INTERIM REPORT

Assessment of the Ability of the CFE System to Support the San Diego Area During Outages of the Southwest Power Link

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Introduction and Summary

The purpose of this interim report is to summarize the results of a California Independent System Operator (CA ISO) technical assessment of the ability of the Comisión Federal de Electricidad (CFE) system to provide support to the San Diego area during an outage of the Southwest Power Link (SWPL). These studies are currently in draft form because they have yet to be reviewed by CFE and San Diego Gas and Electric Company (SDG&E). Until CFE and SDG&E have had an opportunity to review and comment, the CA ISO views these studies as interim in nature. In addition, the studies were completed in a very short period of time and are necessarily abbreviated. Thus, to confirm the results of the analyses, additional studies may be advisable.

The CA ISO studies examined two potential ways that the CFE system could assist in supporting the CA ISO during an outage of the SWPL. The first is the ability of the CFE system to support through-flows during an outage of the SWPL. Through-flows would be power flows that leave the CA ISO grid east of San Diego at Imperial Valley Substation and return to the CA ISO grid near San Diego at Miguel Substation. The second means of support from the CFE system would be direct exports to the CA ISO at Miguel Substation from power generated from within the CFE system.

The conclusions of the study are the following:

- CFE Through-Flow: Given the completion of the new generation in Mexico that is currently under construction, there would not be any through-flow capability available to support the San Diego area during outages of the SWPL nearly half of the time. Given the low availability of this capability, it would not be prudent to count on this capability as being available to support the San Diego Area. In addition, CFE is considering additional generation additions to meet their own needs. If this additional generation were to be developed in the eastern portion of their system near La Rosita Substation, then the ability of the CFE system to support through-flows would be even less.

- CFE Exports: Historical data indicates that CFE rarely exports power to the CA ISO Grid. These exports are particularly rare during the summer peak load period, which is the focus of these studies. In fact, CFE is normally importing power from the CA ISO grid during these peak load periods. While an examination of future CFE loads and resources indicates that the amount of reserve margin in the CFE system may be increasing in the near future, this increase will be quickly consumed by CFE load growth. Given this information, it does not appear likely that exports from CFE will be available to support the San Diego area during outages of the SWPL.

1. System Description

The following diagram shows a schematic representation of the Mexican and California transmission system near the California-Mexico Border. It can be seen from the diagram how the Mexican 230 kV system would transfer power from Imperial Valley to Miguel during an outage of the Imperial Valley-Miguel 500 kV line.

