3.0 ALTERNATIVES

The following sections discuss alternatives to the Palomar Energy Project as proposed in this AFC. These include the “no project” alternative, power plant site alternatives, linear facility route alternatives, plant design alternatives, and power generation technology alternatives. These alternatives were evaluated in relation to the environmental, technological, public policy, and business issues embodied in the objectives of the proposed project. The objectives of the Palomar Energy Project are as follows:

- Add an efficient, reliable, dispatchable, and environmentally sound power generating facility of substantial size to the SDG&E load pocket.
- Interconnect the facility at a location within the SDG&E load pocket that results in a megawatt-for-megawatt addition to the load-serving capability of the SDG&E transmission grid (i.e., avoid the displacement of existing SDG&E import capability, avoid the displacement of existing generating capacity, avoid intra-zonal congestion). Generally, this objective translates to locating the facility near electrical load.
- Avoid the construction of new transmission lines (i.e., locate the facility adjacent to existing transmission lines and/or substation facilities that will accommodate interconnection of the project).
- Locate the facility in a portion of the SDG&E gas system that minimizes the need for system upgrades.
- Locate the facility in an area with readily available non-potable water of sufficient quantity and quality to meet the facility’s process water requirements.
- Locate the facility at a site with compatible adjacent land uses.
- Given that some of the above objectives lead to siting of the facility in or near an urban area, locate the facility at a site that offers landforms that are substantial enough to afford significant visual screening but do not adversely affect plume dispersion.

The approach of Palomar Energy, LLC is to strive to meet the above objectives in order to create a project with superior fundamental environmental and economic characteristics. The conclusion of the analyses of the various alternatives is that only the proposed project meets these objectives.

3.1 “NO PROJECT” ALTERNATIVE

Over the past decade, the population growth and economic growth in California has created a steadily increasing demand for electrical power. However, the growth in electrical generating capacity serving California has not kept pace with the growth in demand. This imbalance has led to a shortfall in generating capacity, with potentially serious consequences for California’s residents and businesses. Such consequences started to appear in 2000. Electrical demand forecasts predict continuing growth over the coming years, which makes the need for additional generating capacity even more acute.

In particular, the SDG&E load pocket faces future prospects of inability to serve load due to insufficient SDG&E import capability combined with insufficient local generating capacity. This problem is of particular concern for the northern two-thirds of the SDG&E system. Generation projects recently added to the southern third of the SDG&E system do little to alleviate this concern, as they are located south of transmission constraints. Addressing this concern is a key objective of the proposed project, and the “no project” alternative would not meet this objective.

The Palomar Energy Project is among those resources that have been identified as potential suppliers of electricity under a contract between Sempra Energy Resources and the California Department of Water Resources for the sale of 1,900 MW. The proposed project will provide competitively priced electrical power to help meet California’s growing demand, and it will help replace nuclear and fossil fuel generation resources that are retired due to age or cost of producing power. The “no project” alternative would not meet these objectives.

Given the need for additional generating capacity, and even with the various other power plants under construction and proposed, the "no project" alternative likely would result in more energy production from existing power plants than otherwise would occur with the Palomar plant in operation. Because the proposed project will employ advanced combustion turbine technology and state-of-the-art emissions control systems, existing power plants operating in place of the Palomar plant most likely would consume more fuel and emit more air pollutants per kilowatt-hour generated.

According to the CEQA Guidelines, in addition to considering existing environmental conditions, the “no project” analysis is to consider what would be reasonably expected to occur in the foreseeable future if the project were not approved (14 CCR Sec. 15126.6(e)(3)). The Guidelines state that the analysis is to consider predictable actions such as the proposal of some other project. The 20-acre area proposed as the Palomar project site is within a 186-acre area planned as an industrial park pursuant to the 1988 Quail Hills Specific Plan as well as the draft Escondido Research and Technology Center Specific Plan currently under review by the City of Escondido. It is therefore foreseeable that grading and other improvement of an industrial park will take place, including the area proposed as the Palomar project site. However, if the Palomar project were not constructed, the site would be instead improved with other industrial land uses, and the objectives of the Palomar project would not be met.

