	1,800
Total Retirements	4,140	4,140
Additions to Replace Retired Capacity		
- Eastern LA Basin Units	1,988	394
- Western LA Basin Units	0	501
- Victorville/Vincent Area Units	1,140	1,140
- Southern Nevada Units	1,141	1,141
- Imports from Arizona	0	1,099 [15]
Total [16]	4,269	4,275
Add'l Capacity to Replace SONGS #3		
- Western LA Basin Units	501	0
- Imports from Arizona	581	1,151 [15]
Total [16]	1,082	1,151
Total Capacity Requirements	5,351	5,426

The information presented in Table 5 shows that, as would be expected, load growth in the SCE area after 2012 would result in overloads on certain facilities if a total of 4,140 MW of Aged Plant capacity is retired as described above. In 2016 these negative impacts could be mitigated by:

- Reconductoring three 230-kV lines (with a combined length of 28 miles) in the LA Basin,
- Reconductoring the two Pisgah-Lugo lines (with a combined length of 130 miles)[17], and
- Utilizing the short-term emergency rating (rather than the long-term emergency rating) for one line in the LA Basin to determine post-contingency overloads during L-1/L-1 overlapping outage conditions,

[15] SCIT imports were in excess of 19,000 MW for these two cases

[16] Capacity additions are higher than amounts retired or outaged due to increases in SCE area losses and in changes in the output of the SCE area swing machine.

[17] These overloads are primarily due to the interconnection of 550 MW of solar generation with the Pisgah 230-kV bus by 2016

The overloads and low voltages noted in the 2020 case could be mitigated by:

- Converting the Antelope-Pardee line to 500-kV operation[18],
- Looping the Vincent-Santa Clara 230-kV line into Pardee and operating the resultant Vincent-Pardee line at 500-kV (this line was built for 500-kV operation),
- Installing approximately 500 MVAR of reactive support at various substations in the LA Basin and Ventura County,
- Upgrading the series capacitors in the Eldorado-Lugo 500-kV line, and
- Extending significant new transmission facilities (such as the LEAPS Project) into the Serrano/SONGS area.

TABLE 5
COMPARISON OF WORST CASE LOADINGS ON IMPACTED LINES
(%)

Impacted Facilities	Study Year			Potential Mitigation
	2012	2016	2020	
Mira Loma-Chino #1 230-kV line	113	141	149	Upgrade 0.5 miles of line and wave-traps by 2012; reconductor balance of line (7 miles) by 2016
La Fresa-Redondo Beach #1 and #2 230-kV lines	108	109	117	Remove wave-traps on line (part of SCE's latest 10-year plan)
Pardee-Moorpark #2 and #3 230-kV lines	105	110	121	Replace limiting elements on lines so that ratings match those of the Pardee-Moorpark #1 line
Barre-Ellis 230-kV line	103	110	120	Reconductor line (13 miles)
Mira Loma-Chino #3 230-kV line		108	112	Reconductor line (8 miles)
Pisgah-Lugo #1 and #2 230-kV lines		103	115	Reconductor lines (each 65 miles)
Serrano-Villa Park #1 and #2 230-kV lines		102	109	Utilize short-term emergency rating for L-1 + L-1 outages
Eldorado-Lugo 500-kV line			149	Upgrade series capacitors in line
Pardee-Sylmar #1 and #2 230-kV lines			110	Loop Vincent-Santa Clara 230-kV line into Pardee & operate Vincent-Pardee section at 500-kV (it is built for 500-kV operation)
Serrano-SONGS area system			Div.[19]	Major reinforcements into the area (such as the LEAPS Project)

[18] This would require the development of a 500-kV substation at Pardee

[19] Four L-2 outages with SONGS #3 off-line diverged due to low voltages when simulated on the 2020 case.

Both the 2016 and 2020 post-retirement cases would also require that:

- Approximately 4,270 MW of Aged Plant replacement capacity was developed in or was deliverable to the eastern portion of the SCE system, and
- Approximately 1,080 MW of SONGS #3 outage replacement capacity was developed in or was deliverable to the eastern portion of the SCE system.

Studies for 2012 Load Conditions With All Aged Plants Retired

Upon the completion of the above studies NCI developed base cases for the 2012 load conditions which modeled all 6,650 MW of Aged Plant generation as having been retired. Table 6 presents information on the location and amounts of Aged Plant replacement capacity assumed in this "maximum" retirements case. Additional, detailed information on the locations and sizes (MW) of the assumed capacity additions summarized in Table 6 is contained in Table A-9 in Appendix A.

TABLE 6
2012 MAXIMUM RETIREMENT STUDIES
CAPACITY RETIREMENTS AND ADDITIONS

	MW Retired	
	4,140	**6,650**
Capacity Retirements (MW)		
- In LA Basin	2,340	4,850
- In Ventura County	1,800	1,800
Total Retirements	4,140	6,650
Capacity Additions (MW)		
- Eastern LA Basin Units	1,990	2,495
- Western LA Basin Units	0	804
- Victorville/Vincent Area Units	1,140	1,140
- Southern Nevada Units	1,141	1,141
- Imports from Arizona	0	1,260 [20]
Subtotal [21]	4,271	6,840
Add'l Capacity to Replace SONGS #3		
- Eastern LA Basin Units	505	0
- Western LA Basin Units	501	0
- Imports from Arizona	76	1,140 [20]
Subtotal [21]	1,082	1,140
Total Capacity Additions	5,353	7,980

[20] SCIT imports in these two instances are over 19,000 MW

[21] Capacity additions are higher than amounts retired or outaged due to increases in SCE area losses and in changes in the output of the SCE area swing machine.

Once the 2012 "maximum" retirement base case summarized in Table 6 was developed, the various types of outages discussed above (L-1, L-2, and L-1/L-1 both with and without SONGS 3 in service) were simulated on it to identify the number and magnitude of overloads due to the increase in the amounts of generation assumed to have been retired. Table 7 summarizes and compares information on the number of impacted lines and the magnitude of such impacts as noted in these studies. Additional information on these study results is contained in Tables A-10 and A-11 in Appendix A.

TABLE 7
COMPARISON OF WORST CASE LOADINGS ON IMPACTED LINES
4,140 MW OF RETIREMENTS VS 6,650 MW OF RETIREMENTS
(%)

Impacted Lines	MW Retired		Potential Mitigation
	4,140	6,650	
Mira Loma-Chino #1 230-kV line	113	121	Upgrade 0.5 miles of line and wave-traps by 2012; reconductor entire line (7 miles) for maximum retirements case
La Fresa-Redondo Beach #1 and #2 230-kV lines	108		Remove wave-traps on line (part of SCE's latest 10-year plan)
Pardee-Moorpark #2 and #3 230-kV lines	105	105	Replace limiting elements on lines so that ratings match those of the Pardee-Moorpark #1 line
Barre-Ellis 230-kV line	103	111	Reconductor line (13 miles)
Mira Loma-Chino #3 230-kV line		106	Reconductor line (8 miles)
Serrano-Villa Park #1 and #2 230-kV lines		128	Reconductor lines (each 3 miles)
Lewis-Barre 230-kV line		125	Reconductor line (5 miles)
Barre-Villa Park 230-kV line		113	Reconductor line (9 miles)
Villa Park-Lewis 230-kV line		113	Reconductor line (4 miles)
La Cienega-La Fresa 230-kV line		121	Reconductor line (12 miles)
Mesa-Lighthipe 230-kV line		134	Reconductor line (12 miles)
Mesa-Redondo 230-kV line		116	Replace limiting elements in line
Serrano-Lewis #1 and #2 230-kV lines		112	Replace limiting elements in lines
Eldorado-Lugo 500-kV line		146	Upgrade series capacitors in line

The information presented in Table 7 shows that, as would be expected, retiring all of the Aged Plant generation in the SCE area by 2012 would result in a number of overloads on the SCE system. In addition, low voltage conditions would also occur at certain points on the system. These negative impacts could be mitigated by:

- Reconductoring eight 230-kV lines (with a combined length of 56 miles),
- Replacing limiting elements on three 230-kV lines in the LA Basin,
- Upgrading the series capacitors in the Eldorado-Lugo 500-kV line, and
- Installing approximately 500 MVAR of shunt capacitors at various 230-kV substations in the SCE area.

In addition to the above upgrades and modifications, it would be necessary that approximately 8,000 MW of replacement capacity be developed within or located such that it could be readily delivered into the LA Basin.

In all of the studies discussed above NCI assumed that the queued generation located in the eastern portion of the SCE area would be dispatched before the queued generation in the western portion of the SCE area to serve increased load and replace retired capacity. This was done so as to place the maximum stress on the transmission system in the LA Basin. It is likely that some of the mitigation measures discussed above would not be required if higher levels of western LA Basin generation were modeled in the studies.

APPENDIX A

DETAILED INFORMATION ON STUDY ASSUMPTIONS AND RESULTS

TABLE A-1
NEW RENEWABLE GENERATION MODELED IN SCE AREA AGED PLANT STUDIES
(Cumulative MW)

Trans Area	Unit Type	2012 Nameplate	2012 Dependable	2016 Nameplate	2016 Dependable	2020 Nameplate	2020 Dependable
CSP15	**Bio**	50	50	50	50	50	50
	Solar CSP	**350**	**305**	**825**	**718**	**825**	**718**
	- Pisgah	350	305	550	479	550	479
	- Mohave	0	0	170	148	170	148
	- Kramer	0	0	105	91	105	91
	Wind	**1,513**	**343**	**3,038**	**689**	**3,272**	**742**
	- Tehachapi	1,361	299	2,734	601	2,945	648
	- Devers	151	43	304	87	327	94
	Total	**1,913**	**697**	**3,913**	**1,456**	**4,147**	**1,509**
CSDGE	**NRen Bio**	**150**	**70**	**150**	**70**	**178**	**83**
	- Sampson	38	17.5	38	17.5	45	20.7
	- Sweetwater	38	17.5	38	17.5	45	20.7
	- Otay	38	17.5	38	17.5	45	20.7
	- Carlton Heights	38	17.5	38	17.5	45	20.7
	NRen Wind	**100**	**29**	**100**	**29**	**128**	**37**
	- Campo	100	29	100	29	128	37
	Total	**250**	**99**	**250**	**99**	**306**	**120**
Imperial Valley	**Solar CSP**	30	26	330	287	330	287
	Wind	0	0	125	27.5	125	27.5
	Total	**30**	**26**	**455**	**315**	**455**	**315**
IID	**Bio**	**60**	**60**	**70**	**70**	**70**	**70**
	- Coachella	30	30	35	35	35	35
	- El Centro	30	30	35	35	35	35
	Geothermal	**530**	**530**	**740**	**740**	**771**	**771**
	Subtotal	**590**	**590**	**810**	**810**	**841**	**841**
	Solar CSP	0	0	1	0	1	0
	Total	**590**	**590**	**811**	**810**	**842**	**841**
LADWP	**Bio (Valley)**	**25**	**25**	**35**	**35**	**35**	**35**
	Solar CSP (Victorville)	**35**	**30**	**35**	**30**	**35**	**30**
	Wind	**335**	**74**	**335**	**74**	**340**	**75**
	- Barren Ridge	120	26.4	120	26.4	120	26.4
	- Utah	215	47.3	215	47.3	220	48.4
	Total	**395**	**129**	**405**	**139**	**410**	**140**

TABLE A-2
NEW THERMAL GENERATION IS SCE AREA
MODELED IN NCI AGED PLANT STUDIES
(Interconnection Queue Position/AFC Status/PPA Status)

ISO/SCE Queue Data		Aged Plant Study Modeling		AFC-Related Information [1/]			PPA Signed
Queue Position	In-Service Date	Plant Name	Capacity (MW)	Docket #	Capacity (MW)	AFC Status	
ISO 17	6/1/08	Blythe CC	490	02-AFC-01	520	Approved	Yes, for 490 MW
ISO 50	5/31/08	Valley CC	810	01-AFC-17	800	Approved	
ISO 56	8/1/09	Eldorado CC	591				
ISO 80	3/31/09	Laguna Bell CC	610	06-AFC-4	943 [2/]	Data Adequate	
ISO 88	7/1/11	Hinson CC	614				
ISO 89	4/1/10	Victorville CC	570	07-AFC-1	550	Filed	
ISO 92	8/1/10	Palmdale CC	570		570	Filing in 5/07 anticipated	
ISO 118	1/8/09	Mohave CC	550				
ISO 139	6/1/10	Rancho Vista CC	698				
		Total CCs	***5,503***				
WDAT 2	1/1/08	Highgrove CTs	300	06-AFC-2	300	Application complete	
WDAT 12	9/1/07	Valley CTs	507	05-AFC-3	500	Data Adequate	
WDAT 30	7/2/07	Etiwanda CT	44.6				Emergency Peaker
WDAT 31	7/2/07	Mandalay CT	47.2				Emergency Peaker
WDAT 32		Mira Loma CT	45				Emergency Peaker
WDAT 33	7/2/07	Center CT	47.1				Emergency Peaker
WDAT 34	7/2/07	Barre CT	47.9				Emergency Peaker
ISO 3	5/1/08	Ocotillo CTs	728		800	Filing in 4/07 anticipated	Yes, for 455 MW
ISO 41	7/31/06	Pastoria CT	159	0F-AFC-1	159	Approved	
ISO 65	6/1/10	Long Beach CTs	425				Yes, for 260 MW
ISO 66	9/1/07	Walnut CTs	501	05-AFC-2	500	Data Adequate	
ISO 104	7/31/09	Laguna Bell CTs	304	[2/]		Data Adequate	
ISO 141	6/1/10	Rancho Vista CTs	504				
ISO 136	1/1/10	Etiwanda CTs	330				
		Total CTs	***3,990***				

[1/] Based on information on CEC website as of March 29, 2007

[2/] It appears that docket # 06-AFC-4 applies to both the Vernon CC and Vernon CTs modeled in NCI's Aged Plant studies

TABLE A-3
SCE AREA AGED PLANT RETIREMENT STUDY
ASSUMPTIONS - 2012 CASE 0 AND
2012 THRU 2020 REFERENCE CASES

	2012 Case 0	Reference Cases		
		2012 Case	2016 Case	2020 Case
Capacity Requirements (MW)				
Loads (1-in-10 from CEC Projection)	26,894	26,894	28,213	29,608
Losses	438	456	483	509
Total	27,332	27,350	28,696	30,117
Capacity Resources (MW)				
On-Line Aged Plants				
- LA Basin [1/]	4,850	4,230	4,230	4,230
- Ventura County	1,800	1,800	1,800	1,800
Subtotal	6,650	6,030	6,030	6,030
Other Existing Generation				
- SONGS	2,150	2,150	2,150	2,150
- Huntington Beach 3 & 4	420	420	420	420
- Mountain View Combined Cycle	950	950	950	950
- LA Basin QFs	776	776	776	776
- North of Lugo	2,410	2,410	2,410	2,410
- Devers-Mirage Area Peakers	136	136	136	136
- Anaheim & Pasadena	165	165	165	165
- Northwestern System	1,728	1,728	1,728	1,728
- Big Creek Hydro	881	858	859	860
Subtotal	9,616	9,593	9,594	9,595
Existing Renewables (Dependable)				
- Existing Tehachapi Wind [2/]	126	126	126	126
- Existing Devers Area Wind [3/]	201	201	201	201
Subtotal	327	327	327	327
Units with PPA's				
- NRG Peakers (Long Beach)	260	260	260	0
- CPV Peakers (Devers)	455	455	455	455
- Blythe Energy	490	490	490	490
Subtotal	1,205	1,205	1,205	945
New Renewables (Dependable)				
- Biomass	50	50	50	50
- New Tehachapi Wind [2/]	299	299	601	650
- New Devers Area Wind [3/]	29	29	87	94
- New Pisgah Solar [4/]	305	305	479	479
- New Mohave Solar [4/]	0	0	148	148
- New Kramer Solar [4/]	0	0	91	91
Subtotal	683	683	1,456	1,512

[1/] Etiwanda 3 & 4 (620 MW) assumed to have been retired in Reference Cases

[2/] Tehachapi area wind resources operating at 22% of installed capacity

[3/] Devers area wind resources operating at 28.7% of installed capacity

[4/] Solar resources operating at 87% of installed capacity

TABLE A-3
SCE AREA AGED PLANT RETIREMENT STUDY
ASSUMPTIONS - 2012 CASE 0 AND
2012 THRU 2020 REFERENCE CASES

	2012 Case 0	Reference Cases 2012 Case	2016 Case	2020 Case
Other New Resources				
- Emergency Peakers	232	232	232	232
- Pastoria Peaker	159	159	159	159
- CPV (Ocotillo) Peakers	91	182	182	273
- Valley Peakers	0	0	507	507
- Highgrove Peakers	0	0	0	300
- Rancho Vista Peakers	0	0	0	505
- Etiwanda Peakers	0	0	0	0
- Walnut Peakers	0	0	0	0
- Laguna Bell Peakers	0	0	0	0
Subtotal - Peakers	482	573	1,080	1,976
- Valley Combined Cycle	810	810	810	810
- Victorville Combined Cycle	0	570	570	570
- Rancho Vista Combined Cycle	0	0	0	698
- Palmdale Combined Cycle	0	0	0	0
- Mohave Combined Cycle	0	0	0	0
- Eldorado Combined Cycle	0	0	0	0
- Hinson Combined Cycle	0	0	0	0
- Laguna Bell Combined Cycle	0	0	0	0
Subtotal - Combined Cycle	810	1,380	1,380	2,078
Less Pump Loads	(975)	(975)	(975)	(975)
Total Generation	18,798	18,816	20,097	21,488
Plus, Imports	8,534	8,534	8,599	8,629
Total Resources	27,332	27,350	28,696	30,117
Other New Resources - MW by Location				
- Western SCE System	301	301	301	301
- Eastern SCE System	991	1,652	2,159	3,753
Total Other New Resources	1,292	1,953	2,460	4,054
- Change in Western System	-----	0	0	0
- Change in Eastern System	-----	661	1,168	2,762
Major Path Flows (MW)				
- Path 26 (N-to-S)	3,640	3,641	3,653	3,620
- IPP DC (N-to-S)	1,915	1,915	1,915	1,915
- West-of-River (E-to-W)	6,897	6,900	7,003	7,146
- PDCI (N-to-S)	2,734	2,736	2,737	2,736
- North-of-Lugo (N-to-S)	1,078	1,634	1,613	1,548
Total SCIT Imports	16,264	16,826	16,921	16,965
- South-of-Lugo (N-to-S)	3,723	4,139	4,341	4,015

TABLE A-3
SCE AREA AGED PLANT RETIREMENT STUDY
ASSUMPTIONS - 2012 CASE 0 AND
2012 THRU 2020 REFERENCE CASES

	2012	Reference Cases		
	Case 0	2012 Case	2016 Case	2020 Case
Key Assumptions for Other Areas [5/]				
SDG&E Area (MW)				
- Load + Losses	5,575	5,575	5,890	6,214
- New Renewables - Including IV Area	125	125	414	434
- Other Generation	2,720	2,720	2,747	2,980
- Imports	2,730	2,730	2,729	2,800
LADWP Area (MW)				
- Load + Losses	7,341	7,341	7,365	7,407
- New Renewables	128	128	138	139
- Other Generation	4,846	4,846	4,862	4,903
- Imports	2,367	2,367	2,365	2,365
IID Area (MW)				
- Load	989	989	1,062	1,112
- New Renewables	590	590	810	841
- Existing Geothermal	533	533	533	533
- Other Generation	613	613	675	684
- Exports	747	747	956	946
Arizona Exports (MW)	8,438	8,438	8,313	8,502

[5/] Dependable capacity shown for renewables

TABLE A-4
SCE AREA AGED PLANT RETIREMENT ASSESSMENT
2012 CASES - ASSUMPTIONS

	Case 0	Reference Case (620 MW Retired)		Case 2012-1 (2,340 MW Retired)		Case 2012-2 (4,140 MW Retired)	
		Base	SONGS G1	Base	SONGS G1	Base	SONGS G1
Capacity Requirements (MW)							
Loads	26,894	26,894	26,894	26,894	26,894	26,894	26,894
Losses	438	456	457	477	484	509	515
Total	27,332	27,350	27,351	27,371	27,378	27,403	27,409
Capacity Resources (MW)							
Aged Plants On-Line							
- LA Basin [1/]	4,850	4,230	4,230	2,510	2,510	2,510	2,510
- Ventura County	1,800	1,800	1,800	1,800	1,800	0	0
Subtotal	6,650	6,030	6,030	4,310	4,310	2,510	2,510
Other Existing Generation							
- SONGS	2,150	2,150	1,070	2,150	1,070	2,150	1,070
- Huntington Beach 3 & 4	420	420	420	420	420	420	420
- Mountain View Combined Cycle	950	950	950	950	950	950	950
- LA Basin QFs	776	776	776	776	776	776	776
- North of Lugo	2,410	2,410	2,410	2,410	2,410	2,410	2,410
- Devers-Mirage Area Peakers	136	136	136	136	136	136	136
- Anaheim & Pasadena	165	165	165	165	165	165	165
- Northwestern System	1,728	1,728	1,728	1,728	1,728	1,728	1,728
- Big Creek Hydro	881	858	829	824	803	821	825
Subtotal	9,616	9,593	8,484	9,559	8,458	9,556	8,480
Existing Renewables							
- Existing Tehachapi Wind [2/]	126	126	126	126	126	126	126
- Existing Devers Area Wind [3/]	201	201	201	201	201	201	201
Subtotal	327	327	327	327	327	327	327
Units with PPA's							
- NRG Peakers (Long Beach)	260	260	260	260	260	260	260
- CPV Peakers (Devers)	455	455	455	455	455	455	455
- Blythe Energy	490	490	490	490	490	490	490
Subtotal	1,205	1,205	1,205	1,205	1,205	1,205	1,205
New Renewables							
- Biomass	50	50	50	50	50	50	50
- New Tehachapi Wind [2/]	299	299	299	299	299	299	299
- New Devers Area Wind [3/]	29	29	29	29	29	29	29
- New Pisgah Solar [4/]	305	305	305	305	305	305	305
- New Mohave Solar [4/]	0	0	0	0	0	0	0
- New Kramer Solar [4/]	0	0	0	0	0	0	0
Subtotal	683	683	683	683	683	683	683

[1/] Etiwanda 3 & 4 assumed to have been retired in Reference Case and subsequent cases

[2/] Tehachapi area wind resources operating at 22% of installed capacity

[3/] Devers area wind resources operating at 28.7% of installed capacity

[4/] Solar resources operating at 87% of installed capacity

TABLE A-4
SCE AREA AGED PLANT RETIREMENT ASSESSMENT
2012 CASES - ASSUMPTIONS

	Case 0	Reference Case (620 MW Retired)		Case 2012-1 (2,340 MW Retired)		Case 2012-2 (4,140 MW Retired)	
		Base	SONGS G1	Base	SONGS G1	Base	SONGS G1
Other New Resources							
- Emergency Peakers	232	232	232	232	232	232	232
- Pastoria Peaker	159	159	159	159	159	159	159
- Ocotillo Peakers	91	182	182	182	182	273	273
- Valley Peakers	0	0	507	507	507	507	507
- Highgrove Peakers	0	0	300	0	300	300	300
- Etiwanda Peakers	0	0	303	0	303	303	303
- Rancho Vista Peakers	0	0	0	0	505	0	505
- Walnut Peakers	0	0	0	0	0	0	501
- Laguna Bell Peakers	0	0	0	0	0	0	0
Subtotal - Peakers	482	573	1,683	1,080	2,188	1,774	2,780
- Valley Combined Cycle	810	810	810	810	810	810	810
- Victorville Combined Cycle	0	570	570	570	570	570	570
- Rancho Vista Combined Cycle	0	0	0	698	698	698	698
- Palmdale Combined Cycle	0	0	0	570	570	570	570
- Mohave Combined Cycle	0	0	0	0	0	550	550
- Eldorado Combined Cycle	0	0	0	0	0	591	591
- Hinson Combined Cycle	0	0	0	0	0	0	0
- Laguna Bell Combined Cycle	0	0	0	0	0	0	0
Subtotal - Combined Cycle	810	1,380	1,380	2,648	2,648	3,789	3,789
Less Pump Loads	(975)	(975)	(975)	(975)	(975)	(975)	(975)
Total Generation	18,798	18,816	18,817	18,837	18,844	18,869	18,799
Plus, Imports	8,534	8,534	8,534	8,534	8,534	8,534	8,610
Total Resources	27,332	27,350	27,351	27,371	27,378	27,403	27,409
Other New Resources - MW by Location							
- Western SCE System	301	301	301	301	301	301	301
- Eastern SCE System	991	1,652	2,762	3,427	4,535	5,262	6,268
Total Other New Resources	1,292	1,953	3,063	3,728	4,836	5,563	6,569
- Change in Western System	-----	0	0	0	0	0	0
- Change in Eastern System	-----	661	1,771	2,436	3,544	4,271	5,277
Major Path Flows (MW)							
- Path 26 (N-to-S)	3,640	3,641	3,640	3,646	3,638	3,679	3,709
- IPP DC (N-to-S)	1,915	1,915	1,915	1,915	1,915	1,915	1,915
- West-of-River (E-to-W)	6,897	6,900	6,960	6,917	6,969	8,029	8,641
- PDCI (N-to-S)	2,734	2,736	2,737	2,735	2,736	2,736	2,734
- North-of-Lugo (N-to-S)	1,078	1,634	1,633	1,631	1,631	1,630	1,630
Total SCIT Imports	16,264	16,826	16,885	16,844	16,889	17,989	18,629
- South-of-Lugo (N-to-S)	3,723	4,139	4,094	4,130	4,058	4,019	4,160

TABLE A-5
SCE AREA AGED PLANT RETIREMENT ASSESSMENT
2016 CASES - ASSUMPTIONS

	Reference Case	Case "od2510" (3,520 MW Retired)	
	620 MW Ret.	Base	SONGS G1
Capacity Requirements (MW)			
Loads	28,213	28,213	28,213
Losses	483	552	583
Total	28,696	28,765	28,796
Capacity Resources (MW)			
Aged Plants On-Line			
- LA Basin [1/]	4,230	2,510	2,510
- Ventura County	1,800	0	0
Subtotal	6,030	2,510	2,510
Other Existing Generation			
- SONGS	2,150	2,150	1,070
- Huntington Beach 3 & 4	420	420	420
- Mountain View Combined Cycle	950	950	950
- LA Basin QFs	776	776	776
- North of Lugo	2,410	2,410	2,410
- Devers-Mirage Area Peakers	136	136	136
- Anaheim & Pasadena	165	165	165
- Northwestern System	1,728	1,728	1,728
- Big Creek Hydro	859	842	870
Subtotal	9,594	9,577	8,525
Existing Renewables			
- Existing Tehachapi Wind [2/]	126	126	126
- Existing Devers Area Wind [3/]	201	201	201
Subtotal	327	327	327
Units with PPA's			
- NRG Peakers (Long Beach)	260	260	260
- CPV Peakers (Devers)	455	455	455
- Blythe Energy	490	490	490
Subtotal	1,205	1,205	1,205
New Renewables			
- Biomass	50	50	50
- New Tehachapi Wind [2/]	601	601	601
- New Devers Area Wind [3/]	87	87	87
- New Pisgah Solar [4/]	479	479	479
- New Mohave Solar [4/]	148	148	148
- New Kramer Solar [4/]	91	91	91
Subtotal	1,456	1,456	1,456

[1/] Etiwanda 3 & 4 assumed to have been retired
[2/] Tehachapi area wind resources operating at 22% of installed capacity
[3/] Devers area wind resources operating at 28.7% of installed capacity
[4/] Solar resources operating at 87% of installed capacity

TABLE A-5
SCE AREA AGED PLANT RETIREMENT ASSESSMENT
2016 CASES - ASSUMPTIONS

	Reference Case	Case "od2510" (3,520 MW Retired)	
	620 MW Ret.	Base	SONGS G1
Other New Resources			
- Emergency Peakers	232	232	232
- Pastoria Peaker	159	159	159
- Ocotillo Peakers	182	273	273
- Valley Peakers	507	507	507
- Highgrove Peakers	0	300	300
- Rancho Vista Peakers	0	505	505
- Etiwanda Peakers	0	303	303
- Walnut Peakers	0	0	501
- Laguna Bell Peakers	0	0	0
Subtotal - Peakers	1,080	2,279	2,780
- Valley Combined Cycle	810	810	810
- Victorville Combined Cycle	570	570	570
- Rancho Vista Combined Cycle	0	698	698
- Palmdale Combined Cycle	0	570	570
- Mohave Combined Cycle	0	550	550
- Eldorado Combined Cycle	0	591	591
- Hinson Combined Cycle	0	0	0
- Laguna Bell Combined Cycle	0	0	0
Subtotal - Combined Cycle	1,380	3,789	3,789
Less Pump Loads	(975)	(975)	(975)
Total Generation	20,097	20,168	19,617
Plus, Imports	8,599	8,598	9,179
Total Resources	28,696	28,766	28,796
Other New Resources - MW by Location			
- Western SCE System	301	301	802
- Eastern SCE System	2,159	5,767	5,767
Total Other New Resources	2,460	6,068	6,569
- Change in Western System	-----	0	501
- Change in Eastern System	-----	3,608	3,608
Major Path Flows (MW)			
- Path 26 (N-to-S)	3,653	3,681	3,705
- IPP DC (N-to-S)	1,915	1,915	1,915
- West-of-River (E-to-W)	7,003	8,152	8,791
- PDCI (N-to-S)	2,737	2,732	2,729
- North-of-Lugo (N-to-S)	1,613	1,610	1,611
Total SCIT Imports	16,921	18,090	18,751
- South-of-Lugo (N-to-S)	4,341	4,158	4,320

TABLE A-6
SCE AREA AGED PLANT RETIREMENT ASSESSMENT
2020 CASES - ASSUMPTIONS

	Reference Case	Case "od2510" (3,520 MW Retired)	
	620 MW Ret.	Base	SONGS G1
Capacity Requirements (MW)			
Loads	29,608	29,608	29,608
Losses	509	619	678
Total	30,117	30,227	30,286
Capacity Resources (MW)			
Aged Plants On-Line			
- LA Basin [1/]	4,230	2,510	2,510
- Ventura County	1,800	0	0
Subtotal	6,030	2,510	2,510
Other Existing Generation			
- SONGS	2,150	2,150	1,070
- Huntington Beach 3 & 4	420	420	420
- Mountain View Combined Cycle	950	950	950
- LA Basin QFs	776	776	776
- North of Lugo	2,410	2,410	2,410
- Devers-Mirage Area Peakers	136	136	136
- Anaheim & Pasadena	165	165	165
- Northwestern System	1,728	1,728	1,728
- Big Creek Hydro	860	876	864
Subtotal	9,595	9,611	8,519
Existing Renewables			
- Existing Tehachapi Wind [2/]	126	126	126
- Existing Devers Area Wind [3/]	201	201	201
Subtotal	327	327	327
Units with PPA's			
- NRG Peakers (Long Beach)	0	0	0
- CPV Peakers (Devers)	455	455	455
- Blythe Energy	490	490	490
Subtotal	945	945	945
New Renewables			
- Biomass	50	50	50
- New Tehachapi Wind [2/]	650	650	650
- New Devers Area Wind [3/]	94	94	94
- New Pisgah Solar [4/]	479	479	479
- New Mohave Solar [4/]	148	148	148
- New Kramer Solar [4/]	91	91	91
Subtotal	1,512	1,512	1,512

[1/] Etiwanda 3 & 4 assumed to have been retired

[2/] Tehachapi area wind resources operating at 22% of installed capacity

[3/] Devers area wind resources operating at 28.7% of installed capacity

[4/] Solar resources operating at 87% of installed capacity

TABLE A-6
SCE AREA AGED PLANT RETIREMENT ASSESSMENT
2020 CASES - ASSUMPTIONS

	Reference Case	Case "od2510" (3,520 MW Retired)	
	620 MW Ret.	Base	SONGS G1
Other New Resources			
- Emergency Peakers	232	232	232
- Pastoria Peaker	159	159	159
- Ocotillo Peakers	273	273	273
- Valley Peakers	507	507	507
- Highgrove Peakers	300	300	300
- Rancho Vista Peakers	505	505	505
- Etiwanda Peakers	0	303	303
- Walnut Peakers	0	501	501
- Laguna Bell Peakers	0	0	0
Subtotal - Peakers	1,976	2,780	2,780
- Valley Combined Cycle	810	810	810
- Victorville Combined Cycle	570	570	570
- Rancho Vista Combined Cycle	698	698	698
- Palmdale Combined Cycle	0	570	570
- Mohave Combined Cycle	0	550	550
- Eldorado Combined Cycle	0	591	591
- Hinson Combined Cycle	0	0	0
- Laguna Bell Combined Cycle	0	0	0
Subtotal - Combined Cycle	2,078	3,789	3,789
Less Pump Loads	(975)	(975)	(975)
Total Generation	21,488	20,499	19,407
Plus, Imports	8,629	9,728	10,879
Total Resources	30,117	30,227	30,286
Other New Resources - MW by Location			
- Western SCE System	301	802	802
- Eastern SCE System	3,753	5,767	5,767
Total Other New Resources	4,054	6,569	6,569
- Change in Western System	-----	501	501
- Change in Eastern System	-----	2,014	2,014
Major Path Flows (MW)			
- Path 26 (N-to-S)	3,620	3,711	3,759
- IPP DC (N-to-S)	1,915	1,915	1,915
- West-of-River (E-to-W)	7,147	9,340	10,521
- PDCI (N-to-S)	2,736	2,737	2,736
- North-of-Lugo (N-to-S)	1,548	1,547	1,549
Total SCIT Imports	16,966	19,250	20,480
- South-of-Lugo (N-to-S)	4,015	4,368	4,692

TABLE A-7
SCE AREA AGED PLANT RETIREMENT STUDIES
COMPARISON OF OVERLOADS FOR THREE STUDY YEARS
WITH 4,140 MW OF RETIREMENTS

	Study Year		**2012**	**2016**	**2020**
	SCE Area Load (MW)		26,894	28,213	29,608
	Change in SCE Load (MW)		-----	1,319	2,714
Critical Outage(s)	**Impacted Line**	**Rating (Amps) [1/]**	**Loading (%) on Impacted Facility**		
Category A					
None	Eldorado-Lugo 500-kV line	1,600 [2/]			107
None	Mira Loma-Chino #3 230-kV line	2,480			102
Category B Contingencies					
Mohave-Lugo 500-kV line	Eldorado-Lugo 500-kV line	1,600 [2/]	103	102	117
Category B With SONGS 3 Off-Line					
Mohave-Lugo 500-kV line	Eldorado-Lugo 500-kV line	1,600 [2/]	108	106	132
Vista-Jurupa 230-kV line	Mira Loma-Chino #3 230-kV line	2,849		100	103
Harquahala-Devers 500-kV line	Devers-Midpoint 500-kV line	2,700 [3/]			110
One La Fresa-Redondo 230-kV line	Other La Fresa-Redondo 230-kV line	2,400			103
Category C (L-2) Contingencies					
Mira Loma-Chino #2 & #3 230-kV lines	Mira Loma-Chino #1 230-kV line	2,141		114	125
Pardee-Moorpark #1 & Pardee-Moorpark #2 or #3 230-kV lines	Pardee-Moorpark #2 or #3 230-kV line	2,568		101	113
San Onofre-Santiago #1 & #2 230-kV line	Barre-Ellis 230-kV line	3,211			106
Category C (L-2) With SONGS 3 Off-Line					
Mira Loma-Chino #2 & #3 230-kV lines	Mira Loma-Chino #1 230-kV line	2,141	113	141	149
Mira Loma-Chino #1 & #2 230-kV lines	Mira Loma-Chino #3 230-kV line	3,211		108	112
Eldorado-Lugo 500-kV line	Pisgah-Lugo #1 & #2 230-kV lines	725		103	115
Pardee-Moorpark #1 & Pardee-Moorpark #2 or #3 230-kV lines	Pardee-Moorpark #2 or #3 230-kV line	2,568		102	110
San Onofre-Santiago #1 & #2 230-kV line	Barre-Ellis 230-kV line	3,211			103
Ellis-Santiago & Johanna-Santiago 230-kV lines					These outages diverged for this case [4/]
Chino-Viejo & San Onofre-Serrano 230-kV lines					
Devers-Valley #1 and #2 500-kV lines					
Barre-Ellis & Ellis-Johanna 230-kV lines					

TABLE A-7
SCE AREA AGED PLANT RETIREMENT STUDIES
COMPARISON OF OVERLOADS FOR THREE STUDY YEARS
WITH 4,140 MW OF RETIREMENTS

Critical Outage(s)	Impacted Line	Rating (Amps) [1/]	2012	2016	2020
	Study Year		2012	2016	2020
	SCE Area Load (MW)		26,894	28,213	29,608
	Change in SCE Load (MW)		-----	1,319	2,714
			Loading (%) on Impacted Facility		
Category C (L-1 + L-1) Contingencies					
Lugo-Victorville + Lugo-Mohave 500-kV lines	Eldorado-Lugo 500-kV line	1,600 [2/]	126	125	149
Laguna Bell-Rio Hondo + La Fresa-Redondo #1 230-kV	La Fresa-Redondo #2 230-kV	2,400	108	109	117
Laguna Bell-Rio Hondo + La Fresa-Redondo #2 230-kV	La Fresa-Redondo #1 230-kV	2,400	108	109	117
Pardee-Moorpark #1 + Pardee-Moorpark #2 230-kV lines	Pardee-Moorpark #3 230-kV line	2,400	105	110	121
	Pardee-Santa Clara 230-kV line	1,323			101
Pardee-Moorpark #1 + Pardee-Moorpark #3 230-kV lines	Pardee-Moorpark #2 230-kV line	2,400	105	110	121
	Pardee-Santa Clara 230-kV line	1,323			101
SONGS-Santiago #1 + SONGS-Santiago #2 230-kV lines	Barre-Ellis 230-kV line	2,850	103	110	120
Serrano-Villa Park #1 + Lewis-Serrano #1 230-kV lines	Serrano-Villa Park #2 230-kV line	3,450	101	102	109
Serrano-Villa Park #2 + Lewis-Serrano #1 230-kV lines	Serrano-Villa Park #1 230-kV line	3,450	101	102	109
Mira Loma-Chino #2 + Mira Loma-Chino #3 230-kV lines	Mira Loma-Chino #1 230-kV line	2,000		123	133
Olinda-Mira Loma + Jurupa-Vista 230-kV lines	Mira Loma-Chino #3 230-kV line	2,849		106	105
Jurupa-Vista + Olinda-Mira Loma 230-kV lines	Mira Loma-Chino #3 230-kV line	2,849		106	105
Antelope-Pardee 500-kV line + Pardee-Sylmar #1 230-kV line	Pardee-Sylmar #2 230-kV line	3,000			110
Antelope-Pardee 500-kV line + Pardee-Sylmar #2 230-kV line	Pardee-Sylmar #1 230-kV line	3,000			110
Lugo-Victorville 500-kV line + Pisgah-Lugo #1 230-kV line	Pisgah-Lugo #2 230-kV line	725			102
Lugo-Victorville 500-kV line + Pisgah-Lugo #2 230-kV line	Pisgah-Lugo #1 230-kV line	725			102

1/ SCE ratings used as follows: "N" for N-0, "A" for L-1 and L-1+L-1, and "B" for L-2

2/ Normal rating for series capacitors in the line; emergency rating for the series capacitors is 2,400 amps

3/ Normal rating for series capacitors in the line; emergency rating for the series capacitors is 3,450 amps

4/ Impacts of outage could be mitigated by adding transmission facilities (such as the LEAPS Tie)

TABLE A-8
SCE AREA AGED PLANT RETIREMENT STUDIES
SUMMARY OF POTENTIAL OVERLOAD MITIGATION MEASURES
WITH 4,140 MW OF RETIREMENTS

			Study Year	2012	2016	2020	
Impacted Line	**Length (Miles)**	**Rating [1] (Amps)**	**Critical Conditions Resulting in Overloads**	**Loading (%) on Impacted Line**			**Potential Mitigation Measures**
Mira Loma-Chino #1 230-kV	7	2,141	Category C		114	125	Replace limiting elements on line by 2012 [2]; reconductor balance of line by 2016
		2,141	Cat. C w/ SONGS 3 Out	113	141	149	
		2,000	Category C (L1+L1)		123	133	
La Fresa-Redondo #1 & #2 230-kV	5	2,400	Cat. B w/ SONGS 3 Out			103	Replace limiting element(s) on lines by 2012 [3]
			Category C (L1+L1)	108	109	117	
Pardee-Moorpark #2 and #3 230-kV	26	2,568	Category C		102	113	Replace limiting element(s) on lines by 2012 [4]
		2,568	Cat. C w/ SONGS 3 Out		101	110	
		2,400	Category C (L1+L1)	105	110	121	
Barre-Ellis 230-kV	13	3,211	Category C			106	Reconductor line by 2016
		3,211	Cat. C w/ SONGS 3 Out			103	
		2,850	Category C (L1+L1)	103	110	120	
Mira Loma-Chino #3 230-kV	8	2,480	Category A			102	Reconductor line by 2016
		2,849	Cat. B w/ SONGS 3 Out		100	103	
		3,211	Cat. C w/ SONGS 3 Out		108	112	
		2,849	Category C (L1+L1)		106	105	
Pisgah-Lugo #1 & #2 230-kV	65	725	Cat. C w/ SONGS 3 Out		103	115	Reconductor lines by 2016
		725	Category C (L1+L1)			102	
Eldorado-Lugo 500-kV	-----	1,600 [5]	Category A			107	Upgrade series capacitors in the line by 2020; application of emergency rating in prior years would mitigate overloads
			Category B	103	102	117	
			Cat. B w/ SONGS 3 Out	108	106	132	
			Category C (L1+L1)	126	125	149	
Serrano-Villa Park #1 & #2 230-kV	3	3,450	Category C (L1+L1)	101	102	109	[6]
Pardee-Sylmar #1 & #2 230-kV		3,000	Category C (L1+L1)			110	Loop Vincent-Santa Clara 230-kV line into Pardee & operate Vincent-Pardee section at 500-kV (it is built for 500-kV operation)

TABLE A-8
SCE AREA AGED PLANT RETIREMENT STUDIES
SUMMARY OF POTENTIAL OVERLOAD MITIGATION MEASURES
WITH 4,140 MW OF RETIREMENTS

1/ SCE N, A, & B ratings applied as follows: "N" for N-0, "A" for L-1 and L-1+L-1; and "B" for L-2

2/ Limiting components are 0.5-mile long line segment and wave trap at Chino (per latest SCE 10-year transmission plan)

3/ SCE plans to remove the wave traps on this line (per latest SCE 10-year transmission plan); the normal rating for the conductors on these lines is 3,320 amps

4/ "A" and "B" ratings for the Pardee-Moorpark #1 line are 3,000 amps and 3,211 amps; respectively. All three Pardee-Moorpark 230-kV lines utilize the same conductor (based on information submitted to the CEC by SCE in 1993)

5/ Normal rating for series capacitors in the line; emergency rating for the series capacitors is 2,400 amps

6/ L-2 studies with SONGS #3 off-line for 2020 indicate that transmission reinforcements are needed into the Serrano/Santiago area by 2020

TABLE A-9
SCE AREA AGED PLANT RETIREMENT ASSESSMENT
2012 MAXIMUM RETIREMENT CASE - ASSUMPTIONS

	Case 0	Case 2012-2 (4,140 MW Retired)		Case 2012-3 (6,650 MW Retired)	
		Base	SONGS G1	Base	SONGS G1
Capacity Requirements (MW)					
Loads	26,894	26,894	26,894	26,894	26,894
Losses	438	509	515	609	669
Total	27,332	27,403	27,409	27,503	27,563
Capacity Resources (MW)					
Aged Plants On-Line					
- LA Basin [1/]	4,850	2,510	2,510	0	0
- Ventura County	1,800	0	0	0	0
Subtotal	6,650	2,510	2,510	0	0
Other Existing Generation					
- SONGS	2,150	2,150	1,070	2,150	1,070
- Huntington Beach 3 & 4	420	420	420	420	420
- Mountain View Combined Cycle	950	950	950	950	950
- LA Basin QFs	776	776	776	776	776
- North of Lugo	2,410	2,410	2,410	2,410	2,410
- Devers-Mirage Area Peakers	136	136	136	136	136
- Anaheim & Pasadena	165	165	165	165	165
- Northwestern System	1,728	1,728	1,728	1,728	1,728
- Big Creek Hydro	881	821	825	862	862
Subtotal	9,616	9,556	8,480	9,597	8,517
Existing Renewables					
- Existing Tehachapi Wind [2/]	126	126	126	126	126
- Existing Devers Area Wind [3/]	201	201	201	201	201
Subtotal	327	327	327	327	327
Units with PPA's					
- NRG Peakers (Long Beach)	260	260	260	260	260
- CPV Peakers (Devers)	455	455	455	455	455
- Blythe Energy	490	490	490	490	490
Subtotal	1,205	1,205	1,205	1,205	1,205
New Renewables					
- Biomass	50	50	50	50	50
- New Tehachapi Wind [2/]	299	299	299	299	299
- New Devers Area Wind [3/]	29	29	29	29	29
- New Pisgah Solar [4/]	305	305	305	305	305
- New Mohave Solar [4/]	0	0	0	0	0
- New Kramer Solar [4/]	0	0	0	0	0
Subtotal	683	683	683	683	683

[1/] Etiwanda 3 & 4 assumed to have been retired in Reference Case and subsequent cases

[2/] Tehachapi area wind resources operating at 22% of installed capacity

[3/] Devers area wind resources operating at 28.7% of installed capacity

[4/] Solar resources operating at 87% of installed capacity

TABLE A-9
SCE AREA AGED PLANT RETIREMENT ASSESSMENT
2012 MAXIMUM RETIREMENT CASE - ASSUMPTIONS

	Case 0	Case 2012-2 (4,140 MW Retired)		Case 2012-3 (6,650 MW Retired)	
		Base	SONGS G1	Base	SONGS G1
Other New Resources					
- Emergency Peakers	232	232	232	232	232
- Pastoria Peaker	159	159	159	159	159
- Ocotillo Peakers	91	273	273	273	273
- Valley Peakers	0	507	507	507	507
- Highgrove Peakers	0	300	300	300	300
- Etiwanda Peakers	0	303	303	303	303
- Rancho Vista Peakers	0	0	505	505	505
- Walnut Peakers	0	0	501	501	501
- Laguna Bell Peakers	0	0	0	303	303
Subtotal - Peakers	482	1,774	2,780	3,083	3,083
- Valley Combined Cycle	810	810	810	810	810
- Victorville Combined Cycle	0	570	570	570	570
- Rancho Vista Combined Cycle	0	698	698	698	698
- Palmdale Combined Cycle	0	570	570	570	570
- Mohave Combined Cycle	0	550	550	550	550
- Eldorado Combined Cycle	0	591	591	591	591
- Hinson Combined Cycle	0	0	0	0	0
- Laguna Bell Combined Cycle	0	0	0	0	0
Subtotal - Combined Cycle	810	3,789	3,789	3,789	3,789
Less Pump Loads	(975)	(975)	(975)	(975)	(975)
Total Generation	18,798	18,869	18,799	17,709	16,629
Plus, Imports	8,534	8,534	8,610	9,794	10,934
Total Resources	27,332	27,403	27,409	27,503	27,563
Major Path Flows (MW)					
- Path 26 (N-to-S)	3,640	3,679	3,709	3,759	3,811
- IPP DC (N-to-S)	1,915	1,915	1,915	1,915	1,915
- West-of-River (E-to-W)	6,897	8,029	8,641	9,253	10,408
- PDCI (N-to-S)	2,734	2,736	2,734	2,734	2,734
- North-of-Lugo (N-to-S)	1,078	1,630	1,630	1,633	1,634
Total SCIT Imports	16,264	17,989	18,629	19,294	20,502
- South-of-Lugo (N-to-S)	3,723	4,019	4,160	4,151	4,437

TABLE A-10
SCE AREA AGED PLANT RETIREMENT STUDIES
SUMMARY OF RESULTS - 2012 MAXIMUM RETIREMENTS

Critical Outage	Impacted Line	Rating (Amps) [1/]	Retirements (MW) 4,140	Retirements (MW) 6,650
			Loading (%) on Impacted Line	
Category B Contingencies				
Lugo-Victorville 500-kV line	Eldorado-Lugo 500-kV	1,600 [2/]	103	119
Serrano-Villa Park #1 230-kV line	Serrano-Villa Park #2 230-kV	3,450		104
Barre-Villa Park 230-kV line	Lewis-Barre 230-kV	3,000		116
Mesa-Redondo 230-kV line	Mesa-Lighthipe 230-kV	2,400		114
Serrano-Villa Park #2 230-kV line	Serrano-Villa Park #1 230-kV	3,450		105
Barre-Lewis 230-kV line	Villa Park-Barre 230-kV	3,000		105
Category B With SONGS 3 Off-lIne				
Lugo-Victorville 500-kV line	Eldorado-Lugo 500-kV	1,600 [2/]	108	133
Serrano-Villa Park #1 230-kV line	Serrano-Villa Park #2 230-kV	3,450		110
Barre-Villa Park 230-kV line	Lewis-Barre 230-kV	3,000		125
Mesa-Redondo 230-kV line	Mesa-Lighthipe 230-kV	2,400		120
Serrano-Villa Park #2 230-kV line	Serrano-Villa Park #1 230-kV	3,450		110
Jurupa-Vista 230-kV line	Mira Loma-Chino #3 230-kV	2,850		101
Barre-Lewis 230-kV line	Villa Park-Barre 230-kV	3,000		113
Harquahala-Devers 500-kV line	Devers-Midpoint 500-kV	2,700 [3/]		110
Mesa-Lighthipe 230-kV	Mesa-Redondo 230-kV line	2,001		101
Category C (L-2) Contingencies				
Laguna Bell-Rio Hondo & Mesa-Redondo 230-kV lines	Mesa-Lighthipe 230-kV	2,568		127
El Nido-La Fresa #3 & #4 230-kV lines	La Cienega-La Fresa 230-kV	2,031		120
Laguna Bell-La Fresa & Mesa-Lighthipe 230-kV lines	Mesa-Redondo 230-kV	2,141		111
One Lewis-Serrano & Serrano-Villa Park #2 230-kV lines	Serrano-Villa Park #1 230-kV	4,000		110
One Lewis-Serrano & Serrano-Villa Park #1 230-kV lines	Serrano-Villa Park #2 230-kV	4,000		110
Lewis-Serrano #1 & #2 230-kV lines	Villa Park-Lewis 230-kV	2,568		107
Serrano-Villa Park #1 & #2 230-kV lines	Serrano-Lewis #1 and #2 230-kV	3,000		107
La Fresa-Redondo #1 & #2 230-kV lines	Hinson-La Fresa 230-kV	2,141		101
Category C (L-2) With SONGS 3 Off-Line				
Laguna Bell-Rio Hondo & Mesa-Redondo 230-kV lines	Mesa-Lighthipe 230-kV	2,568		134
El Nido-La Fresa #3 & #4 230-kV lines	La Cienega-La Fresa 230-kV	2,031		121
Mira Loma-Chino #2 & #3 230-kV lines	Mira Loma-Chino #1 230-kV line	2,141		121
Laguna Bell-La Fresa & Mesa-Lighthipe 230-kV lines	Mesa-Redondo 230-kV	2,141		116
One Lewis-Serrano & Serrano-Villa Park #2 230-kV lines	Serrano-Villa Park #1 230-kV	4,000		115
One Lewis-Serrano & Serrano-Villa Park #1230-kV lines	Serrano-Villa Park #2 230-kV	4,000		115
Lewis-Serrano #1 & #2 230-kV lines	Villa Park-Lewis 230-kV	2,568		113
Serrano-Villa Park #1 & #2 230-kV lines	Serrano-Lewis #1 and #2 230-kV	3,000		112
Category C (L-1 + L1)				
Lugo-Victorville + Lugo-Mohave 500-kV lines	Eldorado-Lugo 500-kV line	1,600 [2/]	126	146
Laguna Bell-Rio Hondo + La Fresa-Redondo #1 230-kV	La Fresa-Redondo #2 230-kV	2,400	108	
	Mesa-Lighthipe 230-kV	2,400		106

TABLE A-10
SCE AREA AGED PLANT RETIREMENT STUDIES
SUMMARY OF RESULTS - 2012 MAXIMUM RETIREMENTS

			Retirements (MW)	
			4,140	6,650
Critical Outage	**Impacted Line**	**Rating (Amps) [1/]**	**Loading (%) on Impacted Line**	
Category C (L-1 + L1)				
Laguna Bell-Rio Hondo + La Fresa-Redondo #2 230-kV	La Fresa-Redondo #1 230-kV	2,400	108	
	Mesa-Lighthipe 230-kV	2,400		106
Pardee-Moorpark #1 + Pardee-Moorpark #2 230-kV lines	Pardee-Moorpark #3 230-kV line	2,400	105	105
	Pardee-Santa Clara 230-kV line	1,323		
Pardee-Moorpark #1 + Pardee-Moorpark #3 230-kV lines	Pardee-Moorpark #2 230-kV line	2,400	105	105
	Pardee-Santa Clara 230-kV line	1,323		
SONGS-Santiago #1 + SONGS-Santiago #2 230-kV lines	Barre-Ellis 230-kV line	2,850	103	111
	Barre-Lewis 230-kV line	3,000		113
Serrano-Villa Park #1 + Lewis-Serrano #1 230-kV lines	Serrano-Villa Park #2 230-kV line	3,450	101	128
Serrano-Villa Park #2 + Lewis-Serrano #1 230-kV lines	Serrano-Villa Park #1 230-kV line	3,450	101	128
Mira Loma-Chino #2 + Mira Loma-Chino #3 230-kV lines	Mira Loma-Chino #1 230-kV line	2,000		105
Olinda-Mira Loma + Jurupa-Vista 230-kV lines	Mira Loma-Chino #3 230-kV line	2,849		106
Jurupa-Vista + Olinda-Mira Loma 230-kV lines	Mira Loma-Chino #3 230-kV line	2,849		106

[1/] SCE ratings used as follows: "N" for N-0, "A" for L-1 and L-1+L-1, and "B" for L-2

[2/] Normal rating for series capacitors in the line; emergency rating for the series capacitors is 2,400 amps

[3/] Normal rating for series capacitors in the line; emergency rating for the series capacitors is 3,450 amps

TABLE A-11
SCE AREA AGED PLANT RETIREMENT STUDIES
SUMMARY OF POTENTIAL OVERLOAD MITIGATION MEASURES
2012 WITH 4,140 MW AND 6,650 MW OF RETIREMENTS

Impacted Line	Length (Miles)	Rating [1/] (Amps)	MW Retired / Critical Conditions Resulting in Overloads	4,140 Loading (%) on Impacted Line	6,650 Loading (%) on Impacted Line	Potential Mitigation Measures
Mira Loma-Chino #1 230-kV	7	2,141	Cat. C w/ SONGS 3 Out	113	121	Replace limiting element(s) on line [2/] for 4,140 MW level of retirements; reconductor entire line for 6,650 MW retirement level
		2,000	Category C (L1+L1)		105	
La Fresa-Redondo #1 & #2 230-kV	5	2,400	Category C (L1+L1)	108		Replace limiting element(s) on lines [3/]
Pardee-Moorpark #2 and #3 500-kV	26	2,400	Category C (L1+L1)	105	105	Replace limiting element(s) on lines [4/]
Barre-Ellis 230-kV	13	2,850	Category C (L1+L1)	103	111	Reconductor line by 2012 for max retirements case
Mira Loma-Chino #3 230-kV	8	2,849	Cat. B w/ SONGS 3 Out		101	Reconductor line by 2012 for max retirements case
		2,849	Category C (L1+L1)		106	
Eldorado-Lugo 500-kV	-----	1,600 [5/]	Category A			Upgrade series capacitors in the line by 2012 for max retirements case
			Category B	103	119	
			Cat. B w/ SONGS 3 Out	108	133	
			Category C (L1+L1)	126	146	
Serrano-Villa Park #1 and #2 230-kV	3	3,450	Category B		105	Reconductor lines
		3,450	Cat. B w/ SONGS 3 Out		110	
		4,000	Category C		110	
		4,000	Cat. C w/ SONGS 3 Out		115	
		3,450	Category C (L1 + L1)	101	128	
Lewis-Barre 230-kV	5	3,000	Category B		116	Reconductor line
			Cat. B w/ SONGS 3 Out		125	
			Category C (L1 + L1)		113	
Barre-Villa Park 230-kV	9	3,000	Category B		105	Reconductor line
			Cat. B w/ SONGS 3 Out		113	

TABLE A-11
SCE AREA AGED PLANT RETIREMENT STUDIES
SUMMARY OF POTENTIAL OVERLOAD MITIGATION MEASURES
2012 WITH 4,140 MW AND 6,650 MW OF RETIREMENTS

Impacted Line	Length (Miles)	Rating [1/] (Amps)	MW Retired / Critical Conditions Resulting in Overloads	4,140	6,650	Potential Mitigation Measures
				Loading (%) on Impacted Line		
La Cienega-La Fresa 230-kV	12	2,031	Category C		120	Reconductor line
			Cat. C w/ SONGS 3 Out		121	
Mesa-Lighthipe 230-kV	12	2,400	Category B		114	Reconductor line
		2,400	Cat. B w/ SONGS 3 Out		120	
		2,568	Category C		127	
		2,568	Cat. C w/ SONGS 3 Out		134	
		2,400	Category C (L1 + L1)		106	
Villa Park-Lewis 230-kV	4	2,568	Category C		107	Reconductor line
			Cat. C w/ SONGS 3 Out		113	
Mesa-Redondo 230-kV	26	2,141	Category C		111	Replace limiting element(s) in the line
			Cat. C w/ SONGS 3 Out		116	
Serrano-Lewis #1 and #2 230-kV	7	3,000	Category C		107	Replace limiting element(s) in the lines
			Cat. C w/ SONGS 3 Out		112	

[1/] SCE N, A, & B ratings applied as follows: "N" for N-0, "A" for L-1 and L-1+L-1; and "B" for L-2

[2/] Limiting components are 0.5-mile long line segment and wave trap at Chino (per latest SCE 10-year transmission plan)

[3/] SCE plans to remove the wave traps on this line (per latest SCE 10-year transmission plan); the normal rating for the conductors on these lines is 3,320 amps

[4/] "A" and "B" ratings for the Pardee-Moorpark #1 line are 3,000 amps and 3,211 amps; respectively. All three Pardee-Moorpark 230-kV lines utilize the same conductor (based on information submitted to the CEC by SCE in 1993)

[5/] Normal rating for series capacitors in the line; emergency rating for the series capacitors is 2,400 amps

APPENDIX 2

DETAILED LOAD AND RESOURCE INFORMATION USED IN UPDATE STUDY CASES

APPENDIX 2
SCE AREA LOADS AND RESOURCES MODELED IN STUDIES WITH 4,140 MW OF AGED PLANTS RETIRED (WITH SONGS 3 OUT)

	Reference	Updated Initial Case			Case 1B			Case 3A			Case 4A		
	Case	2012	2016	2020	2012	2016	2020	2012	2016	2020	2012	2016	2020
Capacity Requirements													
Loads	26,894	26,894	28,213	29,608	26,894	28,213	29,609	26,894	28,213	29,608	26,894	28,213	29,608
Pumps	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275
Energy Efficiency [1/]	0	0	0	0	(874)	(1,637)	(2,269)	(1,145)	(2,292)	(3,427)	(874)	(1,637)	(2,269)
Solar PV [2/]	0	0	0	0	(64)	(139)	(150)	(63)	(139)	(150)	(303)	(789)	(854)
Losses	426	532	558	652	483	489	519	466	482	488	458	477	546
Net	28,595	28,701	30,046	31,535	27,714	28,201	28,984	27,427	27,539	27,794	27,450	27,539	28,306
Capacity Resources													
Imports	8,734	8,994	9,079	9,979	8,734	8,799	8,829	8,754	8,799	8,829	8,733	8,783	8,829
Aged Plants													
Alamitos 1-4	980	0	0	0	0	0	0	0	0	0	0	0	0
Alamitos 5 & 6	950	950	950	950	950	950	950	950	950	950	950	950	950
El Segundo 3 & 4	660	660	660	660	660	660	660	660	660	660	660	660	660
Etiwanda 3 & 4	620	0	0	0	0	0	0	0	0	0	0	0	0
Huntington Beach 1 & 2	400	0	0	0	0	0	0	0	0	0	0	0	0
Mandalay 1&2	400	0	0	0	0	0	0	0	0	0	0	0	0
Ormond Beach 1 & 2	1,400	0	0	0	0	0	0	0	0	0	0	0	0
Redondo Beach 5 & 6	340	0	0	0	0	0	0	0	0	0	0	0	0
Redondo Beach 7 & 8	900	900	900	900	900	900	900	900	900	900	900	900	900
Total	6,650	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510
New Renewables (Dependable Capacity)													
Biomass [2/]	0	50	50	50	50	50	50	50	50	50	26	131	235
Geothermal (Kramer Area)	0	0	0	0	0	0	0	0	0	0	29	147	264
Solar (CSP) [3/]													
Pisgah Area	0	305	479	479	305	479	479	305	479	479	131	305	539
Kramer Area	0	0	91	91	0	91	91	0	91	91	0	131	244
Mohave Area	0	0	148	148	0	148	148	0	148	148	0	218	392
Subtotal	0	305	718	718	305	718	718	305	718	718	131	654	1,175

1/ Loads at all SCE load busses reduced pro-rata to reflect energy efficiency effects

2/ Represented at selected busses based on information prepared for the CEC's Intermittency Analysis Project Study; refer to Appendix 3

3/ Dependable capacity assumed to be equal to 87% of installed capacity

APPENDIX 2
SCE AREA LOADS AND RESOURCES MODELED IN STUDIES WITH 4,140 MW OF AGED PLANTS RETIRED (WITH SONGS 3 OUT)

	Reference	Updated Initial Case			Case 1B			Case 3A			Case 4A		
	Case	2012	2016	2020	2012	2016	2020	2012	2016	2020	2012	2016	2020
Wind [4/]													
Devers Area	0	29	87	94	31	86	92	29	86	94	29	86	94
Tehachapi Area	0	236	527	574	236	527	574	236	527	574	178	527	1,021
Pisgah Area	0	0	0	0	0	0	0	0	0	0	0	123	149
Eldorado Area	0	0	0	0	0	0	0	0	0	0	0	104	209
Victor Area	0	0	0	0	0	0	0	0	0	0	0	43	43
Subtotal	0	265	614	668	267	613	666	265	613	668	207	883	1,516
Total Renewables	0	620	1,382	1,436	622	1,381	1,434	620	1,381	1,436	393	1,815	3,190
Queued Thermal Projects													
Projects With PPAs													
ISO Queue #3 (Ocotillo)	455	455	455	455	455	455	455	455	455	455	455	455	455
ISO Queue #17 (Blythe)	490	490	490	490	490	490	490	490	490	490	490	490	490
ISO Queue #65 (L. Beach)	260	260	260	0	260	260	0	260	260	0	260	260	0
Subtotal	1,205	1,205	1,205	945	1,205	1,205	945	1,205	1,205	945	1,205	1,205	945
"Emergency" Peakers													
WDAT #30 (Etiwanda)	45	45	45	45	45	45	45	45	45	45	45	45	45
WDAT #31 (Mandalay)	47	47	47	47	47	47	47	47	47	47	47	47	47
WDAT #32 (Mira Loma)	45	45	45	45	45	45	45	45	45	45	45	45	45
WDAT #33 (Center)	47	47	47	47	47	47	47	47	47	47	47	47	47
WDAT #34 (Barre)	48	48	48	48	48	48	48	48	48	48	48	48	48
Subtotal	232	232	232	232	232	232	232	232	232	232	232	232	232
Other Peaking Projects													
ISO Queue #3 (Balance)	91	182	182	273	182	182	182	91	91	91	182	182	91
ISO Queue #41 (Pastoria)	159	159	159	159	159	159	159	159	159	159	159	159	159
ISO Queue #66 (Walnut)	0	0	501	501	0	0	505	202	0	0	404	0	0
ISO Queue #136 (Etiwanda)	0	303	303	303	303	303	303	303	303	303	303	303	303
ISO Queue #141 (R. Vista)	505	505	505	505	404	101	505	505	0	505	505	101	101
WDAT #2 (Highgrove)	300	300	300	300	300	300	300	300	300	300	300	300	0
WDAT #12 (Sun Valley)	505	505	505	505	505	505	505	505	505	505	505	505	505
Subtotal	1,560	1,954	2,455	2,546	1,853	1,550	2,459	2,065	1,358	1,863	2,358	1,550	1,159

[4/] Dependable capacity of wind in Tehachapi area assumed to be 22% of installed capacity; dependable capacity in all other areas assumed to be 29% of installed capacity.

