3.1 SUMMARY OF PROPOSED PROJECT

3.1.1 Overview

Segments 2 and 3 of the Antelope Transmission Project consist of the following two primary elements:

- Segment 2 – Antelope to Vincent 500 kV and 220 kV T/L facilities (refer to Figures 3-1 and 3-2)
- Segment 3 – Antelope to Substation One 500 kV T/L; 500/220/66 kV substation (Substation One); Substation One to Substation Two 220 kV T/L; and 220/66 kV substation (Substation Two) (refer to Figures 3-1 and 3-3)

These Segments of the project are part of SCE's MOS to interconnect and integrate several alternative energy projects proposed by independent energy producers to SCE's electrical system. The two segments would interconnect and integrate additional generation from several potential generators north of the Antelope Substation. Interconnection agreements for the potential generation have not been entered into as of September 2005. Refer to Section 2.0 of this PEA for more information regarding the project objectives.

The following sections provide a summary of the major elements of Segments 2 and 3 of the proposed Antelope Transmission Project.

3.1.2 Segment 2: Antelope-Vincent

Segment 2 of the project is needed to enable the interconnection of potential wind generation to the SCE grid. Segment 2 facilities are shown on Figures 3-1 and 3-2. Segment 2 consists of the construction of 21.5 total miles of 500 kV and 220 kV T/L facilities on new R-O-W to be acquired over private land.

The following is a summary of the major elements of Segment 2.

3.1.2.1 T/L Facilities

500 kV T/L Scope. Segment 2 consists of the construction of 21.0 miles of 500 kV T/L facilities and 0.5 mile of 220 kV T/L facilities between the Antelope and Vincent substations. In order to minimize the number of 500 kV crossings, the new T/L route between Antelope and Vincent substations would utilize a portion of the existing Midway-Vincent No. 3 500 kV line described as follows (refer to Figure 3-4A).

A proposed new segment of 500 kV T/L would be constructed from the Antelope Substation to its intersection at MP 14.8 (refer to Figure 3-2) with the existing Midway-Vincent No. 3

500 kV T/L. The portion of the Midway Vincent No. 3 line between MP 14.8 and the Vincent Substation would be cut into the proposed new segment of 500 kV T/L from Antelope to form the Antelope-Vincent 500 kV T/L (refer to Figure 3-4A). The Antelope-Vincent 500 kV T/L would be energized initially at 220 kV. From MP 14.8, a new segment of 500 kV T/L would be constructed to the east of the existing Midway-Vincent No. 3 500 kV T/L to replace the appropriated portion of the Midway-Vincent No. 3 T/L, reinstating its route to the Vincent Substation. At the Vincent Substation, the new Midway-Vincent No. 3 500 kV T/L would be cut-over to restore its connection to the existing 500 kV rack positions (refer to Figure 3-4B).

The new 21.0 miles of T/L would use two-bundled (2B) 2156 kcmil aluminum conductor steel reinforced (ACSR) conductor on tubular steel poles (TSPs) and single-circuit lattice steel towers (LSTs). It is currently estimated that approximately two new TSPs and 106 new 500 kV LSTs would be installed in the new R-O-W as preliminarily depicted on the road story aerials (Appendix I). The TSPs would be 70-feet tall and the single-circuit LSTs would range in height between 113 feet and 188 feet. Most of the tower sites would require minor grading.

66 kV Relocation Scope. To enable construction of the new 500 kV T/L adjacent to the existing R-O-W from the Antelope Substation to approximately MP 4.4, it would be necessary to relocate 4.4 miles of a double-circuit wood 66 kV line 180 feet west of and parallel to its existing location to the westerly edge of the proposed R-O-W. Approximately 96 new 75-foot-tall light-weight, direct-buried steel poles would be utilized for the 66 kV relocation. The 4.4 miles of relocated 66 kV T/L would use 954 kcmil stranded aluminum conductor (SAC).

220 kV Connection to Vincent Substation Scope. To make the initial connection of the new Antelope-Vincent 500 kV T/L to the Vincent Substation 220 kV switchrack, 0.5 mile of 220 kV T/L would be constructed from the existing 500 kV T/L tower outside of the Vincent Substation around the substation to the 220 kV switchrack. This T/L would use 2B 1590 kcmil ACSR conductor on single circuit LSTs. It is currently estimated that approximately 6 new LSTs would be required as preliminarily depicted on Figure 3-4B. The 220 kV single-circuit LSTs would range in height between 70 feet and 115 feet. Most of the tower sites would require minor grading.

Right-of-Way (R-O-W). Segment 2 of the project would require the acquisition of a new R-O-W over private land for the new segment of the Antelope – Vincent 500 kV T/L from the Antelope Substation to MP 14.8. The remainder of the Antelope-Vincent 500 kV T/L would be made up of a portion of the existing Midway-Vincent No. 3 500 kV T/L facilities within existing R-O-W. The replacement for the portion of the existing Midway-Vincent No. 3 T/L that would be cut-over to become the balance of the Antelope-Vincent 500 kV T/L would be built within a new 6.2-mile-long R-O-W to be acquired over private land from the cutover point the rest of the way to the Vincent Substation. Just north of the Vincent Substation, a 2,400-foot-long 220 kV T/L to be constructed within an existing R-O-W would bring the proposed Antelope-Vincent 500 kV T/L to the 220 kV side of the Vincent Substation.

Access and Spur Roads. Where existing R-O-W would be widened, existing access and spur roads would be repaired. Drainage structures would be installed. New spur roads or spur road extensions would be built from existing access roads to the new tower sites.

For new R-O-W not adjacent to existing R-O-W (between MP 8.1 and MP 10.6), access and spur roads would be built in or near the new R-O-W to each tower location.

Pulling and Splicing Locations. It is currently estimated that approximately 44 new pulling locations and approximately 12 new splicing locations would be required as preliminarily depicted on the road story aerials (Appendix I).

3.1.2.2 Substation Facilities

The proposed expansion of the Antelope Substation is part of Segment 1 of the Antelope Transmission Project, which is addressed in a separate CPCN Application and PEA. The proposed expansion of the Antelope Substation, including Segment 2 related modifications is shown on Figure 3-5 filed with the CPUC in December 2004. Proposed Segment 2 related modifications are also shown on Figure 3-5 in this PEA.

At the Antelope Substation, 220 kV Position No. 11 would be fully equipped for the Vincent 500 kV T/L. Three coupling capacitor voltage transformers (CCVTs), two circuit breakers, and two disconnect switches would be installed.

At the Vincent Substation, 220 kV Position No. 3 would be fully equipped for the termination of the new Antelope 500 kV T/L. One line dead-end, three CCVTs, one circuit breaker, and two disconnect switches would be installed. The proposed modifications at the Vincent Substation are shown on Figure 3-6.

3.1.2.3 Information Technology (IT) Facilities

Two telecommunication paths would be provided for redundancy. The primary path would use the existing SCE infrastructure between the Antelope and Vincent substations. The secondary path would be provided by Optical Ground Wire (OPGW), which would be installed on all new T/Ls.

3.1.3 Segment 3: Antelope-Substation One and Substation Two

Segment 3 of the project is needed to enable the interconnection of potential wind generation in the Tehachapi area. Segment 3 is shown on Figures 3-1 and 3-3. Segment 3 consists of the construction of a new 25.6-mile-long 500 kV T/L between the existing Antelope Substation and proposed Substation One. Although this T/L would be designed and built for operation at 500 kV, it would initially be operated at 220 kV. Segment 3 also includes construction of proposed Substation One, a 500/220/66 kV substation and proposed Substation Two, a 220/66 kV substation. A new 9.6-mile-long 220 kV T/L would be installed between Substation One and Substation Two. New R-O-W acquisition would be required for the 35.2 total miles of 500 kV and 220 kV T/Ls.

The following is a summary of the major elements of Segment 3.

3.1.3.1 T/L Facilities – Antelope to Substation One (500 kV)

T/L Scope. From Antelope Substation to approximately MP 1.8, a new 500 kV T/L would be constructed within a new 180 foot wide R-O-W adjacent to the existing Midway-Vincent No. 3 T/L. From approximately MP 1.8 to Substation One, the new 500 kV T/L would be constructed within a new 200-foot-wide R-O-W as shown on the strip maps (Figure 3-3, Sheets 1-6). The construction of proposed Segment 3 would use LSTs to match the existing T/Ls from MP 0.0 to approximately MP 1.8. Single-circuit TSPs would be primarily used between approximately MP 1.8 and MP 18.8. LSTs would be used at angle points between these MPs and where the line parallels the existing LADWP line, as detailed on the tower data sheets submitted with the road story aerials (Appendix I). Because a TSP requires less land at its base than an LST, TSPs are preferred in agricultural areas. TSPs have an additional benefit of lower electric and magnetic field (EMF) for single circuit construction, due to more compact spacing of the conductors. From approximately MP 18.8 to Substation One, LST construction would again be used due to the higher elevation. At elevations over 3,000 feet, SCE is required under CPUC General Order 95 to design structures for ice-loading. This design necessitates taking ice-shedding into consideration. Therefore, SCE is proposing to use horizontal construction (LSTs) above the 3,000-foot elevation for Segment 3.

It is currently estimated that approximately 79 dull galvanized steel 500 kV single-circuit TSPs and 44 dull galvanized 500 kV single-circuit LSTs would be constructed for Segment 3 between the Antelope Substation and Substation One as preliminarily depicted on the road story aerials (Appendix I). The 500 kV single-circuit TSPs would be 135-feet tall, the single-circuit 500 kV LSTs would range in height between 113 feet and 188 feet, and the 220 kV double circuit TSPs would be 70-feet tall.

The new 25.6-mile-long, 500 kV T/L would use 2B-2156 kcmil ACSR conductor.

Right-of-Way (R-O-W). Acquisition of a new R-O-W over private land would be required for the entire 25.6-mile-long 500 kV T/L route.

Access and Spur Roads. New access and spur roads would be built to access the new structure locations.

Pulling and Splicing Locations. It is currently estimated that approximately 36 new pulling locations and 9 new splicing locations would be required as preliminarily depicted on the road story aerials (Appendix I).

3.1.3.2 T/L Facilities – Substation One to Substation Two (220 kV)

220 kV T/L Scope. The new 220 kV line would be constructed on single-circuit LSTs. The 220 kV line would exit Substation One (refer to Figure 3-3) and head west along the south side of Oak Creek Road for 1.3 miles until it reached the Cal Cement-Monolith-Windparks 66 kV line at which point it would turn north, cross Oak Creek Road and enter the windpark area. The new line would parallel the 66 kV line to its termination point at Substation Two as shown on the strip maps (Figure 3-3, Sheets 6 and 7).

The new 9.6-mile-long 220 kV T/L between Substation One and Substation Two would use 2B-1590 kcmil ACSR conductor on approximately 57 new 220 kV LSTs. Road story aerials for the proposed Substation One to Substation Two 220 kV T/L will be submitted to the CPUC at a later date, along with a spreadsheet indicating approximate tower locations, heights, and pulling and splicing locations.

Right-of-Way (R-O-W). Acquisition of a new, 160-foot-wide R-O-W over private land would be required for the entire 9.6-mile-long 220 kV T/L.

Access and Spur Roads. Where existing R-O-W would be widened, existing access and spur roads would be repaired. Drainage structures would be installed. New spur roads or spur road extensions would be built from existing access roads to the new tower sites.

Pulling and Splicing Locations. It is currently estimated that approximately 13 new pulling locations and 6 new splicing locations would be required. Road story aerials for the proposed Substation One to Substation Two 220 kV T/L will be submitted to the CPUC at a later date, along with a spreadsheet indicating approximate tower locations, heights, and pulling and splicing locations.

3.1.3.3 Substation Facilities

Antelope Substation. The 220 kV Antelope switchrack Position No. 6 (refer to Figure 3-5) would be upgraded to a 3000 ampere (A) rating by replacing tie-downs, conductors, and disconnects. New protective relaying equipment would be installed for the new line.

Substation One (Near Cal Cement). Proposed Substation One would be constructed on a 2,200- by 1,550-foot 500/220/66 kV substation site to be acquired by SCE (refer to Figure 3-7). Because SCE currently does not know the magnitude of the potential wind generation, the timing of such generation, or its location, SCE currently plans to equip a 400-foot by 200-foot area of the substation with a four-position bus structure, three line dead-end structures, and four 220 kV disconnect switches. Additional equipment would be installed as necessary, as generation projects apply for interconnection and sign interconnection facilities agreements.

Substation Two (Near Monolith). Proposed Substation Two would be constructed on a 1,250- by 950-foot 220/66 kV substation site to be acquired by SCE (refer to Figure 3-8). Because SCE currently does not know the magnitude of the potential wind generation, the timing of such generation, or its location, SCE currently plans to equip a 450-foot by 150-foot area of the substation with a two line dead-end structure, one 220 kV circuit breaker, four 220 kV disconnect switches, three CCVTs, a new Mechanical Electrical Equipment Room (MEER), and new protective relaying equipment. Additional equipment would be installed as necessary, as generation projects apply for interconnection and sign interconnection facilities agreements.

3.1.3.4 Information Technology (IT) Facilities

Two telecommunication paths would be provided for redundancy. The primary path would use existing SCE infrastructure to the Antelope Substation and new microwave paths between the Antelope Substation and the Oak Peak Communication Site, Oak Peak Communication Site and new Substation One, and Oak Peak Communication Site and new Substation Two. The secondary path would be provided by OPGW, which would be installed on all of the new T/Ls. Refer to Figure 3-1 for the location of the existing Oak Peak Communication Site, which would be modified as part of this project.

3.2 T/L FACILITIES – SEGMENT 2 (ANTELOPE-VINCENT)

3.2.1 T/L Engineering Plan

3.2.1.1 Routing

Antelope to Vincent. The proposed new Antelope-Vincent 500 kV line would exit the Antelope Substation on 220 kV tubular steel poles by crossing under the existing Midway-Vincent No. 3 500 kV T/L (refer to Figure 3-9). The line would be built within a new 14.8-mile-long R-O-W between 180- and 200-feet wide. At MP 14.8, the line would be cut-over (refer to Figures 3-4 and 3-4A) to the existing Midway-Vincent No. 3 within the existing Midway-Vincent No. 3 500 kV R-O-W for the remaining 6.7 miles to the existing Vincent Substation.

The proposed initial 8.1 miles would leave the Antelope Substation parallel to the west side of the existing 220 kV and 500 kV R-O-W. At MP 8.1, the proposed T/L would turn south then west away from the existing R-O-W into a new 200-foot-wide R-O-W. The proposed T/L route would turn southwest at MP 9.2, and then southeast at MP 10.6 into a new 180-foot-wide R-O-W adjacent to the existing Midway-Vincent No.1 500 kV R-O-W. The T/L would parallel this line until MP 14.8. At this location, the proposed T/L would intersect the existing Midway-Vincent No. 3 500 kV T/L. The proposed T/L would be cutover to use the Midway-Vincent No. 3 500 kV T/L the remaining 6.2 miles into the north side of the Vincent Substation. At Vincent Substation, a 2,400-foot-long 220 kV T/L would be constructed to the end of the former Midway-Vincent No. 3 T/L and connect it to the 220 kV rack at Vincent Substation, thus completing the 220 kV connection to the Antelope Substation.

With the remainder of the original Midway-Vincent No. 3 R-O-W now occupied by the proposed Antelope-Vincent T/L, the replacement for the existing Midway-Vincent No. 3 500 kV T/L would cross over the existing 220 kV T/Ls and continue to the south side of the Vincent Substation within a new 6.7-mile-long, 180-foot-wide R-O-W, on the east side of the existing 220 kV and 500 kV R-O-Ws. At MP 19.5, the new Midway-Vincent No. 3 500 kV T/L would cross over the Los Angeles Department of Water and Power (LADWP) Adelanto-Rinaldi 500 kV T/L, the Victorville-Rinaldi 500 kV T/Ls, and the Sagebrush 220 kV T/L (refer to Figure 3-9).

At MP 20.3, the new Midway-Vincent No. 3 T/L segment would cross over the existing Antelope-Mesa and Antelope-Vincent 220 kV T/Ls to realign with the existing 500 kV R-O-Ws. The proposed new Midway-Vincent 500 kV T/L segment would cross Highway 14 at MP 20.5 and would cross over the existing 220 kV R-O-W at MP 20.9. The proposed new Midway-Vincent 500 kV T/L segment would end at MP 21.5 where it would connect to the existing 500 kV rack at the Vincent Substation, reinstating the 500 kV connection to the Midway Substation.

3.2.1.2 Structures

It is currently anticipated that the Segment 2 would utilize a combination of 500 kV and 220 kV structures, as follows:

- 500 kV structures (line construction):
    - Four-legged single-circuit LSTs (refer to Figure 3-10)
- 220 kV structures (for exit/entry into substations):
    - Four-legged single-circuit LSTs (refer to Figure 3-11)

- Double-circuit tubular steel TSPs (refer to Figure 3-12)

It is currently estimated that approximately 106 single-circuit 500 kV LSTs would be constructed of dull galvanized lattice steel angle members connected by steel bolts. The single-circuit 500 kV LSTs would range in heights between 113 feet and 188 feet. The single-circuit 220 kV LSTs would range in heights between 70 feet and 80 feet. The double-circuit tubular steel TSPs would be constructed of dull galvanized steel and would be approximately 70 feet tall.

Each four-legged lattice steel tower would be built on four drilled pier concrete footings. Each tubular steel pole would be built on one drilled pier concrete footing. The dimensions of each footing are dependent on variables such as topography, tower height, span lengths and soil properties. On average, a typical footing would have an aboveground projection of about 3 feet.

3.2.1.3 Conductor

The proposed Segment 2 500 kV T/L would be strung with 2B-2156 kcmil ACSR with nonspecular finish. Approximately 767,000 feet of conductor would be strung. The proposed Segment 2 220 kV T/L would be strung with 2B-1590 KCMIL ACSR with nonspecular finish.

3.2.1.4 Insulators

The tangent and angle 500 kV insulator assemblies would consist of two strings of insulators in the form of a “V”. Each leg of the “V” assembly would contain one or two one-piece gray polymer insulators, depending on the load. On dead-end structures, the insulators would be arranged in a “barrel” configuration consisting of four polymer insulators.

3.2.1.5 Overhead Ground Wires

The overhead ground wires would be located on the peaks of the transmission structures. The 500 kV structures would have two overhead ground wires, one approximately 0.5 inch in diameter. The other ground wire would contain optical fibers for communications and line protection and would be approximately 11/16 inch in diameter.

3.2.1.6 Tower Site Preparation

It is currently estimated that approximately 106 new 500 kV LSTs and 6 new 220 kV LSTs would be constructed for Segment 2. Where vegetation exists, tower sites approximately 50 feet by 50 feet would be cleared and grubbed, and where necessary, graded such that water would run toward the direction of the natural drainage. Each tower site would be graded in such a way that no ponding would occur and no erosive water flow would cause damage to the tower footings. The graded area would be compacted to at least 90 percent relative density, and would be capable of supporting heavy vehicular traffic.

3.2.1.7 Access Roads and Spur Roads

T/L roads would be classified into two groups – access roads and spur roads. Access roads are through roads that run between tower sites and form the main transport route along the major extent of the T/L. Spur roads are roads that lead from the access road and dead-end into one or more tower sites. Since most of Segment 2 would be built adjacent to existing R-O-Ws where access and spur roads already exist, it is assumed that some of the access roads as well as spur roads would be usable. Some tower sites may require new access road extensions. Others may require new spur roads from existing access roads to new tower sites. Short spur road extensions may be required on others, depending on how the new transmission towers are located in relation to the existing roads. New access and spur roads to the portion of the line between MP 8.1 and 10.6 would need to be established. Refer to Figures 3-13 through 3-17 for typical road cross sections.

In addition, the following items of work may be necessary:

- Re-grading and repair of existing access and spur roads. These roads would be cleared of vegetation, blade-graded to remove potholes, ruts, and other surface irregularities, and re-compacted to provide a smooth and dense riding surface capable of supporting heavy construction equipment. The graded road would have a minimum drivable width of 12 feet (preferably with 2 feet of shoulder on either side).
- Drainage structures such as wet crossings, water bars and overside drains, and pipe culverts would be installed to allow for construction traffic usage, as well as prevent road damage due to uncontrolled water flow. Refer to Figures 3-18 through 3-23 for typical erosion and drainage control structures.
- Slides, washouts, and other slope failures would be repaired and stabilized by installing retaining walls or other means necessary to prevent future failures. The type of structure to be used would be based on specific site conditions. Refer to Figure 3-24 for a typical mechanically stabilized earth retaining structure.

3.2.1.8 Pulling and Splicing Locations

It is currently estimated that approximately 44 new pulling locations and 12 new splicing locations would be required as preliminarily depicted on the road story aerials (Appendix I). These setup locations require some reasonably level areas for maneuvering equipment. Similar to the tower site locations, these setup locations would most likely be located on existing level areas and existing roads and, therefore, would only require minimal grading and cleanup.

3.2.2 T/L Construction Plan

3.2.2.1 Introduction

SCE would determine and consider the factors that have the potential to affect the construction methods for each part of the proposed project. Factors that have the potential to affect hours of operation, method of construction, mitigations necessary to address environmental and safety issues, and other factors that may directly impact construction planning would be considered.

All work would be performed with conventional construction techniques in accordance with an SCE construction specification, CPUC General Order 95 (GO-95), IEEE, American Concrete Institute (ACI), and other industry-specific standards. As part of the SCE specification requirements, crews would be constrained to work within the stipulations of governing documents for compliance with regional environmental, storm water pollution prevention, and fire prevention criteria.

Environmental protection procedures would be incorporated as part of SCE general work practices. These procedures include making every effort to utilize existing roads, spur roads, and previously used construction set-up areas for the erection of cranes, placement of foundations, erection of steel, and placement of stringing equipment along the R-O-W. All SCE and contractor field personnel would be required to attend Worker Environmental Awareness Protection (WEAP) training.

In addition, all work conducted by SCE personnel and contractors would be carried out in accordance with all applicant and CPUC proposed mitigation measures. SCE's proposed mitigation measures are discussed further in Section 5.0.

