SECTION 9.0

Alternatives

In a CEQA alternatives analysis, the range of alternatives should be limited to those that would attain most of the basic objectives of a proposed project, would be feasible, and would avoid or substantially lessen any of the significant adverse effects of the project. Factors to consider include site suitability, availability of infrastructure, general plan consistency, other plans or regulatory limitations, jurisdictional boundaries, economic viability, and whether the Applicant can reasonably acquire, control or otherwise have access to an alternative site. A CEQA alternatives analysis need not consider an alternative whose impact cannot be reasonably ascertained and/or whose implementation is not feasible.

A CEQA alternative to a given project must permit feasible attainment of most of the project's basic objectives, without consideration of cost relative to the proposed project; it need not fully attain all the project goals.

This section identifies and evaluates a range of reasonable alternatives to the proposed Chevron Richmond Refinery Power Plant Replacement Project (PPRP, or the Project) pursuant to the required CEQA alternatives analysis process. This section includes the following sections:

- **Section 9.1—Project Objectives.**
- **Section 9.2—No Project Alternative.** Provides information on what would be expected to occur if the PPRP does not occur.
- **Section 9.3—Alternative Sites Analysis.** Provides a discussion of potential site selection and examines why alternative sites were not feasible.
- **Section 9.4—Alternative Project Configurations.** Provides information on other feasible power generation configuration alternatives to the combustion turbine and steam generator currently proposed for the PPRP.
- **Section 9.5—Alternative Power Generating Technologies.** Provides information on alternative power generation technologies that were considered for the PPRP.

9.1 Project Objectives

Chevron's basic objectives for the PPRP include the following:

- To safely construct and operate a nominal 60-megawatt (MW) addition to Refinery generation capacity
- To provide additional electrical generation to meet the Refinery's growing electrical load
- To replace the aged boiler plant steam supply with a more efficient state-of-the-art cogeneration system steam supply and shut down the existing boiler plant

- To incorporate energy efficiency in the new hydrogen plant replacement by recovering heat for steam and power generation
- To improve the reliability of critical Refinery operations by reduced dependence on power imported from the PG&E grid
- To assist the State of California by reducing the amount of utility power used by the Refinery, thus helping to reduce the state's dependence on imported power
- To contribute to the diversification of the area's economic base by providing increased employment opportunities during construction and additional tax base
- To enhance the reliability of local power supply through self-generation of power

9.2 No Project Alternative

9.2.1 Description

Under the No Project Alternative, Chevron would not receive authorization to construct and operate the proposed new power generation facilities, meaning that Chevron would continue to operate the aging, inefficient steam generation facilities (Power Plant #1) and would not incorporate energy recovery provisions in the new hydrogen plant. The following analysis considers the effects of the No Project Alternative.

Compared to the proposed Project, the No Project Alternative would avoid all potential construction-related impacts to air quality, noise, traffic, geology, soil resources, hazardous materials, public health, traffic and transportation, water resources, and cultural resources because the electrical generating facilities would not be constructed. From an operational standpoint, the No Project Alternative will avoid any impacts associated with air quality and visual resources because no changes in current steam generating facilities operations or location would occur. The No Project Alternative would also result in some energy inefficiency associated with the new hydrogen plant, as high-pressure steam produced in the new hydrogen plant would need to be introduced directly to the Refinery's lower-pressure main steam system through a pressure reducing station instead of being expanded through a new steam turbine to generate electricity.

Although the No Project Alternative is technically feasible, it would fail to meet many of Chevron's Project objectives. If the PPRP is not implemented, the Refinery would continue to operate using existing inefficient steam generating facilities and would require extensive maintenance with long shutdown periods as compared to the proposed Project. The Project would provide significant energy efficiency and reliability, whereas implementation of the No Project Alternative could result in adverse effects to energy supplies and climate change due to the use of existing inefficient, aging steam generation equipment, and could ultimately affect public safety through an increase in Refinery upsets due to the unscheduled outage of the existing steam generating facilities. Therefore, the No Project Alternative would directly conflict with the stated objectives of the Project.