APPENDIX 2
SCE AREA LOADS AND RESOURCES MODELED IN STUDIES
WITH 4,140 MW OF AGED PLANTS RETIRED (WITH SONGS 3 OUT)

	Reference	Updated Initial Case			Case 1B			Case 3A			Case 4A		
	Case	2012	2016	2020	2012	2016	2020	2012	2016	2020	2012	2016	2020
Combined Cycle Projects													
ISO Queue #50 (IEEC)	810	810	810	810	810	810	810	810	810	810	810	810	810
ISO Queue #89 (Victor)	0	570	570	570	570	570	570	570	570	570	570	0	0
ISO Queue #92 (Vincent)	0	570	570	570	570	570	570	570	570	570	570	570	570
ISO Queue #118 (Mohave)	0	550	550	550	550	550	550	0	0	0	0	0	0
ISO Queue #139 (R. Vista)	0	698	698	698	698	698	698	698	698	698	698	698	698
ISO Queue #145 (Eldorado)	0	591	591	591	0	0	0	0	0	0	0	0	0
ISO Queue #167 (Midpoint)	0	0	0	700	0	0	0	0	0	0	0	0	0
Subtotal	810	3,789	3,789	4,489	3,198	3,198	3,198	2,648	2,648	2,648	2,648	2,078	2,078
Total Queued Thermal	3,807	7,180	7,681	8,212	6,488	6,185	6,834	6,150	5,443	5,688	6,443	5,065	4,414
Existing Wind Generation													
Devers Area	201	201	201	201	201	201	201	201	201	201	201	201	201
Tehachapi Area	126	126	126	126	126	126	126	126	126	126	126	126	126
Total	327	327	327	327	327	327	327	327	327	327	327	327	327
Other Existing Generation													
Eastwood (Area Swing)	201	196	193	197	159	125	176	192	205	130	170	165	162
SONGS	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070
Mountain View	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070
High Desert	835	835	835	835	835	835	835	835	835	835	835	835	835
Pastoria 1 & 2	758	758	758	758	758	758	758	758	758	758	758	758	758
Big Creek	500	500	500	500	500	500	500	500	500	500	500	500	500
Huntington Beach 3 & 4	420	420	420	420	420	420	420	420	420	420	420	420	420
Arco 1-6	400	400	400	400	400	400	400	400	400	400	400	400	400
Omar 1-4	300	300	300	300	300	300	300	300	300	300	300	300	300
Sycamore	280	280	280	280	280	280	280	280	280	280	280	280	280
Alta Unit 4	235	235	235	235	235	235	235	235	235	235	235	235	235
Alta Unit 3	230	230	230	230	230	230	230	230	230	230	230	230	230
Devils Canyon	208	208	208	208	208	208	208	208	208	208	208	208	208
Sungen 3-7	172	172	172	172	172	172	172	172	172	172	172	172	172
Mammoth	170	170	170	170	170	170	170	170	170	170	170	170	170
Luz 8 & 9	160	160	160	160	160	160	160	160	160	160	160	160	160
Indigo CTs	135	135	135	135	135	135	135	135	135	135	135	135	135

APPENDIX 2
SCE AREA LOADS AND RESOURCES MODELED IN STUDIES
WITH 4,140 MW OF AGED PLANTS RETIRED (WITH SONGS 3 OUT)

	Reference	Updated Initial Case			Case 1B			Case 3A			Case 4A		
	Case	2012	2016	2020	2012	2016	2020	2012	2016	2020	2012	2016	2020
Malburg	130	130	130	130	130	130	130	130	130	130	130	130	130
Appgen 1&2	110	110	110	110	110	110	110	110	110	110	110	110	110
Mc Gen	105	105	105	105	105	105	105	105	105	105	105	105	105
Alta Unit 2	80	80	80	80	80	80	80	80	80	80	80	80	80
Calgen 1-3	80	80	80	80	80	80	80	80	80	80	80	80	80
Chevron	76	76	76	76	76	76	76	76	76	76	76	76	76
Warne	76	76	76	76	76	76	76	76	76	76	76	76	76
Navy 4-6	75	75	75	75	75	75	75	75	75	75	75	75	75
Broadway (Pasadena)	65	65	65	65	65	65	65	65	65	65	65	65	65
Alta Unit 1	60	60	60	60	60	60	60	60	60	60	60	60	60
BLM 7-9	60	60	60	60	60	60	60	60	60	60	60	60	60
Kerr McGee/Kerrgen	58	58	58	58	58	58	58	58	58	58	58	58	58
Mogen	57	57	57	57	57	57	57	57	57	57	57	57	57
Pandol	55	55	55	55	55	55	55	55	55	55	55	55	55
Procgen	51	51	51	51	51	51	51	51	51	51	51	51	51
Anaheim CT	50	50	50	50	50	50	50	50	50	50	50	50	50
Oxbow	50	50	50	50	50	50	50	50	50	50	50	50	50
Pasadena 1&2	50	50	50	50	50	50	50	50	50	50	50	50	50
SEGS 1 & 2	50	50	50	50	50	50	50	50	50	50	50	50	50
Borax	47	47	47	47	47	47	47	47	47	47	47	47	47
Hillgen	45	45	45	45	45	45	45	45	45	45	45	45	45
Icegen	45	45	45	45	45	45	45	45	45	45	45	45	45
Mobgen	45	45	45	45	45	45	45	45	45	45	45	45	45
Tenn Gen 1 & 2	44	44	44	44	44	44	44	44	44	44	44	44	44
Ultragen	41	41	41	41	41	41	41	41	41	41	41	41	41
Simpson	37	37	37	37	37	37	37	37	37	37	37	37	37
Pulpgen	35	35	35	35	35	35	35	35	35	35	35	35	35
Oxgen	34	34	34	34	34	34	34	34	34	34	34	34	34
Serffgen	33	33	33	33	33	33	33	33	33	33	33	33	33
Cimgen	30	30	30	30	30	30	30	30	30	30	30	30	30
Pitchgen	30	30	30	30	30	30	30	30	30	30	30	30	30
Inland	30	30	30	30	30	30	30	30	30	30	30	30	30

APPENDIX 2
SCE AREA LOADS AND RESOURCES MODELED IN STUDIES
WITH 4,140 MW OF AGED PLANTS RETIRED (WITH SONGS 3 OUT)

	Reference	Updated Initial Case			Case 1B			Case 3A			Case 4A		
	Case	2012	2016	2020	2012	2016	2020	2012	2016	2020	2012	2016	2020
Bishop Hydro	28	28	28	28	28	28	28	28	28	28	28	28	28
Willamet	25	25	25	25	25	25	25	25	25	25	25	25	25
Alamo	16	16	16	16	16	16	16	16	16	16	16	16	16
Rush Creek	15	15	15	15	15	15	15	15	15	15	15	15	15
Poole/Lundy	13	13	13	13	13	13	13	13	13	13	13	13	13
Total	9,075	9,070	9,067	9,071	9,033	8,999	9,050	9,066	9,079	9,004	9,044	9,039	9,036
Total Resources	28,593	28,701	30,046	31,535	27,714	28,201	28,984	27,427	27,539	27,794	27,450	27,539	28,306

APPENDIX 3

MODELING OF NEW BIOMASS

AND SOLAR PV RESOURCES

APPENDIX 3
MODELING OF BIOMASS GENERATION

Bus			Cases 1B and 3A			Case 4A		
#	Name	kV	2012	2016	2020	2012	2016	2020
24024	CHINO	66	7	7	7	7	7	7
24032	AMERON	66	7	7	7	7	7	7
24111	PADUA	66	7	7	7	7	7	7
24160	VALLEYSC	115	7	7	7		9	9
24902	VSTA	66	7	7	7		7	7
24055	ETIWANDA	66	5	5	5	5	7	5
24903	VSTA	115	5	5	5		5	5
24909	PEPPER	115	5	5	5		5	5
24807	MIRAGE	115					9	9
24814	BANNING	115					9	9
24815	GARNET	115					9	9
24816	SANTA RO	115					9	9
24817	EISENHOW	115					9	9
24818	FARREL	115					9	9
24809	YUCCA	115					7	7
24819	CONCHO	115					5	5
24820	THORNHIL	115					5	5
24824	CARODEAN	115					5	5
24073	LA FRESA	66						20
24157	WALNUT	66						20
24203	CENTER S	66						20
24211	OLINDA	66						20
24223	MANDALAY	66						20
24810	HI DESER	115						7
Totals			50	50	50	26	130	235

APPENDIX 3
MODELING OF PV RESOURCES

Bus			Cases 1B and 3A			Case 4A		
#	Name	kV	2012	2016	2020	2012	2016	2020
24007	ALMITOSW	66	0.6	1.4	1.5	3.1	8.0	8.7
24028	DELAMO	66	0.6	1.4	1.5	3.1	8.0	8.7
24032	AMERON	66	0.9	1.9	2.0	4.1	10.7	11.5
24039	EL NIDO	66	1.9	4.2	4.6	9.2	24.0	26.0
24083	LITEHIPE	66	1.1	2.4	2.5	5.1	16.5	14.4
24133	SANTIAGO	66	2.8	6.1	6.6	13.3	34.6	37.5
24135	SAUGUS	66	5.6	12.2	13.2	26.6	69.3	75.0
24157	WALNUT	66	3.4	7.5	8.1	16.4	42.6	46.1
24160	VALLEYSC	115	2.1	4.7	5.1	10.2	26.7	28.8
24201	BARRE	66	1.5	3.3	3.5	7.2	21.3	23.1
24205	EAGLROCK	66	1.7	3.8	4.1	8.2	21.3	23.1
24207	JOHANNA	66	1.3	2.8	3.0	6.1	16.0	17.3
24211	OLINDA	66	1.7	3.8	4.1	8.2	21.3	23.1
24212	RECTOR	66	1.9	4.2	4.6	9.2	24.0	26.0
24213	RIOHONDO	66	1.9	4.2	4.6	9.2	24.0	26.0
24216	VILLA PK	66	1.5	3.3	3.5	7.2	18.7	20.2
24407	ANAVERDE	66	0.6	1.4	1.5	3.1	8.0	8.7
24418	LANCSTR	66	2.1	4.7	5.1	10.2	26.7	28.8
24421	OASIS SC	66	0.6	1.4	1.5	3.1	8.0	8.7
24422	PALMDALE	66	1.1	2.4	2.5	5.1	16.5	14.4
24424	QUARTZHL	66	1.3	2.8	3.0	6.1	16.0	17.3
24426	SHUTTLE	66	1.1	2.4	2.5	5.1	16.5	14.4
24602	VICTOR	115	0.9	1.9	2.0	4.1	10.7	11.5
24603	APPLEVAL	115	0.6	1.4	1.5	3.1	8.0	8.7
24604	AQUEDUCT	115	0.6	1.4	1.5	3.1	8.0	8.7
24605	HESPERIA	115	0.6	1.4	1.5	3.1	8.0	8.7
24606	PHELAN	115	0.6	1.4	1.5	3.1	8.0	8.7
24607	ROADWAY	115	0.6	1.4	1.5	3.1	8.0	8.7
24608	SAVAGE	115	0.9	1.9	2.0	4.1	10.7	11.5
24610	BLKMTN	115	0.6	1.4	1.5	3.1	8.0	8.7
24622	PERMANTE	115	0.6	1.4	1.5	3.1	8.0	8.7
24623	GOLDHILS	115	0.6	1.4	1.5	3.1	8.0	8.7
24815	GARNET	115	0.6	1.4	1.5	3.1	8.0	8.7
24817	EISENHOW	115	1.3	2.8	3.0	6.1	16.0	17.3
24818	FARREL	115	0.6	1.4	1.5	3.1	8.0	8.7
24819	CONCHO	115	1.3	2.8	3.0	6.1	16.0	17.3
25002	GOODRICH	33	1.5	3.3	3.5	7.2	18.7	20.2
25202	LEWIS	66	1.3	2.8	3.0	6.1	16.0	17.3

APPENDIX 3
MODELING OF PV RESOURCES

Bus			Cases 1B and 3A			Case 4A		
#	Name	kV	2012	2016	2020	2012	2016	2020
25632	TERAWND	115	1.3	2.8	3.0	6.1	16.0	17.3
25633	CAPWIND	115	1.3	2.8	3.0	6.1	16.0	17.3
25634	BUCKWND	115	1.3	2.8	3.0	6.1	16.0	17.3
25635	ALTWIND	115	1.3	2.8	3.0	6.1	16.0	17.3
25636	RENWIND	115	1.3	2.8	3.0	6.1	16.0	17.3
25639	SEAWIND	115	1.3	2.8	3.0	6.1	16.0	17.3
25645	VENWIND	115	1.3	2.8	3.0	6.1	16.0	17.3
25646	SANWIND	115	1.3	2.8	3.0	6.1	16.0	17.3
25655	VIEJO66	66	2.1	4.7	5.1	10.2	26.7	28.8
Total PV Resources			63.1	139.1	149.9	302.9	800.9	856.5

APPENDIX 4

COMPARISON OF 230-KV LINE RATINGS

WECC 2016 SUMMER PEAK CASE AND

CALIFORNIA ISO TRANSMISSION REGISTER

APPENDIX 4
COMPARISON OF RATINGS
WECC 2016HS CASE AND ISO TRANSMISSION REGISTER

From Bus			To Bus			Ckt #	WECC 2016 case (May 30, 2006)		CAISO Transmission Register		Change - 2016 Case vs Trans. Reg	
#	Name	kV	#	Name	kV		Normal Amps	Emer. Amps	Normal Amps	Emer. Amps	Normal Amps	Emer. Amps
Impacted Lines in Aged Plant Studies												
24016	BARRE	230	24044	ELLIS	230	1	2,480	3,211	2,480	2,480	(0)	(731)
24021	CENTER S	230	24091	MESA CAL	230	1	2,480	3,351	2,480	2,480	(0)	(871)
24025	CHINO	230	24093	MIRALOMW	230	1	1,770	2,141	1,790	2,200	20	59
24025	CHINO	230	25656	MIRALOME	230	3	2,480	3,211	2,480	2,480	(0)	(731)
24074	LA FRESA	230	24125	REDONDO	230	1	2,400	2,568	2,400	2,640	0	72
24074	LA FRESA	230	24125	REDONDO	230	2	2,400	2,568	2,400	2,640	0	72
25201	LEWIS	230	24154	VILLA PK	230	1	2,400	2,568	2,400	2,540	0	(28)
24114	PARDEE	230	24099	MOORPARK	230	2	2,400	2,568	1,800	2,280	(600)	(288)
24114	PARDEE	230	24099	MOORPARK	230	3	2,400	2,568	1,800	2,280	(600)	(288)
24114	PARDEE	230	24128	S.CLARA	230	1	1,150	1,549	1,240	1,240	90	(309)
24137	SERRANO	230	24154	VILLA PK	230	1	3,231	3,999	3,230	3,810	(1)	(189)
24137	SERRANO	230	24154	VILLA PK	230	2	3,000	3,999	3,230	4,050	230	51
Other Lines												
24008	ALMITOSW	230	24084	LITEHIPE	230	1	2,480	3,211	2,480	2,480	(0)	(731)
24016	BARRE	230	24154	VILLA PK	230	1	3,000	4,049	3,230	3,750	230	(299)
24016	BARRE	230	25201	LEWIS	230	1	3,000	4,049	3,000	3,750	0	(299)
24025	CHINO	230	24093	MIRALOMW	230	2	2,480	3,211	2,480	2,480	(0)	(731)
24029	DELAMO	230	24021	CENTER S	230	1	2,480	3,351	2,480	2,480	(0)	(871)
24029	DELAMO	230	24044	ELLIS	230	1	2,480	3,211	2,480	2,480	(0)	(731)
24036	EAGLROCK	230	24147	SYLMAR S	230	1	3,000	3,211	2,720	3,000	(280)	(211)
24040	EL NIDO	230	24082	LCIENEGA	230	1	1,501	2,031	1,615	1,615	114	(416)
24044	ELLIS	230	24134	SANTIAGO	230	1	3,000	3,211	3,000	3,000	0	(211)
24065	HINSON	230	24029	DELAMO	230	1	2,400	2,568	2,400	2,450	0	(118)
24074	LA FRESA	230	24076	LAGUBELL	230	1	3,000	4,049	3,000	3,810	0	(239)
24076	LAGUBELL	230	24126	RIOHONDO	230	1	2,480	3,211	2,480	2,480	(0)	(731)
24077	LBEACH	230	24084	LITEHIPE	230	1	1,150	1,549	1,150	1,185	0	(364)
24082	LCIENEGA	230	24074	LA FRESA	230	1	1,501	2,031	1,615	1,615	114	(416)
24091	MESA CAL	230	24126	RIOHONDO	230	1	2,480	3,351	2,480	2,480	(0)	(871)
24091	MESA CAL	230	24158	WALNUT	230	1	2,480	3,211	2,480	2,480	(0)	(731)
24100	OLINDA	230	24158	WALNUT	230	1	2,480	3,351	1,800	2,000	(680)	(1,351)
24114	PARDEE	230	24147	SYLMAR S	230	1	3,000	3,211	3,000	3,000	0	(211)
24114	PARDEE	230	24147	SYLMAR S	230	2	3,000	3,211	3,000	3,000	0	(211)
24114	PARDEE	230	24155	VINCENT	230	1	2,480	3,351	2,480	2,480	(0)	(871)
24125	REDONDO	230	24084	LITEHIPE	230	1	2,299	3,110	2,480	2,540	181	(570)
24128	S.CLARA	230	24099	MOORPARK	230	1	1,240	1,669	1,200	1,520	(40)	(149)
24147	SYLMAR S	230	24059	GOULD	230	1	3,000	3,211	2,720	3,000	(280)	(211)
24155	VINCENT	230	24128	S.CLARA	230	1	1,150	1,549	1,240	1,240	90	(309)
24155	VINCENT	230	24401	ANTELOPE	230	1	1,150	1,549	1,240	1,425	90	(124)
25001	GOODRICH	230	24076	LAGUBELL	230	1	2,480	3,211	2,480	2,480	(0)	(731)
25201	LEWIS	230	24137	SERRANO	230	1	3,000	3,999	3,000	3,810	0	(189)
25654	VIEJOSC	230	24025	CHINO	230	1	3,231	3,710	3,000	3,360	(231)	(350)
25654	VIEJOSC	230	24131	S.ONOFRE	230	1	3,231	3,710	3,000	3,360	(231)	(350)
25656	MIRALOME	230	24100	OLINDA	230	1	2,480	3,211	2,480	2,480	(0)	(731)

APPENDIX 5

CONTINGENCY LISTS

CATEGORY B CONTINGENCIES

Open Line ELDORDO 500-LUGO 500 #1	Open Line PARDEE 230-S.CLARA 230 #1
Open Line LUGO 500-MIRALOMA 500 #2	Open Line PARDEE 230-SYLMAR S 230 #1
Open Line LUGO 500-MIRALOMA 500 #3	Open Line PARDEE 230-SYLMAR S 230 #2
Open Line LUGO 500-MOHAVE 500 #1	Open Line PARDEE 230-VINCENT 230 #1
Open Line LUGO 500-VINCENT 500 #2	Open Line PARDEE 230-SAUG TAP 230 #1
Open Line MIRALOMA 500-SERRANO 500 #1	Open Line PARDEE 230-SAUG TAP 230 #2
Open Line MOHAVE 500-ELDORDO 500 #1	Open Line PARDEE 230-WARNETAP 230 #1
Open Line SERRANO 500-VALLEY SC 500 #1	Open Line PARDEE 230-BAILEY 230 #1
Open Line DEVERS 500-VALLEYSC 500 #1	Open Line PASTORIA 230-WARNETAP 230 #1
Open Line DEVRSVC1 500-DEVERS 500 #1	Open Line PASTORIA 230-EDMONSTN 230 #1
Open Line LUGO 500-RANCHVST 500 #1	Open Line PASTORIA 230-PSTRIA 230 #1
Open Line RANCHVST 500-SERRANO 500 #1	Open Line REDONDO 230-LITEHIPE 230 #1
Open Line MIDWAY 500-VINCENT 500 #1	Open Line RIOHONDO 230-VINCENT 230 #2
Open Line MIDWAY 500-VINCENT 500 #2	Open Line S.CLARA 230-GOLETA 230 #1
Open Line LUGO 500-VICTORVL 500 #1	Open Line S.CLARA 230-GOLETA 230 #2
Open Line HARQUAHA 500-DEVERS 500 #1	Open Line S.CLARA 230-MANDALAY 230 #1
Open Line VALLEYSC 500-IEEC CC 500 #1	Open Line S.CLARA 230-MANDALAY 230 #2
Open Line DEVERS 500-VALLEYSC 500 #2	Open Line S.CLARA 230-MOORPARK 230 #1
Open Line ANTELOPE 500-PARDEE 500 #n1	Open Line S.CLARA 230-MOORPARK 230 #2
Open Line ANTELOPE 500-WINDHUB 500 #n1	Open Line S.ONOFRE 230-SANTIAGO 230 #1
Open Line ANTELOPE 500-VINCENT 500 #n1	Open Line S.ONOFRE 230-SANTIAGO 230 #2
Open Line MIDWAY 500-LOWWIND 500 #3	Open Line S.ONOFRE 230-SERRANO 230 #1
Open Line LOWWIND 500-VINCENT 500 #3	Open Line SANBRDNO 230-DEVERS 230 #1
Open Line PALOVRDE 500-MIDPOINT 500 #1	Open Line SERRANO 230-VILLA PK 230 #1
Open Line MIDPOINT 500-DEVERS 500 #1	Open Line SERRANO 230-VILLA PK 230 #2
Open Line ANTELOPE 500-LOWWIND 500 #n1	Open Line SPRINGVL 230-BIG CRK4 230 #1
Open Line VINCENT 500-MESA CAL 500 #n1	Open Line SYC CYN 230-OMAR 230 #1
Open Line MESA CAL 500-MIRALOMA 500 #n1	Open Line SYLMAR S 230-GOULD 230 #1
Open Line VINCENT 500-RIOHONDO 500 #n1	Open Line VESTAL 230-RECTOR 230 #1
Open Line RIOHONDO 500-MIRALOMA 500 #n1	Open Line VINCENT 230-MESA CAL 230 #1
Open Line ALMITOSE 230-BARRE 230 #1	Open Line VINCENT 230-RIOHONDO 230 #1
Open Line ALMITOSE 230-CENTER S 230 #1	Open Line VINCENT 230-SEAWEST 230 #1
Open Line ALMITOSW 230-ALMITOSE 230 #1	Open Line VINCENT 230-ANTELOPE 230 #1
Open Line ALMITOSW 230-BARRE 230 #2	Open Line VINCENT 230-PEARBLSM 230 #1
Open Line ALMITOSW 230-LITEHIPE 230 #1	Open Line WARNE 230-WARNETAP 230 #1
Open Line ARCO SC 230-HINSON 230 #1	Open Line PISGAH 230-ELDORDO 230 #2
Open Line ARCO SC 230-HINSON 230 #2	Open Line PISGAH 230-LUGO 230 #1
Open Line BARRE 230-ELLIS 230 #1	Open Line PISGAH 230-LUGO 230 #2
Open Line BARRE 230-VILLA PK 230 #1	Open Line PISGAH 230-CIMA 230 #1
Open Line BARRE 230-LEWIS 230 #1	Open Line RECTOR 230-VESTAL 230 #2
Open Line CAMINO 230-GENE 230 #1	Open Line RANCHVST 230-PADUA 230 #2
Open Line CENTER S 230-MESA CAL 230 #1	Open Line RANCHVST 230-MIRALOME 230 #1
Open Line CENTER S 230-OLINDA 230 #1	Open Line BIG CRK1 230-RECTOR 230 #1
Open Line CHINO 230-MIRALOMW 230 #1	Open Line BIG CRK1 230-BIG CRK2 230 #1
Open Line CHINO 230-MIRALOMW 230 #2	Open Line BIG CRK1 230-EASTWOOD 230 #1
Open Line CHINO 230-SERRANO 230 #1	Open Line BIG CRK2 230-BIG CRK3 230 #1
Open Line CHINO 230-MIRALOME 230 #3	Open Line BIG CRK2 230-BIG CRK8 230 #1

CATEGORY B CONTINGENCIES

Open Line ELDORDO 500-LUGO 500 #1	Open Line PARDEE 230-S.CLARA 230 #1
Open Line DELAMO 230-CENTER S 230 #1	Open Line BIG CRK3 230-RECTOR 230 #1
Open Line DELAMO 230-ELLIS 230 #1	Open Line BIG CRK4 230-BIG CRK3 230 #1
Open Line DELAMO 230-LAGUBELL 230 #1	Open Line BIG CRK8 230-BIG CRK3 230 #1
Open Line EAGLROCK 230-MESA CAL 230 #1	Open Line MAMMOTH 230-BIG CRK3 230 #1
Open Line EAGLROCK 230-PARDEE 230 #1	Open Line HIDESERT 230-VICTOR 230 #1
Open Line EAGLROCK 230-SYLMAR S 230 #1	Open Line BAILEY 230-PASTORIA 230 #1
Open Line EL NIDO 230-LA FRESA 230 #3	Open Line VICTOR 230-LUGO 230 #1
Open Line EL NIDO 230-LA FRESA 230 #4	Open Line VICTOR 230-LUGO 230 #2
Open Line EL NIDO 230-LCIENEGA 230 #1	Open Line CIMA 230-ELDORDO 230 #1
Open Line EL NIDO 230-CHEVMAIN 230 #1	Open Line KRAMER 230-LUGO 230 #1
Open Line ELLIS 230-HUNTGBCH 230 #1	Open Line KRAMER 230-LUGO 230 #2
Open Line ELLIS 230-HUNTGBCH 230 #3	Open Line KRAMER 230-COLWATER 230 #1
Open Line ELLIS 230-JOHANNA 230 #1	Open Line KRAMER 230-COLWATER 230 #2
Open Line ELLIS 230-SANTIAGO 230 #1	Open Line BLM EAST 230-BLM WEST 230 #1
Open Line ELLIS 230-HUNTBCH1 230 #2	Open Line BLM WEST 230-KRAMER 230 #1
Open Line ELLIS 230-HUNTBCH1 230 #4	Open Line LUZ LSP 230-KRAMER 230 #1
Open Line ELSEGNDO 230-EL NIDO 230 #1	Open Line OXBOW B 230-OXBOW A 230 #1
Open Line ELSEGNDO 230-CHEVMAIN 230 #1	Open Line LUZ8 230-LUZ LSP 230 #1
Open Line ETIWANDA 230-SANBRDNO 230 #1	Open Line LUZ9 230-LUZ LSP 230 #1
Open Line ETIWANDA 230-RANCHVST 230 #1	Open Line NAVYCOSO 230-BLM EAST 230 #1
Open Line ETIWANDA 230-RANCHVST 230 #2	Open Line OAK_VLLY 230-SANBRDNO 230 #1
Open Line ETIWANDA 230-VSTA 230 #1	Open Line DEVERS 230-OAK_VLLY 230 #1
Open Line HARBOR 230-HINSON 230 #1	Open Line DEVERS 230-MIRAGE 230 #1
Open Line HARBOR 230-LBEACH 230 #1	Open Line DEVERS 230-VSTA 230 #2
Open Line HINSON 230-DELAMO 230 #1	Open Line VSTA 230-SANBRDNO 230 #2
Open Line JOHANNA 230-SANTIAGO 230 #1	Open Line VSTA 230-DEVERS 230 #1
Open Line LA FRESA 230-HINSON 230 #1	Open Line GOODRICH 230-GOULD 230 #1
Open Line LA FRESA 230-LAGUBELL 230 #1	Open Line GOODRICH 230-LAGUBELL 230 #1
Open Line LA FRESA 230-REDONDO 230 #1	Open Line LEWIS 230-SERRANO 230 #1
Open Line LA FRESA 230-REDONDO 230 #2	Open Line LEWIS 230-SERRANO 230 #2
Open Line LAGUBELL 230-RIOHONDO 230 #1	Open Line LEWIS 230-VILLA PK 230 #1
Open Line LBEACH 230-LITEHIPE 230 #1	Open Line EAGLEMTN 230-IRON MTN 230 #1
Open Line LCIENEGA 230-LA FRESA 230 #1	Open Line IRON MTN 230-CAMINO 230 #1
Open Line LITEHIPE 230-HINSON 230 #1	Open Line J.HINDS 230-MIRAGE 230 #1
Open Line LITEHIPE 230-MESA CAL 230 #1	Open Line J.HINDS 230-EAGLEMTN 230 #1
Open Line MAGUNDEN 230-OMAR 230 #1	Open Line VIEJOSC 230-CHINO 230 #1
Open Line MAGUNDEN 230-PASTORIA 230 #1	Open Line VIEJOSC 230-S.ONOFRE 230 #1
Open Line MAGUNDEN 230-PASTORIA 230 #2	Open Line MIRALOME 230-OLINDA 230 #1
Open Line MAGUNDEN 230-PASTORIA 230 #3	Open Line MIRALOME 230-VSTA 230 #2
Open Line MAGUNDEN 230-SPRINGVL 230 #1	Open Line RECTOR 230-RECTRSVC 230 #1
Open Line MAGUNDEN 230-SPRINGVL 230 #2	Open Line SPRINGVL 230-RECTOR 230 #1
Open Line MAGUNDEN 230-VESTAL 230 #1	Open Line RECTOR 230-BIG CRK3 230 #2
Open Line MAGUNDEN 230-VESTAL 230 #2	Open Line MNTVIEW 230-SANBRDNO 230 #1
Open Line MAGUNDEN 230-ANTELOPE 230 #1	Open Line MNTVIEW 230-SANBRDNO 230 #2
Open Line MAGUNDEN 230-ANTELOPE 230 #2	Open Line MIRALOMW 230-JURUPA 230 #1
Open Line MESA CAL 230-REDONDO 230 #1	Open Line JURUPA 230-VSTA 230 #1

CATEGORY B CONTINGENCIES

Open Line ELDORDO 500-LUGO 500 #1	Open Line PARDEE 230-S.CLARA 230 #1
Open Line MESA CAL 230-RIOHONDO 230 #1	Open Line RANCHVST 230-PADUA 230 #1
Open Line MESA CAL 230-WALNUT 230 #1	Open Line RANCHVST 230-MIRALOME 230 #2
Open Line MESA CAL 230-ANTELOPE 230 #1	Open Line MEAD S 230-ELDORDO 230 #1
Open Line MIRALOMW 230-WALNUT 230 #1	Open Line MEAD S 230-ELDORDO 230 #2
Open Line MOORPARK 230-ORMOND 230 #1	Open Line CAMINO 230-MEAD S 230 #E
Open Line MOORPARK 230-ORMOND 230 #2	Open Line CAMINO 230-MEAD S 230 #W
Open Line MOORPARK 230-ORMOND 230 #3	Open Xfmr SYLMARLA 230/SYLMAR S 230 #2
Open Line MOORPARK 230-ORMOND 230 #4	Open Line PARDEE 500-VINCENT 500 #n1
Open Line OLINDA 230-WALNUT 230 #1	Open Line VINCENT 500-MESA CAL 500 #n1
Open Line PARDEE 230-MOORPARK 230 #1	Open Line MESA CAL 500-MIRALOMA 500 #n1
Open Line PARDEE 230-MOORPARK 230 #2	Open Xfmr MESA CAL 500/MESA CAL 230 #1
Open Line PARDEE 230-MOORPARK 230 #3	Open Xfmr MOHAVE 500/MOHAVE 230 #n1
Open Line PARDEE 230-PASTORIA 230 #1	Open Xfmr MIRALOMA 500/MIRALOMW 230 #1
Open Line PARDEE 230-PASTORIA 230 #1	Open Xfmr MIRALOMA 500/MIRALOMW 230 #2

CATEGORY C CONTINGENCIES

Open Line ALMITOSE 230-BARRE 230 #1	and	Open Line ALMITOSE 230-CENTER S 230 #1
Open Line ALMITOSE 230-BARRE 230 #1	and	Open Line ALMITOSW 230-BARRE 230 #2
Open Line ALMITOSE 230-BARRE 230 #1	and	Open Line ALMITOSW 230-LITEHIPE 230 #1
Open Line ALMITOSE 230-BARRE 230 #1	and	Open Line DELAMO 230-ELLIS 230 #1
Open Line ALMITOSE 230-CENTER S 230 #1	and	Open Line ALMITOSW 230-BARRE 230 #2
Open Line ALMITOSW 230-BARRE 230 #2	and	Open Line ALMITOSW 230-LITEHIPE 230 #1
Open Line ALMITOSW 230-BARRE 230 #2	and	Open Line DELAMO 230-ELLIS 230 #1
Open Line ALMITOSE 230-CENTER S 230 #1	and	Open Line ALMITOSW 230-LITEHIPE 230 #1
Open Line ALMITOSE 230-CENTER S 230 #1	and	Open Line DELAMO 230-CENTER S 230 #1
Open Line ALMITOSE 230-CENTER S 230 #1	and	Open Line DELAMO 230-ELLIS 230 #1
Open Line ALMITOSE 230-CENTER S 230 #1	and	Open Line HINSON 230-DELAMO 230 #1
Open Line ALMITOSW 230-LITEHIPE 230 #1	and	Open Line DELAMO 230-LAGUBELL 230 #1
Open Line ALMITOSW 230-LITEHIPE 230 #1	and	Open Line HINSON 230-DELAMO 230 #1
Open Line ARCO SC 230-HINSON 230 #1	and	Open Line ARCO SC 230-HINSON 230 #2
Open Line DELAMO 230-CENTER S 230 #1	and	Open Line DELAMO 230-LAGUBELL 230 #1
Open Line DELAMO 230-LAGUBELL 230 #1	and	Open Line HINSON 230-DELAMO 230 #1
Open Line DELAMO 230-LAGUBELL 230 #1	and	Open Line LA FRESA 230-LAGUBELL 230 #1
Open Line DELAMO 230-LAGUBELL 230 #1	and	Open Line LITEHIPE 230-MESA CAL 230 #1
Open Line DELAMO 230-LAGUBELL 230 #1	and	Open Line MESA CAL 230-REDONDO 230 #1
Open Line BARRE 230-ELLIS 230 #1	and	Open Line DELAMO 230-ELLIS 230 #1
Open Line BARRE 230-VILLA PK 230 #1	and	Open Line DELAMO 230-ELLIS 230 #1
Open Line BARRE 230-LEWIS 230 #1	and	Open Line DELAMO 230-ELLIS 230 #1
Open Line BARRE 230-VILLA PK 230 #1	and	Open Line BARRE 230-LEWIS 230 #1
Open Line BARRE 230-VILLA PK 230 #1	and	Open Line LEWIS 230-SERRANO 230 #1
Open Line BARRE 230-VILLA PK 230 #1	and	Open Line LEWIS 230-SERRANO 230 #2
Open Line BARRE 230-VILLA PK 230 #1	and	Open Line LEWIS 230-VILLA PK 230 #1
Open Line LEWIS 230-SERRANO 230 #1	and	Open Line LEWIS 230-VILLA PK 230 #1
Open Line LEWIS 230-SERRANO 230 #2	and	Open Line LEWIS 230-VILLA PK 230 #1
Open Line LEWIS 230-SERRANO 230 #1	and	Open Line LEWIS 230-SERRANO 230 #2
Open Line LEWIS 230-SERRANO 230 #1	and	Open Line SERRANO 230-VILLA PK 230 #1
Open Line LEWIS 230-SERRANO 230 #1	and	Open Line SERRANO 230-VILLA PK 230 #2
Open Line LEWIS 230-SERRANO 230 #2	and	Open Line SERRANO 230-VILLA PK 230 #1
Open Line LEWIS 230-SERRANO 230 #2	and	Open Line SERRANO 230-VILLA PK 230 #2
Open Line SERRANO 230-VILLA PK 230 #1	and	Open Line SERRANO 230-VILLA PK 230 #2
Open Line HINSON 230-DELAMO 230 #1	and	Open Line LA FRESA 230-HINSON 230 #1
Open Line HINSON 230-DELAMO 230 #1	and	Open Line LBEACH 230-LITEHIPE 230 #1
Open Line HINSON 230-DELAMO 230 #1	and	Open Line LITEHIPE 230-HINSON 230 #1
Open Line LA FRESA 230-HINSON 230 #1	and	Open Line LITEHIPE 230-HINSON 230 #1
Open Line LBEACH 230-LITEHIPE 230 #1	and	Open Line LITEHIPE 230-HINSON 230 #1
Open Line HARBOR 230-HINSON 230 #1	and	Open Line LBEACH 230-LITEHIPE 230 #1
Open Line LA FRESA 230-HINSON 230 #1	and	Open Line LBEACH 230-LITEHIPE 230 #1
Open Line HARBOR 230-HINSON 230 #1	and	Open Line HARBOR 230-LBEACH 230 #1
Open Line LA FRESA 230-HINSON 230 #1	and	Open Line LA FRESA 230-LAGUBELL 230 #1
Open Line LA FRESA 230-HINSON 230 #1	and	Open Line MESA CAL 230-REDONDO 230 #1
Open Line LA FRESA 230-HINSON 230 #1	and	Open Line REDONDO 230-LITEHIPE 230 #1
Open Line LA FRESA 230-LAGUBELL 230 #1	and	Open Line REDONDO 230-LITEHIPE 230 #1
Open Line LA FRESA 230-REDONDO 230 #1	and	Open Line REDONDO 230-LITEHIPE 230 #1

CATEGORY C CONTINGENCIES

Open Line ALMITOSE 230-BARRE 230 #1	and	Open Line ALMITOSE 230-CENTER S 230 #1
Open Line LA FRESA 230-REDONDO 230 #2	and	Open Line REDONDO 230-LITEHIPE 230 #1
Open Line MESA CAL 230-REDONDO 230 #1	and	Open Line REDONDO 230-LITEHIPE 230 #1
Open Line LA FRESA 230-REDONDO 230 #1	and	Open Line LCIENEGA 230-LA FRESA 230 #1
Open Line LA FRESA 230-REDONDO 230 #2	and	Open Line LCIENEGA 230-LA FRESA 230 #1
Open Line EL NIDO 230-LA FRESA 230 #3	and	Open Line LCIENEGA 230-LA FRESA 230 #1
Open Line EL NIDO 230-LA FRESA 230 #4	and	Open Line LCIENEGA 230-LA FRESA 230 #1
Open Line EL NIDO 230-LCIENEGA 230 #1	and	Open Line LCIENEGA 230-LA FRESA 230 #1
Open Line EL NIDO 230-CHEVMAIN 230 #1	and	Open Line ELSEGNDO 230-EL NIDO 230 #1
Open Line EL NIDO 230-CHEVMAIN 230 #1	and	Open Line ELSEGNDO 230-CHEVMAIN 230 #1
Open Line EL NIDO 230-LA FRESA 230 #3	and	Open Line EL NIDO 230-LA FRESA 230 #4
Open Line EL NIDO 230-LA FRESA 230 #3	and	Open Line LA FRESA 230-REDONDO 230 #1
Open Line EL NIDO 230-LA FRESA 230 #3	and	Open Line LA FRESA 230-REDONDO 230 #2
Open Line EL NIDO 230-LA FRESA 230 #4	and	Open Line LA FRESA 230-REDONDO 230 #1
Open Line EL NIDO 230-LA FRESA 230 #4	and	Open Line LA FRESA 230-REDONDO 230 #2
Open Line LA FRESA 230-REDONDO 230 #1	and	Open Line LA FRESA 230-REDONDO 230 #2
Open Line EL NIDO 230-LA FRESA 230 #3	and	Open Line MESA CAL 230-REDONDO 230 #1
Open Line EL NIDO 230-LA FRESA 230 #4	and	Open Line MESA CAL 230-REDONDO 230 #1
Open Line LA FRESA 230-REDONDO 230 #1	and	Open Line MESA CAL 230-REDONDO 230 #1
Open Line LA FRESA 230-REDONDO 230 #2	and	Open Line MESA CAL 230-REDONDO 230 #1
Open Line GOODRICH 230-LAGUBELL 230 #1	and	Open Line MESA CAL 230-REDONDO 230 #1
Open Line LA FRESA 230-LAGUBELL 230 #1	and	Open Line MESA CAL 230-REDONDO 230 #1
Open Line LAGUBELL 230-RIOHONDO 230 #1	and	Open Line MESA CAL 230-REDONDO 230 #1
Open Line LITEHIPE 230-MESA CAL 230 #1	and	Open Line MESA CAL 230-REDONDO 230 #1
Open Line LA FRESA 230-LAGUBELL 230 #1	and	Open Line LITEHIPE 230-MESA CAL 230 #1
Open Line GOODRICH 230-LAGUBELL 230 #1	and	Open Line LITEHIPE 230-MESA CAL 230 #1
Open Line LAGUBELL 230-RIOHONDO 230 #1	and	Open Line LITEHIPE 230-MESA CAL 230 #1
Open Line GOODRICH 230-GOULD 230 #1	and	Open Line GOODRICH 230-LAGUBELL 230 #1
Open Line GOODRICH 230-LAGUBELL 230 #1	and	Open Line LAGUBELL 230-RIOHONDO 230 #1
Open Line EAGLROCK 230-MESA CAL 230 #1	and	Open Line GOODRICH 230-LAGUBELL 230 #1
Open Line GOODRICH 230-LAGUBELL 230 #1	and	Open Line VINCENT 230-MESA CAL 230 #1
Open Line CENTER S 230-MESA CAL 230 #1	and	Open Line LAGUBELL 230-RIOHONDO 230 #1
Open Line LAGUBELL 230-RIOHONDO 230 #1	and	Open Line MESA CAL 230-RIOHONDO 230 #1
Open Line LAGUBELL 230-RIOHONDO 230 #1	and	Open Line MESA CAL 230-WALNUT 230 #1
Open Line LAGUBELL 230-RIOHONDO 230 #1	and	Open Line MESA CAL 230-ANTELOPE 230 #1
Open Line MESA CAL 230-RIOHONDO 230 #1	and	Open Line MESA CAL 230-WALNUT 230 #1
Open Line MESA CAL 230-RIOHONDO 230 #1	and	Open Line MESA CAL 230-ANTELOPE 230 #1
Open Line CENTER S 230-MESA CAL 230 #1	and	Open Line MESA CAL 230-RIOHONDO 230 #1
Open Line CENTER S 230-MESA CAL 230 #1	and	Open Line CENTER S 230-OLINDA 230 #1
Open Line CENTER S 230-MESA CAL 230 #1	and	Open Line MESA CAL 230-WALNUT 230 #1
Open Line CENTER S 230-MESA CAL 230 #1	and	Open Line MESA CAL 230-ANTELOPE 230 #1
Open Line MESA CAL 230-WALNUT 230 #1	and	Open Line MESA CAL 230-ANTELOPE 230 #1
Open Line MESA CAL 230-WALNUT 230 #1	and	Open Line MIRALOMW 230-WALNUT 230 #1
Open Line MESA CAL 230-WALNUT 230 #1	and	Open Line OLINDA 230-WALNUT 230 #1
Open Line CENTER S 230-OLINDA 230 #1	and	Open Line MESA CAL 230-WALNUT 230 #1
Open Line CENTER S 230-OLINDA 230 #1	and	Open Line MIRALOME 230-OLINDA 230 #1
Open Line CENTER S 230-OLINDA 230 #1	and	Open Line MIRALOMW 230-WALNUT 230 #1

CATEGORY C CONTINGENCIES

Open Line ALMITOSE 230-BARRE 230 #1	and	Open Line ALMITOSE 230-CENTER S 230 #1
Open Line CENTER S 230-OLINDA 230 #1	and	Open Line OLINDA 230-WALNUT 230 #1
Open Line MIRALOME 230-OLINDA 230 #1	and	Open Line OLINDA 230-WALNUT 230 #1
Open Line MIRALOMW 230-WALNUT 230 #1	and	Open Line OLINDA 230-WALNUT 230 #1
Open Line EAGLROCK 230-MESA CAL 230 #1	and	Open Line GOODRICH 230-GOULD 230 #1
Open Line GOODRICH 230-GOULD 230 #1	and	Open Line VINCENT 230-MESA CAL 230 #1
Open Line EAGLROCK 230-MESA CAL 230 #1	and	Open Line EAGLROCK 230-PARDEE 230 #1
Open Line EAGLROCK 230-MESA CAL 230 #1	and	Open Line EAGLROCK 230-SYLMAR S 230 #1
Open Line EAGLROCK 230-MESA CAL 230 #1	and	Open Line SYLMAR S 230-GOULD 230 #1
Open Line EAGLROCK 230-MESA CAL 230 #1	and	Open Line VINCENT 230-MESA CAL 230 #1
Open Line EAGLROCK 230-PARDEE 230 #1	and	Open Line EAGLROCK 230-SYLMAR S 230 #1
Open Line EAGLROCK 230-SYLMAR S 230 #1	and	Open Line SYLMAR S 230-GOULD 230 #1
Open Line EAGLROCK 230-SYLMAR S 230 #1	and	Open Line PARDEE 230-SYLMAR S 230 #1
Open Line EAGLROCK 230-SYLMAR S 230 #1	and	Open Line PARDEE 230-SYLMAR S 230 #2
Open Line PARDEE 230-SYLMAR S 230 #1	and	Open Line SYLMAR S 230-GOULD 230 #1
Open Line PARDEE 230-SYLMAR S 230 #2	and	Open Line SYLMAR S 230-GOULD 230 #1
Open Line EAGLROCK 230-PARDEE 230 #1	and	Open Line SYLMAR S 230-GOULD 230 #1
Open Line PARDEE 230-SYLMAR S 230 #1	and	Open Line PARDEE 230-SYLMAR S 230 #2
Open Line ELLIS 230-HUNTGBCH 230 #1	and	Open Line ELLIS 230-HUNTBCH1 230 #2
Open Line ELLIS 230-HUNTBCH1 230 #2	and	Open Line ELLIS 230-HUNTGBCH 230 #3
Open Line ELLIS 230-HUNTGBCH 230 #3	and	Open Line ELLIS 230-HUNTBCH1 230 #4
Open Line ELLIS 230-JOHANNA 230 #1	and	Open Line ELLIS 230-SANTIAGO 230 #1
Open Line ELLIS 230-SANTIAGO 230 #1	and	Open Line JOHANNA 230-SANTIAGO 230 #1
Open Line S.ONOFRE 230-SANTIAGO 230 #1	and	Open Line S.ONOFRE 230-SANTIAGO 230 #2
Open Line S.ONOFRE 230-SANTIAGO 230 #1	and	Open Line S.ONOFRE 230-SERRANO 230 #1
Open Line CHINO 230-VIEJOSC 230 #1	and	Open Line S.ONOFRE 230-SANTIAGO 230 #1
Open Line S.ONOFRE 230-SANTIAGO 230 #2	and	Open Line S.ONOFRE 230-SERRANO 230 #1
Open Line CHINO 230-VIEJOSC 230 #1	and	Open Line S.ONOFRE 230-SANTIAGO 230 #2
Open Line S.CLARA 230-GOLETA 230 #1	and	Open Line S.CLARA 230-GOLETA 230 #2
Open Line S.CLARA 230-MANDALAY 230 #1	and	Open Line S.CLARA 230-MANDALAY 230 #2
Open Line MOORPARK 230-ORMOND 230 #1	and	Open Line MOORPARK 230-ORMOND 230 #2
Open Line PARDEE 230-PASTORIA 230 #1	and	Open Line VINCENT 230-S.CLARA 230 #1
Open Line PARDEE 230-BAILEY 230 #1	and	Open Line VINCENT 230-S.CLARA 230 #1
Open Line PARDEE 230-MOORPARK 230 #1	and	Open Line PARDEE 230-MOORPARK 230 #2
Open Line PARDEE 230-S.CLARA 230 #1	and	Open Line S.CLARA 230-MOORPARK 230 #1
Open Line PARDEE 230-S.CLARA 230 #1	and	Open Line VINCENT 230-S.CLARA 230 #1
Open Line S.CLARA 230-MOORPARK 230 #1	and	Open Line S.CLARA 230-MOORPARK 230 #2
Open Line S.CLARA 230-MOORPARK 230 #2	and	Open Line VINCENT 230-S.CLARA 230 #1
Open Line EAGLROCK 230-PARDEE 230 #1	and	Open Line MESA CAL 230-ANTELOPE 230 #1
Open Line EAGLROCK 230-PARDEE 230 #1	and	Open Line PARDEE 230-VINCENT 230 #1
Open Line EAGLROCK 230-PARDEE 230 #1	and	Open Line VINCENT 230-MESA CAL 230 #1
Open Line EAGLROCK 230-PARDEE 230 #1	and	Open Line VINCENT 230-S.CLARA 230 #1
Open Line MESA CAL 230-ANTELOPE 230 #1	and	Open Line VINCENT 230-ANTELOPE 230 #1
Open Line PARDEE 230-VINCENT 230 #1	and	Open Line VINCENT 230-S.CLARA 230 #1
Open Line MESA CAL 230-ANTELOPE 230 #1	and	Open Line VINCENT 230-S.CLARA 230 #1
Open Line MESA CAL 230-ANTELOPE 230 #1	and	Open Line RIOHONDO 230-VINCENT 230 #2
Open Line MESA CAL 230-ANTELOPE 230 #1	and	Open Line VINCENT 230-RIOHONDO 230 #1

CATEGORY C CONTINGENCIES

Open Line ALMITOSE 230-BARRE 230 #1	and	Open Line ALMITOSE 230-CENTER S 230 #1
Open Line RIOHONDO 230-VINCENT 230 #2	and	Open Line VINCENT 230-RIOHONDO 230 #1
Open Line CHINO 230-VIEJOSC 230 #1	and	Open Line S.ONOFRE 230-SERRANO 230 #1
Open Line CHINO 230-SERRANO 230 #1	and	Open Line S.ONOFRE 230-SERRANO 230 #1
Open Line MIRALOME 230-OLINDA 230 #1	and	Open Line MIRALOMW 230-WALNUT 230 #1
Open Line CHINO 230-VIEJOSC 230 #1	and	Open Line MIRALOMW 230-WALNUT 230 #1
Open Line CHINO 230-SERRANO 230 #1	and	Open Line MIRALOMW 230-WALNUT 230 #1
Open Line CHINO 230-VIEJOSC 230 #1	and	Open Line MIRALOME 230-OLINDA 230 #1
Open Line CHINO 230-SERRANO 230 #1	and	Open Line MIRALOME 230-OLINDA 230 #1
Open Line CHINO 230-MIRALOMW 230 #1	and	Open Line CHINO 230-MIRALOMW 230 #2
Open Line CHINO 230-MIRALOMW 230 #2	and	Open Line CHINO 230-MIRALOME 230 #3
Open Line CHINO 230-VIEJOSC 230 #1	and	Open Line CHINO 230-SERRANO 230 #1
Open Line RANCHVST 230-PADUA 230 #1	and	Open Line RANCHVST 230-PADUA 230 #2
Open Line ETIWANDA 230-SANBRDNO 230 #1	and	Open Line MIRALOME 230-VSTA 230 #2
Open Line ETIWANDA 230-SANBRDNO 230 #1	and	Open Line ETIWANDA 230-VSTA 230 #1
Open Line DEVERS 230-SANBRDNO 230 #1	and	Open Line ETIWANDA 230-SANBRDNO 230 #1
Open Line DEVERS 230-VSTA 230 #2	and	Open Line ETIWANDA 230-SANBRDNO 230 #1
Open Line ETIWANDA 230-SANBRDNO 230 #1	and	Open Line SANBRDNO 230-DEVERS 230 #1
Open Line ETIWANDA 230-SANBRDNO 230 #1	and	Open Line VSTA 230-SANBRDNO 230 #2
Open Line ETIWANDA 230-SANBRDNO 230 #1	and	Open Line VSTA 230-DEVERS 230 #1
Open Line VSTA 230-SANBRDNO 230 #2	and	Open Line VSTA 230-DEVERS 230 #1
Open Line SANBRDNO 230-DEVERS 230 #1	and	Open Line VSTA 230-SANBRDNO 230 #2
Open Line DEVERS 230-SANBRDNO 230 #1	and	Open Line VSTA 230-SANBRDNO 230 #2
Open Line DEVERS 230-SANBRDNO 230 #1	and	Open Line DEVERS 230-VSTA 230 #2
Open Line DEVERS 230-SANBRDNO 230 #1	and	Open Line VSTA 230-DEVERS 230 #1
Open Line DEVERS 230-VSTA 230 #2	and	Open Line SANBRDNO 230-DEVERS 230 #1
Open Line SANBRDNO 230-DEVERS 230 #1	and	Open Line VSTA 230-DEVERS 230 #1
Open Line DEVERS 230-MIRAGE 230 #1	and	Open Line J.HINDS 230-MIRAGE 230 #1
Open Line RAMON 230-MIRAGE 230 #1	and	Open Line J.HINDS 230-MIRAGE 230 #1
Open Line MEAD S 230-ELDORDO 230 #1	and	Open Line MEAD S 230-ELDORDO 230 #2
Open Line CAMINO 230-MEAD S 230 #E	and	Open Line CAMINO 230-MEAD S 230 #W
Open Line PISGAH 230-LUGO 230 #1	and	Open Line PISGAH 230-LUGO 230 #2
Open Line ELDORDO 500-LUGO 500 #1	and	Open Line PISGAH 230-ELDORDO 230 #2
Open Line ELDORDO 500-LUGO 500 #1	and	Open Line PISGAH 230-LUGO 230 #1
Open Line ELDORDO 500-LUGO 500 #1	and	Open Line PISGAH 230-LUGO 230 #2
Open Line LUGO 500-MIRALOMA 500 #2	and	Open Line LUGO 500-MIRALOMA 500 #3
Open Line LUGO 500-MIRALOMA 500 #2	and	Open Line LUGO 500-RANCHVST 500 #1
Open Line ETIWANDA 230-SANBRDNO 230 #1	and	Open Line LUGO 500-MIRALOMA 500 #2
Open Line ETIWANDA 230-VSTA 230 #1	and	Open Line LUGO 500-MIRALOMA 500 #2
Open Line ETIWANDA 230-SANBRDNO 230 #1	and	Open Line LUGO 500-MIRALOMA 500 #3
Open Line ETIWANDA 230-VSTA 230 #1	and	Open Line LUGO 500-MIRALOMA 500 #3
Open Line LUGO 500-MOHAVE 500 #1	and	Open Line PISGAH 230-LUGO 230 #1
Open Line LUGO 500-MOHAVE 500 #1	and	Open Line PISGAH 230-LUGO 230 #2
Open Line CHINO 230-MIRALOMW 230 #1	and	Open Line RANCHVST 500-SERRANO 500 #1
Open Line CHINO 230-MIRALOMW 230 #2	and	Open Line RANCHVST 500-SERRANO 500 #1
Open Line CHINO 230-MIRALOME 230 #3	and	Open Line RANCHVST 500-SERRANO 500 #1
Open Line CHINO 230-SERRANO 230 #1	and	Open Line RANCHVST 500-SERRANO 500 #1