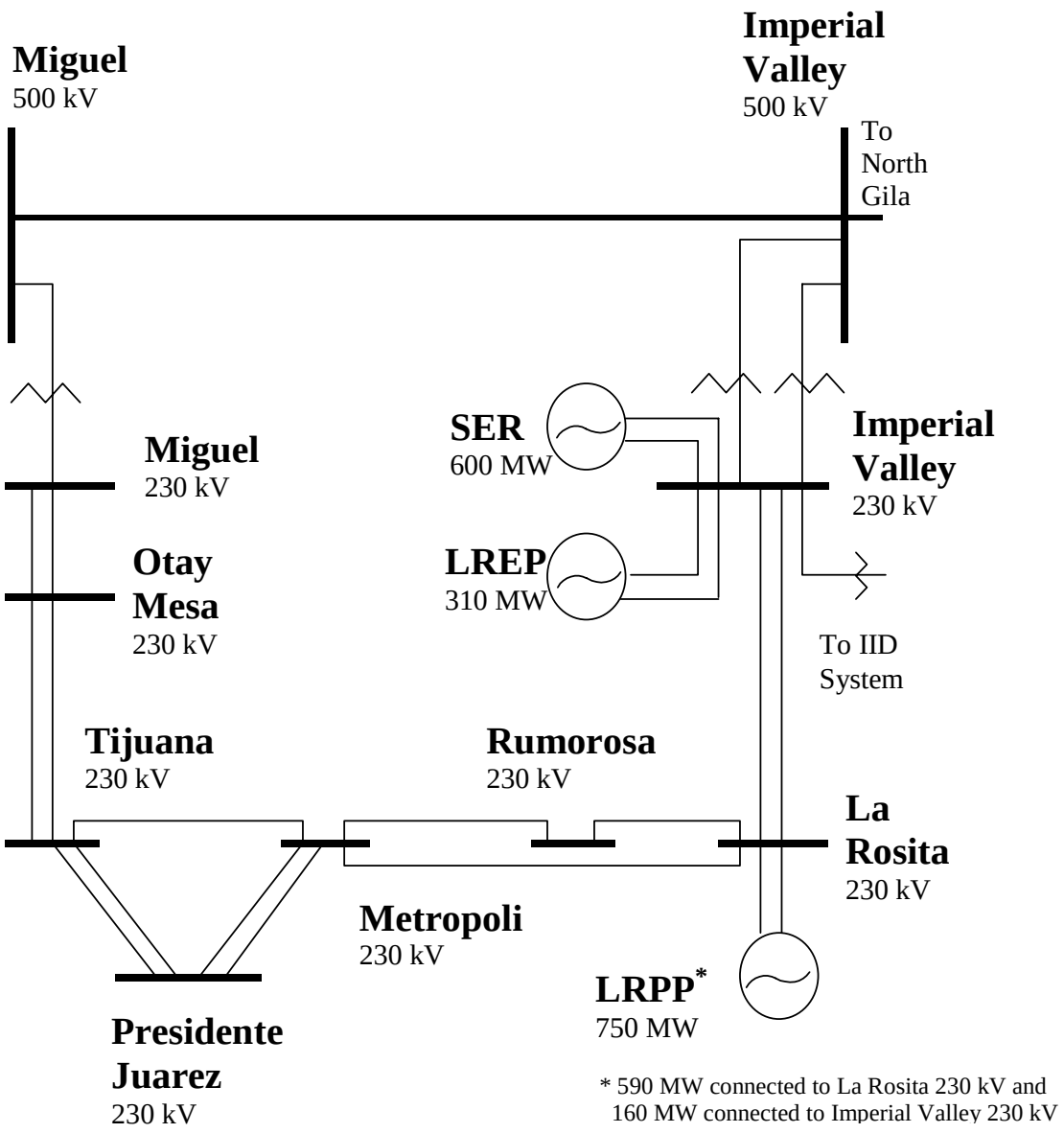


Figure 1: US/Mexico Border Transmission System

2. CFE Flow-Through Capabilities

The purpose of this section is to estimate the maximum amount of power that can be transferred to the CA ISO through the CFE 230 kV system, from Imperial Valley to Miguel, when the Imperial Valley – Miguel 500 kV line (a.k.a. SWPL) is out of service. This amount is called CFE flow-through capabilities.

2.1.1 Study Assumptions

a) The CA ISO and CFE systems were analyzed using a 2003 Heavy Summer Base Case and historical system data.

b) The following transmission upgrades were assumed in the base case:

- Two 1,120 MVA, 500/230 kV transformers at Imperial Valley, in place of the existing bank.
- A second 230 kV circuit from Miguel to Mission.
- A second 230 kV circuit from Tijuana to Otay Mesa.
- A second 230 kV circuit from Miguel to Otay Mesa.
- A second 230 kV circuit from Imperial Valley to La Rosita.

c) Only new generation projects that are currently under construction in the US/Mexico border area were modeled in the base case. These include:

- La Rosita Power Plant (LRPP): 590 MW connected to the La Rosita 230 kV Substation and 160 MW connected at the Imperial Valley 230 kV Substation with a commercial operation date of March 2003. The 160 MW portion of this plant that is connected to Imperial Valley can be connected to La Rosita instead of Imperial Valley, depending on the plant substation switching arrangement.
- La Rosita Expansion Plant (LREP): 310 MW connected to the Imperial Valley 230 kV Substation, with commercial operation dates of July 2002 for the first 160 MW and June 2003 for the additional 150 MW.
- Sempra generation project (SER): 600 MW connected at the Imperial Valley 230 kV Substation, with a commercial operation date of June 2003.

d) Table 1 lists the different combinations of generation dispatch scenarios at Imperial Valley and La Rosita 230 kV substations, which were analyzed. For each scenario, the impact of the SWPL outage was studied.

