SECTION 7.0

Efficiency Analysis

The Cogen 3000 component of the Chevron Richmond Refinery Power Plant Replacement Project (PPRP, or the Project) will utilize a General Electric (GE) Frame 6B combustion turbine generator (CTG) in a cogeneration configuration, with a fired heat recovery steam generator. The Cogen 3000 configuration will not include a steam turbine generator (STG), as produced steam will be used in the Chevron Richmond Refinery.

The hydrogen production process generates significant quantities of hot exhaust which will be used to generate steam for electrical production by the STG. No fuel will be combusted in the hydrogen process specifically for electricity generation. The produced steam will be directed to an extraction, condensing STG capable of producing approximately 17 net megawatts (MW). Steam not condensed by the STG will be used to satisfy the Refinery's steam demand. As no fuel is combusted specifically for electrical generation, an estimate of efficiency was not prepared for the H_2-STG.

The Frame 6B engine is a heavy-duty combustion turbine achieving a gross electrical efficiency of approximately 33 percent on a lower heating value (LHV) basis. The net electrical efficiency is approximately 31.8 percent after accounting for plant parasitic load. This level of efficiency is achieved when the CTG is operating at full load with no duct firing at International Standards Organization (ISO) ambient conditions. The combined heat and power (CHP) efficiency[1] is approximately 88.6 percent at full power and full steam production levels.

Other types of plant operations, particularly those at less than full combustion turbine output, will result in slightly lower efficiencies. The Project will be expected to normally operate at full load to support Refinery operations. However, the CTG will also be designed for flexible load following and cyclic duty capabilities, depending on Refinery steam and electrical demand. The CTG will use variable inlet guide vanes that will allow the engine to maintain high fuel efficiency at reduced loads. This includes the ability to operate within the load range of approximately 60 percent load to full-load.

[1] CHP Efficiency is the sum of the net plant electrical output plus all useful heat output divided by the total fuel LHV input.