CATEGORY C CONTINGENCIES

Open Line ALMITOSE 230-BARRE 230 #1	and	Open Line ALMITOSE 230-CENTER S 230 #1
Open Line ETIWANDA 230-RANCHVST 230 #1	and	Open Line RANCHVST 500-SERRANO 500 #1
Open Line ETIWANDA 230-SANBRDNO 230 #1	and	Open Line RANCHVST 500-SERRANO 500 #1
Open Line ETIWANDA 230-VSTA 230 #1	and	Open Line RANCHVST 500-SERRANO 500 #1
Open Line MIRALOME 230-OLINDA 230 #1	and	Open Line RANCHVST 500-SERRANO 500 #1
Open Line RANCHVST 230-PADUA 230 #1	and	Open Line RANCHVST 500-SERRANO 500 #1
Open Line MIRALOMW 230-WALNUT 230 #1	and	Open Line RANCHVST 500-SERRANO 500 #1
Open Line LUGO 500-VINCENT 500 #1	and	Open Line LUGO 500-VINCENT 500 #2
Open Line MIDWAY 500-VINCENT 500 #1	and	Open Line MIDWAY 500-VINCENT 500 #2
Open Line VINCENT 230-ANTELOPE 230 #1	and	Open Line MIDWAY 500-VINCENT 500 #1
Open Line MESA CAL 230-ANTELOPE 230 #1	and	Open Line MIDWAY 500-VINCENT 500 #1
Open Line VINCENT 230-ANTELOPE 230 #1	and	Open Line MIDWAY 500-VINCENT 500 #2
Open Line MESA CAL 230-ANTELOPE 230 #1	and	Open Line MIDWAY 500-VINCENT 500 #2
Open Line CHINO 230-VIEJOSC 230 #1	and	Open Line MIRALOMA 500-SERRANO 500 #1
Open Line CHINO 230-SERRANO 230 #1	and	Open Line MIRALOMA 500-SERRANO 500 #1
Open Line MOENKOPI 500-ELDORDO 500 #1	and	Open Line PISGAH 230-ELDORDO 230 #2
Open Line MOHAVE 500-ELDORDO 500 #1	and	Open Line PISGAH 230-ELDORDO 230 #2
Open Line DEVERS 230-MIRAGE 230 #1	and	Open Line DEVERS 500-VALLEYSC 500 #2
Open Line DEVERS 500-VALLEYSC 500 #2	and	Open Line J.HINDS 230-MIRAGE 230 #1
Open Line S.ONOFRE 230-SERRANO 230 #1	and	Open Line SERRANO 500-VALLEYSC 500 #1
Open Line CHINO 230-VIEJOSC 230 #1	and	Open Line SERRANO 500-VALLEYSC 500 #1
Open Line CHINO 230-SERRANO 230 #1	and	Open Line SERRANO 500-VALLEYSC 500 #1
Open Line CHINO 230-MIRALOMW 230 #1	and	Open Line CHINO 230-VIEJOSC 230 #1
Open Line CHINO 230-VIEJOSC 230 #1	and	Open Line CHINO 230-SERRANO 230 #1
Open Line DEVERS 500-VALLEYSC 500 #1	and	Open Line DEVERS 500-VALLEYSC 500 #2
Open Line VSTA 230-DEVERS 230 #1	and	Open Line DEVERS 500-VALLEYSC 500 #2
Open Line DEVERS 230-VSTA 230 #2	and	Open Line SANBRDNO 230-DEVERS 230 #1
Open Line DEVERS 230-MIRAGE 230 #1	and	Open Line RAMON 230-MIRAGE 230 #1
Open Line MEAD S 230-ELDORDO 230 #2	and	Open Line PISGAH 230-ELDORDO 230 #2
Open Line CIMA 230-ELDORDO 230 #1	and	Open Line MEAD S 230-ELDORDO 230 #1
Open Line DELAMO 230-ELLIS 230 #1	and	Open Line ELLIS 230-SANTIAGO 230 #1
Open Line BARRE 230-ELLIS 230 #1	and	Open Line ELLIS 230-JOHANNA 230 #1
Open Line HARBOR 230-HINSON 230 #1	and	Open Line HARBOR 230-LBEACH 230 #1
Open Line ARCO SC 230-HINSON 230 #2	and	Open Line HINSON 230-DELAMO 230 #1
Open Line LUGO 500-MIRALOMA 500 #3	and	Open Line LUGO 500-MOHAVE 500 #1
Open Line ELDORDO 500-LUGO 500 #1	and	Open Line LUGO 500-MIRALOMA 500 #2
Open Line RANCHVST 500-SERRANO 500 #1	and	Open Line LUGO 500-VINCENT 500 #1
Open Line LUGO 500-VINCENT 500 #2	and	Open Line LUGO 500-VICTORVL 500 #1
Open Line VICTOR 230-LUGO 230 #2	and	Open Line PISGAH 230-LUGO 230 #2
Open Line KRAMER 230-LUGO 230 #1	and	Open Line PISGAH 230-LUGO 230 #1
Open Line CHINO 230-MIRALOMW 230 #2	and	Open Line MIRALOMW 230-WALNUT 230 #1
Open Line CHINO 230-MIRALOME 230 #3	and	Open Line MIRALOME 230-OLINDA 230 #1
Open Line ETIWANDA 230-RANCHVST 230 #1	and	Open Line RANCHVST 230-PADUA 230 #1
Open Line MOORPARK 230-ORMOND 230 #3	and	Open Line PARDEE 230-MOORPARK 230 #1
Open Line MOORPARK 230-ORMOND 230 #4	and	Open Line S.CLARA 230-MOORPARK 230 #2
Open Line MIRALOME 230-OLINDA 230 #1	and	Open Line OLINDA 230-WALNUT 230 #1
Open Line LAGUBELL 230-RIOHONDO 230 #1	and	Open Line RIOHONDO 230-VINCENT 230 #2

CATEGORY C CONTINGENCIES

Open Line ALMITOSE 230-BARRE 230 #1	and	Open Line ALMITOSE 230-CENTER S 230 #1
Open Line ETIWANDA 230-SANBRDNO 230 #1	and	Open Line SANBRDNO 230-DEVERS 230 #1
Open Line S.CLARA 230-GOLETA 230 #1	and	Open Line S.CLARA 230-MOORPARK 230 #1
Open Line S.CLARA 230-GOLETA 230 #2	and	Open Line S.CLARA 230-MOORPARK 230 #2
Open Line ELLIS 230-SANTIAGO 230 #1	and	Open Line S.ONOFRE 230-SANTIAGO 230 #2
Open Line EAGLROCK 230-PARDEE 230 #1	and	Open Line PARDEE 230-PASTORIA 230 #1
Open Line PARDEE 230-MOORPARK 230 #3	and	Open Line PARDEE 230-SYLMAR S 230 #1
Open Line LEWIS 230-SERRANO 230 #2	and	Open Line S.ONOFRE 230-SERRANO 230 #1
Open Line CHINO 230-SERRANO 230 #1	and	Open Line LEWIS 230-SERRANO 230 #2
Open Line CHINO 230-SERRANO 230 #1	and	Open Line SERRANO 230-VILLA PK 230 #2
Open Line LEWIS 230-SERRANO 230 #1	and	Open Line SERRANO 230-VILLA PK 230 #1
Open Line S.ONOFRE 230-SERRANO 230 #1	and	Open Line SERRANO 230-VILLA PK 230 #1
Open Line PARDEE 230-SYLMAR S 230 #1	and	Open Line SYLMAR S 230-GOULD 230 #1
Open Line EAGLROCK 230-SYLMAR S 230 #1	and	Open Line PARDEE 230-SYLMAR S 230 #2
Open Line VINCENT 230-S.CLARA 230 #1	and	Open Line VINCENT 230-ANTELOPE 230 #1
Open Line PARDEE 230-VINCENT 230 #1	and	Open Line VINCENT 230-MESA CAL 230 #1
Open Line LEWIS 230-SERRANO 230 #1	and	Open Line LEWIS 230-VILLA PK 230 #1
Open Line BARRE 230-LEWIS 230 #1	and	Open Line LEWIS 230-SERRANO 230 #2
Open Line BARRE 230-VILLA PK 230 #1	and	Open Line SERRANO 230-VILLA PK 230 #1
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	and	Open Xfmr MIRALOMA 500/MIRALOMW 230 #2
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	and	Open Line MIRALOME 230-OLINDA 230 #1
Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	and	Open Line MIRALOME 230-OLINDA 230 #1
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	and	Open Line MIRALOMW 230-JURUPA 230 #1
Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	and	Open Line MIRALOMW 230-JURUPA 230 #1
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	and	Open Line JURUPA 230-VSTA 230 #1
Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	and	Open Line JURUPA 230-VSTA 230 #1

OVERLAPPING OUTAGES

Open Line LUGO 500-MIRALOMA 500 #3	and	Open Line RANCHVST 500-SERRANO 500 #1
Open Line LUGO 500-MOHAVE 500 #1	and	Open Line LUGO 500-VICTORVL 500 #1
Open Line MIDPOINT 500-DEVERS 500 #1	and	Open Line MIDWAY 500-VINCENT 500 #2
Open Line MIDPOINT 500-DEVERS 500 #1	and	Open Line MIDWAY 500-LOWWIND 500 #3
Open Line LUGO 500-MOHAVE 500 #1	and	Open Line MIDWAY 500-VINCENT 500 #2
Open Line LUGO 500-MOHAVE 500 #1	and	Open Line ELDORDO 500-LUGO 500 #1
Open Line ANTELOPE 500-PARDEE 500 #n1	and	Open Line VINCENT 500-MESA CAL 500 #n1
Open Line ANTELOPE 500-PARDEE 500 #n1	and	Open Line PARDEE 230-MOORPARK 230 #1
Open Line ANTELOPE 500-PARDEE 500 #n1	and	Open Line MOORPARK 230-ORMOND 230 #1
Open Line ANTELOPE 500-PARDEE 500 #n1	and	Open Line PARDEE 230-S.CLARA 230 #1
Open Line ANTELOPE 500-PARDEE 500 #n1	and	Open Line PARDEE 230-SYLMAR S 230 #1
Open Line ANTELOPE 500-PARDEE 500 #n1	and	Open Line PARDEE 230-VINCENT 230 #1
Open Line PARDEE 230-SYLMAR S 230 #1	and	Open Line PARDEE 230-SYLMAR S 230 #2
Open Line LA FRESA 230-REDONDO 230 #1	and	Open Line LAGUBELL 230-RIOHONDO 230 #1
Open Line LA FRESA 230-REDONDO 230 #2	and	Open Line LAGUBELL 230-RIOHONDO 230 #1
Open Line PARDEE 230-MOORPARK 230 #1	and	Open Line PARDEE 230-MOORPARK 230 #2
Open Line PARDEE 230-MOORPARK 230 #1	and	Open Line PARDEE 230-MOORPARK 230 #3
Open Line S.ONOFRE 230-SANTIAGO 230 #1	and	Open Line S.ONOFRE 230-SANTIAGO 230 #2
Open Line LEWIS 230-SERRANO 230 #1	and	Open Line SERRANO 230-VILLA PK 230 #1
Open Line LEWIS 230-SERRANO 230 #2	and	Open Line SERRANO 230-VILLA PK 230 #2
Open Line MIRALOME 230-OLINDA 230 #1	and	Open Line JURUPA 230-VSTA 230 #1
Open Line CHINO 230-MIRALOMW 230 #2	and	Open Line CHINO 230-MIRALOME 230 #3

APPENDIX 6

SCE TRANSMISSION LINE INFORMATION

SUBMITTED TO THE ENERGY COMMISSION

IN JUNE 1993

Utility Service Area: Southern California Edison
Date Filed: June 1993
Utility Contact: Tambre Doyle
Phone: (818) 302-6404

CEC Contact: Yvonne Nelson
Phone: (916) 654-4981

EXISTING TRANSMISSION FACILITIES

Transmission Line Name/Designation	Design/Operating Voltage (kV)	Conductor Size & Type (kcmil)	Conductor Capacity (SUM NOR - AMPS)*	Conductor Capacity (WIN NOR - AMPS)*	Conductor Capacity (SUM EM - AMPS)*	Conductor Capacity (WIN EM - AMPS)*	Circuit Miles (miles)
Alamitos-Barre #1	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	15
Alamitos-Barre #2	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	15
Alamitos-Center	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	12
Alamitos-Lighthipe	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	12
Antelope-Magunden #1	230/230	ACSR 30/19	895	895	1029	1029	59
Antelope-Magunden #2	230/230	1033 ACSR 54/7	1240	1240	1426	1426	59
Antelope-Mesa	230/230	605 ACSR 30/19	895	895	1029	1029	60
Antelope-Vincent	230/230	1033 ACSR 54/7	1240	1240	1426	1426	18
ARCO-Hinson #1 or 2	230/230	1033 ACSR 54/7	1240	1240	1426	1426	2
Bailey-Pardee	230/230	605 ACSR 54/7	885	885	1018	1018	26
Bailey-Pastoria	230/230	605 ACSR 54/7	885	885	1018	1018	12
Barre-Ellis	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	13
Barre-Lewis	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	5
Barre-Villa Park	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	9
Big Creek 1-Big Creek 2	230/230	605 ACSR 54/7	885	885	974	974	5
Big Creek 1-Eastwood	230/230	605 ACSR 30/19	895	895	985	985	5
Big Creek 1-Rector	230/230	605 ACSR 54/7	885	885	974	974	75
Big Creek 2-Big Creek 3	230/230	605 ACSR 54/7	885	885	974	974	7
Big Creek 2-Big Creek 8	230/230	605 ACSR 54/7	885	885	974	974	2
Big Creek 3-Big Creek 4	230/230	605 ACSR 30/19	895	895	985	985	6
Big Creek 3-Big Creek 8	230/230	605 ACSR 54/7	885	885	974	974	7
Big Creek 3-Mammoth Pool	230/230	605 ACSR 30/19	895	895	985	985	6
Big Creek 3-Rector	230/230	605 ACSR 54/7	885	885	974	974	64
Big Creek 3-Springville	230/230	1033 ACSR 54/7	1240	1240	1364	1364	77
Big Creek 4-Springville	230/230	605 ACSR 30/19	895	895	985	985	61

*AMPS can be converted to MVA by multiplying the AMPS times voltage times square root of 3. For 230 kV, multiply AMPS by 0.3984 to get MVA.

Utility Service Area: Southern California Edison
Date Filed: June 1993
Utility Contact: Tambre Doyle
Phone: (818) 302-6404

Form T-4, p. 3 of 7
CEC Contact: Yvonne Nelson
Phone: (916) 654-4981

EXISTING TRANSMISSION FACILITIES

Transmission Line Name/Designation	Design/Operating Voltage	Conductor Size & Type	Conductor Capacity (SUM NOR - AMPS)*	Conductor Capacity (WIN NOR - AMPS)*	Conductor Capacity (SUM EM - AMPS)*	Conductor Capacity (WIN EM - AMPS)*	Circuit Miles
Center-Del Amo	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	6
Center-Mesa	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	12
Center-Olinda	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	19
Chino-Mira Loma #1	230/230	2-505 ACSR	1770	1770	2036	2036	7
Chino-Mira Loma #2 or 3	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	6
Chino-San Onofre	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	48
Chino-Serrano	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	25
Coachella-Devers	230/230	1033 ACSR 54/7	1240	1240	1426	1426	34
Cool Water-Kramer #1 or 2	230/230	1590 ACSR 45/7	1615	1615	1857	1857	44
Coso-Kramer	230/230	1033 ACSR 54/7	1240	1240	1426	1426	76
Del Amo-Ellis	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	23
Del Amo-Laguna Bell	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	14
Del Amo-Hinson	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	13
Devers-Mirage	230/230	1033 ACSR 54/7	1240	1240	1426	1426	15
Devers-San Bernardino #1	230/230	605 ACSR 30/19	708	708	708	708	43
Devers-San Bernardino #2	230/230	1033 Alum Str	1150	1150	1150	1150	43
Devers-Vista #1	230/230	1033 Alum Str	1150	1150	1150	1150	45
Devers-Vista #2	230/230	1033 ACSR 54/7	1240	1240	1240	1240	45
Eagle Rock-Mesa	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	25

*AMPS can be converted to MVA by multiplying the AMPS times voltage times square root of 3. For 230 kV, multiply AMPS by 0.3984 to get MVA.

Utility Service Area: Southern California Edison
Date Filed: June 1993
Utility Contact: Tambre Doyle
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CEC Contact: Yvonne Nelson
Phone: (916) 654-4981

EXISTING TRANSMISSION FACILITIES

Transmission Line Name/Designation	Design/Operating Voltage	Conductor Size & Type	Conductor Capacity (SUM NOR - AMPS)*	Conductor Capacity (WIN NOR - AMPS)*	Conductor Capacity (SUM EM - AMPS)*	Conductor Capacity (WIN EM - AMPS)*	Circuit Miles
Eagle Rock-Pardee	230/230	1033 ACSR 54/7	1240	1240	1426	1426	50
Eagle Rock-Sylmar	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	26
Eldorado-Mead #1 or 2	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	15
Eldorado-Pisgah #1 or 2	230/230	605 ACSR	725	725	834	834	49
Ellis-Huntington Beach #1 or 2	230/230	1033 ACSR 54/7	1240	1240	1426	1426	4
Ellis-Huntington Beach #3 or 4	230/230	1033 ACSR 54/7	1240	1240	1426	1426	4
Ellis-Johanna	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	6
Ellis-Santiago	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	15
El Nido-El Segundo #1 or 2	230/230	2-3000 CU	2008	2008	2309	2309	4
El Nido-La Cienega	230/230	1590 ACSR 45/7	1615	1615	1857	1857	7
El Nido-La Fresa #3 or 4	230/230	4-336 ACSR 18/1	2420	2420	2783	2783	4
Etiwanda-Mira Loma	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	7
Etiwanda-Padua	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	15
Etiwanda-San Bernardino	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	24
Etiwanda-Vista	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	16
Goleta-Santa Clara #1 or 2	230/230	1033 ACSR 54/7	1240	1240	1426	1426	49
Goodrich-Gould	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	9
Goodrich-Laguna Bell	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	14
Gould-Sylmar	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	28
Harborgen-Hinson	230/230	650 Calson Bronze	1185	1185	1363	1363	2
Harborgen-Long Beach	230/230	650 Calson Bronze	1185	1185	1363	1363	1
Hinson-La Fresa	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	14

*AMPS can be converted to MVA by multiplying the AMPS times voltage times square root of 3. For 230 kV, multiply AMPS by 0.3984 to get MVA.

Utility Service Area: Southern California Edison
Date Filed: June 1993
Utility Contact: Tambre Doyle
Phone: (818) 302-6404

CEC Contact: Yvonne Nelson
Phone: (916) 654-4981

EXISTING TRANSMISSION FACILITIES

Transmission Line Name/Designation	Design/Operating Voltage	Conductor Size & Type	Conductor Capacity (SUM NOR - AMPS)*	Conductor Capacity (WIN NOR - AMPS)*	Conductor Capacity (SUM EM - AMPS)*	Conductor Capacity (WIN EM - AMPS)*	Circuit Miles
Hinson-Lighthipe	230/230	650 Calson Bronze	1185	1185	1363	1363	6
Johanna-Santiago	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	8
Kramer-Lugo #1 or 2	230/230	1033 ACSR 54/7	1240	1240	1426	1426	48
Julian Hinds-Mirage	230/230	605 ACSR 30/19	895	895	1029	1029	47
La Cienega-La Fresa	230/230	1590 ACSR 45/7	1615	1615	1857	1857	12
La Fresa-Laguna Bell	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	17
La Fresa-Redondo #1 or 2	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	5
Laguna Bell-Rio Hondo	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	16
Lewis-Serrano #1 or 2	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	7
Lewis-Villa Park	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	4
Lighthipe-Long Beach	230/230	650 Calson Bronze	1185	1185	1363	1363	10
Lighthipe-Mesa	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	12
Lighthipe-Redondo	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	14
Lugo-Pisgah #1 or 2	230/230	605 ACSR 30/19	725	725	834	834	65
Lugo-Victor #1 or 2	230/230	1033 ACSR 54/7	1240	1240	1426	1426	11
Luz-Kramer	230/230	1590 ACSR 45/7	1615	1615	1857	1857	14
Magunden-Omar	230/230	1590 ACSR 45/7	1615	1615	1857	1857	9
Magunden-Pastoria #1 or 2	230/230	605 ACSR 54/7	885	885	1018	1018	30
Magunden-Pastoria #3	230/230	1033 ACSR 54/7	1240	1240	1426	1426	30
Magunden-Springville #1	230/230	1033 ACSR 54/7	1240	1240	1426	1426	52
Magunden-Springville #2	230/230	605 ACSR 30/19	895	895	1029	1029	52

*AMPS can be converted to MVA by multiplying the AMPS times voltage times square root of 3. For 230 kV, multiply AMPS by 0.3984 to get MVA.

Utility Service Area: Southern California Edison
Date Filed: June 1993
Utility Contact: Tambre Doyle
Phone: (818) 302-6404

Form T-4, p. 6 of 7
CEC Contact: Yvonne Nelson
Phone: (916) 654-4981

EXISTING TRANSMISSION FACILITIES

Transmission Line Name/Designation	Design/Operating Voltage	Conductor Size & Type	Conductor Capacity (SUM NOR - AMPS)*	Conductor Capacity (WIN NOR - AMPS)*	Conductor Capacity (SUM EM - AMPS)*	Conductor Capacity (WIN EM - AMPS)*	Circuit Miles
Magunden-Vestal #1 or 2	230/230	605 ACSR 54/7	885	885	1018	1018	36
Mandalay-Santa Clara #1 or 2	230/230	1033 ACSR 54/7	1240	1240	1426	1426	9
Mesa-Redondo	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	26
Mesa-Rio Hondo	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	11
Mesa-Walnut	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	14
Mesa-Vincent	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	36
Mira Loma-Olinda	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	25
Mira Loma-Padua	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	22
Mira Loma-Vista #1 or 2	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	16
Mira Loma-Walnut	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	28
Moorpark-Ormond Beach #1-4	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	22
Moorpark-Pardee #1-3	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	26
Moorpark-Santa Clara #1 or 2	230/230	1033 ACSR 54/7	1240	1240	1426	1426	25
Olinda-Walnut	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	6
Pardee-Pastoria	230/230	605 ACSR 30/19	895	895	1029	1029	39
Pardee-Warne-Pastoria	230/230	1033 ACSR 54/7	1240	1240	1426	1426	41
Pardee-Santa Clara #1 or 2	230/230	1033 ACSR 54/7	1240	1240	1426	1426	40
Pardee-Sylmar #1 or 2	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	12
Pardee-Vincent #1	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	33
Pardee-Vincent #2	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	30
Pearblossom-Vincent	230/230	605 ACSR 54/7	885	885	1018	1018	13
Rector-Vestal #1 or2	230/230	605 ACSR 54/7	885	885	1018	1018	33
Rio Hondo-Vincent #1	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	32

*AMPS can be converted to MVA by multiplying the AMPS times voltage times square root of 3. For 230 kV, multiply AMPS by 0.3984 to get MVA.

Utility Service Area: Southern California Edison
Date Filed: June 1993
Utility Contact: Tambre Doyle
Phone: (818) 302-6404

Form T-4, p. 7 of 7
CEC Contact: Yvonne Nelson
Phone: (916) 654-4981

EXISTING TRANSMISSION FACILITIES

Transmission Line Name/Designation	Design/Operating Voltage	Conductor Size & Type	Conductor Capacity (SUM NOR - AMPS)*	Conductor Capacity (WIN NOR - AMPS)*	Conductor Capacity (SUM EM - AMPS)*	Conductor Capacity (WIN EM - AMPS)*	Circuit Miles
Rio Hondo-Vincent #2	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	32
San Bernardino-Vista	230/230	2-1033 ACSR 54/7	2480	2480	2852	2852	8
San Onofre-Santiago #1 or 2	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	29
San Onofre-Serrano	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	40
Serrano-Villa Park #1 or 2	230/230	2-1590 ACSR 45/7	3230	3230	3715	3715	3

*AMPS can be converted to MVA by multiplying the AMPS times voltage times square root of 3. For 230 kV, multiply AMPS by 0.3984 to get MVA.

APPENDIX 7

SCE LINE RATING AND LIMITING FACTOR INFORMATION SUBMITTED TO THE ENERGY COMMISSION IN JUNE 2007

"Mike Jaske"
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06/26/2007 02:55 PM

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bcc

Subject Fwd: Transmission Path Ratings

Response from SCE that came in moments ago.

>>> <Jacqueline.Jones@sce.com> 6/26/2007 2:50 PM >>>
Per the California Energy Commission's (CEC's) request for clarification about the ratings on certain SCE 230-kV lines, SCE has drafted a report which clarifies the factors and reasoning behind the line ratings.

We have confirmed that the "New" ratings in the study case are correct as of June 25, 2007.

The Barre-Ellis 230-kV Transmission Line (T/L) is a bundled 1033 MCM ACSR conductor, Limited by Clearance and its rating is (2480 Amps(Normal) & 2480 Amps(Emergency)).
The Center-Mesa 230-kV T/L is a bundled 1033 MCM ACSR conductor, Limited by Clearance and its rating is (2480 Amps(Normal) & 2480 Amps(Emergency)).
The Chino-Miraloma #3 230-kV T/L is a bundled 1033 MCM ACSR conductor, Limited by Clearance and its rating is (2480 Amps(Normal) & 2480 Amps(Emergency)).
The Barre-Lewis 230-kV T/L is a bundled 1033 MCM ACSR conductor, Limited by Termination Equipment and its rating is (3000 Amps(Normal) & 3750 Amps(Emergency)).
The Moorpark-Pardee #2 and #3 230-kV T/L's are bundled 1590 MCM ACSR conductor, Limited by Disconnect Switches and their ratings are (1800 Amps(Normal) & 2280 Amps(Emergency)).
The Moorpark-Pardee #1 230-kV T/L's is a bundled 1590 MCM ACSR conductor, Limited by a Wavetrap and its rating is (3000 Amps(Normal) & 3300 Amps(Emergency)).
The Pardee-Santa Clara 230-kV T/L is a single 1033 MCM ACSR conductor, Limited by Clearance, and its rating is (1240 Amps(Normal) & 1240 Amps(Emergency)).
The Moorpark-Sata Clara 230-kV T/L is a single 1033 MCM ACSR conductor, Limited by a Drop Conductor, and its rating is (1150 Amps(Normal) & 1320 Amps(Emergency)).

Note: Please refer to the attachment provided by Rolf L. Henriks for further clarification.

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CEC Response 6-25-07.doc

Response regarding SCE Transmission Line Ratings:

First, let me clarify that a transmission line, according to NERC regulations includes its overhead conductor, its termination equipment at each end, and other considerations such as line sag, relay settings, series compensation or anything that limits flow of power over the transmission line. It is not just the wires and towers.

Transmission Lines ratings are most commonly limited by termination equipment, overhead conductor, or line clearance from ground or objects. SCE continuously evaluates these ratings and reports our engineering assessment in the CAISO Transmission Register as they change. An overhead conductor is generally a fixed installation and, by itself, should, and does, have the same rating for all lines that use the same conductor. However, we are often confronted with clearance encroachments by objects, such as trees, roadways, railways, buildings, structures, distribution lines, telephone lines, cable TV, and so forth. We are not permitted to operate transmission lines at temperatures that might cause conductor sag to violate clearances required by California GO 95. Such factors contribute to seeming inconsistencies in our rating methods. For example, two transmission lines with identical conductors may have different ratings because one is limited by clearance due to a new highway under it and the other is not. The conductor ratings are the same, but the evaluated transmission line ratings are different.

Also, we are constantly in the process of upgrading or re-evaluating the capacity of our termination equipment. And in some cases we will calculate, per IEEE methods, temporary emergency ratings to overcome a specific loading requirement, usually in conjunction with a planned upgrade. For example a 2000A disconnect switch can carry 3220A for 15-min without exceeding its thermal capacity. So we may use this rating under the requirement that this temporary overload must be mitigated within the time limit. Logically this might also generate an upgrade plan for this circuit.

And, finally, new NERC regulations are forcing us revise our rating methodology by placing new requirements on how we rate our facilities and how we report them. We intend full compliance with these new regulations. There are undoubtedly some changes to our ratings due to these new regulations and especially to any ratings that were in place prior to 2003 in the wake of the Northeast Blackout.

The end result of the foregoing is that transmission line ratings are not static. The CAISO Transmission Register holds our latest "official" and "up-to-date" ratings. It is updated virtually everyday in response to new installations, new rating evaluations, temporary limitations, etc. This is required by the Transmission Control Agreement. And needless to say, any mistakes we find need to be corrected as soon as discovered. Each change reported in CAISO's Transmission Register is accompanied with the date and reason for the change (from a menu), and who made the change. We do not formally maintain a readily available history as to why it was decided to remove or replace a system component. Such information can be researched only for a period of time depending on company records retention policies.

Against the above, power flow studies are carried out, perhaps once or twice per year, and necessarily consider a snapshot of our system configuration at one point in time. That there are a few differences between data in the Register and data used in studies should be expected. Until power flow studies can be carried out in real-time, this situation appears to be unavoidable. Any comparison between a power flow study data and the Transmission Register data should only be made "as-of" the date the data was taken.

In summary, all overhead conductor (COND) ratings are the same for each type of conductor and may be looked upon as the ultimate rating of that transmission line. These are listed in the Transmission Register under:

Station: [TRANSMISSION LINE] Component: COND.

But other components in the path of power flow are often more limiting for the overall transmission line (TLS) rating. The overall transmission line rating is listed in the Register under:

Station: [TRANSMISSION LINE], Component: TLS.

To gain full capacity equal to the overhead conductor, we need to upgrade termination equipment or mitigate the clearance issues, or both. These, of course, come with their own set of feasibility and economic issues.

As of June 25, 2007, the ampere limitations for the lines you mention are as follows:

	Norm	Emerg.	Limited by
Barre-Ellis	2480	2480	Clearance
Center-Mesa	2480	2480	Clearance
Chino-Mira Loma 3	2480	2480	Clearance
Barre-Lewis	3000	3750	Termination Equip
Moorpark-Pardee 1	3000	3300	Wave trap
Moorpark-Pardee 2	1800	2280	Disconnects
Moorpark-Pardee 3	1800	2280	Disconnects
Pardee-Santa Clara	1240	1240	Clearance
Moorpark-Santa Clara	1150	1320	Drop conductor

R Henriks 6-25-07

APPENDIX 8

DETAILED INFORMATION ON RESULTS OF CONTINGENCY STUDIES FOR CASES WITH ALL RETIREMENTS IN 2012

2012 HS Case With 4,140 MW of Aged Plants Retired - Updated Initial Case

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B Outages With SONGS 3 On-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(576)	1,494	120
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(576)	1,494	120
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,707	118
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,707	118
Category C Outages With SONGS 3 On-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(1,051)	2,820	114
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(919)	2,462	108
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,286)	3,344	135
Overlapping Outages With SONGS 3 On-Line						
Open Line LUGO 500-MOHAVE 500 #1 Open Line LUGO 500-VICTORVL 500 #1	ELDORDO -LUGO 500.00kV Ckt#1 Sec# 3	1,600	Amps	1,644	1,825	114
Open Line LA FRESA 230-REDONDO 230 #1 Open Line LAGUBELL 230-RIOHONDO 230 #1	LA FRESA-REDONDO 230.00kV Ckt#2 Sec# 1	2,400	Amps	(992)	2,519	105
Open Line LA FRESA 230-REDONDO 230 #2 Open Line LAGUBELL 230-RIOHONDO 230 #1	LA FRESA-REDONDO 230.00kV Ckt#1 Sec# 1	2,400	Amps	(992)	2,519	105
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	1,800	Amps	(919)	2,462	137
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #3	MOORPARK-PARDEE 230.00kV Ckt#2 Sec# 1	1,800	Amps	(919)	2,462	137
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(1,051)	2,820	114
Open Line LEWIS 230-SERRANO 230 #1 Open Line SERRANO 230-VILLA PK 230 #1	SERRANO -VILLA PK 230.00kV Ckt#2 Sec# 1	3,231	Amps	1,309	3,414	106
Open Line LEWIS 230-SERRANO 230 #2 Open Line SERRANO 230-VILLA PK 230 #2	SERRANO -VILLA PK 230.00kV Ckt#1 Sec# 1	3,231	Amps	1,309	3,414	106
Open Line MIRALOME 230-OLINDA 230 #1 Open Line JURUPA 230-VSTA 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,029)	2,660	107
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	1,790	Amps	773	2,004	112
Category B Outages With SONGS 3 Off-Line						
Open Line LUGO 500-VICTORVL 500 #1	ELDORDO -LUGO 500.00kV Ckt#1 Sec# 1	1,600	Amps	1,472	1,629	102
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(576)	1,498	121
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(576)	1,498	121
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,712	118

2012 HS Case With 4,140 MW of Aged Plants Retired - Updated Initial Case

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B Outages With SONGS 3 Off-Line						
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,712	118
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,091)	2,834	114
Category C Outages With SONGS 3 Off-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(1,035)	2,786	112
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(920)	2,478	109
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	944	2,470	112
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,479)	3,878	156

2016 HS Case With 4,140 MW of Aged Plants Retired - Updated Initial Case

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B Outages With SONGS 3 On-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(629)	1,630	131
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(629)	1,630	131
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,712	118
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,712	118
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,027)	2,650	107
Category C Outages With SONGS 3 On-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(1,128)	3,045	123
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(968)	2,704	119
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	943	2,439	111
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,407)	3,658	148
Overlapping Outages With SONGS 3 On-Line						
Open Line LUGO 500-MOHAVE 500 #1 Open Line LUGO 500-VICTORVL 500 #1	ELDORDO -LUGO 500.00kV Ckt#1 Sec# 1	1,600	Amps	1,636	1,794	112
Open Line LA FRESA 230-REDONDO 230 #1 Open Line LAGUBELL 230-RIOHONDO 230 #1	LA FRESA-REDONDO 230.00kV Ckt#2 Sec# 1	2,400	Amps	(1,003)	2,546	106
Open Line LA FRESA 230-REDONDO 230 #2 Open Line LAGUBELL 230-RIOHONDO 230 #1	LA FRESA-REDONDO 230.00kV Ckt#1 Sec# 1	2,400	Amps	(1,003)	2,546	106
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	1,800	Amps	(968)	2,704	150
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #3	MOORPARK-PARDEE 230.00kV Ckt#2 Sec# 1	1,800	Amps	(968)	2,704	150
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(1,128)	3,045	123
Open Line LEWIS 230-SERRANO 230 #1 Open Line SERRANO 230-VILLA PK 230 #1	SERRANO -VILLA PK 230.00kV Ckt#2 Sec# 1	3,231	Amps	1,316	3,431	106
Open Line LEWIS 230-SERRANO 230 #2 Open Line SERRANO 230-VILLA PK 230 #2	SERRANO -VILLA PK 230.00kV Ckt#1 Sec# 1	3,231	Amps	1,316	3,431	106
Open Line MIRALOME 230-OLINDA 230 #1 Open Line JURUPA 230-VSTA 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,129)	2,914	118
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	1,790	Amps	943	2,439	136

2016 HS Case With 4,140 MW of Aged Plants Retired - Updated Initial Case

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B Outages With SONGS 3 Off-Line						
Open Line LUGO 500-MOHAVE 500 #1	LUGO -ELDORDO 500.00kV Ckt#1 Sec# 1	1,600	Amps	(1,442)	1,624	102
Open Line DELAMO 230-ELLIS 230 #1	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	999	2,609	105
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(629)	1,632	132
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(629)	1,632	132
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,721	119
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,721	119
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,152)	2,993	121
Category C Outages With SONGS 3 Off-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(1,095)	2,957	119
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(967)	2,716	119
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	1,137	2,957	134
Open Line ELDORDO 500-LUGO 500 #1 Open Line PISGAH 230-LUGO 230 #1	PISGAH -LUGO 230.00kV Ckt#2 Sec# 1	725	Amps	295	727	100
Open Line ELDORDO 500-LUGO 500 #1 Open Line PISGAH 230-LUGO 230 #2	PISGAH -LUGO 230.00kV Ckt#1 Sec# 1	725	Amps	296	730	101
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,549)	4,060	164

2020 - 4,140 MW Retired - Updated Initial Case

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B Outages - SONGS 3 On-Line						
Open Line LUGO 500-VICTORVL 500 #1	ELDORDO -LUGO 500.00kV Ckt#1 Sec# 1	1,600	Amps	1,705	1,887	118
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(676)	1,751	141
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(676)	1,751	141
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,744	120
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,744	120
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,069)	2,763	111
Category C Outages - SONGS 3 On-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(1,240)	3,348	135
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(1,009)	2,785	122
	S.CLARA -PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(457)	1,254	101
	S.CLARA -PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(457)	1,254	101
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	1,044	2,715	123
Open Line ELDORDO 500-LUGO 500 #1 Open Line PISGAH 230-LUGO 230 #1	PISGAH -LUGO 230.00kV Ckt#2 Sec# 1	725	Amps	320	789	109
Open Line ELDORDO 500-LUGO 500 #1 Open Line PISGAH 230-LUGO 230 #2	PISGAH -LUGO 230.00kV Ckt#1 Sec# 1	725	Amps	321	791	109
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,455)	3,789	153
Overlapping Outages - With SONGS 3 On-Line						
Open Line LUGO 500-MOHAVE 500 #1 Open Line LUGO 500-VICTORVL 500 #1	ELDORDO -LUGO 500.00kV Ckt#1 Sec# 1	1,600	Amps	2,157	2,401	150
Open Line LA FRESA 230-REDONDO 230 #1 Open Line LAGUBELL 230-RIOHONDO 230 #1	LA FRESA-REDONDO 230.00kV Ckt#2 Sec# 1	2,400	Amps	(1,065)	2,724	114
Open Line LA FRESA 230-REDONDO 230 #2 Open Line LAGUBELL 230-RIOHONDO 230 #1	LA FRESA-REDONDO 230.00kV Ckt#1 Sec# 1	2,400	Amps	(1,065)	2,724	114
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	1,800	Amps	(1,009)	2,785	155
	S.CLARA -PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(457)	1,254	101
	S.CLARA -PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(457)	1,254	101
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #3	MOORPARK-PARDEE 230.00kV Ckt#2 Sec# 1	1,800	Amps	(1,009)	2,785	155
	S.CLARA -PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(457)	1,254	101
	S.CLARA -PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(457)	1,254	101
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(1,240)	3,348	135
Open Line LEWIS 230-SERRANO 230 #1 Open Line SERRANO 230-VILLA PK 230 #1	SERRANO -VILLA PK 230.00kV Ckt#2 Sec# 1	3,231	Amps	1,415	3,700	115

2020 - 4,140 MW Retired - Updated Initial Case

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Overlapping Outages - With SONGS 3 On-Line						
Open Line LEWIS 230-SERRANO 230 #2 Open Line SERRANO 230-VILLA PK 230 #2	SERRANO -VILLA PK 230.00kV Ckt#1 Sec# 1	3,231	Amps	1,415	3,700	115
Open Line MIRALOME 230-OLINDA 230 #1 Open Line JURUPA 230-VSTA 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,180)	3,056	123
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	1,790	Amps	1,044	2,715	152
Category B Outages - SONGS 3 Off-Line						
Open Line LUGO 500-VICTORVL 500 #1	ELDORDO -LUGO 500.00kV Ckt#1 Sec# 1	1,600	Amps	1,784	1,980	124
Open Line HARQUAHA 500-DEVERS 500 #1	DEVERS -MIDPOINT 500.00kV Ckt#1 Sec# 2	2,700	Amps	(2,716)	3,146	117
Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	1,790	Amps	732	1,924	108
Open Line DELAMO 230-ELLIS 230 #1	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,026	2,679	108
Open Line LA FRESA 230-REDONDO 230 #1	LA FRESA-REDONDO 230.00kV Ckt#2 Sec# 1	2,400	Amps	(940)	2,406	100
Open Line LA FRESA 230-REDONDO 230 #2	LA FRESA-REDONDO 230.00kV Ckt#1 Sec# 1	2,400	Amps	(940)	2,406	100
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(676)	1,755	142
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(676)	1,755	141
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,769	121
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,769	121
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,181)	3,078	124
Category C Outages - SONGS 3 Off-Line						
Open Line LEWIS 230-SERRANO 230 #1 Open Line SERRANO 230-VILLA PK 230 #2	SERRANO -VILLA PK 230.00kV Ckt#1 Sec# 1	3,811	Amps	1,469	3,876	102
Open Line LEWIS 230-SERRANO 230 #2 Open Line SERRANO 230-VILLA PK 230 #2	SERRANO -VILLA PK 230.00kV Ckt#1 Sec# 1	3,811	Amps	1,469	3,876	102
Open Line LA FRESA 230-REDONDO 230 #1 Open Line REDONDO 230-LITEHIPE 230 #1	LA FRESA-REDONDO 230.00kV Ckt#2 Sec# 1	2,641	Amps	(1,045)	2,675	101
Open Line LA FRESA 230-REDONDO 230 #2 Open Line REDONDO 230-LITEHIPE 230 #1	LA FRESA-REDONDO 230.00kV Ckt#1 Sec# 1	2,641	Amps	(1,045)	2,675	101
Open Line LAGUBELL 230-RIOHONDO 230 #1 Open Line LITEHIPE 230-MESA CAL 230 #1	MESA CAL-CENTER S 230.00kV Ckt#1 Sec# 1	2,480	Amps	956	2,481	100
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(1,216)	3,287	133
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(1,009)	2,806	123
	S.CLARA -PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(458)	1,263	102
	S.CLARA -PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(458)	1,263	102
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	1,220	3,201	146

2020 - 4,140 MW Retired - Updated Initial Case

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category C Outages - SONGS 3 Off-Line						
Open Line ELDORDO 500-LUGO 500 #1 Open Line PISGAH 230-LUGO 230 #1	PISGAH -LUGO 230.00kV Ckt#2 Sec# 1	725	Amps	326	804	111
Open Line ELDORDO 500-LUGO 500 #1 Open Line PISGAH 230-LUGO 230 #2	PISGAH -LUGO 230.00kV Ckt#1 Sec# 1	725	Amps	327	806	111
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,584)	4,163	168

2012 HS Case With 4,140 MW of Aged Plants Retired - Case 1b Renewables

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B Outages With SONGS 3 On-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(546)	1,417	114
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(546)	1,417	114
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,708	118
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,708	118
Category C Outages With SONGS 3 On-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(1,006)	2,681	108
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(887)	2,416	106
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,198)	3,113	126
Overlapping Outages With SONGS 3 On-Line						
Open Line LUGO 500-MOHAVE 500 #1 Open Line LUGO 500-VICTORVL 500 #1	ELDORDO -LUGO 500.00kV Ckt#1 Sec# 1	1,600	Amps	1,574	1,745	109
Open Line LA FRESA 230-REDONDO 230 #1 Open Line LAGUBELL 230-RIOHONDO 230 #1	LA FRESA-REDONDO 230.00kV Ckt#2 Sec# 1	2,400	Amps	(951)	2,409	100
Open Line LA FRESA 230-REDONDO 230 #2 Open Line LAGUBELL 230-RIOHONDO 230 #1	LA FRESA-REDONDO 230.00kV Ckt#1 Sec# 1	2,400	Amps	(951)	2,409	100
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	1,800	Amps	(887)	2,416	134
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #3	MOORPARK-PARDEE 230.00kV Ckt#2 Sec# 1	1,800	Amps	(887)	2,416	134
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(1,006)	2,681	108
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	1,790	Amps	700	1,815	101
Category B Outages With SONGS 3 Off-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(546)	1,417	114
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(546)	1,417	114
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,692	118
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,032)	2,662	107
Category C Outages With SONGS 3 Off-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(984)	2,617	106
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(887)	2,418	106

2012 HS Case With 4,140 MW of Aged Plants Retired - Case 1b Renewables

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category C Outages With SONGS 3 Off-Line						
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	892	2,312	105
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,402)	3,644	147

2016 HS Case With 4,140 MW of Aged Plants Retired - Case 1b Renewables

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B Outages With SONGS 3 On-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(570)	1,462	118
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(570)	1,462	118
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,728	119
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,728	119
Category C Outages With SONGS 3 On-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(1,030)	2,740	110
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(907)	2,437	107
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	873	2,253	102
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,281)	3,332	134
Overlapping Outages With SONGS 3 On-Line						
Open Line LUGO 500-MOHAVE 500 #1 Open Line LUGO 500-VICTORVL 500 #1	ELDORDO -LUGO 500.00kV Ckt#1 Sec# 3	1,600	Amps	1,610	1,763	110
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	1,800	Amps	(907)	2,437	135
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #3	MOORPARK-PARDEE 230.00kV Ckt#2 Sec# 1	1,800	Amps	(907)	2,437	135
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(1,030)	2,740	110
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	1,790	Amps	873	2,253	126
Category B Outages With SONGS 3 Off-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(570)	1,462	118
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,702	118
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,072)	2,764	111
Category C Outages With SONGS 3 Off-Line						
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(908)	2,440	107
Open Line CHINO 230-VIEJOSC 230 #1 Open Line S.ONOFRE 230-SERRANO 230 #1	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,035	2,691	109
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	1,075	2,781	126
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,466)	3,817	154

2020 HS Case With 4,140 MW of Aged Plants Retired - Case 1b Renewables

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B Outages - SONGS 3 On-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(597)	1,535	124
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(597)	1,535	124
Open Line MIRALOME 230-OLINDA 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(976)	2,497	101
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,696	118
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,696	118
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,010)	2,588	104
Category C Outages - SONGS 3 On-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,124	2,922	118
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(928)	2,561	112
Open Line CHINO 230-MIRALOMW 230 #2 Open Line RANCHVST 500-SERRANO 500 #1	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	960	2,467	112
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,364)	3,524	142
Overlapping Outages - SONGS 3 On-Line						
Open Line LUGO 500-MOHAVE 500 #1 Open Line LUGO 500-VICTORVL 500 #1	ELDORDO -LUGO 500.00kV Ckt#1 Sec# 3	1,600	Amps	1,485	1,633	102
Open Line LA FRESA 230-REDONDO 230 #1 Open Line LAGUBELL 230-RIOHONDO 230 #1	LA FRESA-REDONDO 230.00kV Ckt#2 Sec# 1	2,400	Amps	(972)	2,462	103
Open Line LA FRESA 230-REDONDO 230 #2 Open Line LAGUBELL 230-RIOHONDO 230 #1	LA FRESA-REDONDO 230.00kV Ckt#1 Sec# 1	2,400	Amps	(972)	2,462	103
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	1,800	Amps	(928)	2,561	142
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #3	MOORPARK-PARDEE 230.00kV Ckt#2 Sec# 1	1,800	Amps	(928)	2,561	142
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,124	2,922	118
Open Line LEWIS 230-SERRANO 230 #1 Open Line SERRANO 230-VILLA PK 230 #1	SERRANO -VILLA PK 230.00kV Ckt#2 Sec# 1	3,231	Amps	1,262	3,257	101
Open Line LEWIS 230-SERRANO 230 #2 Open Line SERRANO 230-VILLA PK 230 #2	SERRANO -VILLA PK 230.00kV Ckt#1 Sec# 1	3,231	Amps	1,262	3,257	101
Open Line MIRALOME 230-OLINDA 230 #1 Open Line JURUPA 230-VSTA 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,131)	2,903	117
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	1,790	Amps	960	2,467	138

2020 HS Case With 4,140 MW of Aged Plants Retired - Case 1b Renewables

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B Outages - SONGS 3 Off-Line						
Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	1,790	Amps	697	1,797	100
Open Line DELAMO 230-ELLIS 230 #1	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,004	2,592	105
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(597)	1,537	124
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(597)	1,537	124
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,701	118
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,701	118
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,106)	2,843	115
Category C Outages - SONGS 3 Off-Line						
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(928)	2,569	113
Open Line CHINO 230-VIEJOSC 230 #1 Open Line S.ONOFRE 230-SERRANO 230 #1	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,119	2,896	117
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	1,160	2,993	136
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,476)	3,821	154

2012 HS Case With 4,140 MW of Aged Plants Retired - Case 3a Renewables

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B Outages With SONGS 3 On-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(538)	1,393	112
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(538)	1,393	112
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,688	117
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,688	117
Category C Outages With SONGS 3 On-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(994)	2,634	106
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(876)	2,364	104
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,207)	3,118	126
Overlapping Outages With SONGS 3 On-Line						
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	1,800	Amps	(876)	2,364	131
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #3	MOORPARK-PARDEE 230.00kV Ckt#2 Sec# 1	1,800	Amps	(876)	2,364	131
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(994)	2,634	106
Open Line MIRALOME 230-OLINDA 230 #1 Open Line JURUPA 230-VSTA 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(966)	2,481	100
Category B Outages With SONGS 3 Off-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(538)	1,393	112
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(538)	1,393	112
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,679	117
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,679	117
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,020)	2,616	105
Category C Outages With SONGS 3 Off-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(965)	2,551	103
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(877)	2,365	104
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	890	2,290	104
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,374)	3,549	143

2016 HS Case With 4,140 MW of Aged Plants Retired - Case 3a Renewables

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B Outages With SONGS 3 On-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(551)	1,399	113
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(551)	1,399	113
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,682	117
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,682	117
Category C Outages With SONGS 3 On-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(994)	2,623	106
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(884)	2,335	102
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,250)	3,218	130
Overlapping Outages With SONGS 3 On-Line						
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	1,800	Amps	(884)	2,335	130
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #3	MOORPARK-PARDEE 230.00kV Ckt#2 Sec# 1	1,800	Amps	(884)	2,335	130
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(994)	2,623	106
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	1,790	Amps	857	2,188	122
Category B Outages With SONGS 3 Off-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(551)	1,400	113
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(551)	1,400	113
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,689	117
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,689	117
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,034)	2,654	107
Category C Outages With SONGS 3 Off-Line						
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(885)	2,347	103
Open Line CHINO 230-VIEJOSC 230 #1 Open Line S.ONOFRE 230-SERRANO 230 #1	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,009	2,616	105
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	1,048	2,695	123
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,419)	3,675	148

2020 HS Case With 4,140 MW of Aged Plants Retired - Case 3a Renewables

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B With SONGS 3 On-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(563)	1,437	116
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(563)	1,437	116
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,688	117
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,688	117
Category C With SONGS 3 On-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,067	2,754	111
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(886)	2,389	105
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	899	2,297	104
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,278)	3,286	132
Overlapping Outages With SONGS 3 On-Line						
Open Line LUGO 500-MOHAVE 500 #1 Open Line LUGO 500-VICTORVL 500 #1	ELDORDO -LUGO 500.00kV Ckt#1 Sec# 1	1,600	Amps	1,512	1,661	104
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	1,800	Amps	(886)	2,389	133
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #3	MOORPARK-PARDEE 230.00kV Ckt#2 Sec# 1	1,800	Amps	(886)	2,389	133
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,067	2,754	111
Open Line MIRALOME 230-OLINDA 230 #1 Open Line JURUPA 230-VSTA 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,045)	2,670	108
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	1,790	Amps	899	2,297	128
Category B With SONGS 3 Off-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(563)	1,439	116
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(563)	1,439	116
Open Line MIRALOME 230-OLINDA 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,048)	2,680	108
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,689	117
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,689	117
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,087)	2,786	112

2020 HS Case With 4,140 MW of Aged Plants Retired - Case 3a Renewables

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category C With SONGS 3 Off-Line						
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(886)	2,392	105
Open Line CHINO 230-VIEJOSC 230 #1 Open Line S.ONOFRE 230-SERRANO 230 #1	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,081	2,780	112
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	1,092	2,804	128
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,455)	3,758	152

2012 HS Case With 4,140 MW of Aged Plants Retired - Case 4a Renewables

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B Outages With SONGS 3 On-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(525)	1,358	110
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(525)	1,358	110
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,688	117
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,688	117
Category C Outages With SONGS 3 On-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(999)	2,645	107
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(887)	2,402	105
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,229)	3,175	128
Overlapping Outages With SONGS 3 On-Line						
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	1,800	Amps	(887)	2,402	133
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #3	MOORPARK-PARDEE 230.00kV Ckt#2 Sec# 1	1,800	Amps	(887)	2,402	133
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(999)	2,645	107
Open Line MIRALOME 230-OLINDA 230 #1 Open Line JURUPA 230-VSTA 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(999)	2,563	103
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	1,790	Amps	700	1,802	101
Category B Outages With SONGS 3 Off-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(525)	1,358	109
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(525)	1,358	109
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,068)	2,678	117
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,068)	2,678	117
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,015)	2,598	105
Category C Outages With SONGS 3 Off-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(965)	2,547	103
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(887)	2,398	105
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	899	2,310	105
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,362)	3,511	142

2016 HS Case With 4,140 MW of Aged Plants Retired - Case 4a Renewables

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B Outages With SONGS 3 On-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(518)	1,318	106
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(518)	1,318	106
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,716	119
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,716	119
Category C Outages With SONGS 3 On-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(1,001)	2,648	107
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(909)	2,423	106
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,255)	3,250	131
Overlapping Outages With SONGS 3 On-Line						
Open Line LUGO 500-MOHAVE 500 #1 Open Line LUGO 500-VICTORVL 500 #1	ELDORDO -LUGO 500.00kV Ckt#1 Sec# 3	1,600	Amps	1,502	1,635	102
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	1,800	Amps	(909)	2,423	135
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #3	MOORPARK-PARDEE 230.00kV Ckt#2 Sec# 1	1,800	Amps	(909)	2,423	135
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	ELLIS -BARRE 230.00kV Ckt#1 Sec# 1	2,480	Amps	(1,001)	2,648	107
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	1,790	Amps	854	2,191	122
Category B Outages With SONGS 3 Off-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(518)	1,319	106
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(518)	1,318	106
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,693	118
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,693	118
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,056)	2,713	109
Category C Outages With SONGS 3 Off-Line						
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(909)	2,425	106
Open Line CHINO 230-VIEJOSC 230 #1 Open Line S.ONOFRE 230-SERRANO 230 #1	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,009	2,614	105
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	1,056	2,716	124
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,440)	3,732	150

2020 HS Case With 4,140 MW of Aged Plants Retired - Case 4a Renewables

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B Outages With SONGS 3 On-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(535)	1,373	111
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(535)	1,373	111
Open Line PISGAH 230-LUGO 230 #1	PISGAH -LUGO 230.00kV Ckt#2 Sec# 1	725	Amps	354	869	120
Open Line PISGAH 230-LUGO 230 #2	PISGAH -LUGO 230.00kV Ckt#1 Sec# 1	725	Amps	355	872	120
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,737	120
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,737	120
Category C Outages - SONGS 3 On-Line						
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,086	2,822	114
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(921)	2,543	112
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	915	2,360	107
Open Line PISGAH 230-LUGO 230 #1 Open Line PISGAH 230-LUGO 230 #2	PISGAH -CIMA 230.00kV Ckt#1 Sec# 1	725	Amps	345	858	118
	CIMA -ELDORDO 230.00kV Ckt#1 Sec# 1	725	Amps	324	853	118
	PISGAH -ELDORDO 230.00kV Ckt#2 Sec# 1	725	Amps	343	852	117
Open Line ELDORDO 500-LUGO 500 #1 Open Line PISGAH 230-LUGO 230 #1	PISGAH -LUGO 230.00kV Ckt#2 Sec# 1	725	Amps	388	954	131
Open Line ELDORDO 500-LUGO 500 #1 Open Line PISGAH 230-LUGO 230 #2	PISGAH -LUGO 230.00kV Ckt#1 Sec# 1	725	Amps	389	957	132
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,292)	3,356	135
Overlapping Outages - SONGS 3 On-Line						
Open Line LUGO 500-MOHAVE 500 #1 Open Line LUGO 500-VICTORVL 500 #1	ELDORDO -LUGO 500.00kV Ckt#1 Sec# 3	1,600	Amps	1,697	1,875	117
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	1,800	Amps	(921)	2,543	141
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #3	MOORPARK-PARDEE 230.00kV Ckt#2 Sec# 1	1,800	Amps	(921)	2,543	141
Open Line S.ONOFRE 230-SANTIAGO 230 #1 Open Line S.ONOFRE 230-SANTIAGO 230 #2	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,086	2,822	114
Open Line MIRALOME 230-OLINDA 230 #1 Open Line JURUPA 230-VSTA 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(977)	2,516	101
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	1,790	Amps	915	2,360	132

2020 HS Case With 4,140 MW of Aged Plants Retired - Case 4a Renewables

OUTAGE	IMPACTED FACILITY(IES)	RATING		FLOW MW	FLOW AMPS	FLOW P.U.
Category B Outages - SONGS 3 Off-Line						
Open Line DELAMO 230-ELLIS 230 #1	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	974	2,517	102
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(535)	1,375	111
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(535)	1,375	111
Open Line PISGAH 230-LUGO 230 #1	PISGAH -LUGO 230.00kV Ckt#2 Sec# 1	725	Amps	352	864	119
Open Line PISGAH 230-LUGO 230 #2	PISGAH -LUGO 230.00kV Ckt#1 Sec# 1	725	Amps	353	867	119
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,739	120
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,739	120
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,050)	2,715	109
Category C Outages - SONGS 3 Off-Line						
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(921)	2,547	112
Open Line CHINO 230-VIEJOSC 230 #1 Open Line S.ONOFRE 230-SERRANO 230 #1	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,076	2,788	112
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	1,104	2,864	130
Open Line PISGAH 230-LUGO 230 #1 Open Line PISGAH 230-LUGO 230 #2	PISGAH -CIMA 230.00kV Ckt#1 Sec# 1	725	Amps	345	858	118
	CIMA -ELDORDO 230.00kV Ckt#1 Sec# 1	725	Amps	324	853	118
	PISGAH -ELDORDO 230.00kV Ckt#2 Sec# 1	725	Amps	343	852	117
Open Line ELDORDO 500-LUGO 500 #1 Open Line PISGAH 230-LUGO 230 #1	PISGAH -LUGO 230.00kV Ckt#2 Sec# 1	725	Amps	385	947	131
Open Line ELDORDO 500-LUGO 500 #1 Open Line PISGAH 230-LUGO 230 #2	PISGAH -LUGO 230.00kV Ckt#1 Sec# 1	725	Amps	386	950	131
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,453)	3,790	153

APPENDIX 9

LOAD AND RESOURCE INFORMATION
FOR SENSITIVITY CASES

APPENDIX 9
SCE AREA LOADS AND RESOURCES MODELED IN STUDIES WITH AGED PLANT RETIREMENTS ADJUSTED (WITH SONGS 3 OUT)

	Reference	Case 1B (Mod)			Case 3A (Mod)			Case 4A (Mod)		
	Case	2012	2016	2020	2012	2016	2020	2012	2016	2020
Capacity Requirements										
Loads	26,894	26,894	28,213	29,609	26,894	28,213	29,608	26,894	28,213	29,608
Pumps	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275
Energy Efficiency [1/]	0	(874)	(1,637)	(2,269)	(1,145)	(2,292)	(3,427)	(874)	(1,637)	(2,269)
Solar PV [2/]	0	(64)	(139)	(150)	(63)	(139)	(150)	(303)	(789)	(854)
Losses	426	455	488	516	433	463	469	420	472	548
Net	28,595	27,686	28,200	28,981	27,394	27,520	27,775	27,412	27,534	28,308
Capacity Resources										
Imports	8,734	8,734	8,799	8,829	8,754	8,799	8,829	8,733	8,799	8,829
Aged Plants										
Alamitos 1-4	980	0	0	0	0	0	0	320	0	0
Alamitos 5 & 6	950	950	950	950	950	950	950	950	950	950
El Segundo 3 & 4	660	660	660	660	660	660	660	660	660	660
Etiwanda 3 & 4	620	0	0	0	0	0	0	0	0	0
Huntington Beach 1 & 2	400	400	0	0	400	0	0	400	200	0
Mandalay 1&2	400	200	0	0	200	0	0	400	0	0
Ormond Beach 1 & 2	1,400	0	0	0	0	0	0	700	0	0
Redondo Beach 5 & 6	340	0	0	0	0	0	0	0	0	0
Redondo Beach 7 & 8	900	900	900	900	900	900	900	900	900	900
Total	6,650	3,110	2,510	2,510	3,110	2,510	2,510	4,330	2,710	2,510
New Renewables (Dependable Capacity)										
Biomass [2/]	0	50	50	50	50	50	50	26	131	235
Geothermal (Kramer Area)	0	0	0	0	0	0	0	29	147	264
Solar (CSP) [3/]										
Pisgah Area	0	305	479	479	305	479	479	131	305	539
Kramer Area	0	0	91	91	0	91	91	0	131	244
Mohave Area	0	0	148	148	0	148	148	0	218	392
Subtotal	0	305	718	718	305	718	718	131	654	1,175
Wind [4/]										
Devers Area	0	31	86	92	29	86	94	29	86	94
Tehachapi Area	0	236	527	574	236	527	574	178	527	1,021
Pisgah Area	0	0	0	0	0	0	0	0	123	149
Eldorado Area	0	0	0	0	0	0	0	0	104	209
Victor Area	0	0	0	0	0	0	0	0	43	43
Subtotal	0	267	613	666	265	613	668	207	883	1,516
Total Renewables	0	622	1,381	1,434	620	1,381	1,436	393	1,815	3,190
Queued Thermal Projects										
Projects With PPAs										
ISO Queue #3 (Ocotillo)	455	455	455	455	455	455	455	455	455	455
ISO Queue #17 (Blythe)	490	490	490	490	490	490	490	490	490	490
ISO Queue #65 (L. Beach)	260	260	260	0	260	260	0	260	260	0
Subtotal	1,205	1,205	1,205	945	1,205	1,205	945	1,205	1,205	945

[1/] Loads at all SCE load busses reduced pro-rata to reflect energy efficiency effects

[2/] Represented at selected busses based on information prepared for the CEC's Intermittency Analysis Project Study; refer to Appendix 3

[3/] Dependable capacity assumed to be equal to 87% of installed capacity

[4/] Dependable capacity of wind in Tehachapi area assumed to be 22% of installed capacity; dependable capacity in all other areas assumed to be 29% of installed capacity.