Table 1: Generation Dispatch Scenarios

Case no.	Description	Generation at Imperial Valley 230 kV	Generation at La Rosita 230 kV
1	No new generation	0 MW	0 MW
2	Only CFE's portion of LRPP	0 MW	590 MW
3	Entire LRPP	160	590
4	LRPP + LREP + SER	1070	590

2.2 Study Results

2.2.1 Impact of SWPL Outage

As shown in Figure 1, the 230 kV transmission system comprised of the Imperial Valley - La Rosita – Tijuana – Miguel 230 kV path, referred to hereafter as "Parallel Path", operates in parallel to the SWPL. Therefore, an outage of SWPL would greatly impact the flow on the Parallel Path. Table 3 below lists the Line outage distribution factors for the surrounding system following a loss of SWPL. A 26% Line outage Distribution Factor (LODF) on the La Rosita – Rumorosa 230 kV Line means that 26% of the SWPL pre-outage flow will add to the flow on the La Rosita – Rumorosa 230 kV line after the outage of SWPL.

Table 3: SWPL Line Outage Distribution Factors (LODFs) and Line Ratings

Line	LODFs	Normal Rating (MVA)	Emergency Rating (MVA)
N. Gila – Imperial Valley 500 kV Line	- 40%	1273	1818
Imperial Valley 500/230 kV Bank #1	30%	1120	1329
Imperial Valley 500/230 kV Bank #2	30%	1120	1329
Imperial Valley – La Rosita 230 kV Line	53%	796	1153
El Centro 230/161 kV Bank	7%	225	258
La Rosita – Rumorosa 230 kV Line	**26%**	**388**	**430**
La Rumorosa – Metropoli 230 kV Line	26%	388	430
La Rosita – Metropoli 230 kV Line	26%	388	430

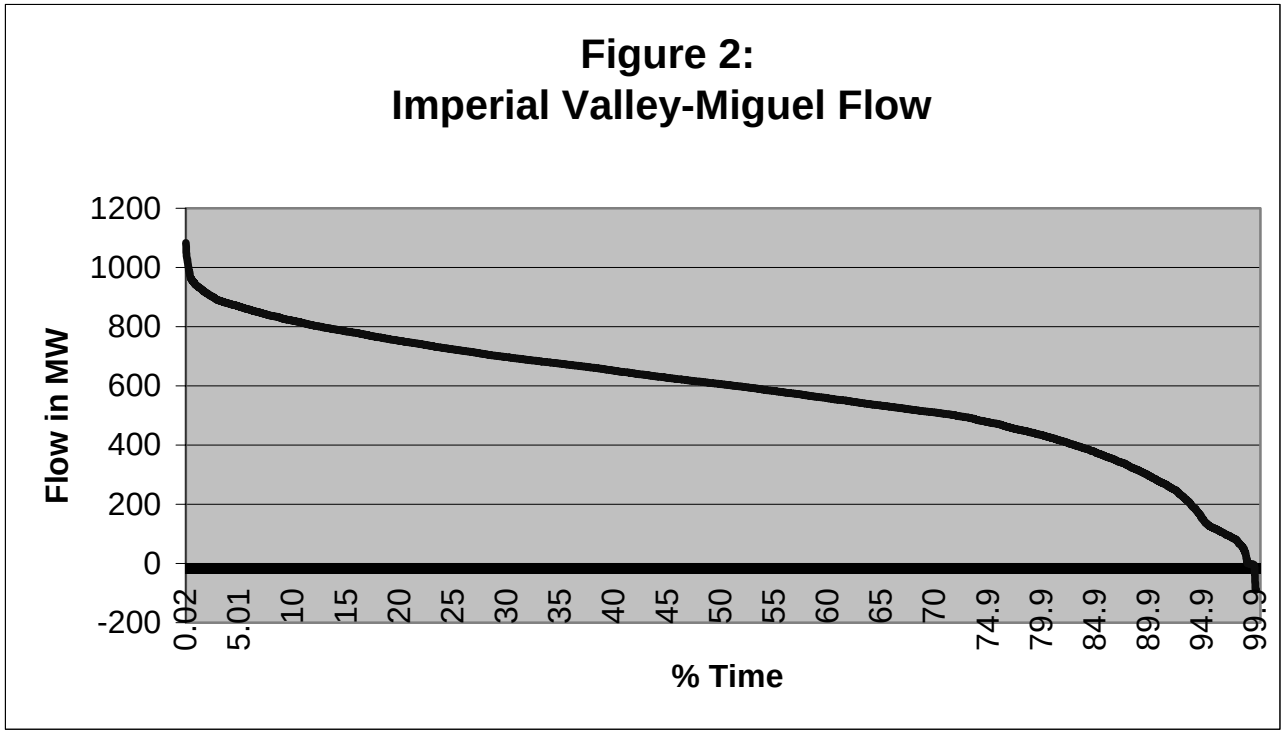
Metropoli – Tijuana 230 kV Line	36%	1153	1400
Metropoli – Presidenti #1	8%	444	493
Metropoli – Presidenti #2	8%	444	493
Presidenti – Tijuana 230 kV Line	16%	444	493
Tijuana – Miguel 230 kV Line	16%	1592	2306