3.2.2.2 Scope of Construction

3.2.2.2.1 Segment 2 Scope. Between the existing Antelope and Vincent substations, crews would construct 21.0 miles of new single-circuit 500 kV T/L facilities using single-circuit LSTs. Crews would also construct 0.5 mile of new single-circuit 220 kV line from the last existing 500 kV tower outside of the Vincent Substation to connect the new Antelope-Vincent 500 kV line to the 220 kV switchrack. In addition approximately 4.4 miles of double-circuit wood-pole 66 kV line would be relocated onto lightweight TSPs, 180 feet to the northwest of its existing position. Segment 2 would be constructed across hilly terrain. Details of new construction work including access to each location, waste disposal and recycling, foundation installation, tower assembly and erection, wire stringing, restoration methods, and type of equipment used are discussed in the following sections. All work would be completed using conventional construction techniques for access roads, foundations, tower erection, and conductor installations.

3.2.2.3 Construction Activities

Construction activities would include establishment of marshalling yards for staging of material and equipment, and completion of any roadwork. Following this, or in parallel, installation of foundations, steel, guard poles, conductor, then cleanup and demobilization would occur. The exact construction method employed and the sequence with which construction tasks are completed would be dependent upon final engineering, contract award, conditions of permits, and contractor preference.

3.2.2.3.1 Primary Marshalling Yard. It is anticipated that the primary marshalling yard for Segments 2 and 3 would be the same marshalling yard established for Segment 1 in the 500 kV expansion area at the Antelope Substation. This yard location has been selected based on its central location, and proximity to good access roads. Additionally, proximity to existing phone and power infrastructure has been considered in the selection of this area. An area up to approximately 5 acres in size would be required. Materials and equipment that would be staged at this yard include, but are not limited to, steel bundles, spur angles, palletized bolts, rebar, wire reels, insulators and hardware, heavy equipment, light trucks, construction trailers, and portable sanitation facilities. In addition to the materials and equipment already detailed for new construction, the following may be routed through this yard: removed conductor, removed steel, removed concrete, and other debris associated with the removal process. Additional equipment and trash and recycle bins may be staged to this yard. Preparation of the yard would include the application of road base, installation of perimeter fencing, and implementation of Storm Water Pollution Prevention Plan (SWPPP) conditions.

3.2.2.3.2 Secondary Marshalling Yards. Secondary marshalling yards would be established for short-term utilization near the construction sites. Where possible, suitable sites along the construction corridors would be selected where previously disturbed property, abandoned excavations, operational industrial yards, or abandoned parking areas exist. Final siting of these yards would depend upon availability of appropriately zoned property in this area that is suitable for this purpose. The number and size of the secondary marshalling yards would be dependent upon a detailed R-O-W inspection and would take into account, where practical, suggestions by the successful bidder for the work. Typically, an area approximately 200 feet by 200 feet (approximately 0.9 acre) would be required. Materials and equipment to be staged in secondary marshalling yards would be similar to that described previously for the primary yard. Since the secondary yards have not been identified yet, biological and cultural resource studies may not have been conducted, but would be performed prior to site selection.

3.2.2.3.3 Roadwork. Grading preparation would be required to provide access for heavy equipment for all aspects of construction. Every effort would be made to utilize previously disturbed areas including existing R-O-W and patrol roads in order to minimize land disturbances. If new roads are necessary, erosion control measures would be enforced in accordance with SWPPP, and existing SCE specifications.

In mountainous areas, benching may be required to provide access for footing construction, assembly, erection, and wire stringing activities during line construction. Benching, a technique where a tracked earth mover vehicle excavates a terraced access to LST excavations in extremely steep rugged terrain, would be used minimally and for the principal purpose of helping to ensure personnel safety during construction and, secondarily, to control costs in situations where potentially hazardous, manual excavations would be required. Road building and upkeep would be an ongoing process during the entire construction process on all elements of the work.

Details of roadwork are described below.

Roadwork Related to New T/L Activities. For spur roads to new LST locations, grading would be employed in order to establish both temporary and new spur roads to as many new LST locations as possible for new line construction.

Grading would be employed in order to establish temporary new spur roads to pulling and stringing locations along the R-O-W. The number of locations required would be dependent upon final engineering, topographical considerations, and availability of suitable terrain that would be appropriate for stringing set-up.

Access Roads to Splice Locations. In some circumstances, it might be necessary to construct an access road to a splice location. These locations would be used to remove temporary pulling splices and install permanent splices once the conductor is strung through the stringing travelers located on each LST. This may be required, as the permanent splices joining conductor together cannot pass through stringing travelers.

3.2.2.3.4 Foundations. Footing work would be completed using standard "poured-in-place" augered excavation techniques. At the time of construction, elevations would be established, rebar cages set, spur angles and concrete placed, and survey positioning would be verified. Concrete samples would be drawn at time of pour and tested to ensure engineered strengths were achieved. Typically, on regular terrain, under ideal circumstances, a single footing crew could be expected to excavate, place steel cages and stub angles, and pour in place concrete for one complete LST every two days. A foundation set for each LST would include four footings. A normally specified SCE concrete mix typically takes approximately 30 calendar days to cure to an engineered strength. This strength is verified by controlled testing of sampled concrete. Once this strength has been achieved, crews would be permitted to commence erection of steel.

Conventional construction techniques would generally be used as described above for new footing installation. In certain cases, equipment and material may be deposited at the LST site using helicopters or by workers on foot, and crews may prepare the footings using hand labor assisted by hydraulic or pneumatic equipment, or other methods.

3.2.2.3.5 Steel. Steel work would consist of hauling and stacking bundles of steel at each LST location per engineering drawing requirements. This activity would require several tractors with 40-foot floats and an on-site loader. Follow-up activities include the assembly of leg extensions, body panels, boxed sections and the bridges. The steel work would be completed by a combined erection and torqueing crew with a lattice boom crane. Ground disturbance would be kept to a minimum to the extent practical. The construction crew may opt to install insulators and wire rollers (travelers) at this time. Depending on the accessibility solution for tower erection site access, helicopter erection may be required. Erection of this sort would be in accordance with SCE specifications and be similar to methods detailed in IEEE 951-1996, Guide to the Assembly and Erection of Metal Transmission Structures, Section 8.6, Helicopter Methods of Construction.

3.2.2.3.6 Guard Structures. Guard poles or guard structures may be installed at all transportation, flood control and utility crossings. Guard structures may also be installed at other locations such as parks or near residences. These are temporary facilities and are removed after conductors are installed. If required, temporary netting (see Figure 3-25) would be installed to protect some types of under-built infrastructure. In some cases, guard structures can be specially equipped boom type trucks with heavy outriggers. Typical guard structures (see Figures 3-26 and 3-27) are standard wood poles, 60-feet to 80-feet tall, arranged in such a manner as to arrest the travel of conductor should it momentarily drop below a conventional stringing height.

For highway and open channel aqueduct crossings, SCE would work closely with the applicable jurisdiction to secure the necessary permits to string conductor across the applicable infrastructure. Agencies differ on guard structure policy and method of public protection preferred.

For major roadway crossings, typically one of four methods is employed to protect the public:

- Erection of a highway net guard structure system

- Detour of all traffic off of the highway at the crossing position
- Implementation of a controlled continuous traffic break while stringing operations are performed
- Establishment of special line trucks with extension booms onto the highway deck at strategic positions

3.2.2.3.7 Wire Installation. Wire stringing includes all activities associated with the installation of conductors onto the LSTs and TSPs. This activity includes the installation of primary conductor and ground wire, vibration dampeners, weights, spacers, and suspension and dead-end hardware assemblies. Insulators and stringing sheaves (rollers or travelers) are attached as part of the wire stringing activity if the work is a part of a reconductor effort, otherwise they are attached typically during the steel erection process. A standard wire stringing plan includes a sequenced program of events starting with determination of wire pulls and wire pull equipment set-up positions. Advanced planning by supervision determines circuit outages, pulling times, and safety protocols needed for ensuring that safe and quick installation of wire is accomplished.

Typically, wire pulls occur every 15,000 feet on flat terrain and every 9,000 feet in mountainous terrain. Wire splices typically occur every 4,500 feet. “Wire pulls” are the length of any given continuous wire installation process between two selected points along the line. Wire pulls are selected, where possible, based on availability of dead-end LSTs at the ends of each pull, geometry of the line as affected by points of inflection, terrain, and suitability of stringing and splicing equipment set ups. In some cases, it may be preferable to select an equipment set up position between two suspension towers in which case anchor rods or dead men would be installed against which wire could be hard dead-ended for sagging purposes and also provide for convenient splicing capability. The dimensions of the area needed for stringing set ups varies depending upon the terrain, however, a typical stringing set up is 200 feet by 400 feet (approximately 1.8 acres each). Where necessary due to suitable space limitations, crews can work from within a substantially smaller area.

Special equipment is positioned at each end of the wire pull. On one side, a puller is positioned and on the other side a tensioner and wire reel stand truck is positioned. Supplemental specialized support equipment such as skidders and wire crimping equipment is strategically positioned to support the operation. Crews ensure all safety devices such as traveling grounds, guard structures, and radio-equipped public safety roving vehicles and lineman are in place to protect the public and workers. Once positioned, a helicopter flies a lightweight sock line from LST to LST, carefully slipping the sock line through the stringing sheaves thus engaging a cam-lock device that secures the pulling sock in the sheave. The threading process is continued between all LSTs through the rollers for the particular set of spans selected for a conductor pull. The sock line is then used to pull in the conductor pulling cable. The conductor-pulling cable is then attached to the conductor using a special swivel joint to prevent the wire from being damaged and allow it to rotate freely thus preventing complications from twisting as the conductor unwinds off of the reel. A special piece of hardware called an alligator is also installed to help the conductor feed into the stringing sheave properly. Pulling, sagging and clipping-in (attaching) or permanent dead-ending of the conductors is then completed. The final activity is then to attach spacers between the bundled conductors of each phase. To do this, typically a lineman rides a small spacer cart between the wires and stops periodically to attach the spacers. Stringing equipment from one end of the pull is then rotated 180 degrees to face the new pull direction and the equipment from the other end of the pull is then "leapfrogged" to its new pulling position and the process is repeated. A similar process is employed for the ground wire. All activities related to conductor installation are heavy equipment intensive. Wire stringing would be in accordance with SCE specifications and similar to process methods detailed in IEEE Standard 524-1992, Guide to the Installation of Overhead T/L Conductors.

3.2.2.3.8 Earth-Disturbing Activities. Earth-disturbing activities would occur along new access and spur roads, and at each foundation installation site. During grading and/or excavation activities, placement of rebar cages, stub angle steel, and placement of concrete, soil and vegetation may be disturbed by both multiaxle auger trucks, multiaxle concrete trucks, and pedestrian activity. In some circumstances, benching of small areas around the tower footing sites may be required. Typically, the ground would be augered to create a hole, rebar cages would be placed, stub angle steel would be placed, and concrete would be poured. In exceptionally rugged terrain, footing excavations may be performed entirely by hand using hand-operated power tools.

Assembly and erection of new LSTs may require that a crane pad approximately 50 feet by 50 feet (approximately 0.06 acre each) be built to allow an erection crane to set up 60 feet from the centerline of each LST. The crane pad would be located transversely from each applicable LST location.

Excavations may be required at each conductor pulling location in order to safely string conductor. A pulling site excavation would be excavated at each pulling site as determined by final engineering and the successful bidder. Pulling locations are also subject to line angle changes of significant magnitude. Pulling excavations would be located in line with the overhead conductors, at a distance approximately three times further back from the center of the LST than the LST height.

3.3 SUBSTATION FACILITIES – SEGMENT 2 (ANTELOPE-VINCENT)

3.3.1 Substation Engineering Plan

3.3.1.1 Antelope Substation

Segment 2 of the Project requires that Antelope Substation Position No. 11, which would be installed during Segment 1 of the Project, be equipped to terminate the Vincent No. 2 500 kV T/L. The proposed modifications to the Antelope Substation are shown on Figure 3-5 (note: the proposed expansion of the Antelope Substation is addressed in the separate CPCN Application and PEA submitted to the CPUC for Segment 1).

In summary, the following work would be required at the Antelope Substation.

3.3.1.1.1 220 kV Switchyard. The following equipment would be installed at existing 220 kV Line Position 11:

- Three 60-foot tie-downs with 2B-1590 kcmil conductors per phase each
- Three 220 kV capacitor voltage transformers
- Two 220 kV 3000A 40 kA circuit breakers and foundations
- Four 220 kV group operated, horizontally mounted disconnect switches with support structures and foundations, one equipped with grounding attachments
- Three 200-foot segments of 2B-1590 kcmil conductors; total: 600 feet

3.3.1.1.2 Mechanical Electrical Equipment Room (MEER). The scope of work in the MEER, which was proposed as part of Segment 1, would include installation of all required protective relays for the new Vincent No. 2 T/L on Line Position No. 11.

3.3.1.1.3 Substation Lighting. The proposed modifications to the Antelope Substation would not require any additional lighting.

3.3.1.2 Vincent Substation

Vincent Substation is an existing 500/220 kV substation owned, operated, and maintained by SCE. Segment 2 of the project requires that the existing 220 kV Position No. 3 at the Vincent Substation be equipped to terminate the Antelope No. 2 220 kV T/L (refer to Figure 3-6).

In summary, the following work is required at Vincent Substation.

3.3.1.2.1 220 kV Switchyard. The following equipment would be installed at existing 220 kV Line Position No. 3:

- One 60-foot-high by 45-foot-wide line dead-end structure and foundations
- Three 60-foot tie-downs with 2B-1590 kcmil conductors per phase each
- Three 220 kV capacitor voltage transformers
- One 220 kV 3000A 40 kA circuit breakers and foundations
- Two 220 kV group operated, horizontally mounted disconnect switches with support structures and foundations; one equipped with grounding attachments
- Three 100-foot segments of 2B-1590 kcmil conductors; total: 600 feet

Fifteen existing 220 kV bus supports and corresponding steel pedestals and foundations would be removed.

3.3.1.2.2 Existing Control Room. The existing Control Room scope of work would include installation of all required protective relays for the new Antelope 500 kV T/L in 220 kV Line Position No. 3.

The aforementioned summary of needed substation work associated with Segment 2 assumes the following:

- No capacitor banks are required at the Antelope Substation
- No capacitor banks are required at the Vincent Substation
- There is adequate space for all new relays in the existing Control Room at the Vincent Substation

3.3.1.2.3 Substation Lighting. The proposed modifications to the Vincent Substation would not require any additional lighting.

3.3.2 Substation Construction Plan

3.3.2.1 Antelope Substation

3.3.2.1.1 Substation Construction. The construction efforts would occur in accordance with accepted construction industry standards.

Work would generally be scheduled in daylight hours, Monday through Friday. Extended hours or days may be required in order to meet schedule requirements. In the event that construction needs to occur outside of the specified hours, a variance would need to be obtained.

All materials for the proposed substation would be delivered by truck to the site. Material would be staged in the 500 kV expansion area during construction. Truck traffic would use major streets and would be scheduled for off-peak traffic hours.

3.3.2.1.2 <u>Post-Construction Cleanup</u>. All construction debris associated with the construction effort would be placed in appropriate onsite containers and periodically disposed of according to all applicable regulations during construction of the proposed substation and modifications.

3.3.2.2 <u>Vincent Substation</u>

3.3.2.2.1 <u>Substation Construction</u>. The construction efforts would occur in accordance with accepted construction industry standards.

Work would generally be scheduled in daylight hours, Monday through Friday. Extended hours or days may be required in order to meet schedule requirements. In the event that construction needs to occur outside of the specified hours, a variance would need to be obtained.

All materials for the proposed substation would be delivered by truck to the site. Material would be staged along the east perimeter fence during construction. Truck traffic would use major streets and would be scheduled for off-peak traffic hours.

3.3.2.2.2 <u>Post-Construction Cleanup</u>. All construction debris associated with the construction effort would be placed in appropriate onsite containers and periodically disposed of according to all applicable regulations during construction of the proposed substation.

3.4 INFORMATION TECHNOLOGY (IT) FACILITIES – SEGMENT 2 (ANTELOPE-VINCENT)

3.4.1 Overview

SCE is proposing to install telecommunication infrastructure to operate the existing substations and protect the new T/L facilities from electrical interruptions. Types of circuits would include fault protection, Supervisory Control and Data Acquisition (SCADA), telephone, and, if necessary, Remedial Action Scheme (RAS).

3.4.2 Telecommunication Systems

Two telecommunication paths would be provided for redundancy. The primary path would use existing SCE infrastructure between the Antelope and Vincent substations. The secondary path would be provided by OPGW, which would be installed on the new T/Ls between Antelope and Vincent.

3.4.3 OPGW Installation

OPGW would be installed as part of the new T/Ls. Within the substations, fiber optic cable in underground conduit would be constructed to extend the OPGW fibers to the communication room. At the cut-over near MP 14.8 on Segment 2, fiber optic cable in underground conduit would be constructed between the two new T/L sections in order to maintain continuity of the OPGW fibers (refer to Figure 3-4A). Trenching and grading would be required to bury the underground conduit at this location. At all other locations, no new roads, grading, or laydown areas other than those necessary for T/L and substation construction would be required.

3.4.4 Operation and Maintenance

There would be no change in the operational work force for existing sites. All telecommunications equipment would be operated and maintained by SCE technicians. Preventative maintenance is typically scheduled every 6 months in order to ensure system reliability and performance.

3.5 T/L FACILITIES – SEGMENT 3 (ANTELOPE-SUBSTATION ONE 500 kV LINE)

3.5.1 T/L Engineering Plan

3.5.1.1 Routing

Antelope to Tehachapi Area. The proposed Antelope-Substation One 500 kV T/L route leaves the Antelope Substation on TSPs and crosses the existing Antelope-Magunden 220 kV T/L and the Midway-Vincent No. 3 500 kV T/L. The proposed line would parallel the southwest side of the Midway-Vincent T/L and, at MP 1.3, cross over it as well as the Antelope-Magunden 220 kV T/L No. 1 and No. 2 and the private Sagebrush 220 kV T/L. The line would route around the planned community of Del Sur Ranch, north of the Antelope Substation, and would eventually align itself on the west side of 105th Street at MP 1.8. At MP 9.1, the proposed route turns north-northwest for about 0.5 mile then turns back due north to align itself on the west side of 107th Street. The line crosses from Los Angeles County into Kern County at MP 9.6. At MP 10.6, the proposed line crosses the existing Sagebrush 200 kV T/L.

Starting at MP 11.9, the line parallels the LADWP Sylmar-Celilo 1000 kV DC T/L and the Owens Gorge-Rinaldi 220 kV T/L lines for approximately 1 mile. The proposed line crosses under the LADWP lines at MP 13, where it then parallels the west side of 103rd Street.

At MP 22.6, the line turns northeast for 2.5 miles and then turns north again until it reaches Substation One at approximately MP 25.6. A new 200-foot-wide R-O-W would need to be acquired for the entire length of this line.

3.5.1.2 Structures

It is currently anticipated that the proposed 500 kV T/L between Antelope and Substation One would utilize a combination of 500 kV and 220 kV structures, as follows:

- 500 kV structures (line construction):
  - Four-legged single-circuit towers (refer to Figure 3-10)
  - Single circuit tubular steel poles (TSP) (refer to Figure 3-28)
- 220 kV structures (for exit/entry into Antelope Substation):
  - Double circuit tubular steel poles (refer to Figure 3-12)

It is currently estimated that approximately 79, 500 kV single-circuit TSPs would be constructed out of dull galvanized steel and 44, 500 kV four-legged single-circuit towers would be constructed of dull galvanized lattice steel angle members connected by steel bolts. However, the exact number and location of structures has not yet been determined. The 500 kV single-circuit TSPs would be approximately 135 feet in height. The single-circuit 500 kV LSTs would range in height between 107 feet and 188 feet. Two 220 kV double circuit TSPs would be constructed of dull galvanized steel and would be approximately 70-feet tall.

Each four-legged lattice steel tower would be built on four drilled pier concrete footings. Each tubular steel pole would be built on one drilled pier concrete footing. The dimension of each footing would be dependent on variables such as topography, tower height, span lengths, and soil properties. On average, a typical footing would have an aboveground projection of about 3 feet.

3.5.1.3 Conductor

On all 500 kV structures, the line would be installed with 2B-2156 kcmil ACSR with nonspecular finish. Approximately 889,000 feet of conductor would be installed.

3.5.1.4 Insulators

The tangent and angle 500 kV insulator assemblies would consist of two strings of insulators in the form of a "V". Each leg of the "V" assembly would contain one or two one-piece gray polymer insulators, depending on the load. On dead-end structures, the insulators would be arranged in a "barrel" configuration consisting of four polymer insulators.

3.5.1.5 Overhead Ground Wires

The overhead ground wires would be located on the peaks of the transmission structures. The 500 kV structures would have two overhead ground wires, one approximately 0.5 inch in diameter. The other ground wire would contain optical fibers for communications and line protection and would be approximately 11/16 inch in diameter.

3.5.1.6 Tower Sites Preparation

The proposed new Antelope to Substation One 500 kV T/L route would require a total of about 25.6 miles of new R-O-W. Approximately 123 new 500 kV structures would be needed for the new 500 kV T/L. Where vegetation exists, tower sites approximately 50 feet by 50 feet would be cleared and grubbed, and where necessary, graded such that water would run towards the direction of the natural drainage. Each tower site would be graded in such a way that no ponding would occur and no erosive water flow would cause damage to the tower footings. The graded area would be compacted to at least 90 percent relative density, and would be capable of supporting heavy vehicular traffic.

3.5.1.7 Access Roads and Spur Roads

Based on the fact that the new T/L would be built on entirely new R-O-W, the following items of work would be required:

- Clearing and grubbing. All new road alignments would be cleared and grubbed. Trees and other vegetations have to be removed or trimmed to obtain a minimum 12 feet clear, drivable width (preferably with 2 feet of shoulder on either side).
- New access and spur roads would be built based on the site topography, such that they would be accessible to all construction equipment. New roads would be built such that existing roads near and within the new R-O-W would be utilized. These new roads would be built with gradients and curvatures that would permit heavy equipment usage and maneuvering. New roads would be built according to SCE's Transmission Construction Standards. Refer to Figures 3-13 through 3-17 for typical road cross sections.