APPENDIX 9
SCE AREA LOADS AND RESOURCES MODELED IN STUDIES WITH AGED PLANT RETIREMENTS ADJUSTED (WITH SONGS 3 OUT)

	Reference	Case 1B (Mod)			Case 3A (Mod)			Case 4A (Mod)		
	Case	2012	2016	2020	2012	2016	2020	2012	2016	2020
"Emergency" Peakers										
WDAT #30 (Etiwanda)	45	45	45	45	45	45	45	45	45	45
WDAT #31 (Mandalay)	47	47	47	47	47	47	47	47	47	47
WDAT #32 (Mira Loma)	45	45	45	45	45	45	45	45	45	45
WDAT #33 (Center)	47	47	47	47	47	47	47	47	47	47
WDAT #34 (Barre)	48	48	48	48	48	48	48	48	48	48
Subtotal	232	232	232	232	232	232	232	232	232	232
Other Peaking Projects										
ISO Queue #3 (Balance)	91	91	182	182	91	91	91	0	182	91
ISO Queue #41 (Pastoria)	159	159	159	159	159	159	159	159	159	159
ISO Queue #66 (Walnut)	0	0	202	505	202	101	505	0	101	0
ISO Queue #136 (Etiwanda)	0	303	303	303	303	303	303	303	303	303
ISO Queue #141 (R. Vista)	505	404	404	505	505	505	505	505	505	505
WDAT #2 (Highgrove)	300	300	300	300	300	300	300	300	300	300
WDAT #12 (Sun Valley)	505	505	505	505	505	505	505	505	505	505
Subtotal	1,560	1,762	2,055	2,459	2,065	1,964	2,368	1,772	2,055	1,863
Combined Cycle Projects										
ISO Queue #50 (IEEC)	810	810	810	810	810	810	810	810	810	810
ISO Queue #89 (Victor)	0	570	570	570	0	0	0	0	0	0
ISO Queue #92 (Vincent)	0	570	570	570	570	570	570	570	570	570
ISO Queue #118 (Mohave)	0	0	0	550	0	0	0	0	0	0
ISO Queue #139 (R. Vista)	0	698	698	698	698	698	698	0	0	0
Subtotal	810	2,648	2,648	3,198	2,078	2,078	2,078	1,380	1,380	1,380
Total Queued Thermal	3,807	5,847	6,140	6,834	5,580	5,479	5,623	4,589	4,872	4,420
Existing Wind Generation										
Devers Area	201	201	201	201	201	201	201	201	201	201
Tehachapi Area	126	126	126	126	126	126	126	126	126	126
Total	327	327	327	327	327	327	327	327	327	327
Other Existing Generation										
Eastwood (Area Swing)	201	172	169	173	129	150	176	166	137	158
SONGS	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070
Mountain View	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070
High Desert	835	835	835	835	835	835	835	835	835	835
Pastoria 1 & 2	758	758	758	758	758	758	758	758	758	758
Big Creek	500	500	500	500	500	500	500	500	500	500
Huntington Beach 3 & 4	420	420	420	420	420	420	420	420	420	420
Arco 1-6	400	400	400	400	400	400	400	400	400	400
Omar 1-4	300	300	300	300	300	300	300	300	300	300
Sycamore	280	280	280	280	280	280	280	280	280	280
Alta Unit 4	235	235	235	235	235	235	235	235	235	235
Alta Unit 3	230	230	230	230	230	230	230	230	230	230
Devils Canyon	208	208	208	208	208	208	208	208	208	208
Sungen 3-7	172	172	172	172	172	172	172	172	172	172
Mammoth	170	170	170	170	170	170	170	170	170	170
Luz 8 & 9	160	160	160	160	160	160	160	160	160	160
Indigo CTs	135	135	135	135	135	135	135	135	135	135

APPENDIX 9
SCE AREA LOADS AND RESOURCES MODELED IN STUDIES WITH AGED PLANT RETIREMENTS ADJUSTED (WITH SONGS 3 OUT)

	Reference	Case 1B (Mod)			Case 3A (Mod)			Case 4A (Mod)		
	Case	2012	2016	2020	2012	2016	2020	2012	2016	2020
Other Existing Generation										
Malburg	130	130	130	130	130	130	130	130	130	130
Appgen 1&2	110	110	110	110	110	110	110	110	110	110
Mc Gen	105	105	105	105	105	105	105	105	105	105
Alta Unit 2	80	80	80	80	80	80	80	80	80	80
Calgen 1-3	80	80	80	80	80	80	80	80	80	80
Chevron	76	76	76	76	76	76	76	76	76	76
Warne	76	76	76	76	76	76	76	76	76	76
Navy 4-6	75	75	75	75	75	75	75	75	75	75
Broadway (Pasadena)	65	65	65	65	65	65	65	65	65	65
Alta Unit 1	60	60	60	60	60	60	60	60	60	60
BLM 7-9	60	60	60	60	60	60	60	60	60	60
Kerr McGee/Kerrgen	58	58	58	58	58	58	58	58	58	58
Mogen	57	57	57	57	57	57	57	57	57	57
Pandol	55	55	55	55	55	55	55	55	55	55
Procgen	51	51	51	51	51	51	51	51	51	51
Anaheim CT	50	50	50	50	50	50	50	50	50	50
Oxbow	50	50	50	50	50	50	50	50	50	50
Pasadena 1&2	50	50	50	50	50	50	50	50	50	50
SEGS 1 & 2	50	50	50	50	50	50	50	50	50	50
Borax	47	47	47	47	47	47	47	47	47	47
Hillgen	45	45	45	45	45	45	45	45	45	45
Icegen	45	45	45	45	45	45	45	45	45	45
Mobgen	45	45	45	45	45	45	45	45	45	45
Tenn Gen 1 & 2	44	44	44	44	44	44	44	44	44	44
Ultragen	41	41	41	41	41	41	41	41	41	41
Simpson	37	37	37	37	37	37	37	37	37	37
Pulpgen	35	35	35	35	35	35	35	35	35	35
Oxgen	34	34	34	34	34	34	34	34	34	34
Serffgen	33	33	33	33	33	33	33	33	33	33
Cimgen	30	30	30	30	30	30	30	30	30	30
Pitchgen	30	30	30	30	30	30	30	30	30	30
Inland	30	30	30	30	30	30	30	30	30	30
Bishop Hydro	28	28	28	28	28	28	28	28	28	28
Willamet	25	25	25	25	25	25	25	25	25	25
Alamo	16	16	16	16	16	16	16	16	16	16
Rush Creek	15	15	15	15	15	15	15	15	15	15
Poole/Lundy	13	13	13	13	13	13	13	13	13	13
Total	9,075	9,046	9,043	9,047	9,003	9,024	9,050	9,040	9,011	9,032
Total Resources	28,593	27,686	28,200	28,981	27,394	27,520	27,775	27,412	27,534	28,308

APPENDIX 10

DETAILED INFORMATION ON RESULTS OF CONTINGENCY STUDIES FOR SENSITIVITY CASES

Case 1B with Revised Retirment Schedule and Adjusted New Thermal Resources

2012 - Case 1B With 3,540 MW of Aged Plants Retired

OUTAGE	FACILTY	RATING	UNIT	[MW	FLOW FLOW	PU FLOW
Category B With SONGS 3 Off-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(546)	1,410	114
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(546)	1,410	114
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,681	117
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,681	117
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(998)	2,561	103
Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(995)	2,552	103
Category C With SONGS 3 Off-Line						
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	850	2,188	100
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,361)	3,521	142

2016 - Case 1B With 4,140 MW of Aged Plants Retired

OUTAGE	FACILTY	RATING	UNIT	[MW	FLOW FLOW	PU FLOW
Category B With SONGS 3 Off-Line						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(570)	1,457	117
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(570)	1,457	117
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,688	117
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,688	117
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,094)	2,806	113
Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,090)	2,797	113
Category C With SONGS 3 Off-Line						
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(907)	2,428	107
Open Line CHINO 230-VIEJOSC 230 #1 Open Line S.ONOFRE 230-SERRANO 230 #1	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,043	2,700	109
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	1,088	2,798	127
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,471)	3,808	154

Case 3A with Revised Retirement Schedule and Adjusted New Thermal Additions

2012 - Case 3A With 3,540 MW of Aged Plants Retired

OUTAGE	FACILTY	RATING	UNIT	[MW	FLOW FLOW	PU FLOW
Category B With SONGS 3 Out						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(538)	1,389	112
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(538)	1,389	112
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,068)	2,672	117
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,068)	2,672	117
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(987)	2,519	102
Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(984)	2,511	101
Category C With SONGS 3 Out						
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,330)	3,421	138

2016 - Case 3A With 4,140 MW of Aged Plants Retired

OUTAGE	FACILTY	RATING	UNIT	[MW	FLOW FLOW	PU FLOW
Category B With SONGS 3 Out						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(551)	1,399	113
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(551)	1,399	113
Open Line MIRALOME 230-OLINDA 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,031)	2,630	106
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,068)	2,678	117
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,068)	2,678	117
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,081)	2,765	112
Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,078)	2,757	111
Category C With SONGS 3 Out						
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(884)	2,336	102
Open Line CHINO 230-VIEJOSC 230 #1 Open Line S.ONOFRE 230-SERRANO 230 #1	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,016	2,625	106
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	1,056	2,705	123
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,447)	3,731	150

Case 3A with Revised Retirement Schedule and Adjusted New Thermal Additions

2020 - Case 3A With 4,140 MW of Aged Plants Retired

OUTAGE	FACILTY	RATING	UNIT	[MW	FLOW FLOW	PU FLOW
Category B With SONGS 3 Out						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(563)	1,434	116
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(563)	1,433	116
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,679	117
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,679	117
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,060)	2,702	109
Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,057)	2,694	109
Category C With SONGS 3 Out						
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(886)	2,381	104
Open Line CHINO 230-VIEJOSC 230 #1 Open Line S.ONOFRE 230-SERRANO 230 #1	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,076	2,756	111
Open Line CHINO 230-MIRALOMW 230 #2 Open Line CHINO 230-MIRALOME 230 #3	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	1,106	2,826	129
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,403)	3,602	145

Case 4A with Revised Retirement Schedule and Adjusted New Thermal Additions

2012 - Case 4A With 2,320 MW of Aged Plants Retired

OUTAGE	FACILTY	RATING	UNIT	[MW	FLOW FLOW	PU FLOW
Category B With SONGS 3 Out						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(525)	1,332	107
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(525)	1,331	107
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,679	117
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,679	117
Category C With SONGS 3 Out						
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,272)	3,278	132

2016 - Case 4A With 3,340 MW of Aged Plants Retired

OUTAGE	FACILTY	RATING	UNIT	[MW	FLOW FLOW	PU FLOW
Category B With SONGS 3 Out						
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(518)	1,318	106
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(518)	1,317	106
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,697	118
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,697	118
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,003)	2,573	104
Category C With SONGS 3 Out						
Open Line PARDEE 230-MOORPARK 230 #1 Open Line PARDEE 230-MOORPARK 230 #2	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(909)	2,422	106
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1 Open Xfmr MIRALOMA 500/MIRALOMW 230 #2	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,386)	3,589	145

2020 - Case 4A With 4,140 MW of Aged Plants Retired

OUTAGE	FACILTY	RATING	UNIT	[MW	FLOW FLOW	PU FLOW
Category B With SONGS 3 Out						
Open Line DELAMO 230-ELLIS 230 #1	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	973	2,515	101
Open Line PARDEE 230-SAUG TAP 230 #1	SAUG TAP-PARDEE 230.00kV Ckt#2 Sec# 1	1,240	Amps	(535)	1,375	111
Open Line PARDEE 230-SAUG TAP 230 #2	SAUG TAP-PARDEE 230.00kV Ckt#1 Sec# 1	1,240	Amps	(535)	1,375	111
Open Line PISGAH 230-LUGO 230 #1	PISGAH -LUGO 230.00kV Ckt#2 Sec# 1	725	Amps	352	865	119
Open Line PISGAH 230-LUGO 230 #2	PISGAH -LUGO 230.00kV Ckt#1 Sec# 1	725	Amps	353	868	120

Case 4A with Revised Retirement Schedule and Adjusted New Thermal Additions

2020 - Case 4A With 4,140 MW of Aged Plants Retired

				[	FLOW	
OUTAGE	**FACILTY**	**RATING**	**UNIT**	**MW**	**FLOW**	**PU FLOW**
Category B With SONGS 3 Out						
Open Line MNTVIEW 230-SANBRDNO 230 #1	SANBRDNO-MNTVIEW 230.00kV Ckt#2 Sec# 1	2,289	Amps	(1,067)	2,724	119
Open Line MNTVIEW 230-SANBRDNO 230 #2	SANBRDNO-MNTVIEW 230.00kV Ckt#1 Sec# 1	2,289	Amps	(1,067)	2,724	119
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,032)	2,668	108
Category C With SONGS 3 Out						
Open Line PARDEE 230-MOORPARK 230 #1	MOORPARK-PARDEE 230.00kV Ckt#3 Sec# 1	2,279	Amps	(921)	2,548	112
Open Line PARDEE 230-MOORPARK 230 #2						
Open Line CHINO 230-VIEJOSC 230 #1	BARRE -ELLIS 230.00kV Ckt#1 Sec# 1	2,480	Amps	1,075	2,786	112
Open Line S.ONOFRE 230-SERRANO 230 #1						
Open Line PISGAH 230-LUGO 230 #1	PISGAH -CIMA 230.00kV Ckt#1 Sec# 1	725	Amps	345	858	118
Open Line PISGAH 230-LUGO 230 #2	CIMA -ELDORDO 230.00kV Ckt#1 Sec# 1	725	Amps	324	853	118
	PISGAH -ELDORDO 230.00kV Ckt#2 Sec# 1	725	Amps	343	852	117
Open Line ELDORDO 500-LUGO 500 #1	PISGAH -LUGO 230.00kV Ckt#2 Sec# 1	725	Amps	386	948	131
Open Line PISGAH 230-LUGO 230 #1						
Open Line ELDORDO 500-LUGO 500 #1	PISGAH -LUGO 230.00kV Ckt#1 Sec# 1	725	Amps	387	951	131
Open Line PISGAH 230-LUGO 230 #2						
Open Line CHINO 230-MIRALOMW 230 #2	MIRALOMW-CHINO 230.00kV Ckt#1 Sec# 1	2,199	Amps	1,112	2,873	131
Open Line CHINO 230-MIRALOME 230 #3						
Open Xfmr MIRALOMA 500/MIRALOMW 230 #1	CHINO -MIRALOME 230.00kV Ckt#3 Sec# 1	2,480	Amps	(1,431)	3,731	150
Open Xfmr MIRALOMA 500/MIRALOMW 230 #2						

APPENDIX 11

INFORMATION REGARDING THE CALCULATION OF ESTIMATED LCR AND AVAILABLE CAPACITY

APPENDIX 11
LA BASIN ESTIMATED LCR REQUIREMENTS AND RESOURCES
FOR CASES 1B, 3A, AND 4A

	2008	Case 1B			Case 3A			Case 4A		
	Actual	2012	2016	2020	2012	2016	2020	2012	2016	2020
Load	19,409	20,031	20,329	20,868	19,822	19,829	19,985	20,031	20,329	20,868
Less, PV	0	(42)	(93)	(100)	(42)	(93)	(100)	(202)	(531)	(571)
Less, Biomass	0	(50)	(50)	(50)	(50)	(50)	(50)	(26)	(130)	(208)
Pumps	23	23	23	23	23	23	23	23	23	23
Net "Load"	19,432	19,962	20,209	20,741	19,753	19,709	19,858	19,826	19,691	20,112
Losses	226	232	235	242	230	229	231	231	229	234
Total "Load"+Losses	19,658	20,194	20,444	20,983	19,983	19,938	20,089	20,057	19,920	20,346
LCR Requirement	10,130	10,666	10,916	11,455	10,455	10,410	10,561	10,529	10,392	10,818
Import Limit	9,528	9,528	9,528	9,528	9,528	9,528	9,528	9,528	9,528	9,528
QFs	780	780	780	780	780	780	780	780	780	780
Wind	11	11	11	11	11	11	11	11	11	11
Muni	508	508	508	508	508	508	508	508	508	508
Nuclear	2,246	2,246	2,246	2,246	2,246	2,246	2,246	2,246	2,246	2,246
Total "Must Take"	3,545	3,545	3,545	3,545	3,545	3,545	3,545	3,545	3,545	3,545
Required Market Gen	6,585	7,121	7,371	7,910	6,910	6,865	7,016	6,984	6,847	7,273
Available Market Gen	8,814	9,088	9,088	9,434	9,298	9,298	9,038	9,593	9,593	9,333
Total Available Generation	12,359	12,633	12,633	12,979	12,843	12,843	12,583	13,138	13,138	12,878
Existing Market Unit(s)										
Mountain View CC	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230
Alamitos 1	175	0	0	0	0	0	0	0	0	0
Alamitos 2	175	0	0	0	0	0	0	0	0	0
Alamitos 3	332	0	0	0	0	0	0	0	0	0
Alamitos 4	336	0	0	0	0	0	0	0	0	0
Alamitos 5	498	498	498	498	498	498	498	498	498	498
Alamitos 6	495	495	495	495	495	495	495	495	495	495

APPENDIX 11
LA BASIN ESTIMATED LCR REQUIREMENTS AND RESOURCES
FOR CASES 1B, 3A, AND 4A

	2008	Case 1B			Case 3A			Case 4A		
	Actual	2012	2016	2020	2012	2016	2020	2012	2016	2020
El Segundo 3	335	335	335	335	335	335	335	335	335	335
El Segundo 4	335	335	335	335	335	335	335	335	335	335
Huntington Beach 1	226	0	0	0	0	0	0	0	0	0
Huntington Beach 2	226	0	0	0	0	0	0	0	0	0
Huntington Beach 3	225	225	225	225	225	225	225	225	225	225
Huntington Beach 4	227	227	227	227	227	227	227	227	227	227
Redondo 5	179	0	0	0	0	0	0	0	0	0
Redondo 6	175	0	0	0	0	0	0	0	0	0
Redondo 7	493	493	493	493	493	493	493	493	493	493
Redondo 8	496	496	496	496	496	496	496	496	496	496
Etiwanda 3	320	0	0	0	0	0	0	0	0	0
Etiwanda 4	320	0	0	0	0	0	0	0	0	0
Etiwanda 66-kV	38	38	38	38	38	38	38	38	38	38
Wintec CTs	129	129	129	129	129	129	129	129	129	129
Brigen	35	35	35	35	35	35	35	35	35	35
Harbor	100	100	100	100	100	100	100	100	100	100
Carbogen	29	29	29	29	29	29	29	29	29	29
Pulpgen	35	35	35	35	35	35	35	35	35	35
Riverside CTs	140	140	140	140	140	140	140	140	140	140
Santiago	10	10	10	10	10	10	10	10	10	10
Long Beach	554	0	0	0	0	0	0	0	0	0
Malberg	136	136	136	136	136	136	136	136	136	136
Subtotal	8,004	4,986	4,986	4,986	4,986	4,986	4,986	4,986	4,986	4,986
Potential Market Units										
IEEC	810	810	810	810	810	810	810	810	810	810
PPA Peakers	0	715	715	455	715	715	455	715	715	455
Emergency Peakers	0	185	185	185	185	185	185	185	185	185
Generic Peakers	0	1,694	1,694	2,300	1,904	1,904	1,904	2,199	2,199	2,199
Generic CCs	0	698	698	698	698	698	698	698	698	698
Subtotal	810	4,102	4,102	4,448	4,312	4,312	4,052	4,607	4,607	4,347
Total Market Units	8,814	9,088	9,088	9,434	9,298	9,298	9,038	9,593	9,593	9,333

APPENDIX 11
BC/VENTURA ESTIMATED LCR REQUIREMENTS AND RESOURCES
FOR CASES 1B, 3A, AND 4A

	2008	Case 1B			Case 3A			Case 4A		
	Actual	2012	2016	2020	2012	2016	2020	2012	2016	2020
Load	4,435	4,763	4,953	5,132	4,713	4,831	4,915	4,763	4,953	5,132
Less, PV	0	(8)	(17)	(18)	(8)	(17)	(18)	(36)	(93)	(101)
Less, Biomass	0	0	0	0	0	0	0	0	0	(20)
Pumps	420	420	420	420	420	420	420	420	420	420
Net "Load"	4,855	5,175	5,356	5,534	5,125	5,234	5,317	5,147	5,280	5,431
Losses	156	166	172	178	165	168	171	165	170	175
Total "Load" + Losses	5,011	5,341	5,528	5,712	5,290	5,402	5,488	5,312	5,450	5,606
LCR Requirement	3,658	3,388	3,575	3,759	3,337	3,449	3,535	3,359	3,497	3,653
Import Limit	1,353	1,953	1,953	1,953	1,953	1,953	1,953	1,953	1,953	1,953
QFs	1,117	1,117	1,117	1,117	1,117	1,117	1,117	1,117	1,117	1,117
Existing Wind	346	346	346	346	346	346	346	346	346	346
Muni	0	0	0	0	0	0	0	0	0	0
Nuclear	0	0	0	0	0	0	0	0	0	0
Total "Must Take"	1,463	1,463	1,463	1,463	1,463	1,463	1,463	1,463	1,463	1,463
Required Market Gen	2,195	1,925	2,112	2,296	1,874	1,986	2,072	1,896	2,034	2,190
Available Market Gen	3,933	2,869	3,160	3,207	2,869	3,160	3,207	2,811	3,160	3,654
Total Available Generation	5,396	4,332	4,623	4,670	4,332	4,623	4,670	4,274	4,623	5,117
Existing Market Unit(s)										
Alamo	18	18	18	18	18	18	18	18	18	18
Appgen 1 & 2	122	122	122	122	122	122	122	122	122	122
Big Creek	606	606	606	606	606	606	606	606	606	606
Eastwood	201	201	201	201	201	201	201	201	201	201
Portal	9	9	9	9	9	9	9	9	9	9
Ellwood	54	54	54	54	54	54	54	54	54	54
Kern River	24	24	24	24	24	24	24	24	24	24
Pastoria	715	715	715	715	715	715	715	715	715	715

APPENDIX 11
BC/VENTURA ESTIMATED LCR REQUIREMENTS AND RESOURCES
FOR CASES 1B, 3A, AND 4A

	2008	Case 1B			Case 3A			Case 4A		
	Actual	2012	2016	2020	2012	2016	2020	2012	2016	2020
Procgen	56	56	56	56	56	56	56	56	56	56
Warne	39	39	39	39	39	39	39	39	39	39
Goldtown	13	13	13	13	13	13	13	13	13	13
Mandalay 1	215	0	0	0	0	0	0	0	0	0
Mandalay 2	215	0	0	0	0	0	0	0	0	0
Mandalay 3	130	0	0	0	0	0	0	0	0	0
Ormond 1	741	0	0	0	0	0	0	0	0	0
Ormond 2	775	0	0	0	0	0	0	0	0	0
Subtotal	3,933	1,857	1,857	1,857	1,857	1,857	1,857	1,857	1,857	1,857
Potential Market Units										
Pastoria Peaker	0	159	159	159	159	159	159	159	159	159
Emergency Peaker	0	47	47	47	47	47	47	47	47	47
Palmdale Project	0	570	570	570	570	570	570	570	570	570
New Wind [1/]	0	236	527	574	236	527	574	178	527	1,021
Subtotal	0	1,012	1,303	1,350	1,012	1,303	1,350	954	1,303	1,797
Total	3,933	2,869	3,160	3,207	2,869	3,160	3,207	2,811	3,160	3,654

[1/] Amounts shown are equal to 22% of installed capacity

APPENDIX 11
LA BASIN ESTIMATED LCR REQUIREMENTS AND RESOURCES
FOR CASES 1B (Mod), 3A (Mod), AND 4A (Mod)

	2008	Case 1B (Mod)			Case 3A (Mod)			Case 4A (Mod)		
	Actual	2012	2016	2020	2012	2016	2020	2012	2016	2020
Load	19,409	20,031	20,329	20,868	19,822	19,829	19,985	20,031	20,329	20,868
Less, PV	0	(42)	(93)	(100)	(42)	(93)	(100)	(202)	(531)	(571)
Less, Biomass	0	(50)	(50)	(50)	(50)	(50)	(50)	(26)	(130)	(208)
Pumps	23	23	23	23	23	23	23	23	23	23
Net "Load"	19,432	19,962	20,209	20,741	19,753	19,709	19,858	19,826	19,691	20,112
Losses	226	232	235	242	230	229	231	231	229	234
Total "Load"+Losses	19,658	20,194	20,444	20,983	19,983	19,938	20,089	20,057	19,920	20,346
LCR Requirement	10,130	10,666	10,916	11,455	10,455	10,410	10,561	10,529	10,392	10,818
Import Limit	9,528	9,528	9,528	9,528	9,528	9,528	9,528	9,528	9,528	9,528
QFs	780	780	780	780	780	780	780	780	780	780
Wind	11	11	11	11	11	11	11	11	11	11
Muni	508	508	508	508	508	508	508	508	508	508
Nuclear	2,246	2,246	2,246	2,246	2,246	2,246	2,246	2,246	2,246	2,246
Total "Must Take"	3,545	3,545	3,545	3,545	3,545	3,545	3,545	3,545	3,545	3,545
Required Market Gen	6,585	7,121	7,371	7,910	6,910	6,865	7,016	6,984	6,847	7,273
Available Market Gen	8,814	9,088	9,290	9,434	9,750	9,298	9,038	9,882	9,516	9,030
Total Available Generation	12,359	12,633	12,835	12,979	13,295	12,843	12,583	13,427	13,061	12,575
Existing Market Unit(s)										
Mountain View CC	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230
Alamitos 1	175	0	0	0	0	0	0	0	0	0
Alamitos 2	175	0	0	0	0	0	0	0	0	0
Alamitos 3	332	0	0	0	0	0	0	332	0	0
Alamitos 4	336	0	0	0	0	0	0	0	0	0
Alamitos 5	498	498	498	498	498	498	498	498	498	498
Alamitos 6	495	495	495	495	495	495	495	495	495	495

APPENDIX 11
LA BASIN ESTIMATED LCR REQUIREMENTS AND RESOURCES
FOR CASES 1B (Mod), 3A (Mod), AND 4A (Mod)

	2008	Case 1B (Mod)			Case 3A (Mod)			Case 4A (Mod)		
	Actual	2012	2016	2020	2012	2016	2020	2012	2016	2020
El Segundo 3	335	335	335	335	335	335	335	335	335	335
El Segundo 4	335	335	335	335	335	335	335	335	335	335
Huntington Beach 1	226	0	0	0	226	0	0	226	226	0
Huntington Beach 2	226	0	0	0	226	0	0	226	0	0
Huntington Beach 3	225	225	225	225	225	225	225	225	225	225
Huntington Beach 4	227	227	227	227	227	227	227	227	227	227
Redondo 5	179	0	0	0	0	0	0	0	0	0
Redondo 6	175	0	0	0	0	0	0	0	0	0
Redondo 7	493	493	493	493	493	493	493	493	493	493
Redondo 8	496	496	496	496	496	496	496	496	496	496
Etiwanda 3	320	0	0	0	0	0	0	0	0	0
Etiwanda 4	320	0	0	0	0	0	0	0	0	0
Etiwanda 66-kV	38	38	38	38	38	38	38	38	38	38
Wintec CTs	129	129	129	129	129	129	129	129	129	129
Brigen	35	35	35	35	35	35	35	35	35	35
Harbor	100	100	100	100	100	100	100	100	100	100
Carbogen	29	29	29	29	29	29	29	29	29	29
Pulpgen	35	35	35	35	35	35	35	35	35	35
Riverside CTs	140	140	140	140	140	140	140	140	140	140
Santiago	10	10	10	10	10	10	10	10	10	10
Long Beach	554	0	0	0	0	0	0	0	0	0
Malberg	136	136	136	136	136	136	136	136	136	136
Subtotal	8,004	4,986	4,986	4,986	5,438	4,986	4,986	5,770	5,212	4,986
Potential Market Units										
IEEC	810	810	810	810	810	810	810	810	810	810
PPA Peakers	0	715	715	455	715	715	455	715	715	455
Emergency Peakers	0	185	185	185	185	185	185	185	185	185
Generic Peakers	0	1,694	1,896	2,300	1,904	1,904	1,904	1,704	1,896	1,896
Generic CCs	0	698	698	698	698	698	698	698	698	698
Subtotal	810	4,102	4,304	4,448	4,312	4,312	4,052	4,112	4,304	4,044
Total Market Units	8,814	9,088	9,290	9,434	9,750	9,298	9,038	9,882	9,516	9,030

APPENDIX 11
BC/VENTURA ESTIMATED LCR REQUIREMENTS AND RESOURCES FOR CASES 1B (Mod), 3A (Mod), AND 4A (Mod)

	2008	Case 1B (Mod)			Case 3A (Mod)			Case 4A (Mod)		
	Actual	2012	2016	2020	2012	2016	2020	2012	2016	2020
Load	4,435	4,763	4,953	5,132	4,713	4,831	4,915	4,763	4,953	5,132
Less, PV	0	(8)	(17)	(18)	(8)	(17)	(18)	(36)	(93)	(101)
Less, Biomass	0	0	0	0	0	0	0	0	0	(20)
Pumps	420	420	420	420	420	420	420	420	420	420
Net "Load"	4,855	5,175	5,356	5,534	5,125	5,234	5,317	5,147	5,280	5,431
Losses	156	166	172	178	165	168	171	165	170	175
Total "Load" + Losses	5,011	5,341	5,528	5,712	5,290	5,402	5,488	5,312	5,450	5,606
LCR Requirement	3,658	3,388	3,575	3,759	3,337	3,449	3,535	3,359	3,497	3,653
Import Limit	1,353	1,953	1,953	1,953	1,953	1,953	1,953	1,953	1,953	1,953
QFs	1,117	1,117	1,117	1,117	1,117	1,117	1,117	1,117	1,117	1,117
Existing Wind	346	346	346	346	346	346	346	346	346	346
Muni	0	0	0	0	0	0	0	0	0	0
Nuclear	0	0	0	0	0	0	0	0	0	0
Total "Must Take"	1,463	1,463	1,463	1,463	1,463	1,463	1,463	1,463	1,463	1,463
Required Market Gen	2,195	1,925	2,112	2,296	1,874	1,986	2,072	1,896	2,034	2,190
Available Market Gen	3,933	3,084	3,160	3,207	3,084	3,160	3,207	3,982	3,160	3,654
Total Available Generation	5,396	4,547	4,623	4,670	4,547	4,623	4,670	5,445	4,623	5,117
Existing Market Unit(s)										
Alamo	18	18	18	18	18	18	18	18	18	18
Appgen 1 & 2	122	122	122	122	122	122	122	122	122	122
Big Creek	606	606	606	606	606	606	606	606	606	606
Eastwood	201	201	201	201	201	201	201	201	201	201
Portal	9	9	9	9	9	9	9	9	9	9
Ellwood	54	54	54	54	54	54	54	54	54	54
Kern River	24	24	24	24	24	24	24	24	24	24
Pastoria	715	715	715	715	715	715	715	715	715	715

APPENDIX 11
BC/VENTURA ESTIMATED LCR REQUIREMENTS AND RESOURCES FOR CASES 1B (Mod), 3A (Mod), AND 4A (Mod)

	2008	Case 1B (Mod)			Case 3A (Mod)			Case 4A (Mod)		
	Actual	2012	2016	2020	2012	2016	2020	2012	2016	2020
Procgen	56	56	56	56	56	56	56	56	56	56
Warne	39	39	39	39	39	39	39	39	39	39
Goldtown	13	13	13	13	13	13	13	13	13	13
Mandalay 1	215	215	0	0	215	0	0	215	0	0
Mandalay 2	215	0	0	0	0	0	0	215	0	0
Mandalay 3	130	0	0	0	0	0	0	0	0	0
Ormond 1	741	0	0	0	0	0	0	741	0	0
Ormond 2	775	0	0	0	0	0	0	0	0	0
Subtotal	3,933	2,072	1,857	1,857	2,072	1,857	1,857	3,028	1,857	1,857
Potential Market Units										
Pastoria Peaker	0	159	159	159	159	159	159	159	159	159
Emergency Peaker	0	47	47	47	47	47	47	47	47	47
Palmdale Project	0	570	570	570	570	570	570	570	570	570
New Wind [1/]	0	236	527	574	236	527	574	178	527	1,021
Subtotal	0	1,012	1,303	1,350	1,012	1,303	1,350	954	1,303	1,797
Total	3,933	3,084	3,160	3,207	3,084	3,160	3,207	3,982	3,160	3,654

[1/] Amounts shown are equal to 22% of installed capacity

APPENDIX B

ASSESSMENT OF PRODUCTION COST RESULTS OF ALTERNATIVE AGED POWER PLANT RETIREMENT AND REPLACEMENT CASES

Prepared by Global Energy Decisions, Inc.

Economic Dispatch Analysis of the Aging Plant Study

Prepared for:
California Energy Commission

Date Submitted:
August 1, 2007

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Global Energy Decisions

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Overview of the Aging Plant Study

As part of its work related to the 2007 Integrated Energy Policy Report (IEPR), the California Energy Commission retained Navigant Consulting, Inc. (NCI) to undertake a preliminary assessment of the impacts that retiring some or all of the Aged Plants could have on the electric system in Southern California. These studies evaluated both the impacts on the transmission system and the requirement for resources to replace the retired generation.

The work performed by NCI looked at certain extreme loading hours, but such work did not involve an hourly economic dispatch analysis, predicted production costs, fuel cost, and other outputs resulting from a production simulation for the retirement of the Aged Plants and the replacement of these plants with other resources. NCI customized its basic analysis by preparing three alternative sets of replacements customizing each to one of three thematic scenarios of the overall Scenarios Project.

As a part of the Scenarios Project analysis, Global Energy has already developed input datasets and run production simulation models for nine thematic scenarios and a variety of alternative sensitivity cases. In this new work, Global Energy was asked to perform an economic dispatch analysis that would be consistent with NCI's assessment of the impacts of retiring some or all of the Aged Plants.

Study Input Assumptions

To perform this analysis, Global Energy was asked to re-run Case 1b, Case 3a, and Case 4a in two variations. The first variation (2012 Retirement) assumes that a specified amount of aging power plants are retired for the time period of 2012-2020. The second variation (Phased Retirement) assumes a delayed or staggered retirement schedule of these same plants. For purposes of comparing the aging plant retirements in the 2012 Retirement and Phased Retirement cases presented in the following pages of this analysis, Table 1 reports the retirement assumptions used in the original cases for the identified aging plants considered in this analysis.[1] [2]

[1] Global's aging plant retirement assumptions are based on a 55-year life expectancy estimate for large gas-fired steam generators.
[2] Global's capacity numbers for the aging plants studied in this analysis are slightly higher than reported by NCI. Global's capacity numbers reflect nameplate capacity while NCI's capacity numbers assume a summer de-rate.

Table 1
Original Case - Aging Plant Capacity

Original Case Aging Plant Retirement Assumptions	Capacity (MW) On-Line in								
	2012	2013	2014	2015	2016	2017	2018	2019	2020
Alamitos 1 & 2	0	0	0	0	0	0	0	0	0
Alamitos 3 & 4	667	667	667	667	335	0	0	0	0
Alamitos 5 & 6	980	980	980	980	980	980	980	495	495
El Segundo 3 & 4	660	660	660	660	660	660	660	325	0
Etiwanda 3 & 4	640	640	640	640	640	640	0	0	0
Huntington Beach 1 & 2	452	0	0	0	0	0	0	0	0
Mandaly 1 & 2	430	430	0	0	0	0	0	0	0
Ormond Beach 1 & 2	1,516	1,516	1,516	1,516	1,516	1,516	1,516	1,516	1,516
Redondo Beach 5 & 6	0	0	0	0	0	0	0	0	0
Redondo Beach 7 & 8	980	980	980	980	980	980	980	980	980
Total	6,325	5,873	5,443	5,443	5,111	4,776	4,136	3,316	2,991

NCI identified generic thermal resource additions (both peaking and combined-cycle facilities) as needed to balance the retiring capacity and to maintain resource adequacy. In adding these generic resources NCI did not attempt to optimize the mix of assumed resources. The size and location of these assumed thermal resources was based on information in the ISO's interconnection queue as of March 2007.

The following outlines each of the three scenarios with two variations each:

1) Re-run Case 1b (compliance with current requirements) with the following "2012 Retirement" modifications:

   - Modify Scenario Case 1b data set, as necessary, so that the following aging plant capacity is online:

Case 1b - 2012 Retirement	Capacity (MW) On-Line in								
	2012	2013	2014	2015	2016	2017	2018	2019	2020
Alamitos 1 & 2	0	0	0	0	0	0	0	0	0
Alamitos 3 & 4	0	0	0	0	0	0	0	0	0
Alamitos 5 & 6	950	950	950	950	950	950	950	950	950
El Segundo 3 & 4	660	660	660	660	660	660	660	660	660
Etiwanda 3 & 4	0	0	0	0	0	0	0	0	0
Huntington Beach 1 & 2	0	0	0	0	0	0	0	0	0
Mandaly 1 & 2	0	0	0	0	0	0	0	0	0
Ormond Beach 1 & 2	0	0	0	0	0	0	0	0	0
Redondo Beach 5 & 6	0	0	0	0	0	0	0	0	0
Redondo Beach 7 & 8	900	900	900	900	900	900	900	900	900
Total	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510

   - Modify Scenario Case 1b data set to include the following additions to replace the retired aging plants above (in megawatts):

Case 1b - 2012 Retirement	2012	2016	2020
Peaking Capacity in So. California	2,802	2,802	3,144
Combined Cycle Capacity			
- In Southern California	3,138	3,138	3,138
- In Southern Nevada	550	550	550
Total CC's	3,688	3,688	3,688
Total Thermal	6,490	6,490	6,832

- Modify Scenario Case 1b data set to limit the simultaneous imports into the SCE transarea[3] to about 10,100 MW.

2) Re-run Case 1b (compliance with current requirements) with the following "Phased Retirement" modifications:

- Modify Scenario Case 1b data set, as necessary, so that the following aging plant capacity is online:

Case 1b - Phased Retirement	Capacity (MW) On-Line in								
	2012	2013	2014	2015	2016	2017	2018	2019	2020
Alamitos 1 & 2	0	0	0	0	0	0	0	0	0
Alamitos 3 & 4	0	0	0	0	0	0	0	0	0
Alamitos 5 & 6	950	950	950	950	950	950	950	950	950
El Segundo 3 & 4	660	660	660	660	660	660	660	660	660
Etiwanda 3 & 4	0	0	0	0	0	0	0	0	0
Huntington Beach 1 & 2	400	0	0	0	0	0	0	0	0
Mandaly 1 & 2	200	0	0	0	0	0	0	0	0
Ormond Beach 1 & 2	0	0	0	0	0	0	0	0	0
Redondo Beach 5 & 6	0	0	0	0	0	0	0	0	0
Redondo Beach 7 & 8	900	900	900	900	900	900	900	900	900
Total	3,110	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510

- Modify Scenario Case 1b data set to include the following additions to replace the retired aging plants above (in megawatts):

Case 1b - Phased Retirement	2012	2016	2020
Peaking Capacity in So. California	2,800	3,002	3,146
Combined Cycle Capacity			
- In Southern California	3,138	3,138	3,138
- In Southern Nevada	0	0	550
Total CC's	3,138	3,138	3,688
Total Thermal	5,938	6,140	6,834

- Modify Scenario Case 1b data set to limit the simultaneous imports into the SCE transarea to about 10,100 MW.

[3] A transarea is a geographic region used in production cost modeling. It is the basic unit for load forecasts and generally assumes no internal transmission limitations for generation from power plants located therein to serve load. Figure 5-1 of the Results Report identifies the 29 transareas making up the entire Western Interconnection as it was modeled for this project.

3) Re-run Case 3a (High Energy Efficiency and Variable Demand Reduction in California only) with the following "2012 Retirement" modifications:

- Modify Scenario Case 3a data set, as necessary, so that the following aging plant so that the following aging plant capacity is online:

Case 3a - 2012 Retirement	Capacity (MW) On-Line in								
	2012	2013	2014	2015	2016	2017	2018	2019	2020
Alamitos 1 & 2	0	0	0	0	0	0	0	0	0
Alamitos 3 & 4	0	0	0	0	0	0	0	0	0
Alamitos 5 & 6	950	950	950	950	950	950	950	950	950
El Segundo 3 & 4	660	660	660	660	660	660	660	660	660
Etiwanda 3 & 4	0	0	0	0	0	0	0	0	0
Huntington Beach 1 & 2	0	0	0	0	0	0	0	0	0
Mandaly 1 & 2	0	0	0	0	0	0	0	0	0
Ormond Beach 1 & 2	0	0	0	0	0	0	0	0	0
Redondo Beach 5 & 6	0	0	0	0	0	0	0	0	0
Redondo Beach 7 & 8	900	900	900	900	900	900	900	900	900
Total	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510

- Modify Scenario Case 3a data set to include the following additions to replace the retired aging plants above (in megawatts):

Case 3a - 2012 Retirement	2012	2016	2020
Peaking Capacity in So. California	3,010	3,010	2,750
Combined Cycle Capacity			
- In Southern California	3,138	3,138	3,138
- In Southern Nevada	0	0	0
Total CC's	3,138	3,138	3,138
Total Thermal	6,148	6,148	5,888

- Modify Scenario Case 3a data set to limit the simultaneous imports into the SCE transarea to about 10,100 MW.

4) Re-run Case 3a (High Energy Efficiency and Variable Demand Reduction in California only) with the following "Phased Retirement" modifications:

- Modify Scenario Case 3a data set, as necessary, so that the following aging plant capacity is online:

Case 3a - Phased Retirement	Capacity (MW) On-Line in								
	2012	2013	2014	2015	2016	2017	2018	2019	2020
Alamitos 1 & 2	0	0	0	0	0	0	0	0	0
Alamitos 3 & 4	0	0	0	0	0	0	0	0	0
Alamitos 5 & 6	950	950	950	950	950	950	950	950	950
El Segundo 3 & 4	660	660	660	660	660	660	660	660	660
Etiwanda 3 & 4	0	0	0	0	0	0	0	0	0
Huntington Beach 1 & 2	400	0	0	0	0	0	0	0	0
Mandaly 1 & 2	200	0	0	0	0	0	0	0	0
Ormond Beach 1 & 2	0	0	0	0	0	0	0	0	0
Redondo Beach 5 & 6	0	0	0	0	0	0	0	0	0
Redondo Beach 7 & 8	900	900	900	900	900	900	900	900	900
Total	3,110	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510

- Modify Scenario Case 3a data set to include the following additions to replace the retired aging plants above (in megawatts):

Case 3a - Phased Retirement	2012	2016	2020
Peaking Capacity in So. California	3,010	3,010	3,141
Combined Cycle Capacity			
- In Southern California	2,568	2,568	2,568
- In Southern Nevada	0	0	0
Total CC's	2,568	2,568	2,568
Total Thermal	5,578	5,578	5,709

- Modify Scenario Case 3a data set to limit the simultaneous imports into the SCE transarea to about 10,100 MW.

5) Re-run Case 4a (High Renewables in California only) with the following "2012 Retirement" modifications:

- Modify Scenario Case 4a data set, as necessary, so that the following aging plant capacity is online:

Case 4a - 2012 Retirement	Capacity (MW) On-Line in								
	2012	2013	2014	2015	2016	2017	2018	2019	2020
Alamitos 1 & 2	0	0	0	0	0	0	0	0	0
Alamitos 3 & 4	0	0	0	0	0	0	0	0	0
Alamitos 5 & 6	950	950	950	950	950	950	950	950	950
El Segundo 3 & 4	660	660	660	660	660	660	660	660	660
Etiwanda 3 & 4	0	0	0	0	0	0	0	0	0
Huntington Beach 1 & 2	0	0	0	0	0	0	0	0	0
Mandaly 1 & 2	0	0	0	0	0	0	0	0	0
Ormond Beach 1 & 2	0	0	0	0	0	0	0	0	0
Redondo Beach 5 & 6	0	0	0	0	0	0	0	0	0
Redondo Beach 7 & 8	900	900	900	900	900	900	900	900	900
Total	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510

- Modify Scenario Case 4a data set to include the following additions by 2020 to replace the retired aging plants above (in megawatts)::

Case 4a - 2012 Retirement	2012	2016	2020
Peaking Capacity in So. California	3,305	3,305	3,045
Combined Cycle Capacity			
- In Southern California	3,138	3,138	3,138
- In Southern Nevada	0	0	0
Total CC's	3,138	3,138	3,138
Total Thermal	6,443	6,443	6,183

- Modify Scenario Case 4a data set to limit the simultaneous imports into the SCE transarea to about 10,100 MW.

6) Re-run Case 4a (High Renewables in California only) with the following "Phased Retirement" modifications:

- Modify Scenario Case 4a data set, as necessary, so that the following aging plant capacity is online:

Case 4a - Phased Retirement	Capacity (MW) On-Line in								
	2012	2013	2014	2015	2016	2017	2018	2019	2020
Alamitos 1 & 2	0	0	0	0	0	0	0	0	0
Alamitos 3 & 4	320	0	0	0	0	0	0	0	0
Alamitos 5 & 6	950	950	950	950	950	950	950	950	950
El Segundo 3 & 4	660	660	660	660	660	660	660	660	660
Etiwanda 3 & 4	0	0	0	0	0	0	0	0	0
Huntington Beach 1 & 2	400	400	400	400	200	200	0	0	0
Mandaly 1 & 2	400	400	400	400	0	0	0	0	0
Ormond Beach 1 & 2	700	700	700	0	0	0	0	0	0
Redondo Beach 5 & 6	0	0	0	0	0	0	0	0	0
Redondo Beach 7 & 8	900	900	900	900	900	900	900	900	900
Total	4,330	4,010	4,010	3,310	2,710	2,710	2,510	2,510	2,510

- Modify Scenario Case 4a data set to include the following additions by 2020 to replace the retired aging plants above (in megawatts):

Case 4a - Phased Retirement	2012	2016	2020
Peaking Capacity in So. California	2,810	3,002	2,742
Combined Cycle Capacity			
- In Southern California	1,870	1,870	1,870
- In Southern Nevada	0	0	0
Total CC's	1,870	1,870	1,870
Total Thermal	4,680	4,872	4,612

- Modify Scenario Case 4a data set to limit the simultaneous imports into the SCE transarea to about 10,100 MW.

The re-run of these Scenarios resulted in different dispatch cost, different capital costs for the new generation supplies, and additional transmission costs as identified by NCI. These different costs are included in the scorecards prepared for these modified Scenarios. There may also be both reduced costs associated with the retirement of these units (e.g. by lowering Fixed O&M charges) and increased costs (e.g. from dismantling the plants and cleaning up the sites). We do not have detail on these aspects of retiring the aged plants and therefore no such decreased or increased costs are included.

Finally, Global's assessment relies upon the work by NCI to develop a retirement and replacement schedule. No independent confirmation or rejection of the feasibility of the two retirement and replacement schedules was performed by Global.

Aging Plant Study Results

The results of the re-running of cases 1b, 3a and 4a under the two variations described earlier, are consistent between cases. Comparing original results with 2012 Retirement results shows increases in SCE transarea natural gas-fired generation and production cost, increases in California total system costs, decreases in SCE transarea net imports, and slight decreases in CO_2 emissions. Similar results are found when comparing the original results with Phased Retirements results although to a varying amount. These results can be explained by the addition of efficient natural gas generation in the SCE transarea due to the retiring of aging plants in the area and by the 10,100 MW simultaneous import limitation introduced in the 2012 Retirement and Phased Retirement scenarios which increase in-area generation. The differences between 2012 Retirement and Phased Retirement scenarios can be explained by differences in aging plant retirements and the corresponding changes in resource additions needed to replace the aging plant capacity as described earlier in this section.

Changes in Generation

Figures 1, 2, and 3 illustrate the differences in natural gas-fired generation in the SCE transarea for each of the aging plant variations in Case 1b, 3a, and 4a, respectively. The same basic pattern exists for each of the three sets of revised scenarios. Both 2012 and Phased Retirement variants show more natural gas fired energy generation than in the original analysis. In Cases 1b (Figure 1-1) and 3a (Figure 1-2) reasonably high capacity factors result from the added thermal generation that was assumed. In Case 4a (Figure 1-3), the thermal capacity installed prior to the retirement assessments produces progressively less energy through time. The new thermal capacity increases aggregate thermal output, but the capacity factor of these new units is lower than in the original analysis and the incremental replacement capacity suffers from a reduced capacity factor through time.

Figure 1
Case 1b SCE Transarea Natural Gas Generation

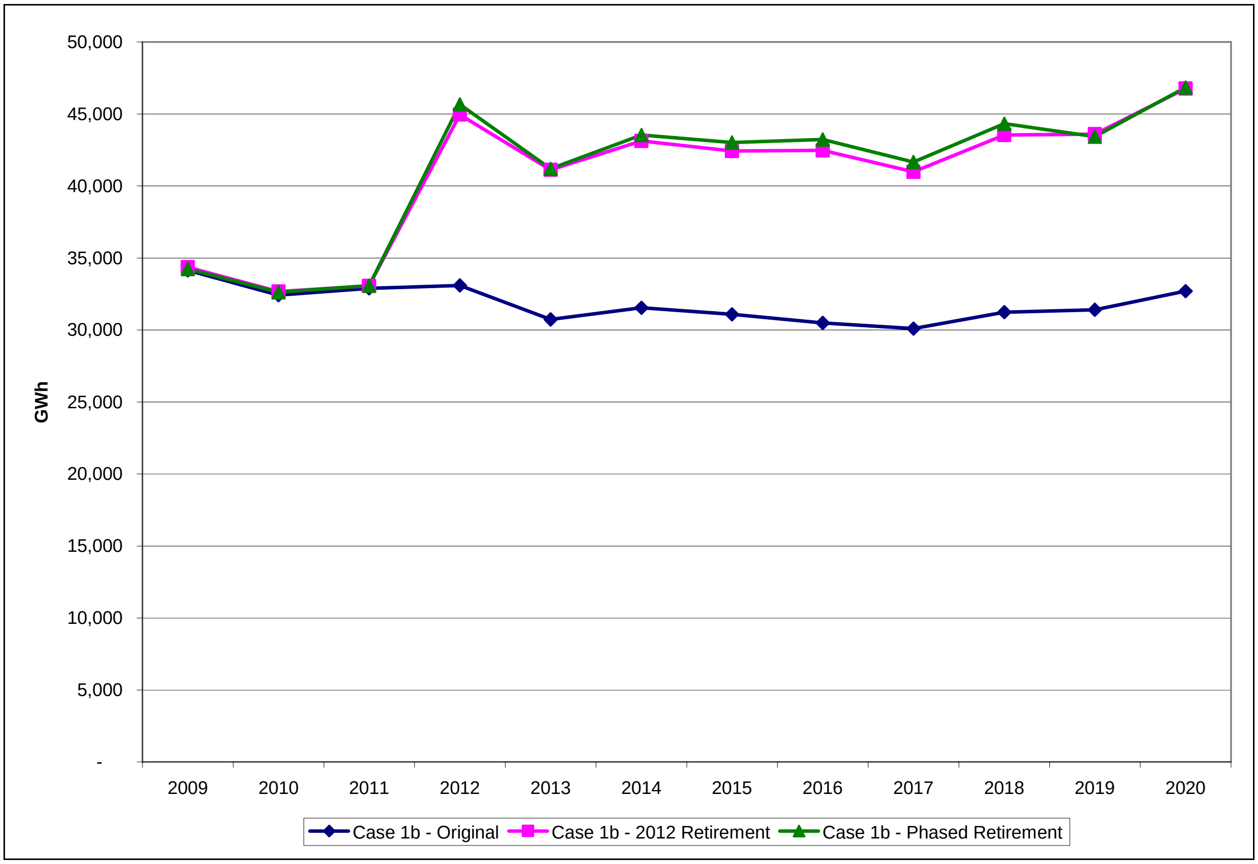


Figure 2
Case 3a SCE Transarea Natural Gas Generation

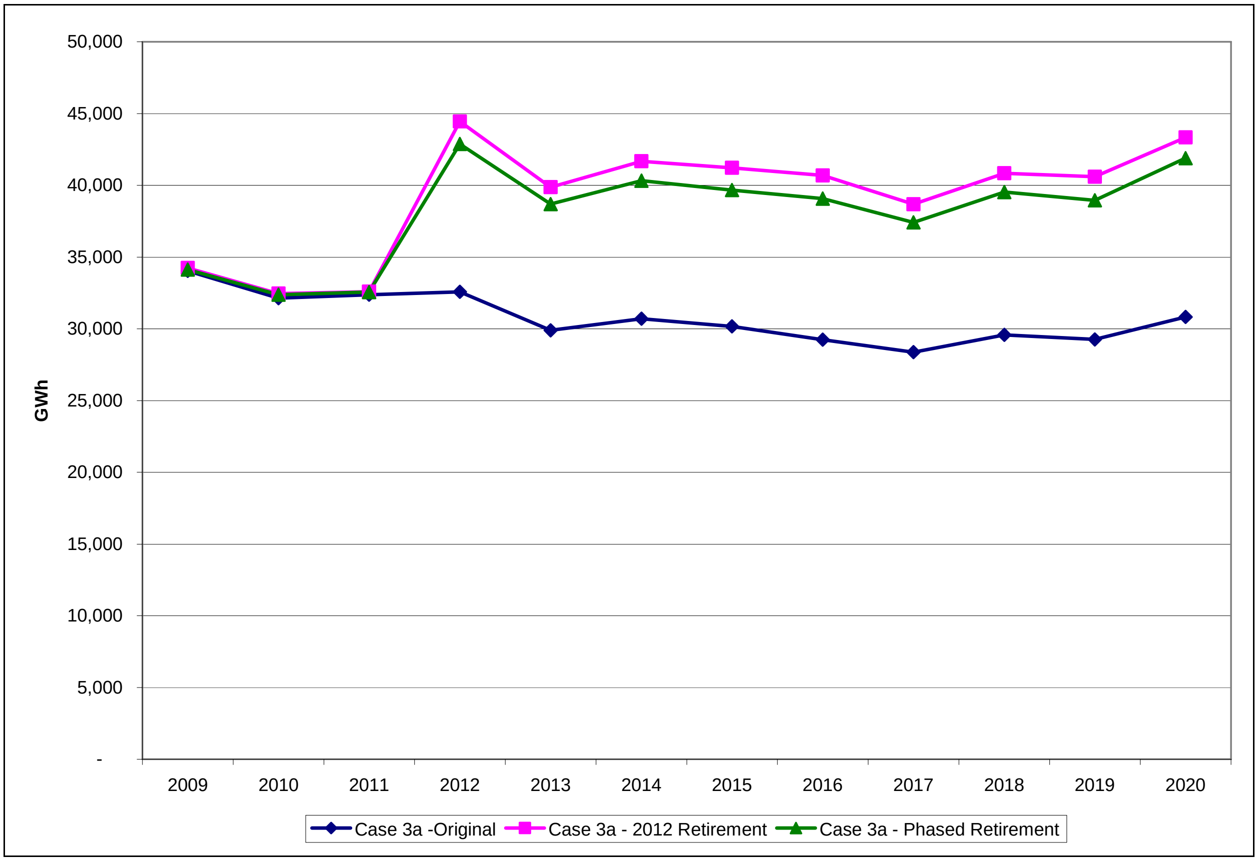
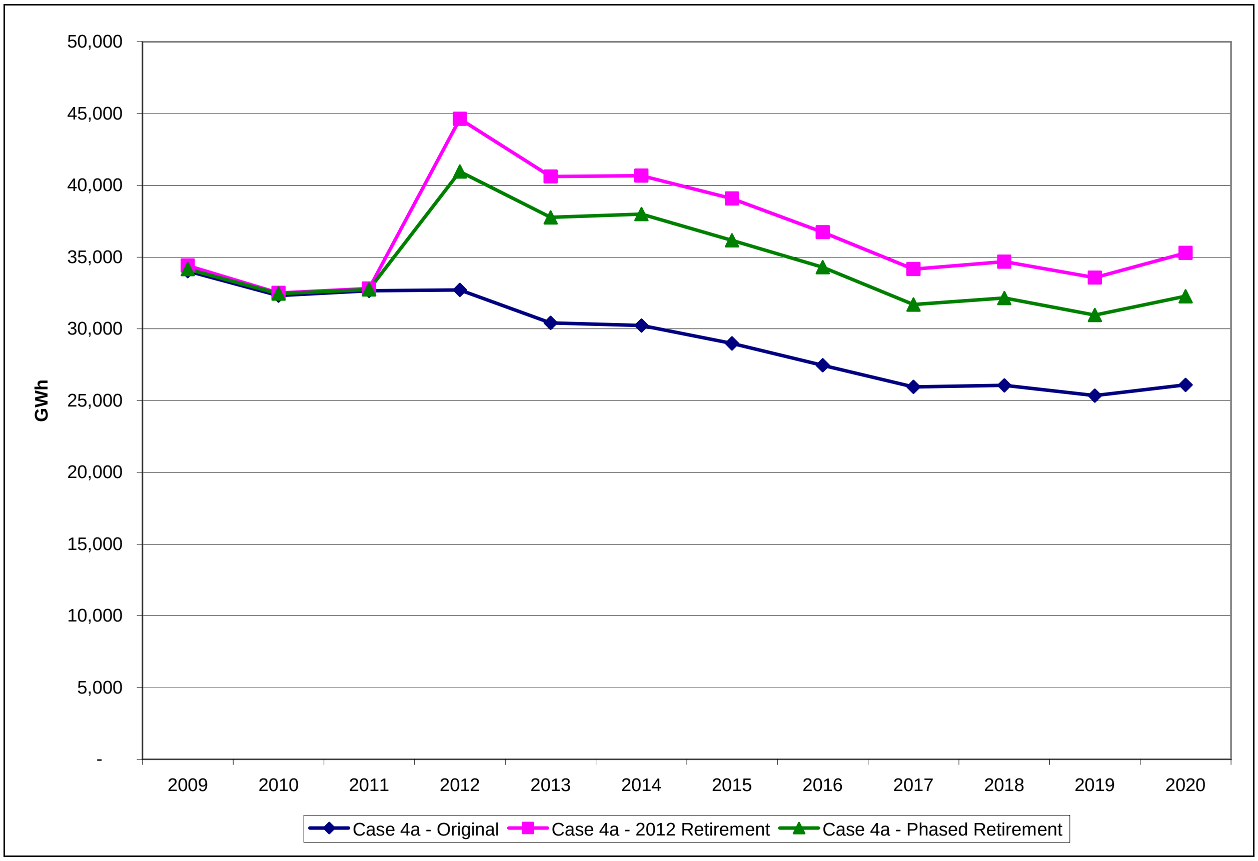


Figure 3
Case 4a SCE Transarea Natural Gas Generation



Changes in Costs

Figures 4 through 9 report the changes in production cost and system cost for the three thematic scenarios.

