CHAPTER 2 – PURPOSE AND NEED

2.1 Project Purpose

Southern California Edison Company (SCE) proposes to construct a new substation (Viejo Substation) with 220/66 kV and 66/12 kV transformation, four 12 kV distribution lines and one 66 kV subtransmission line (all together forming the proposed Viejo System Project) to improve reliability and meet projected electrical load requirements in the South Orange County area. Minor modifications to two existing 220 kV transmission lines as well as modifications at Chiquita Substation would also be required to complete the Viejo System Project.

Under the Federal Energy Regulatory Commission (FERC), North American Energy Reliability Council (NERC), Western Energy Coordinating Council (WECC), and California Public Utilities Commission (CPUC) rules, guidelines or regulations, electrical transmission systems must have sufficient capacity to maintain safe, reliable, and adequate service to customers. The safety and reliability of the system must be maintained under normal conditions, when all facilities are in service, and also under abnormal conditions resulting from equipment or line failures, maintenance outages or outages that cannot be predicted or controlled due to weather, earthquakes, traffic accidents, and other unforeseeable events.

SCE has a multi-step planning process that ensures that the development of appropriate system facilities is undertaken in time to meet increased electrical load demand. The planning process begins with the development of a peak demand forecast for each substation. Peak demand forecasts are developed using demographic and business condition information. Technical engineering studies are conducted to determine whether the forecast of peak demand can be accommodated on the existing transmission, subtransmission, and distribution systems. System facilities, such as substations and lines, have certain loading limits. When projections indicate that these loading limits will be exceeded within an appropriate planning horizon, a project is proposed to keep the electrical system within specified loading limits.

2.2 Project Need

South Orange County's electrical needs are currently served from SCE's main electrical grid via the 220/66 kV Santiago Substation and connecting transmission, subtransmission and distribution facilities (Santiago System). The Santiago System serves approximately 250,000 metered customers and is bounded by SCE's service territory to the north, the Pacific Ocean to the west, San Diego Gas & Electric Company's (SDG&E) service territory to the south, and the Cleveland National Forest to the east. Several substations (Limestone, Chiquita, and O'Neill) located within the south and southeast region of the Santiago System have become heavily loaded due to rapid growth in recent years. The natural and SCE's service area boundaries limit SCE's ability to shift load from these substations to other SCE facilities. Figure 2-1 – Santiago System, illustrates these boundaries and the existing Santiago System including 220/66 kV and 66/12 kV substations, 220 kV transmission lines, and 66 kV subtransmission lines.

Insert Figure 2-1, Santiago System

Figure 2-1 Santiago System

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Voltage is stepped-down from 220 kV to 66 kV at Santiago Substation by four 280 mega-volt amperes (MVA) transformer banks. Currently, the amount of electrical load that can be served in South Orange County is limited to the maximum amount of electrical power that these four transformers can transmit before they exceed their operating limits. Operating limits are established to insure that facilities are not damaged by overload conditions. The capacity of the existing Santiago System is presently limited to 1,120 MVA under normal operating conditions. The 2002 weather adjusted peak demand[1] of the Santiago System was 1,010 MVA. SCE projects the peak demand to increase by 122 MVA (3.9% annual growth rate) to approximately 1,132 MVA by 2005. This projected electrical demand will exceed the operating limits of the transformers currently serving the Santiago System. Figure 2-2 – Santiago System Capacity and Peak Demand, depicts the existing capacity limits and forecasted demand projections for the Santiago System. The data used to create Figure 2-2 is represented in Table 2-1 – Santiago System - Weather Adjusted Peak Demand.

[1] Demand for electricity varies with temperature. SCE analyzes recorded peak demand and temperature data and adjusts the recorded peak demand to account for variations between the recorded high temperature and that of the rolling ten year average high temperature.