- Drainage structures such as wet crossings, water bars and overside drains, and pipe culverts would be installed to allow for construction traffic usage, as well as prevent road damage due to uncontrolled water flow.
- Depending on the site geology, when big rocks are encountered during the cut-and-fill operations, blasting may be considered, with permission from all governing agencies.
- In areas where the slope is not stable enough to be self supporting, retaining walls may be necessary. These retaining walls would be selected based on site specific-conditions. Refer to Figure 3-24 for a typical Mechanically Stabilized Earth retaining structure.

3.5.1.8 Pulling and Splicing Locations

It is currently estimated that approximately 36 new pulling locations and 9 new splicing locations would be required as preliminarily depicted on the road story aerials (Appendix I). These setup locations require some reasonably level areas for maneuvering equipment. Similar to the tower site locations, these setup locations would most likely be located on existing level areas and existing roads and, therefore, would only require minimal grading and cleanup.

3.5.2 T/L Construction Plan

3.5.2.1 Introduction

The overview of the T/L construction plan for the 500 kV T/L portion of Segment 3 is the same as that described previously for Segment 2 in Section 3.2.2.

3.5.2.2 Scope of Construction

3.5.2.2.1 Segment 3 Scope. Segment 3 would include construction of one new single circuit 500 kV T/L from the Antelope Substation to Substation One using single-circuit LSTs and TSPs. Although built for 500 kV operation, initially this T/L would be operated at 220 kV. Approximately 25.6 miles of new T/L would be built. All work would be completed using conventional construction techniques for access roads, foundations, tower erection, and conductor installations.

3.5.2.3 Construction Activities

The primary construction activities associated with installation of the proposed Segment 3 500 kV T/L between Antelope and Substation One are generally as described previously for Segment 2 in Section 3.2.2.3. Both Segment 2 and Segment 3 would utilize 500 kV four-legged single circuit towers. Segment 3 would also utilize 500 kV single circuit TSPs. A summary of foundation work and steel work associated with 500 kV TSP installation follows.

3.5.2.3.1 **Foundations for New TSPs**. After a geotechnical investigation has been completed and a TSP location-specific design has been determined, pier-type foundations would be poured in place using augered excavation techniques. At the time of construction, the elevations would be verified so that the rebar cages and anchor bolts could be properly set in the hole. A normally specified SCE concrete mix typically takes approximately 30 calendar days to cure to an engineered strength. This strength is verified by controlled testing of sampled concrete. Once this strength has been achieved crews would be permitted to commence erection of steel.

3.5.2.3.2 **Steel Work for TSPs.** Steel work would consist of hauling the TSPs to their designated sites using semi-trucks with 40-foot trailers and rough terrain cranes. Due to the size of TSPs, each pole would require at least two trucks with 40-foot trailers to deliver the pole in sections to the site. At the site, the poles would be set on the foundations once the proper cure time for the concrete had been attained. The poles could either be assembled into a complete structure or be set one piece at a time by stacking them together. This would depend largely on the terrain and available equipment. The method involving stacking the poles would cause the least amount of ground disturbance.

3.6 T/L FACILITIES – SEGMENT 3 (SUBSTATION ONE – SUBSTATION TWO 220 kV LINE)

3.6.1 T/L Engineering Plan

3.6.1.1 Routing

A new 9.6-mile-long single-circuit 220 kV T/L would be built between new Substation One and new Substation Two within a new 160-foot-wide R-O-W. The 220 kV line would exit Substation One (refer to Figure 3-3) and head west along the south side of Oak Creek Road for 1.3 miles until it reached the Cal Cement-Monolith-Windparks 66 kV line at which point it would turn north, cross Oak Creek Road and enter the windpark area. The new line would parallel the existing Cal Cement-Monolith-Windparks 66 kV line up to its termination point at Substation Two as shown on the strip maps (Figure 3-3, Sheets 6 and 7).

3.6.1.2 Structures

The proposed 220 kV T/L would utilize four-legged single-circuit 220 kV LSTs (refer to Figure 3-11).

Approximately 57 four-legged single-circuit LSTs would be constructed of dull galvanized lattice steel angle members connected by steel bolts. However, the exact numbers and locations of towers have not yet been determined.

The single-circuit 220 kV LSTs would range in heights between 70 feet and 115 feet. Each four-legged lattice steel tower would be built on four drilled pier concrete footings. The dimensions of each footing would be dependent on variables such as topography, tower height, span lengths and soil properties. On average, a typical footing would have an above ground projection of about 3 feet.

3.6.1.3 Conductor

The 220 kV T/L between Substations One and Two would be installed with 2B-1590 kcmil ACSR with nonspecular finish.

3.6.1.4 Insulators

The tangent 220 kV insulator assembly would consist of a single gray polymer insulator. On dead-end structures, the insulators would be arranged in a side-by-side configuration consisting of two polymer insulators.

3.6.1.5 Overhead Ground Wires

The overhead ground wires would be located on the peaks of the transmission structures. The 220 kV structures would have two overhead ground wires, one approximately 0.5 inch in diameter. The other ground wire may contain optical fibers for communications and line protection and would be approximately 11/16 inch in diameter.

3.6.1.6 Tower Site Preparation

The proposed 220 kV T/L would require a total of approximately 9.6 miles of new R-O-W. Where vegetation exists, tower sites approximately 35 feet by 35 feet would be cleared and grubbed, and where necessary, graded such that water would run toward the direction of the natural drainage. Each tower site would be graded in such a way that no ponding would occur and no erosive water flow would cause damage to the tower footings. The graded area would be compacted to at least 90 percent relative density, and would be capable of supporting heavy vehicular traffic.

3.6.1.7 Access Roads and Spur Roads

The method of construction and general design considerations for access and spur roads along the proposed 220 kV T/L between Substations One and Two would generally be as described previously in Section 3.5.1.7.

3.6.1.8 Pulling and Splicing Locations

It is currently estimated that approximately 13 new pulling locations and 6 new splicing locations would be required. Road story aerials for the proposed Substation One to Substation Two 220 kV T/L will be submitted to the CPUC at a later date, along with a spreadsheet indicating approximate tower locations, heights, and pulling and splicing locations. These setup locations require some reasonably level areas for maneuvering equipment. Similar to the tower site locations, these setup locations would be most likely located on existing level areas and existing roads and, therefore, would only require minimal grading and cleanup.

3.6.2 T/L Construction Plan

3.6.2.1 Introduction

The overview of the T/L construction plan for the 220 kV T/L (Substation One to Substation Two) portion of Segment 3 is generally as described for Segment 2 in Section 3.2.2.

3.6.2.2 Scope of Construction

The scope of work for Segment 3 would involve construction of a new 220 kV T/L between Substation One and Substation Two.

3.6.2.2.1 Segment 3 220 kV T/L – Substation One to Substation Two. The scope of work for Segment 3 includes construction of one new single-circuit 220 kV T/L from Substation One to Substation Two using 220 kV single-circuit LSTs. Approximately 9.6 miles of new T/L would be built. All work would be completed using conventional construction techniques for access roads, foundations, tower erection, and conductor installations.

3.6.2.3 Construction Activities

The primary construction activities associated with installation of the proposed 220 kV T/L between Substations One and Two would generally be as described previously in Section 3.2.2.3.

3.7 SUBSTATION FACILITIES – SEGMENT 3 (ANTELOPE-SUBSTATION ONE AND SUBSTATION TWO)

3.7.1 Substation Engineering Plan

3.7.1.1 Antelope Substation

Segment 3 of the Project would terminate at the existing Antelope Substation Line Position No. 6. This would require an upgrade of the position to 3000A Rating.

In summary, the following work would be required at the Antelope Substation associated with the Substation One to Substation Two component of Segment 3.

3.7.1.1.1 220 kV Switchyard. It would be necessary to upgrade the existing Line Position No. 6 to 3000A rating to terminate the Substation One 500 kV T/L as follows:

- Replace three existing 1033 kcmil tie-downs with new 2B-1590 kcmil ACSR
- Replace two existing 1200A rated disconnect switches with new 3000A rated switches
- Replace two existing disconnect switch support structures and foundations with new facilities
- Replace all existing 1033 kcmil ACSR conductors (approximately 150 feet) with new 2B-1590 kcmil ACSR (approximately 300 feet)
- Leave the three existing CCVTs in place and re-connect to new conductors
- Remove the existing wave trap and line tuner

3.7.1.1.2 Control Room. The scope of work for the Control Room would include installation of all required line protective relays for the new Substation One 500 kV T/L on existing Line Position No. 6.

3.7.1.1.3 Other Miscellaneous Work. It would also be necessary to install four foundations for a new microwave tower.

3.7.1.2 Substation One – Near Cal Cement

Substation One would be an 1800-foot by 1300-foot 500/220/66 kV enclosed substation pad comprising approximately 53.7 acres. (Refer to Figure 3-7). Because SCE currently does not know the magnitude of the potential wind generation, the timing of such generation or its location, SCE currently plans to equip a 400- foot by 200-foot area of the substation with a four-position bus structure, three line dead-end structures, and four 220 kV disconnect switches. Additional equipment would be installed as generation projects apply for interconnection and sign interconnection facilities agreements. This substation is proposed to be oriented east-to-west. Depending on final generation project locations, the orientation of the substation may need to change to a north-to-south orientation for optimal future 220 kV and 66 kV line routing to the generation projects.

3.7.1.2.1 <u>220 kV Switchyard</u>. The scope of work for the Substation One, 220 kV Switchyard would include installation of the following equipment:

- Two 40-foot-high by 50-foot-wide bus dead-end structures and foundations
- Six insulators dead-end assemblies
- One 195-foot segment of 220 kV Bus equipped with 2B-1590 kcmil ACSR conductors per phase - total: 1,200 feet
- Three 94-foot-high by 45-foot-wide wide line dead-end structures and foundations
- Six tie-downs with 2B-1590 kcmil conductors per phase each
- Twenty-four bus supports with individual steel pedestals and foundations
- Four 220 kV group operated - horizontally mounted disconnect switches with support structures and foundations; one equipped with grounding attachments
- Six 100-foot segments of 2B-1590 kcmil ACSR conductors - total: 600 feet

3.7.1.2.2 <u>Site Preparation</u>. Although the initial installation would be confined to an area of 400 feet by 200 feet, the entire 1,800 feet by 1,300 feet substation pad would be graded, fenced and covered with a 4-inch thick layer of crushed rock.

Beyond the limits of the graded pad some additional grading for side slopes would be required to blend the existing terrain with the new pad. The extents for these side slopes would increase the disturbed area to approximately 1,930 feet by 1,400 feet, or 62.0 acres.

Furthermore, allowances for transmission line passage, county road frontage setbacks and vehicular access would increase the total land requirements to 2,200 feet by 1,550 feet, or 78.3 acres.

The following elements are required:

- Grade the entire 1,800-foot by 1,300-foot substation pad
- Grade the cut and fill side slopes
- Grade and install the substation access road

- Install 6200 feet of 8-foot high chain link perimeter fence with barbed wire, and one 24-foot wide double drive gate to surround the entire 1800-foot by 1300-foot substation pad
- Install 1200 feet of 8-feet high chain link fence with barbed wire, and one 24-foot wide double drive gate to enclose the initial 400-foot by 200-foot area that would initially be equipped
- Install new 4/0 copper conductor ground grid to cover the 400-foot by 200-foot area that would initially be equipped

Grading Concept. To accomplish the scope of this project, the entire substation pad would be graded including the portion where the initial equipment would be located. The portion of the overall substation pad to be initially equipped would measure 400 feet by 200 feet (1.8 acres) and would be located in the southeastern quadrant of the substation pad and approximately 900 feet south of the adjacent Oak Creek Road.

The proposed site is desert terrain with a 3 to 4 percent slope from northwest to southeast that is diagonal to the proposed substation equipment layout. In order to bring the grade into a slope that is parallel with the equipment flow and to reduce the slope to a workable 1.5 to 2 percent, it would be necessary to alter the existing topography through grading.

Grading and Earthwork. The proposed grading scheme would establish a high point at the western end of the substation pad and slope down between 1.5 to 2.0 percent towards the eastern end of the pad resulting in a change of elevation of between 27 and 36 feet. During final engineering, a slope percentage would be selected that results in the least amount of earth movement while meeting the physical requirement of the substation.

Prior to the start of grading, the entire area to be graded would be stripped of all organic matter and loose rocks. Any waste materials encountered would be removed as required by the environmental and geotechnical investigations. Waste material collected from the stripping operations would be tested for contaminants, if appropriate. An estimated quantity of approximately 18,000 cubic yards of soil mixed with stones and organic matter would be transported from the site.

Once the surface had been cleared, the grading operations would begin. The actual quantity of earth to be moved would be calculated as part of the final grading engineering and design. For purposes of this document an estimated quantity of 500,000 cubic yards of soil would be cut from the higher elevations and relocated to the lower elevation as fill. A portion of the cut soil would be used to form a protective earthen berm barrier along the upslope boundaries to prevent surface storm water runoff from entering the substation.

If excessive cut or fill would result, minor alterations to the site elevation and/or slopes might be needed in an attempt to achieve an overall balance. Should it prove impossible or impractical to balance the earthwork quantities, it would be necessary to either export excess soil or import new fill soil.

During grading operations, dust would be controlled by watering.

Earthwork Quantities Resulting from Foundation Excavation. Approximately 60 foundations of various sizes would be constructed throughout the 220 kV interconnection facility area to support equipment and steel structures. In addition, a network of partially buried concrete trenches would be installed throughout the substation area. Upon the completion of grading and other yard improvements, excavation of these foundations and trenches would commence and continue during the course of several weeks. The estimated total volume of soil that would need to be excavated for foundations and trenches is 600 cubic yards.

This soil would be placed and spread on a portion of the substation property. Provisions for this material would be detailed as part of the grading approval process.

Drainage. During final engineering design, the site drainage would be developed to control surface runoff that would be in compliance with regulations regarding the alteration of natural drainage patterns. All new site drainage installations would be consistent with the National Pollutant Discharge Elimination System (NPDES) and the SWPPP prepared for the site and local ordinances. Typical drainage improvements would consist of concrete swales, ditches and culverts.

Surface runoff from existing upslope areas would be modified to direct the flow around the site and would be mitigated by energy dissipation fields and earthen berms as needed.

Access. The main facility access would be a 30-foot wide asphalt concrete paved road connecting Oak Creek Road to the gate in the outer substation perimeter fence. The estimated length of the access road would be 200 feet.

From the outer perimeter gate, a 20-foot wide asphalt concrete driveway would be constructed across the graded pad to the 400-foot by 200-foot area that would initially be equipped. This driveway would be approximately 1,600 feet in length.

Geotechnical Testing. Soils testing would be conducted and analyzed by a professional, licensed Geotechnical Engineer or Geologist, to determine existing soil conditions. Borings in a sufficient quantity to adequately gather variations in the site soils would be conducted to remove sample cores for testing. The type of soils, soil pressure, relative compaction, resistivity and percolation factor are among the items that would be tested for. If contaminants were encountered, special studies and remediation measures in compliance with environmental regulations would be implemented by qualified professionals.

Paving. Asphalt concrete paving would be applied to the access road and to all designated internal driveways over an aggregate base material and a properly compacted sub-grade as recommended by the geotechnical investigation.

Asphalt concrete paving would be installed after all major construction had been completed.

Rock Surfacing. All areas within the facility perimeter that were not paved or covered with concrete foundations or trenches would be surfaced with a 4-inch layer of untreated, ¾ inch nominal crusher-run rock.

The rock would be applied to the finished grade surface after all grading and below-grade construction had been completed.

Spill Prevention Control and Countermeasures (SPCC). Initially, none of the 220 kV interconnection facilities would contain any oil that would trigger preparation of an SPCC plan. An SPCC plan would be prepared and implemented when SPCC thresholds for oil volume are reached.

Storm Water Pollution Prevention Plan (SWPPP). During construction activities, measures would be in place to ensure that contaminates were not discharged from the construction site.

An SWPPP would be developed that would define areas where hazardous materials would be stored, where trash would be placed, where rolling equipment would be parked, fueled and serviced, and where construction materials such as reinforcing bars and structural steel members would be stored.

Erosion control during grading of the unfinished site and during subsequent construction would be in place and monitored as specified by the SWPPP. A silting basin(s) would be established to capture silt and other materials that might otherwise be carried from the site by rainwater surface runoff.

Approximately 1 percent of the completed substation site would consist of impervious materials due to site improvements.

Perimeter Security. The entire facility would be enclosed by perimeter gates and fencing. Perimeter chain link fencing would conform to the requirements for electrical substations and have a minimum height of 8 feet above the adjacent finished grade to the outside of the substation. All perimeter fences and gates would be fitted with barbed wire.

3.7.1.3 Substation Two – Near Monolith

Substation Two would be an 1,100-foot by 800-foot 220/66 kV enclosed substation pad comprising approximately 20.2 acres. (Refer to figure 3-8). Because SCE currently does not know the magnitude of the potential wind generation, the timing of such generation or its location, SCE currently plans to equip a 450-foot by 150-foot area (1.5 acres) of the substation with a one-position bus structure, two line dead-end structures, one 220 kV circuit breaker, four 220 kV disconnect switches, three CCVTs, a new MEER, and new protective relaying equipment. Additional equipment would be installed as generation projects applied for interconnection and signed interconnection facilities agreements. This substation is proposed to be oriented north-to-south. Depending on final generation project locations, the orientation of the substation may need to change to an east-to-west orientation for optimal future 220 kV and 66 kV line routing to the generation projects.

The initial configuration for Segment 3 of the project requires the installation of all the necessary 220 kV equipment to connect the new Substation One to Substation Two 220 kV T/L to a generator-owned tie-line.

3.7.1.3.1 220 kV Switchyard. It would be necessary to install the following equipment to allow the Substation One 220 kV T/L to connect to a generator-owned tie-line:

- One 94-foot-high by 45-foot-wide line dead-end structure and foundation
- One 64-foot-high by 45-foot-wide line dead-end structure and foundation
- Three tie-downs with 2B-1590 kcmil conductors per phase each
- Three 220 kV capacitor voltage transformers
- One 220 kV 3000A 40 kA circuit breaker and foundation
- Four 220 kV group operated - horizontally mounted disconnect switches with support structures and foundations; one equipped with grounding attachments
- Three 100-foot segments of 2B-1590 kcmil ACSR conductors; total: 300 feet

3.7.1.3.2 MEER/IT. It would be necessary to install one 45 foot by 70 foot MEER/IT. The MEER would be equipped with air conditioner equipment and house the following equipment:

- Battery charger
- Batteries
- Light and power panel

- AC distribution panel
- DC distribution panel
- Circuit breaker control switch
- All required remote control and automation equipment
- All required protective relay equipment

The initial installation would be constructed in a 450-foot by 150-foot area surrounded by a temporary fence inside the 1,100-foot by 800-foot area allocated for the 220 kV substation.

3.7.1.3.3 Site Preparation. Although the initial installation would be confined to an area of 450 feet by 150 feet, the entire 1,100 feet by 800 feet substation pad would be graded, fenced and covered with a 4-inch think layer of crushed rock.

Beyond the limits of the graded pad, some additional grading for side slopes would be required to blend the existing terrain with the new pad. The extents for these side slopes would increase the disturbed area to approximately 1,150 feet by 850 feet, or 22.4 acres.

Furthermore, allowances for transmission line passage and vehicular access would increase the land requirements to 1,250 feet by 950 feet, or 27.3 acres.

Since the location of this property is not adjacent to a country road, access would be gained by an access road corridor 50 feet wide and approximately 830 feet long that extends from the northeast substation corner due east, connecting to an existing private road. This additional 1 acre corridor would bring the total land requirement for Substation Two to 28.3 acres.

The following elements would be required:

- Grade the entire 1,100-foot by 800-foot substation pad
- Grade the cut and fill side slopes
- Grade and install the substation access road
- Install 3,800 feet of 8-foot high chain link perimeter fence with barbed wire, and one 24-foot wide double drive gate to surround the entire 1,100-foot by 800-foot substation pad
- Install 1,200 feet of 8-feet high chain link fence with barbed wire, and one 24-foot wide double drive gate to enclose the initial 450-foot by 150-foot area that would initially be equipped

- Install new 4/0 copper conductor ground grid to cover the 450-foot by 150-foot area that would be initially equipped

3.7.1.3.4 Grading Concept. To accomplish the scope of this project, the entire substation pad would be graded including the portion where the initial equipment would be located. The portion of the overall substation pad to be initially equipped would measure 450 feet by 150 feet (2.1 acres) and would be located in the northeastern quadrant of the substation pad.

The proposed site is desert terrain with a 2.5 to 3 percent slope from southwest to northeast that is diagonal to the proposed substation equipment layout. In order to bring the grade into a slope that is parallel with the equipment flow and to reduce the slope to a workable 1 to 1.5 percent, it would be necessary to alter the existing topography through grading.

3.7.1.3.5 Grading and Earthwork. The proposed grading scheme would establish a high point at the southern end of the substation pad and slope down between 1 to 1.5 percent towards the eastern end of the pad resulting in a change of elevation of between 11 and 16 feet. During final engineering, a slope percentage would be selected that results in the least quantity of earth movement while meeting the physical requirement of the substation.

Prior to the start of grading, the entire area to be graded would be stripped of all organic matter and loose rocks. Any waste materials encountered would be removed as required by the environmental and geotechnical investigations. Waste material collected from the stripping operations would be tested for contaminants, as appropriate. An estimated quantity of approximately 6,800 cubic yards of soil mixed with stones and organic matter would be transported from the site.

Once the surface had been cleared, the grading operations would begin. The actual quantity of earth to be moved would be calculated as part of the final grading engineering and design. For purposes of this document an estimated quantity of 90,000 cubic yards of soil would be cut from the higher elevations and relocated to the lower elevation as fill. A portion of the cut soil would be used to form a protective earthen berm barrier along the upslope boundaries to prevent surface storm water runoff from entering the substation.

If excessive cut or fill would result, minor alterations to the site elevation and/or slopes might be needed in an attempt to achieve an overall balance. Should it prove impossible or impractical to balance to the earthwork quantities, it would be necessary to either export excess soil or import new fill soil.

During grading operations, dust would be controlled by watering.

3.7.1.3.6 Earthwork Quantities Resulting From Foundation Excavation. Approximately 20 foundations of various sizes would be constructed throughout the area to support equipment and steel structures. In addition, a network of partially buried concrete trenches would be installed throughout the substation area. Upon the completion of grading and other yard improvements, excavation of these foundations and trenches would commence and might continue during the course of approximately one month. The estimated total volume of soil excavated for foundations and trenches is 300 cubic yards.