In summary, the "no project" alternative would not serve the growing needs of residents and businesses in California and in the San Diego load pocket in particular for efficient, reliable, and environmentally sound power generation resources.

3.2 POWER PLANT SITE ALTERNATIVES

The project objectives described previously were used to guide the selection of an appropriate site for the Palomar project. Nine alternative locations were investigated. Locations were postulated that are adjacent to existing, substantial SDG&E transmission lines and/or substation facilities in order to avoid the construction of new transmission lines. To assess electrical interconnection issues for each alternative, SDG&E was commissioned to prepare the System Impact Study provided as Appendix B. The nine alternatives are as follows, and their locations relative to SDG&E electric transmission facilities are shown in Figure 3.2-1:

- Escondido: a site along the Escondido-Sycamore Canyon/Escondido-Encina 230 kV transmission lines, near Escondido Substation (the site proposed in this AFC).
- San Marcos: a site along the Escondido-Sycamore Canyon 230 kV transmission line, at the retired North County Resource Recovery Facility in the City of San Marcos.
- Sycamore Canyon: a location near the 230 kV Sycamore Canyon Substation at the north edge of the Miramar Marine Corps Air Station, south of the City of Poway.
- Penasquitos: a location near the 230 kV Penasquitos Substation in the Sorrento Hills area of the City of San Diego.
- Mission: on the 230 kV Mission Substation site in the Serra Mesa area of the City of San Diego.
- Rainbow: a location along the Talega-Escondido 230 kV transmission line, near the community of Rainbow.
- Talega: a location near the 230 kV Talega Substation, in southern Orange County.
- San Luis Rey: a location near the 230 kV San Luis Rey Substation, in the City of Oceanside.
- Sampson: on the retired Silvergate Power Plant site, interconnecting with the 69 kV Sampson Substation in the City of San Diego.

The alternative locations were evaluated in relation to the project objectives. The conclusions of this evaluation are as follows:

- Escondido: The transmission grid will accommodate a nominal 500 MW facility at this location. The proposed site meets all of the project objectives.
- San Marcos: The transmission grid will accommodate a nominal 500 MW facility at this location. This site meets the project objectives except a) availability of non-potable water is uncertain, b) the site is surrounded by open space rather than industrial land uses, and c) adjacent terrain over 200 feet higher than the site bounds the site on two sides, presenting plume dispersion and/or stack height issues.

Figure 3.2-1 Power Plant Site Alternatives

Sycamore Canyon: The transmission grid will accommodate a nominal 500 MW facility at this location. This location meets the project objectives except a) availability of non-potable water is uncertain, b) the location consists of open space rather than industrial land uses, and c) the terrain at this location is extremely steep and may present plume dispersion/stack height issues depending upon the specific site. Land at this location is not readily available as it is part of the Miramar Marine Corps Air Station reserve under federal ownership.

- Penasquitos: The transmission grid will accommodate a nominal 250 MW facility at this location, and might accommodate a 500 MW facility. However, this location is largely residential, and there are no sites available with compatible adjacent land uses.
- Mission: The transmission grid will accommodate a nominal 250 MW facility at this location, and would probably accommodate a 500 MW facility. However, there is not sufficient land available on the Mission Substation site to accommodate even a 250 MW facility.
- Rainbow: Interconnecting a generating facility at this location would tend to use and/or displace import capability into the SDG&E load pocket (i.e., there would tend to be no net addition to the load-serving capability of the SDG&E transmission grid).
- Talega: Interconnecting a generating facility at this location would tend to use and/or displace import capability into the SDG&E load pocket (i.e., there would tend to be no net addition to the load-serving capability of the SDG&E transmission grid).
- San Luis Rey: The transmission grid will accommodate a nominal 250 MW facility at this location, and might accommodate a 500 MW facility. However, this location is largely residential, and there are no sites available with compatible adjacent land uses.
- Sampson: The transmission grid will accommodate a nominal 250 MW facility at this location. However, the Silvergate Power Plant site might not be large enough to accommodate such a facility, and this location would necessitate substantial upgrades to the SDG&E gas system.