Figure 2-2 Santiago System Capacity and Peak Demand

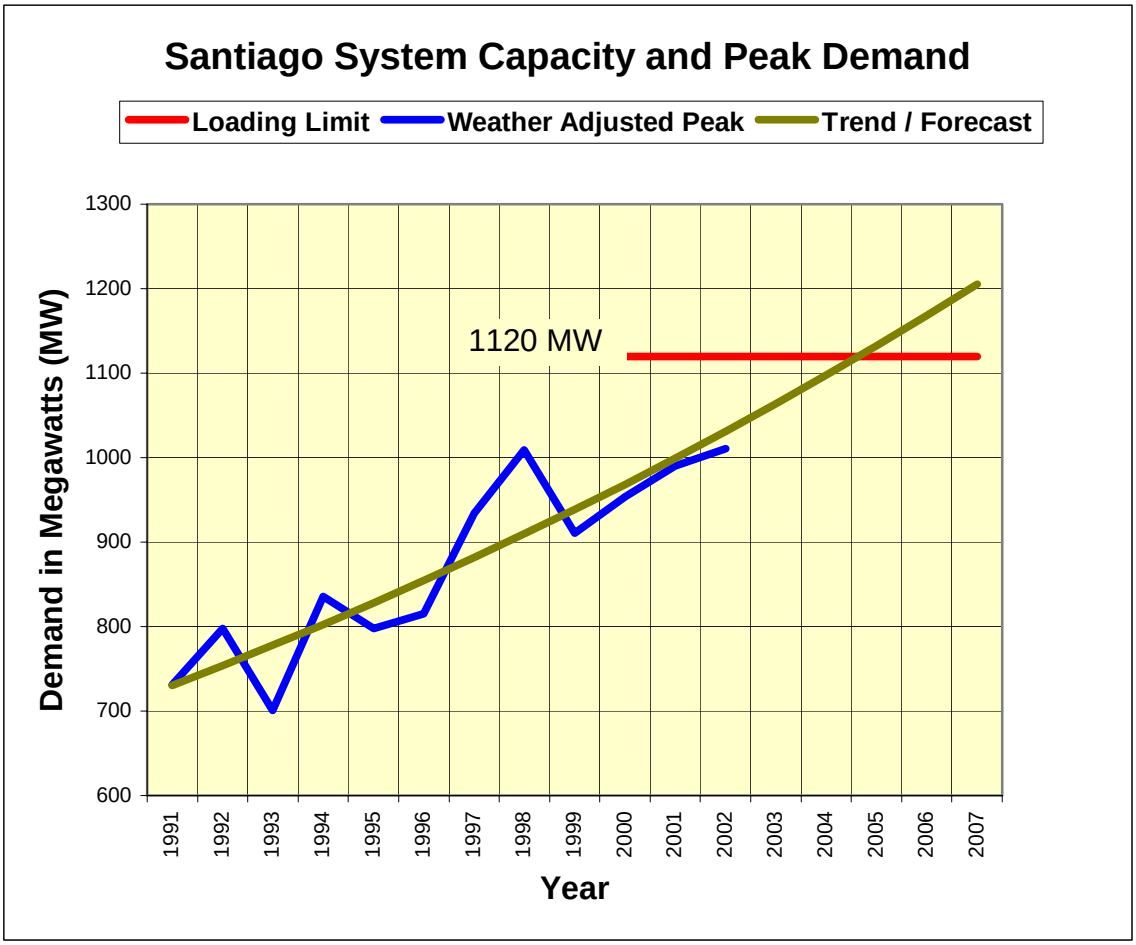

Table 2-1 Santiago System – Weather Adjusted Peak Demand

Santiago System - Weather Adjusted Peak Demand

	Historical								
Year	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Demand (MW)	731	798	701	836	798	815	934	1009	911

	Historical			Forecast				
Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Demand (MW)	954	990	1010	1064	1098	1132	1168	1206

In addition to transformer capacity, the supporting transmission, subtransmission, and distribution facilities must be able to adequately deliver the power under both normal and abnormal conditions. System power flow studies that model projected electrical loads for 2005 also indicate that the following system conditions will exist unless system upgrades are installed:

- Facilities at Limestone Substation will exceed maximum ratings under normal and abnormal operating conditions.
- Three 66 kV subtransmission lines (Santiago-Limestone, Santiago-Limestone-Moulton, and Santiago-Moulton) in the Santiago System will exceed their maximum ratings for normal and abnormal operating conditions.
- Loading on the Barre-Ellis 220 kV transmission line will exceed the conductor rating under certain abnormal conditions.
- Voltage at three 220/66 kV substations (Barre, Ellis, and Santiago) will drop below minimum acceptable levels for certain normal and abnormal conditions.