This soil would be placed and spread on a portion of the substation property. Provisions for this material would be detailed as part of the grading approval process.

3.7.1.3.7 Drainage. During final engineering design, the site drainage would be developed to control surface runoff that would be in compliance with regulations regarding the alteration of natural drainage patterns. All new site drainage installations would be consistent with the NPDES and the SWPPP prepared for the site and local ordinances. Typical drainage improvements would consist of concrete swales, ditches, and culverts.

Surface runoff from existing upslope areas would be modified to direct the flow around the facility and would be mitigated by energy dissipation fields and earthen berms as needed.

3.7.1.3.8 Access. The main facility access would be a 30-foot-wide asphalt concrete paved road connecting a private road east of the substation site to the gate in the outer substation perimeter fence. The estimated length of the needed access road is 1,000 feet.

From the outer perimeter gate, a 20-foot-wide asphalt concrete driveway would be constructed across the graded pad to the 450-foot by 150-foot area that would initially be equipped. This driveway would be approximately 400 feet in length.

3.7.1.3.9 Geotechnical Testing. Soils testing would be conducted and analyzed by a professional, licensed Geotechnical Engineer or Geologist, to determine existing soil conditions. Borings in a sufficient quantity to adequately gather variations in the site soils would be conducted to remove sample cores for testing. The type of soils, soil pressure, relative compaction, resistivity, and percolation factor are among the items that would be tested for. If contaminants were encountered, special studies and remediation measures in compliance with environmental regulations would be implemented by qualified professionals.

The results of the geotechnical investigation would be applied as needed by various engineering disciplines during the course of final engineering design.

3.7.1.3.10 Paving. Asphalt concrete paving would be applied to the facility access road and to all designated internal driveways over an aggregate base material and a properly compacted sub-grade as recommended by the geotechnical investigation.

Asphalt concrete paving would be installed after all major construction had been completed.

3.7.1.3.11 Rock Surfacing. All areas within the substation perimeter that were not paved or covered with concrete foundations or trenches would be surfaced with a 4-inch layer of untreated, ¾ inch nominal crusher run rock.

The rock would be applied to the finished grade surface after all grading and below grade construction had been completed.

3.7.1.3.12 Spill Prevention Control and Countermeasures (SPCC). None of the 220 kV interconnection facilities would contain sufficient quantities of oil to trigger preparation of an SPCC plan. An SPCC plan would be prepared and implemented when SPCC thresholds for oil volume are reached.

3.7.1.3.13 Storm Water Pollution Prevention Plan (SWPPP). During construction activities, measures would be in place to ensure that contaminates are not discharged from the construction site.

A SWPPP would be developed that would define areas where hazardous materials would be stored, where trash would be placed, where rolling equipment would be parked, fueled and serviced, and where construction materials such as reinforcing bars and structural steel members would be stored.

Erosion control during grading of the unfinished site and during subsequent construction would be in place and monitored as specified by the SWPPP. A silting basin(s) would be established to capture silt and other materials, which might otherwise be carried from the site by rainwater surface runoff.

Approximately 1 percent of the completed substation would consist of impervious materials due to site improvements.

3.7.1.3.14 Perimeter Security. The entire site would be enclosed by perimeter gates and fencing. Perimeter chain link fencing would conform to the requirements for electrical substations and have a minimum height of 8 feet above the adjacent finished grade to the outside of the substation. All perimeter fences and gates would be fitted with barbed wire.

3.7.1.3.15 Other Miscellaneous Work. Four foundations would be installed for a new microwave tower.

3.7.2 Substation Construction Plan

3.7.2.1 Antelope Substation

3.7.2.1.1 Substation Construction. The construction efforts would occur in accordance with accepted construction industry standards. Work would generally be scheduled in daylight hours, Monday through Friday. Extended hours or days may be required in order to meet schedule requirements. In the event that construction needs to occur outside of the specified hours, a variance would need to be obtained.

All materials for the proposed substation would be delivered by truck to the site. Material would be staged along the north perimeter fence during construction. Truck traffic would use major streets and would be scheduled for off-peak traffic hours.

Post-Construction Cleanup. All construction debris associated with the construction effort would be placed in appropriate onsite containers and periodically disposed of according to all applicable regulations during construction of the proposed substation.

3.7.2.2 Substation One (Near Cal Cement)

3.7.2.2.1 Substation Construction. The construction effort would occur in accordance with accepted construction industry standards. The 220 kV interconnection facility would be constructed in a 400-foot by 200-foot contained area within the 1,800-foot by 1,300-foot area allocated for the 500 kV substation. Construction of grading, perimeter fences, foundations, and below-ground facilities would then be completed followed by installation of the aboveground structures and electrical equipment.

Work would generally be scheduled in daylight hours, Monday through Friday. Extended hours or days may be required in order to meet schedule requirements. In the event that construction needs to occur outside of the specified hours, a variance would need to be obtained.

All materials for the proposed substation would be delivered by truck to the site. Material would be staged along the east perimeter fence during construction. Truck traffic would use major streets and would be scheduled for off-peak traffic hours.

Grading. The proposed site, Substation One (Segment 3), would be graded and surfaced with untreated rock over an approximate area of 1,800 feet by 1,300 feet.

Water Usage. Construction estimates one water truck would be in continual usage during the grading cycle of the project.

Post-Construction Cleanup. All construction debris associated with the construction effort would be placed in appropriate onsite containers and periodically disposed of according to all applicable regulations during construction of the proposed substation.

3.7.2.3 Substation Two (Near Monolith)

3.7.2.3.1 Substation Construction. The construction efforts would occur in accordance with accepted construction industry standards. The 220 kV interconnection facility would be constructed in a 450-foot by 150-foot contained area within the 1,100-foot by 800-foot area allocated for the 220/66 kV substation. Construction of grading, perimeter fences, foundations, and below-ground facilities would then be completed followed by installation of the aboveground structures and electrical equipment.

Work would generally be scheduled in daylight hours, Monday through Friday. Extended hours or days may be required in order to meet schedule requirements. In the event that construction needs to occur outside of the specified hours, a variance would need to be obtained.

All materials for the proposed substation would be delivered by truck to the site. Material would be staged along the east perimeter fence during construction. As applicable, truck traffic would use major streets and would be scheduled for off-peak traffic hours.

Grading. The proposed site, Substation Two (Segment 3), would be graded and surfaced with untreated rock over an area that is estimated to be approximately 1,100 feet by 800 feet, including the 450- by 150- foot area that would be equipped initially.

Water Usage. It is expected that one water truck would be in continual usage during the grading cycle of the project.

Post-Construction Cleanup. All construction debris associated with the construction effort would be placed in appropriate onsite containers and periodically disposed of according to all applicable regulations during construction of the proposed substation.

3.8 INFORMATION TECHNOLOGY (IT) FACILITIES – SEGMENT 3 (ANTELOPE-SUBSTATIONS ONE AND TWO)

3.8.1 Overview

SCE is proposing to install telecommunication infrastructure to operate the new substations and to protect the new T/L facilities from electrical faults. The types of circuits would include fault protection, SCADA, telephone, and, if necessary, Remedial Action Scheme (RAS).

3.8.2 Telecommunication Systems

Two telecommunication paths would be provided for redundancy. The primary path would use existing SCE infrastructure to the Antelope Substation and new microwave paths between the Antelope Substation and Oak Peak Communication Site (refer to Figure 3-1), Oak Peak Communication Site and new Substation One, and Oak Peak Communication Site and new Substation Two. The secondary path would be provided by OPGW, which would be installed on all of the new T/Ls.

3.8.3 Antelope Substation Microwave Facilities

At the Antelope Substation in the City of Lancaster, Los Angeles County, a new microwave radio would be installed in the existing communication room. New microwave antennas would be installed on a tower immediately outside the communication room. The existing 80-foot-tall tower is not sufficient to support the additional antennas and would be replaced with a new 120-foot-tall tower, which would be installed adjacent to the existing tower. Approximately 400 square feet of land would be required. If antennas were installed on the top of the new tower, the maximum height would be 135 feet. Concrete footings would be installed to support the new tower. All of the antennas on the existing tower would be moved to the new tower and the old tower would be removed. No new roads or grading would be required. The laydown area would be within the substation.

3.8.4 Oak Peak Communication Site

Three new microwave radios would be installed in the existing communication room at the Oak Peak Communication Site. The existing Oak Peak Communication Site is located in unincorporated Kern County approximately 2.8 miles southeast of Monolith (refer to Figure 3-1). New microwave antennas would be installed on a tower immediately outside the communication room. The existing 50-foot-tall tower would not be sufficient to support the additional antennas and would be replaced with a new 120-foot-tall tower, which would be installed adjacent to the existing tower. Approximately 600 square feet of land would be required. It might be necessary to lease additional land. If antennas were installed on the top of the new tower, the maximum height would be 135 feet. Concrete footings would be installed to support the new tower. All of the antennas on the existing tower would be moved to the new tower and the old tower would be removed. No new roads would be required however the road near the gate to the site may need to be widened. Minimal grading might be required, in an area up to 600 square feet. The laydown area would be adjacent to the existing SCE leased area.

3.8.5 Substation One and Substation Two

A new microwave radio would be installed in the communication room at both proposed substations. New microwave antennas would be installed on new 100-foot-tall towers immediately outside the communication rooms. Approximately 400 square feet of land would be required for the tower at each location. If antennas were installed on the top of the new tower, the maximum height would be 115 feet. Concrete footings would be installed to support the new tower. No new roads or grading, other than those necessary for substation construction, would be required. The laydown area would be within the proposed substation.

3.8.6 OPGW Installation

OPGW would be installed as part of the new T/Ls. Within the substations (Antelope, Substation One and Substation Two) conduits would be constructed to extend the fiber optic cable to the communication room. No new roads, grading, or laydown areas, other than those necessary for T/L and substation construction, would be required.

3.8.7 Communication Alternative 1

With the current proposed locations of new Substation One and Substation Two there should be no problem establishing direct microwave paths to the Oak Peak Communication Site. This alternative would be used in the event that no direct microwave path could be established at one or both of the new substation sites. The plan would be to install a 30-foot by 30-foot passive reflector in order to bounce the microwave signal around any obstructions. The location would depend on the new substation location. Road grading and laydown requirements would depend on the reflector location.

3.8.8 Communication Alternative 2

With the current proposed locations of new Substation One and Substation Two there should be no problem establishing direct microwave paths to the Oak Peak Communication Site. This alternative would be used in the event that no direct or reflected microwave path can be established at one or both of the new substation sites. The plan would be to install Aerial Dielectric Self Supporting (ADSS) fiber optic cable from the Oak Peak Communication Site to the new substation on subtransmission and distribution poles. The length of the cable would depend on the new location for the substation and the available routes between the Oak Peak Communication Site and the substation. No roads, grading or laydown areas should be required. Some additional wooden poles may be required depending on the new locations.

3.8.9 Operation and Maintenance

After construction, the new substations would be unmanned. There would be no change in manning for existing sites. All telecommunications equipment would be operated and maintained by SCE technicians. Preventative maintenance is typically scheduled every 6 months in order to ensure system reliability and performance.

3.9 PROJECT CONSTRUCTION

3.9.1 Introduction

This section summarizes construction-related details for the proposed Segments 2 and 3 (Antelope-Vincent and Antelope-Substations One and Two) project, including:

- Construction schedule and workforce
- Construction equipment
- Land disturbance during construction
- Hazardous material usage
- Waste generation and disposal

3.9.2 Construction Schedule and Workforce

The proposed project construction schedule is presented in Table 3-1. Construction activities for Segments 2 and 3 are planned to begin in March 2008 and end in June of 2009.

Assuming Segments 2 and 3 are constructed simultaneously, the combined construction workforce for all proposed Segments 2 and 3 project components is anticipated to range from approximately 50 to 300, with an estimated average daily workforce of 130.

3.9.3 Construction Equipment

Construction equipment estimates by segment and proposed project component/activity are presented in Table 3-2.

3.9.4 Land Disturbance During Construction

Estimates of land disturbance for Segments 2 and 3 due to construction activities (temporary and permanent) are presented in Table 3-3. In summary, construction of the proposed Segment 2 project is expected to temporarily disturb approximately 88 acres and result in the permanent disturbance of approximately 27 acres. In summary, construction of the proposed Segment 3 project is expected to temporarily disturb approximately 134 acres and result in

TABLE 3-1
CONSTRUCTION SCHEDULE

Activity Description	Forecast Start	Forecast Finish	2003	2004	2005	2006	2007	2008	2009
CRT Approval - Permitting & Licensing									
Permitting & Licensing/CRT Approval/CPCN Submission	Jun-03	Jul-06							
Preliminary Engineering/PEA Preparation/CPCN Filing (Original)	Jun-03	Dec-04							
Regulatory Milestones									
CAISO Approval		Fall-04							
CPCN Supplemental Filing Segment 2 & 3		Sep-05							
CPUC/CPCN Review Process (12-18 months)	Dec-04	Jul-06							
CPCN Approval		Jul-06							
Segment 2									
Segment 2: Engineering	Sep-06	Dec-07							
Segment 2: R-O-W & Sub Site Acquisition	Sep-06	May-08							
Segment 2: Procurement	Jul-07	Jul-08							
Segment 2: Construction & Testing									
Subtransmission Line 66 kV Relocation	Mar-08	Sept-08							
Transmission Line 500/220 kV	Mar-08	Jun-09							
Substations									
Antelope Substation	Jun-08	May-09							
Vincent Substation	Jun-08	May-09							
Testing	May-09	Jun-09							
Segment 2: Antelope to Vincent O.D.		Jun-09							

TABLE 3-1 (CONTINUED)
CONSTRUCTION SCHEDULE

Activity Description	Forecast Start	Forecast Finish	2003	2004	2005	2006	2007	2008	2009
Segment 3									
Segment 3: Engineering	Sep-06	Dec-07							
Segment 3: R-O-W & Sub Site Acquisition	Sep-06	May-08							
Segment 3: Procurement	Jul-07	Jul-08							
Segment 3: Construction & Testing									
Transmission Line 500/220 kV	Mar-8	Jun-09							
Substations									
Antelope Substation	Jun-08	May-09							
Substation One	Jun-08	May-09							
Substation Two	Jun-08	May-09							
Testing	May-09	Jun-09							
Segment 3: Antelope to Substations One and Two O.D.		Jun-09							◆

the permanent disturbance of approximately 49 acres. The combined Segments 2 and 3 would be expected to temporarily disturb approximately 222 acres and to permanently disturb approximately 76 acres.

3.9.5 Hazardous Materials Usage and Waste Generation

Construction of the proposed Segments 2 and 3 project would require limited use of hazardous materials, including fuel, lubricants, and cleaning solvents. All hazardous materials would be stored, handled, and used in accordance with applicable regulations, including the Construction Storm Water Pollution Prevention Plan(s) for the T/L segments and substation components.

Construction of the proposed project would result in the generation of various waste materials. A summary of estimated waste generation by segment and item is presented in Table 3-4.

Construction of Segment 2 would include demolition of approximately 4.4 miles of existing 66 kV subtransmission line south of the Antelope Substation and relocation/new construction of 4.4 miles of 66 kV line approximately 180 feet to the west of the existing 66 kV line. The demolition work would generate waste from removal of approximately 96 wood poles, cross arms, 130,000 feet of conductor, and 575 insulators. Typically for SCE projects, recyclable or salvageable items will be handled by construction crews processing those materials into roll-off boxes that will be provided by Alpert and Alpert Iron and Metal, located in Long Beach, CA. Alpert will provide roll-off bins for salvageable items, and make exchanges on an as needed basis. The salvageable materials, such as conductor, steel, and hardware, are received, sorted, and baled at Alpert's, then sold on the open market. This salvage process is typical but can be modified as needed. Conductor includes all overhead wire associated with the 66 kV subtransmission line, and 100 percent of conductor would be recycled. Hardware includes any shackles, clevises, yoke plates, links, or other connectors used to support conductor; 100 percent of hardware would be recycled.

All waste material types not to be recycled will be reviewed by SCE to ensure that the waste streams are characterized and profiled accurately, thus guaranteeing proper final disposal. The type of waste will determine how it is to be disposed of, and by whom. Examples of this type of waste stream include wood from cribbing and packing materials, soil and vegetative matter from excavations and land clearing activity, and miscellaneous refuse generated during construction activities. For soil and vegetation, local conditions will determine whether these materials are landfilled or recycled. Sanitation waste refers to human generated waste and 100 percent of this will be recycled by nature of sanitation waste management practices. A local approved landfill will be used for nontreated wood waste and other nonhazardous waste. Typically, at a jobsite where treated wood product waste is generated,

TABLE 3-2
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Segment 2: T/L Construction (Antelope to Vincent) (21.5 miles; 11-month period)							
Survey					**(1 Crew)**		
Truck, Pick-Up	180	Gas	2	3	25 days	2.5	1 mile per day
Marshalling Yards					**(1 Crew)**		
Crane, Hydraulic, Rough Terrain, 35 Ton	125	Diesel	1	4	300 work days	2.5	Duration of Project
Truck, Semi, Tractor	310	Diesel	1		300 work days	1.5	
Trailer, Flatbed, 40'	N/A	N/A	1		300 work days	N/A	
Loader, Front End, w/ Bucket	145	Diesel	1		300 work days	1.0	
Forklift, 5 Ton	75	Diesel	1		300 work days	5.0	
Forklift, 10 Ton	85	Diesel	1		300 work days	5.0	
Truck, Pick-Up	180	Gas	1		300 work days	3.0	
Truck, Flatbed, 1 Ton	180	Gas	1		300 work days	1.5	
Trailer, Office, 40' - 60'	N/A	N/A	1		300 work days	N/A	
Trailer, Storage, 40'	N/A	N/A	3		300 work days	N/A	
Road Work					**(1 Crew)**		
Crawler, Track Type, w/ Blade (D8 type)	305	Diesel	1	10	65 work days	9.0	1 mile per day
Crawler, Track Type, w/ Blade (D6 type)	165	Diesel	1		65 work days	9.0	
Truck, Semi, Tractor	310	Diesel	1		65 work days	1.5	
Trailer, Lowboy, 30'	N/A	N/A	1		65 work days	N/A	
Motor Grader	110	Diesel	1		201 work days	5.0	
Truck, Water, 2,000 – 4,000 gal	175	Diesel	1		201 work days	5.0	
Back Hoe, w/ Bucket	85	Diesel	1		65 work days	3.0	
Truck, Pick-Up	210	Diesel	1		201 work days	3.0	
Truck, Flatbed, 1 Ton	210	Diesel	1		65 work days	3.0	

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Foundations					**(3 Crews)**		
Digger, Transmission Type, Truck Mount	190	Diesel	1	18	60 work days	9.0	2 structures per day
Truck, Flatbed, 2 Ton	210	Diesel	3		60 work days	2.5	
Truck, Concrete, 10 Yd	310	Diesel	6		60 work days	5.0	
Truck, Flatbed w/Boom, 5 Ton	235	Diesel	2		60 work days	2.5	
Crawler, Track Type, Drill Rig, Pneumatic	305	Diesel	1		60 work days	9.0	
Crawler, Track Type, w/ Blade (D6 type)	165	Diesel	1		60 work days	4.0	
Truck, Semi, Tractor	310	Diesel	1		60 work days	2.0	
Trailer. Lowboy, 30'	N/A	N/A	1		60 work days	N/A	
Back Hoe, w/Bucket	85	Diesel	1		60 work days	5.0	
Truck, Dump, 10 Ton	235	Diesel	1		60 work days	2.5	
Truck, Water, 2,000 - 5,000 Gal	175	Diesel	2		60 work days	5.0	
Truck, Mechanics, 1 - 2 Ton	260	Diesel	1		60 work days	5.0	
Truck, Pick-Up	210	Diesel	3		60 work days	3.0	
Truck, Flatbed, 1 Ton	210	Diesel	3		60 work days	3.0	
Motor, Auxiliary Power	5	Gas	3		60 work days	2.0	
Trailer, Storage, 40'	N/A	N/A	3		60 work days	N/A	
Steel (Shake-out, Hauling, Light Assembly, Heavy Assembly, Erection)					**(8 Crews)**		
Crane, Hydraulic, 150 Ton	250	Diesel	1	61	135 work days	9.0	2 structures per day
Crane, Hydraulic, Rough Terrain, 35 Ton	125	Diesel	5		77 work days	9.0	
Truck, Flatbed w/ Boom, 5 Ton	235	Diesel	2		77 work days	5.0	
Truck, Flatbed, 2 Ton	235	Gas	4		77 work days	2.5	
Truck, Pick-Up	180	Gas	8		77 work days	7.5	
Truck, Flatbed, 1 Ton	180	Gas	6		77 work days	1.0	
Trailer, Lowboy, 30'	N/A	N/A	N/A		77 work days	N/A	

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Truck, Semi, Tractor	310	Diesel	3	61	77 work days	2.0	2 structures per day
Crawler, Track Type, w/ Blade (D6 type)	165	Diesel	1		77 work days	2.0	
Crawler, Track Type, w/ Blade (D8 type)	305	Diesel	1		135 work days	2.0	
Trailer, Flatbed, 40'	N/A	N/A	3		77 work days	N/A	
Truck, Water, 2,000 - 5,000 Gal	175	Diesel	1		135 work days	7.5	
Truck, Mechanics, 1 - 2 Ton	260	Diesel	1		135 work days	7.5	
Compressor, Air	75	Gas	5		77 work days	7.5	
Conductor (Sheaves, Insulators, Stringing, Deadening, Clipping and Spacing, Anchors)					**(8 Crews)**		
Truck, Flatbed, w/ Bucket, 5 Ton	235	Diesel	3	49	63 work days	9.0	0.3 miles per day
Tension Machine	135	Diesel	1		46 work days	5.0	
Truck, Wire Puller, 3 Drum	310	Diesel	1		46 work days	2.5	
Truck, Wire Puller, 1 Drum	310	Diesel	1		46 work days	5.0	
Truck, Semi, Tractor	310	Diesel	3		46 work days	7.5	
Trailer, Lowboy & Reel Stand	N/A	N/A	5		46 work days	N/A	
Truck, Water, 2,000 - 5,000 Gal	175	Diesel	1		63 work days	9.0	
Crawler, Track Type, w/ Blade (D8 type)	305	Diesel	1		63 work days	2.5	
Crawler, Track Type, Sagging (D8 type)	305	Diesel	2		53 work days	5.0	
Truck, Flatbed, 1 Ton	180	Gas	7		65 work days	5.0	
Truck, Pick-Up	180	Gas	3		63 work days	9.0	
Back Hoe, w/ Bucket	85	Diesel	1		63 work days	3.5	
Digger, Transmission Type, Truck Mount	190	Diesel	1		46 work days	1.0	
Truck, Mechanics, 1 - 2 Ton	260	Diesel	1		63 work days	7.5	
Crane, Hydraulic, Rough Terrain, 35 Ton	125	Diesel	2		63 work days	3.5	