The Escondido, San Marcos, and Sycamore Canyon alternatives are substantially superior to the other six. The Escondido site was selected because it is the only alternative that is clearly feasible in all respects, and it is the only one that meets all of the project objectives. In particular, the Escondido site:

- accommodates the addition of a 500 MW facility to the SDG&E load pocket,
- results in a megawatt-for-megawatt addition to the load-serving capability of the SDG&E transmission grid,
- avoids the construction of new transmission lines, as an existing 230 kV line that will accommodate facility interconnection is located immediately adjacent to the site,

- minimizes the need for SDG&E gas system upgrades, as an existing 16-inch pipeline with sufficient capacity to serve the facility is located immediately adjacent to the site,
- makes use of readily available non-potable water from the City of Escondido's nearby Hale Avenue Resource Recovery Facility for the facility's process water requirements,
- is surrounded by existing and future industrial land uses, and
- offers landforms that are sufficient in size to screen the facility but are not problematic for plume dispersion.

3.3 LINEAR FACILITY ROUTE ALTERNATIVES

3.3.1 Transmission Line Route Alternatives

Avoiding the construction of new transmission lines is an important objective of the Palomar project. The proposed project meets this objective, as an existing 230 kV line that will accommodate facility interconnection is located immediately adjacent to the project site. Because no new transmission lines are needed for the project, no transmission line route alternatives were evaluated.

3.3.2 Natural Gas Pipeline Route Alternatives

Minimizing the need for upgrade of the existing SDG&E gas system is an important objective of the Palomar project. The proposed project meets this objective, as an existing 16-inch natural gas pipeline with sufficient capacity to serve the project is located immediately adjacent to the project site. In order to relieve a bottleneck in a segment of the existing SDG&E gas system located about 1 mile northeast of the project site, SDG&E will construct an upgrade consisting of approximately 2,600 feet of 16-inch pipeline. This upgrade will be installed in existing paved streets along its entire route. As this construction by SDG&E will have impacts that are both minimal and short-term in nature, no natural gas pipeline route alternatives were evaluated.

3.3.3 Reclaimed Water and Brine Return Pipeline Route Alternatives

Reclaimed water will be supplied to the project by the City of Escondido's nearby Hale Avenue Resource Recovery Facility (HARRF). The water will be conveyed by a new 1.1 mile, 16-inch pipeline extending from an existing City of Escondido reclaimed water main. Brine from the project will be returned to the HARRF by a new 1.1 mile, 8-inch return pipeline routed alongside the reclaimed water supply pipeline and extending to a connection point with a planned City of Escondido brine return main. The new pipelines will be installed in existing paved streets along a portion of their route, and the remainder of their route extends through an area that will be fully disturbed by grading of the planned 186-acre industrial park.

The latter, remainder portion of the pipeline route runs north-south, parallel to an existing SDG&E transmission corridor and roughly parallel to the future Citracado Parkway to be constructed with the industrial park. The pipeline may be installed in the future Citracado

Parkway instead of strictly parallel to the SDG&E transmission corridor. However, the Citracado Parkway alignment lies within the area that will be fully disturbed by grading of the industrial park, lies well within the biological resource survey corridor for the pipeline route, and would have essentially identical impacts to an alignment strictly parallel to the SDG&E transmission corridor.

A pipeline route was briefly considered that represents an alternative to the portion of the route that extends along existing paved streets. However, this alternative would have required a crossing of Escondido Creek, and it was abandoned when it was learned that connection points for both the reclaimed water supply pipeline and brine return pipeline already exist on the project's side of the creek.

As construction of the pipelines along the proposed route (including the Citracado Parkway alignment variation) will have impacts that are both minimal and short-term in nature, no other route alternatives were evaluated.