Figures 4, 5, and 6 illustrate the differences in production costs in the SCE transarea for each of the aging plant variations in Case 1b, 3a, and 4a, respectively. Production costs reported here are for physically located generators in the SCE transarea and include variable operating and maintenance costs, fuel costs, fixed operating and maintenance costs, start costs, and emissions costs. As expected, total production costs increase in the SCE transarea because total generation in the SCE transarea increased.

Figure 4
Case 1b SCE Transarea Production Costs

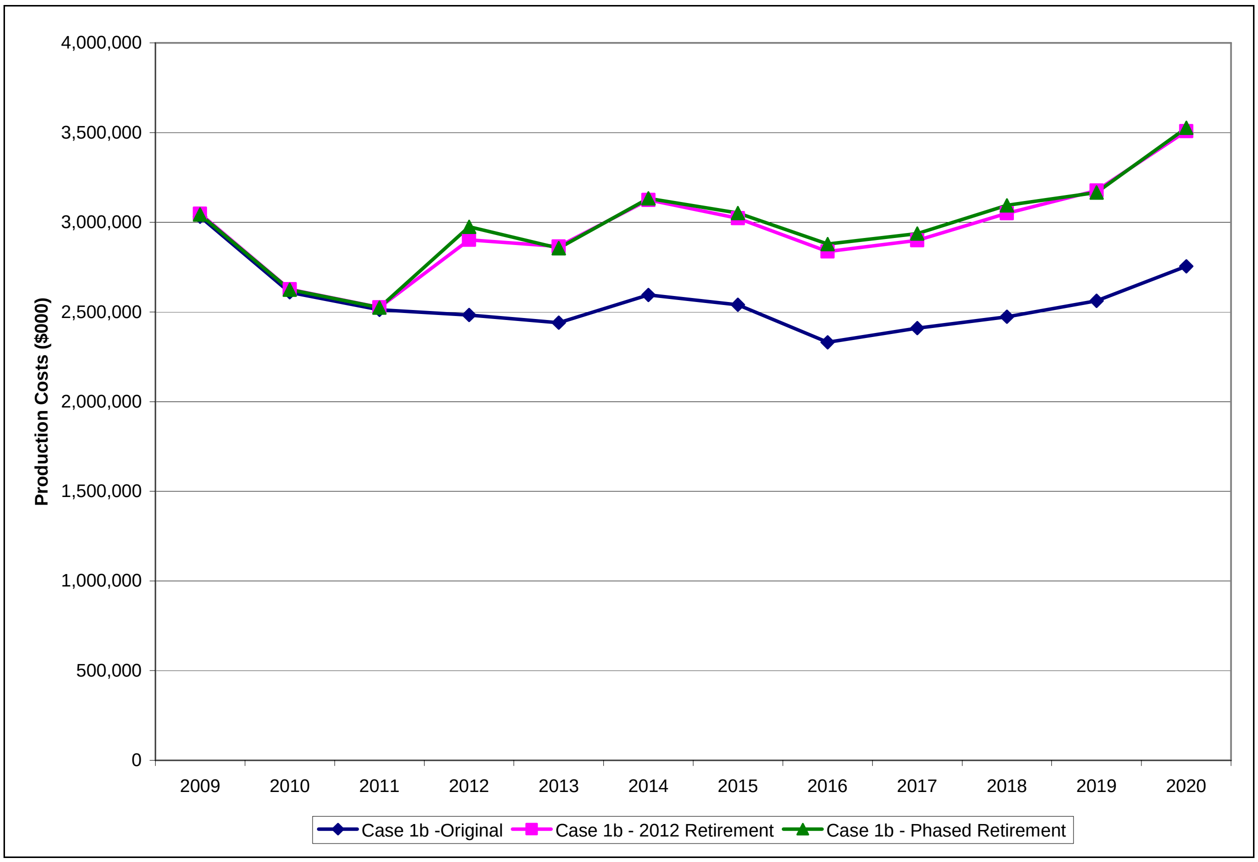


Figure 5
Case 3a SCE Transarea Production Costs

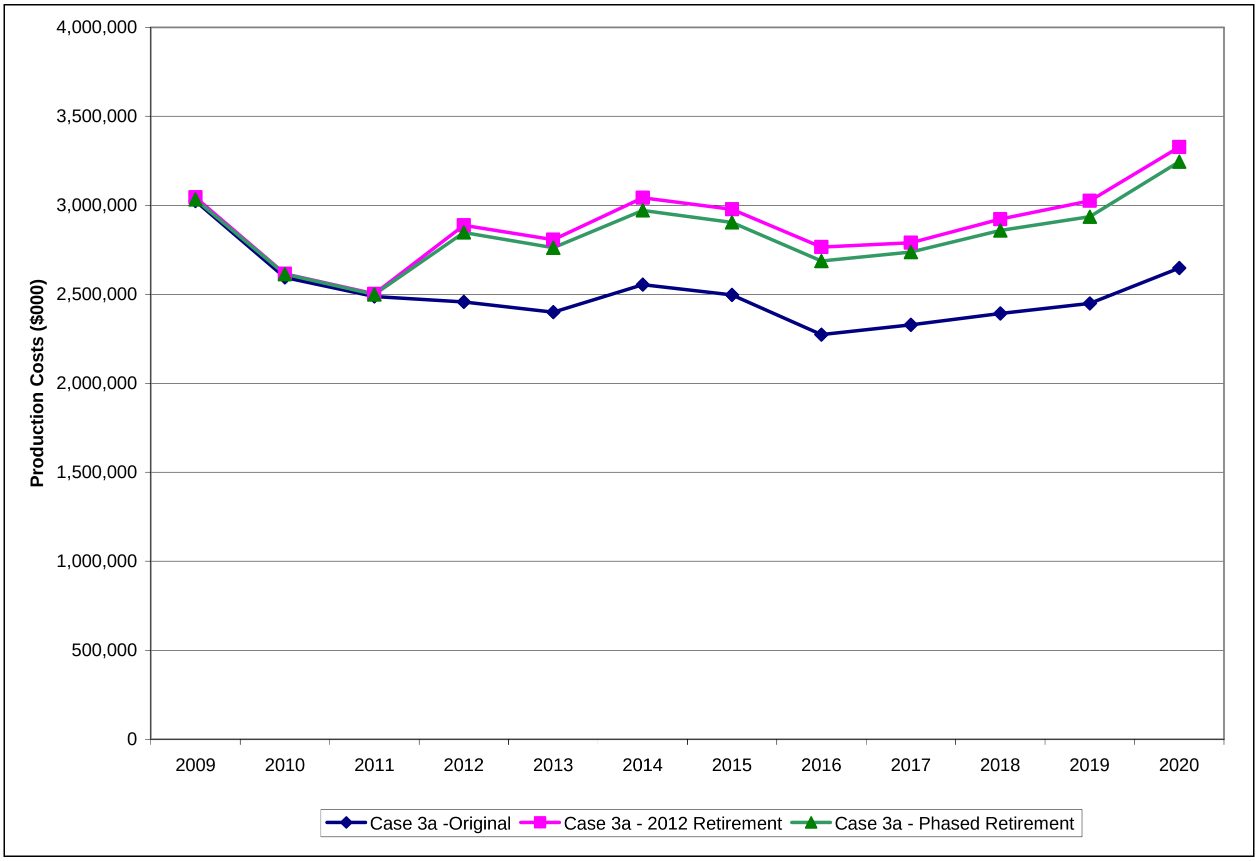
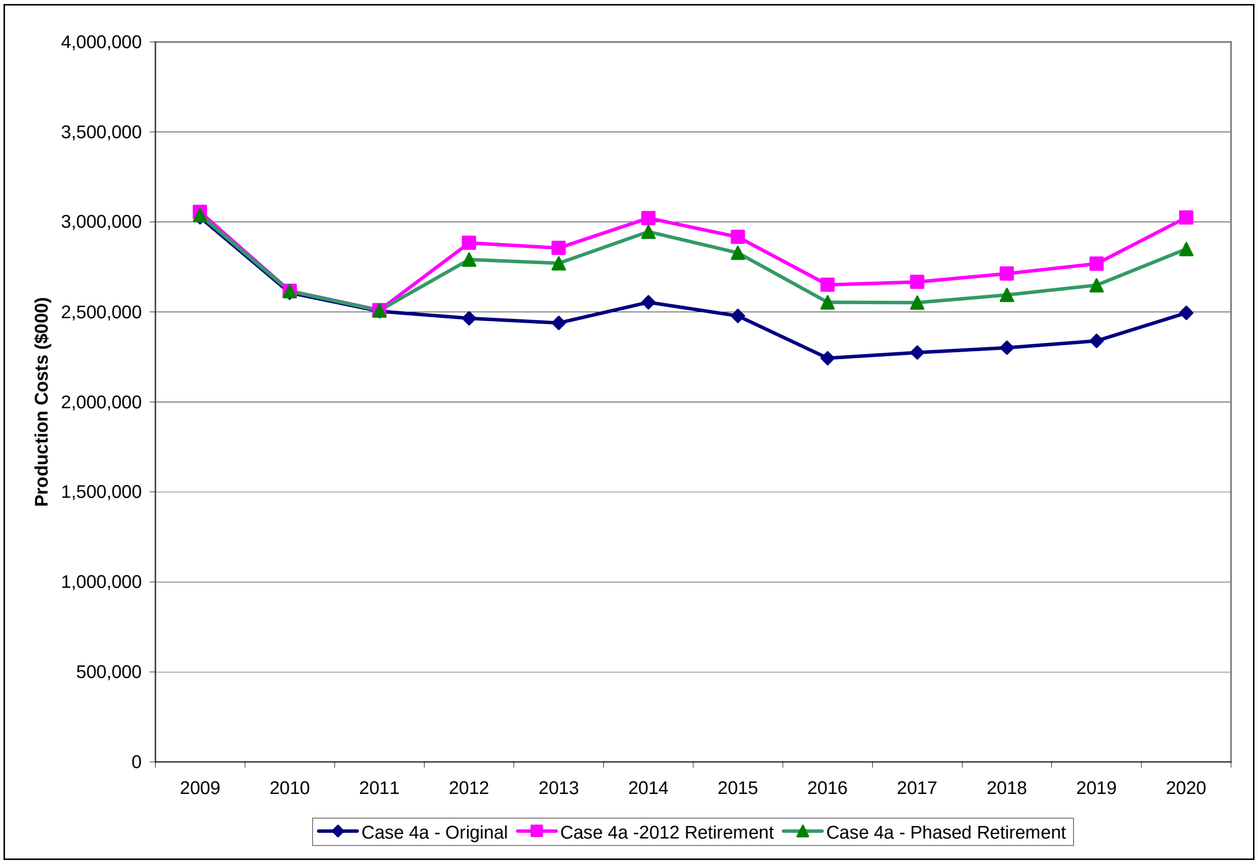


Figure 6
Case 4a SCE Transarea Production Costs



Figures 7, 8, and 9 illustrate the differences in Total System Costs in California for each of the aging plant variations in Case 1b, 3a, and 4a, respectively. The results show an increase in total system costs in California across all three cases in the 2012 Retirement case and in the Phased Retirement Case. Total System Costs for California reported here are inclusive of generation costs, wheeling costs, incremental resource capital costs, incremental transmission costs, emissions costs, import energy costs, and costs associated with remote generators that serve California load. Additional detail of these individual costs can be found in Attachment A.

Figure 7
Case 1b California Total System Costs

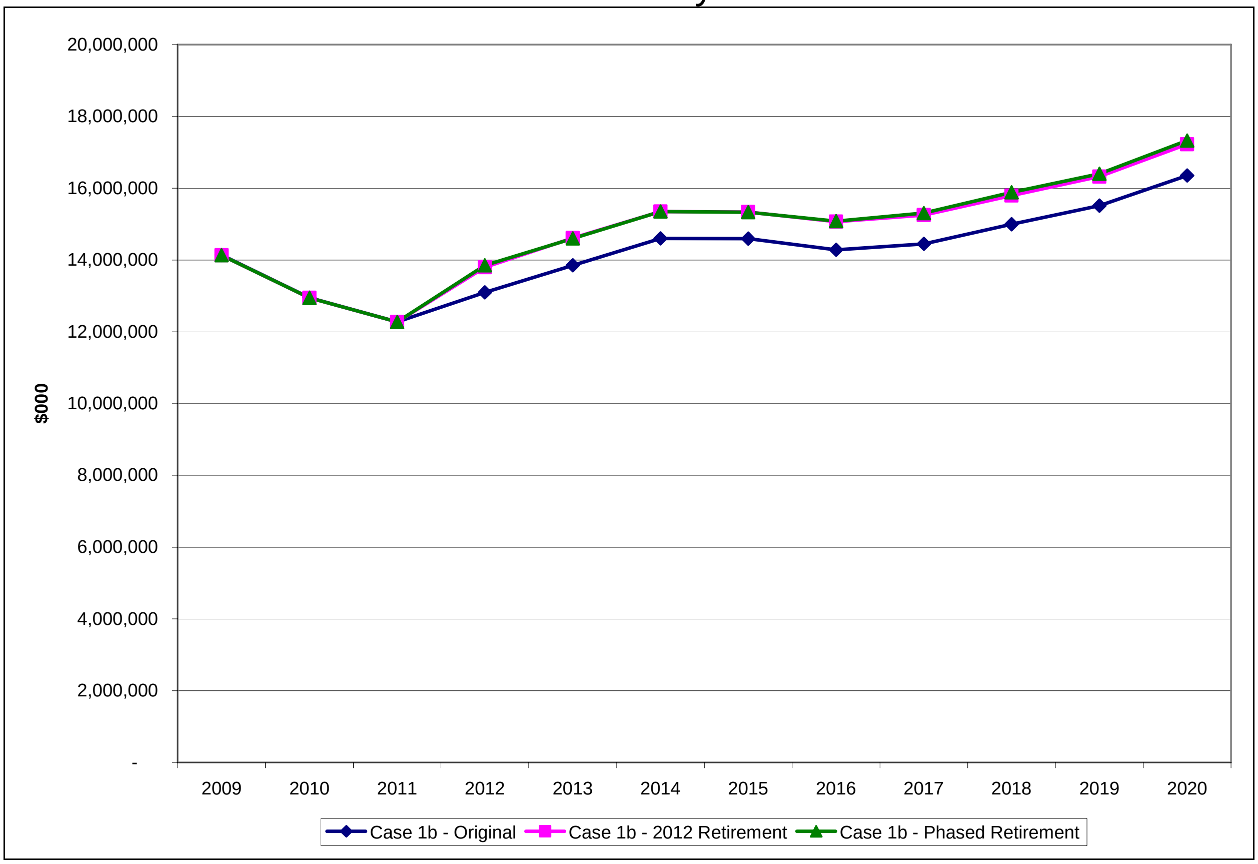


Figure 8
Case 3a California Total System Costs

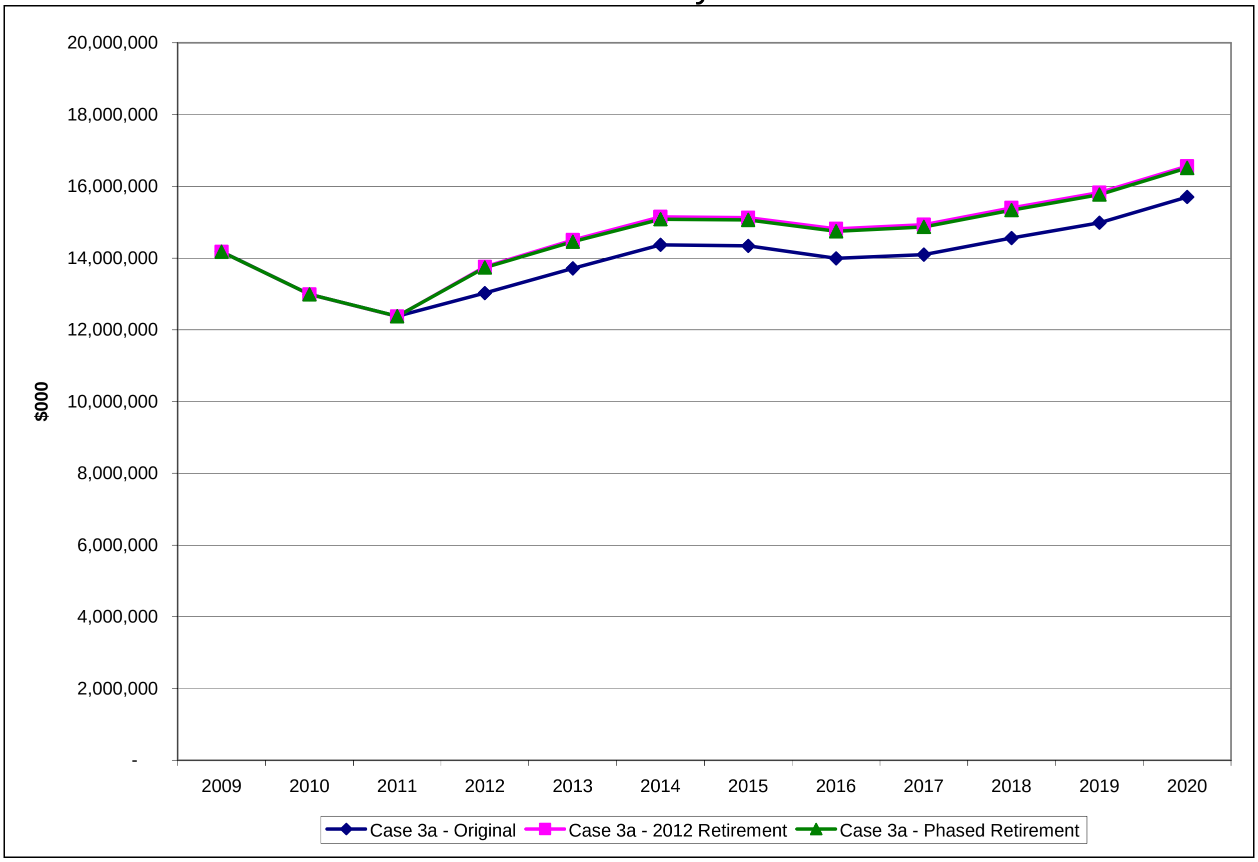
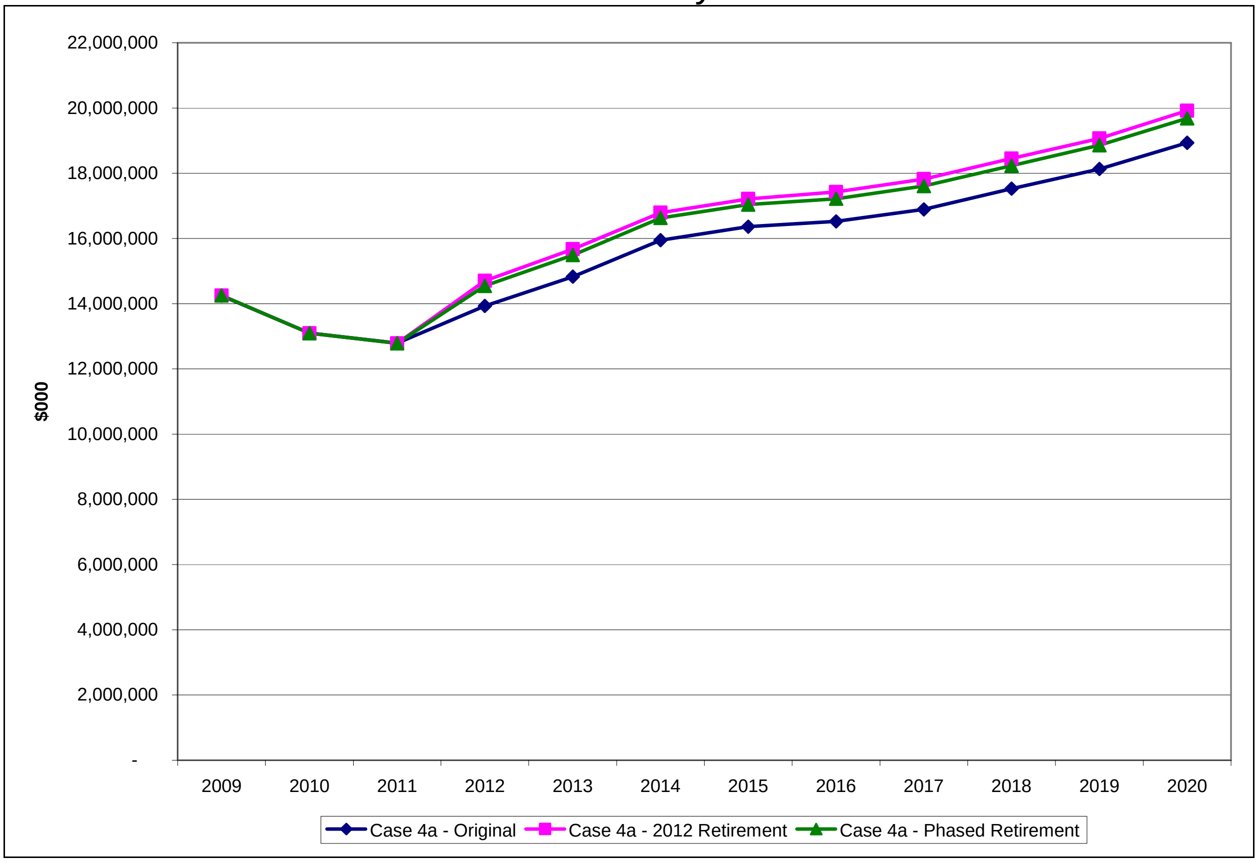


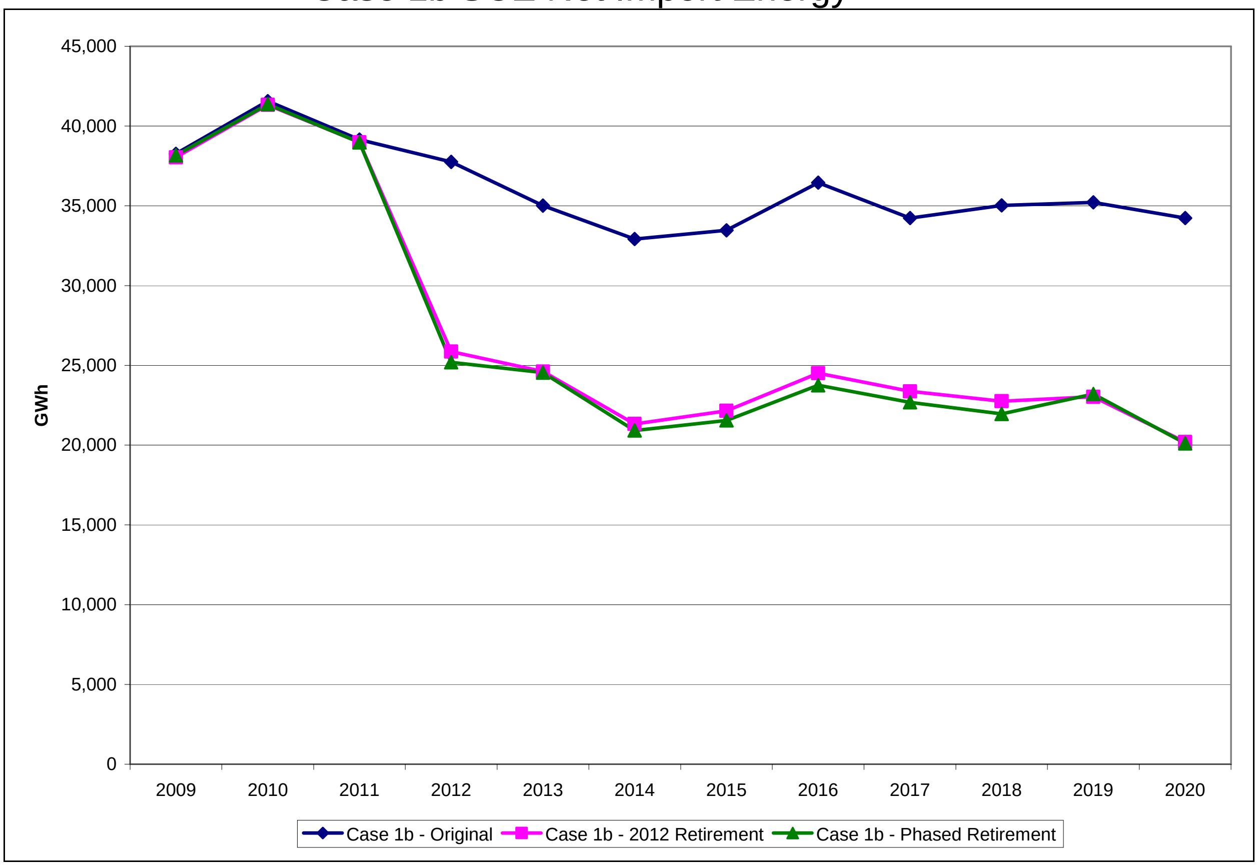
Figure 9
Case 4a California Total System Costs



Changes in Imports for the SCE Transarea

Figures 10, 11 and 12 illustrate the differences in net import energy into the SCE transarea for each of the variations in Case 1b, 3a, and 4a, respectively. Net import energy is the annual value obtained by subtracting gross annual exports from gross annual imports.[4] We can expect that there are substantial variations for individual months, but a net decrease in imports is to be expected with the addition of thousands of MWs of new thermal capacity.

Figure 10
Case 1b SCE Net Import Energy



[4] The term "imports" as used for a transareas may not match the used of the term "imports" as reported in the June 2007 *Results Report*. There the primary reporting was for two regions of the entire WECC – California and Rest-of WECC. Imports in such a setting are net transfers into California from Rest-of-WECC. In the present setting focusing on the SCE transareas, imports and exports are with respect to the boundary of the SCE transareas. Transfers from one of the nine other California transareas to the SCE transarea would be considered a gross import as reported in figures X-7 through X-9.

Figure 11
Case 3a SCE Net Import Energy

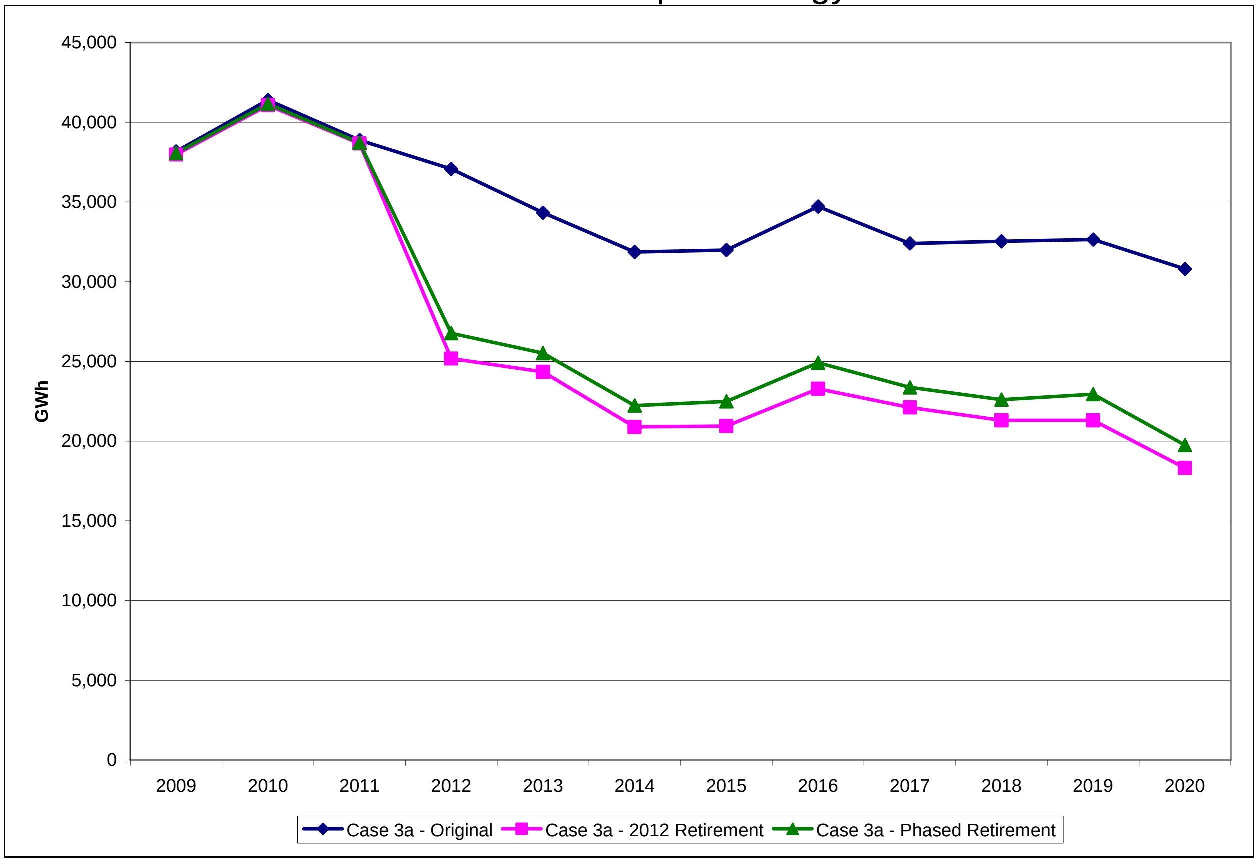
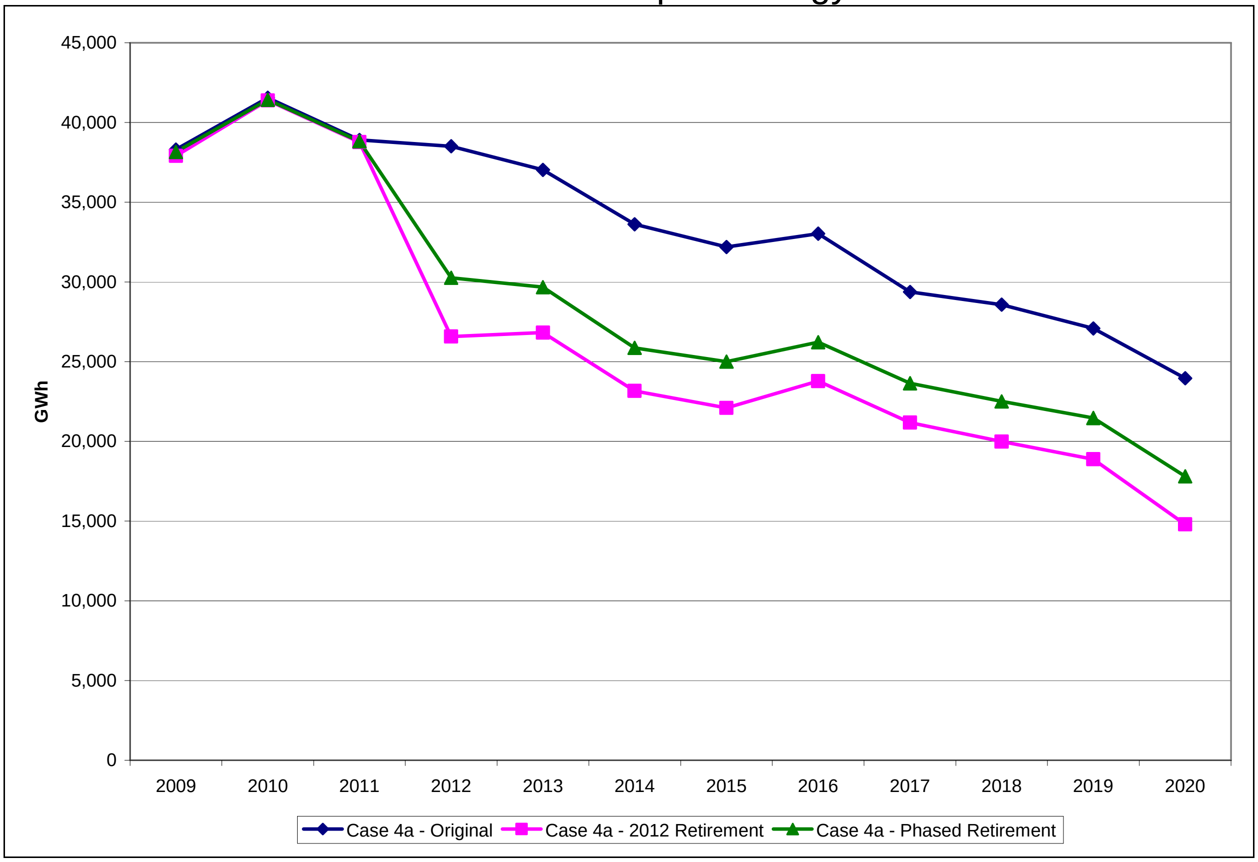


Figure 12
Case 4a SCE Net Import Energy



Changes in Carbon Dioxide Emissions

The CO2 emissions reported below include emissions from California located generation, emissions from generators located outside of California that are assigned to meeting California load, and emissions from import energy into California. The aging plant results show an increase of 3 percent in year 2020 in CO2 emissions from California located generation due to the increase in generation from the addition of efficient resources in the SCE transarea, a decrease of 17 percent in 2020 in CO2 from economy imports into California, and very little change in CO2 from remote generators. Comparing CO2 emissions across the WECC between cases shows a slight decrease in total CO2 emissions of less than one percent in the aging plant variations.

Focusing on the year 2020, Figures 13, 14, and 15 illustrates the differences in CO2 emissions by source for California for each of the aging plant variations for Case 1b, Case 3a, and Case 4a, respectively.

The net effect of these changes in California source CO2 emissions result in a slight decrease in California CO2 emissions starting in 2012 where the changes in resource mix begin in the 2012 Retirement and Phased Retirement scenarios. Figures 16, 17, and 18 illustrate the differences in total California CO2 emissions across each of the cases.

Figure 13
Case 1b California CO2 by Source for 2020

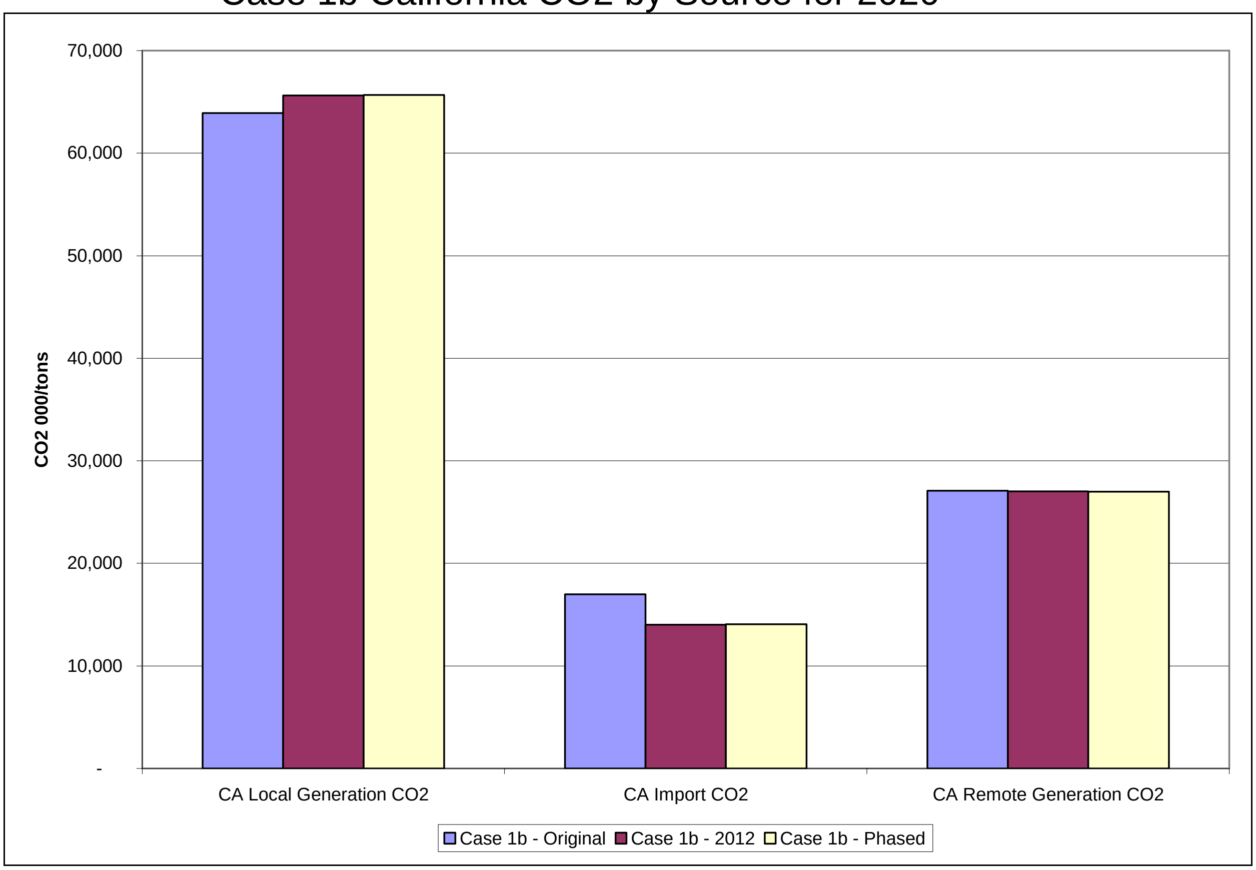


Figure 14
Case 3a California CO2 by Source for 2020

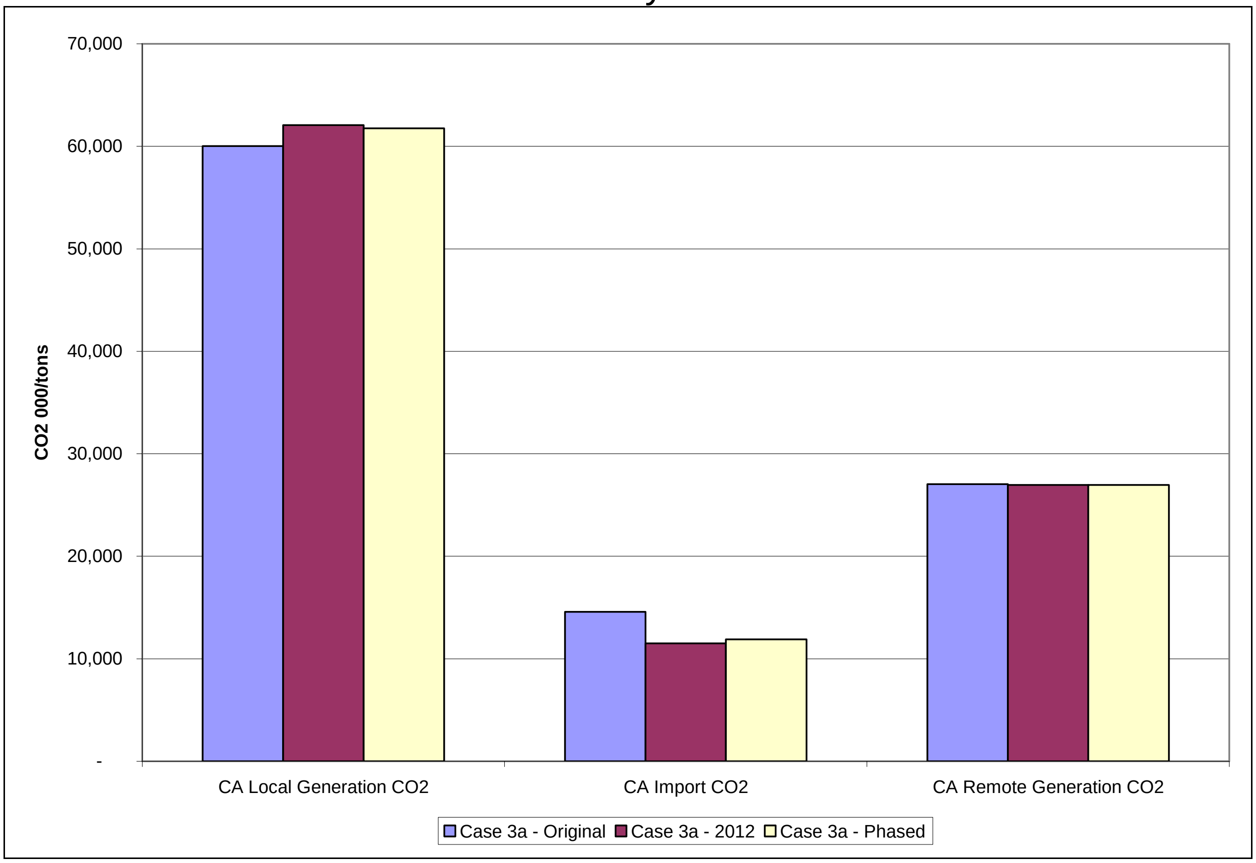


Figure 15
Case 4a California CO2 by Source for 2020

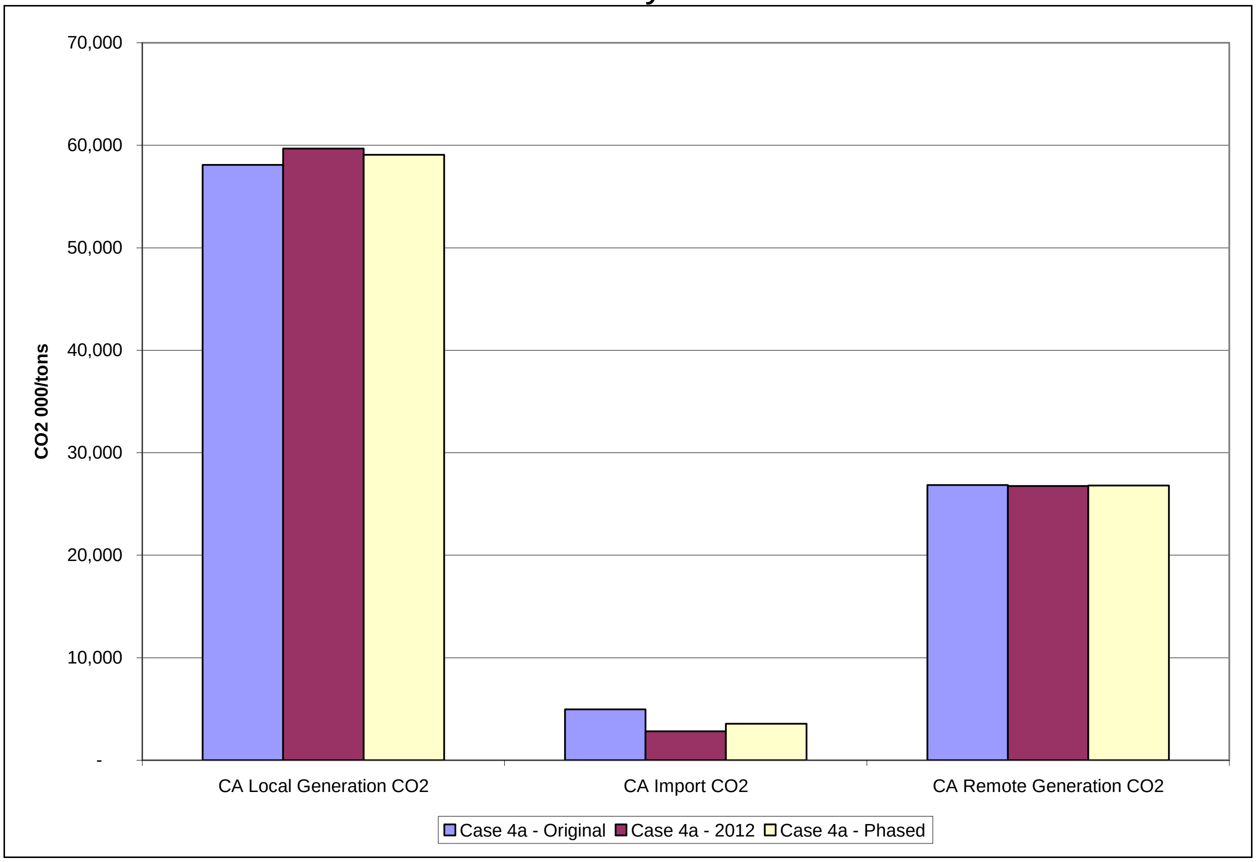


Figure 16
Case 1b California CO2 Emissions

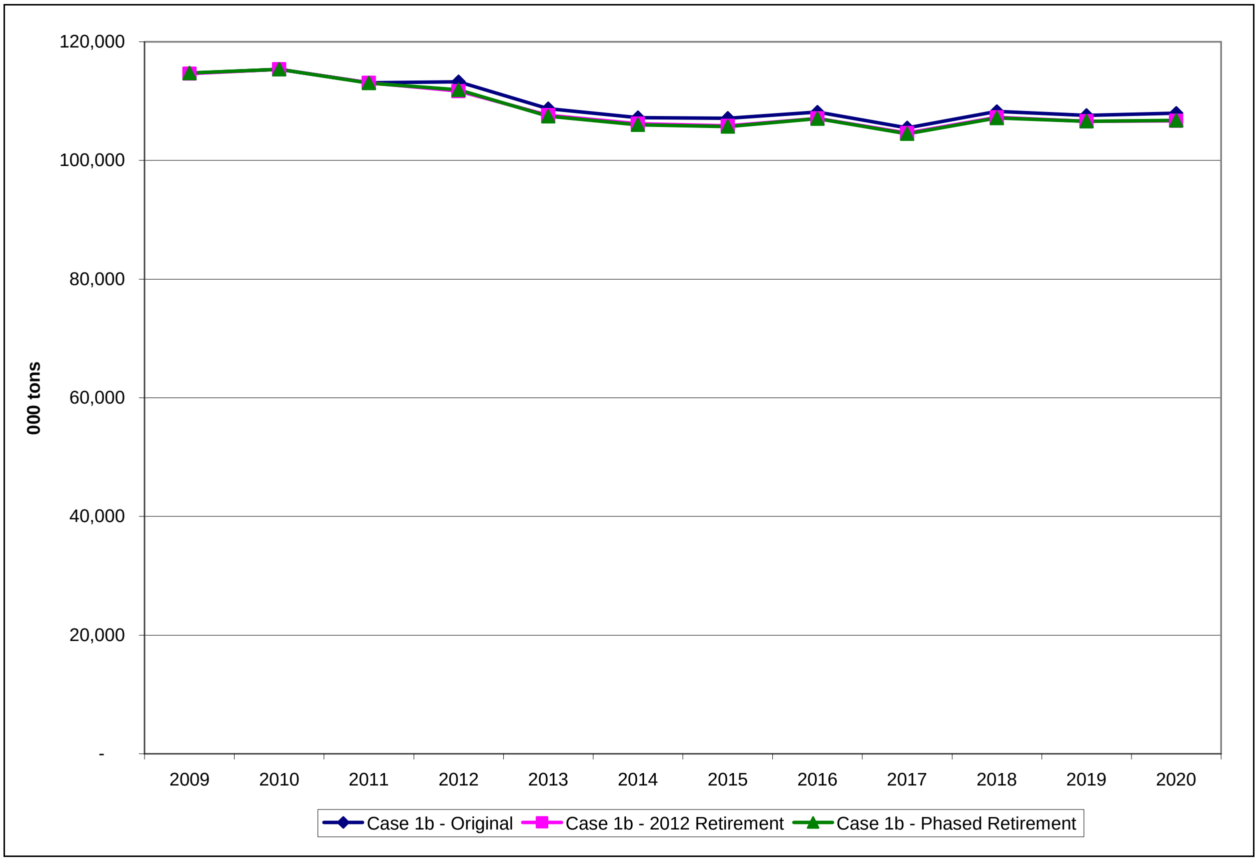


Figure 17
Case 3a California CO2 Emissions

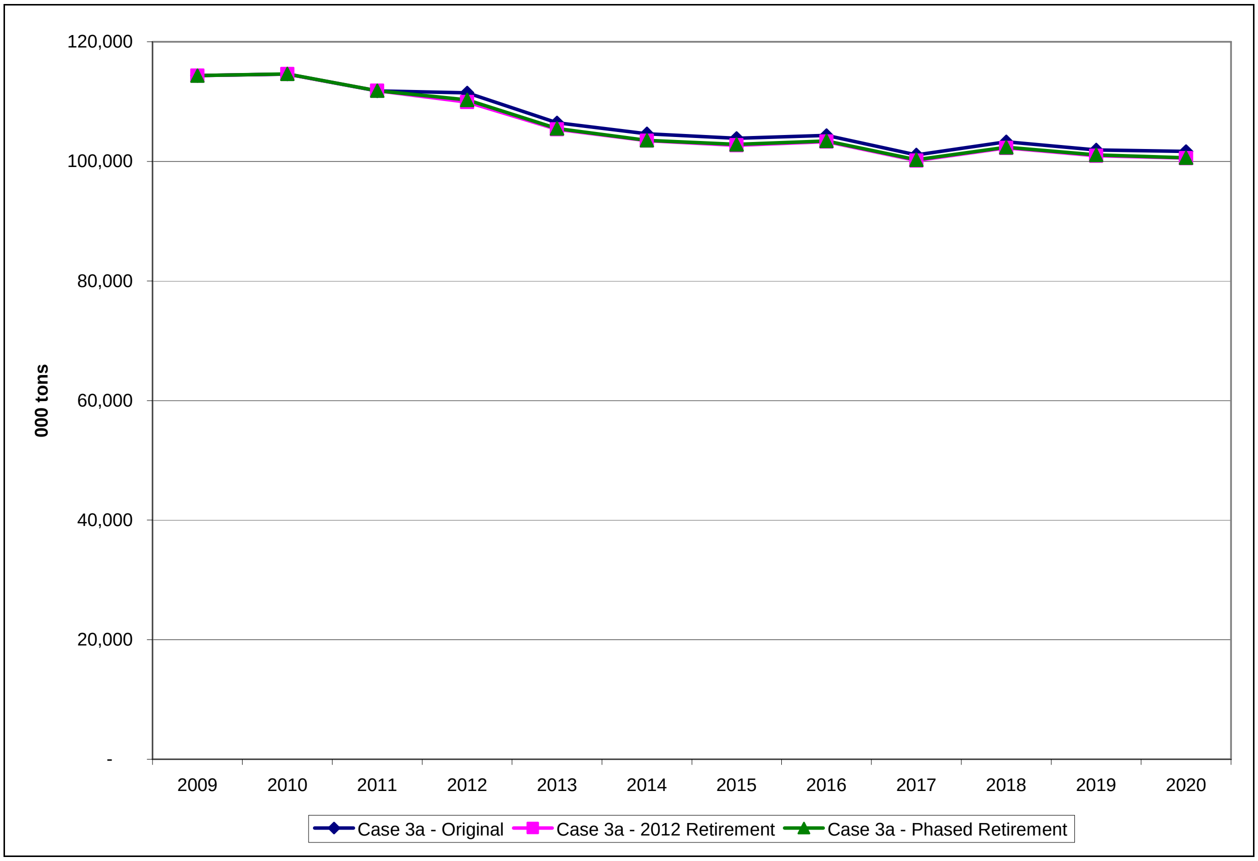
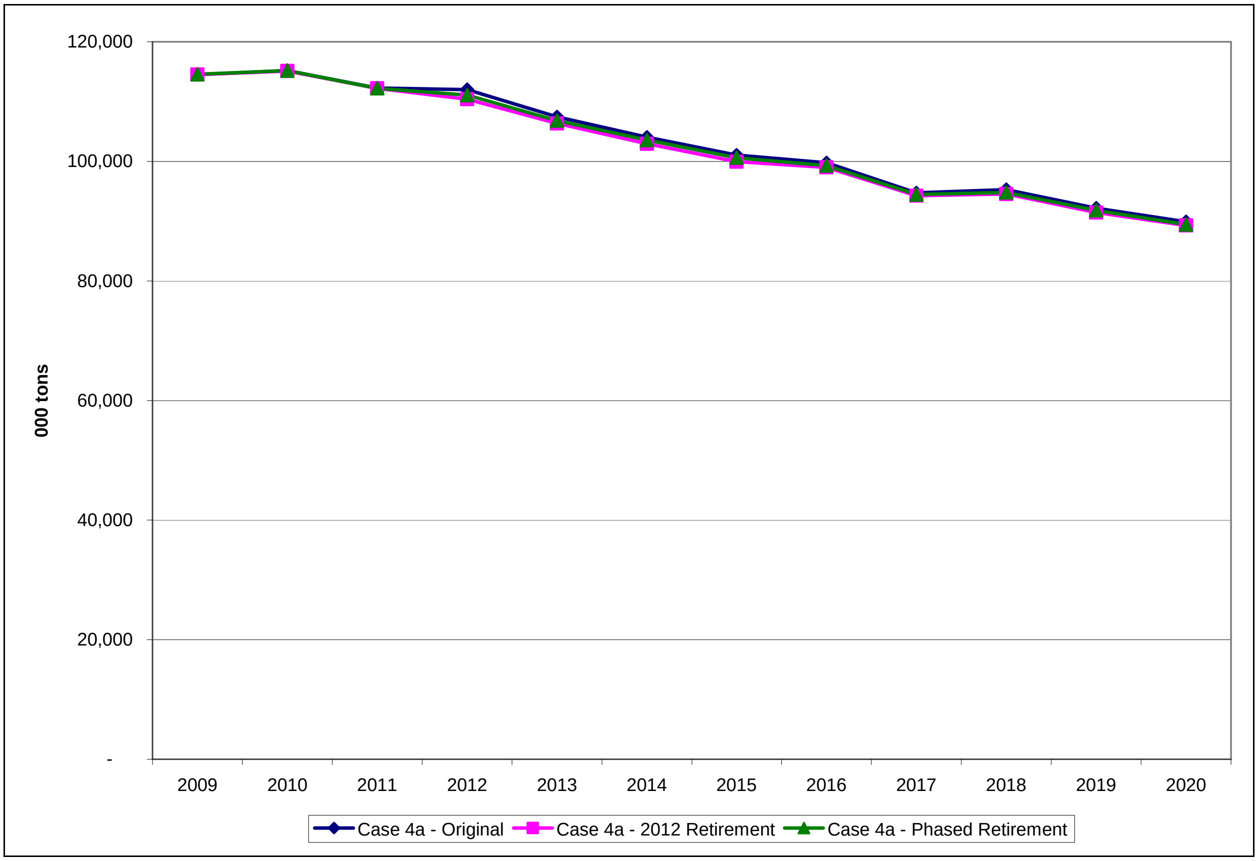


Figure 18
Case 4a California CO2 Emissions



Detailed Scorecard Results

Appendix A consists of the California versus Rest-of-WECC scorecard for the sample year of 2020 for the original, 2012 Retirement, and Phased Retirement cases. This scorecard is in the same format as reported in the June 2007 Results Report which allow a direct comparison of geographic aggregations and variables as defined in Appendix C-1 (of the June 2007 report). The results include load, generation, production costs, capital costs, import energy, export energy, emissions data, and fuel data.