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Motor, Auxiliary Power	5	Gas	4	49	53 work days	4.0	0.3 miles per day
Cleanup & Guard Poles					**(2 Crews)**		
Truck, Flatbed w/ Boom, 5 Ton	235	Diesel	1	6	15 days	5.0	1 mile per day
Truck, Flatbed, w/ Bucket, 5 Ton	235	Diesel	1		15 days	5.0	
Back Hoe, w/ Bucket	85	Diesel	1		15 days	5.0	
Truck, Semi, Tractor	310	Diesel	1		15 days	9.0	
Trailer, Extendable Pole	N/A	N/A	1		15 days	N/A	
Motor Grader	110	Diesel	1		15 days	9.0	
Truck, Flatbed, 1 Ton	210	Diesel	2		15 days	7.5	
Truck, Pick-Up	210	Diesel	2		15 days	7.5	
Segment 2: 66 kV Subtransmission Demolition and Relocation (4.4 miles; 7-month period)							
Survey					**(1 Crew)**		
Truck, Pick-Up	180	Gas	2	3	10 days	2.50	1 mile per day
Marshalling Yards					**(1 Crew)**		
Crane, Hydraulic, Rough Terrain, 25 Ton	125	Diesel	1	6	190 work days	5.0	Duration of Project
Truck, Semi, Tractor	310	Diesel	1		190 work days	1.5	
Trailer, Flatbed, 40'	N/A	N/A	1		190 work days	N/A	
Loader, Front End, w/ Bucket	145	Diesel	1		190 work days	1.0	
Forklift, 5 Ton	75	Diesel	1		190 work days	5.0	
Forklift, 10 Ton	85	Diesel	1		190 work days	5.0	
Truck, Pick-Up	180	Gas	1		190 work days	1.5	
Truck, Flatbed, 1 Ton	180	Gas	1		190 work days	1.5	
Trailer, Office, 40' - 60'	N/A	N/A	1		190 work days	N/A	
Trailer, Storage, 40'	N/A	N/A	3		190 work days	N/A	

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Road Work					**(1 Crew)**		
Crawler, Track Type, w/ Blade (D8 type)	305	Diesel	1	8	30 work days	7.5	1 mile per day
Crawler, Track Type, w/ Blade (D6 type)	165	Diesel	1		30 work days	7.5	
Truck, Semi, Tractor	310	Diesel	1		30 work days	5.0	
Trailer, Lowboy, 30'	N/A	N/A	1		30 work days	N/A	
Motor Grader	110	Diesel	1		30 work days	7.5	
Back Hoe, w/ Bucket	85	Diesel	1		30 work days	5.0	
Truck, Pick-Up	180	Gas	1		30 work days	7.5	
Truck, Flatbed, 1 Ton	180	Gas	2		30 work days	5.0	
Foundations					**(4 Crews)**		
Digger, Transmission Type, Truck Mount	190	Diesel	3	20	60 work days	7.5	2 structures per day
Truck, Flatbed, 2 Ton	235	Gas	2		60 work days	2.5	
Truck, Concrete, 10 Yd	310	Diesel	4		60 work days	8.5	
Truck, Flatbed w/Boom, 5 Ton	235	Diesel	2		60 work days	2.5	
Crawler, Track Type, Drill Rig, Pneumatic	305	Diesel	1		60 work days	2.0	
Crawler, Track Type, w/ Blade (D6 type)	165	Diesel	1		60 work days	2.0	
Truck, Semi, Tractor	310	Diesel	1		60 work days	2.0	
Trailer. Lowboy, 30'	N/A	N/A	1		60 work days	N/A	
Back Hoe, w/ Bucket	85	Diesel	1		60 work days	5.0	
Truck, Dump, 10 Ton	235	Diesel	1		60 work days	2.5	
Loader, Front End, w/ Bucket	145	Diesel	1		60 work days	3.5	
Truck, Water, 2,000 - 5,000 Gal	175	Diesel	1		60 work days	7.5	
Truck, Mechanics, 1 - 2 Ton	260	Diesel	1		60 work days	7.5	
Truck, Pick-Up	180	Gas	2		60 work days	7.5	
Truck, Flatbed, 1 Ton	180	Gas	2		60 work days	5.0	

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Motor, Auxiliary Power	5	Gas	2	20	60 work days	1.0	2 structures per day
Trailer, Storage, 40'	N/A	N/A	3		60 work days	N/A	
Steel (Shake-out, Hauling, Light Assembly, Heavy Assembly, Erection)					**(8 Crews)**		
Crane, Hydraulic, 150 Ton	250	Diesel	1	48	60 work days	5.0	2 structures per day
Crane, Hydraulic, Rough Terrain, 25 Ton	125	Diesel	3		60 work days	5.0	
Truck, Flatbed w/ Boom, 5 Ton	235	Diesel	2		60 work days	5.0	
Truck, Flatbed, 2 Ton	235	Gas	1		60 work days	2.5	
Truck, Pick-Up	180	Gas	1		60 work days	7.5	
Truck, Flatbed, 1 Ton	180	Gas	5		60 work days	1.0	
Trailer, Lowboy, 30'	N/A	N/A	N/A		60 work days	N/A	
Truck, Semi, Tractor	310	Diesel	2		60 work days	2.0	
Crawler, Track Type, w/ Blade (D6 type)	165	Diesel	1		60 work days	2.0	
Trailer, Flatbed, 40'	N/A	N/A	4		60 work days	N/A	
Truck, Water, 2,000 - 5,000 Gal	175	Diesel	1		60 work days	7.5	
Truck, Mechanics, 1 - 2 Ton	260	Diesel	1		60 work days	7.5	
Compressor, Air	75	Gas	3		60 work days	7.5	
Conductor (Sheaves, Insulators, Stringing, Deadening, Clipping and Spacing, Anchors)					**(8 Crews)**		
Truck, Flatbed, w/ Bucket, 5 Ton	235	Diesel	3	39	65 work days	7.5	0.5 mile per day
Tension Machine	135	Gas	1		65 work days	2.5	
Truck, Wire Puller, 3 Drum	310	Diesel	1		65 work days	2.5	
Truck, Wire Puller, 1 Drum	310	Diesel	1		65 work days	2.5	
Truck, Semi, Tractor	310	Diesel	2		65 work days	7.5	
Trailer, Lowboy	N/A	N/A	2		65 work days	N/A	
Truck, Water, 2,000 - 5,000 Gal	175	Diesel	1		65 work days	7.5	
Crawler, Track Type, w/ Blade (D8 type)	305	Diesel	1		65 work days	2.5	

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Crawler, Track Type, Sagging (D8 type)	305	Diesel	1	39	65 work days	2.5	0.5 mile per day
Truck, Flatbed, 1 Ton	180	Gas	6		65 work days	5.0	
Truck, Pick-Up	180	Gas	3		65 work days	7.5	
Back Hoe, w/ Bucket	85	Diesel	1		65 work days	3.5	
Digger, Transmission Type, Truck Mount	190	Diesel	1		65 work days	1.0	
Truck, Mechanics, 1 - 2 Ton	260	Diesel	1		65 work days	7.5	
Crane, Hydraulic, Rough Terrain, 25 Ton	125	Diesel	2		65 work days	3.5	
Motor, Auxiliary Power	5	Gas	4		65 work days	1.0	
Cleanup & Guard Poles					**(2 Crews)**		
Truck, Flatbed w/ Boom, 5 Ton	235	Diesel	1	6	30 days	5.0	1 mile per day
Truck, Flatbed, w/ Bucket, 5 Ton	235	Diesel	1		30 days	5.0	
Back Hoe, w/ Bucket	85	Diesel	1		30 days	5.0	
Crawler, Track Type, w/ Blade (D6 type)	165	Diesel	1		30 days	7.5	
Truck, Semi, Tractor	310	Diesel	1		30 days	2.0	
Trailer, Lowboy, 30'	N/A	N/A	1		30 days	N/A	
Motor Grader	110	Diesel	1		30 days	7.5	
Truck, Flatbed, 1 Ton	180	Gas	2		30 days	7.5	
Truck, Pick-Up	180	Gas	2		30 days	7.5	
Wreck-Out (Remove Conductors, Structures, Foundations)					**(4 Crews)**		
Truck, Flatbed, w/ Bucket, 5 Ton	235	Diesel	3	30	30 work days	7.5	0.75 mile per day
Truck, Wire Puller, 1 Drum	310	Diesel	1		30 work days	7.5	
Truck, Semi, Tractor	310	Diesel	3		30 work days	7.5	
Trailer, Lowboy	N/A	N/A	2		30 work days	N/A	
Trailer, Flatbed, 40'	N/A	N/A	3		30 work days	N/A	
Truck, Dump, 10 Ton	235	Diesel	2		30 work days	7.5	

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Truck, Water, 2,000 - 5,000 Gal	175	Diesel	1	30	30 work days	7.5	0.75 mile per day
Crawler, Track Type, w/ Blade (D6 type)	165	Diesel	1		30 work days	7.5	
Truck, Flatbed, 1 Ton	180	Gas	6		30 work days	7.5	
Truck, Pick-Up	180	Gas	3		30 work days	7.5	
Back Hoe, w/ Bucket	85	Diesel	1		30 work days	7.5	
Truck, Mechanics, 1 - 2 Ton	260	Diesel	1		30 work days	5.0	
Crane, Hydraulic, Rough Terrain, 35 Ton	150	Diesel	2		30 work days	5.0	
Motor, Auxiliary Power	5	Gas	2		30 work days	1.0	
Shu - Fly (Install Structures and Conductors)					**(2 Crews)**		
Truck, Flatbed w/ Boom, 5 Ton	235	Diesel	1	12	20 days	5.0	0.25 mile per day
Truck, Flatbed, w/ Bucket, 5 Ton	235	Diesel	2		20 days	5.0	
Tension Machine	135	Gas	1		20 days	1.0	
Truck, Wire Puller, 3 Drum	310	Diesel	1		20 days	1.5	
Truck, Wire Puller, 1 Drum	310	Diesel	1		20 days	1.5	
Back Hoe, w/ Bucket	85	Diesel	1		20 days	2.5	
Digger, Transmission Type, Truck Mount	135	Diesel	1		20 days	2.5	
Crawler, Track Type, w/ Blade (D8 type)	305	Diesel	1		20 days	2.5	
Crawler, Track Type, Sagging (D8 type)	305	Diesel	1		20 days	1.0	
Truck, Semi, Tractor	310	Diesel	2		20 days	5.0	
Trailer, Flatbed, 40'	N/A	N/A	2		20 days	N/A	
Trailer, Lowboy, 30'	N/A	N/A	2		20 days	N/A	
Truck, Water, 2,000 - 5,000 Gal	175	Diesel	1		20 days	3.5	
Truck, Flatbed, 1 Ton	180	Gas	3		20 days	7.5	
Truck, Pick-Up	180	Gas	2		20 days	7.5	
Motor, Auxiliary Power	5	Gas	2		20 days	1.0	
Shu - Fly (Removal of Conductors and Structures)					**(2 Crews)**		
Truck, Flatbed w/ Boom, 5 Ton	235	Diesel	2	12	20 days	5.0	1 mile per day

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Truck, Flatbed, w/ Bucket, 5 Ton	235	Diesel	2	12	20 days	5.0	1 mile pre day
Tension Machine	135	Gas	1		20 days	1.0	
Truck, Wire Puller, 1 Drum	310	Diesel	1		20 days	1.5	
Back Hoe, w/ Bucket	85	Diesel	1		20 days	5.0	
Crawler, Track Type, w/ Blade (D6 type)	165	Diesel	1		20 days	2.5	
Truck, Semi, Tractor	310	Diesel	2		20 days	5.0	
Trailer, Flatbed, 40'	N/A	N/A	2		20 days	N/A	
Trailer, Lowboy, 30'	N/A	N/A	2		20 days	N/A	
Truck, Water, 2,000 - 5,000 Gal	175	Diesel	1		20 days	3.5	
Truck, Flatbed, 1 Ton	180	Gas	3		20 days	7.5	
Truck, Pick-Up	180	Gas	2		20 days	7.5	
Motor, Auxiliary Power	5	Gas	2		20 days	1.0	
Segment 2: Antelope Substation (3-month period)							
Civil Element							
Crew Trucks	180	Gas	2	6	15 work days	10	
Dump Truck	180	Gas	1		15 work days	5	
Ditch Digger	75	Gas	1		10 work days	7.5	
Driller	305	Diesel	1		10 work days	7.5	
Tractor/Backhoe	85	Diesel	2		15 work days	7	
Forklift	75	Diesel	1		15 work days	5	
Electrical Element							
Crew Trucks	180	Gas	2	8	25 work days	10.0	
5-ton Truck	180	Diesel	1		25 work days	5.0	
Crane	250	Diesel	1		15 work days	5.0	
Tractor/Backhoe	85	Diesel	1		25 work days	5.0	
Forklift	75	Diesel	1		25 work days	5.0	

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Segment 2: Vincent Substation (3-month period)							
Civil Element							
Crew Trucks	180	Gas	2	6	20 work days	10.0	
Dump Truck	180	Gas	1		20 work days	5.0	
Ditch Digger	75	Gas	1		20 work days	7.5	
Tractor/ Backhoe	85	Diesel	2		20 work days	7.0	
Forklift	75	Diesel	1		20 work days	5.0	
Electrical Element							
Crew Trucks	180	Gas	2	6	35 work days	10.0	
5-ton Truck	180	Diesel	1		35 work days	5.0	
Ditch Digger	75	Gas	1		25 work days	7.5	
Crane 150-ton	250	Diesel	1		15 work days	5.0	
Forklift	75	Diesel	1		35 work days	5.0	
Segment 3: 500 kV T/L Construction (Antelope to Substation One) (25.6 miles; 13-month period)							
Survey					**(1 Crew)**		
Truck, Pick-Up	180	Gas	2	3	30days	2.5	1 mile per day
Marshalling Yards					**(1 Crew)**		
Crane, Hydraulic, Rough Terrain, 35 Ton	125	Diesel	1	4	335 work days	2.5	Duration of Project
Truck, Semi, Tractor	310	Diesel	1		335 work days	1.5	
Trailer, Flatbed, 40’	N/A	N/A	1		335 work days	N/A	
Loader, Front End, w/ Bucket	145	Diesel	1		335 work days	1.0	
Forklift, 5 Ton	75	Diesel	1		335 work days	5.0	
Forklift, 10 Ton	85	Diesel	1		335 work days	5.0	
Truck, Pick-Up	180	Gas	1		335 work days	3.0	
Truck, Flatbed, 1 Ton	180	Gas	1		335 work days	1.5	
Trailer, Office, 40’ – 60’	N/A	N/A	1		335 work days	N/A	

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Trailer, Storage, 40'	N/A	N/A	3	4	335 work days	N/A	Duration of Project
Road Work					**(1 Crew)**		
Crawler, Track Type, w/ Blade (D8 type)	305	Diesel	1		72 work days	9.0	
Crawler, Track Type, w/ Blade (D6 type)	165	Diesel	1		72 work days	9.0	
Truck, Semi, Tractor	310	Diesel	1		72 work days	1.5	
Trailer, Lowboy, 30'	N/A	N/A	1	10	72 work days	N/A	1 mile per day
Motor Grader	110	Diesel	1		219 work days	5.0	
Truck, Water, 2,000 – 4,000 gal	175	Diesel	1		219 work days	5.0	
Back Hoe, w/ Bucket	85	Diesel	1		72 work days	3.0	
Truck, Pick-Up	210	Diesel	3		219 work days	3.0	
Truck, Flatbed, 1 Ton	210	Diesel	1		72 work days	3.0	
Foundations					**(2 Crews)**		
Digger, Transmission Type, Truck Mount	190	Diesel	1		90 work days	9.0	
Truck, Flatbed, 2 Ton	210	Diesel	2		90 work days	2.5	
Truck, Concrete, 10 Yd	310	Diesel	4		90 work days	5.0	
Truck, Flatbed w/Boom, 5 Ton	235	Diesel	1		90 work days	2.5	
Crawler, Track Type, Drill Rig, Pneumatic	305	Diesel	1	12	90 work days	9.0	1 structure per day
Crawler, Track Type, w/ Blade (D6 type)	165	Diesel	1		90 work days	4.0	
Truck, Semi, Tractor	310	Diesel	1		90 work days	2.0	
Trailer. Lowboy, 30'	N/A	N/A	1		90 work days	N/A	
Back Hoe, w/Bucket	85	Diesel	1		90 work days	5.0	
Truck, Dump, 10 Ton	235	Diesel	1		90 work days	2.5	
Truck, Water, 2,000 - 5,000 Gal	175	Diesel	1		90 work days	5.0	

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Truck, Mechanics, 1 - 2 Ton	260	Diesel	1	12	90 work days	5.0	1 structure per day
Truck, Pick-Up	210	Diesel	2		90 work days	3.0	
Truck, Flatbed, 1 Ton	210	Diesel	2		90 work days	3.0	
Motor, Auxiliary Power	5	Gas	2		90 work days	2.0	
Trailer, Storage, 40'	N/A	N/A	2		90 work days	N/A	
Steel (Shake-out, Hauling, Light Assembly, Heavy Assembly, Erection)					**(8 Crews)**		
Crane, Hydraulic, 150 Ton	250	Diesel	2	49	134 work days	9.0	2 structures per day
Crane, Hydraulic, Rough Terrain, 35 Ton	125	Diesel	7		134 work days	9.0	
Truck, Flatbed w/ Boom, 5 Ton	235	Diesel	2		134 work days	5.0	
Truck, Flatbed, 2 Ton	235	Gas	7		134 work days	2.5	
Truck, Pick-Up	180	Gas	9		134 work days	7.5	
Truck, Flatbed, 1 Ton	180	Gas	9		134 work days	1.0	
Trailer, Lowboy, 30'	N/A	N/A	N/A		134 work days	N/A	
Truck, Semi, Tractor	310	Diesel	3		134 work days	2.0	
Crawler, Track Type, w/ Blade (D6 type)	165	Diesel	1		134 work days	2.0	
Crawler, Track Type, w/ Blade (D8 type)	305	Diesel	1		134 work days	2.0	
Trailer, Flatbed, 40'	N/A	N/A	3		134 work days	N/A	
Truck, Water, 2,000 - 5,000 Gal	175	Diesel	1		134 work days	7.5	
Truck, Mechanics, 1 - 2 Ton	260	Diesel	1		134 work days	7.5	
Compressor, Air	75	Gas	6		134 work days	7.5	
Conductor (Sheaves, Insulators, Stringing, Deadening, Clipping and Spacing, Anchors)					**(8 Crews)**		
Truck, Flatbed, w/ Bucket, 5 Ton	235	Diesel	3	49	172 work days	9.0	0.5 mile per day
Tension Machine	135	Diesel	1		172 work days	5.0	
Truck, Wire Puller, 3 Drum	310	Diesel	1		172 work days	2.5	
Truck, Wire Puller, 1 Drum	310	Diesel	1		172 work days	5.0	

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Truck, Semi, Tractor	310	Diesel	3	49	172 work days	7.5	0.5 mile per day
Trailer, Lowboy & Reel Stand	N/A	N/A	5		172 work days	N/A	
Truck, Water, 2,000 - 5,000 Gal	175	Diesel	1		172 work days	9.0	
Crawler, Track Type, w/ Blade (D8 type)	305	Diesel	1		172 work days	2.5	
Crawler, Track Type, Sagging (D8 type)	305	Diesel	2		172 work days	5.0	
Truck, Flatbed, 1 Ton	180	Gas	7		172 work days	5.0	
Truck, Pick-Up	180	Gas	3		172 work days	9.0	
Back Hoe, w/ Bucket	85	Diesel	1		172 work days	3.5	
Digger, Transmission Type, Truck Mount	190	Diesel	1		172 work days	1.0	
Truck, Mechanics, 1 - 2 Ton	260	Diesel	1		172 work days	7.5	
Crane, Hydraulic, Rough Terrain, 35 Ton	125	Diesel	2		172 work days	3.5	
Motor, Auxiliary Power	5	Gas	4		172 work days	4.0	
Cleanup & Guard Poles					**(2 Crews)**		
Truck, Flatbed w/ Boom, 5 Ton	235	Diesel	1	6	24 days	5.0	1.5 miles per day
Truck, Flatbed, w/ Bucket, 5 Ton	235	Diesel	1		24 days	5.0	
Back Hoe, w/ Bucket	85	Diesel	1		24 days	5.0	
Truck, Semi, Tractor	310	Diesel	1		24 days	9.0	
Trailer, Extendable Pole	N/A	N/A	1		24 days	N/A	
Motor Grader	110	Diesel	1		24 days	9.0	
Truck, Flatbed, 1 Ton	210	Diesel	2		24 days	7.5	
Truck, Pick-Up	210	Diesel	2		24 days	7.5	
Segment 3: 220 kV T/L Construction (Substation One to Substation Two) (9.6 miles; 8-month period)							
Survey					**(1 Crew)**		
Truck, Pick-Up	180	Gas	2	3	30 days	2.5	1 mile per day