9.2.2 Potential Environmental Impacts

Implementation of the proposed Project would produce energy-efficient electricity and steam to serve the Refinery in a manner that would consume less fuel. The No Project Alternative would provide for the continued operation of the existing, older steam generation facilities and a less efficient new hydrogen plant. These existing steam generation facilities produce steam but no electricity, with a lower efficiency (energy production per unit of energy consumed), resulting in the consumption of more energy resources than would be the case with implementation of the proposed Project. Furthermore, the No Project Alternative would mean air pollutants would be emitted at a higher rate on a pound per unit energy basis than under the proposed Project. Overall, the No Project Alternative would not avoid significant environmental impacts as compared to the proposed Project.

9.3 Alternative Sites Analysis

The Project is proposed to replace existing steam generation facilities at the Refinery, to add electricity generation for more energy-efficient hydrogen production, and to increase the overall generation of electrical power. The location of the proposed Project components outside of the Refinery would not reduce any significant impact, but would likely result in new significant impacts associated with Project development and the need to transmit steam and electricity to the Refinery. Furthermore, it would not be feasible to locate the hydrogen plant steam generator offsite, at a location distant from its source of steam. Therefore, evaluation of alternative offsite locations was not performed.

Furthermore, as the Project is not expected to have significant unmitigated impacts at the proposed site, relocating to another location at the Refinery would not reduce impacts below the levels identified for the Project. Therefore, evaluating alternative onsite locations for the Project was not performed.

9.4 Alternative Project Configurations

The Applicant has reviewed two configurations for the replacement of steam production currently generated by the Refinery's power house. The two configurations were reviewed for the cogeneration aspect of the Project (Cogen 3000). The focus of this review was on combined cycle combustion turbine systems due to energy efficiency considerations and the need for both electrical and steam generation for Refinery process use. The two alternatives reviewed by the Applicant were the General Electric (GE) LM6000 SPRINT® and the GE Frame 6B. Both configurations provide a high thermal efficiency and reliability. Furthermore, both systems generate both electricity and steam. However, the selection of the Frame 6B engine was made based on its ability to fire the types of fuels (specifically butane) available at the Refinery.

The alternative of not utilizing high-pressure steam generated in the hydrogen plant for electricity generation was rejected as being less energy-efficient relative to the proposed configuration, since high-pressure steam would need to be let down to a lower pressure in order to be introduced to the Refinery main steam header.

9.5 Alternative Power Generating Technologies

A review of alternative technologies was limited to those technologies that allowed for continuous steam and electrical production; technologies with limited capacity to generate these commodities on a continuous basis were eliminated as not feasible.

9.5.1 Selection Methodology

Technologies considered were primarily those that could provide baseload steam and power generation. The reason for using this screening criterion was Chevron's need for continuous steam and electricity to support Refinery operations. Two intermittent technologies with no fuel cost, solar and wind, were examined but rejected as not feasible due to the intermittent nature of these technologies.

The selection methodology included a stepped approach with each step containing a number of criteria. The selected technology would have to pass Steps 1 and 2 and provide the lowest or near lowest cost in Step 3. The steps are as follows:

Step 1. Commercial Availability—The technology had to be proven commercially practical with readily available, reliable equipment.

Step 2. Implementable—The technology had to be implementable; specifically, it had to be able to meet baseload generating needs as well as environmental, public safety, public acceptability, fuel availability, financial, and system integration requirements.

Step 3. **Cost-effective**—The technology had to be cost-effective. Relevant costs included both capital and operation and maintenance costs.

This methodology was applied to a number of potential baseload generation technology alternatives, as discussed below.

9.5.2 Technologies Reviewed

The technologies reviewed can be grouped according to the fuel used (i.e., oil, natural gas, coal, nuclear, water (including hydropower, ocean conversion, and geothermal), biomass, municipal solid waste, and solar radiation). However, due to the need for baseload generation and steam production, many of the technologies were immediately rejected due to not being feasible. These technologies were simple-cycle combustion turbines, solar thermal, photovoltaic, wind, hydroelectric, and ocean energy. Furthermore, biomass, municipal solid waste, coal, and nuclear technologies were excluded due to environmental, cost, and public acceptance concerns.