To address these issues, SCE considered three alternatives:

Alternative 1 - Create the Viejo System

- Option A: Construct Viejo Substation, associated 66 kV subtransmission line (overhead construction), and four 12 kV distribution lines; or
- Option B: Construct Viejo Substation, associated 66 kV subtransmission line (combined overhead and underground construction), and four 12 kV distribution lines; or
- Option C: Construct Viejo Substation, associated 66 kV subtransmission line (underground construction), and four 12 kV distribution lines; or

Alternative 2 - Santiago System Upgrade

Upgrade Santiago Substation, construct necessary overhead 66 kV subtransmission line additions, and perform upgrades to 220 kV transmission system; or

Alternative 3 - No Project Alternative

SCE determined that a “No Project” alternative was not a viable option because it would prevent SCE from providing safe and reliable electrical service to its customers in South Orange County. As a result, no further consideration was given to this alternative.

2.2.1 Alternatives

Alternative 1, Option A – Create Viejo System

Scope: Construct Viejo Substation, associated 66 kV subtransmission line (overhead construction), and four underground 12 kV distribution lines.

Construction of the proposed Viejo System would consist of the proposed 560 MVA Viejo Substation, associated 66 kV subtransmission line, and four underground 12 kV distribution lines. The existing Chino-San Onofre 220 kV transmission line would serve as the source for the Viejo System, thus making the Viejo System independent of the Santiago System (i.e., having a separate 220 kV transmission source of supply). The Viejo System would tie into the Santiago System through the 66 kV subtransmission system and through the 12 kV distribution system, thereby providing the capability to transfer load between systems under both normal and abnormal conditions.

The Viejo System would provide load relief to the Santiago System through the transfer of three existing 66/12 kV substations from the Santiago System to the Viejo System. These substations, Limestone, Chiquita and O'Neill, are located in the south and southeast regions of the existing Santiago System. In 2005, these substations are projected to have a combined peak demand of approximately 390 MVA. Following this transfer, the loading of the existing transformers at Santiago Substation would not exceed operating limits for the foreseeable future. Construction of a new overhead 3.1-mile, 66 kV subtransmission line between the proposed Viejo Substation and the existing Chiquita Substation, within an existing SCE 220 kV corridor[1], would be required to perform this load relief. Without the addition of this new line, the two existing 66 kV subtransmission lines that would connect the proposed Viejo Substation and the Chiquita Substation would exceed the conductor ratings under emergency conditions. Figure 2-3 – Alternative 1, Create Viejo System, depicts the proposed configuration of the Santiago and Viejo Systems.

The Viejo Substation would also provide load relief to the 66/12 kV Limestone Substation which is located in a high load-growth area and has limited options for further expansion. This load transfer would be accomplished with the construction of four new underground 12 kV distribution lines to be energized by the 66/12 kV transformers at the proposed Viejo Substation. This load transfer would keep Limestone Substation within specified loading limits for the foreseeable future and would allow additional electrical demand in the area to be served by 12 kV distribution circuits out of either Limestone or Viejo Substation.

The transfer of approximately 390 MVA of load from the Santiago System to the Viejo System would also relieve the San Onofre-Santiago #1 and #2 220 kV transmission lines. This transfer would defer the need for transmission system upgrades, thereby ensuring that specified loading limits are not exceeded in 2005.

The estimated total cost to construct Alternative 1, Option A is $42,389,000. This estimate includes $37,496,000 for substation, transmission and distribution costs and $4,893,000 for subtransmission costs.

Alternative 1, Option A is SCE's preferred project alternative.

[1] SCE owns a right-of-way that runs adjacent to the proposed Viejo Substation to the existing Chiquita Substation. The right-of-way currently contains two 220 kV transmission lines, the Chino-San Onofre and the San Onofre-Serrano lines, and two 66 kV subtransmission lines, the Chiquita-Limestone-O'Neil and the Chiquita-Limestone-Moulton lines. This right-of-way is referred to as the existing 220 kV corridor throughout this PEA.

Figure 2-3, Alternative 1, Create Viejo System

Figure 2-3 Alternative 1, Create Viejo System

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Alternative 1, Option B – Create Viejo System.

Scope: Construct Viejo Substation, associated 66 kV subtransmission line (combined overhead and underground construction), and four underground 12 kV distribution lines

Alternative 1, Option B contains the same elements as Alternative 1, Option A except the 66 kV subtransmission line would be constructed partially overhead and partially underground. The overhead segment would be approximately 1.1 miles long and would be constructed within the existing 220 kV corridor in a southerly direction from the proposed Viejo Substation towards the existing Chiquita Substation. The remaining 2.5-mile segment of the 66 kV subtransmission line would be constructed underground within city streets. Construction of the underground segment would require trenching through city streets, installing a conduit system and necessary vaults, and pulling cable from Chiquita Substation north towards the overhead segment in the existing 220 kV corridor.

