Executive Summary
Instantaneous Water Heater

1 – Gas Quality and LNG Study Objectives

This research study was designed to assess how residential and small commercial/industrial end-use equipment responded to changes in gas quality and to determine if Southern California Gas Company (SCG) needs to modify its current Gas Quality Standards (Rule 30). The major objectives of the study were as follows:

- Evaluate each selected unit to determine any issues relating to equipment safety and performance. Equipment safety includes changes in carbon Monoxide (CO) levels, combustion stability and lifting, flashback, and yellow tipping.
- Compare measured and observed results against the major natural gas interchangeability indices, including Wobbe Number, lifting, flashback, yellow tipping and incomplete combustion.
- Collect NO_X emissions data during testing

2 – Selection Criteria

Instantaneous Water Heaters available in the southern California market include high-end units that have a computerized control system to adjust fuel input rate and air flow. As indicated by manufacturers of these units, the computerized controls should permit the units to operate properly over a range of gas heating values and Wobbe Numbers. Conversely, the Instantaneous Water Heater selected for this study is equipped with an atmospheric burner and does not have the more sophisticated computerized fuel/air management system. The instantaneous water heaters are compact units and units equipped with atmospheric burners have a high firing intensity. The flame can lengthen as richer gases are supplied with the potential that the flame could be quenched by the heat exchanger. This could result in higher CO emissions or damage to the heat exchanger. Also, as the flame changes, combustion equilibrium can shift with resulting increases in CO and NO_X emissions. Factors and concerns that led to the selection of the atmospheric burner-equipped Instantaneous Water Heater for this study include:

- Narrow air/fuel ratio operating band
- Performance/safety may be dependent on flame characteristics
- Safety concerns related to flue gases

- Sophisticated heat exchanger/combustion system
- Recommendations from credible industry experts
- Technology entering southern California marketplace

3 – Results Summary and Findings

Results from all tests indicated no operational, ignition or flame stability problems with any of the test gas blends used in this study. The Instantaneous Water Heaters was tested over a wide range of operating conditions and gas compositions according to developed test protocols[1]. Test results and findings include:

- Stack temperature, outlet water temperature, flame length, orange tinting, equivalence ratio, and both NO_X and CO emissions concentrations tracked with the Wobbe number.
- Interestingly HC emission concentrations had no identifiable pattern with respect to gas blend properties.
- CO emissions were sensitive to gas supply pressure pulsations.
- The unit required retesting due to a regulator failure in the initial testing.

4 – Characteristics of the Instantaneous Water Heater used in this study:

- **Description:** Automatic Instantaneous Water Heater
- **Burner:** High firing intensity atmospheric burner
- **Maximum input rating:** 117,000 Btu/hr
- **Minimum input rating:** 28,000 Btu/hr
- **Type of fuel:** Natural Gas
- **Required gas supply pressure:** 7" W.C.

[1] Testing protocols used in this program were derived from industry standards and regulatory test procedures. Note, however, that based on the needs of this program and the operating and design characteristics of equipment tested, adherence to the industry and regulatory testing standards was not literal. The reader is cautioned that no inference can nor should be drawn as regards certification of these devices to the industry or regulatory requirements as a result of this program.