ATTACHMENT 1

ISO Response to the Fourth Set of Data Requests of
The Utility Reform Network

Response to Numbers 1 & 2

San Diego Gas & Electric Company
Performance Category Upgrade Request
for
Imperial Valley – Miguel 500 kV and
Imperial Valley – Central 500 kV

San Diego Gas and Electric

A Sempra Energy company

December 19, 2007

Performance Category Upgrade Request for Imperial Valley - Miguel 500 kV and Imperial Valley - Central 500 kV

Double Line Outage Probability Analysis

Seven Step Process Document

Final Report

Prepared By

San Diego Gas & Electric
Transmission Planning

Appendix F
Alternative Path Analysis

This analysis is a modified version of the proposed path analysis for the seven step process analyzing the performance requirements for the double-contingency outage of the existing, Imperial Valley - Miguel 500 kV line, and the proposed Imperial Valley - Central 500 kV line. The Imperial Valley - Miguel 500 kV line segment is part of the existing "Southwest Powerlink" (SWPL) which runs from Palo Verde to Hassayampa to North Gila to Imperial Valley to Miguel. The Imperial Valley - Central 500 kV line is part of the proposed "Sunrise Powerlink" (SRPL) which will connect Imperial Valley to SDG&E's Sycamore substation via the proposed 500 kV Central substation.

This analysis is to evaluate the performance category for an alternative path that is being considered for the Sunrise Powerlink project. For this alternative route, the 500kV Imperial Valley - Central line originates at the Imperial Valley substation and parallels the Imperial Valley - Miguel 500kV line for approximately 36 miles in the same right of way, before heading north to Central substation. (See Figure 13)

The Robust Line Design factors are the differentiating variables, within the seven step process, from this portion of the report to the previous portion analyzing the proposed path. The calculated MTBF range of 21 to 928 still holds true for the alternative path.

After reviewing the robust line design, SDG&E requests that the RPEWG evaluate and decide if the alternative path would also qualify for the performance category upgrade to Category D.

Alternative Path Analysis:

R1: Risk of fire affecting both lines

There have been weather-related incidents on the shared right of way for the alternative path. The line parallels a portion of the Imperial Valley – Miguel line for 36 miles with a minimal line separation of 400 feet. After these 36 miles, it continues to parallel the Imperial Valley - Miguel line for another 23 miles with varying degrees of separation. The separation ranges from 4 miles to 9 miles from the Imperial Valley – Miguel line. In order to better classify the different portions of the line paralleling the Imperial Valley – Miguel line, the alternative path will be divided into the following three segments.

Segment 1: Desert Terrain (Towers 50281-50162)
Distance of approximately 36 miles; 400 foot separation from Imperial Valley – Central line; no fires. The shared right of way is desert terrain, where there is a minimal chance of fires.

Segment 2: Partial Desert/Partial Chaparral Terrain (Towers 50162-50104)
Distance of approximately 11 miles; gradually increasing 8 mile separation from Imperial Valley – Central line; 2 fires. There are two fires which occurred in Oct 1999 and are located 9 miles from the point where the Imperial Valley – Miguel line no longer parallels the line.

Segment 3: Chaparral Terrain (Towers 50104-50059)
Approximately 12 miles in distance: approximately 4 mile separation from Imperial Valley – Central line; 9 fires; The reason behind the increased number of fire related incidents is this portion of the line is due to the highly vegetated area.