Attachment A includes the complete CA versus Rest-of-WECC and Transarea scorecards in the same format as reported in the June 2007 Results Report for the cases discussed in this analysis.

Appendix A

CA vs. Rest-of-WECC scorecard for 2020 for Cases 1b, 3a, and 4a under the Original, 2012 Retirement, and Phased Retirement cases

Table A-1
Scorecard Line Definitions and Notes

1	Line	Definition
2	Total WECC System Cost ($000)	Sum of Lines 4 and 64
3	California	
4	CA System Production Cost ($000)	Sum of Lines 29, 38, 50, 53, and 59
5	CA Per Unit Production Cost ($/MWh)	Line 4 divided by the difference of Line 7 and 23
6	CA Peak Load (MW)	California coincident peak load in MW
7	CA Energy Load (GWh)	California energy load in GWh (Includes Losses and Pumping Load)
8	CA "Energy Not Served" (GWh)	California Loss of load in GWh
9	CA Generation By Fuel (GWh)	
10	*Coal*	California Coal-fired Generation (GWh)
11	*Fuel Oil*	California Fuel Oil-fired Generation (GWh)
12	*Geothermal*	California Geothermal Generation (GWh)
13	*Hydro*	California Hydro Generation (GWh)
14	*Natural Gas*	California Natural Gas-fired Generation (GWh)
15	*Nuclear*	California Nuclear Generation (GWh)
16	*Biomass/Other*	California plants including Biomass, Solar, Refuse, Wood, Jet Fuel-fired plants, Petroleum Coke-fired plants, and Variable Demand Reduction (GWh)
17	*Pumped Storage*	California Pumped Storage Generation (GWh)
18	*Wind*	California Wind Generation (GWh)
19	*Total CA Generation (GWh)*	Sum of lines 10 through 18
20	CA Energy Efficiency and PV Solar (GWh)	
21	*Energy Efficiency*	California Energy Efficiency Load Reduction (GWh)
22	*PV Solar*	California PV Solar Load Reduction (GWh)
23	*Total CA Energy Efficiency and PV Solar (GWh)*	Sum of Lines 21 and 22
24	CA O&M Costs	
25	CA Fuel Costs ($000)	California Located Generation Fuel Costs
26	CA VOM Costs ($000)	California Located Generation Variable Operations and Maintanence Costs
27	CA Start Costs ($000)	California Located Generation Start Costs
28	CA FOM Costs ($000)	California Located Generation Fixed Operations and Maintenance Costs
29	*Total CA O&M Costs ($000)*	Sum of Lines 25 through 28
30	CA Other Costs	
31	CA Wheeling Costs ($000)	California incurred Wheeling Costs
32	CA Energy Efficiency Costs ($000)	California Energy Efficiency Program Capital Costs
33	CA PV Solar Costs ($000)	California PV Solar Program Capital Costs
34	CA Variable Demand Response Costs ($000)	California Variable Demand Response Costs (includes Program Capital Costs and Variable Costs)
35	CA Transmission Capital Costs ($000)	California Transmission Capital Costs relative to Line 36
36	CA Transmission Miles	California Transmission Miles relative to Line 35
37	CA Incremental Resource Capital Costs ($000)	California cost of generic resource additions including the following resource types: Gas Turbines, Combined Cycles, Wind, Geothermal, Concentrated Solar Power, and Biomass
38	*Total CA Other Costs ($000)*	Sum of of Lines 31 through 35, and Line 37
39	CA Renewable Generation	
40	CA Renewable Generation (GWh) - without Hydro	California renewable generation excluding hydro and pumped storage generation
41	CA Renewable Energy (%) - without Hydro	California renewable generation excluding hydro and pumped storage as a percent of California Load (Line 7) net of California EE and PV Solar (Line 23)
42	CA Renewable Generation (GWh) - with Hydro	California renewable generation including hydro and pumped storage generation
43	CA Renewable Energy (%) - with Hydro	California renewable generation including hydro and pumped storage as a percent of California Load (Line 7) net of California EE and PV Solar (Line 23)
44	CA Emissions	
45	CA CO2 Production (000 tons)	California CO2 production from generation located within California only
46	CA GHG 2020/1990 Ratio	
47	CA SO2 (000 tons)	California SO2 production from generation located within California only
48	CA NOx (000 tons)	California NOx production from generation located within California only
49	CA HG (000 tons)	California HG production from generation located within California only
50	CA Emission Costs SO2/NOx/HG ($000)	California Total Emission Costs from generation located within California only
51	CA Remote Generation	
52	CA Remote Generation (GWh)	California share of generation from remote located plants
53	CA Remote Generation Cost ($000)	California share of generation costs from remote located plants including costs associated with Fuel, VOM , Start-up , FOM, and Emissions.
54	CA Remote CO2 (000 tons)	California share of CO2 emissions from remote located plants
55	CA Remote SO2 (000 tons)	California share of SO2 emissions from remote located plants
56	CA Remote NOx (000 tons)	California share of NOx emissions from remote located plants
57	CA Remote HG (000 tons)	California share of HG emissions from remote located plants
58	CA Imports	
59	CA Net Import ($000)	Cost of energy imports from the Rest of WECC priced at California marginal clearing price (SP15)
60	CA Net Import (GWh)	Net Energy imports from the Rest of WECC (i.e. the difference in California load and generation)
61	CA Import CO2 (000 tons)	CO2 from imported energy from plants in the Rest of WECC into California
62	CA Gas and Water Consumption	
63	CA Gas Consumption (Gbtu)	Natural gas fuel burn from plants located within California
64	CA Water Consumption	Water consumption used in power generation by plants located within California

Continued on next page.

(continued)

1	Line	Definition
65	**Rest of WECC (excludes California results)**	
66	**WECC System Production Cost ($000)**	Sum of Lines 93, 102, 108, and 111
67	**WECC Per Unit Production Cost ($/MWh)**	Line 66 divided by the difference of Line 69 and 87
68	**WECC Peak Load (MW)**	Rest of WECC coincident peak load in MW
69	**WECC Energy Load (GWh)**	Rest of WECC energy load in GWh (Includes Losses and Pumping Load)
70	**WECC "Energy Not Served" (GWh)**	Rest of WECC Loss of load in GWh
71	**Rest of WECC Generation by Fuel (GWh)**	
72	***Coal***	Rest of WECC Coal-fired Generation (GWh)
73	***Fuel Oil***	Rest of WECC Fuel Oil-fired Generation (GWh)
74	***Geothermal***	Rest of WECC Geothermal Generation (GWh)
75	***Hydro***	Rest of WECC Hydro Generation (GWh)
76	***Natural Gas***	Rest of WECC Natural Gas-fired Generation (GWh)
77	***Nuclear***	Rest of WECC Nuclear Generation (GWh)
78	***Biomass/Other***	Rest of WECC plants including Biomass, Solar, Refuse, Wood, Jet Fuel-fired plants, Petroleum Coke-fired plants, and Variable Demand Reduction (GWh)
79	***Pumped Storage***	Rest of WECC Pumped Storage Generation (GWh)
80	***Wind***	Rest of WECC Wind Generation (GWh)
81	***Total Rest of WECC Generation (GWh)***	Sum of Lines 71 through 80
82	***Total Rest ofWECC Exports (GWh)***	Net energy exports from the Rest of WECC into California
83	***Total Rest of WECC Generation Serving WECC Load (GWh)***	The difference of Lines 81 and 82
84	**Rest of WECC Energy Efficiency and PV Solar (GWh)**	
85	***Energy Efficiency***	Rest of WECC Energy Efficiency Load Reduction (GWh)
86	***PV Solar***	Rest of WECC PV Solar Load Reduction (GWh)
87	***Total Rest of WECC Energy Efficiency and PV Solar (GWh)***	Sum of Lines 86 and 87
88	**Rest of WECC O&M Costs**	
89	**WECC Fuel Costs ($000)**	Rest of WECC Located Generation Fuel Costs (excludes cost from WECC/CA shared generation)
90	**WECC VOM Costs ($000)**	Rest of WECC Located Generation Variable Operations and Maintanence Costs(excludes cost from WECC/CA shared generation)
91	**WECC Start Costs ($000)**	Rest of WECC Located Generation Start Costs(excludes cost from WECC/CA shared generation)
92	**WECC FOM Costs ($000)**	Rest of WECC Located Generation Fixed Operations and Maintenance Costs(excludes cost from WECC/CA shared generation)
93	***Total Rest of WECC O&M Costs ($000)***	Sum of Lines 89 through 92
94	**Rest of WECC Other Costs**	
95	**WECC Wheeling Costs ($000)**	Rest of WECC incurred Wheeling Costs
96	**WECC Energy Efficiency Costs ($000)**	Rest of WECC Energy Efficiency Program Capital Costs
97	**WECC PV Solar Costs ($000)**	Rest of WECC PV Solar Program Capital Costs
98	**WECC Variable Demand Response Costs ($000)**	Rest of WECC Variable Demand Response Costs (includes Program Capital Costs and Variable Costs)
99	**WECC Transmission Capital Costs ($000)**	Rest of WECC Transmission Capital Costs relative to Line 100
100	**WECC Transmission Miles**	Rest of WECC Transmission Miles relative to Line 99
101	**WECC Incremental Resource Capital Costs ($000)**	Rest of WECC cost of generic resource additions including the following resource types: Gas Turbines, Combined Cycles, Wind, Geothermal, Concentrated Solar Power, and Biomass
102	***Total Rest of WECC Other Costs ($000)***	Sum of of Lines 95 through 99, and Line 101
103	**Rest of WECC Emissions**	
104	**WECC CO2 Production (000 tons)**	Rest of WECC CO2 production from generation (excludes CO2 from WECC/CA shared generators) also excludes CO2 accounting to CA exports
105	**WECC SO2 (000 tons)**	Rest of WECC SO2 production from generation (excludes SO2 from WECC/CA shared generators)
106	**WECC NOx (000 tons)**	Rest of WECC NOx production from generation (excludes NOx from WECC/CA shared generators)
107	**WECC HG (000 tons)**	Rest of WECC HG production from generation (excludes HG from WECC/CA shared generators)
108	**WECC Emission Costs SO2/NOx/HG ($000)**	Rest of WECC Total Emission Costs (exlcludes emission costs from WECC/CA shared generators)
109	**Rest of WECC Remote Generation**	
110	**WECC Remote Generation (GWh)**	WECC share of generation from WECC/CA shared plants
111	**WECC Remote Generation Cost ($000)**	WECC share of generation costs from WECC/CA shared plants including costs associated with Fuel, VOM , Start-up , FOM, and Emissions.
112	**WECC Remote CO2 (000 tons)**	WECC share of CO2 emissions from WECC/CA shared plants
113	**WECC Remote SO2 (000 tons)**	WECC share of SO2 emissions from WECC/CA shared plants
114	**WECC Remote NOx (000 tons)**	WECC share of NOx emissions from WECC/CA shared plants
115	**WECC Remote HG (000 tons)**	WECC share of HG emissions from WECC/CA shared plants
116	**Rest of WECC Gas Consumption**	
117	**WECC Gas Consumption (Gbtu)**	Natural gas fuel burn from plants located in the Rest of WECC

Table A-2
CA vs Rest-of-WECC Scorecard[5]

	CA vs. Rest-of-WECC ScoreCard - Aging Plant Study	Case 1b			Case 3a			Case 4a		
		Original	2012	Phased	Original	2012	Phased	Original	2012	Phased
YEAR	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
		Case 1b			Case 3a			Case 4a		
1										
2	Total WECC System Cost ($000)	43,847,073	44,496,890	44,537,395	42,983,772	43,561,274	43,553,686	45,595,810	46,385,903	46,198,740
3	California									
4	CA System Cost ($000)	16,354,098	17,221,287	17,327,376	15,701,704	16,561,389	16,511,249	19,002,410	19,981,787	19,747,065
5	CA Per Unit System Cost ($/MWh)	53	56	56	53	56	56	63	66	65
6	CA Peak Load (MW)	66,903	66,903	66,903	66,903	66,903	66,903	66,903	66,903	66,903
7	CA Energy Load (GWh) *Includes Losses and Pumping Load*	339,831	339,834	339,849	339,597	339,631	339,628	339,750	339,774	339,768
8	CA "Energy Not Served" (GWh)	0	0	0	0	0	0	0	0	0
9	CA (Excludes Remote*) Generation By Fuel (GWh)									
10	*Coal*	3,158	3,158	3,158	3,158	3,158	3,158	3,157	3,157	3,157
11	*Fuel Oil*	31	16	10	4	0	3	26	7	1
12	*Geothermal*	20,022	20,022	20,022	20,022	20,022	20,022	33,178	33,178	33,178
13	*Hydro*	33,910	33,910	33,910	33,910	33,910	33,910	33,910	33,910	33,910
14	*Natural Gas*	116,771	122,267	122,220	108,511	114,241	113,540	95,282	99,303	97,932
15	*Nuclear*	33,694	33,666	33,666	33,694	33,666	33,666	33,694	33,666	33,666
16	*Other*	13,290	13,288	13,288	13,285	13,282	13,282	22,668	22,665	22,667
17	*Pumped Storage Output*	2,370	2,374	2,386	2,204	2,230	2,229	2,302	2,324	2,319
18	*Wind*	16,813	16,813	16,813	16,813	16,813	16,813	31,220	31,220	31,220
19	*Total CA Generation*	240,059	245,514	245,473	231,600	237,321	236,622	255,437	259,429	258,049
20	CA Distributed Generation (GWh)									
21	*Energy Efficiency*	29,638	29,638	29,638	42,263	42,263	42,263	29,638	29,638	29,638
22	*PV Solar*	1,629	1,629	1,629	1,629	1,629	1,629	8,036	8,036	8,036
23	*Total Distributed Generation*	31,267	31,267	31,267	43,892	43,892	43,892	37,674	37,674	37,674
24	CA (Excludes Remote*) O&M Costs									
25	CA Fuel Costs ($000)	7,505,968	7,718,898	7,725,685	6,955,756	7,211,000	7,171,036	6,723,190	6,923,504	6,846,262
26	CA VOM Costs ($000)	457,798	468,679	469,435	441,083	452,288	450,672	506,803	515,558	512,745
27	CA Start Costs ($000)	67,112	67,818	66,678	59,217	57,478	57,650	60,141	60,309	59,201
28	CA FOM Costs ($000)	1,153,892	1,156,102	1,156,102	1,153,892	1,156,102	1,156,102	1,153,892	1,156,102	1,156,102
29	*Total CA Ot&M Costs*	9,184,771	9,411,497	9,417,899	8,609,947	8,876,867	8,835,459	8,444,026	8,655,473	8,574,310
30	CA Other Costs									
31	CA Wheeling Costs ($000)	33,060	30,461	30,088	32,134	30,204	30,415	30,792	29,452	30,024
32	CA Energy Efficiency Costs ($000)	1,100,203	1,100,203	1,100,203	1,271,481	1,271,481	1,271,481	1,100,203	1,100,203	1,100,203
33	CA PV Solar Costs ($000)	633,822	633,822	633,822	633,822	633,822	633,822	2,987,984	2,987,984	2,987,984
34	CA Variable Demand Response Costs ($000)	135,544	135,552	135,532	230,009	230,009	230,009	135,583	135,562	135,612
35	CA Transmission Capital Costs ($000)	315,567	341,063	341,063	315,567	341,063	341,063	433,382	458,878	458,878
36	CA Transmission Miles	258	258	258	258	258	258	618	618	618
37	CA Incremental Resource Capital Costs ($000)	2,273,399	3,218,002	3,314,002	2,182,693	3,083,506	3,031,295	4,428,736	5,388,978	5,159,924
38	*Total CA Other Costs*	4,491,594	5,459,103	5,554,710	4,665,706	5,590,085	5,538,085	9,116,680	10,101,057	9,872,626
39	CA Renewable Generation									
40	CA Renewable Generation (GWh)	45,586	45,586	45,586	48,740	45,586	45,586	85,710	85,710	85,710
41	CA Renewable Energy (%)	15%	15%	15%	16%	15%	15%	28%	28%	28%
42	CA Renewable Generation (GWh) - with Hydro	84,915	84,919	84,931	87,902	84,774	84,773	124,971	124,992	124,987
43	CA Renewable Energy (%) - with Hydro	28%	28%	28%	30%	29%	29%	41%	41%	41%
44	CA (Excludes Remote*) Emissions									
45	CA CO2 Production (000 tons)	63,907	65,629	65,677	60,032	62,071	61,749	58,078	59,681	59,063
46	CA GHG 2020/1990 Ratio	0	0	0	0	0	0		0	0
47	CA SO2 (000 tons)	68	68	68	68	68	68	67	67	67
48	CA NOx (000 tons)	238	238	238	237	237	237	243	244	243
49	CA HG (000 tons)	13	13	13	13	13	13	13	13	13
50	CA Emission Costs SO2/NOx/HG ($000)	98,239	108,870	109,657	97,017	106,985	105,637	106,817	114,986	112,473
51	CA Remote* Generation									
52	CA Remote* Generation (GWh)	38,307	38,164	38,116	38,228	38,024	38,034	37,855	37,676	37,766
53	CA Remote* Generation Cost ($000)	950,937	943,328	940,692	947,054	935,787	936,317	930,590	920,194	925,619
54	CA Remote* CO2 (000 tons)	27,087	27,023	27,003	27,048	26,957	26,962	26,843	26,756	26,800
55	CA Remote* SO2 (000 tons)	14	14	14	14	14	14	14	14	14
56	CA Remote* NOx (000 tons)	47	46	46	46	46	46	46	46	46
57	CA Remote* HG (000 tons)	222	222	222	222	222	222	221	221	221
58	CA Imports									
59	CA Net Import ($000)	1,628,557	1,298,488	1,304,417	1,381,980	1,051,665	1,095,752	404,297	190,077	262,037
60	CA Net Import (GWh)	30,197	24,890	24,993	25,877	20,394	21,080	8,784	4,995	6,279
61	CA Import CO2 (000 tons)	16,982	14,017	14,072	14,572	11,503	11,888	4,970	2,829	3,554
62	CA Gas and Water Consumption									
63	CA Gas Consumption (Gbtu)	921,037	954,193	955,678	861,060	900,143	894,719	770,884	800,202	789,913
64	CA Water Consumption									

Continued on next page.

Note: the full spreadsheet of results is available at:

www.energy.ca.gov/2007publications/CEC-200-2007-010/addendum2/

[5] California transmission costs in Case 4a Original are $67.4 million higher from 2017-2020 compared to what was reported in the June 2007 Scenarios scorecards. This increase reflects additional transmission costs identified by NCI during the Aging Plant study. These costs are also present in the Case 4a 2012 Retirement and Phased Retirement cases.

(continued)

YEAR		CA vs. Rest-of-WECC ScoreCard - Aging Plant Study	Case 1b Original	Case 1b 2012	Case 1b Phased	Case 3a Original	Case 3a 2012	Case 3a Phased	Case 4a Original	Case 4a 2012	Case 4a Phased
			2020	2020	2020	2020	2020	2020			
2020	65	**Rest of WECC (excluding California results)**									
	66	**Rest of WECC System Cost ($000)**	27,492,976	27,275,603	27,210,019	27,282,068	26,999,885	27,042,437	26,593,399	26,404,117	26,451,675
	67	**Rest of WECC Per Unit System Cost ($/MWh)**	36	36	36	36	36	36	35	35	35
	68	**Rest of WECC Peak Load (MW)**	125,514	125,514	125,514	125,514	125,514	125,514	125,514	125,514	125,514
	69	**Rest of WECC Energy Load (GWh)** *Includes Losses and Pumping Load*	757,743	757,749	757,747	757,750	757,743	757,739	757,749	757,750	757,750
	70	**Rest of WECC "Energy Not Served" (GWh)**	0	0	0	0	0	0	0	0	0
	71	**Rest of WECC (Excludes Remote*) Generation by Fuel (GWh)**									
	72	*Coal*	271,629	271,549	271,558	271,510	271,484	271,480	270,692	270,605	270,685
	73	*Fuel Oil*	80	93	88	127	102	86	89	115	111
	74	*Geothermal*	16,407	16,407	16,407	16,407	16,407	16,407	16,407	16,407	16,407
	75	*Hydro*	207,385	207,385	207,385	207,385	207,385	207,385	207,385	207,385	207,385
	76	*Natural Gas*	166,441	161,398	161,574	162,303	157,154	157,927	146,781	143,279	144,392
	77	*Nuclear*	9,251	9,251	9,251	9,251	9,251	9,251	9,251	9,251	9,251
	78	*Other*	19,315	19,310	19,311	19,309	19,305	19,306	19,275	19,269	19,274
	79	*Pumped Storage Output*	448	452	450	452	448	445	452	453	453
	80	*Wind*	34,609	34,609	34,609	34,609	34,609	34,609	34,609	34,609	34,609
	81	*Total Rest of WECC Generation*	725,565	720,453	720,632	721,353	716,145	716,893	704,940	701,373	702,566
	82	*Total Rest of WECC Exports*	30,197	24,890	24,993	25,877	20,394	21,080	8,784	4,995	6,279
	83	*Total Excluding Remote* Generation and Exports*	695,368	695,563	695,639	695,476	695,751	695,813	696,156	696,378	696,287
2020	84	**Rest of WECC Distributed Generation (GWh)**									
	85	*Energy Efficiency*	0	0	0	0	0	0	0	0	0
	86	*PV Solar*	527	527	527	527	527	527	527	527	527
	87	*Total Distributed Generation*	527	527	527	527	527	527	527	527	527
	88	**Rest of WECC (Excludes Remote*) O&M Costs**									
	89	**Rest of WECC Fuel Costs ($000)**	15,083,628	14,815,518	14,819,709	14,882,260	14,621,565	14,666,258	14,145,567	13,972,925	14,009,762
	90	**Rest of WECC VOM Costs ($000)**	1,103,652	1,093,266	1,093,717	1,095,073	1,085,105	1,087,268	1,063,024	1,056,127	1,057,119
	91	**Rest of WECC Start Costs ($000)**	65,791	69,316	70,900	70,967	73,336	72,570	87,192	88,515	93,089
	92	**Rest of WECC FOM Costs ($000)**	1,712,561	1,712,561	1,712,561	1,712,561	1,712,561	1,712,561	1,712,561	1,712,561	1,712,561
	93	*Total Rest of WECC O&M Costs*	17,965,633	17,690,661	17,696,887	17,760,862	17,492,568	17,538,658	17,008,345	16,830,129	16,872,531
	94	**Rest of WECC Other Costs**									
2020	95	**Rest of WECC Wheeling Costs ($000)**	213,979	213,756	214,076	212,746	214,351	214,651	213,593	215,225	214,581
	96	**Rest of WECC Energy Efficiency Costs ($000)**	0	0	0	0	0	0	0	0	0
	97	**Rest of WECC PV Solar Costs ($000)**	208,108	208,108	208,108	208,108	208,108	208,108	208,108	208,108	208,108
	98	**Rest of WECC Variable Demand Response Costs ($000)**	0	0	0	0	0	0	0	0	0
	99	**Rest of WECC Transmission Capital Costs ($000)**	1,187,588	1,187,588	1,187,588	1,187,588	1,187,588	1,187,588	1,308,908	1,308,908	1,308,908
	100	**Rest of WECC Transmission Miles**	4,535	4,535	4,535	4,535	4,535	4,535	4,535	4,535	4,535
	101	**Rest of WECC Incremental Resource Capital Costs ($000)**	6,063,888	6,131,738	6,063,888	6,063,888	6,063,888	6,063,888	6,037,957	6,037,957	6,037,957
	102	*Total Rest of WECC Other Costs*	7,673,562	7,741,190	7,673,660	7,672,330	7,673,935	7,674,235	7,768,566	7,770,198	7,769,554
	103	**Rest of WECC (Excludes Remote*) Emissions**									
	104	**Rest of WECC CO2 Production (000 tons)**	354,757	355,503	355,494	355,389	356,319	356,306	357,924	358,601	358,275
	105	**Rest of WECC SO2 (000 tons)**	402	401	401	401	401	401	400	400	400
	106	**Rest of WECC NOx (000 tons)**	462	462	462	461	461	461	459	459	459
	107	**Rest of WECC HG (000 tons)**	2,724	2,724	2,724	2,723	2,723	2,723	2,717	2,716	2,716
	108	**Rest of WECC Emission Costs SO2/NOx/HG ($000)**	231,442	231,329	231,332	231,333	231,260	231,239	230,189	230,114	230,233
2020	109	**Rest of WECC Remote* Generation**									
	110	**Rest of WECC Remote* Generation (GWh)**	61,849	61,659	61,581	61,747	61,465	61,399	61,066	60,846	60,937
	111	**Rest of WECC Remote* Generation Cost ($000)**	1,622,338	1,612,423	1,608,141	1,617,543	1,602,122	1,598,305	1,586,300	1,573,677	1,579,356
	112	**Rest of WECC Remote* CO2 (000 tons)**	36,294	36,209	36,177	36,247	36,123	36,093	35,932	35,830	35,871
	113	**Rest of WECC Remote* SO2 (000 tons)**	27	27	27	27	27	27	27	27	27
	114	**Rest of WECC Remote* NOx (000 tons)**	61	61	61	61	61	61	61	61	61
	115	**Rest of WECC Remote* HG (000 tons)**	343	343	343	343	343	343	342	342	342
	116	**Rest of WECC Gas Consumption**									
	117	**Rest of WECC Gas Consumption (Gbtu)**	1,309,985	1,267,106	1,266,276	1,276,222	1,232,948	1,239,133	1,163,891	1,135,438	1,141,515

APPENDIX C

IMPACTS ON NATURAL GAS MARKET PRICES OF LOW DEMAND FOR GAS AS A POWER GENERATION FUEL IN THE WEST

Prepared by Global Energy Decisions, Inc.

Appendix H-5 – Impacts on Natural Gas Market Prices of Low Demand for Gas as a Power Generation Fuel in the West

1 OVERVIEW

This appendix summarizes the modeling of the Western U.S. natural gas system and Henry Hub price forecasts using GPCM® that have been conducted as part of the IEPR scenario project. This modeling addressed the varying impacts on natural gas prices of various scenarios of lowered demand for natural gas during the forecast period of 2009 through 2020. Such lowered demand would result from increased use in WECC of energy efficiency (in Cases 3B and 3C) and of both energy efficiency and renewables (in Case 5B). There was agreement within the study team that such lowered demand would naturally impact market prices for gas and that such an impact needed to be modeled and forecast scenarios prepared.

This Appendix describes the step-by-step process by which the Low-Gas-Demand GPCM forecasts were developed by Global Energy Decisions under the direction of the IEPR study team. The final section (Section 5) is the most important for policy makers, as it describes the development of Forecast "5B-Plus," which models the increased application of energy efficiency and renewables throughout WECC. The process systematically leading up to Forecast 5B-Plus will now be summarized.

Within the Low-Gas-Demand forecast study project, four gas forecasts were produced for different IEPR electricity scenarios. Each is the focus of a separate section of this appendix.

- Section 2: Forecast 3B, energy efficiency increased throughout WECC
- Section 3:Forecast 3C, energy efficiency increased in those states of WECC having specific mandates (California, Oregon, Washington, Nevada, Arizona)
- Section 4: Forecast 5B (energy efficiency and renewables increased throughout WECC)
- Section 5: Forecast 5B-Plus (energy efficiency and renewables increased throughout WECC) with the addition of a shaped supply response (limitation) to correct the "supply bubble" that would result from the decrease in demand. As has been emphasized, this section is the most important for policy makers.

The results of these low-demand forecasts are summarized in comparison to the Illustrative Base Case (IBC) and Scarcity Case in the figures and tables below.

Figure 1-1

Results of the Low-Demand Forecasts (2006$/MMBtu) Compared to IBC and Scarcity Forecasts

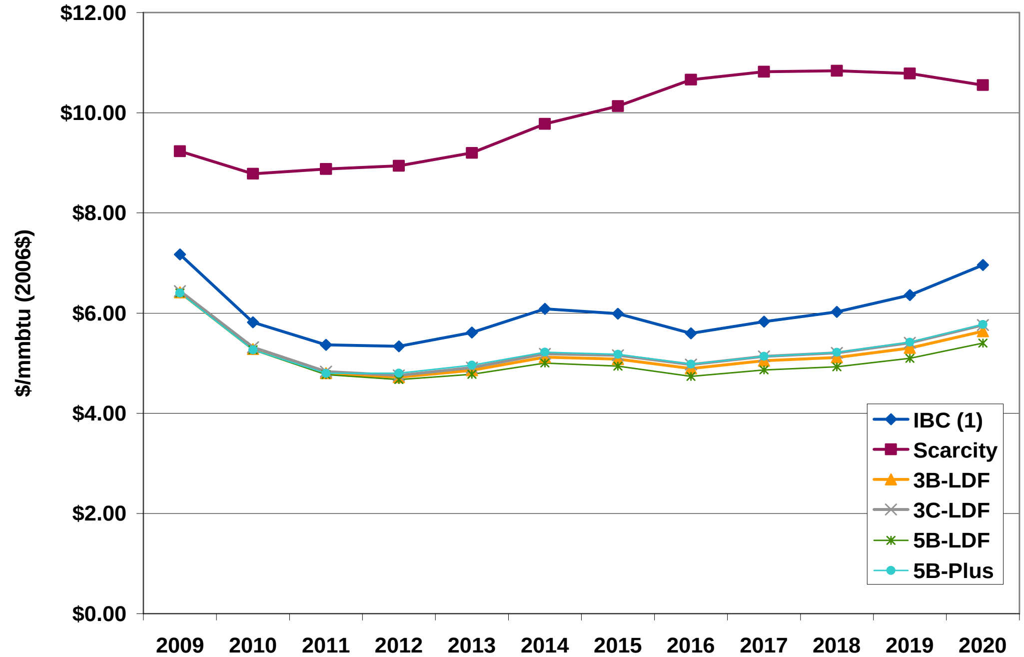


Table 1-1

Results of the Forecasts

$/mmbtu (2006$)	IBC (1)	Scarcity	3B-LDF	3C-LDF	5B-LDF	5B-Plus	5B-Plus Drop in HH	5B-Plus: % Drop in HH	5B-LDF: Drop in HH	5B-LDF: % Drop in HH	3B-LDF: Drop in HH	3B-LDF: % Drop in HH	3C-LDF: Drop in HH	3C-LDF: % Drop in HH
2009	$7.17	$9.23	$6.42	$6.44	$6.40	$6.40	$0.77	-10.7%	$0.77	-10.7%	$0.75	-10.5%	$0.73	-10.2%
2010	$5.82	$8.78	$5.28	$5.32	$5.27	$5.27	$0.55	-9.5%	$0.55	-9.5%	$0.53	-9.2%	$0.50	-8.6%
2011	$5.36	$8.88	$4.80	$4.83	$4.77	$4.80	$0.57	-10.6%	$0.59	-11.1%	$0.56	-10.5%	$0.53	-9.9%
2012	$5.34	$8.94	$4.72	$4.76	$4.67	$4.80	$0.53	-10.0%	$0.66	-12.5%	$0.62	-11.5%	$0.58	-10.9%
2013	$5.61	$9.20	$4.86	$4.91	$4.78	$4.96	$0.65	-11.6%	$0.83	-14.9%	$0.75	-13.4%	$0.70	-12.5%
2014	$6.09	$9.78	$5.12	$5.19	$5.00	$5.22	$0.87	-14.2%	$1.08	-17.8%	$0.97	-15.9%	$0.90	-14.8%
2015	$5.99	$10.13	$5.08	$5.16	$4.94	$5.18	$0.81	-13.5%	$1.05	-17.5%	$0.91	-15.1%	$0.83	-13.8%
2016	$5.60	$10.66	$4.89	$4.97	$4.73	$4.98	$0.62	-11.0%	$0.86	-15.4%	$0.70	-12.6%	$0.63	-11.2%
2017	$5.83	$10.82	$5.05	$5.14	$4.86	$5.14	$0.69	-11.8%	$0.96	-16.5%	$0.78	-13.3%	$0.69	-11.9%
2018	$6.02	$10.84	$5.11	$5.21	$4.93	$5.22	$0.80	-13.4%	$1.10	-18.2%	$0.91	-15.1%	$0.82	-13.6%
2019	$6.36	$10.78	$5.30	$5.41	$5.10	$5.42	$0.94	-14.8%	$1.27	-19.9%	$1.06	-16.6%	$0.95	-15.0%
2020	$6.96	$10.55	$5.64	$5.76	$5.40	$5.77	$1.19	-17.1%	$1.56	-22.4%	$1.33	-19.0%	$1.20	-17.2%
2011-2020	Average						$0.77		$1.00		$0.86		$0.78	

Table 1-2

Sources and Uses for Each Forecast (Tcf)

IBC

Canada	2010	2015	2020	USA	2010	2015	2020	Total NA	2010	2015	2020
Demand				Demand				Demand			
Core	1.17	1.20	1.31	Core	8.05	8.39	8.79	Core	9.27	9.66	10.19
Industrial	1.33	1.47	1.61	Industrial	7.00	7.32	7.61	Industrial	8.95	9.44	9.91
Electric	0.37	0.50	0.60	Electric	7.09	8.50	10.07	Electric	8.42	10.16	12.1
LP & PF	0.54	0.61	0.65	LP & PF	1.49	1.56	1.66	LP & PF	2.31	2.52	2.66
Total	3.41	3.78	4.17	Total	23.63	25.77	28.13	Total	28.95	31.78	34.86
Supply				**Supply**				**Supply**			
Dry Gas Production	6.59	6.88	6.56	Dry Gas Production	16.88	17.71	19.41	Dry Gas Production	24.78	26.01	27.27
Pipeline Imports	-3.33	-3.38	-2.71	Pipeline Imports	3.01	2.84	1.82	Pipeline Imports	0.00	0.00	0.00
LNG Imports	0.18	0.31	0.39	Net LNG Imports	3.81	5.09	6.89	Net LNG Imports	4.23	5.71	7.6
Total	3.44	3.81	4.24	Total	23.70	25.64	28.12	Total	29.01	31.72	34.87
	0.03	0.03	0.07		0.07	-0.13	-0.01		0.06	-0.06	0.01
	0.87%	0.79%	1.65%		0.30%	-0.51%	-0.04%		0.21%	-0.19%	0.03%

Scarcity Scenario

Canada	2010	2015	2020	USA	2010	2015	2020	Total NA	2010	2015	2020
Demand				Demand				Demand	2010	2015	2020
Core	1.11	1.13	0.50	Core	8.06	8.40	8.53	Core	9.22	9.60	9.04
Industrial	0.61	0.68	0.53	Industrial	7.02	7.31	7.59	Industrial	8.23	8.62	8.25
Electric	0.35	0.47	0.57	Electric	7.09	8.48	7.93	Electric	8.39	9.17	8.50
LP & PF	0.52	0.48	0.38	LP & PF	1.47	1.31	1.12	LP & PF	2.21	2.14	1.82
Total	2.59	2.76	1.98	Total	23.64	25.50	25.17	Total	28.05	29.53	27.61
Supply				**Supply**				**Supply**			
Dry Gas Production	6.05	5.47	4.25	Dry Gas Production	15.66	14.78	12.83	Dry Gas Production	23.10	21.70	18.27
Pipeline Imports	-3.88	-3.51	-3.16	Pipeline Imports	3.82	4.16	4.42	Pipeline Imports	0.00	0.00	0.00
LNG Imports	0.42	0.80	0.9	LNG Imports	4.16	6.60	7.96	LNG Imports	5.03	7.87	9.39
Total	2.59	2.76	1.99	Total	23.64	25.54	25.21	Total	28.13	29.57	27.66
	0.00	0.00	0.01		0.00	0.04	0.04		0.08	0.04	0.05
	0.00%	0.00%	0.50%		0.00%	0.16%	0.16%		0.28%	0.14%	0.18%

3B

Canada	2010	2015	2020	USA	2010	2015	2020	Total NA	2010	2015	2020
Demand				Demand				Demand			
Core	1.18	1.23	1.34	Core	8.06	8.41	8.81	Core	9.29	9.69	10.22
Industrial	1.34	1.48	1.65	Industrial	7.02	7.34	7.63	Industrial	8.96	9.46	9.96
Electric	0.37	0.51	0.61	Electric	6.93	7.90	9.16	Electric	8.25	9.60	11.20
LP & PF	0.53	0.60	0.64	LP & PF	1.47	1.52	1.62	LP & PF	2.33	2.45	2.60
Total	3.42	3.82	4.24	Total	23.48	25.17	27.22	Total	28.83	31.20	33.98
Supply				**Supply**				**Supply**			
Dry Gas Production	6.42	6.60	6.22	Dry Gas Production	16.61	17.32	18.74	Dry Gas Production	24.41	25.35	26.38
Pipeline Imports	-3.28	-3.36	-2.65	Pipeline Imports	3.21	3.07	2.13	Pipeline Imports	0.00	0.00	0.00
LNG Imports	0.27	0.58	0.68	LNG Imports	3.72	4.77	6.37	LNG Imports	4.49	5.86	7.65
Total	3.41	3.82	4.25	Total	23.54	25.16	27.24	Total	28.90	31.21	34.03
	-0.01	0.00	0.01		0.06	-0.01	0.02		0.07	0.01	0.05
	-0.29%	0.00%	0.24%		0.25%	-0.04%	0.07%		0.24%	0.03%	0.15%

5B and 5B -Plus

Canada

	2010	2015	2020
Demand			
Core	1.18	1.23	1.34
Industrial	1.34	1.48	1.65
Electric	0.37	0.51	0.61
LP & PF	0.53	0.60	0.64
Total	3.42	3.82	4.24
Supply			
Dry Gas Production	6.42	6.60	6.22
Pipeline Imports	-3.28	-3.36	-2.65
LNG Imports	0.28	0.58	0.68
Total	3.42	3.82	4.25
	0.00	0.00	0.01
	0.00%	0.00%	0.24%

USA

	2010	2015	2020
Demand			
Core	8.06	8.41	8.81
Industrial	7.02	7.34	7.63
Electric	6.91	7.66	8.71
LP & PF	1.47	1.51	1.59
Total	23.46	24.92	26.74
Supply			
Dry Gas Production	16.60	17.22	18.54
Pipeline Imports	3.21	3.00	1.99
LNG Imports	3.71	4.71	6.25
Total	23.52	24.93	26.78
	0.06	0.01	0.04
	0.26%	0.04%	0.15%

Total NA

	2010	2015	2020
Demand			
Core	9.29	9.69	10.23
Industrial	8.96	9.46	9.96
Electric	8.24	9.36	10.76
LP & PF	2.33	2.48	2.58
Total	28.82	30.99	33.53
Supply			
Dry Gas Production	24.40	25.20	26.07
Pipeline Imports	0.00	0.00	0.00
LNG Imports	4.48	5.80	7.50
Total	28.88	31.00	33.57
	0.06	0.01	0.04
	0.21%	0.03%	0.12%

2 3B LOW DEMAND FORECAST ("3B-LDF") OF HENRY HUB PRICES BASED UPON 3B IEPR ELECTRICITY SCENARIO

2.1 Results

This GPCM Forecast 3B-LDF models the electricity demand for gas from IEPR Case 3B, characterized by High Energy Efficiency throughout WECC.

The 3B Low Demand Forecast ("3B-LDF") results in an average decrease from the Illustrative Base Case ("IBC") of $0.85/MMBtu (real 2006$) (Table 2-1). The decrease ranges from approximately $0.50/MMBtu at the beginning of the study period to approximately $1.35/MMBtu by the end of the study period. The following tables and figures show that annual Henry Hub prices are impacted by a significant multiple of the percentage difference (decrease) in total WECC and total North America demand. This multiple is the result of overall low price elasticity; small changes in supply and/or demand can create large affects on prices.

Table 2-1
Initial Results, Low-Demand Gas Forecast for IEPR Scenarios (2006$)

	3B-LDF	IBC	Drop in HH	% Drop in HH
2007	$6.54	$7.22	0.68	9.4%
2008	$6.39	$7.79	1.40	17.9%
2009	$6.42	$7.17	0.75	10.5%
2010	$5.28	$5.82	0.53	9.2%
2011	$4.80	$5.36	0.56	10.5%
2012	$4.72	$5.34	0.62	11.5%
2013	$4.86	$5.61	0.75	13.4%
2014	$5.12	$6.09	0.97	15.9%
2015	$5.08	$5.99	0.91	15.1%
2016	$4.89	$5.60	0.70	12.6%
2017	$5.05	$5.83	0.78	13.3%
2018	$5.11	$6.02	0.91	15.1%
2019	$5.30	$6.36	1.06	16.6%
2020	$5.64	$6.96	1.33	19.0%

The sources and uses of natural gas for 3B-LDF and IBC are shown in Tables 2-2 (for the U.S.), 2-3 (For Canada), and 2-4 (for North America).

Table 2-2

US Demand Supply Disposition

(TCF)	Illustrative Base Case			Low Demand Case (3B)		
US Demand	2010	2015	2020	2010	2015	2020
Core	8.05	8.39	8.79	8.06	8.41	8.81
Industrial	7.00	7.32	7.61	7.02	7.34	7.63
Electric Gen	7.09	8.50	10.07	6.93	7.90	9.16
Fuel	1.49	1.56	1.66	1.47	1.52	1.62
Total	23.63	25.77	28.13	23.48	25.17	27.22
US Supply	2010	2015	2020	2010	2015	2020
Production	16.88	17.71	19.41	16.61	17.32	18.74
Net Pipeline Imports	3.01	2.84	1.82	3.21	3.07	2.13
Net LNG imports	3.81	5.09	6.89	3.72	4.77	6.37
Total	23.70	25.64	28.12	23.54	25.16	27.24
Discrepancy	0.07	-0.13	-0.01	0.06	-0.01	0.02
Discrepancy (% of Total Supply)	0.30%	0.51%	0.04%	0.25%	0.04%	0.07%

Table 2-3

Canadian Demand Supply Disposition

(TCF)	Illustrative Base Case			Low Demand Case (3B)		
Canada Demand	2010	2015	2020	2010	2015	2020
Core	1.17	1.20	1.31	1.18	1.22	1.34
Industrial	1.33	1.47	1.61	1.33	1.48	1.65
Electric Gen	0.37	0.50	0.60	0.38	0.51	0.61
Fuel	0.54	0.61	0.65	0.52	0.60	0.64
Total	3.41	3.78	4.17	3.41	3.81	4.24
Canada Supply	2010	2015	2020	2010	2015	2020
Production	6.59	6.88	6.56	6.42	6.65	6.32
Net Pipeline Imports	-3.33	-3.38	-2.71	-3.28	-3.43	-2.77
Net LNG imports	0.18	0.31	0.39	0.27	0.59	0.69
Total	3.44	3.81	4.24	3.41	3.81	4.24
Discrepancy	0.03	0.03	0.07	-0.01	-0.01	0.00
Discrepancy (% of Total Supply)	0.87%	0.79%	1.65%	-0.29%	-0.26%	0.00%

Table 2-4

North American Demand Supply Disposition

(TCF)	Illustrative Base Case			Low Demand Case (3B)		
NA Demand	2010	2015	2020	2010	2015	2020
Core	9.27	9.66	10.19	9.29	9.69	10.22
Industrial	8.95	9.44	9.91	8.96	9.46	9.96
Electric Gen	8.42	10.16	12.10	8.25	9.60	11.20
Fuel	2.31	2.52	2.66	2.28	2.45	2.60
Total	28.95	31.78	34.86	28.78	31.20	33.98
NA Supply	2010	2015	2020	2010	2015	2020
Production	24.78	26.01	27.27	24.41	25.35	26.38
Net Pipeline Imports	0.00	0.00	0.00	0.00	0.00	0.00
Net LNG imports	4.23	5.71	7.60	4.49	5.86	7.65
Total	29.01	31.72	34.87	28.90	31.21	34.03
Discrepancy	0.06	-0.06	0.01	0.12	0.01	0.05
Discrepancy (% of Total Supply)	0.21%	-0.19%	0.03%	0.42%	0.03%	0.15%

2.2 Characteristics of 3B-LDF

To produce 3B-LDF, natural gas demand data for electricity generation from IEPR 3b were inserted as replacement data into the IBC. Other sectors of demand for natural gas i.e. Residential, Commercial, and Industrial, in WECC are not changed from their values in IBC. Furthermore, for 3B-LDF, demand for natural gas in all other regions is kept the same as in IBC.

Tables 2-5 and 2-6 show the demand from power generation and other sectors, comparing 3B-LDF to IBC.

In IBC, the demand for gas for power generation in WECC (excluding Alberta and British Columbia[1]) was approximately 4.3 Bcf/d in 2009 and approximately 6.3 Bcf/d in 2020 (end of the study period). In 3B-LDF, natural gas demand for power generation is 4.1 Bcf/d in 2009 and approximately 3.9 Bcf/d in 2020. These values represent a drop of 39% in demand for power generation by 2020 (Figures 2-1 and 2-2).

[1] The Alberta and British Columbia portions of WECC are excluded from the power generation demand drop in this forecast because, in the GPCM model, these two provinces fall into separate modeling regions from the Mountain and Pacific (the two GPCM and EIA regions comprising the vast majority of WECC). The exclusion of the two Canadian provinces is not substantive because of the very small contribution they make to the overall supply of gas-fired electricity in WECC.

Table 2-5

Natural Gas Demand for Power Gen (MMCF/d)

Low Demand Case (3B)

mmcf/d	AK	CAN	ENC	ESC	MA	MNT	NE	PAC	SA	WNC	WSC	Total
2009	0	913	680	709	1,962	1,518	1,177	2,577	3,362	338	5,332	18,570
2010	0	1,017	750	735	2,190	1,597	1,416	2,464	3,899	363	5,568	19,999
2011	0	1,028	761	827	2,300	1,541	1,561	2,367	4,177	358	5,680	20,600
2012	0	1,164	881	869	2,310	1,556	1,608	2,396	4,479	380	5,923	21,565
2013	0	1,289	939	921	2,250	1,531	1,564	2,308	4,446	389	5,975	21,612
2014	0	1,337	999	1,046	2,241	1,555	1,600	2,276	4,639	404	6,112	22,207
2015	0	1,396	1,043	1,153	2,342	1,577	1,582	2,271	4,962	422	6,286	23,033
2016	0	1,519	1,164	1,234	2,513	1,596	1,632	2,264	5,597	462	6,537	24,517
2017	0	1,567	1,187	1,359	2,546	1,575	1,685	2,215	5,735	476	6,653	24,999
2018	0	1,593	1,207	1,425	2,540	1,588	1,678	2,275	5,950	476	6,643	25,373
2019	0	1,634	1,252	1,487	2,525	1,634	1,688	2,305	6,070	483	6,753	25,830
2020	0	1,660	1,333	1,573	2,635	1,619	1,733	2,263	6,448	514	6,914	26,693

IBC

mmcf/d	AK	CAN	ENC	ESC	MA	MNT	NE	PAC	SA	WNC	WSC	Total
2009	0	902	680	709	1,962	1,598	1,177	2,712	3,362	338	5,332	18,774
2010	0	1,005	750	735	2,190	1,774	1,416	2,738	3,899	363	5,568	20,438
2011	0	1,015	761	827	2,300	1,771	1,561	2,720	4,177	358	5,680	21,171
2012	0	1,148	881	869	2,310	1,921	1,608	2,958	4,479	380	5,923	22,476
2013	0	1,268	939	921	2,250	2,014	1,564	3,036	4,446	389	5,975	22,803
2014	0	1,309	999	1,046	2,241	2,131	1,600	3,117	4,639	404	6,112	23,595
2015	0	1,368	1,043	1,153	2,342	2,252	1,582	3,244	4,962	422	6,286	24,654
2016	0	1,496	1,164	1,234	2,513	2,382	1,632	3,379	5,597	462	6,537	26,395
2017	0	1,542	1,187	1,359	2,546	2,423	1,685	3,408	5,735	476	6,653	27,014
2018	0	1,562	1,207	1,425	2,540	2,482	1,678	3,555	5,950	476	6,643	27,516
2019	0	1,598	1,252	1,487	2,525	2,594	1,688	3,659	6,070	483	6,753	28,108
2020	0	1,619	1,333	1,573	2,635	2,655	1,733	3,711	6,448	514	6,914	29,135

Table 2-6

Total Natural Gas Demand (Res + Com + Ind + Pow) (MMCf/d)

Low Demand Case (3B)

mmcf/d	AK	CAN	ENC	ESC	MA	MNT	NE	PAC	SA	WNC	WSC	Total
2009	239	7,815	9,488	2,971	6,965	3,746	2,360	7,441	6,964	3,499	14,893	66,380
2010	243	7,916	9,643	3,018	7,211	3,859	2,615	7,405	7,564	3,551	15,185	68,211
2011	247	8,124	9,745	3,133	7,322	3,838	2,769	7,384	7,907	3,575	15,350	69,394
2012	250	8,270	9,943	3,196	7,322	3,886	2,815	7,481	8,270	3,622	15,645	70,700
2013	253	8,519	10,113	3,276	7,292	3,895	2,774	7,447	8,296	3,674	15,751	71,288
2014	256	8,684	10,252	3,426	7,298	3,950	2,815	7,456	8,542	3,726	15,940	72,346
2015	258	8,823	10,363	3,560	7,421	4,003	2,805	7,493	8,917	3,782	16,169	73,593
2016	261	9,078	10,559	3,668	7,630	4,055	2,868	7,530	9,603	3,862	16,476	75,590
2017	263	9,238	10,642	3,820	7,691	4,066	2,932	7,520	9,789	3,913	16,648	76,520
2018	266	9,443	10,707	3,911	7,698	4,112	2,934	7,621	10,056	3,944	16,693	77,384
2019	268	9,676	10,811	4,000	7,716	4,194	2,958	7,700	10,230	3,989	16,862	78,405
2020	271	9,854	10,959	4,115	7,856	4,216	3,017	7,718	10,665	4,057	17,082	79,811

IBC

mmcf/d	AK	CAN	ENC	ESC	MA	MNT	NE	PAC	SA	WNC	WSC	Total
2009	239	7,738	9,487	2,971	6,965	3,826	2,360	7,576	6,964	3,499	14,893	66,518
2010	243	7,847	9,642	3,018	7,211	4,036	2,615	7,679	7,564	3,551	15,185	68,593
2011	247	8,049	9,744	3,133	7,322	4,068	2,769	7,738	7,907	3,575	15,350	69,902
2012	250	8,179	9,943	3,196	7,322	4,251	2,815	8,043	8,270	3,622	15,645	71,536
2013	253	8,412	10,112	3,276	7,292	4,378	2,774	8,175	8,296	3,674	15,751	72,392
2014	256	8,554	10,250	3,426	7,298	4,526	2,815	8,298	8,542	3,726	15,940	73,631
2015	258	8,689	10,362	3,560	7,421	4,679	2,805	8,466	8,917	3,782	16,169	75,107
2016	261	8,960	10,559	3,668	7,630	4,841	2,868	8,645	9,603	3,862	16,476	77,372
2017	263	9,107	10,641	3,820	7,691	4,914	2,932	8,712	9,789	3,913	16,648	78,429
2018	266	9,288	10,706	3,911	7,698	5,005	2,934	8,901	10,056	3,944	16,693	79,402
2019	268	9,494	10,810	4,000	7,716	5,154	2,958	9,053	10,230	3,989	16,862	80,535
2020	271	9,607	10,958	4,115	7,856	5,251	3,017	9,166	10,665	4,057	17,082	82,044

Figure 2-1

WECC: Natural Gas Demand for Electricity Generation

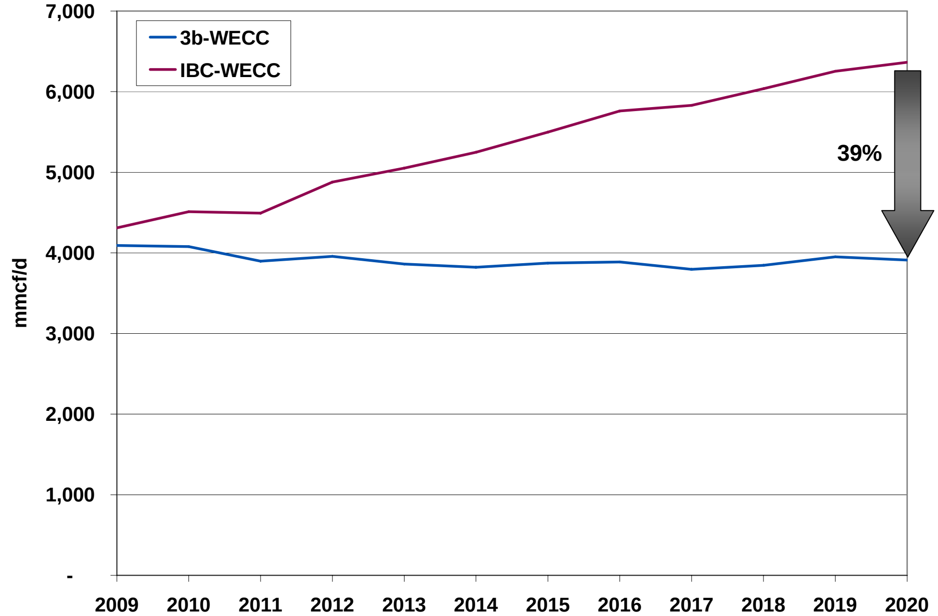
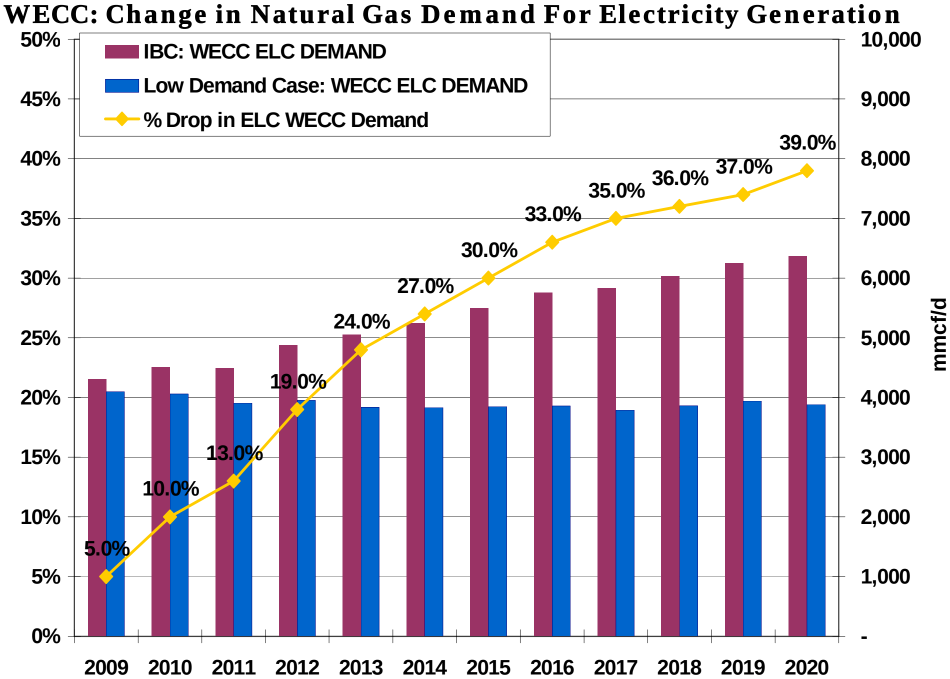


Figure 2-2

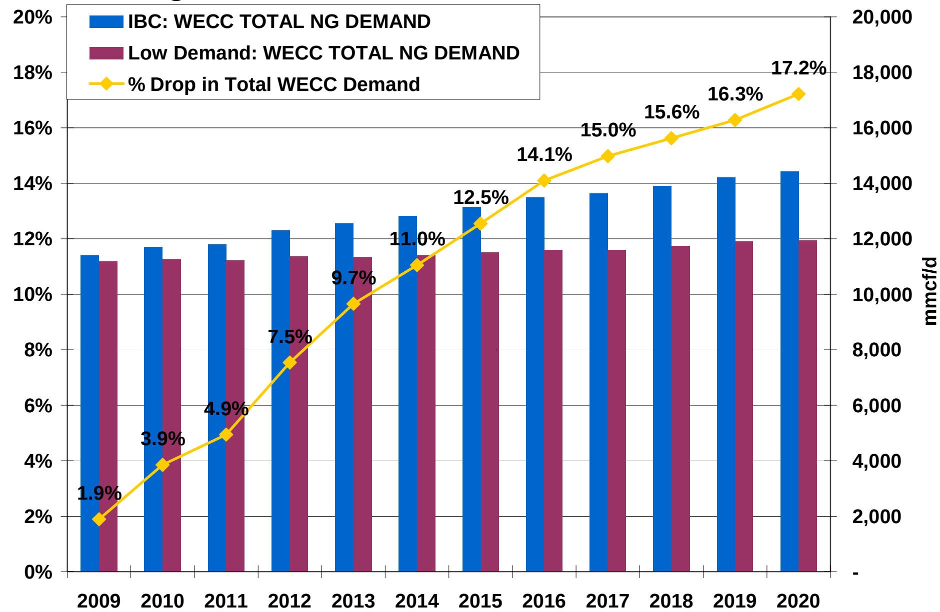
WECC: Change in Natural Gas Demand For Electricity Generation



This 39% drop in demand for power generation in WECC (excluding Alberta and British Columbia) in 2020 represents a 17% drop in total demand for natural gas in WECC (excluding Alberta and British Columbia) in 2020 (Figure 2-3). In 2020, total demand for natural gas in WECC (excluding Alberta and British Columbia) drops from 14.4 Bcf/d to 11.9 Bcf/d.

Figure 2-3

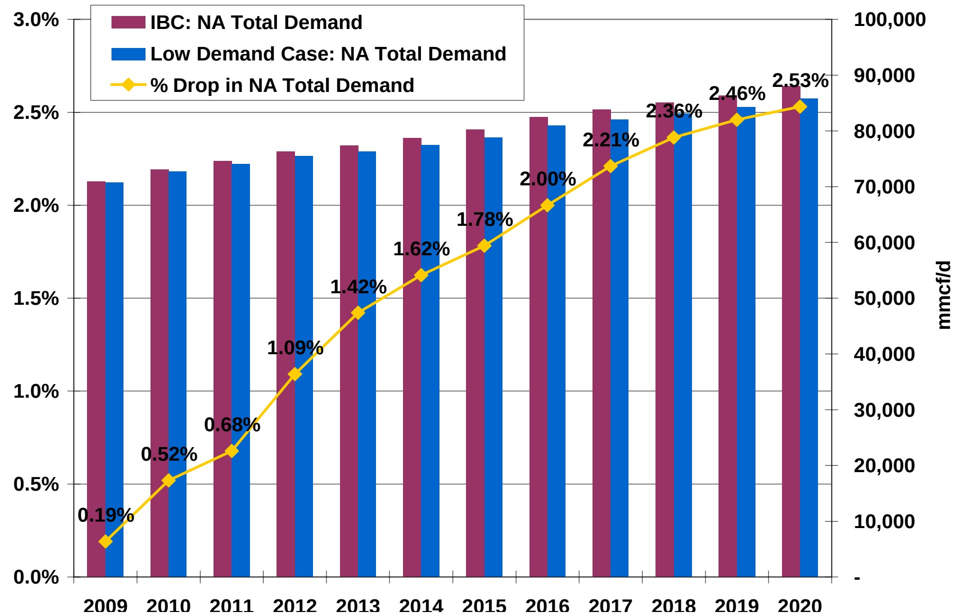
WECC: Change in Total Natural Gas Demand



This decrease in total WECC gas demand is equivalent to a 2.5% decrease in total North America gas demand (Figure 2-4). There is no demand increase in the other sectors in response to low prices in WECC or in the balance of the USA, as over-all the demand/supply scenario does not change. However, as shown on Table 2-3, there is a very small increase in demand in Canada in the range of 1%-3% across all sectors. This small increase in Canadian consumption reflects the situation that Canada gas is usually a base-load supply in WECC, with only a slight decrease in exports to WECC as the result of this demand decline, more gas remains in Canada, changing the overall demand/supply scenario for Canada.