The post-outage flow for any of the lines listed in Table 3 can be calculated as:

Post-outage flow for line XY = pre-outage flow for line XY +

*SWPL pre-outage flow * SWPL LODF for line XY*

Applying this calculation to the various cases studied identified that CFE's La Rosita - Rumorosa 230 kV line would be the most limiting element in the CFE system for through flow following the outage of the SWPL. Figure 2 shows the historical flow duration curve for SWPL from Jan. 1, 2000 to Apr. 1, 2002. As shown in Figure 2, SWPL's flow could be as high as 1082 MW. Therefore, the outage of SWPL could increase the loading on the La Rosita – Rumorosa 230 kV line by up to 280 MW. To protect this line against thermal overload, CFE currently has a special protection system (SPS) that will trip the Imperial Valley – La Rosita 230 kV lines following the outage of SWPL if the La Rosita – Rumorosa line overloads. Of course the loss of the Imperial Valley-La Rosita lines would eliminate the transmission path through Mexico and through-flow would then be zero. Therefore, it is important to ensure that the CFE system remains within its capabilities so that flow-through can assist in supporting the San Diego area when possible.



2.2.2 Interaction Between La Rosita Generation[1] and CFE System

The different generation dispatch scenarios listed in Table 1 were used to estimate the maximum amount of generation that can be dispatched from La Rosita to Miguel without overloading any of CFE's transmission lines, particularly the La Rosita – Rumorosa 230 kV Line, which proved to be the most limiting line in the CFE system following the outage of the SWPL. Using the cases described above the impact of new generation can be estimated by calculating the generation shift response factors, by assuming linear system operation and through the use of the principle of superposition. The generation shift response factors are calculated using the following formula.

GSRF=(post-generation line flow minus pre-generation line flow)/Generation Increase

[1] La Rosita Generation, in this context, means the total amount of any generating units connected at La Rosita 230 kV and the portion of Imperial Valley generation which flows to CFE 230 kV system through La Rosita 230 kV Substation.

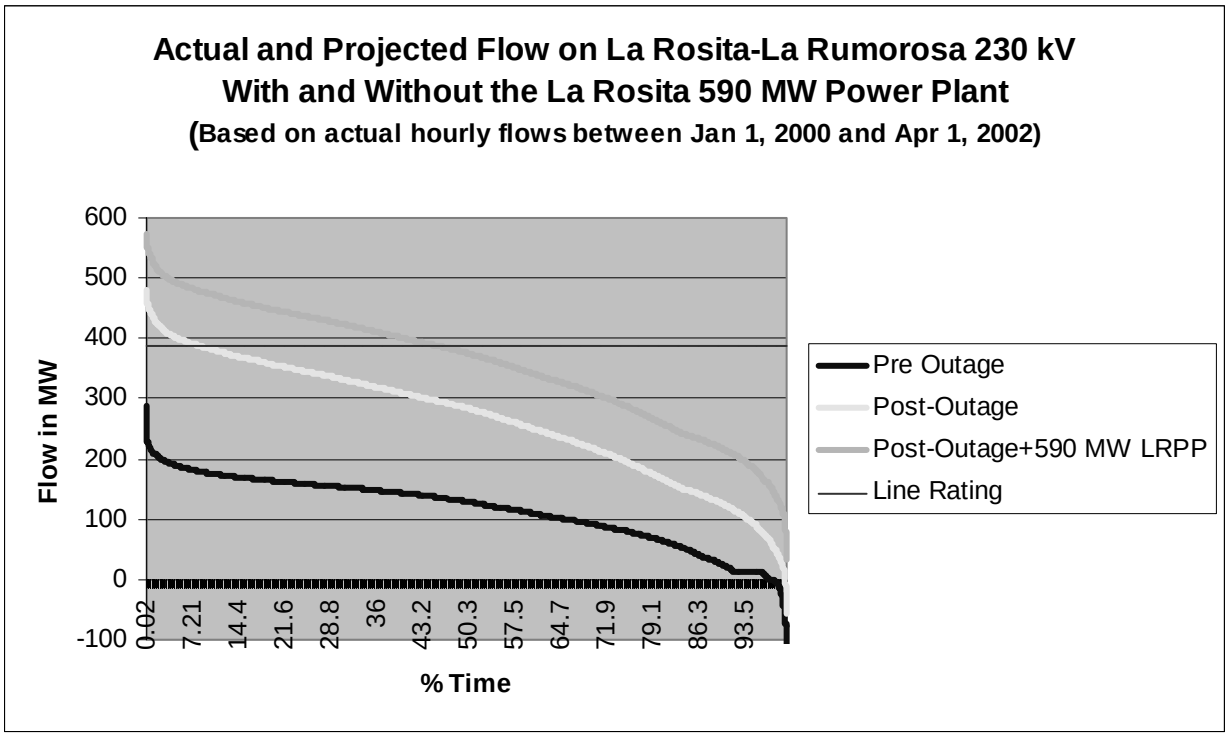
Table 4: Generation Shift Response Factors