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Marshalling Yards					**(1 Crew)**		
Crane, Hydraulic, Rough Terrain, 35 Ton	125	Diesel	1	4	209 work days	2.5	Duration of Project
Truck, Semi, Tractor	310	Diesel	1		209 work days	1.5	
Trailer, Flatbed, 40'	N/A	N/A	1		209 work days	N/A	
Loader, Front End, w/ Bucket	145	Diesel	1		209 work days	1.0	
Forklift, 5 Ton	75	Diesel	1		209 work days	5.0	
Forklift, 10 Ton	85	Diesel	1		209 work days	5.0	
Truck, Pick-Up	180	Gas	1		209 work days	3.0	
Truck, Flatbed, 1 Ton	180	Gas	1		209 work days	1.5	
Trailer, Office, 40' - 60'	N/A	N/A	1		209 work days	N/A	
Trailer, Storage, 40'	N/A	N/A	3		209 work days	N/A	
Road Work					**(1 Crew)**		
Crawler, Track Type, w/ Blade (D8 type)	305	Diesel	1	10	41 work days	9.0	1 mile per day
Crawler, Track Type, w/ Blade (D6 type)	165	Diesel	1		41 work days	9.0	
Truck, Semi, Tractor	310	Diesel	1		41 work days	1.5	
Trailer, Lowboy, 30'	N/A	N/A	1		41 work days	N/A	
Motor Grader	110	Diesel	1		123 work days	5.0	
Truck, Water, 2,000 – 4,000 gal	175	Diesel	1		123 work days	5.0	
Back Hoe, w/ Bucket	85	Diesel	1		41 work days	3.0	
Truck, Pick-Up	210	Diesel	3		123 work days	3.0	
Truck, Flatbed, 1 Ton	210	Diesel	1		41 work days	3.0	
Foundations					**(2 Crews)**		
Digger, Transmission Type, Truck Mount	190	Diesel	1	12	55 work days	9.0	1 structure per day
Truck, Flatbed, 2 Ton	210	Diesel	2		55 work days	2.5	
Truck, Concrete, 10 Yd	310	Diesel	4		55 work days	5.0	

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Truck, Flatbed w/Boom, 5 Ton	235	Diesel	1	12	55 work days	2.5	1 structure per day
Crawler, Track Type, Drill Rig, Pneumatic	305	Diesel	1		55 work days	9.0	
Crawler, Track Type, w/ Blade (D6 type)	165	Diesel	1		55 work days	4.0	
Truck, Semi, Tractor	310	Diesel	1		55 work days	2.0	
Trailer. Lowboy, 30'	N/A	N/A	1		55 work days	N/A	
Back Hoe, w/Bucket	85	Diesel	1		55 work days	5.0	
Truck, Dump, 10 Ton	235	Diesel	1		55 work days	2.5	
Truck, Water, 2,000 - 5,000 Gal	175	Diesel	1		55 work days	5.0	
Truck, Mechanics, 1 - 2 Ton	260	Diesel	1		55 work days	5.0	
Truck, Pick-Up	210	Diesel	2		55 work days	3.0	
Truck, Flatbed, 1 Ton	210	Diesel	2		55 work days	3.0	
Motor, Auxiliary Power	5	Gas	2		55 work days	2.0	
Trailer, Storage, 40'	N/A	N/A	2		55 work days	N/A	
Steel (Shake-out, Hauling, Light Assembly, Heavy Assembly, Erection)					**(10 Crews)**		
Crane, Hydraulic, 150 Ton	250	Diesel	2	49	81 work days	9.0	2 structures per day
Crane, Hydraulic, Rough Terrain, 35 Ton	125	Diesel	7		81 work days	9.0	
Truck, Flatbed w/ Boom, 5 Ton	235	Diesel	2		81 work days	5.0	
Truck, Flatbed, 2 Ton	235	Gas	7		81 work days	2.5	
Truck, Pick-Up	180	Gas	9		81 work days	7.5	
Truck, Flatbed, 1 Ton	180	Gas	9		81 work days	1.0	
Trailer, Lowboy, 30'	N/A	N/A	N/A		81 work days	N/A	
Truck, Semi, Tractor	310	Diesel	3		81 work days	2.0	
Crawler, Track Type, w/ Blade (D6 type)	165	Diesel	1		81 work days	2.0	
Crawler, Track Type, w/ Blade (D8 type)	305	Diesel	1		81 work days	2.0	

TABLE 3-2 (CONTINUED) CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Trailer, Flatbed, 40'	N/A	N/A	3	49	81 work days	N/A	2 structures per day
Truck, Water, 2,000 - 5,000 Gal	175	Diesel	1		81 work days	7.5	
Truck, Mechanics, 1 - 2 Ton	260	Diesel	1		81 work days	7.5	
Compressor, Air	75	Gas	6		81 work days	7.5	
Conductor (Sheaves, Insulators, Stringing, Deadening, Clipping and Spacing, Anchors)					**(8 Crews)**		
Truck, Flatbed, w/ Bucket, 5 Ton	235	Diesel	3	49	83 work days	9.0	0.5 mile per day
Tension Machine	135	Diesel	1		83 work days	5.0	
Truck, Wire Puller, 3 Drum	310	Diesel	1		83 work days	2.5	
Truck, Wire Puller, 1 Drum	310	Diesel	1		83 work days	5.0	
Truck, Semi, Tractor	310	Diesel	3		83 work days	7.5	
Trailer, Lowboy & Reel Stand	N/A	N/A	5		83 work days	N/A	
Truck, Water, 2,000 - 5,000 Gal	175	Diesel	1		83 work days	9.0	
Crawler, Track Type, w/ Blade (D8 type)	305	Diesel	1		83 work days	2.5	
Crawler, Track Type, Sagging (D8 type)	305	Diesel	2		83 work days	5.0	
Truck, Flatbed, 1 Ton	180	Gas	7		83 work days	5.0	
Truck, Pick-Up	180	Gas	3		83 work days	9.0	
Back Hoe, w/ Bucket	85	Diesel	1		83 work days	3.5	
Digger, Transmission Type, Truck Mount	190	Diesel	1		83 work days	1.0	
Truck, Mechanics, 1 - 2 Ton	260	Diesel	1		83 work days	7.5	
Crane, Hydraulic, Rough Terrain, 35 Ton	125	Diesel	2		83 work days	3.5	
Motor, Auxiliary Power	5	Gas	4		83 work days	4.0	
Cleanup & Guard Poles					**(2 Crews)**		
Truck, Flatbed w/ Boom, 5 Ton	235	Diesel	1	6	69 days	5.0	1.5 miles per day

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Truck, Flatbed, w/ Bucket, 5 Ton	235	Diesel	1	6	69 days	5.0	1.5 miles per day
Back Hoe, w/ Bucket	85	Diesel	1		69 days	5.0	
Truck, Semi, Tractor	310	Diesel	1		69 days	9.0	
Trailer, Extendable Pole	N/A	N/A	1		69 days	N/A	
Motor Grader	110	Diesel	1		69 days	9.0	
Truck, Flatbed, 1 Ton	210	Diesel	2		69 days	7.5	
Truck, Pick-Up	210	Diesel	2		69 days	7.5	
Segment 3: Antelope Substation (3-month period)							
Civil Element							
Crew Trucks	180	Gas	2	6	15 work days	10.0	
Dump Truck	180	Gas	1		15 work days	5.0	
Ditch Digger	75	Gas	1		10 work days	7.5	
Driller	305	Diesel	1		10 work day	7.5	
Tractor/ Backhoe	85	Diesel	2		15 work days	7.0	
Forklift	75	Diesel	1		15 work days	5.0	
Electrical Element							
Crew Trucks	180	Gas	2	8	25 work days	10.0	
5-ton Truck	180	Diesel	1		25 work days	5.0	
Crane	250	Diesel	1		15 work days	5.0	
Tractor/ Backhoe	85	Diesel	1		25 work days	5.0	
Forklift	75	Diesel	1		25 work days	5.0	
Segment 3: Substation One (6-month period)							
Grading Element							
980 Loader/Scraper	305	Diesel	2	6	30 work days	7.5	
Grader	110	Diesel	1		30 work days	5.0	
Compactor	165	Diesel	1		20 work days	5.0	
Water Truck	180	Gas	3		30 work days	7.5	

**TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY**

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Survey Truck	180	Gas	1	6	30 work days	9.0	
Soils Test Crew Truck	180	Gas	1		20 work days	5.0	
Civil Element							
Crew Trucks	180	Gas	2	8	25 work days	10.0	
Dump Truck	180	Gas	1		25 work days	5.0	
5-ton Truck	180	Diesel	1		25 work days	5.0	
Ditch Digger	75	Gas	1		15 work days	7.5	
Driller	305	Diesel	1		15 work days	7.5	
Crane	180	Gas	1		20 work days	5.0	
Tractor/ Backhoe	85	Diesel	2		20 work days	7.0	
Forklift	75	Diesel	1		20 work days	5.0	
Electrical Element							
Crew Trucks	180	Gas	2	10	35 work days	10.0	
5-ton Truck	180	Diesel	1	10	35 work days	5.0	
150-ton Crane	305	Diesel	1	1	20 work days	7.5	
Truck Crane	180	Gas	1	1	20 work days	7.5	
Forklift	75	Diesel	1	1	20 work days	5.0	
Manlift	75	Gas	2	2	30 work days	7.5	
Support Truck	180	Gas	1	1	35 work days	5.0	
Segment 3: Substation Two (6-month period)							
Grading Element							
980 Loader/Scraper	305	Diesel	1	4	15 work days	7.5	
Grader	110	Diesel	1		15 work days	5.0	
Compactor	165	Diesel	1		15 work days	5.0	
Water Truck	180	Gas	2		15 work days	7.5	
Survey Truck	180	Gas	1		15 work days	9.0	
Soils Test Crew Truck	180	Gas	1		15 work days	5.0	

TABLE 3-2 (CONTINUED)
CONSTRUCTION EQUIPMENT ESTIMATES BY ACTIVITY

Primary Equipment Description	Horse-power	Fuel Type[1]	Primary Equip. Quantity	Estimated Total Full Time Equivalents for this Activity	Estimated Activity Schedule	Estimated Equipment Usage Time (Hr./Day)	Estimated Production Per Day
Civil Element							
Crew Trucks	180	Gas	2	8	20 work days	10.0	
Dump Truck	180	Gas	1		20 work days	5.0	
5-ton Truck	180	Diesel	1		20 work days	5.0	
Ditch Digger	75	Gas	1		10 work days	7.5	
Driller	305	Diesel	1		10 work days	7.5	
Crane	180	Gas	1		15 work days	5.0	
Tractor/ Backhoe	85	Diesel	1		15 work days	7.0	
Forklift	75	Diesel	1		15 work days	5.0	
Electrical Element							
Crew Trucks	180	Gas	2	10	35 work days	10.0	
5-ton Truck	180	Diesel	1	10	35 work days	5.0	
150-ton Crane	305	Diesel	1	1	20 work days	7.5	
Truck Crane	180	Gas	1	1	20 work days	7.5	
Forklift	75	Diesel	1	1	20 work days	5.0	
Manlift	75	Gas	2	2	30 work days	7.5	
Support Truck	180	Gas	1	1	35 work days	5.0	

TABLE 3-3
PROPOSED PROJECT LAND DISTURBANCE ESTIMATE

Project Feature	Quantity	Disturbed Acreage Calculation	Acres Disturbed During Construction	Acres to be Restored	Acres Permanently Disturbed
Segment 2: Antelope to Vincent					
Guard Pole Hole[1] (qty street crossings on quad maps)	30	P/4(28"/12)**2x3 locs *1.5	0.06	0.06	
Guard Pole Truck Damage[2] (same above)	30	2 tracks x10'x2'x6 locs	0.17	0.17	
TSP Foundation Hole[3] (qty TSP)	2	P/4(66"/12)**2	0.0011		0.0011
TSP Foundation Hole Truck Damage[4] (same above)	2	2 tracks x10'x2'	0.0018	0.0018	
TSP Laydown Area (same above)	2	175'x8'	0.06	0.06	
LST Footings Holes[5] (qty LST structures)	106	P/4(2)**3x4 locs	0.05		0.05
LST Footings Truck Damage[6] (same above)	106	2 tracks x10'x2'x4 locs	0.39	0.39	
LST Laydown and Assembly Area (same above)	106	175'x60'	25.55	25.55	
Crane Pad for Erection (qty structures)	108	50'x50'	6.20	6.20	
Stringing Setups[7,11] (qty setups) <Puller only D.E.>	19	100'x100'	0.87	0.87	
Stringing Setups[7,11] (qty setups) <Tensioner only D.E.>	20	200'x180'	3.31	3.31	
Stringing Setups[7,11] (qty setups) <snubs turnaround>	1	500'x180'	0.41	0.41	
Splicing Setups (qty setups)	9	125' x 50'	1.29	1.29	
Roads New Access (qty miles)	2.1	x16' wide	4.07		4.07
Roads New Spur (qty miles)[10]	4.6	x16' wide	8.92		8.92
Roads Existing <impacted areas of roads only>	7.19	x16' wide	13.94		13.94
Radius from access road to spur road	78	50' R requires 1,464 sq. ft.	2.62		2.62
Spur Rd Related Temp Disturbed Areas[8]	78	566 sq. ft per spur road	1.01	1.01	0.00
Additional Spur Rd Radius for TSP Trucks[9]	45	2,285 sq. ft. per spur road	2.36	2.36	0.00
Staging Areas Material and Equipment	4	3-5 acres per yard	20.00	20.00	

TABLE 3-3 (CONTINUED)
PROPOSED PROJECT LAND DISTURBANCE ESTIMATE

Project Feature	Quantity	Disturbed Acreage Calculation	Acres Disturbed During Construction	Acres to be Restored	Acres Permanently Disturbed
Substation Work (Antelope & Vincent[13])	2	Not applicable (0)			
Subtotal for Segment 2			88.44	61.69	26.76
Segment 3: Antelope to Substation One					
Guard Pole Hole[1] (qty street crossings on quad maps)	66	P/4(28"/12)**2x3 locs *1.5	0.14	0.14	
Guard Pole Truck Damage[2] (same above)	66	2 tracks x10'x2'x6 locs	0.36	0.36	
TSP Foundation Hole[3] (qty TSP)	79	P/4(66"/12)**2	0.0431		0.04
TSP Foundation Hole Truck Damage[4] (same above)	79	2 tracks x10'x2'	0.0725	0.0725	
TSP Laydown Area (same above)	79	175'x8'	2.54	2.54	
LST Footings Holes[5] (qty LST structures)	43	P/4(2)**3x4 locs	0.02		0.02
LST Footings Truck Damage[6] (same above)	43	2 tracks x10'x2'x4 locs	0.16	0.16	
LST Laydown and Assembly Area (same above)	43	175'x60'	10.36	10.36	
Crane Pad for Erection (qty structures)	122	50'x50'	7.00	7.00	
Stringing Setups[7,11] (qty setups) <Puller only D.E.>	15	100'x100'	0.69	0.69	
Stringing Setups[7,11] (qty setups) <Tensioner only D.E.>	10	200'x180'	1.65	1.65	
Stringing Setups[7,11] (qty setups) <snubs turnaround>	4	500'x180'	1.65	1.65	
Splicing Setups (qty setups)	9	125' x 50'	1.29	1.29	
Roads New Access (qty miles) <60% of Distance C.M>	10	x16' wide	19.45		19.45
Roads New Spur (qty miles)[10]	4.85	x16' wide	9.41		9.41
Roads Existing, <impacted areas of roads only>	3	x16' wide	5.82		5.82
Radius from access road to spur road	61	50' R requires 1,464 sq. ft.	2.05		2.05
Spur Rd Related Temp Disturbed Areas[8]	61	566 sq. ft per spur road	0.79	0.79	0.00

TABLE 3-3 (CONTINUED)
PROPOSED PROJECT LAND DISTURBANCE ESTIMATE

Project Feature	Quantity	Disturbed Acreage Calculation	Acres Disturbed During Construction	Acres to be Restored	Acres Permanently Disturbed
Additional Spur Rd Radius for TSP Trucks[9]	20	2,285 sq. ft. per spur road	1.05	1.05	0.00
Staging Areas Material and Equipment	3	3-5 acres per yard	15.00	15.00	
Substation Work (Antelope [13])	0	Not applicable (0)			
Substation Work (Substation One)	1	62.7	62.7		62.7
Subtotal for Segment 3 – Antelope to Substation One[13]			84.55	42.76	41.79
Segment 3: Substation One to Substation Two					
Guard Pole Hole[1] (qty street crossings on quad maps)	7	P/4(28"/12)**2x3 locs *1.5	0.01	0.01	
Guard Pole Truck Damage[2] (same above)	7	2 tracks x10'x2'x6 locs	0.04	0.04	
TSP Foundation Hole[3] (qty TSP)	0	P/4(66"/12)**2	0.0000		0.00
TSP Foundation Hole Truck Damage[4] (same above)	0	2 tracks x10'x2'	0.0000	0.0000	
TSP Laydown Area (same above)	0	175'x8'	0.00	0.00	
LST Footings Holes[5] (qty LST structures)	57	P/4(2)**3x4 locs	0.02		0.02
LST Footings Truck Damage[6] (same above)	57	2 tracks x10'x2'x4 locs	0.21	0.21	
LST Laydown and Assembly Area (same above)	57	175'x60'	13.74	13.74	
Crane Pad for Erection (qty structures)	57	50'x50'	3.27	3.27	
Stringing Setups[7,11] (qty setups) <Puller only D.E.>	13	100'x100'	0.60	0.60	
Stringing Setups[7,11] (qty setups) <Tensioner only D.E.>	14	200'x180'	2.31	2.31	
Stringing Setups[7,11] (qty setups) <snubs turnaround>	0	500'x180'	0.00	0.00	
Splicing Setups (qty setups)	6	125' x 50'	0.86	0.86	
Roads New Access (qty miles) <60% of Distance C.M>	0.06	x16' wide	0.12		0.12
Roads New Spur (qty miles)10	0.55	x16' wide	1.07		1.07
Roads Existing <impacted areas of roads only>	0	x16' wide	0.00		0.00

TABLE 3-3 (CONTINUED)
PROPOSED PROJECT LAND DISTURBANCE ESTIMATE

Project Feature	Quantity	Disturbed Acreage Calculation	Acres Disturbed During Construction	Acres to be Restored	Acres Permanently Disturbed
Radius from access road to spur road	25	50' R requires 1,464 sq. ft.	0.84		0.84
Spur Rd Related Temp Disturbed Areas[8]	25	566 sq. ft per spur road	0.32	0.32	0.00
Additional Spur Rd Radius for TSP Trucks[9]	20	2,285 sq. ft. per spur road	1.05	1.05	0.00
Staging Areas Material and Equipment	2	3-5 acres per yard	10.00	10.00	
Substations Work (Substation Two)	1	20.2	20.2		20.2
Subtotal for Segment 3 – Substation One to Substation Two			49.47	32.42	7.05
Total for Segments 2 and 3			**222.46**	**136.87**	**75.6**

1 Guard pole-assume three upright poles per each side of street thus 6 poles for each crossing for standard 'goal post' design, 28" diameter poles, assume that 50% more crossings present (1.5 multiplier) due to preliminary engineering undercrossings not showing mapped distribution includes frontage roads, rural streets, dirt roads and jeep trails.

2 Guard pole-augering process, same as above plus, assume 'dualie' type rear axle trucks with two 2' wide tracks backing to location.

3 TSP -assume 96" diameter with 6" overbore for slurry/concrete backfill, thus 66" diameter hole augered.

4 TSP-assume augering equipment backs in off new stub road 10' with two 2' wide tire tracks.

5 LST-assume 3' diameter hole with no overbore for a 'E' series tower.

6 LST-assume 'dualie' type rear axle trucks with two 2' wide tracks backing to four locations per LST approx. 10" from stub road.

7 Approximately every 14,970' and at Points of Inflection or DE structures when convenient. Only 40% of the 180' x 200' site is disturbed.

8 Parking tracks for 3 utility trucks (180 ft^2), and one turnaround track on an 18' radius (386 ft^2).

9 Difference between 80' radius and 80' radius from access to spur road for access by 80' trailer bed truck.

10 Spur road is required when access road is over 50' from structure site.

11 One end of a stringing setup is 180' x 200' reel and tensioner end, the other is a 180' x 200' puller site. Only 40% of the 180' x 200' sites are disturbed.

12 Total is for stand-alone LSTs only, not overlap LSTs, that is, only those LSTs that would not have new LSTs erected at that location.

13 Substation work at the Antelope and Vincent Substations for Segment 2 and at the Antelope Substation for Segment 3 would occur on previously disturbed land within the existing substation boundaries.