3.4 PLANT DESIGN ALTERNATIVES

3.4.1 NO_x Control Alternatives

To minimize NO_x emissions from the Palomar project, the combustion turbine-generators (CTGs) will be equipped with dry low NO_x combustors, and the heat recovery steam generators will be equipped with post-combustion selective catalytic reduction (SCR) using aqueous ammonia as the reducing agent.

The following combustion turbine NO_x control alternatives were considered:

- Dry low NOx combustors,
- Water/steam injection,
- SCR
- SCONOxTM
- Catalytica XONONTM

A combination of dry low NO_x combustors and SCR was selected because this approach results in the lowest achievable emission rates and is the only alternative to do so reliably. Further information on the alternative technologies and the selection process is provided in Section 5.2.

The following reducing agent alternatives were considered for use with the SCR system:

- Aqueous ammonia
- Anhydrous ammonia

Both aqueous ammonia (a dilute solution of water and ammonia) and anhydrous ammonia (pure ammonia, a liquid when under pressure, but gaseous at typical ambient conditions) are used in many combined cycle facilities for NO_x control. However, anhydrous ammonia is usually not selected for projects in urban settings because of the potential for off-site exposure in the event of an accidental release. For this reason, a dilute solution of aqueous ammonia (<20 percent ammonia, >80 percent water) was selected for use by the Palomar project.

3.4.2 Inlet Air Cooling Alternatives

Combustion turbine output and efficiency both increase as inlet air temperature decreases. Ambient air temperatures for the proposed project are sufficiently high for a large portion of the year to warrant some form of inlet air cooling. Two common forms of combustion turbine inlet air cooling are evaporative cooling and air chilling.

Evaporative cooling is capable of cooling the inlet air to temperatures near the ambient wet-bulb temperature. Air chilling is capable of cooling the inlet air to temperatures far below the ambient wet-bulb temperature, and it is able to maintain a low temperature over a wide range of ambient conditions. Air chilling uses mechanical or absorption refrigeration to produce a cold fluid for cooling of the inlet air, and its capital cost greatly exceeds the cost of evaporative cooling. Air chilling systems may be designed to operate continuously, or they may be designed to produce ice or cold water during off peak periods for cooling of the inlet air during peak periods.

Based on temperature profiles at the proposed site, evaporative cooling was selected for the Palomar project to optimize output and efficiency versus capital cost.

3.4.3 Heat Rejection Alternatives

The Palomar project will employ a surface condenser cooled by circulating water, with heat rejection provided by a mechanical draft, plume-abated, wet cooling tower. Dry cooling (employing an air-cooled condenser) was considered as an alternative. The wet cooling tower with plume abatement was found to be the most cost-effective heat rejection system, and it also yields the highest plant output and efficiency.

The advantages of an air-cooled condenser are reductions in makeup water requirements, water vapor plume, and cooling tower drift. Plume and drift are not necessarily eliminated because, even if an air-cooled condenser is used, a wet cooling tower generally still is required to provide cooling water for plant auxiliaries such as generator coolers and lubrication oil coolers.

However, air-cooled condensers are much more expensive than wet cooling systems, and they have a substantial negative impact on plant output and efficiency. Air-cooled condensers also require much more space, which is limited at the Palomar site, and they result in a generating facility that is visually much more prominent than a facility that employs a wet cooling system.

Because reclaimed water of sufficient quantity and quality to meet the project's cooling needs is available from the City of Escondido's HARRF, dry cooling was eliminated from consideration.

3.4.4 Water Supply Alternatives

The Palomar project will utilize reclaimed water supplied from the City of Escondido's nearby HARRF. This availability of reclaimed water meets an important project objective, and no alternative water supply sources were evaluated.

3.4.5 Wastewater Disposal Alternatives

Wastewater from the Palomar project can be discharged to the City of Escondido's wastewater systems if the wastewater meets quality standards of the City of Escondido. The Palomar project will meet the applicable standards by segregating its wastewater into a sanitary wastewater stream and a brine return stream. The sanitary wastewater will meet the standards for and be discharged to the City of Escondido's general sewer system, and the brine return will meet standards for and be discharged to the City of Escondido's brine return system.