	Increase Gen at La Rosita Decrease Pittsburg	**Increase Gen at Imperial Valley Decrease Pittsburg**
N. Gila – Imperial Valley 500 kV Line	- 47%	- 52%
Imperial Valley-Miguel 500 kV	29%	29%
Imperial Valley 500/230 kV Bank #2	-38%	-41%
Imperial Valley – La Rosita 230 kV Line	-84%	10%
El Centro 230/161 kV Bank	7%	8%
La Rosita – Rumorosa 230 kV Line	**8%**	**5%**
La Rumorosa – Metropoli 230 kV Line	8%	5%
La Rosita – Metropoli 230 kV Line	8%	5%
Metropoli – Tijuana 230 kV Line	11%	7%
Metropoli – Presidenti #1	2%	1%
Metropoli – Presidenti #2	2%	1%
Presidenti – Tijuana 230 kV Line	4%	3%
Tijuana – Miguel 230 kV Line	16%	10%

These generation shift response factors can be combined with the line outage distribution factors to calculate the response of a line to new generation during a line outage. For example, for the critical limit in the CFE system of the La Rosita-La Rumorosa 230 kV line during an outage of the SWPL, the GSRF would be the generation shift response factor for that line (8%) plus the line outage distribution factor for that line for an outage of the SWPL (26%) times the generation shift response factor for SWPL (29%) which equals 15.5%. In other words, during the outage of SWPL, if generation were increased at La Rosita, 15.5% of that increase will flow over the La Rosita-La Rumorosa 230 kV line.

Figure 3 illustrates the relationship between La Rosita Generation and the ability of the Mexican system to accommodate through-flow. As can be seen from the diagram, the current plans for 750 MW of generation essentially eliminates the ability of the Mexican system to accommodate through-flow following the SWPL outage. If the flow on the La Rosita-La Rumorosa 230 kV line exceeds its rating, then CFE will be required to act. The current action taken is to open the Imperial Valley-La Rosita 230 kV lines. Opening these lines eliminates the path for through-flow in the Mexican system and through-flow would then be zero. Therefore, for those hours where loading would be above the rating of the La Rosita-La Rumorosa 230 kV line, through-flow would likely be eliminated if the SWPL were to be outaged.

Figure 3 – Ability of the CFE system to accommodate through-flow



The current generation development in the La Rosita area is 1660 MW, which is well beyond what the system can support during an outage of SWPL. However, for the generation that is directly connected to Imperial Valley Substation, the CA ISO can require that this generation be tripped for an outage of the SWPL. This would eliminate all but a maximum of 750 MW of generation that is connected to CFE's system at La Rosita. Under this condition, there would not be any through-flow capability available to support the San Diego area during outages of the SWPL nearly half of the time. Given the low

availability of this capability, it would not be prudent to count on this capability as being available to support the San Diego Area. In addition, CFE is considering additional generation additions to meet their own needs. If this additional generation were to be developed in the eastern portion of their system near La Rosita Substation, then the ability of the CFE system to support through-flows would be even less

3. CFE Export Capabilities

This section presents an analysis of historical and possible future export capabilities from CFE to the CA ISO. Archived real-time data is used to present past exports from CFE to the CA ISO. Future generation development and a load forecast for the CFE control area are used to estimate future possible CFE exports to the CA ISO.