Figure 2-4

North America: Change in Total Natural Gas Demand



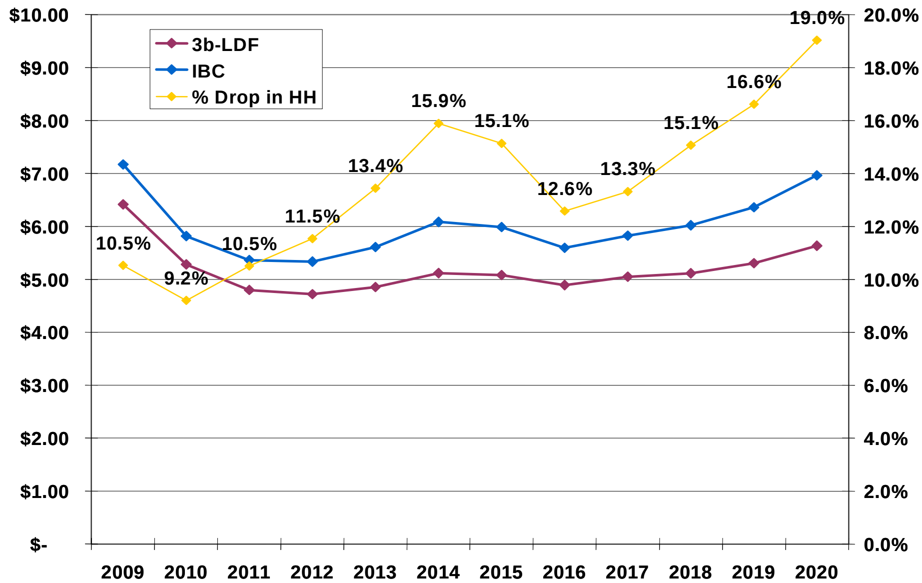
2.3 Rates of Decline in Demand and Gas Price (Compared)

In this section, we discuss the relationship between the rates of decrease of Henry Hub prices that result from varying rates of decrease in demand. So, here, absolute values are not the issue, but rates are, especially the comparison between rates. The term "decline rate" is the rate (annual percentage) at which either gas demand or Henry Hub price is decreasing during a given time period.

The annual decrease (%) in Henry Hub prices from IBC to 3B-LDF after 2011, after the influence of NYMEX pricing has passed, ranges from approximately 10% to 20% (Figure 2-5). The rate of decrease in annual Henry Hub prices is greater than the rate of decrease in annual WECC demand. In 2011 the gas price decrease (10.5%) is approximately twice as great as the gas demand decrease (4.9%). This relationship gradually diminishes to a balanced rate by 2019-2020 (Figure 2-6). An initial small drop in demand (2% to 5%) results in a disproportionate drop in price (10%).

Figure 2-5

Change in Henry Hub (2006$/MMBtu)



(1) For Henry Hub forecast GED uses NYMEX for the first 24 months and then mean reverts for following 24 months to our fundamental forecast. For NYMEX, average of the latest three days is used (for IBC P50 Dec 19-21 2006 were used).

Figure 2-6

% Drop in WECC Total Natural Gas Demand vs. Corresponding % Drop in HH

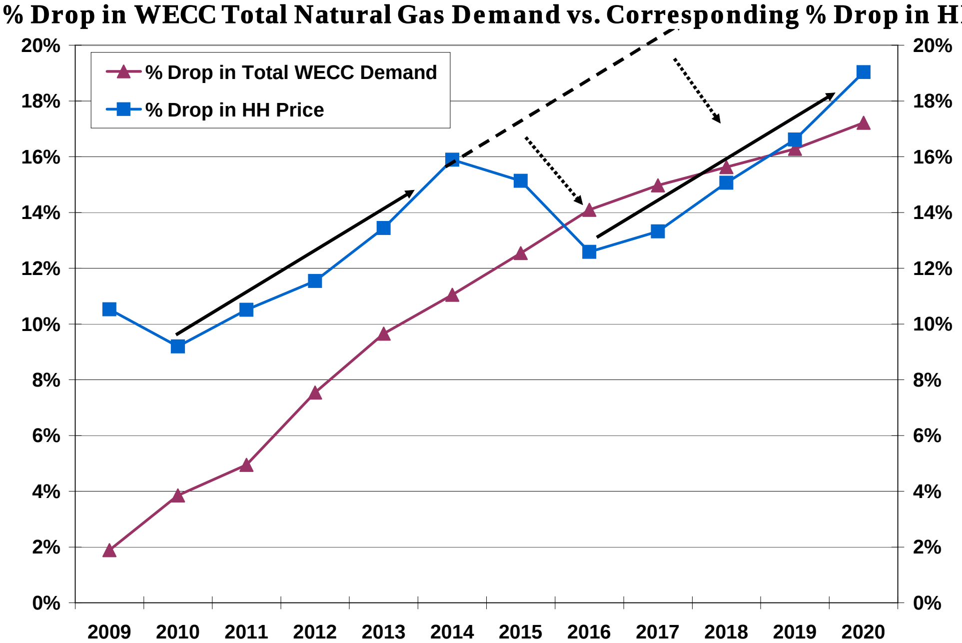


Figure 2-6 shows that the rate of annual WECC demand decline is less than the corresponding rate of annual Henry Hub price decline. The fundamental reason for this outcome is that the GPCM model provides a supply/demand equilibrium result that has no automatic supply feedback loop that would curtail production to minimize price decline (i.e. a cartel-like decrease in production investment or production rate in order to keep prices from declining as rapidly).

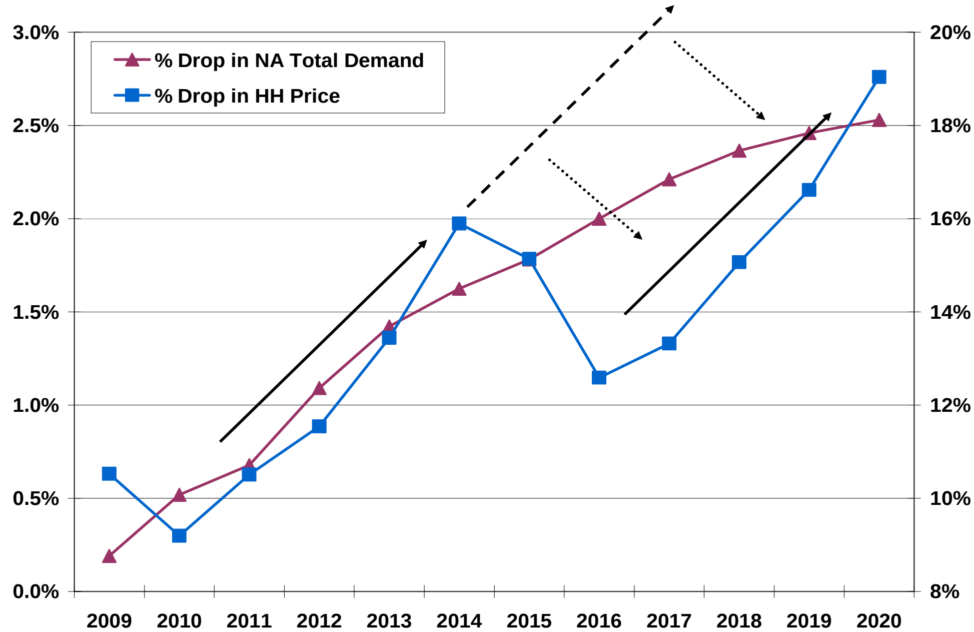
The major sources of gas supply for WECC are Alberta, Rockies, and LNG. Only minor swing gas is available from SW sources. Canada provides approximately 60% of WECC gas, and is usually the least-cost delivered gas. The remaining 40% comes from the Rockies. So Canadian gas is the long-run marginal supply to California. When WECC-wide demand is decreased and no additional capacity to move Canadian gas eastward is built, a minor amount of this surplus gas not exported to WECC, is consumed in Canada. In 3B-LDF, there is a 1.0% to 3.0% increase in Canadian consumption.

The model has forecasted greater elasticity factors over time for Low and High quantities of available production from all of the 70 North American supply basins, thereby creating more flexibility for producers to control production among competing sources, especially LNG, and thereby to minimize surplus production and resultant price declines. In order to illustrate a supply response (decrease) to such a demand decrease, the forecasted elasticity factor for the Low Quantity and Low Price point on the price supply curve for each basin would be adjusted, numerically decreased in order to increase price response.

To compare the rate of Henry Hub price decline and WECC demand decline with North America demand decline, Figure 2-7 was constructed. The rate (slope) of demand decline is essentially the same for WECC and for North America. However, post 2011 (the first year with no NYMEX influence) to 2015 (pre-Alaska gas influence), the Henry Hub price and demand erosion rates are approximately equal, not showing the separation (decline rate differential) seen for WECC (Figure 2-6).

Figure 2-7

Drop in NA Total Natural Gas Demand vs. Corresponding % Drop in HH



2.4 Influence of Alaska North Slope Gas on Decline Rates

After 2015, when Alaska North Slope (ANS) arrives, the rate of decline for Henry Hub price is less than the decline rate for North America demand. Although ANS represents approximately 5.0% of total North American demand, the GPCM model delivers this gas to Alberta to satisfy demand prior to any export. Therefore more gas stays in Canada without expansion of capacity to move surplus gas eastward into U.S. markets in the Midwest and Northeast regions. Consequently, Canadian consumption increases and the Henry Hub price suffers less price erosion due to less competition in its long-haul downstream markets.

After 2015, a similar relationship is seen between the relative rates of decline between Henry Hub price and WECC demand, but the separation (decline rate differential) is much smaller. North America and WECC demand have approximately the same slope post-ANS as the Henry Hub price slope. Both North America and WECC demand decline rates (slopes) have a smaller rate of decrease than the Henry Hub price decline rate (slope) by 2019, three years after delivery of ANS.

Table 2-2 shows that, for 3B-LDF, after delivery of ANS, by 2020 net U.S. pipeline imports increase in comparison to IBC by approximately 0.30 Tcf or 0.85 Bcf/d. This indicates that most of the Canadian Atlantic Coast LNG is being redelivered (imported) to the US as the result of surplus ANS largely staying in Canada under decreased WECC demand.

Table 2-3 shows that net Alaska gas imports to Canada, which are the a major component of "net pipeline imports" though not reported separately as such, are approximately the same between 2015-2020 for both the IBC and 3B-LDF. A component within the model but not reported separately on Table 2-3, Alaska gas imports decline approximately 0.66 Tcf (1.84 Bcf/d) from 2015 to 2020 for both cases.

3 3C LOW DEMAND FORECAST ("3C-LDF") OF HENRY HUB PRICES BASED ON IEPR SCENARIO 3C

In this section, we describe the development of Forecast 3C-LDF. 3C-LDF was developed to reflect less UEG reduction reduction than the interim 3B analysis. Thus it reduces electricity demand through aggressive energy efficiency in the six states/provinces that have signed the Greenhouse Gas reduction Memorandum of Understanding. The states/provinces involved are California, Arizona, New Mexico, Oregon, Washington, and British Columbia.

Global Energy's Market Analytics team handed off the electricity demand data from this Market Analytics scenario to Global Energy's GPCM modeler, who input the reduced electricity demand (compared to the Base Case) into GPCM to produce the forecast 3C-LDF. The results are discussed in this section.

Table 3-1

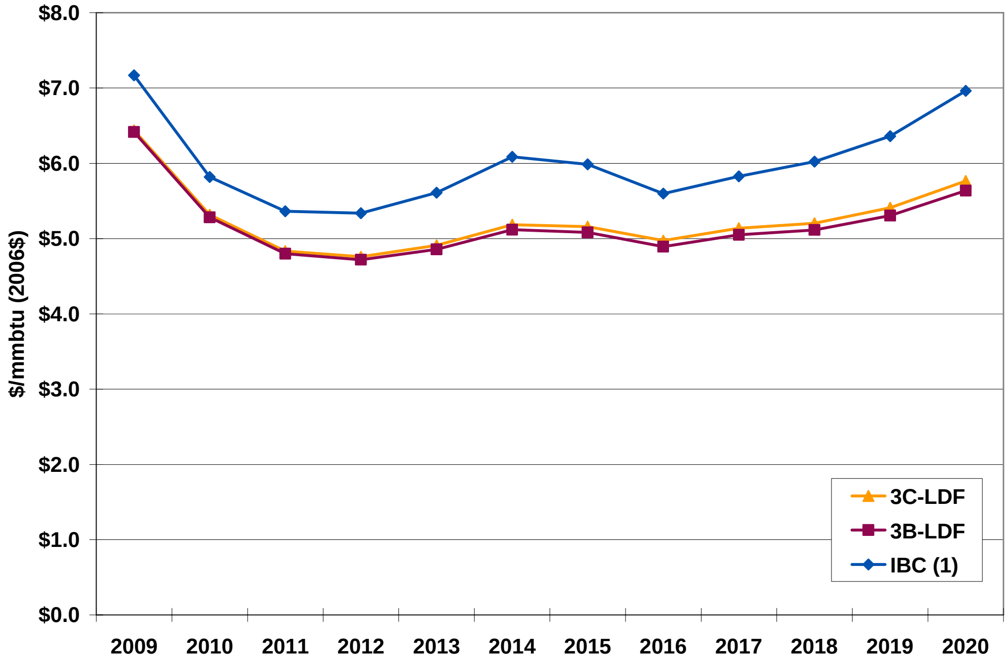
3C-Low Demand Forecast for IEPR Scenarios (2006$/MMBtu)

$/mmbtu (2006$)	IBC (1)	3C-LDF	3C-LDF: Drop in HH	3C-LDF: % Drop in HH	3B-LDF	3B-LDF: Drop in HH	3B-LDF: % Drop in HH
2009	$7.17	$6.44	0.73	10.2%	$6.42	0.75	10.5%
2010	$5.82	$5.32	0.50	8.6%	$5.28	0.53	9.2%
2011	$5.36	$4.83	0.53	9.9%	$4.80	0.56	10.5%
2012	$5.34	$4.76	0.58	10.9%	$4.72	0.62	11.5%
2013	$5.61	$4.91	0.70	12.5%	$4.86	0.75	13.4%
2014	$6.09	$5.19	0.90	14.8%	$5.12	0.97	15.9%
2015	$5.99	$5.16	0.83	13.8%	$5.08	0.91	15.1%
2016	$5.60	$4.97	0.63	11.2%	$4.89	0.70	12.6%
2017	$5.83	$5.14	0.69	11.9%	$5.05	0.78	13.3%
2018	$6.02	$5.21	0.82	13.6%	$5.11	0.91	15.1%
2019	$6.36	$5.41	0.95	15.0%	$5.30	1.06	16.6%
2020	$6.96	$5.76	1.20	17.2%	$5.64	1.33	19.0%
2011-2020	Average		0.78			0.86	

(1) For Henry Hub forecast GED uses NYMEX for the first 24 months and then mean reverts for following 24 months to our fundamental forecast. For IBC forecast starting in 2007 for NYMEX an average of the latest available three days were used (i.e. Dec 19-21 2006).

Figure 3-1

3C-LDF: Change In Henry Hub (2006$)(1)



(1) For Henry Hub forecast GED uses NYMEX for the first 24 months and then mean reverts for following 24 months to our fundamental forecast. For IBC forecast starting in 2007 for NYMEX an average of the latest available three days were used (i.e. Dec 19-21 2006).

Figure 3-2

3C vs. 3B: % Drop In HH

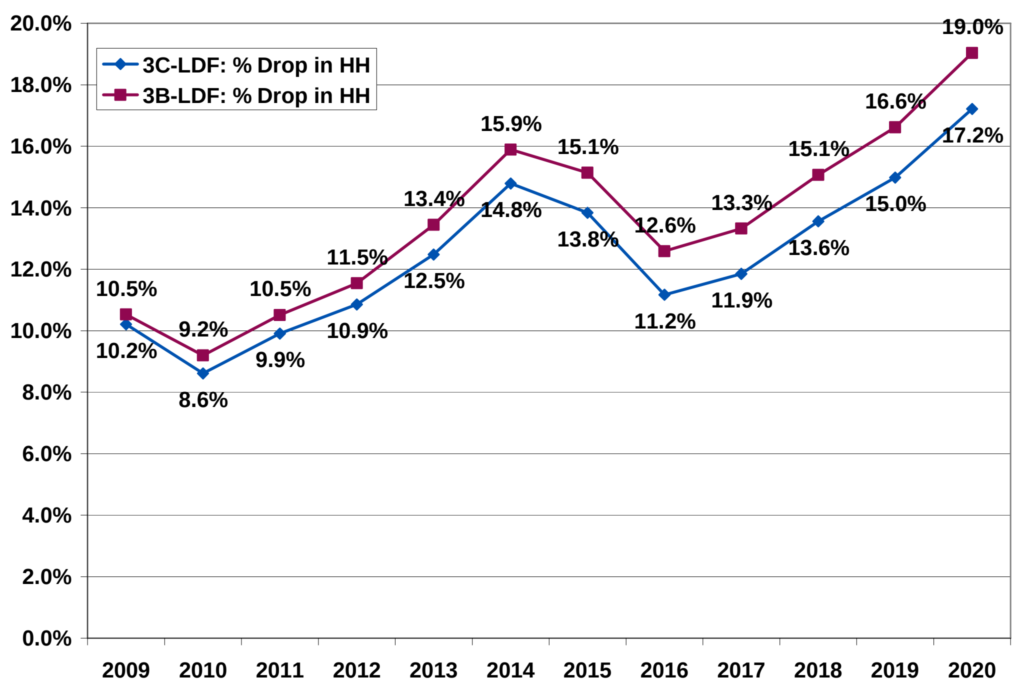


Figure 3-3

3C-LDF: Change In WECC Natural Gas Demand For Electric Gen

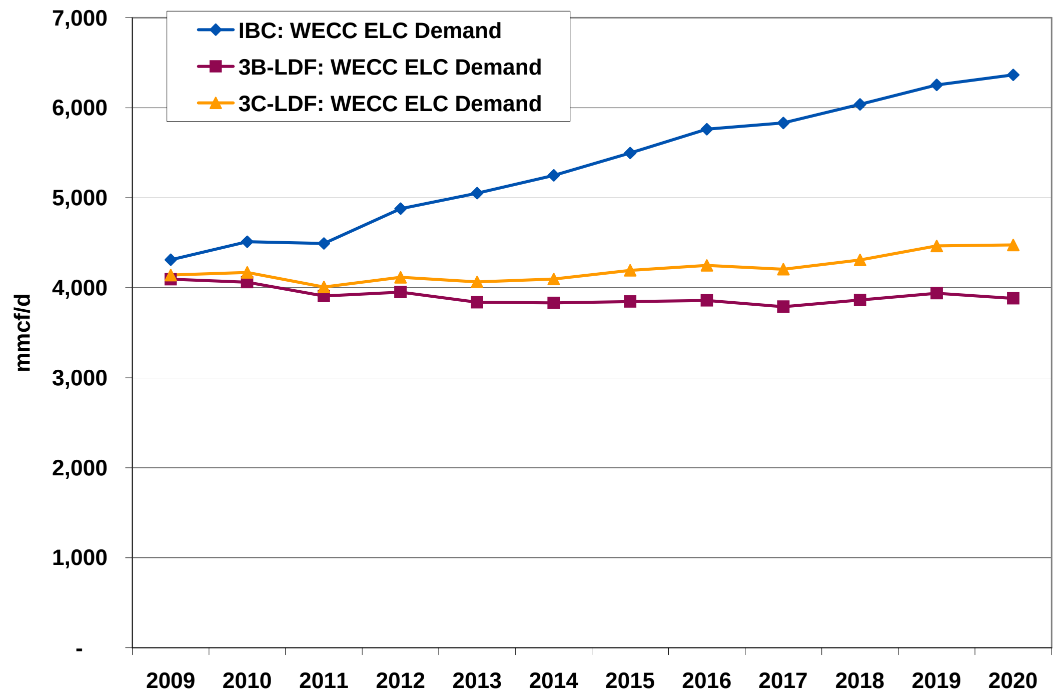


Figure 3-4

3C-LDF: Change In WECC Natural Gas Demand For Electric Gen

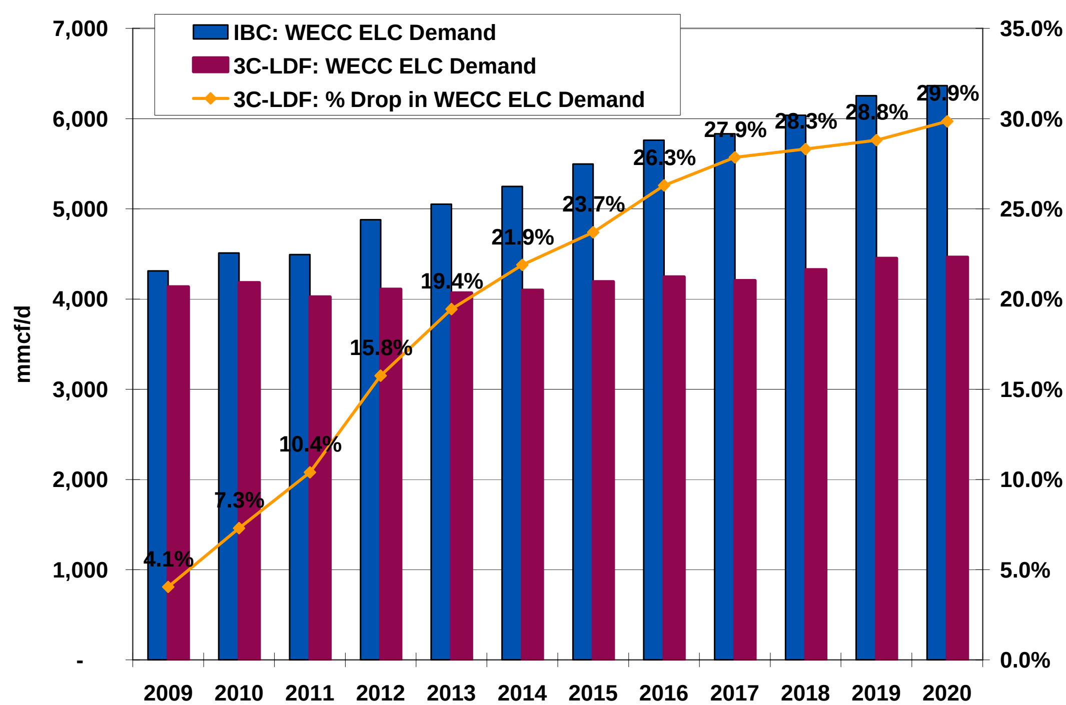


Figure 3-5

3C vs. 3B: % Drop In WECC ELC Demand

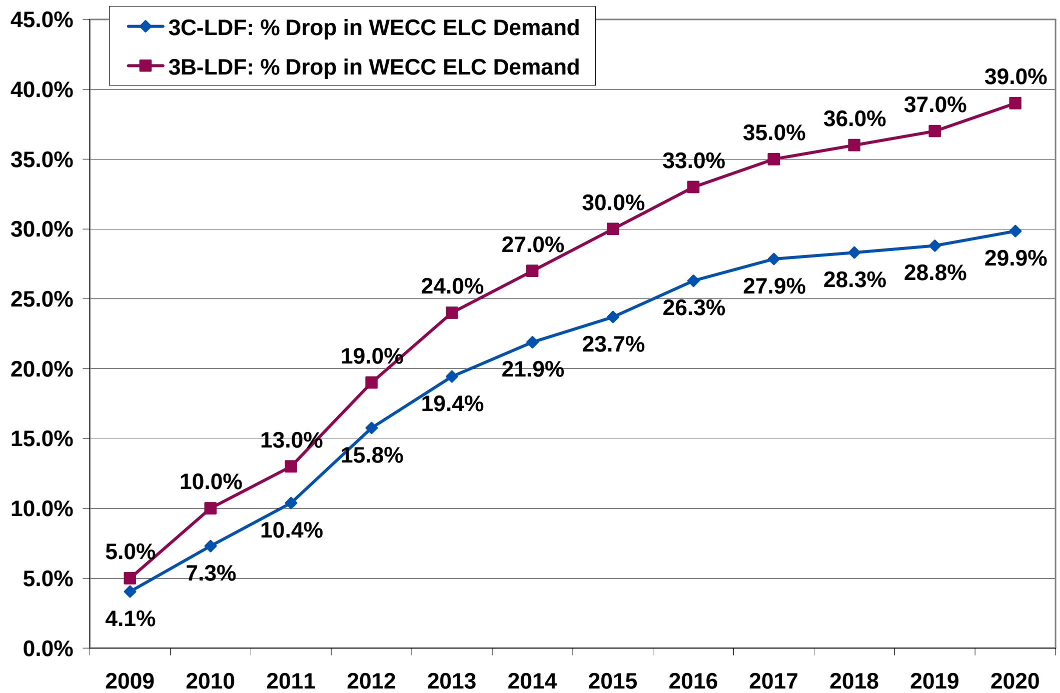


Figure 3-6

3C-LDF: Change In WECC Total Natural Gas Demand

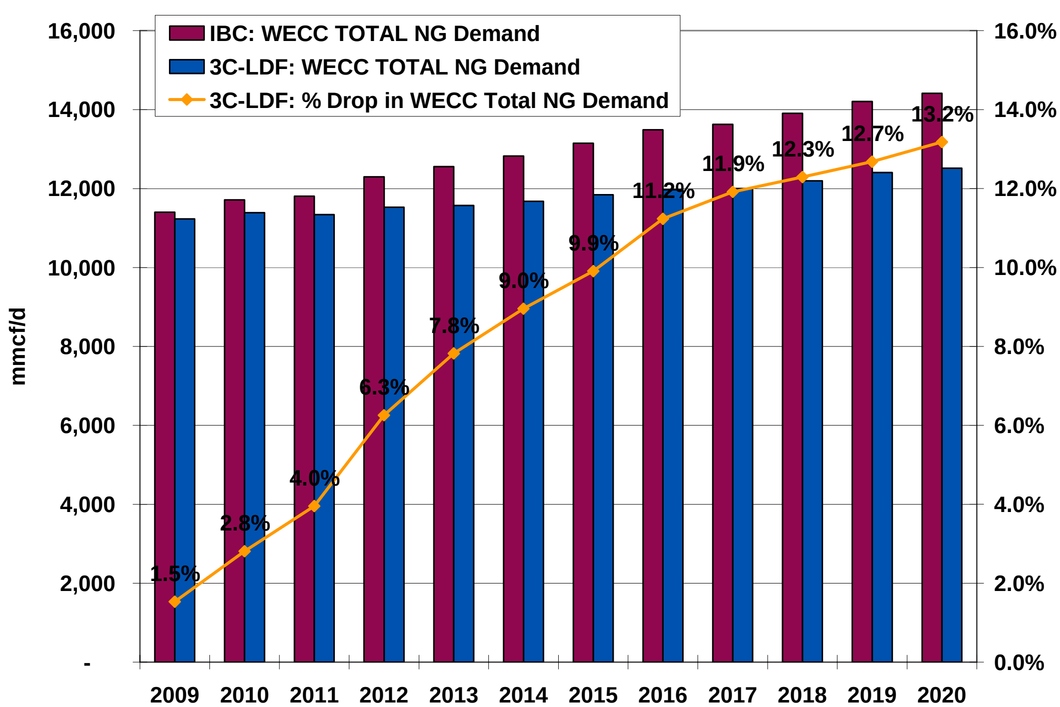


Figure 3-7
3C vs. 3B: % Drop In WECC Total Natural Gas Demand

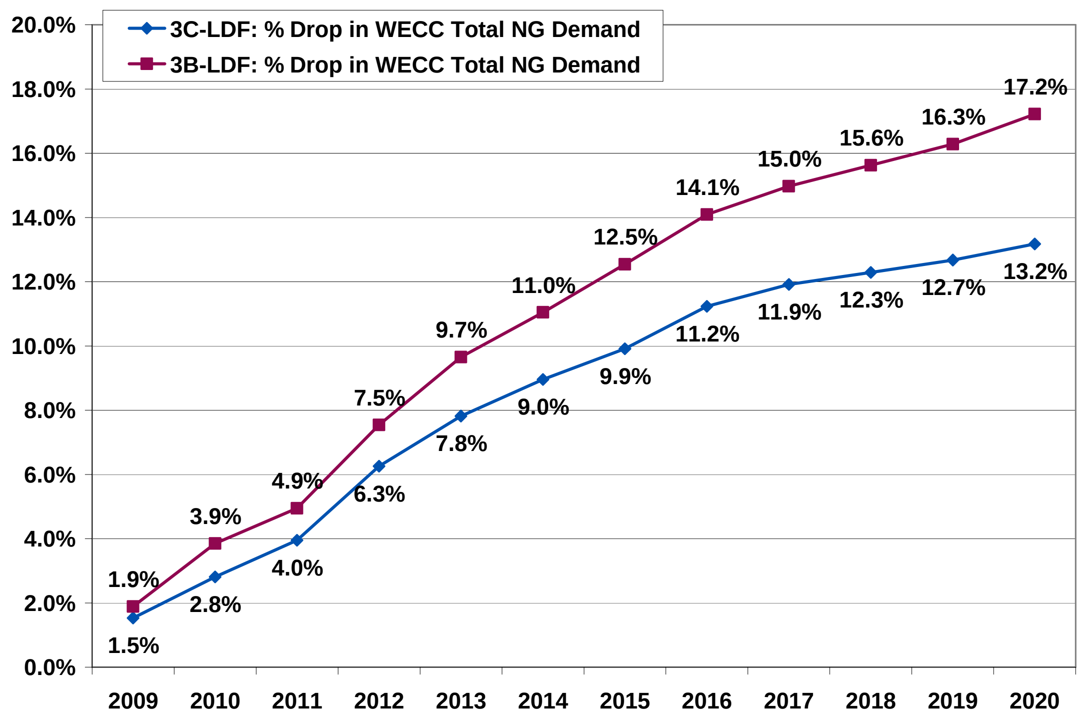


Figure 3-8
3C-LDF: Change In North America Total Natural Gas Demand

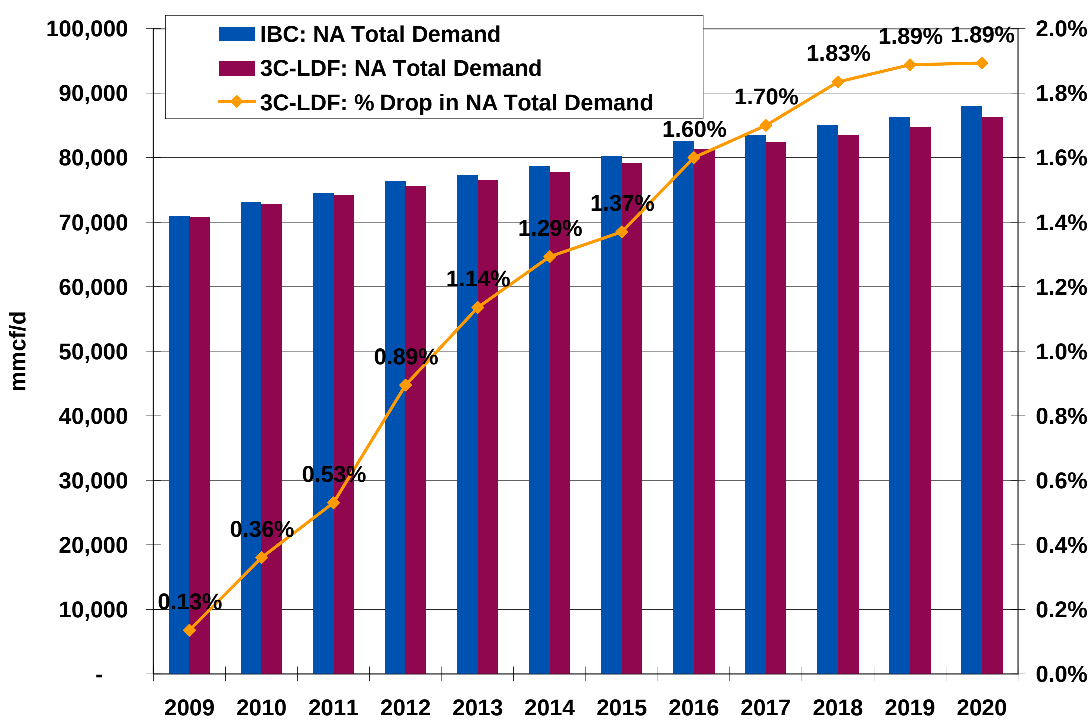


Figure 3-9

3C vs. 3B: % Drop In North America Total Natural Gas Demand

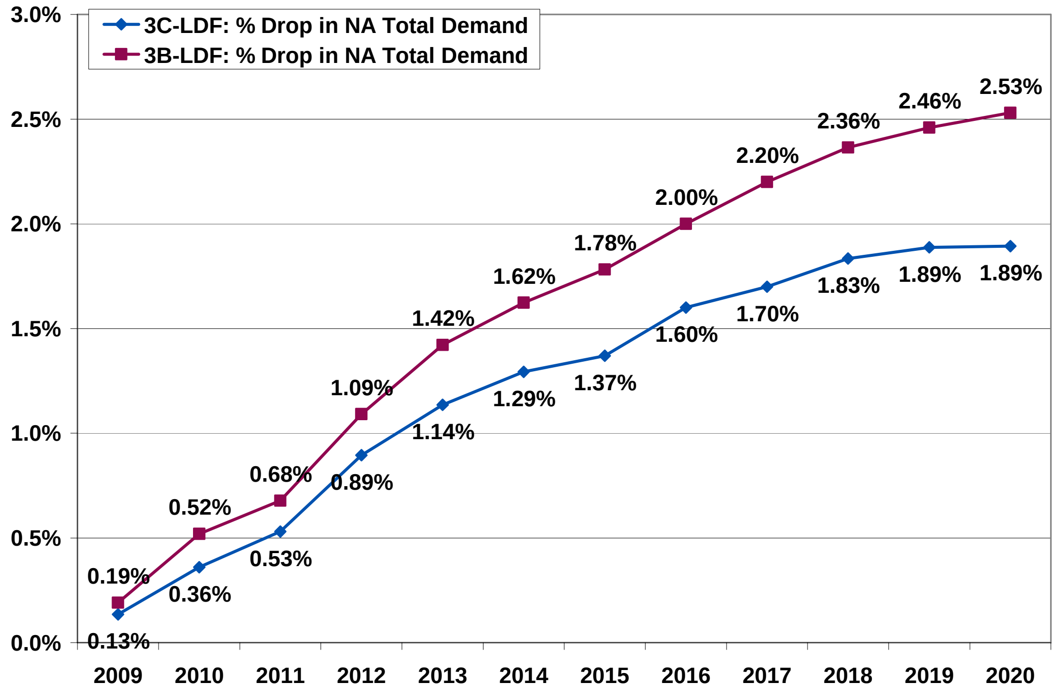
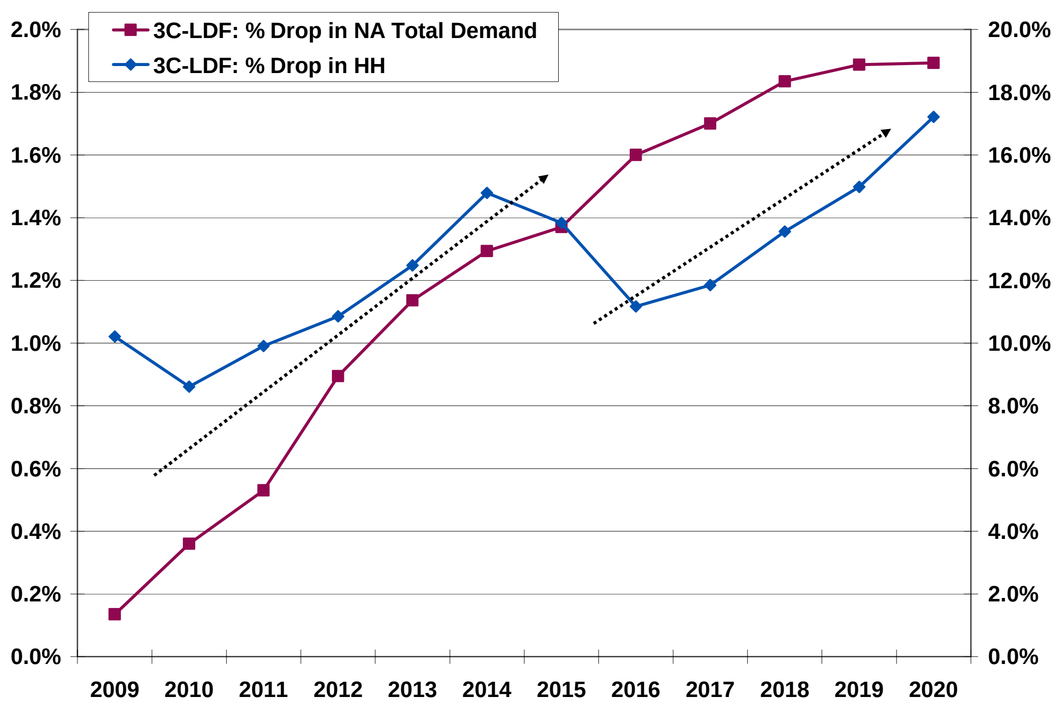


Figure 3-10

3C-LDF: % Drop In HH vs. % Drop In North America Total Demand



4 5B LOW DEMAND FORECAST (5B-LDF) OF HENRY HUB PRICES BASED ON IEPR SCENARIO 5B

In this section, we describe the next step in the process, the development of Forecast 5B-LDF. IEPR Scenario 5B involves High Energy Efficiency and High Renewables throughout WECC. Global Energy's Market Analytics team handed off the electricity demand data from this Market Analytics scenario to Global Energy's GPCM modeler, who input the reduced electricity demand (compared to the Base Case) into GPCM to produce the forecast 3C-LDF.

The results of 5B are not the "final chapter" in the low demand investigation because they lack the production capacity response, a required modeling improvement that we add in the final section (Forecast 5BPlus). The results that we show in this section, therefore, exhibit a higher degree of price response than we deem realistic or appropriate. We include them to document the systematic process that was undertaken under the direction of the IEPR study team. At each step in the process, the full study team reviewed results and agreed upon and authorized the next phase of work.

Table 4-1

IBC, 3B, 3C and 5B-LDF: Change In Henry Hub (2006$)(1)

$/mmbtu (2006$)	IBC (1)	5B-LDF	5B-LDF: Drop in HH	5B-LDF: % Drop in HH	3B-LDF	3B-LDF: Drop in HH	3B-LDF: % Drop in HH	3C-LDF	3C-LDF: Drop in HH	3C-LDF: % Drop in HH
2009	$7.17	$6.40	$0.77	-10.7%	$6.42	$0.75	-10.5%	$6.44	$0.73	-10.2%
2010	$5.82	$5.27	$0.55	-9.5%	$5.28	$0.53	-9.2%	$5.32	$0.50	-8.6%
2011	$5.36	$4.77	$0.59	-11.1%	$4.80	$0.56	-10.5%	$4.83	$0.53	-9.9%
2012	$5.34	$4.67	$0.66	-12.5%	$4.72	$0.62	-11.5%	$4.76	$0.58	-10.9%
2013	$5.61	$4.78	$0.83	-14.9%	$4.86	$0.75	-13.4%	$4.91	$0.70	-12.5%
2014	$6.09	$5.00	$1.08	-17.8%	$5.12	$0.97	-15.9%	$5.19	$0.90	-14.8%
2015	$5.99	$4.94	$1.05	-17.5%	$5.08	$0.91	-15.1%	$5.16	$0.83	-13.8%
2016	$5.60	$4.73	$0.86	-15.4%	$4.89	$0.70	-12.6%	$4.97	$0.63	-11.2%
2017	$5.83	$4.86	$0.96	-16.5%	$5.05	$0.78	-13.3%	$5.14	$0.69	-11.9%
2018	$6.02	$4.93	$1.10	-18.2%	$5.11	$0.91	-15.1%	$5.21	$0.82	-13.6%
2019	$6.36	$5.10	$1.27	-19.9%	$5.30	$1.06	-16.6%	$5.41	$0.95	-15.0%
2020	$6.96	$5.40	$1.56	-22.4%	$5.64	$1.33	-19.0%	$5.76	$1.20	-17.2%
2011-2020	Average		$1.00			$0.86			$0.78	

(1) For Henry Hub forecast GED uses NYMEX for the first 24 months and then mean reverts for following 24 months to our fundamental forecast. For IBC forecast starting in 2007 for NYMEX an average of the latest available three days were used (i.e. Dec 19-21 2006).

Figure 4-1

IBC, 3B-LDF, 3C-LDF, and 5B-LDF: WECC Natural Gas Demand For Electric Gen

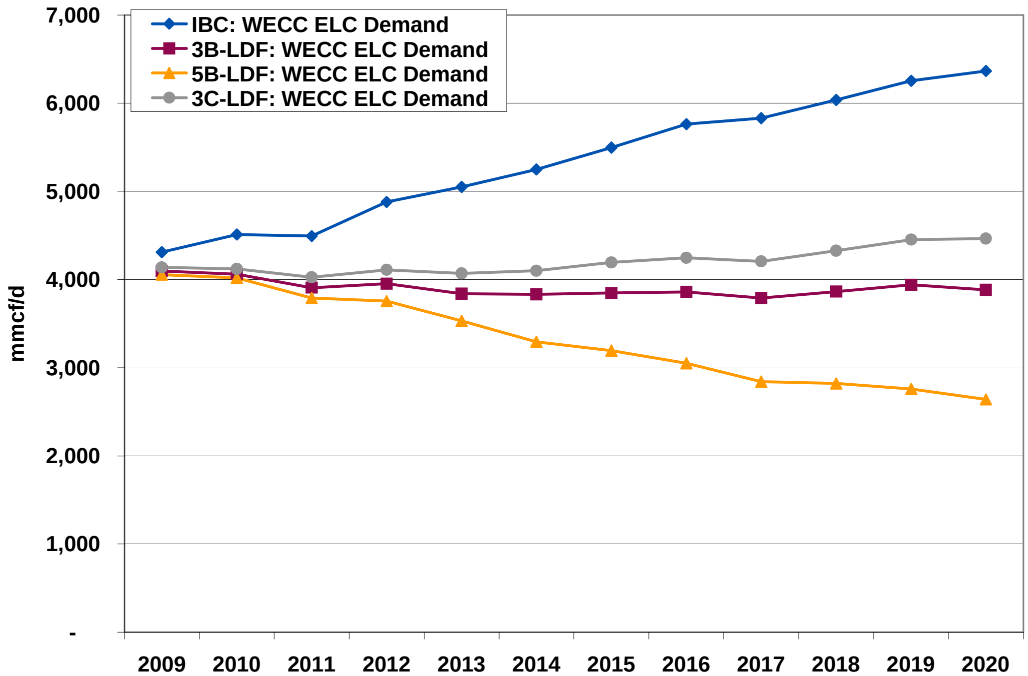


Figure 4-2

IBC vs. 5B-LDF: WECC Natural Gas Demand For Electric Gen and % Change

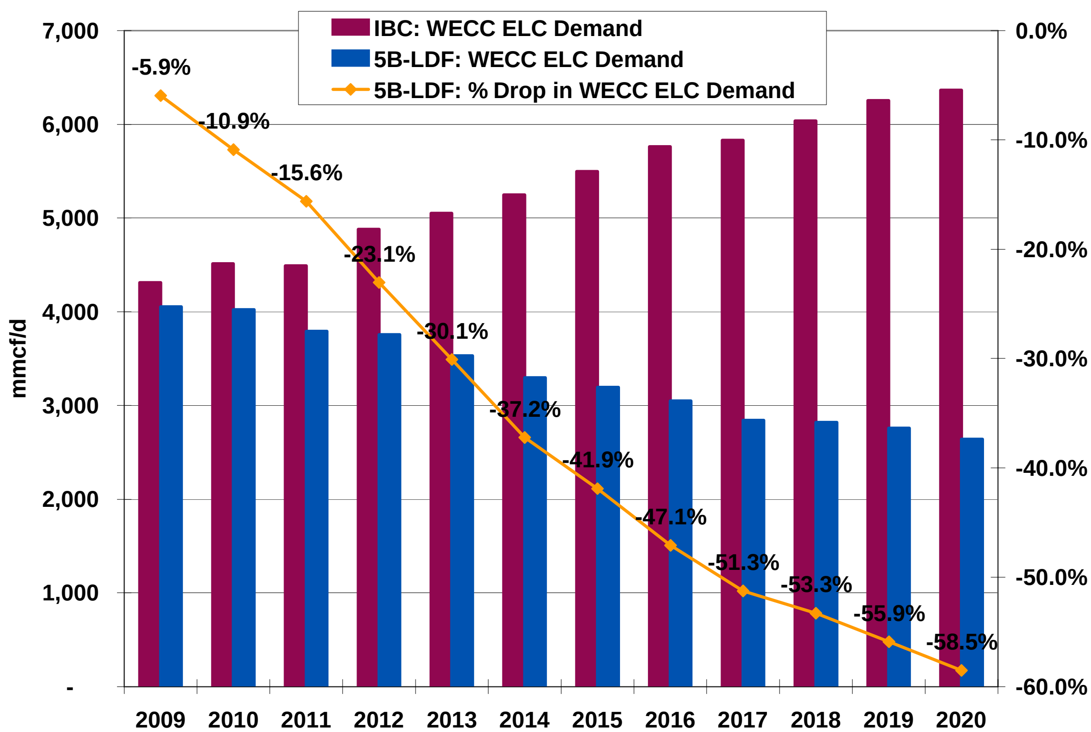


Figure 4-3

5B-LDF vs. 3B-LDF: % Change In WECC Natural Gas Demand For Electric Gen From IBC

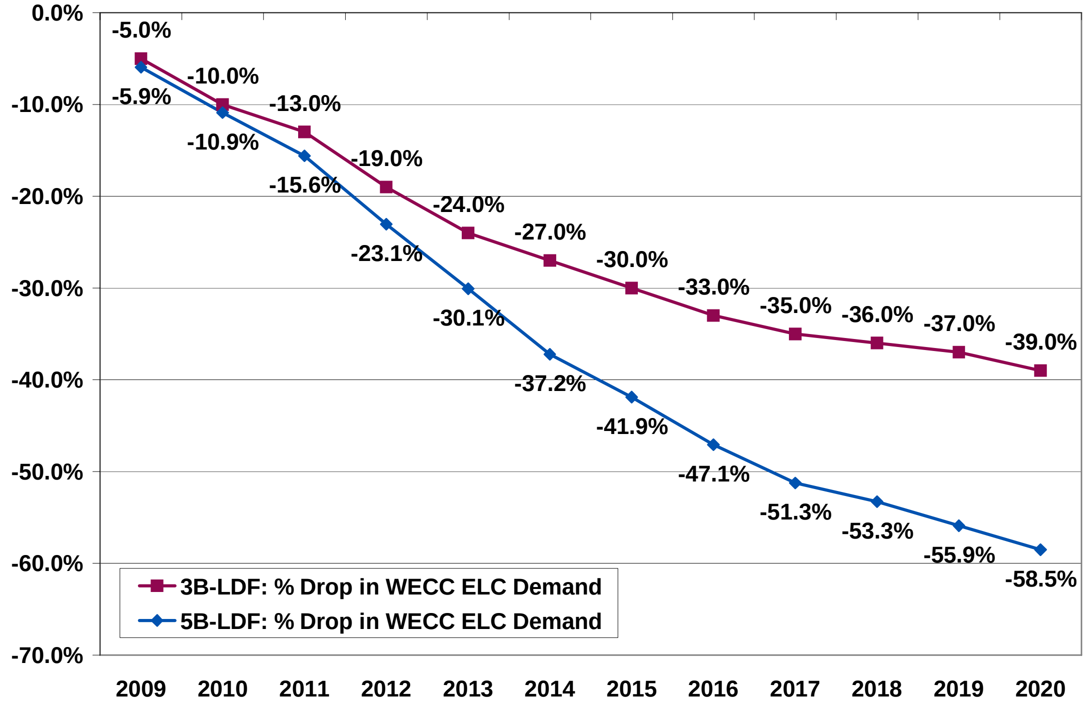


Figure 4-4

IBC vs. 5B-LDF: WECC TOTAL Natural Gas Demand and % Change

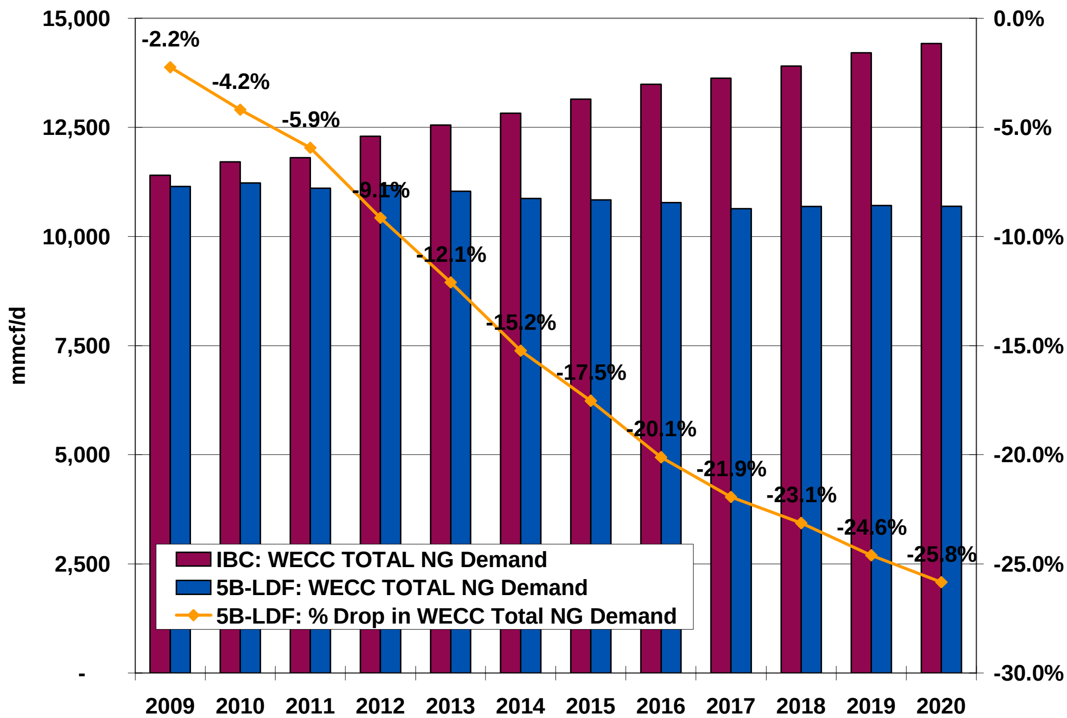


Figure 4-5
5B-LDF vs. 3B-LDF: % Change In WECC TOTAL Natural Gas Demand From IBC

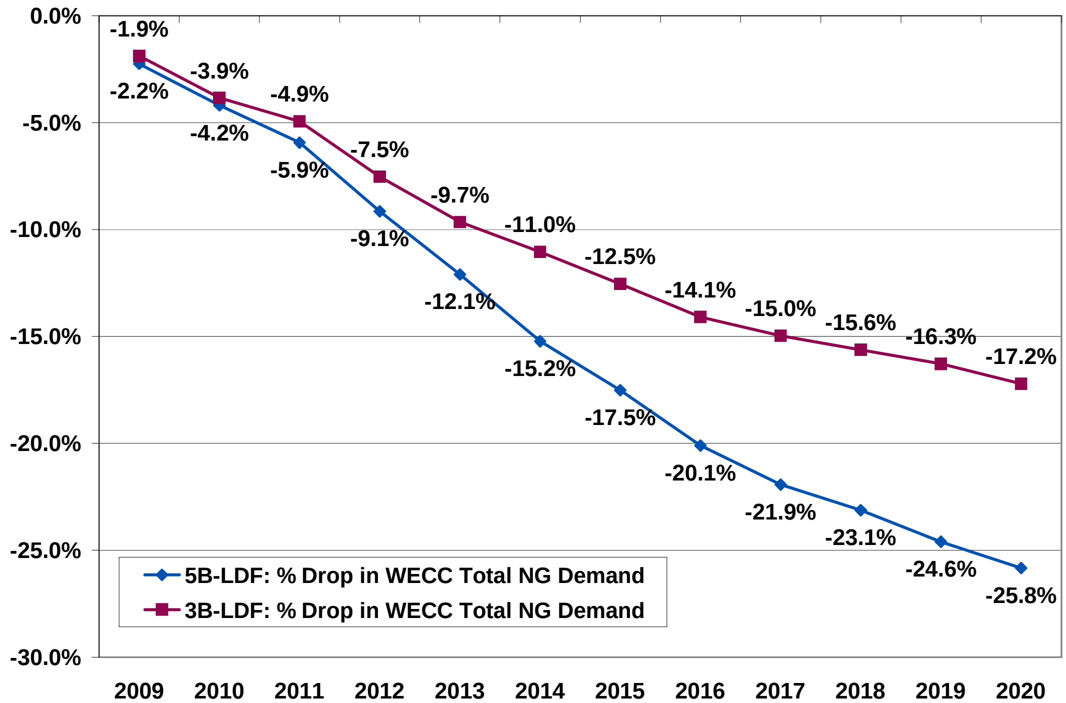


Figure 4-6
IBC vs. 5B-LDF: North America TOTAL Natural Gas Demand and % Change

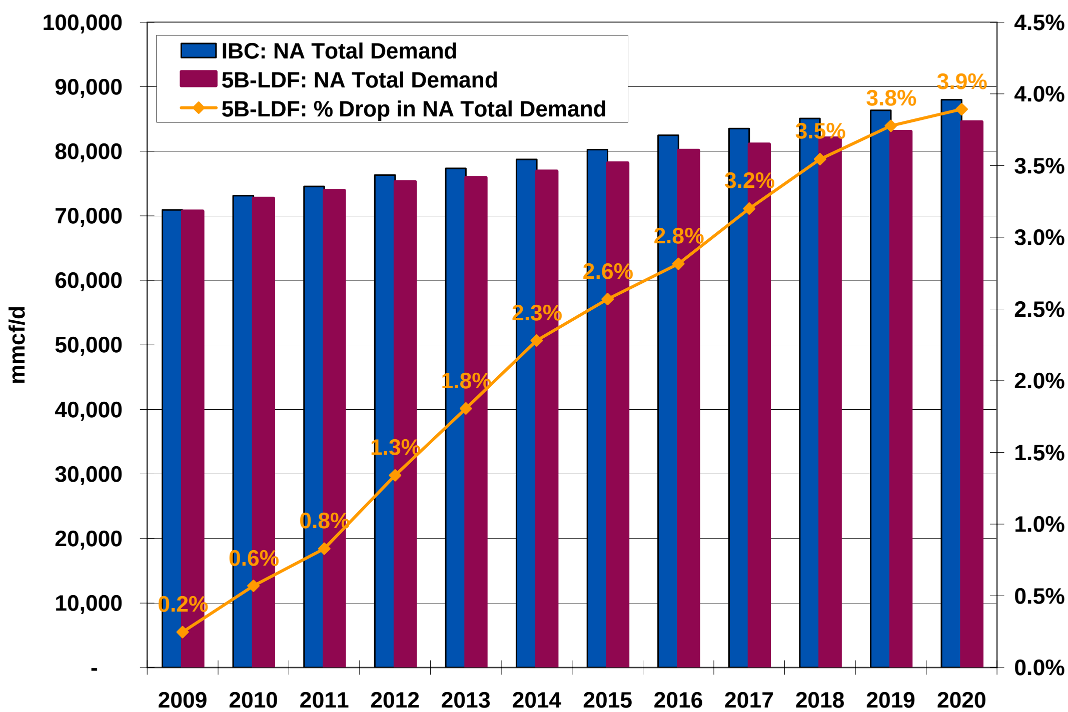


Figure 4-7

5B-LDF vs. 3B-LDF: % Change In North America TOTAL Natural Gas Demand From IBC

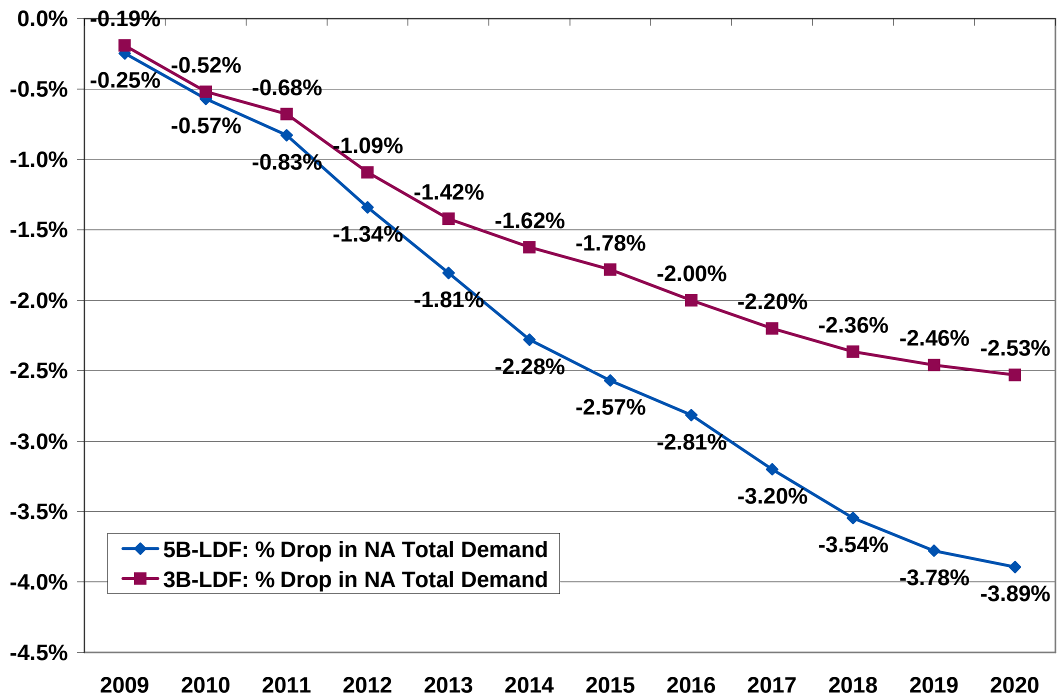
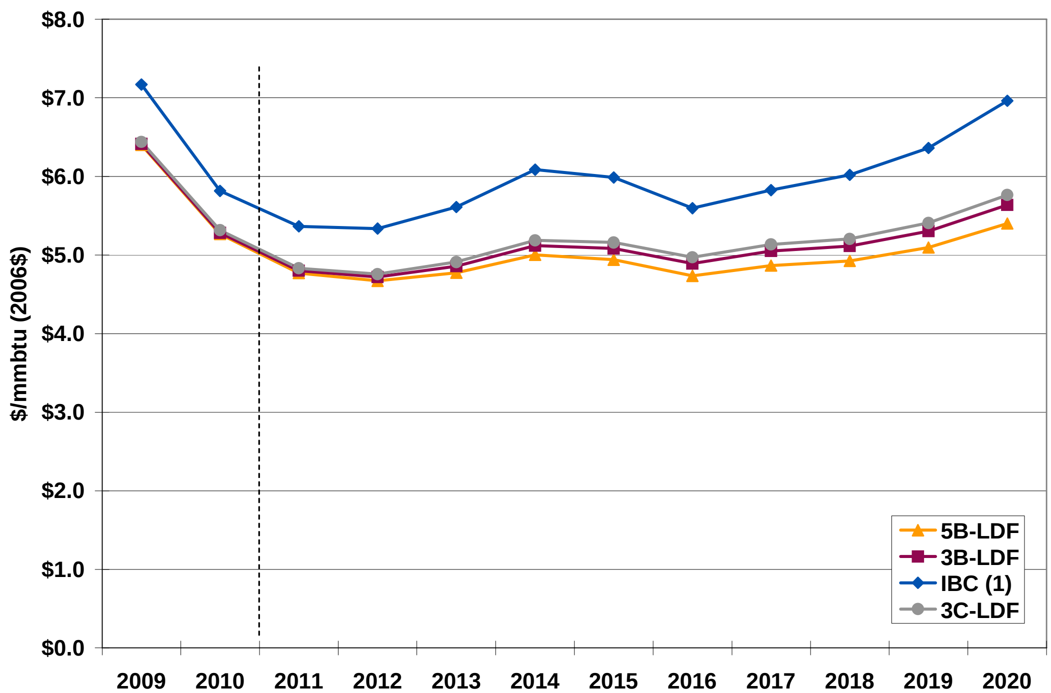


Figure 4-8

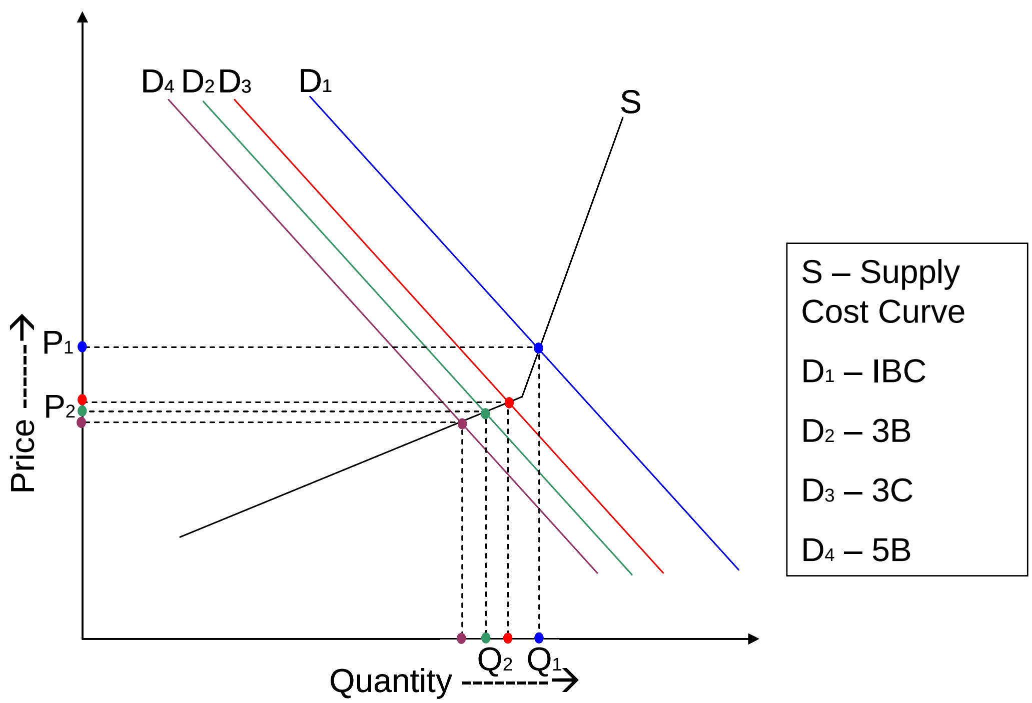
IBC, 3B, 3C, and 5B-LDF: Henry Hub (2006$)(1)



(1) For Henry Hub forecast GED uses NYMEX for the first 24 months and then mean reverts for following 24 months to our fundamental forecast. For IBC forecast starting in 2007 for NYMEX an average of the latest available three days were used (i.e. Dec 19-21 2006).