A zero discharge alternative also was considered. This alternative would require the addition of several power plant design features:

- Raw water pretreatment to soften the water and allow operation of the cooling tower at higher cycles of concentration, thereby reducing the volume of cooling tower blowdown produced,
- Process equipment employing evaporation and crystallization technology to reduce the volume of wastewater and also produce reusable water,
- Additional water reuse loops in the plant water management design, and
- Sludge dewatering equipment and offsite sludge disposal.

Addition of the necessary processes and equipment to implement the zero discharge alternative would result in increased capital cost, increased operating and maintenance cost, additional auxiliary power consumption, and additional site space requirements. This alternative would also substantially increase on-site chemical handling and storage requirements, and would produce large quantities of sludge that must be properly disposed of off-site. These disadvantages were found to outweigh the water saving advantage of the zero discharge alternative, especially given that the project will use reclaimed water rather than potable water to meet its process water requirements.

3.5 POWER GENERATION TECHNOLOGY ALTERNATIVES

The first objective of the Palomar Energy Project is to add an efficient, reliable, dispatchable, and environmentally sound power generating facility of substantial size to the SDG&E load pocket. The power generation technology selected to meet this objective is a natural gas-fired combined cycle utilizing "F" class combustion turbines.

Alternative power generation technologies were considered to determine if any could more effectively meet the project objectives. However, several technologies were not considered because they would clearly not meet the project objectives. For example, some of the project objectives lead to siting of the facility in or near an urban area, and coal-based technologies were not considered suitable for such an environmental setting. This eliminated technologies such as pulverized coal, fluidized bed combustion, and integrated gasification combined cycle. Another project objective is dispatchability, which is a power plant's ability to respond to power output levels and ramp rates dictated by the Independent System Operator or by market conditions. This objective, together with the essential requirement of producing power at a competitive price, eliminated technologies such as nuclear, wind, and solar. Other technologies such as geothermal and hydroelectric were eliminated because the required energy resource is not available in the San Diego load pocket.

Power generation technologies that have at least some possibility of meeting the project objectives were considered and are discussed below. These technologies are all fueled with natural gas, and include conventional combined cycle (the proposed technology), simple cycle, steam cycle, Kalina combined cycle, advanced combustion turbine cycles, and combustion turbine types alternative to the proposed "F" class machines.

3.5.1 Conventional Combined Cycle

This technology consists of the combined use of combustion turbines and steam turbines to achieve higher efficiencies than either type of turbine can achieve individually (hence the term "combined cycle"). The combustion turbine drives a generator, and the high temperature exhaust from the combustion turbine is ducted through a heat recovery steam generator to produce high pressure steam that is used to drive a steam turbine-generator. This technology is able to achieve efficiencies up to about 52 percent, considerably higher than the efficiency of either a combustion turbine alone (i.e., simple cycle) or a steam turbine alone (i.e., steam cycle). This higher efficiency results in both lower fuel usage and lower air emissions per kilowatt-hour produced. Because of its efficiency, reliability, dispatchability, superior environmental performance, and economical capital and operating costs, this technology was selected for the proposed Palomar facility. This technology also has been selected for most other new base load and intermediate load power plants being developed in the United States.

3.5.2 Simple Cycle

This technology uses a combustion turbine to drive a generator, and the high temperature exhaust is released directly to the atmosphere. Simple cycle combustion turbines have relatively low capital cost and rapid startup capability. However, this technology is relatively inefficient, and the most efficient combustion turbines (aeroderivative machines) have efficiencies up to only about 38 percent. As a result, this technology is typically used for meeting peak demand for short periods of time, where efficiency is not of primary concern. This technology produces more air emissions than more efficient technologies, because the high exhaust temperature makes it difficult to apply post-combustion emission controls, and because more fuel must be burned to produce a given amount of electricity. Due to its relatively low efficiency and less than optimal environmental performance, this technology was eliminated from consideration.