3.1.1 Historical the CA ISO Exports from CFE

WECC Path 45 consists of the transmission lines that interconnect the CFE system with the CA ISO Grid. Net north to south flow on Path 45 represents an export from the CA ISO Grid to CFE. Net south to north flow represents an export from CFE to the CA ISO Grid. Figures 4 and 5 below show Path 45 flow duration curves for the summers of 2000 and 2001, respectively.

For Summer 2000, Figure 4 shows that for 94% of the time, CFE is importing 0 to 315 MW from the CA ISO, and for only 6% of the time the CA ISO is importing 0 to 105 MW from CFE.

Figure 4 also shows the following:

- For 42% of summer 2000, CFE is importing between 0 and 100 MW from the CA ISO.
- For 35% of summer 2000, CFE is importing between 100 and 200 MW from the CA ISO.
- For 17% of summer 2000, CFE is importingbetween 200 and 315 MW from the CA ISO.

For Summer 2001, Figure 5 shows that for 97% of the time, CFE is importing 0 to 520 MW from the CA ISO, and for only 3% of the time the CA ISO is importing 0 to 105 MW from CFE.

Figure 5 also shows the following:

- For 19% of summer 2001, CFE is importing between 0 and 100 MW from the CA ISO.
- For 33% of summer 2001, CFE is importing between 100 and 200 MW from the CA ISO.
- For 35% of summer 2001, CFE is importing between 200 and 400 MW from the CA ISO.
- For 10% of summer 2001, CFE is importing more than 400 MW from the CA ISO.

Figure 4:
Path 45 Flow
South to North (Jun 1- Aug 31, 2000)

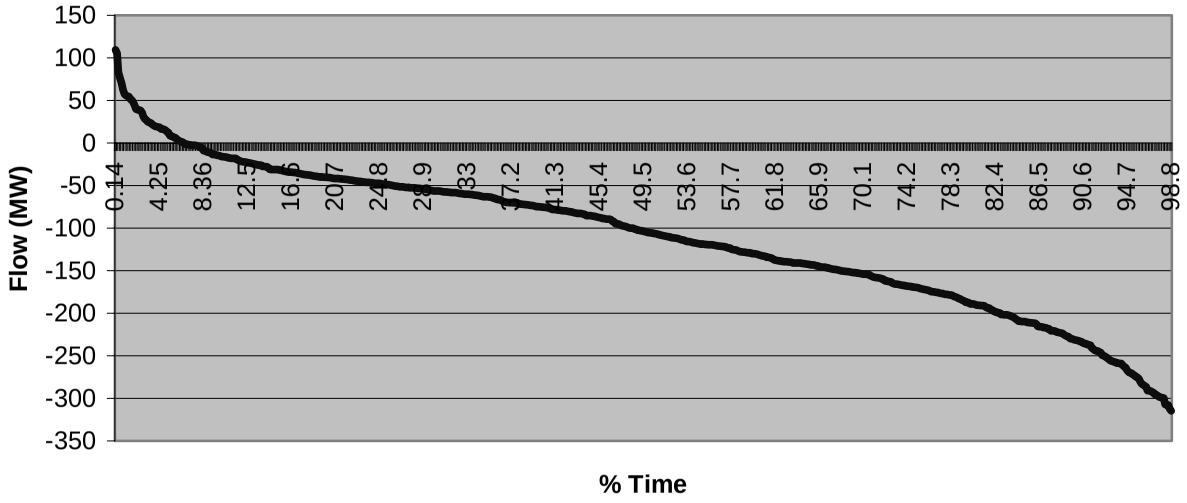
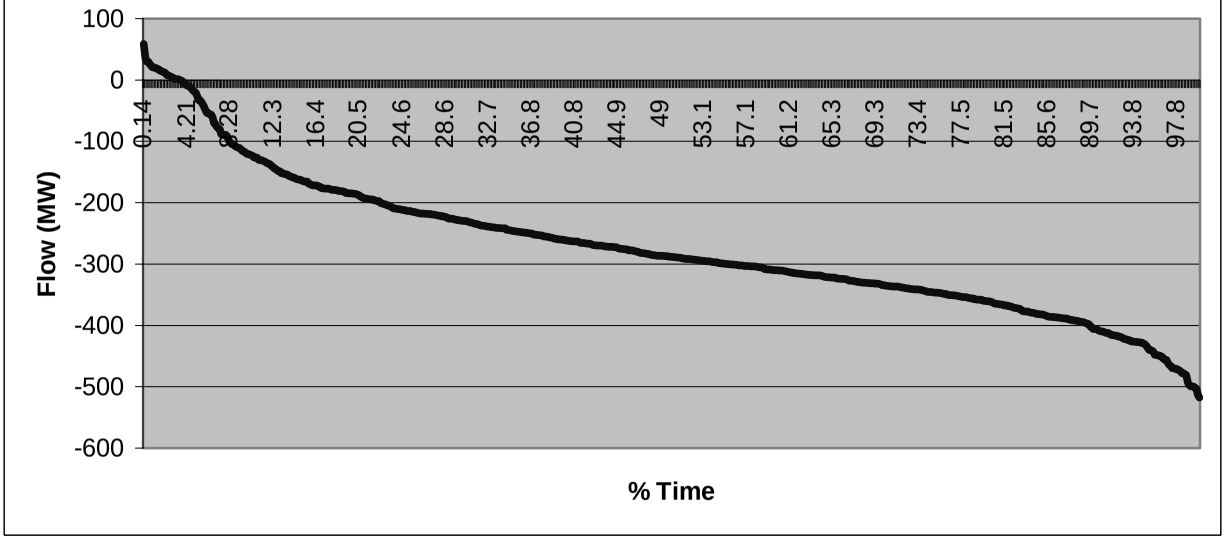