9.5.2.1 Oil and Natural Gas

These technologies use oil or natural gas and include combustion turbines in various configurations, and fuel cells. Descriptions of these technologies are presented below.

Conventional Cogeneration Cycle

This technology integrates combustion turbines and heat recovery steam generators to achieve higher efficiencies. The combustion turbine, which drives a generator, would normally exhaust its hot combustion gas to the atmosphere. However, in the cogeneration

cycle technology, the exhaust gas is passed through a heat recovery steam generator, creating steam that is used to provide steam to the Refinery. The resulting CHP (combined heat and power) efficiency for the system is 70 to 85 percent, which is considerably greater than most other alternatives. In addition, natural gas fuel emits little sulfur dioxide and little particulate matter. For these reasons, the system is considered the benchmark against which all other base load technologies are compared. Applying the review methodology, this technology is commercially available, economical, and can be implemented. Therefore, this technology satisfies Steps 1, 2 and 3.

Kalina Combined-Cycle

This technology is similar to the conventional combined-cycle except water in the heat recovery boiler is replaced with a mixture of water and ammonia. As this technology does not generate steam required for continued Refinery operation, it fails Step 2 and is rejected.

Advanced Gas Turbine Cycles

There are numerous technologies being developed to enhance the performance and/or efficiency of gas turbines by injecting steam, intercooling, and staged firing. These include the steam-injected gas turbine (SIGT), the intercooled steam-recuperated gas turbine, the chemically recuperated gas turbine, and the humid air turbine cycle. The SIGT is commercially available and does pass Steps 1 and 2. However, due to the untested nature of this technology in a refinery setting where high levels of reliability are required, it was eliminated from consideration.

9.5.2.2 Fuel Cells

This technology uses an electrochemical process to combine hydrogen and oxygen to liberate electrons, thereby providing a flow of current. The types of fuel cells include phosphoric acid, molten carbonate, solid oxide, alkaline, and proton exchange membrane. With the exception of the phosphoric acid fuel cell and possibly the molten carbonate fuel cell, none of these technologies are commercially available in the size required for the Project and therefore fail Step 1. The phosphoric acid fuel cell has been operated in smaller-size units, and the molten carbonate fuel cell has completed testing. However, currently neither of these technologies are cost-competitive with conventional combined-cycle technology, and therefore fail Step 3 of the review methodology.

9.5.2.3 Water

These technologies use water as “fuel” and include geothermal (discussed separately below). Other water technologies (hydroelectric and ocean energy conversion) were excluded due to the inherent limitations in these technologies to provide baseload electrical generation and steam production. In addition, it is not clear that these technologies would minimize environmental impacts relative to the proposed Project.

Geothermal

These technologies use steam (vapor-dominated resource) or high-temperature (liquid-dominated resource) water (HTW) obtained from naturally occurring geothermal reservoirs to drive steam turbine/generators. Geothermal technologies use a number of heat recovery techniques to extract energy from the geothermal resource. Geothermal technologies are a commercially available technology. However, geothermal resources are limited, and most, if not all, economical resources have been discovered and developed in

California. Furthermore, no known geothermal resource areas (KGRA) are located near the Project site. The closest KGRA is the Geysers KGRA, which is over 50 miles from the Project site. Therefore, this technology fails Steps 2 and 3 and was rejected.

9.5.3 Conclusions

All feasible technologies that might be available for base load operation and steam production were reviewed using a methodology that considered commercial availability, ability to implement, and cost-effectiveness. None of the technologies other than the cogeneration cycle burning natural gas and Refinery fuels was commercially available and could be feasibly implemented. In addition, for all alternatives commercially available, the implementable technologies were less cost-effective than the cogeneration cycle technology. Consequently, the currently proposed conventional cogeneration cycle technology using gaseous fuels is the best available option for meeting Chevron's need for replacement power and steam generation, and the one that should be employed.