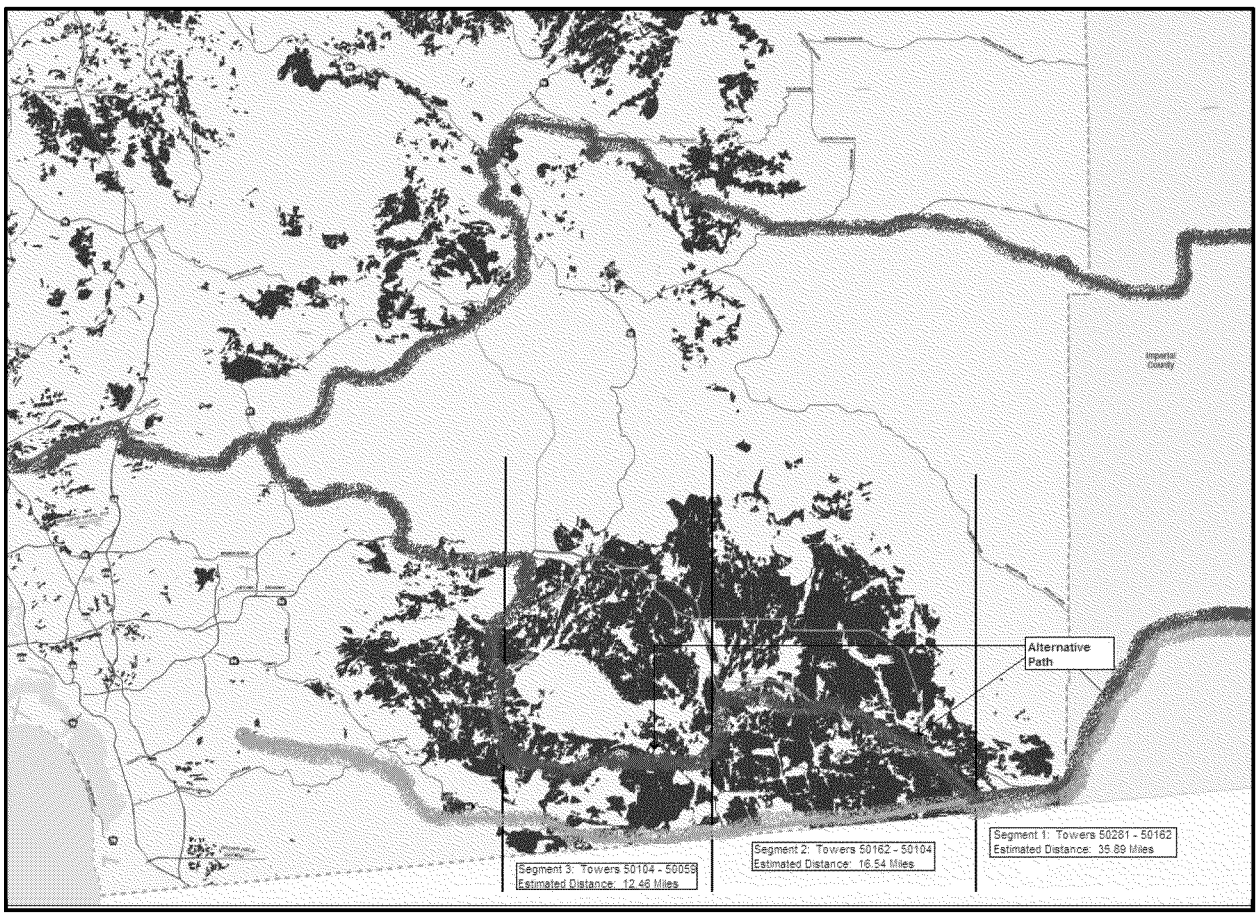

Figure 13: Alternative path segments

As shown in Figure 14 demonstrates that one fire incident may be capable of taking out both lines. The areas shown in red are the burn area. This fire occurred between October 21 and October 24, 2007. During this period of time, TL 50001 was initially de-energized for 74 hours due to safety. If the alternative path is chosen, history shows that a single fire could potentially take out both lines.