Figure 5:
Path 45 Flow
South to North (Jun 1- Aug 31, 2001)



3.2 Future Expectation for Exports from CFE

Table 5 below provides the loads and resources forecast for CFE for the years 2001-2012. The table also estimates the CFE reserve margin, which is defined as:

CFE reserve margin = CFE available generation resources – CFE peak load – Required Operating Reserve

Where the *Required Operating Reserve*, as defined by WECC's MORC, is the largest of either the largest single generation contingency in CFE control area, or 7% of load served by thermal generating units.

Table 5[2]: CFE Loads, Resources and Reserve Margin

Year	Forecasted Load (MW)	% Growth Rate	Generation Resources (MW)	Annual Resource Addition (MW)	Required Operating Reserve (MW)	Reserve Margin= Resources - Load - Operating Reserve (MW)
2001	1707	8.38	2152	542	261	**184**
2002	1796	5.21	2152	0	261	**95**
2003	1903	5.96	2588	436	290	**395**
2004	2017	5.99	2588	0	290	**281**
2005	2138	6.00	2806	218	290	**378**
2006	2247	5.10	3024	218	290	**487**
2007	2372	5.56	3242	218	290	**580**
2008	2478	4.47	3242	0	290	**474**
2009	2613	5.45	3242	0	290	**339**
2010	2738	4.78	3242	0	290	**214**
2011*	2894	5.69	3405.2	163.2	290	**221**
2012*	3058	5.69	3568.4	163.2	290	**220**

[2] Source for years 2001-2010: WSCC Summary of Estimated Loads and Resources Report, Jan 2001. Pages 125-129
*For years 2011 and 2012: load growth rate and estimated annual resource additions are extrapolated based on previous 10 years trend.

Table 5 shows that CFE load is growing at a high rate which would indicate that the ability to export power in the future would be reduced. However, CFE is developing resources such as the La Rosita Power Plant and it is possible that the amount of power available for export from CFE's system could increase in the future. While increased exports from CFE are a possibility, this would be counter to past experience and is dependent on CFE constructing new and yet unannounced power plants.

The studies did not identify any transmission limitation in exporting power from CFE at the 400 MW level (i.e., the CFE transmission system is projected to be sufficient to export at least 400 MW to San Diego). It should be noted that when exports from CFE exceed 300 MW, CFE will likely trip the Imperial Valley-La Rosita 230 kV lines following a SWPL outage. This means that through-flows would be eliminated following a SWPL outage when CFE is exporting 300 MW or more but the CFE exports would remain.