The estimated cost to construct Alternative 1, Option B is $46,228,000. This estimate includes $37,496,000 for substation, transmission and distribution costs and $8,732,000 for subtransmission costs.

Alternative 1, Option C – Create Viejo System.

Scope: Construct Viejo Substation, associated 66 kV subtransmission line (underground construction), and four underground 12 kV distribution lines.

Alternative 1, Option C contains the same elements as Alternative 1, Option A except the 66 kV subtransmission line would be constructed entirely underground within city streets. Construction of the underground line would require approximately 4.4 miles of trenching through city streets, installing a conduit system and necessary vaults, and pulling cable from Chiquita Substation to the proposed Viejo Substation.

The estimated cost to construct Alternative 1, Option C is $49,633,000. This estimate includes $37,496,000 for substation, transmission and distribution costs and $12,137,000 for subtransmission costs.

Alternative 2 – Santiago System Upgrade.

Scope: Upgrade Santiago Substation, construct necessary 66 kV subtransmission line additions, and perform upgrades to 220 kV transmission system.

Santiago Substation is served by four 220 kV lines: the San Onofre-Santiago #1 and #2 lines, the Ellis-Santiago line, and the Johanna-Santiago line. Presently, the Santiago Substation contains four 280 MVA transformer banks serving two bus sections. Figure 2-4 - Existing Santiago System, illustrates the Santiago System as it is currently configured. An upgrade of the Santiago System would require the addition of two 280 MVA transformers, construction of new

overhead 66 kV subtransmission lines to deliver the power, re-conductoring of the Barre-Ellis 220 kV transmission line, and the installation of 220 kV voltage support equipment.

Under abnormal circumstances (e.g., an electrical fault on the system) a tremendous amount of electrical current (i.e., short-circuit duty) passes through equipment until various protective apparatus remedy the condition. Equipment must be designed to withstand this short-duration situation without exceeding its ratings. If the equipment rating is exceeded, damage may result, possibly shortening the lifespan of the equipment and increasing the likelihood of customer outages. To ensure that short-circuit duty limitations are not exceeded, the number of 280 MVA transformer banks that can be installed on a single bus section is limited. To meet SCE's Transmission Planning Criteria and Guidelines, Santiago Substation would need to be reconfigured into three distinct bus sections. Each section would independently serve a portion of the load and each would be comprised of two 280 MVA transformers. These three sections are labeled 'A', 'B', and 'C' on Figure 2-5 – Alternative 2 – Upgrade Santiago System.

Based on evaluations of the existing Santiago System subtransmission line network, the reconfiguration of Santiago Substation would necessitate the construction of approximately 26-circuit miles of new 66 kV subtransmission lines (Figure 2-5 – Alternative 2 – Upgrade Santiago System). These line additions would be required to provide adequate line capacity, under normal and abnormal conditions, to deliver power from the three Santiago Substation bus sections to each of the 66/12 kV substations in the Santiago System.

Alternative 2 would also require transmission system modifications and upgrades. Under certain planning contingencies, such as outages of the San Onofre-Santiago #1 or #2 220 kV transmission lines, the Johanna-Santiago 220 kV transmission line, or the Ellis-Santiago 220 kV transmission line, extensive modifications would be required to alleviate potential line overloads and voltage support problems on the transmission system. The modifications would include re-conductoring the 12.7 mile Barre-Ellis 220 kV transmission line to increase the power it can deliver. In addition, the installation of six 75 megavolt ampere reactive (MVAR) 220 kV capacitors would be required to maintain adequate voltage levels under normal and abnormal conditions. These capacitors would be installed at the Barre, Ellis, and Santiago Substations as the electrical demand in the Santiago System increased.

The estimated cost to construct Alternative 2 is $74,647,000. This includes $59,047,000 for substation, transmission and distribution costs and $15,600,000 for subtransmission costs.

The estimated cost for Alternative 2 is based on order-of-magnitude estimates. Should this alternative be selected, SCE would need to perform a more detailed engineering analysis.