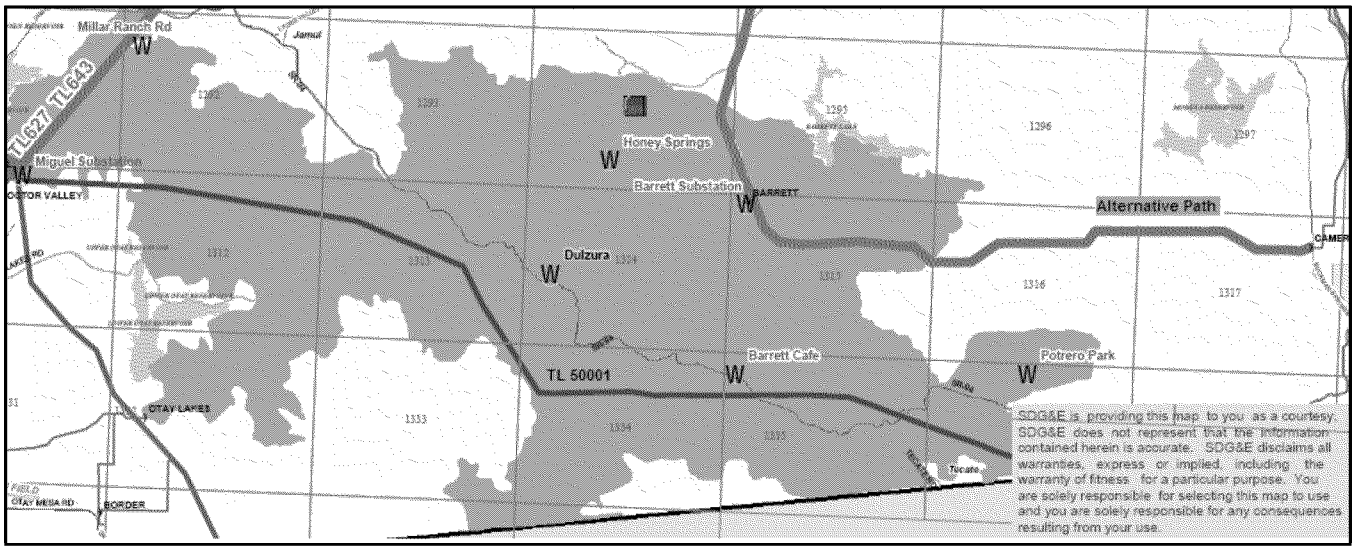

Figure 14: 2007 San Diego Fires

R2: Risk of one tower falling into another line

As stated earlier, there are varying degrees of separation among the Alternative path. Segment 1, which parallels a portion of the Imperial Valley – Miguel line for 36 miles. The other two segments are separated by a significant distance which would make the risk of one tower falling into another difficult.

The risk of one tower falling into another line is not anticipated to be a factor due to the spacing of the lines. The centerline spacing between towers would be greater than 400 feet, which makes it impossible for one tower to fall into another, since the height of the tower is smaller than the distance between the lines. The heights of the towers range from 50 feet to 158 feet.

Within this shared right of way there is a possibility that a generation interconnection transmission line will also be installed. Below is a potential example of this configuration:

SRPL – 400 ft – SWPL – 150 ft – Generation Interconnection line

The Generation Interconnection is south of both 500 kV lines. The maximum tower height for SWPL and SRPL is 158 ft. Even if the SWPL tower fell toward the SRPL tower there would still be spacing between the two towers to avoid collision.

R3: Risk of a conductor from one line being dragged into another line

The risk of a conductor from one line being dragged into another line is similar to having an aircraft fly into both lines. In the case of the alternative path, there is a history of flight related incidents in the shared path. The details of these instances can be found in R5.

R4: Risk of lightning strikes tripping both lines

From SDG&E's data, there has been one outage caused by a lightning strike. This outage occurred on the same portion of the line where the alternative path passes as well. According to outage data, the lightning strike occurred on Tower 50220 in Segment 1 of the route. Other than this outage, there have been no known lightning strikes that have taken place within the shared right of way. As stated previously in the report, the lightning density in the proposed shared right of way is relatively low with a density of 0 - 0.25 flashes/square km/per unit time.

The maps shown in Figures 15 and 16 represent the lightning flash density in California from the years 1989-1996 [Ref 5]. The area marked Imperial Valley is where the corridor will lie. As shown, the IV area has 0 - 0.5 flashes/square km/year.

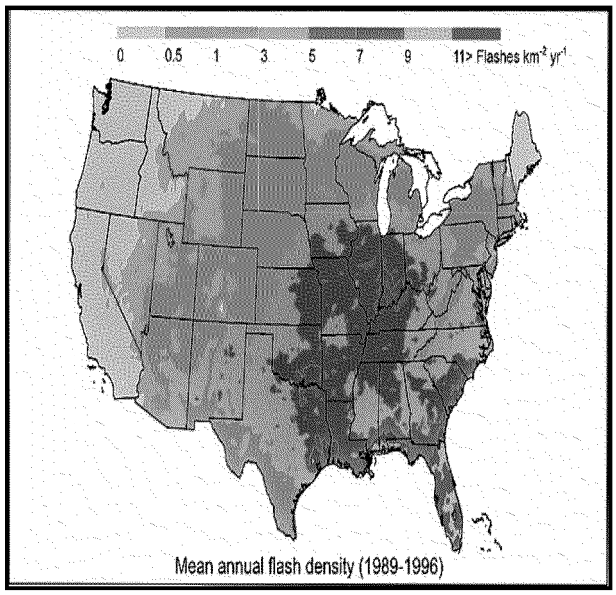

Figure 15: Flash Density (1989-1996)