TABLE 3-4
CONSTRUCTION WASTE ESTIMATE

Waste Item	Pounds Total	Pounds Reusable at SCE or On Site	Pounds Recyclable Outside SCE or Disposed
Segment 2: Antelope – Vincent 500 kV Waste Estimate			
Wood from Cribbing etc.[1,2,3]	57,500	14,400	43,100
Soil/Veg: Ftgs, Stubs & Crane Pads[4]	543,222	380,256	162.967
Miscellaneous	40,000	0	40,000
Sanitation Waste	58,368	0	58,368
Subtotal	**699,090**	**394,656**	**304,435**
Segment 2: Antelope Substation Waste Estimate			
Civil Element			
Wood	2,000	0	2,000
Concrete	2,000	0	2,000
Sanitation Waste	1,000	0	1,000
Miscellaneous	1,000	0	1,000
Electrical Element			
Wood	2,000	0	2,000
Steel/Aluminum/Copper	30,000	0	30,000
Sanitation Waste	1,500	0	1,500
Miscellaneous	2,000	0	2,000
Subtotal	**41,500**	**0**	**41,500**
Segment 2: Vincent Substation Waste Estimate			
Civil Element			
Wood	1,000	0	1,000
Concrete	500	0	500
Sanitation Waste	200	0	200
Miscellaneous	200	0	200
Electrical Element			
Wood	1,000	0	1,000
Steel/Aluminum/Copper	5,000	0	5,000
Sanitation Waste	500	0	500
Miscellaneous	500	0	500
Subtotal	**8,900**	**0**	**8,900**

TABLE 3-4 (CONTINUED)
CONSTRUCTION WASTE ESTIMATE

Waste Item	Pounds Total	Pounds Reusable at SCE or On Site	Pounds Recyclable Outside SCE or Disposed
Segment 2: 66 kV Subtransmission Demolition and Removal (Estimated 96 Poles)			
Wood Pole and X-arm from Removal	150,000	0	150,000
Porcelain from Removal	38,000	0	38,000
Galvanized Steel from Removal	2,400	0	2,400
Copper from Removal	1,000	0	1,000
Aluminum from Removal	1,292,000	0	1,292,000
Subtotal	**1,483,400**	**0**	**1,483,400**
Segment 3: Antelope – Substation One 500 kV Waste Estimate			
Wood from Cribbing etc.[5,6,7]	133,000	6,000	127,000
Soil/Veg: Ftgs, Stubs & Crane Pads[8]	602,257	421,580	180,677
Miscellaneous	40,000	0	40,000
Sanitation Waste	58,368	0	58,368
Subtotal	**833,625**	**427,580**	**406,045**
Segment 3:Substation One to Substation Two 220 kV Waste Estimate			
Wood from Cribbing etc.[9,10,11]	25,000	6,600	18,400
Soil/Veg: Ftgs, Stubs & Crane Pads[12]	246,057	172,240	73,817
Miscellaneous	40,000	0	40,000
Sanitation Waste	58,368	0	58,368
Subtotal	**369,425**	**178,840**	**190,585**
Segment 3: Antelope Substation Waste Estimate			
Civil Element			
Wood	1,000	0	1,000
Concrete	500	0	500
Sanitation Waste	200	0	200
Miscellaneous	200	0	200
Electrical Element			
Wood	1,000	0	1,000
Steel/Aluminum/Copper	5,000	0	5,000
Sanitation Waste	500	0	500
Miscellaneous	500	0	500
Subtotal	**8,900**	**0**	**8,900**

TABLE 3-4 (CONTINUED)
CONSTRUCTION WASTE ESTIMATE

Waste Item	Pounds Total	Pounds Reusable at SCE or On Site	Pounds Recyclable Outside SCE or Disposed
Segment 3: Substation One Waste Estimate			
Grading Element			
Soil Vegetation	13,000	0	13,000
Sanitation Waste	500	0	500
Civil Element			
Wood	2,000	0	2,000
Concrete	2,000	0	2,000
Sanitation Waste	1,000	0	1,000
Miscellaneous	1,000	0	1,000
Electrical Element			
Wood	2,000	0	2,000
Steel/Aluminum/Copper	30,000	0	30,000
Sanitation Waste	1,500	0	1,500
Miscellaneous	2,000	0	2,000
Subtotal	**35,500**	**0**	**35,500**
Segment 3: Substation Two Waste Estimate			
Grading Element			
Soil Vegetation	4,000	0	4,000
Sanitation Waste	500	0	500
Civil Element			
Wood	2,000	0	2,000
Concrete	2,000	0	2,000
Sanitation Waste	1,000	0	1,000
Miscellaneous	1,000	0	1,000
Electrical Element			
Wood	2,000	0	2,000
Steel/Aluminum/Copper	30,000	0	30,000
Sanitation Waste	1,500	0	1,500
Miscellaneous	2,000	0	2,000
Subtotal	**35,500**	**0**	**35,500**
GRAND TOTAL (Segments 2 and 3)	**3,515,840**	**1,001,076**	**2,323,365**

[1] Wood cribbing attained from the job will be approximately 25,000 pounds, 1,000 pounds for TSPs and 24,000 pounds for LSTs, calculated as follows: For LSTs, (106 LSTs @ approx. 45,000 pounds steel per LST divided by 60,000 capacity per

TABLE 3-4 (CONTINUED)
CONSTRUCTION WASTE ESTIMATE

truck = 80 truck loads @ 300 pounds cribbing per truck). For TSPs, 1,000 pounds for the two TSPs (500 pounds wood cribbing per truck). Approximately 60% of the cribbing from the LSTs will be cut into 24" lengths for use on the assembly crews and retained by the contractor. This leaves approximately 9,600 pounds to go to waste.

[2] Wood pallets from the job will be approximately 20 trucks with 15 pallets at 75 pounds each for a total of 22,500 pounds.

[3] Wood crates from the job will be approximately 10 trucks at 1,000 pounds each for a total of 10,000 pounds.

[4] 3.14=PI, 102"=diameter TSP with overbore, 144=inch->foot conv, 40' depth hole, 0.4 weight density, 2 TSPs. 42"=diameter LST with overbore, 30' depth LST hole, 106 LSTs total. 100' long stub roads, 16' wide, 4' deep, & 108 total roads estimated. 50' by 50' crane pad, 2' deep, 108 crane pads.

[5] Wood cribbing attained from the job will be approximately 106,000 pounds, 96,000 pounds for TSPs and 10,000 pounds for LSTs, calculated as follows: For LSTs, (43 LSTs @ approx. 45,000 pounds steel per LST divided by 60,000 capacity per truck = 33 truck loads @ 300 pounds cribbing per truck). For TSPs, 96,000 pounds for the 79 TSPs (600 pounds wood cribbing per truck). Approximately 60% of the cribbing from the LSTs will be cut into 24" lengths for use on the assembly crews and retained by the contractor. This leaves approximately 4,000 pounds to go to waste.

[6] Wood pallets from the job will be approximately 15 trucks with 15 pallets at 75 pounds each for a total of 17,000 pounds.

[7] Wood crates from the job will be approximately 10 trucks at 1,000 pounds each for a total of 10,000 pounds.

[8] 3.14=PI, 102"=diameter TSP with overbore, 144=inch->foot conv, 40' depth hole, 0.4 weight density, 79 TSPs. 42"=diameter LST with overbore, 30' depth LST hole, 43 LSTs total. 100' long stub roads, 16' wide, 4' deep, & 112 total roads estimated. 50' by 50' crane pad, 2' deep, 112 crane pads.

[9] Wood cribbing attained from the job will be approximately 11,000 pounds, 0 pounds for TSPs and 11,000 pounds for LSTs, calculated as follows: For LSTs, (49 LSTs @ approx. 45,000 pounds steel per LST divided by 60,000 capacity per truck = 37 truck loads @ 300 pounds cribbing per truck). For TSPs, 0 pounds for the 0 TSPs (500 pounds wood cribbing per truck). Approximately 60% of the cribbing from the LSTs will be cut into 24" lengths for use on the assembly crews and retained by the contractor. This leaves approximately 6,600 pounds to go to waste.

[10] Wood pallets from the job will be approximately 8 trucks with 15 pallets at 75 pounds each for a total of 9,000 pounds.

[11] Wood crates from the job will be approximately 5 trucks at 1,000 pounds each for a total of 10,000 pounds.

[12] 3.14=PI, 102"=diameter TSP with overbore, 144=inch->foot conv, 40' depth hole, 0.4 weight density, 0 TSPs. 42"=diameter LST with overbore, 30' depth LST hole, 49 LSTs total. 100' long stub roads, 16' wide, 4' deep, & 49 total roads estimated. 50' by 50' crane pad, 2' deep, 49 crane pads.

SCE contracts with McFarland Cascade for all aspects of disposal including hauling. In the future, SCE may use other landfill facilities that are authorized to accept treated wood waste in accordance with the California Health and Safety Code Section 25143.1.5. Treatment Storage Disposal Facilities (TSDFs) for wastes generated in this area, broken down by classification, are:

- **Hazardous Waste:**
  - Clean Harbors Buttonwillow
  - Clean Harbors Los Angeles
- **Non-Hazardous Waste:**
  - Filter Recycling

- TPS Technologies
- Crosby & Overton
- Demenno Kerdoon

- **Non-Regulated Municipal Type Waste:**
  - Chiquita Canyon Landfill
  - Sunshine Canyon Landfill
  - Simi Valley Landfill
  - Lopez Canyon Landfill
  - Bradley Landfill

3.10 FACILITY OPERATIONS AND MAINTENANCE

SCE would operate and maintain all proposed Segment 2 and 3 related project components (i.e., T/Ls and substation facilities) in accordance with existing SCE procedures. The proposed project would not require any additional personnel during the operational phase.

Operation and maintenance of the proposed 500 kV and 220 kV T/Ls would involve periodic inspection (e.g., once per year) via helicopter and truck where accessible. Maintenance of the T/Ls would be performed on an as-needed basis, including maintenance of access roads and erosion/drainage control structures, as applicable.

3.11 ALTERNATIVES TO THE PROPOSED PROJECT

3.11.1 Introduction

This Proponent's Environmental Assessment (PEA) for Segments 2 and 3 of Southern California Edison's proposed Antelope Transmission Project supersedes the PEA that was submitted to the California Public Utilities Commission on December 9, 2004 (Application No. 04-12-008). This PEA has been revised and updated to reflect: 1) additional engineering information; 2) transmission line route revisions (including revisions to affected maps and route mileposts) based on input received from the public and private developers; and 3) environmental data that became available since the PEA was originally submitted in December 2004.

SCE performed a siting and alternatives analysis before selecting the proposed project, including alternatives. The key criteria in the analysis included: 1) where possible, maximize use of existing, previously disturbed T/L R-O-W or roadways to minimize effects on previously undisturbed land and resources; 2) select route and tower locations with the lowest potential for environmental impacts while still having the ability to meet project objectives; 3) select shortest route that is capable of meeting project objectives in order to minimize environmental impacts and project costs and associated costs to ratepayers. This PEA considers the following alternatives:

- No Project Alternative
- T/L Route Alternatives
- Substation Site Alternatives
- Underground Alternative

3.11.2 No Project Alternative

SCE is filing this application pursuant to CPUC Decision D.04-06-010 Ordering Paragraphs No.8 and No.9 which require SCE to file an application seeking a certificate authorizing construction of the first phase of Tehachapi transmission upgrades consistent with its 2002 conceptual study and the study group's recommendations within six months of the effective date of this order, seek transmission rate recovery at the Federal Energy Regulatory Commission, and include, to the extent feasible, projects with existing interconnection requests in its first phase CPCN. In addition, in Docket I. 00-11-001, an Assigned Commissioner Ruling required SCE to file two separate applications (one CPCN application for Segment 1 and one CPCN application for Segments 2 and 3). *See Assigned Commissioner Ruling Regarding Tehachapi CPCN Filing Requirement (October 21, 2004)*. The aforementioned requirements related to the CPUC decision indicate that the No Project Alternative would not satisfy regulatory mandates.

If the No Project Alternative was a viable alternative and it was selected by the CPUC, the environmental impacts associated with the project as well as the benefits would not occur. It is considered likely that were the proposed project not implemented, another transmission project would need to be built, if possible, with potentially greater environmental impacts and fewer benefits to the transmission grid and renewable energy producers in Southern California.

3.11.3 T/L Route Alternatives

3.11.3.1 Proposed Segment 2

SCE proposes to construct 21.5 miles of 500 kV T/L facilities between the Antelope and Vincent substations to import additional power from future wind farms in the north Los Angeles and east Kern Counties and help comply with the requirements of the Renewable Energy and Renewable Portfolio Standard Programs enacted by the California Legislature in

2002. Proposed Segment 2 would require the acquisition of new R-O-W adjacent to existing transmission R-O-Ws over the majority of the distance between these two substations. New R-O-W would also need to be acquired along the portion of the proposed Segment 2 route on Ritter Ranch.

3.11.4 Segment 2 – Alternatives Evaluated and Eliminated from Further Consideration

3.11.4.1 Rebuild within Existing R-O-W

An alternative to the acquisition of new R-O-W examined the possibility of utilizing the existing R-O-W between the Antelope and Vincent substations by removing the Antelope-Mesa 220 kV T/L initially and rebuilding it as a double-circuit 220 kV line so that SCE could then remove the Antelope-Vincent 220 kV T/L and replace it with the proposed Antelope-Vincent 500 kV T/L.

The existing Antelope-Mesa 220 kV T/L R-O-W is 100 feet wide. The existing Antelope-Vincent 220 kV T/L R-O-W is 100 feet wide. To relocate the Antelope-Mesa 220 kV line and Antelope-Vincent 220 kV line on double-circuit towers would require a 150-foot-wide R-O-W. The proposed Antelope-Vincent 500 kV T/L would require 180 feet. This exceeds the available R-O-W by 130 feet. There is insufficient room physically to locate the proposed Antelope-Vincent 500 kV T/L within the existing R-O-W corridor. Consequently, this alternative was eliminated from further consideration.

Furthermore, it is highly unlikely that the CAISO would allow for extended simultaneous outage of both lines so that they could be torn down and rebuilt with the above transmission facilities. Taking both lines out at the same time would result in severe curtailments to the Big Creek Hydro, existing Qualifying Facilities (including wind generation), and new combined cycle market generation resources currently under construction.

Additional issues make this alternative unacceptable from a technical and system operation perspective as well.

- The existing Antelope-Mesa 220 kV T/L extends south of Vincent to the Mesa Substation. SCE cannot reconnect the section between Vincent and Mesa substations to Vincent since the line would overload when operated in parallel with all other lines south of Vincent Substation. Doing so would degrade the overall south of Vincent Substation capability. The line cannot be left unused since it would again reduce the overall south of Vincent Substation capacity.
- High elevations along the route, combined with the vertical conductor configuration for double-circuit structures, would make the double-circuit tower option subject to safety and reliability constraints due to icing conditions.

3.11.4.2 Leona Valley Route

A 500 kV T/L route alternative through Leona Valley was considered to avoid three homes on the proposed route between MP 6.5 and MP 7.5. This route turned due south at approximately MP 7.0 and made its way to the southwest joining the existing Midway-Vincent No. 2 R-O-W at approximately MP 10.7. It then paralleled the Midway-Vincent No. 2 R-O-W for several miles until it rejoined the proposed route at approximately MP 19.8. This route was removed from consideration due to its proximity to a future planned high school site, the concerns of Leona Valley residents and the potential increase in environmental impacts in an area not adjacent to an existing T/L R-O-W.

3.11.4.3 Underground T/L from Antelope to Vincent

Undergrounding the 500 kV T/L between Antelope and Vincent Substations was evaluated and eliminated from further consideration for the reasons discussed further in Section 3.11.8.

3.11.5 Segment 2 – Alternatives Retained for Consideration

3.11.5.1 Segment 2 – Alternative Antelope – Vincent 1 (AV1)

Alternative route AV1 is approximately 2.1 miles long (refer to Figure 3-2) departing the proposed Segment 2 route at approximately MP 5.7 and reuniting with the proposed route at approximately MP 7.6. Alternative AV1 is located parallel to and east of the proposed Segment 2 route. Alternative AV1 would avoid three existing homes that would need to be removed if the corresponding portion of the proposed route were implemented instead. This alternative was considered and not selected as the proposed route for the following reasons:

- Would require two crossings of the entire T/L corridor including two 66 kV lines, the Antelope-Mesa 220 kV line, the Antelope-Vincent 220 kV line, and Midway-Vincent No. 3 500 kV line. These lines constitute a significant portion of the Big Creek Corridor and Path 26. These additional crossings could reduce system reliability in the event of a line failure.
- The crossings would require at least 180-foot-tall towers on each side of the corridor increasing visual impacts.

3.11.5.2 Segment 2 – Alternative Antelope – Vincent 2 (AV2)

Alternative Route AV2 is approximately 3.1 miles long (refer to Figure 3-2) departing the proposed Segment 2 route at approximately MP 8.1 and rejoining it at approximately MP 14.9. Alternative AV2 crosses the Ritter Ranch and Anaverde residential developments. Although Alternative AV2 was the proposed Segment 2 route in the December 2004 CPCN filing, based on discussions between SCE and Ritter Ranch representatives, the proposed route would result in less impacts to planned homes on Ritter Ranch. The proposed Segment 2 route would also result in less potential impacts to the Anaverde development. However, the proposed route would require acquisition of new R-O-W (approximately MPs 8.1 to 10.6) on Ritter Ranch where no T/Ls currently exist. Conversely, Alternative AV2 parallels the existing T/L corridor over its entire 3.1-mile length. If Alternative AV2 were selected for implementation, the overall length of the Segment 2 T/L route would be reduced by approximately 3.7 miles (i.e., versus the proposed Segment 2 route). This alternative was considered and not selected as the proposed route for the following reasons:

- This alternative would adversely impact a residential development and a proposed middle school site.

3.11.6 Segment 3 – Alternatives Evaluated and Eliminated from Further Consideration

3.11.6.1 Underground T/L from Antelope to Substation One

Undergrounding the 500 kV T/L between Antelope and Substation One was evaluated and eliminated from further consideration for the reasons discussed further in Section 3.11.8.

3.11.6.2 Underground T/L from Substation One to Substation Two

Undergrounding the 220 kV T/L between Substation One and Substation Two was evaluated and eliminated from further consideration for the reasons discussed further in Section 3.11.8.

3.11.7 Segment 3 – Alternatives Retained for Consideration

3.11.7.1 Segment 3 – Alternative A (Antelope to Substation One)

The new 500 kV T/L proposed in this alternative is 25.9 miles long (versus 25.6 miles for the Proposed Route). Alternative A was the proposed route in the December 9, 2004 CPCN application for Segments 2 and 3. This alternate route would leave the Antelope Substation on TSPs by cutting across the existing Antelope-Magunden 220 kV R-O-W and the Midway-Vincent No. 3 500 kV R-O-W. The proposed line would parallel the southwest side of the Midway-Vincent No. 3 500 kV T/L and, at MP 1.2, cross over it as well as the Antelope-Magunden 220 kV No. 1 and No. 2 T/Ls and the private Sagebrush 220 kV T/L. The line would need to divert around a planned community north of Antelope but would eventually align itself with 100th Street at MP 5.2. The line would cross from Los Angeles County into Kern County at MP 10.1.

The line would cross the LADWP Sylmar-Celilo 1000 kV DC T/L and the Owens Gorge-Rinaldi 220 kV T/L corridor and the Sagebrush 220 kV T/L again at MP 13.8. At MP 22.3, the line would turn northeast for approximately 2 miles and then turn north again until it reached Substation One at approximately MP 25.9. A new 200-foot-wide R-O-W would need to be acquired for the entire length of this line. This alternative was considered and not selected as the proposed route for the following reason:

- Based on public input received and upon further investigation of the land use along 100th Street West, it was determined that this route would have greater potential to adversely effect existing and developing homesites than the proposed route.

3.11.7.2 Segment 3 – Alternative B (Antelope to Substation One)

The new 500 kV T/L proposed in this alternative is 26 miles long and would leave the Antelope Substation on TSPs by cutting across the existing Antelope-Magunden 220 kV R-O-W and the Midway-Vincent No. 3 500 kV R-O-W (refer to Figure 3-3). This alternate T/L route would parallel the southwest side of the Midway-Vincent No. 3 500 T/L, and at MP 1.2, would cross over it as well as the Antelope-Magunden 220 kV No. 1 and No. 2 T/Ls and the private Sagebrush 220 kV T/L. After the crossings it would align itself with 110th Street. The line would cross from Los Angeles County into Kern County at MP 9.8.

This alternate T/L route would cross the LADWP DC and Owens Gorge corridor and the Sagebrush 220 kV T/L again at MP 11.7. At MP 21.2, the line would turn northeast for 3.5 miles and then turn north at 85th Street, which it would follow until it reaches Substation One at MP 26.0.

A new 200-foot-wide R-O-W would need to be acquired for the entire length of this T/L. This alternative was considered and not selected as the proposed route for the following reason:

- Based on public input received and upon further investigation of the land use along 110th Street West, it was determined that this route would have a greater potential to adversely effect existing and developing homesites and agricultural land than the proposed route.

3.11.7.3 Segment 3 – Alternative C (Substation One to Substation Two)

This 9.5-mile-long 220 kV T/L alternative would be constructed on single circuit LSTs along Oak Creek Road from Substation One to approximately MP 27.3. From approximately MP 27.3 to Substation Two the T/L would be constructed on single circuit LSTs adjacent to the existing Cal Cement-Goldtown-Monolith-Windlands 66 kV line as shown on the strip maps (Figure 3-3, Sheets 6-7). New 160-foot-wide R-O-W would need to be acquired for the entire length of this line. This alternative was considered and not selected as the proposed route for the following reason:

- Based on public input and further investigation of land use in the Cameron Canyon Road area, it was determined that this route would have a greater potential to adversely affect existing homesites than the proposed route.

3.11.7.4 Substation Site Alternatives

3.11.7.4.1 Substation One. Substation site Alternatives 1A, 1B, and 1C would involve the development of a 500/220/66 kV substation initially equipped as a 220 kV interconnection facility. The scope of Alternatives 1A, 1B, and 1C is the same for each Alternative as well as the proposed Substation One as presented in Section 3.7.1.2. However, the location of each alternative site is different.

Substation One – Alternative 1A. Alternative Substation 1A is located west of the proposed Substation One as shown on Figures 3-1 and 3-3.

The proposed site is desert terrain with a 3 to 4 percent slope from the northwest to the southeast that is diagonal to the proposed substation layout. In order to bring the grade into a slope that is parallel with the substation flow and to reduce the slope to a workable 1.5 to 2 percent, it would be necessary to alter the existing topography through grading.

For the purposes of safety, both for personnel and system, certain other requirements based on the existing conditions are also evaluated. In keeping with a long standing SCE practice, any buried utilities such as pipes, cables, and sewers are deemed an unacceptable encumbrance on the substation facility. Such encumbrances may have easements associated with them that could interfere with the substation operation or contain materials that might pose a fire or explosive hazard.

Site 1A (refer to Figure 3-3), although sufficiently large enough to accommodate the substation, is bisected by a buried pipeline. Due to the efforts that would be required to relocate the underground utilities and to mitigate the associated environmental impacts, Site 1A is not considered a viable alternative for Substation One.

Substation One – Alternative 1B. Alternative Substation 1B is located east of the proposed Substation One as shown on Figures 3-1 and 3-3.

The alternative site is desert terrain with a 3 to 4 percent slope from the northwest to the southeast that is diagonal to the proposed substation layout. In order to bring the grade into a slope that is parallel with the substation flow and to reduce the slope to a workable 1.5 to 2 percent, it would be necessary to alter the existing topography through grading.

Substation One – Alternative 1C. Substation 1C is located approximately 3.5 miles northwest of proposed Substation One adjacent to the east side of Cameron Canyon Road (refer to Figures 3-1 and 3-3).

For the purposes of safety, both for personnel and system, certain other requirements based on the existing conditions are also evaluated. In keeping with a long standing SCE practice, any buried utilities such as pipes, cables, and sewers are deemed an unacceptable encumbrance on the substation facility. Such encumbrances may have easements associated with them that could interfere with the substation operation or contain materials that might pose a fire or explosive hazard.

Site 1C (refer to Figure 3-3), although sufficiently large enough to accommodate the substation, is crossed by two buried pipelines. These pipelines located along both the northern and southern site boundaries restrict the free open area to less than the minimum width needed to construct the substation.

An additional encumbrance in the form of a seasonally active streambed is situated through the center of the site in a narrow eroded draw. The stream is the natural drainage for several hundred acres of rolling hillsides. Any measures designed to alter the course of the stream in order to construct a substation would block the natural course of this stream, causing potential harm to the environment and possibly place the substation at risk should extreme storm conditions overwhelm the altered state.