Figure 2-4, Existing Santiago System

Figure 2-4 Existing Santiago System

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Figure 2-5, Alternative 2 – Upgrade Santiago System

Figure 2-5 Alternative 2 – Upgrade Santiago System

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Recommendation

SCE is recommending Alternative 1, Option A (henceforth known as Alternative 1A) as the preferred alternative. Alternative 1A satisfies the project objectives, which are to provide superior reliability and operational flexibility at the lowest cost with no significant impact to the environment.

Each substation has an ultimate capacity, primarily based on property size and configuration. The ultimate planned capacity of Santiago Substation would be reached with the Alternative 2, proposed increase in transformation at Santiago Substation. Although Alternative 2 addresses the immediate need for additional transformer capacity, it does not address the need for increased reliability as no improvement is made to the operational flexibility of the existing Santiago System. Even with Alternative 2 upgrades, if certain abnormal conditions in the Santiago System occur, such as an outage of one of the transformer banks serving the load to the south and southeast, or an outage of the Santiago-Limestone lines, the facilities remaining in-service would not have the capacity to supply the load. The amount of electrical demand in the region and the boundaries surrounding it provide no viable means to transfer the load to another source. Thus, in the future, as demand in the Santiago System once again approached capacity limits, the Viejo System Project would become necessary. Construction of the Viejo System Project requires the construction of significantly fewer miles of 66 kV lines than are required for Alternative 2, thus reducing the cost. Construction of the Viejo System Project also eliminates the near-term need to re-conductor the Barre-Ellis 220 kV transmission line and the need to install 220 kV capacitors for voltage support on the surrounding 220 kV transmission systems. In comparison to Alternative 2, creation of the Viejo System Project improves the reliability of the electrical system serving South Orange County under both normal and abnormal conditions.

Alternatives 1A, 1B and 1C would ensure that the electrical facilities would have the necessary capacity available to meet the projected electrical demand of South Orange County for the foreseeable future. The use of H-Frame structures in Alternative 1A was designed to support construction of the proposed 66 kV subtransmission line and to ultimately provide an available fourth position for the addition of a future circuit. Alternative 1A is preferred over Alternatives 1B and 1C because the underground construction associated with Alternatives 1B and 1C would require the use of all six conduits in the duct bank eliminating the option for the addition of future circuits. The construction of underground 66 kV subtransmission facilities is limited to only six conduits per duct bank to maintain the proper conditions for adequate dissipation of heat resulting from electrical current flow through the cable. An excessive buildup of heat can cause damage to the cable, thus decreasing its useful lifespan and increasing the potential of failure and customer power outages. Two conductors per phase are required for the underground alternatives (Alternatives 1B and 1C) due to the impedance differential when paralleling overhead and underground electrical conductors. This double-run of cable would require the use of all available conduits in the duct bank for the 66 kV underground alternatives, leaving no option for future expansion without the construction of an additional, entirely separate duct bank. This is a significant drawback for Alternatives 1B and 1C in comparison to Alternative 1A. In addition, Alternative 1C would require extensive mitigation measures, in addition to monitoring,

to reduce the potentially significant impacts this alternative would have to cultural resources in comparison with Alternatives 1A and 1B.

Summary

By 2005, electric system upgrades will be required to reliably serve South Orange County's projected electrical demand. The proposed Viejo System Project (i.e. Alternative 1A) is the preferred alternative to improve reliability and to serve future load growth for the following reasons:

- Allows for greater operational flexibility by providing the ability to perform load transfers between the Santiago System and the proposed Viejo System
- The proposed Viejo System Project, Alternative 1A, is the least-cost option considered as shown in Table 2-2 – Estimated Costs for Each Alternative

Table 2-2 Estimated Costs for Each Alternative

	Estimated Costs		
Alternative	**Substation, 220 kV Transmission, and 12 kV Distribution**	**66 kV Subtransmission**	**Total**
Alternative 1, Option A (Viejo System, overhead)	$ 37,496,000	$ 4,893,000	$ 42,389,000
Alternative 1, Option B (Viejo System, overhead/underground)	$ 37,496,000	$ 8,732,000	$ 46,228,000
Alternative 1, Option C (Viejo System, underground)	$ 37,496,000	$ 12,137,000	$ 49,633,000
Alternative 2 (Upgrade Santiago System)	$ 59,047,000	$ 15,600,000	$ 74,647,000