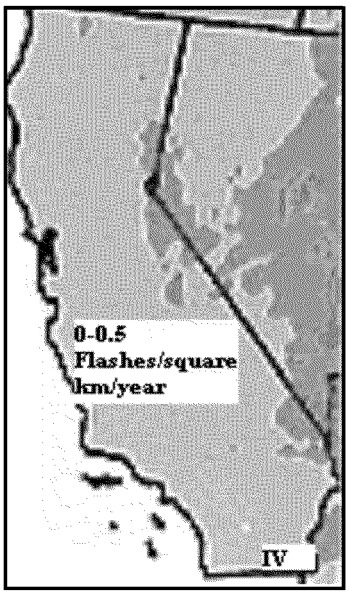

Figure 16: IV Flash Density (1989-1996)

The map shown in Figure 17 was referenced from the Palo Verde Hub to North Gila Lines Report created by APS [Ref 6]. Since this map shows lightning density from 1995-2004, it was also included. As it can be seen from the map shown below, the flash density is 0 - 0.25 flashes/square km/year.

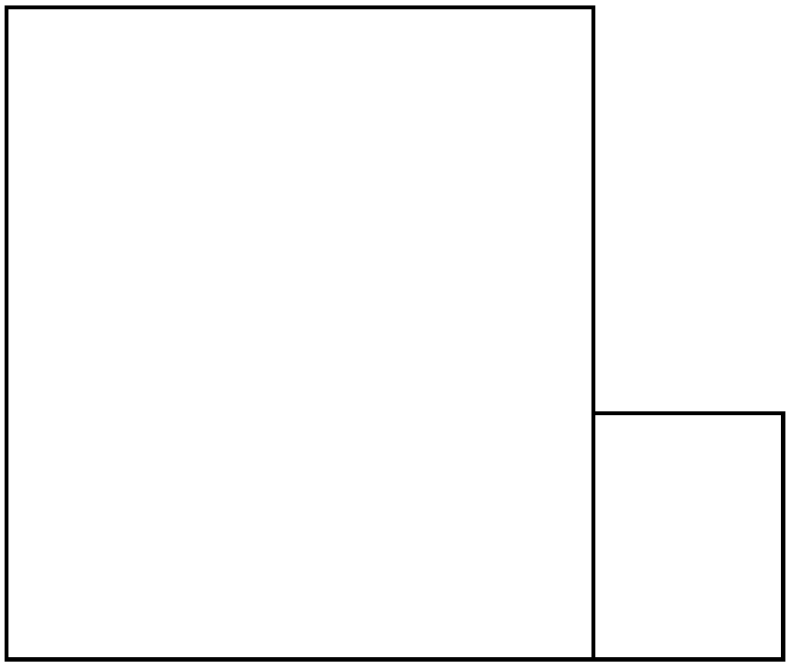

Figure 17: APS Flash Density 1995-2004

The flash density at Imperial Valley in either Figure 7 or 8 is the lowest flash density in comparison to the rest of the United States, making the probability of a lightning strike in the area low.

R5: Risk of an aircraft flying into both lines

There have been flight related incidents that have occurred on the alternative path, making the risk for a double line outage moderate. The alternative path in comparison with the proposed path, tends to directly parallel TL 50001 for 36 miles, which is a greater distance than the proposed path. These flight incidents occurred soon after SWPL was built over 20 years ago and since that time SDG&E has worked to ensure additional incidents do not occur. Aerial marker balls are now present on a portion of the Imperial Valley – Miguel line, which serve as line detectors to warn pilots of the transmission lines. The lines also meet FAA criteria for height regulations.

The first incident happened on the morning of June 14, 1985 when a Border Patrol Pilot failed to gain altitude to clear the power lines, and crashed into the Imperial Valley - Miguel line. This incident took place only a year after the line was put in service. It occurred in Imperial County, 100 yards north of the Southern Pacific Railroad tracks. The second incident that took place occurred on October 24th 1988. This happened on a training flight during a joint drug interdiction mission. The helicopter in route snagged a power line while en route, and exploded into a hillside in western Imperial County. This incident occurred approximately four years after the line was put in service in 1984. Both of these incidents took place within the shared segment of the alternative path route.

Potential Flight Obstacles:

Airport Location: The Imperial County Airport is a small regional airport with feeder service into the Los Angeles International Airport. It is located approximately 4 miles north of downtown El Centro and 94 miles east of San Diego.