Alternative Site 1C is also crossed by the Pacific Crest National Scenic Trail.

Due to the efforts that would be required to relocate the underground utilities and to mitigate the associated environmental impacts, Site 1C is not considered to be a viable alternative for Substation One.

3.11.7.4.2 Substation Two. Substation site Alternatives 2A and 2B would involve the development of a 220 kV substation initially equipped as a 220 kV interconnection facility. The scope of Alternatives 2A and 2B is the same for each Alternative as well as the proposed Substation Two as presented in Section 3.7.1.3. However, the location of each alternative site is different.

Substation Two – Alternative 2A. Substation 2A is located approximately 1,000 feet east of proposed Substation Two (refer to Figures 3-1 and 3-3).

For the purposes of safety, both for personnel and system, certain other requirements based on the existing conditions are also evaluated. In keeping with a long standing SCE practice, any buried utilities such as pipes, cables, and sewers are deemed an unacceptable encumbrance on the substation facility. Such encumbrances may have easements associated with them that could interfere with the substation operation or contain materials that might pose a fire or explosive hazard.

Site 2A, although sufficiently large enough to accommodate the substation, is bisected by a buried natural gas pipeline. In addition, the east boundary is the low point of concentration of an estimated 200 acres of hillside drainage. Under the most severe storm conditions any control improvements constructed at this location could redirect surface runoff onto the adjacent improved property. Due to the efforts that would be required to relocate the underground utilities and to mitigate the associated environmental impacts, Site 2A is not considered a viable alternative for Substation Two.

Substation Two – Alternative 2B. Substation 2B is located approximately 1 mile north of proposed Substation Two north of Tehachapi Boulevard (refer to Figures 3-1 and 3-3).

The proposed site is desert terrain with a 1.5 to 2 percent slope north to south. The need for substantial grading is not apparent, yet uneven surface, subsurface conditions, or natural drainage patterns may dictate a raised earth pad or earthen berms.

The approximate location of the substation facilities would be along the eastern site boundary, about midway between the northern and southern boundaries. This position would avoid several streambeds that cross the site as well as a railroad spur that serves a private facility to the north.

3.11.8 Underground Alternative

3.11.8.1 Summary

The Underground Alternative evaluates the proposed project utilizing underground construction in place of overhead line (OHL) construction. SCE was instructed by the CAISO to construct Segment 1 of the Antelope Transmission Project to 500 kV design and construction standards to avoid the construct and tear down of multiple 220 kV T/Ls. SCE anticipates the same instructions from CAISO for Segments 2 and 3. Consequently, SCE has specified Segment 2 and portions of Segment 3 to 500 kV standards. Any underground construction options must meet the requirement for initial operation at 220 kV and operation at 500 kV.

Underground construction is typically proposed due to the belief that it would have less impact on the environment than overhead lines. Installation of an underground T/L requires grading and clearing of trees and vegetation along the R-O-W prior to trenching (i.e., similar to pipeline construction). Such construction is much more difficult and results in much more land disturbance than overhead lines especially in hilly, rugged terrain where OHLs can typically span ridgetop to ridgetop.

The land that needs to be cleared for overhead lines is usually limited to the tower sites, which are generally spaced at least every 800 to 1,500 feet apart in mountainous terrain and to the access and spur roads built for construction and maintenance purposes. Whenever possible, existing roads are utilized to minimize new road construction.

However, in forest areas, trees and other vegetation would be required to be cleared before the underground construction could begin. While in operation, the land required for operation and maintenance must remain free from secondary surface development or lengthy-rooted trees planted along the line route and only restricted vegetation is permitted above the underground route throughout the life of the proposed project. This contributes to a land use similar to that of a secondary road. Also, duct banks, fluid reservoirs, stop joints, and/or retaining vaults are required for certain underground technologies, increasing the need for cleared land and continued all-weather access for operation and maintenance.

The installation of an underground T/L would require more time than required for construction of an equivalent length of overhead line because of the time required for excavating trenches, constructing the duct banks, fluid reservoirs, and/or stop joints and the limitations on times of the year available for construction, which would be chosen to limit the impacts on the environment.

The following four underground technologies for 220 kV and 500 kV are evaluated herein:

1. High-Pressure Fluid-Filled (HPFF) Cables
2. Solid Dielectric (XLPE) Transmission Cables
3. Compressed Gas Insulated T/Ls (CGTL)
4. Self-Contained Fluid-Filled (SCFF)

HPFF transmission cable technology is a viable technical candidate with a proven performance record for use to construct underground T/Ls with system voltages of 220 kV, 345 kV, and 500 kV.

However, given the need for a pressurization/pumping plant, the additional maintenance required for the pumping plant and cathodic protection, the possibility for leaks of the dielectric fluid to the environment and the associated greater impact to the environment associated with these as compared to conventional overhead construction as discussed in more detail below, this technology is eliminated from further consideration.

Solid dielectric transmission cable technology is a proven, viable technology for constructing 220 kV underground T/L. Solid dielectric cables are commercially available at 345 kV and have performed well in recent European installations. 500 kV solid dielectric cables and accessories are beginning to be commercially available; however, their long-term reliability is unproven at this point in time. Given this unknown regarding reliability, this technology is eliminated from further consideration.

Compressed-gas insulated cable technology is a viable technology for constructing 220 kV, 345 kV, and 500 kV underground T/Ls. This type of underground transmission system can easily match the power transfer capabilities of overhead lines; however, its use has primarily been limited to short installations (less than 1,000 feet) due to its relatively high cost.

With consideration for the potential release of SF6 gas to the atmosphere and the associated environmental impact along with the high cost of this option, this technology is eliminated from further consideration.

SCFF transmission cable technology is a possible candidate with a proven performance record for constructing underground T/L with system voltages of 220 kV, 345 kV, and 500 kV. However, the current trend around the world is to use cable system types other than SCFF for 220 kV and 345 kV cable systems for applications other than submarine cables. This is primarily due to the complexity and higher maintenance of this cable system type.

Given the complexity to design, install, and operate in rugged terrain, and the relative unproven reliability of 500 kV cables for long T/Ls as discussed in more detail below, this technology is eliminated from further consideration.

Given the potential for increased significant environmental impact associated with the construction, operation, and maintenance of an underground T/L, the unproven reliability for long distance underground T/Ls, and the high cost of these technologies, undergrounding of the T/L is eliminated as an option.

3.11.8.2 Evaluation of Underground Options

Four different types of transmission cables are commercially available in voltages greater or equal to 220kV. An evaluation of these four alternatives and the rationale why all four options have been eliminated from further consideration follows.

3.11.8.2.1 High-Pressure Fluid-Filled (HPFF) Cables. This type of cable, which is also called pipe-type or high-pressure oil-filled cable, has historically been the most commonly used transmission cable in the U.S. It has been used for approximately 80 percent of the existing transmission cables in this country. In this design, the three high-voltage cables are contained in a coated and cathodically protected steel pipe.

The pipe provides mechanical protection, prevents the ingress of moisture, and is a pressure vessel for maintaining the 200 psig nominal operating pressure on the dielectric fluid that surrounds the cables in the pipe. The primary function of the high pressure dielectric fluid surrounding the cables is to ensure that there are no electrical discharges in the oil-impregnated paper insulation. This is due to the fact that the high pipe pressure causes any gas voids in the insulation to be compressed and eventually absorbed by the dielectric fluid.

A pressurizing plant is required to maintain dielectric fluid pressure and accommodate pipe volume changes under all load conditions. Therefore, the fluid reservoir in the pressurization unit (sometimes called pumping plant) must be sized so that it can accommodate the dielectric fluid, which flows back into it from the cable pipe when the cable is operating at maximum operating temperature. At the other extreme, the reservoir must contain some reserve fluid when the cable is at its lowest temperature and the dielectric fluid flows back into the line pipe. A source of power must be available for each of the required pressurization plants separate from the primary cable system.

Both mineral (petroleum base) oils and synthetic dielectric fluids have been used for the pipe filling fluid. Currently, however, HPFF cable systems use synthetic fluids because of their superior electrical characteristics. These synthetic fluids are either polybutene or alkylbenzene or a mixture of both.

The maximum distance between splices, typically between 1,200 and 2,000 feet, is usually determined by the amount of cable stored on a transportation spool or the maximum pulling tension that may be placed on the cables when they are pulled into the pipe. There are two key maintenance items for this type of cable system that are necessary to insure that it would operate reliably for 40 or more years. First, the fluid pressurization plant must be monitored on a real time basis with telemetry. This may also require a redundant communication path for gauges and alarms. It must also be checked on a routine basis to make sure that there are no fluid leaks, and that the controls and equipment are functioning properly. The second very important maintenance item is checking that the cathodic protection rectifier and corrosion protection coating are functioning properly. The cathodic protection is typically monitored on a quarterly basis.

HPFF cable systems with system voltages ranging from 69 kV up to 345 kV have been in commercial operation for over 35 years. HPFF cable systems with rated system voltages up and including 765 kV are commercially available and have passed long-term qualification tests.

The primary advantages of this type of cable system are:

- It has proven to be a very reliable system since it was first developed over 50 years ago. The oil-impregnated paper tape construction is more forgiving of minor manufacturing defects than solid dielectric insulation systems.
- In urban areas it has the advantage that streets are open just long enough for welding and burying the cable pipe.
- The steel pipe, which encloses the cables, offers mechanical protection with no added cost.
- The pipe facilitates removal and replacement of the cable if necessary. With the recent development of a new generation of smaller diameter polypropylene-paper (PPP) insulated cables, this presents the possibility of upgrading to a higher voltage level with the same pipe.
- The self-cooled power transmission capability can be significantly increased by cooling and circulating the dielectric fluid inside of the pipe.
- There is domestic supply of this type of cable up to 500 kV, and US-made PPP cable has passed industry tests for 765 kV.
- The external magnetic field is significantly lower than any other form of high voltage power transmission.

The primary disadvantages of this underground transmission system are:

- The larger volume of dielectric fluid in the cable pipe means that there is the potential for a larger release to the environment compared to other cable types. This is of particular consequence when streams or other bodies of water are in the vicinity of the alignment.
- A pressurizing or pumping plant is required to maintain dielectric fluid pressure under all load conditions. These plants would require secondary sources of power at the distribution voltage level.
- The cable system requires significantly more maintenance than solid dielectric cables due to the routine maintenance associated with the fluid pressurization plants and the pipe cathodic protection equipment.
- The cable system requires approximately one day to restore service if there is a total loss of dielectric fluid pressure.
- The current carrying capacity of the cable system is somewhat lower than the other types of cable systems with the same conductor size due to the close proximity of the conductors and magnetic losses in the steel pipe.
- Relatively high charging current and dielectric losses. For long lines, facilities may be required to compensate for the capacitive charging current.

- The availability of skilled cable splicers for this technology is becoming a problem.
- Multiple cables and duct banks would be necessary for the required power transfer capability.

In summary, the HPFF transmission cable technology is a viable candidate with a proven performance record for use to construct underground T/Ls with system voltages of 220 kV, 345 kV, and 500 kV.

However, given the need for a pressurization and pumping plant, the additional maintenance required for the pumping plant and cathodic protection, the possibility for leaks of the dielectric fluid to the environment and the associated greater impact to the environment associated with these as compared to conventional overhead construction, this technology is eliminated from further consideration.

3.11.8.2.2 Solid Dielectric (XLPE) Transmission Cables. This type of cable, which is also called extruded dielectric cable, consists of three independent cables. The cable for each of the three phases consists of a stranded copper or aluminum conductor, and extruded semi-conducting conductor shield, the electrical cable insulation (usually cross-linked polyethylene, XLPE), and extruded semi-conducting insulation shield, a metallic shield or sheath, and a plastic jacket. Solid dielectric transmission cables are frequently manufactured with a lead sheath or some other form of radial moisture seal to prevent the exposure of the cable insulation to water. While solid dielectric transmission cables have operated successfully for many years in some areas without such a moisture seal, it is generally accepted that the long-term reliability of solid dielectric cables would be enhanced by the use of a moisture barrier. This is particularly true for solid dielectric cables for the higher transmission voltages. Other optional features of this type of cable are longitudinal water blocking of the conductor and between the cable core and the metallic sheath. This longitudinal water proofing limits the amount of cable that would be contaminated with water in the case of a "dig in" or in the case of a cable fault.

Although ethylene propylene rubber (EPR) insulation has been used for some transmission-class solid dielectric cables, XLPE insulation has been used exclusively for solid dielectric cables with system voltages above 138 kV. Consequently, all future references to solid dielectric cable in this document would be synonymous with XLPE-insulated EHV transmission cables.

Solid dielectric transmission cables are manufactured with insulation thicknesses that are from 1.5 to 2 times those of oil-impregnated paper insulation. However, the thickness of XLPE insulation used for a given system voltage has decreased over time with improvements in the cable materials and manufacturing technology.

This type of cable has been available for system voltages up to 138 kV since the early 1970s; however, there was a lack of widespread acceptance in this country because of poor reliability problems with the cable and accessories for some of the initial installations.

However, this trend has changed in the last 10 to 15 years because of good service reliability which as been observed for most installations outside of the US and for an increasing number of installations in the US. Currently, the number of 220 kV to 230 kV solid dielectric cable installations in the US is also increasing with approximately 50 circuit miles in service.

Elsewhere, hundreds of miles of 220 kV to 275 kV solid dielectric cable systems have been installed in numerous countries around the world and tens of miles of 400 kV solid dielectric cables have been installed in Europe, Asia, and the Near East. Japan completed installation of the first long-distance (two circuits, 25 miles long) 500 kV XLPE transmission cable system in late 2002.

As with other types of transmission cables, one of the fundamental requirements for reliable operation of this type of cable system is the elimination of partial discharges in the cable insulation. This is accomplished by very close manufacturing control to eliminate any contaminants or voids in the cable insulation. Also, the semi-conducting layers must be manufactured with very smooth surfaces or discharges may occur at these locations.

The primary advantages of extruded dielectric cables are:

- No dielectric fluid or pressurizing equipment is required.
- The insulation dielectric losses are significantly lower than for oil/paper insulation.
- The charging current or reactive VARs generated by the cable are significantly less than oil/paper insulation.
- Circuit restoration is quicker and often simpler than for HPFF systems.
- The current ratings are generally higher for than oil-impregnated transmission cables at system voltages at 220 kV and above.
- The cable system design, operation, and maintenance are less complex than systems with pressurized dielectric fluid.

The primary disadvantages of extruded dielectric cables are:

- It does not have the proven long-term reliability record similar to HPFF or SCFF cable systems for system voltages of 345 kV and above.
- It requires extremely good manufacturing process quality control.

- There is only one US manufacturer of extruded dielectric transmission cables with system voltages of 220 kV.
- The high thermal expansion coefficient of the insulation presents special design problems for the metallic sheath and accessories. This results in an operational and performance problem, which directly leads to longevity concerns.
- Special skills and proprietary equipment associated with the cable supplier may be required for cable splicing.
- Multiple cables and duct banks would be necessary for the required power transfer capability.

In summary, solid dielectric transmission cable technology is a proven, viable technology for constructing 220 kV underground T/Ls. Solid dielectric cables are commercially available at 345 kV and have performed well in recent European installations. Solid dielectric 500 kV cables and accessories are beginning to be commercially available; however, their long-term reliability is unproven at this point in time. Given this unknown regarding the reliability, this technology is eliminated from further consideration.

3.11.8.2.3 Compressed-Gas-Insulated T/Ls (CGTL). The compressed-gas-insulated T/L has primarily been used in applications where high power transfer is required, such as short dips in overhead lines or relatively short substation connections (get-aways) to overhead lines.

This type of underground transmission system has been developed with two different configurations. In the three-conductor configuration the three high voltage conductors are contained in a single cylindrical aluminum enclosure. In isolated phase systems the high voltage conductors for each of the three phases are contained in separate cylindrical aluminum enclosures. In both cases epoxy spacer insulators support the high voltage conductor(s) inside of the enclosures that are filled with sulfur hexaflouride (SF6) or a mixture of SF6 and nitrogen (N_2) gases. The first CGTL systems were designed with SF6 gas at pressures from 40 to 60 psig. More recent systems of this type have reduced the SF6 content to 20 percent with the remainder being nitrogen. This change in the insulating gas was due to a combination of increasing cost for the SF6 gas and environmental concerns (depletion of the earth's ozone layer).

The compressed-gas-insulated lines are typically manufactured in straight rigid sections ranging in length from 40 to 60 feet with field welds required to connect the enclosures for adjacent sections. The aluminum enclosure (typically about 19 inches in diameter for a system voltage of 220 to 275 kV) is coated with corrosion protection for applications where the three enclosures are directly buried.

The CGTL can be installed in concrete-covered trenches, directly buried, or installed in tunnels. The primary application for this type of underground transmission is the transfer of large amounts of power at system voltages up to 500 kV. The ampacity rating of CGIT transmission systems is in the order of 3000 to 5000 amperes or 1140 to 1900 MVA at a system voltage of 220 kV.

Relatively short lengths (i.e., less than 1,000 feet) of the 100 percent SF6 compressed-gas underground T/Ls have been installed in the US, Japan, and European countries for several decades. One 275 kV system, installed in a tunnel with other utilities in Nagoya, Japan, is 2 miles long.

The system voltages for these installations have been from 138 kV up to 765 kV. The first commercial application of the second generation CGITL technology was the construction of a "dip" in an existing 400 kV overhead T/L in Geneva, Switzerland in 2000.

The primary advantages of this type of cable system are:

- Power transfer capabilities that are significantly higher than those for other types of underground transmission.
- Relatively simple system design.
- Relatively low magnetic field levels.
- The charging current or reactive VARs generated by the cable are significantly less than all other types of underground transmission systems.
- Dielectric losses (no-load losses) are very low compared to oil/paper cable systems.

The primary disadvantages of compressed-gas insulated transmission systems are:

- Relatively high cost
- Environmental concerns about releases of SF6 gas to the environment
- A relatively high amount of field assembly work is required
- Less flexibility in avoiding other underground obstacles
- Larger right-of-way required compared to other underground cable systems
- System reliability is sensitive to contaminants introduced during field assembly

In summary, compressed-gas-insulated cable technology is a viable technology for constructing 220 kV, 345 kV, and 500 kV underground T/Ls. This type of underground transmission system can easily match the power transfer capabilities of overhead lines;

however, its use has primarily been limited to short installations (< 1,000 feet) due to its relatively high cost.

With consideration for the potential release of SF6 gas to the atmosphere and the associated environmental impact along with the high cost of this option, this technology is eliminated from further consideration

3.11.8.2.4 <u>Self-Contained Fluid-Filled (SCFF)</u>. This type of cable, which is sometimes simply called self-contained cable, consists of three independent cables. The cable for each of the three phases consists of a hollow conductor, which is filled with dielectric fluid, high quality kraft paper (or PPP) insulation, outer shielding, and a lead or aluminum sheath which is covered by a plastic (polyethylene or PVC) jacket. In this construction the metallic sheath serves both as a hermetic moisture seal, and as a pressure containment vessel since the dielectric fluid in the cable is pressurized at 25 to 50 psig. In the case of lead, bronze tapes are frequently required to strengthen the lead sheath and to keep it from deforming due to the cable pressure. The thickness of the oil-impregnated paper insulation is approximately the same as used for HPFF cables. The dielectric fluid utilized in SCFF cable systems are low viscosity synthetic cable dielectric fluids, typically alkylbenzene.

The cable may be directly buried in the earth or it may be installed in concrete-encased duct banks to avoid long lengths of open trench. Since elevation changes along the cable route can significantly affect the fluid pressure, fluid reservoirs and stop joints are required along the length of the cable circuit (typically at each splice location) to segregate the cable into several hydraulic zones. If the cable route is relatively level, then the distance between fluid reservoirs is dictated by the pressure drop along the fluid duct during expansion and contraction of the fluid during temperature excursions. In no case should the pressure be allowed to drop below a minimum level (10 or 15 psig) nor should it be allowed to increase above the maximum allowable pressure determined by the hoop strength of the sheath.

While this type of cable has been used extensively outside of the US, it currently makes up less than five percent of the transmission cable in this country. This cable has been manufactured for system voltages from 69 kV up to 500 kV. There is one relatively short 500 kV SCFF cable installation in the U.S. Long submarine cable circuits are one application where this type of cable has definite advantages over the other types of cables. This is due to the fact that there are overseas submarine cable factories that have the capability of manufacturing this type of cable in lengths exceeding five miles in length – thus avoiding the necessity of having field- or factory-installed joints.

As in the case of HPFF cable, SCFF cables are designed with quite high electrical stresses and the cable dielectric fluid must be pressurized to suppress ionization – otherwise an electrical breakdown would occur.

The primary advantages of this type of cable system are:

- Good long-term reliability
- Higher rating than pipe-type cables, if directly buried
- Domestic supply available
- Dielectric fluid is present, but in much smaller quantities than HPFF cables
- Can be manufactured in very long lengths without splices for submarine cable applications

The primary disadvantages for this cable type are:

- Historically, higher maintenance than HPFF or solid dielectric cable systems
- More complex to design and operate compared to solid dielectric cable systems
- Concerns about dielectric fluid leaks
- Relatively high charging current and dielectric losses
- Higher magnetic fields than HPFF cable systems
- The availability of skilled cable splicers for this technology is becoming a problem
- Multiple cables and duct banks would be necessary for the required power transfer capability

In summary, the SCFF transmission cable technology is a possible candidate with a proven performance record for constructing underground T/Ls with system voltages of 220 kV, 345 kV, and 500 kV. However, the current trend around the world is to use cable system types other than SCFF for 220 kV and 345 kV cable systems for applications other than submarine cables. This is primarily due to the complexity and higher maintenance of this cable system type.

Given the complexity to design, install, and operate in rugged terrain, and the relative unproven reliability of 500 kV cables for long T/Ls, this technology is eliminated from further consideration.

3.11.8.3 Conclusion

Given the potential for increased significant environmental impact associated with the construction, operation, and maintenance of an underground T/L, the unproven reliability for long distance underground T/Ls, and the high cost of these technologies, undergrounding of the T/L from Antelope to Vincent and/or Antelope to Substation One and Substation One to Substation Two has been eliminated as an option for further consideration.