The supply price curve in Figure 4-9 is a supply curve as defined in GPCM®, which is a three-point curve with P-Med Q-Med, P-High Q-High, and P-Low Q-Low. There is a similar curve for each supply basin and for each year, resulting in a smoother aggregate supply curve. But to simplify this discussion, we have used a three-pointed-kinked supply price curve.

Figure 4-9
Example of a Simplified GPCM Supply Curve



The equilibrium price in the IBC was established where the 'D_1' demand curve intersected 'S' supply price curve, establishing 'P_1' price for 'Q_1' demand quantity. In case 3B, the demand quantity is dropped to 'Q_2,' resulting in the new price 'P_2' with equilibrium establishing on a different slope of the supply price curve.

For the new equilibrium on the different slope of the supply price curve and equilibrium under 3C and 5B resulting on the same slope of supply price curve, changes in the demand quantity from 3B to 3C and 5B (from 'Q_2' to 'Q_3' and 'Q_4') do not result in a proportional change in price (from 'P_2' to 'P_3' and 'P_4') as is witnessed in IBC to 3B ('P_1' to 'P_2').

The demand quantity is dropped from 'Q_1' in IBC to 'Q_2' in 3B and 'Q_4' in 5B, respectively, resulting in the demand curve shifting to the left. The supply price curve was the same in all the three scenarios, resulting in a 'Supply Bubble' situation as the drop in demand quantity should be matched by a drop in supply quantity for an equilibrium model to work. That step of the methodology is described in Section 5.

Table 4-2

IBC, 3B, 3C and 5B-LDF: Change In Henry Hub (2006$)(1)

$/mmbtu (2006$)	IBC (1)	5B-LDF	5B-LDF: Drop in HH	5B-LDF: % Drop in HH	3B-LDF	3B-LDF: Drop in HH	3B-LDF: % Drop in HH	3C-LDF	3C-LDF: Drop in HH	3C-LDF: % Drop in HH
2009	$7.17	$6.40	$0.77	-10.7%	$6.42	$0.75	-10.5%	$6.44	$0.73	-10.2%
2010	$5.82	$5.27	$0.55	-9.5%	$5.28	$0.53	-9.2%	$5.32	$0.50	-8.6%
2011	$5.36	$4.77	$0.59	-11.1%	$4.80	$0.56	-10.5%	$4.83	$0.53	-9.9%
2012	$5.34	$4.67	$0.66	-12.5%	$4.72	$0.62	-11.5%	$4.76	$0.58	-10.9%
2013	$5.61	$4.78	$0.83	-14.9%	$4.86	$0.75	-13.4%	$4.91	$0.70	-12.5%
2014	$6.09	$5.00	$1.08	-17.8%	$5.12	$0.97	-15.9%	$5.19	$0.90	-14.8%
2015	$5.99	$4.94	$1.05	-17.5%	$5.08	$0.91	-15.1%	$5.16	$0.83	-13.8%
2016	$5.60	$4.73	$0.86	-15.4%	$4.89	$0.70	-12.6%	$4.97	$0.63	-11.2%
2017	$5.83	$4.86	$0.96	-16.5%	$5.05	$0.78	-13.3%	$5.14	$0.69	-11.9%
2018	$6.02	$4.93	$1.10	-18.2%	$5.11	$0.91	-15.1%	$5.21	$0.82	-13.6%
2019	$6.36	$5.10	$1.27	-19.9%	$5.30	$1.06	-16.6%	$5.41	$0.95	-15.0%
2020	$6.96	$5.40	$1.56	-22.4%	$5.64	$1.33	-19.0%	$5.76	$1.20	-17.2%
2011-2020	Average		$1.00			$0.86			$0.78	

(1) For Henry Hub forecast GED uses NYMEX for the first 24 months and then mean reverts for following 24 months to our fundamental forecast. For IBC forecast starting in 2007 for NYMEX an average of the latest available three days were used (i.e. Dec 19-21 2006).

Figure 4-10

3B-LDF, 3C-LDF, and 5B-LDF: % Drop In WECC Natural Gas Demand For Electric Gen From IBC

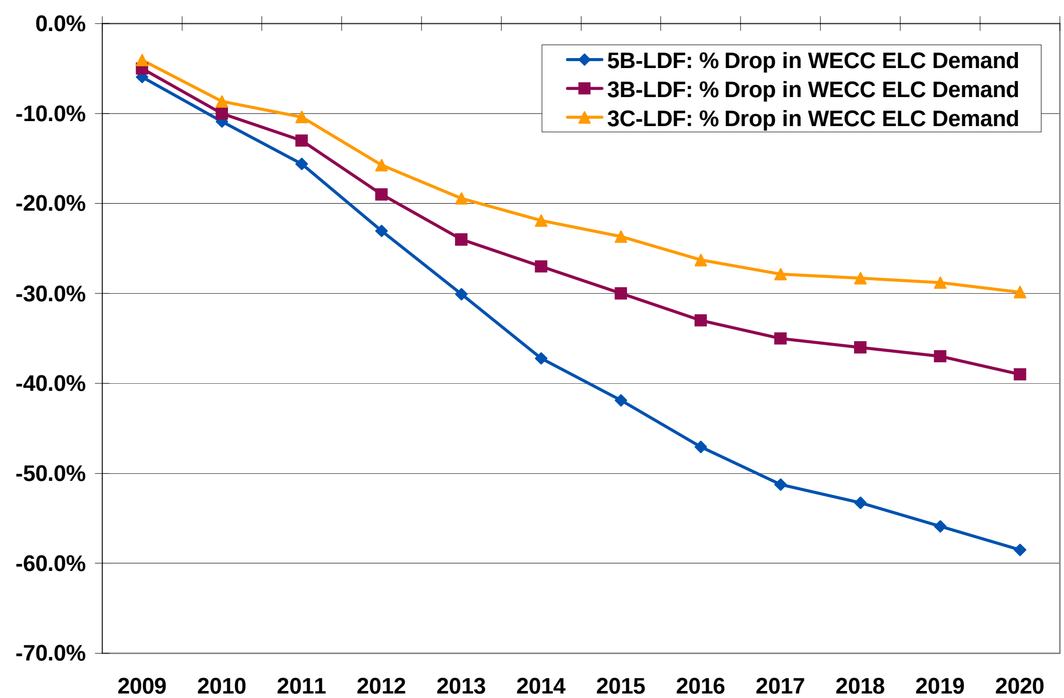


Figure 4-11

3B-LDF, 3C-LDF, and 5B-LDF: % Drop In NA TOTAL Natural Gas Demand From IBC

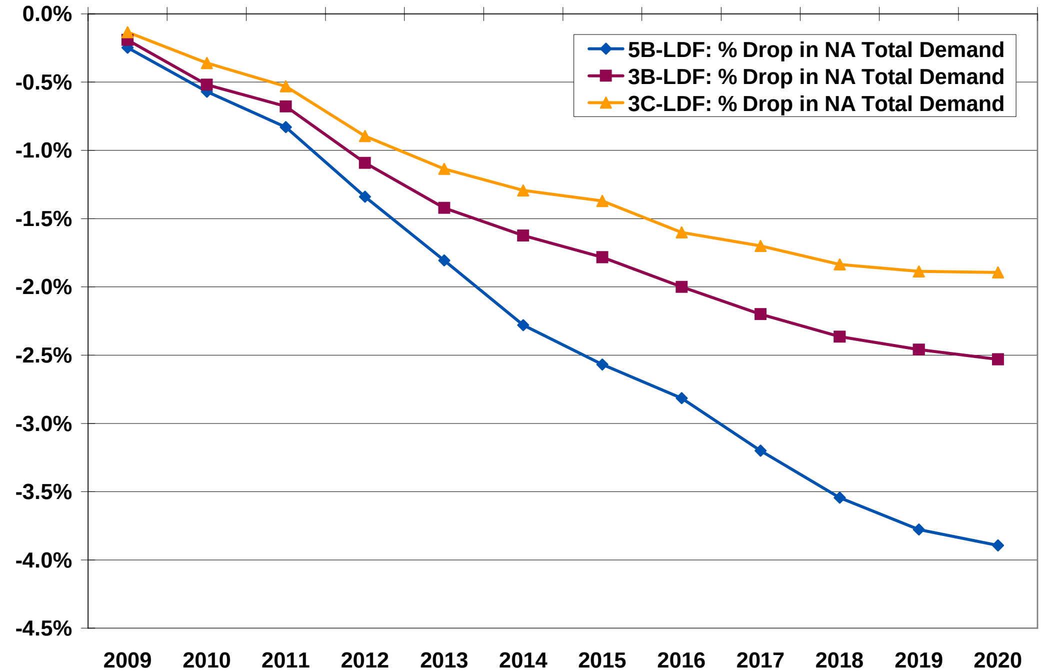
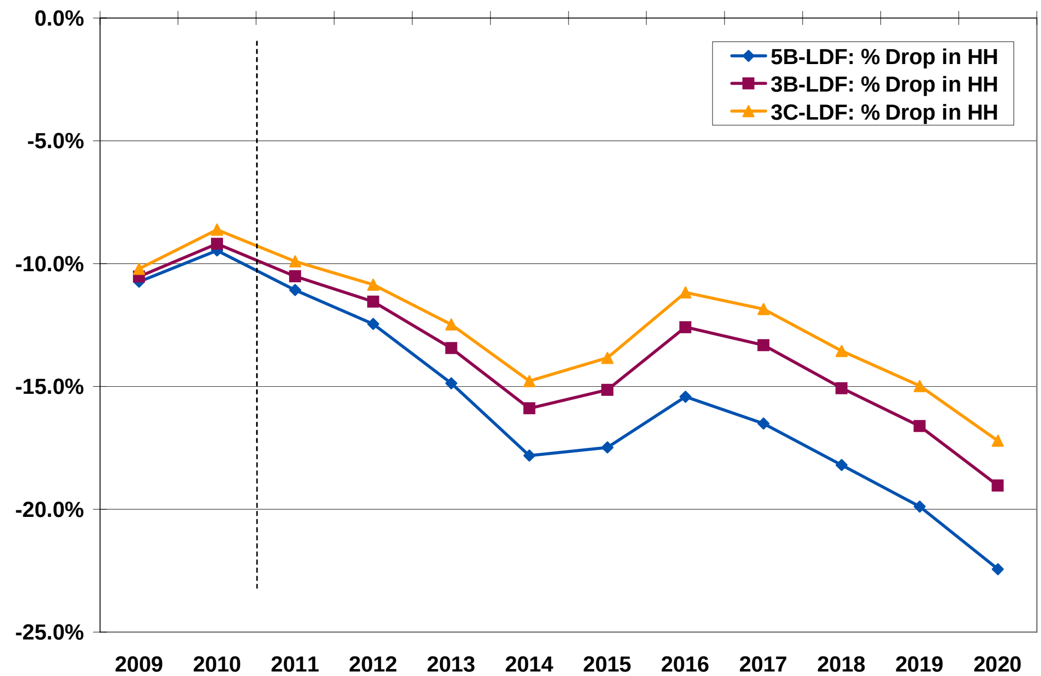


Figure 4-12

3B-LDF, 3C-LDF, and 5B-LDF: % Drop In Henry Hub (2006$)(1) From IBC



(1) For Henry Hub forecast GED uses NYMEX for the first 24 months and then mean reverts for following 24 months to our fundamental forecast. For IBC forecast starting in 2007 for NYMEX an average of the latest available three days were used (i.e. Dec 19-21 2006).

5 5B-PLUS LOW DEMAND FORECAST BASED ON IEPR SCENARIO 5B WITH SHAPED SUPPLY INDUSTRY RESPONSE

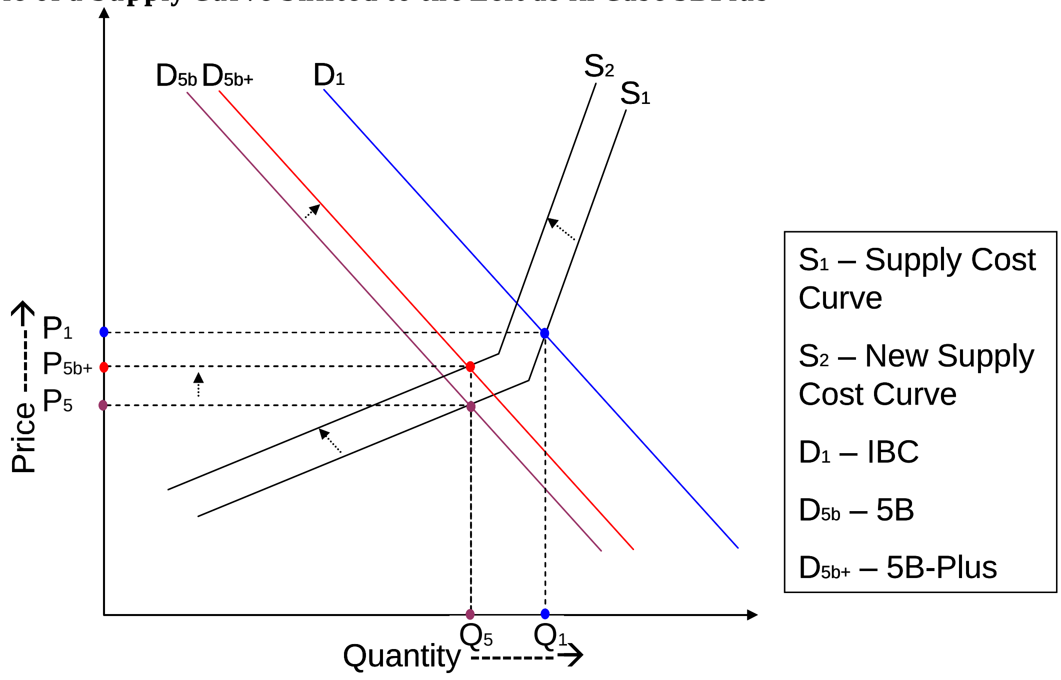
5.1 Objective of Forecast 5B-Plus-LDF

Sections 3 and 4 of this Appendix describe gas forecasts that were flawed by virtue of being incomplete in an important respect: they do not include the modeling of realistic production capacity response to lowered price. In this section, which is the most important of the appendix for policy makers, we incorporate the modeling of such a response, thus completing the low-demand forecast project.

IEPR Scenario 5B involves the WECC-wide use of renewable resources plus energy efficiency to attain government-mandated targets, thus replacing gas-fired electricity generation and decreasing the demand for natural gas. Based upon our experience with Forecast 3B-LDF, there will be a significant price drop which actual industry experience tells us would lead to a subsequent curtailment of existing production and of deployment of exploration and development capital for reserve additions and their incremental production. GPCM® forecast 5B-Plus-LDF will simulate this gas-industry response.

Figure 4-9 in the previous section provided an illustrative supply/demand equilibrium with no supply capacity adjustment. In 5B-Plus methodology, we shifted the supply curve to the left (from 'S_1' to 'S_2'), as much as empirical geological and market conditions would permit, based on our basin-by-basin analysis, resulting in higher prices in 5B-Plus than in 5B ('P_5' to 'P_{5b+}') for the same demand quantity ('Q_5'). An example of the shift of the supply curve to the left is shown below in Figure 5-1.

Figure 5-1
Example of a Supply Curve Shifted to the Left as in Case 5BPlus



In GPCM®, there is no "automatic" function or loop that will decrease indigenous production and/or LNG in response to lower demand and associated price decrease. Such a function must be performed manually, allowing the user to shape the response according to customized criteria drawn from actual industry historical behavior.

The discussion below outlines the concepts we believe are most central to the behavior of the gas exploration and production industry when prices decline markedly and for a sustained period. After discussion of these concepts with Commission staff, Global Energy will review our preliminary analysis and parameters for the more detailed design of the demand/supply adjustment "loop" in the GPCM® model that would be needed to produce 5B Plus-LDF.

5.2 Concepts Relating to Curtailment of Production In Response to Decline in Market Price

In the event of a protracted period of demand and price decline, natural gas that is produced in association with oil production (Associated Gas) and from tight sands and shales and from coalbeds (together classified as Unconventional gas) are far less likely to be curtailed by producers than non-associated gas or gas from conventional porous reservoirs . Associated and unconventional gas production is relatively insensitive to curtailment, because of oil economics and of reservoir damage/reserve leakage, respectively. Non-associated conventional production and higher-cost unconventional production are more amenable to curtailment.

In the history of the modern gas market, curtailment periods greater than three years have been rare for several reasons:

- Net present value destruction is generally not recovered after production is resumed in an inclining price trend. There is the additional risk of a declining price trend.

- Permanent damage to reservoir or escape of gas to competitive drainage.

- The majority of U.S. indigenous gas is produced by smaller independents and debt must be serviced regardless of profitability. Therefore, production curtailment is likely to be a sequence of stair-step two to three year periods where high-cost reservoirs are shut in and then re-opened regardless of price decline. However, after certain number of years and a certain amount of production, the especially high-cost unconventional production would likely be "permanently" shut-in due to unsustainable operating losses and debt default. Distressed sales usually extend production of previously uneconomic fields due to the then-current price adjusted value of the reserves. The tail end of the price decline curve will likely have a greater slope than the front-end, i.e. an accelerated price decline in later years.

- There is a likely 10%-20% uncertainty in the amount of annual total curtailment and in the timing of such curtailment.

- The North American gas industry is fundamentally a competitive market on a cost-of-service basis. Thus, it is very difficult to withhold existing production (even higher-cost unconventional production).

In addition to cutting existing production, the gas industry will also reduce deployment of new capital to replace declining existing production. However, it generally takes 1 to 2 years to effectively cut Exploration and Production dollars even for higher-cost and higher-risk projects. Such cuts are also limited (10%-20%/year) because of work commitments to maintain leases, governmental take requirements (in-kind production), to avoid competitive drainage, and to satisfy contract sales delivery obligations.

In light of these market realities, the following fundamentals are basic to our approach to shaping production curtailment.

1. Curtail existing production only from non-associated gas fields/basins.
    a. It is uneconomic to curtail oil production in associated gas fields
    b. It is uneconomic to curtail gas in most unconventional reservoirs due to
        i. Reservoir damage and

    - ii. Gas recapture risk
  - c. Focus curtailment on higher-cost production (unconventional production and conventional deep onshore and offshore Gulf production).

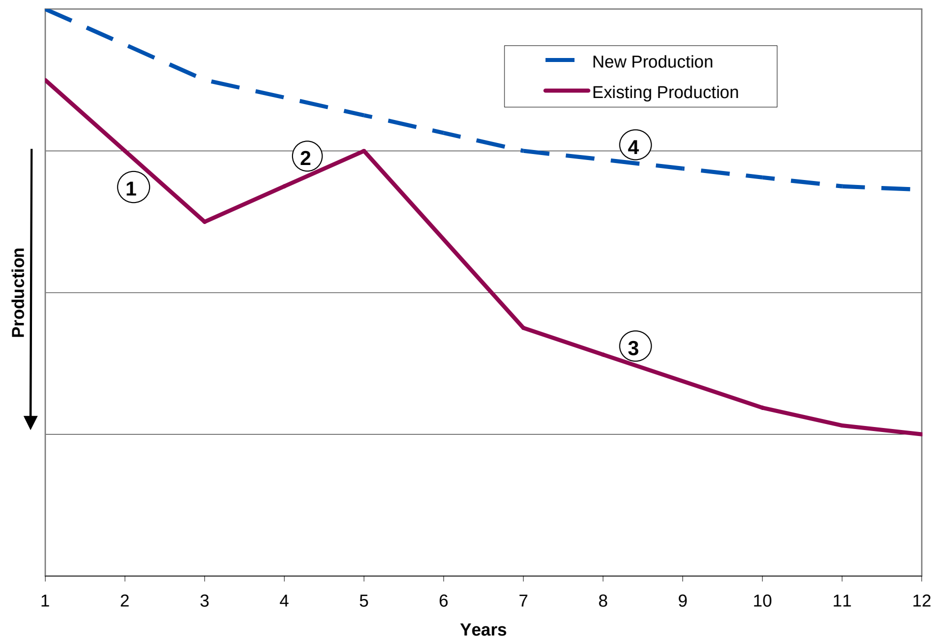
2. Curtail E&P investments for new (incremental) production for non-associated, higher-cost conventional gas and unconventional gas.

3. Indigenous gas curtailment will be shaped by the following prior economic responses.
   - a. Curtailment of existing production generally does not exceed 3 years;
     - i. The NPV loss is too great given the rate of subsequent historical post-curtailment price increases during the 10-year bubble period.
     - ii. The risk that post-curtailment prices continue to decline.
   - b. Most (75%) North American gas is produced by mid- and small-sized independents that cannot generally sustain the cost to shut-in existing production for more than 3 years. They must service debt regardless of profitability.
   - c. Initially, E&P expenditures on new wells will be curtailed, generally 10%-20% in the first 3 years. Such cuts are limited due to work commitments to:
     - i. To maintain leases,
     - ii. To comply with governmental takes,
     - iii. To avoid competitive drainage, and
     - iv. To satisfy supply contract delivery obligations. Thus the rate of new reserve additions are declined.
   - d. During the initial 2 to 3 years, 10% to 25% of the curtailable gas is likely to be curtailed.
   - e. After 2-3 years some percentage (10-25%) of these shut-in existing wells will be reopened for some period (2-3 years), and after that period, some percentage (15%-25% of then curtailed production) will be permanently plugged and abandoned during the balance of the 12-year period.
   - f. The first 3 to 5 years of the supply curtailment curve should have a less steep slope than the slope for the balance of the 12-years.
   - g. North American LNG will be curtailed as a result of indigenous gas curtailment.

The resulting most likely series of industry responses is illustrated in Figure 5-2, which shows the following steps:

1. Initial limited curtailment of existing production with
2. Delayed partial reinstatement of production, followed by
3. Some permanent abandonment, accompanied with
4. A decline in new E&P spending to lessen the price burden of the surplus gas "bubble" from existing production.

Figure 5-2
Steps in Production Curtailment After Market Price Decline



To simulate these relationships, we need to design a curve "shape" of gas production with the following allocations:

- 30% not curtailed because it is related to oil production (associated)
- 30% is not curtailed (75% X 40%) unconventional gas resource
- *Subtotal: 60% not curtailed*
- 40% is curtailable, consisting of non-associated conventional gas (30%) and higher-cost unconventional gas (10%)
- *Total: 100% of North American indigenous gas production*

These fundamental concepts allow for two alternative methods to make production curtailment: (1) North America Wide (a more general and quicker approach) and (2) WECC Wide (a more detailed, accurate, but more labor intensive). We have started with Modeling Approach #1.

5.3 Modeling Approach #1: North America-Wide Production Curtailment

This simulation approach curtails all North America production starting with the most expensive production. The lowest marginal cost flows to greatest profit if unconstrained by transportation capacity.

At this juncture, we explain how imported LNG is modeled in GPCM. Each LNG regasification plant is treated as a supply source similar to a production basin but the pricing methodology is distinct. It includes (a) a floor price set at recovery of marginal costs of regasified LNG from 23 plants and (b) winter prices that reflect international competition in Europe and Asia. LNG is a price taker, helping to establish a "floor price;" rather than a price maker that sets a "ceiling price" above the long-run marginal cost of indigenous pipeline gas. We commonly refer to LNG in GPCM as "infra-marginal" because it will be priced by its sellers just below the marginal cost of gas. Unlike some early (1990s) hopes for LNG supply, imported LNG will not "flood the market" with excess LNG, which if it occurred would provide a definitive price ceiling. Because of international competition and other factors such as the evolving LNG exporters cartel, such a flood of LNG will not occur. But LNG arriving at regasification facilities will compete with the marginal supply of gas in North America, thus our designation of LNG pricing as "infra-marginal."

So LNG is structured as an incremental supply for shortfall of indigenous production with an infra-marginal price. In the case of scarce indigenous production, LNG will flow, when it has a lower marginal cost than the indigenous production. But LNG will not flow under the following two less likely but still theoretically possible cases:

1. LNG will be the first supply to be displaced by surplus indigenous pipeline gas when it is the most expensive marginal gas to satisfy the available transportation corridor to a demand area with reduced consumption.
2. If the most expensive marginal supply is indigenous gas but it can not be curtailed (e.g. unconventional), then LNG will not be the inframarginal supply because the indigenous gas is flowing and LNG will be displaced.

This approach caps annual supply curtailment at the same level as annual demand erosion. For example, in 2020 production curtailment is limited to a maximum of 2.5% for Case 3B and 2.0% for Case 3C. For reasons discussed earlier, supply curtailment will not have a 1.0 to 1.0 ratio with demand erosion. However, we have selected a 1.0 to 1.0 ratio for a trial run on Case 3B that adds a supply curtailment loop and is therefore called Case 3B Plus. Its objective is to determine the <u>maximum</u> increase in price compared to 3B that results from curtailment of <u>all</u> North America supply basins and imported LNG regardless of their curtailment potential in response to WECC demand destruction. Results show a consistent and relatively parallel decrease in the percentage drop in Henry Hub prices for case 3bPlus compared to 3B (from an approximate 3.8% in 2011 to 9.6% by 2020, see Table 5-1). The results also show an approximate split in the Henry Hub price difference between the Base Case (IBC) and 3B. In other words, the 3B Plus prices increased approximately 50% of the IBC minus 3B price difference, increasing approximately \$0.20/MMBtu in 2011 to \$0.67/MMBtu in 2020 (Table 5-1). The average price decline for 3B Plus is approximately 50% of the decline for 3B (\$0.44/MMBtu versus \$0.86/MMBtu). This is the maximum price improvement using a 1.0 to 1.0 ratio for demand decrease to supply decrease. Results from the WECC region production curtailment (Modeling Approach #2) will show an average annual price decline between \$0.86/MMBtu and \$0.44/MMBtu.

Table 5-1
Comparison of Henry Hub Price Differences Among IBC ,3B, and 3B Plus (2006$/MMBtu)

	IBC	3B	3B-Plus	Change 3B	Change 3B-Plus	% Change 3B	% Change 3B-Plus
2011	$5.36	$4.80	$5.00	$0.56	$0.36	10.51%	6.72%
2012	$5.34	$4.72	$4.98	$0.62	$0.36	11.54%	6.68%
2013	$5.61	$4.86	$5.19	$0.75	$0.42	13.44%	7.45%
2014	$6.09	$5.12	$5.53	$0.97	$0.56	15.89%	9.13%
2015	$5.99	$5.08	$5.50	$0.91	$0.49	15.14%	8.11%
2016	$5.60	$4.89	$5.30	$0.70	$0.30	12.59%	5.32%
2017	$5.83	$5.05	$5.51	$0.78	$0.31	13.32%	5.36%
2018	$6.02	$5.11	$5.61	$0.91	$0.41	15.07%	6.76%
2019	$6.36	$5.30	$5.86	$1.06	$0.50	16.61%	7.86%
2020	$6.96	$5.64	$6.30	$1.33	$0.66	19.04%	9.46%
				$0.86	$0.44		

5.4 Modeling Approach #2: WECC Region Production Curtailment

This approach, which Global Energy recommended and the IEPR study team selected after comparison with Modeling Approach #1, requires more detailed analysis of the curtailment potential of WECC supply basins that will respond directly to WECC demand erosion. Such supply is approximately 60% Canadian and 40% US. If total gas demand in WECC decreased in Case 3B from 1.9% to 17.2% by 2020, and in Case 3C from 1.5% to 13%, total gas production in regional basins serving this demand will be curtailed, not Gulf Coast, Midcontinent, Appalachian, and LNG supplies, which are not imported or displaced into the WECC demand region.

Following the parameters previously outlined (Figure 5-1), a schematic diagram (Figure 5-3) shows that industry could curtail a total of 20% to 25% (23%) over this 12-year period; 15%-20% from existing wells (17.0%) and 5% from new wells (6.0%). Curtailment from existing wells is approximately three times greater than from new well additions.

Because this combined potential level of production curtailment is greater than the total WECC demand erosion for Case 3B at 17% (0r Case 3C at 13%), a proportional adjustment will be needed to carry out Case 5B Plus modeling using this approach.

5.5 ALTERNATIVES TO MODEL THE SUPPLY CURTAILMENT IN RESPONSE TO THE "GAS BUBBLE" CREATED BY LOW GAS DEMAND OF CASE 5B-PLUS

Figure 5-3 summarizes the potential curtailment (versus the Base Case) in the WECC supply basins that Global Energy concludes is reasonable under the conditions of much lower demand in Case 5B.

Figure 5-3
Potential Curtailment in WECC Supply Basins

(In Comparison to Illustrative Base Case)

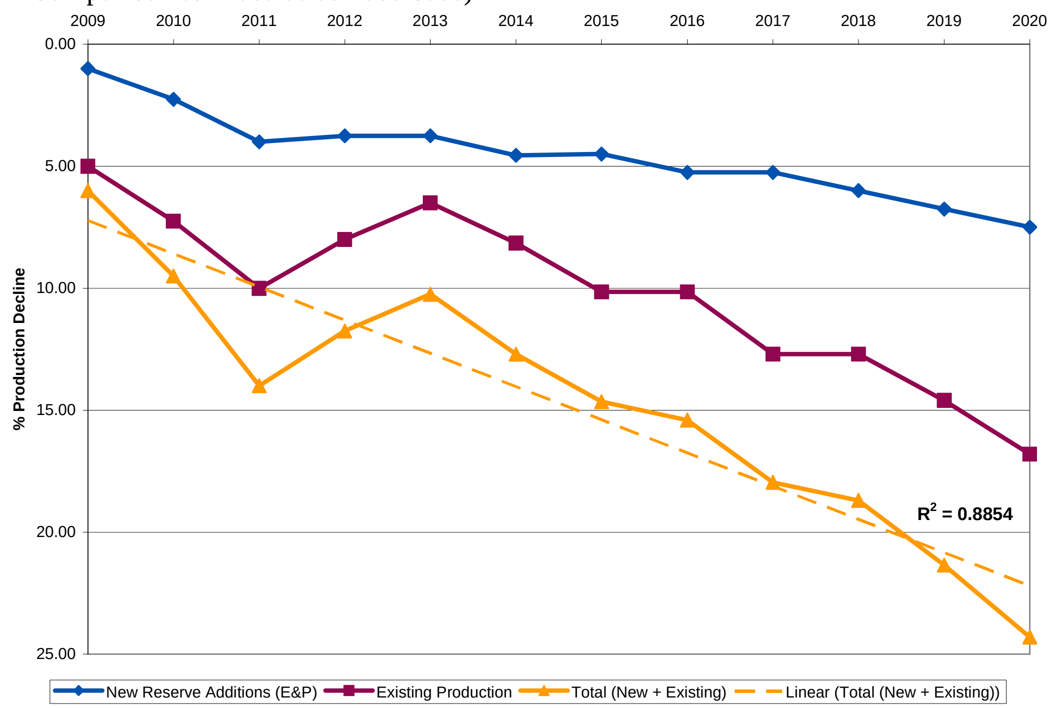


Figure 5-4 and Table 5-2 show three alternatives to model such potential curtailment:

1. *Unlagged Supply Curtailment*: No lag or delay in the supply curtailment response, which begins in 2009 at -7% and increases to -21% in 2020. This supply curtailment profile represents the likely maximum response given the industry's constraints on deployment of capital and on the reservoirs' constraints regarding curtailment of production. The supply decline rate is greater than the demand decline rate in the first three years (2009-2011), the rates equalize during the next two years (2012-2013) and then the supply decline is less than the demand decline by 1% in 2014. This differential increases to approximately 5% by 2020.

2. *Delayed Supply Curtailment*: Industry response is delayed for three years, as compared to the unlagged response. In this alternative, the supply decline rates for 2012 to 2020 equal the unlagged decline. This alternative represents immediate industry curtailment, as in the unlagged case, but price signals in the

market are delayed. This alternative would yield a supply curtailment volume that is 40% of the demand reduction represented by Case 5B.

3. *Lagged Supply Curtailment*: this alternative consists of an industry and market response occurring together but they are lagged for three years, then begins (in 2013) at -7%, increasing to -17% in 2020. This response yields a supply curtailment volume that would be 33% of the demand reduction represented by Case 5B.

Figure 5-4

Curtailment Schematic with Residual "Supply Bubble"

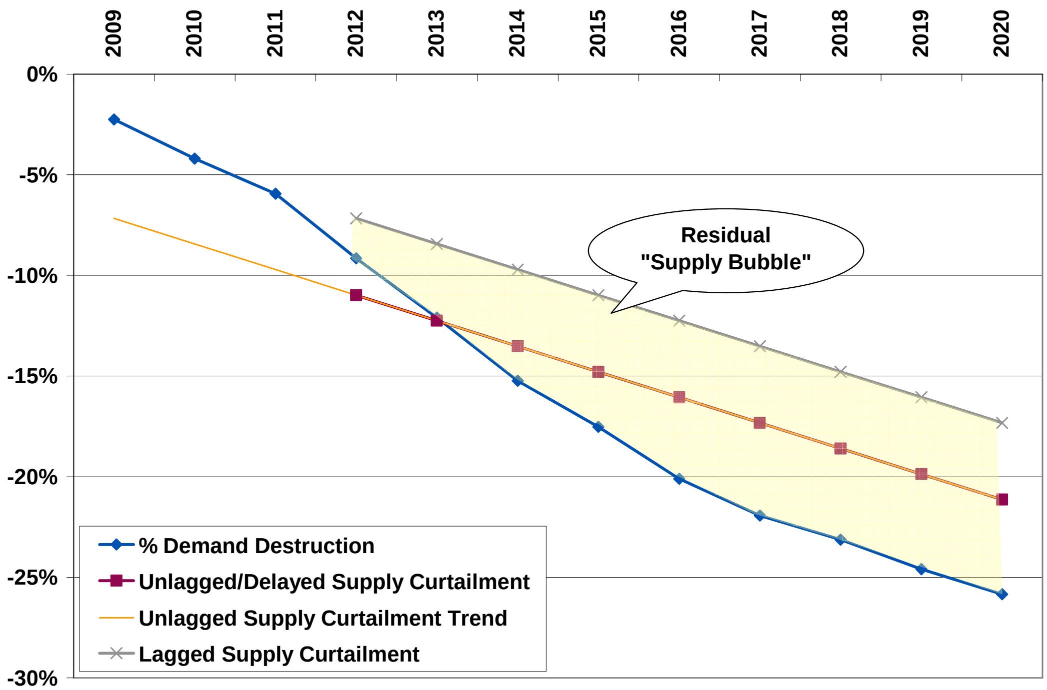


Table 5-2

Curtailment Options

	% Demand Destruction	Unlagged Supply Curtailment Trend	Delayed Supply Curtailment	Lagged Supply Curtailment	Contribution to WECC Demand By 6 Basins	Effective % Curtailment to WECC	Expected Supply Curtailment as % of Demand Destruction
2009	-2%	-7%	0%	0%	59.32%	0.00%	0.00%
2010	-4%	-8%	0%	0%	57.59%	0.00%	0.00%
2011	-6%	-10%	0%	0%	56.72%	0.00%	0.00%
2012	-9%	-11%	-11%	-7%	55.39%	-3.97%	43.42%
2013	-12%	-12%	-12%	-8%	55.23%	-4.66%	38.52%
2014	-15%	-14%	-14%	-10%	54.78%	-5.32%	34.92%
2015	-18%	-15%	-15%	-11%	54.33%	-5.97%	34.05%
2016	-20%	-16%	-16%	-12%	54.36%	-6.66%	33.12%
2017	-22%	-17%	-17%	-14%	53.84%	-7.28%	33.19%
2018	-23%	-19%	-19%	-15%	51.81%	-7.66%	33.13%
2019	-25%	-20%	-20%	-16%	51.27%	-8.23%	33.47%
2020	-26%	-21%	-21%	-17%	50.26%	-8.71%	33.71%

Global Energy concludes that Alternative 3 (Lagged Supply Curtailment) is most realistic in light of experience with previous “supply bubble” conditions analyzed (1990’s). The IEPR study team agreed that, on this basis, Alternative 3 would be used as the methodology for GPCM Case 5BPlus.

5.6 BASINS TO BE CURTAILED FOR CASE 5B-PLUS

Table 5-3 shows the production basins that provide gas supply to WECC and the percentage of their production that flows to WECC. Shown in bold are the basins that Global Energy recommended to the IEPR study team, and the team agreed, should be modeled with the production decline response, consisting of those sending more than 50% of their production to WECC, with the addition of the Colorado San Juan basin. Global Energy recommended that the latter basin be included as it is historically an important basin for WECC, and particularly for California gas supply. The study group agreed to accept Global Energy’s experience-based recommendation and to include the Colorado San Juan basin. If so, the included basins represent approximately 60% of WECC’s total supply.

Table 5-3

Curtailment Basins

% Supply to WECC in 2020>>>>	**55%**	**84%**	15%	32%	**69%**	**88%**	29%	**53%**	8%	**29%**	11%
IBC Gross Production 2020 (mmcf/d)	**Wyoming Southern**	**San Juan Basin (NM)**	AB foothills	BC Plains	**Utah**	**California Onshore**	Colorado Western	**Colorado Northeast**	AB Southeast	**Colorado San Juan**	Colorado Southeast
2009	**3,659**	**2,718**	4,859	2,224	**793**	**619**	1,323	**460**	4,024	**1,147**	368
2010	**3,745**	**2,692**	4,723	2,155	**805**	**578**	1,405	**446**	3,962	**1,094**	382
2011	**3,871**	**2,695**	4,662	2,125	**828**	**568**	1,500	**438**	3,958	**1,047**	400
2012	**4,028**	**2,710**	4,658	2,118	**857**	**575**	1,604	**433**	4,014	**1,006**	416
2013	**4,232**	**2,726**	4,702	2,137	**888**	**592**	1,712	**430**	4,089	**968**	428
2014	**4,462**	**2,741**	4,692	2,161	**920**	**605**	1,833	**427**	4,124	**934**	438
2015	**4,778**	**2,785**	4,632	2,123	**969**	**600**	1,989	**432**	4,125	**918**	454
2016	**5,133**	**2,851**	4,540	2,054	**1,028**	**596**	2,158	**440**	4,101	**911**	471
2017	**5,306**	**2,835**	4,511	2,042	**1,059**	**592**	2,270	**437**	4,121	**877**	473
2018	**5,433**	**2,803**	4,487	2,034	**1,079**	**585**	2,373	**432**	4,118	**838**	470
2019	**5,622**	**2,814**	4,466	2,040	**1,112**	**592**	2,523	**432**	4,124	**814**	471
2020	**5,743**	**2,795**	4,464	2,072	**1,131**	**588**	2,644	**428**	4,141	**781**	462

Thus, for Forecast 5B-Plus, the basins to which the declines will be applied are:

- Wyoming Southern
- San Juan (New Mexico)
- Utah
- California Onshore
- Colorado Northeast
- Colorado San Juan

5.7 CURTAILMENT RESULTS

Table 5-4 and Figure 5-5 show the curtailment of production that results from using the described shaping methodology to simulate a supply response to the low-demand "gas bubble."

Table 5-4

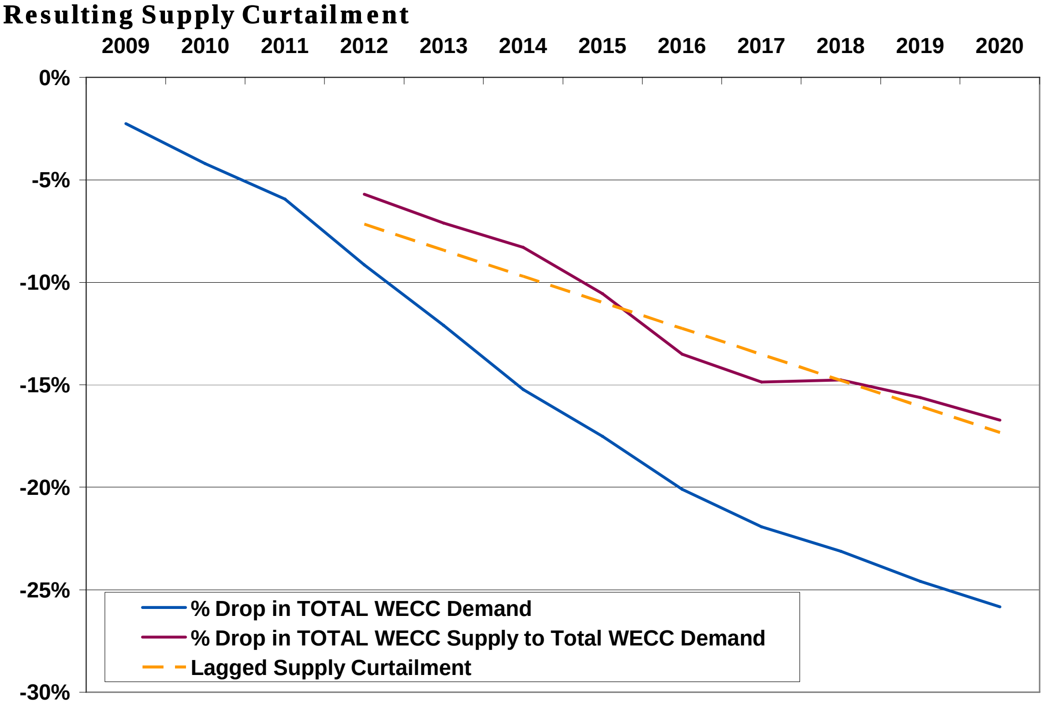
Results in Volume (MMCf/d and %) of the 5B-Plus Forecast, Showing the Supply Curtailment. Demand Volumes in WECC are Reduced Compared to the IBC and 5B.

mmcf/d	IBC: WECC TOTAL NG Demand	5B-LDF: WECC TOTAL NG Demand	Demand Drop in WECC	% Drop in TOTAL WECC Demand	IBC Gross Production*	IBC Net Production to WECC*	5B Plus Gross Production*	5B Plus Net Production to WECC*	Supply Curtailment to WECC*	Lagged Supply Curtailment	% Drop in TOTAL WECC Supply to Total WECC Demand
	A	B	C	D	E	F	G	H	I	J	K
				C / A					H - F		I / A
2009	11,402	11,146	(256)	-2%	9,397	7,260	9,397	7,260			
2010	11,715	11,223	(492)	-4%	9,360	6,970	9,360	6,970			
2011	11,806	11,105	(701)	-6%	9,447	6,817	9,447	6,817			
2012	12,294	11,169	(1,125)	-9%	9,609	6,892	8,960	6,191	(701)	-7%	-6%
2013	12,553	11,034	(1,519)	-12%	9,835	7,011	8,892	6,119	(892)	-8%	-7%
2014	12,823	10,870	(1,953)	-15%	10,090	7,087	8,985	6,023	(1,064)	-10%	-8%
2015	13,145	10,842	(2,303)	-18%	10,482	7,214	9,185	5,826	(1,388)	-11%	-11%
2016	13,486	10,775	(2,711)	-20%	10,960	7,397	9,450	5,576	(1,821)	-12%	-14%
2017	13,626	10,638	(2,988)	-22%	11,106	7,399	9,427	5,371	(2,027)	-14%	-15%
2018	13,906	10,690	(3,216)	-23%	11,170	7,239	9,320	5,185	(2,054)	-15%	-15%
2019	14,207	10,712	(3,495)	-25%	11,387	7,315	9,349	5,095	(2,220)	-16%	-16%
2020	14,417	10,692	(3,725)	-26%	11,466	7,268	9,279	4,857	(2,411)	-17%	-17%

*California Onshore, Colorado Northeast, Colorado San Juan, San Juan (NM), Utah, Wyoming Southern

Figure 5-5

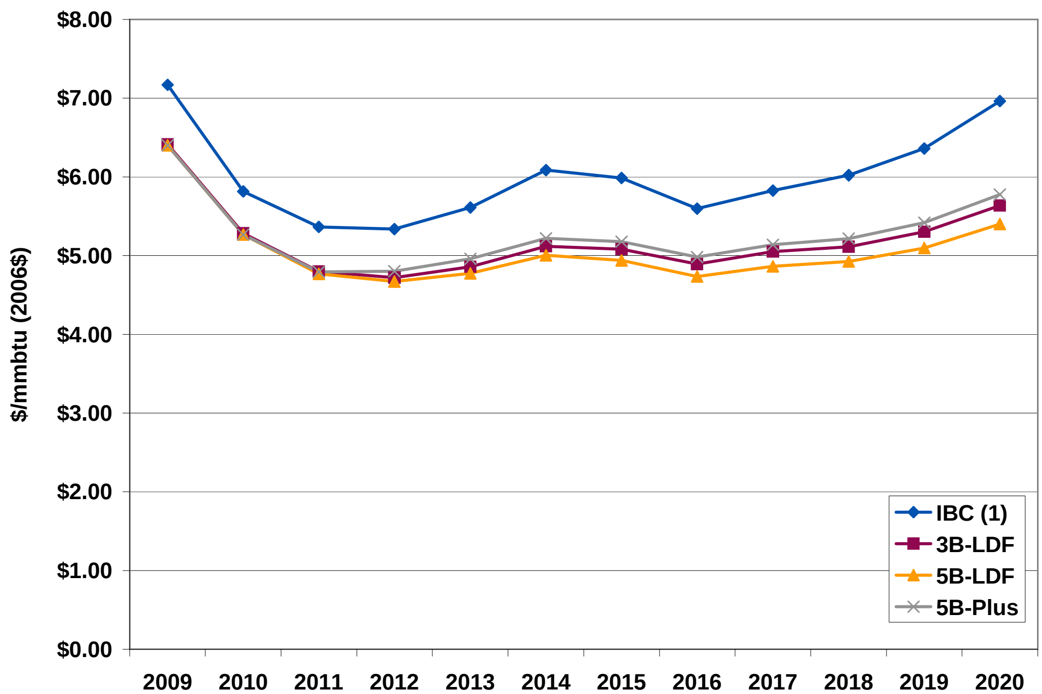
Results of Forecast 5BPlus, Showing the Drop in WECC Demand and the Resulting Supply Curtailment



5.8 5B-PLUS FORECAST PRICE RESULTS

Figure 5-6 shows forecast 5B Plus prices in comparison to the IBC, 3B, and 5B. With the supply adjustment described in this section the resulting price series does not decline as much as it does in the 3B and 5B cases.

Figure 5-6
IBC, 3B, 5B, and 5B-Plus: Henry Hub (2006$)(1)



(1) For Henry Hub forecast GED uses NYMEX for the first 24 months and then mean reverts for following 24 months to our fundamental forecast. For IBC forecast starting in 2007 for NYMEX an average of the latest available three days were used (i.e. Dec 19-21 2006).

These price results (2006$/MMBtu) are the final step in our investigation of the impacts of aggressive application of renewables and energy efficiency in WECC. They show that the application throughout WECC of aggressive energy efficiency and renewables will create lower UEG demand that in turn will create a decrease in demand for natural gas. As shown on Table 5-5 below, the resulting price response would be a decrease in price (versus the IBC) of approximately $1.00 per MMBtu (average for the forecast horizon) were it not for the production capacity response of the gas supply industry to a resulting decrease in demand. The curtailment of production capacity to adjust to lower demand will lessen this price decrease from approximately $-1.00 (5B) to approximately $-0.77 (5BPlus).

Table 5-5
Average Prices Forecast 2011-2020 for IBC, 3B, 5B and 5BPlus
($2006/MMBtu)

Average	IBC	3B	5B	5BPlus
2011-2020	5.92	5.06	4.92	5.15
Decrease vs. IBC		0.86	1.00	0.77

5.9 RELIABILITY AND LIMITATIONS OF THE ANALYSIS RESULTS

Examination of these results by Global Energy analysts as well as other IEPR study team members provide a foundation on which to conclude that the results appear internally consistent and reasonable given the content and underlying assumptions of each forecast case. They were obtained through a systematic step-by-step process with evaluation of results at the end of each step. They therefore have good reliability.

A fundamental limitation of the analysis is that during the time in which it was performed (December, 2006 through June, 2007), events in the energy industry occurred that are significant to a fundamentals-based natural gas price forecast. Periodic updating of inputs is routine for GPCM and other leading forecast models. Since December, 2006, when the Illustrative Base Case was developed for the IEPR study, the GPCM model has undergone two quarterly updates by its owners RBAC (January and April, 2007), and Global Energy has changed its Gas Reference Case once (Spring 2007). The updates include a large variety of aspects of both supply and demand, as well as a new crude oil forecast and oil:gas price ratio data.

Since December, 2006, important new developments have taken place in the world fuel markets. Both EIA and Global Energy have increased their crude oil (WTI or its proxy) forecasts. The crude oil to natural gas price ratio has increased dramatically in the past six months. The Arctic gas pipelines have been significantly delayed and are uncertain. These trends, as well as new pipeline and LNG infrastructure-related events, will be captured in an update of key forecast cases to include RBAC and Global Energy updates of GPCM and Reference Case, respectively.

APPENDIX D

FURTHER MARKET ANALYSES FOR NATURAL GAS

Prepared by Global Energy Decisions, Inc.

APPENDIX H-6 – POTENTIAL NEXT STEPS IN THE GPCM® NATURAL GAS FORECASTING PROCESS

1.0 NEXT STEPS

The GPCM natural gas forecasts carried out as part of the 2007 IEPR study produced a very large body of data of which only the most pertinent to the IEPR study goals could be evaluated in the time allotted to the work. Furthermore, the analysis of the forecasts raised important questions for further study. New events and trends in the energy industry during 2007 gave great importance to some of these questions. The IEPR study team has compiled an outline of topics for further work to which Commissioners, Commission staff, and stakeholders may add additional topics. We now briefly touch upon the topics for next steps that have been outlined to date.

1.1 Additional Analysis of the Benefits of Energy Efficiency and Renewables in Lowering Natural Gas Prices

The GPCM gas forecasts in the 2007 IEPR study characterized by low demand (3B, 3C, 5B, and 5BPlus) showed how lowered demand for natural gas resulted in lower gas prices throughout WECC. What are the long-term overall benefits ("ripple effects") of decreased natural gas prices that occur when EE and renewable energy are aggressively substituted for electricity fueled by natural gas? For example, Lawrence Berkeley Laboratory has authored a study on this subject which should be evaluated for its significance to the Commission studies. Other academic, government, or industry studies may have been performed that bear on this issue. Once all available studies have been reviewed and evaluated, additional GPCM modeling may be warranted.

1.2 Focus on Basis Differentials

The analysis and commentary so far has involved Henry Hub prices because they are key inputs to the IEPR Market Analytics modeling. Time did not permit analysis of the impacts of the different scenario conditions on gas prices delivered to various WECC consumption areas. The forecast step-by-step process through six forecast cases developed a large volume of data on basis differentials which could be analyzed and evaluated to gain an improved understanding of natural gas price relationships in the various WECC market areas.

1.3 Infrastructural Developments – Pipelines and Storage Facilities

A large amount of information is contained in the six model runs that could be analyzed to understand the need and impact of new pipeline and storage infrastructure under the varying conditions represented by the six cases. Where will the constraints be located and will their location and severity change through time?

If additional gas fired resources are planned in pipeline constrained areas such as Southern California, what infrastructure enhancement will be needed and when? If so, what will be the magnitude and cost of pipeline expansions and construction?

1.4 Canadian Natural Gas Demand and Resulting Exports to U.S.

Canadian gas supply and demand trends in 2007 to date indicate the growing requirement to analyze Canada's ability to export natural gas to the U.S., such as:

- The increasing projections for domestic Canadian demand including oil sand development,
- Increasing power demand as coal plants are retired,
- Diminishing production capacity and moderating rig counts in Western Canadian Sedimentary Basin,
- Some disappointing results of exploration in the Canadian Atlantic region

Incremental Canadian gas will likely be largely unconventional, so when will the various unconventional Canadian sources develop, where, and at what cost?

1.5 LNG Supply Development Scenarios

A second area of infrastructure analysis that should be performed to optimize the GPCM work already performed is further evaluation of imported LNG: timing of volume requirement, location, and utilization rate of regasification facilities under various conditions. Such a study would benefit from the incorporation of Global Energy's World LNG Model and World Crude Oil Model.

Further analysis is also needed to identify the likely capacity of imported LNG with and without new pipelines such as Alaska North Slope, Mackenzie Delta, Rockies Express, Millennium and Gulf South's new SE header system.

1.5 Supply Development – Unconventional U.S. Reserves

A significant uncertainty for the natural gas industry is the timing and cost of the development of crucial unconventional reserves to take up the slack for declining conventional production in many fields. GPCM modeling of various upstream supply scenarios, including unconventional reserves would add quantification and discipline to this vital topic. This analysis will benefit from coordination with LNG scenarios, because the development of unconventional reserves will impact the LNG price. Furthermore, it will be crucial to combine this analysis with studies of Canadian demand and resulting exports to U.S. discussed above.

1.6 Scenarios Involving Extraordinary Conditions such as Drought or Nuclear Outages

Much of our modeling of gas demand assumes normal conditions, but the answers would doubtless change under abnormal conditions. An analysis could involve an extreme scenario from the power volatility study such as extreme drought with high load concurrent with an outage at a nuclear facility.

Under the extreme scenario above, even if the pipeline system was adequately built, would the gas commodity supply (gas field infrastructure, gas storage, and LNG capability) be able to deliver sufficient gas to the pipeline system?

What would the results be if prevailing North American conditions of gas supply scarcity (e.g. Arctic gas delayed and steep decline in conventional production) were to occur concurrently with extraordinary demand such as drought or nuclear outages?

1.7 Delay in Accomplishing Renewable and EE Goals and Milestones

The low-demand gas forecasts performed so far assume that renewable and EE goals and milestones are met in the applicable areas. Delay in accomplishing these goals will introduce additional strains on the gas pipeline system. Several alternatives should be considered:

- No new gas infrastructure is built so the low hydro, high weather induced load would result in an exacerbated problem, with constrained pipelines and price spikes, or
- Some of the required pipeline and LNG infrastructure is built as the "back-up" supply for the renewables and EE.

1.8 Timing of Investment and Success in Developing IGCC and Carbon Sequestration Technologies

In a regulatory framework in which EE and renewables are aggressively mandated, the contribution of U.S. coal resources to the electricity generation mix (as compared to natural gas) will be very different depending upon the timing of the huge required investment in IGCC and carbon sequestration technologies, and in the success and acceptance of those results. Scenario analysis is clearly needed to investigate the range of outcomes for natural gas and its needed infrastructure depending upon the future of IGCC and carbon sequestration.