Military Airport Location: There is a military airport within Imperial, CA. The Naval Air Facility is 10 miles east of Imperial located in El Centro, CA. All military training is conducted within the confines of restricted airspace within which neither the SWPL or SRPL lie. Otherwise, military flight routes are generally conducted at high altitudes. Military helicopters, however, may fly at lower altitudes and do not adhere to any specific flight route. SDG&E foresees a low probability of an incident occurring because of the aerial marker balls on the line, as well as the historical data indicating that no plane crashes have taken place on the shared right of way in the past 10 years.

En-route: The transmission lines are well below any criteria to be considered as an obstacle to an en-route IFR (Instrument Flight Rules) airway and are not located in any common corridor for visual operation.

Aerial Crop Dusting Application: The corridor is primarily located to the southeast of areas of vegetation. Since the area is surrounded mostly by desert terrain, crop dusting can be eliminated as a risk factor. Also, the lines are within FAA allowable minimum height limits.

Since the area surrounding the shared right of way is unpopulated desert terrain, there are no altitude restrictions for aircrafts, but based on the information listed above, there is enough significant data to conclude that aircraft would not pose a hazard for the shared right of way. The lack of vegetation eliminates the risk of aerial crop dusting. The lines are also marked with aerial marker balls on a portion of the Imperial Valley – Miguel line to help pilots detect the lines, and from the lack of incidents in the past it can be concluded that there is minimal risk of an aircraft flying into both lines in the corridor.

R6: Risk of station related problems resulting in the loss of two lines for a single event

The Imperial Valley 500kV bus is designed to operate as breaker-and-half, in ultimate configuration. Currently, the bus is being operated as a ring bus. When the new 500kV Sunrise Powerlink line is installed the bus will be reconfigured to operate as a combination breaker-and-half and double-breaker-double-bus. This configuration will increase the bus reliability in a stuck breaker contingency and can be seen in Appendix A5. For a single breaker failure to take out both 500 kV lines under either configuration, there would need to be a breaker out for maintenance followed by a breaker failure.

The existing Imperial Valley - Miguel line is protected by three primary-grade, piloted protection systems. The following equipment is used: 1) SEL-421 distance / over-current relays communicating over power line carrier, using three-phase Mode 1 coupling. The power line carrier transmit/receive equipment is RFL-9780; 2) GE L-90 line differential/distance/over-current relays communicating over digital microwave; and 3)

SEL-311L line differential/over-current relays communicating over digital microwave. In addition, transfer trip is provided using RFL-9780 (power line carrier) and RFL-9745 (microwave) teleprotection units.

At this point, SDG&E plans to install a similar protection system for the Imperial Valley - Central 500 kV line as discussed above, with the understanding that communication options are still under discussion. The three protective relays shown above would be applied, and two diverse communication paths will be incorporated, with power line carrier, digital microwave and fiber optic being the communication systems under discussion.

The Miguel substation terminates the Imperial Valley - Miguel line with two 500/230 kV transformers. The Miguel substation is configured as a ring bus. Therefore, a fault on the either Miguel transformer would not cause an outage to the Imperial Valley - Miguel line.

The initial proposed configuration for the Central substation would be similar to the Miguel substation with a ring bus and two 500/230 kV transformers. Again a fault on either Central transformer would not cause an outage of the Imperial Valley - Central line.

R7: Risk of natural disasters (ice, wind, snow or earth slides, flood, etc.) affecting both lines

The climate in the Imperial Valley area is typical of desert conditions, where it is mostly hot and dry (25 percent average relative humidity). Temperatures range from the low mid 30's in January to highs of 110 in July and August. The average low temperature is around 55 degrees and the average high temperature is 89.6 degrees. There are essentially two seasons for the Imperial Valley area, one being summer and the other winter. The transition periods between these two are very short.

The elevation of most of Imperial Valley is near sea level or below. The Salton Sea is the lowest point at 235 feet below sea level. Due to the terrain, and the climate of Imperial Valley being representative of a desert, it is highly unlikely that there would be a risk of hazardous winter related events occurring. There is also very little moisture, with rainfalls bringing in an average of 2.92 inches of rainfall each year. The maximum precipitation occurs in January with an average of 0.51 inches. This amount of rain is not likely to cause flooding in the area.

There have been three tornadoes that have occurred in the past forty one years in Imperial County with the most recent occurring in 1992, and this tornado was a category F0. The other two took place in the years 1965 and 1972. Both of these occurred long before the SWPL was put in service resulted in little or no damage. The one that occurred in 1965 was a category F1 and the one in 1972 was a category F0. According to the Fujita Tornado Damage Scale, an F0 tornado is typically has wind speeds less than 73 mph. An F1 tornado is between 73 to 112 mph and can cause mild to moderate damage. However, both of these are considered to be weak scaled tornados. There was no SWPL outage associated with the F0 tornado in 1992.