3.5.3 Steam Cycle

This technology burns fuel in a boiler to produce high pressure steam that is used to drive a steam turbine-generator. The low pressure steam leaving the turbine is condensed and returned to the boiler. This technology is relatively inefficient, and is able to achieve efficiencies up to only about 36 percent when burning natural gas fuel. As a result, this technology produces more air emissions than more efficient technologies, because more fuel must be burned to produce a given amount of electricity. Due to its relatively low efficiency and less than optimal environmental performance, this technology was eliminated from consideration.

3.5.4 Kalina Combined Cycle

This technology is similar to conventional combined cycle technology, except the heat recovery steam generator utilizes an ammonia/water mixture instead of pure water. The overall efficiency of this technology is potentially several percent greater than conventional combined cycle technology. However, because this technology is still in the development phase and is not commercially available, it was eliminated from consideration.

3.5.5 Advanced Combustion Turbine Cycles

In addition to conventional combined cycle technology, there are a number of advanced combustion turbine technologies that have been conceived to enhance the efficiency of combustion turbines. These include the humid air turbine (HAT) cycle, the chemically recuperated gas turbine (CRGT) cycle, and the intercooled steam recuperated gas turbine (ISRGT) cycle. However, none of these technologies are commercially available. Another technology, the steam injected gas turbine (STIG), is commercially available, but it is less efficient and produces more air emissions than conventional combined cycle technology. Based on the above factors, these technologies were eliminated from consideration.

3.5.6 Alternative Combustion Turbine Types

The latest generation of commercially proven combustion turbine technology, commonly referred to as “F” technology, was selected for the Palomar project. Selection of this class of combustion turbines was based on economies of scale, fuel efficiency, operational flexibility, and status of commercial demonstration.

For an overall combined cycle output of 500 MW, total combustion turbine output is in the range of 300 to 350 MW. Given the magnitude of this output, combustion turbine selection focused on models larger than 80 MW in order to take advantage of economies of scale. In addition, many of such larger combustion turbine models offer fuel efficiencies and emissions performance that are equivalent or superior to those of smaller models.

Currently available, large combustion turbine models can be grouped into three classes: conventional, advanced, and next generation. Conventional combustion turbines operate at firing temperatures in the range of 2000°F to 2100°F, and are available in sizes up to about 110 MW. Advanced combustion turbines operate at firing temperatures above 2300°F, and are available in sizes up to about 170 MW. Next generation combustion turbines have higher firing temperatures than the advanced turbines and have additional features that provide greater output and somewhat higher efficiencies. Next generation turbines represent models that have been announced by the manufacturers as commercially available, with advertised outputs in the range of 230 to 240 MW.

Examples of commercially available combustion turbines in each class are as follows:

Manufacturer	Conventional	Advanced	Next Generation
ABB	GT 11N2	GT 24	None
GE	7EA	7FA	7H
Siemens	V84.2	V84.3A	None
Westinghouse	501D5A	501F	501G

Advanced combustion turbines offer significant advantages for the proposed project. Their higher firing temperatures offer higher efficiencies than conventional combustion turbines. They offer proven technology, with numerous installations and extensive run time in commercial operation. Emission levels are also proven, and guaranteed emission levels have been reduced based on operational experience and design optimization by the manufacturers. In comparison, the environmental performance and efficiencies of next generation turbines have not been demonstrated in commercial operation. Furthermore, next generation turbines may not be suitable for the frequent startups and periods of low load operation anticipated for the Palomar project.

Two specific advanced combustion turbine models were considered for the Palomar Energy Project, the GE 7FA and the Westinghouse 501F. These turbine models were given consideration because of their commercially proven status, demonstrated emission levels, high thermal efficiencies, and adequate operational flexibility. Of the two turbine models, the GE 7FA offers better emissions performance (9 ppm versus over 20 ppm for the Westinghouse 501F) and more extensive run time in commercial operation. The GE 7FA was selected for the Palomar project because it best supports the project objective of adding an efficient, reliable, dispatchable, and environmentally sound power generating facility of substantial size to the SDG&E load pocket.