Imperial County is the termination point of the San Andreas Fault. The San Andreas Fault runs from San Francisco southeast to the Imperial Valley, where it fragments into a number of small faults. There have not been any reported transmission line failures due to an earthquake in this area. The map shown in Figure 18 recorded all seismic events for 1932-1996. Each red pixel represents an earthquake [Ref 7]. The surface traces, shown as light blue-green lines, are the major faults in the area. The most prominent fault is the San Andreas Fault which runs from the lower right corner to the upper left hand corner.

Figure 18: California Earthquakes for 1932-1996

R8: Risk of loss of two lines due to an overhead crossing

There are no existing or proposed overhead crossings within the shared right of way, making this event unlikely. Pictures of the existing line are shown in Appendix A4.

R9: Risk of loss of two lines due to vandalism/malicious acts

There are no known outages that have occurred due to vandalism or malicious acts on the shared right of way. Shooting of insulators would be a typical vandalism related event, but this has not taken place within the alternative path.

R10: Risk of flashover due to vegetation.

The risk of flashover due to vegetation is moderately high in the alternative path. Segment 1 of the route is mostly dessert terrain with vegetation consisting primarily of cacti and bushes, neither of which grows above five to ten feet in height. The remaining

two segments of the route tend to pass through areas heavily concentrated by chaparral. Chaparral is one of the most fire-prone plant communities in North America.

Fire is an integral part of the life cycle of the chaparral. The low moisture level in summer and dense concentration of shrubs produce conditions ideal for burning. For this reason, the plants are well adapted to survive fire, and many depend on it to reproduce. A typical chaparral plant community consists of densely-growing evergreen scrub oaks and other drought-resistant shrubs.

Land patrols are performed once every three years and aerial patrols are performed twice a year. The frequency of patrols would aid in the prevention of flashovers that could occur due to vegetation. An example of the typical vegetation through the alternative path is shown below.

Figure 19 - Chaparral Example

Tower 50095, as shown above, occurs in Segment 2 of the alternative path. The separation between this tower and the Imperial Valley – Miguel line is approximately 4 miles at this location. In extreme wind and fire situations, it is possible that the fire could spread to both lines causing an outage. Additional pictures of the towers as well as pictures of the surrounding area can be found in Appendix H.

R11: Risk of a single breaker failure causing loss of two lines

As stated before, the Imperial Valley 500 kV substation will initially be reconfigured to a breaker-and-a-half arrangement and a double bus-double breaker arrangement. This arrangement can be seen in Appendix A5. The Imperial Valley substation is designed for a breaker-and-a-half layout and the double bus-double breaker arrangement may ultimately be configured as a breaker-and-a-half. For a single breaker failure to take out both 500 kV lines under either configuration, there would need to be a breaker out for maintenance followed by a breaker failure.

While such an event is possible, it is a very low probability event (see calculations in Step 3 Section of this report: $P_B = 0.0000458$.

A brief summary of all the risk factors is shown below in Table 6. As previously stated, the results of the alternative path, aside from the Robust Line Design factors, are similar to those from the proposed path. The risk factors in comparison to those from the proposed path show that the risk of a double line outage for the alternative path is greater.

	Risk	**Risk Factor**
R1	Fire affecting both lines	High Risk
R2	One tower falling into another line	Low Risk
R3	Conductor from one line being dragged into another line	Moderate Risk
R4	Lightening strikes tripping both lines	Moderate/ High Risk
R5	Aircraft flying into both lines	Moderate Risk
R6	Station related problems resulting in loss of two lines for a single event	Low Risk
R7	Natural disasters	Low Risk
R8	Loss of two lines due to an overhead crossing	Low Risk
R9	Loss of two lines due to vandalism/malicious acts	Low Risk
R10	Flashover to vegetation	High Risk
R11	Single breaker failure causing loss of two lines	Low Risk

Table 6: Alternative Path Risk Factor Summary

The alternative path spans from Towers 50281 to 50059. Shown in Appendix H, are pictures of some of the towers within the alternative path. These pictures demonstrate the terrain as well as tower structures.

In consideration of the risk factors associated with the robust line design criteria for the alternative path, SDG&E requests that the RPEWG determine if the alternative path would also qualify for the performance category upgrade to Category D.