KEY GOALS OF THE PILOT

The proposed Living Pilot is targeted in the high impact area to procure and evaluate the ability of Preferred Resources to meet Local Capacity Requirements (LCR).

The portfolio of Preferred Resources and Energy Storage (ES) will need to provide sufficient assurance of "dependable" load reduction or generation when needed for local reliability.

Resources must be located in the vicinity of selected substations most affected by the recent retirement of San Onofre Nuclear Generating Station (SONGS) with specific efforts to reduce or eliminate need for conventional generation at Johanna and Santiago substations.

FUEL CELL STATIONS SHOULD BE IN THE PREFERRED RESOURCE MIX

The impact of SONGS and the Once-Through Cooling (OTC) shutdowns in the affected areas of the southern California basin create a void in the type and attributes of resources available to fill the gap. The options ranging from zero Greenhouse Gas (GHG) ES to Gas Combined Cycles have been outlined by the California Public Utilities Commission (CPUC) (table below taken from presentation at joint CPUC/California Energy Commission (CEC) workshop July 15, 2013). None of the resources identified fully fill the gap with a perfect balance of low or zero GHG impact, high capacity factor, and the predictability of supply.

Type	Annual Capacity Factor	Expected Availability On-Peak	Dispatchable	Inertia	Reactive power support (VARS)	GHG-free
Energy Efficiency[1]	Reduces total energy demand					Yes
Demand Response	Low [2]	100%	Yes	No	No	Yes
Combined Heat & Power	80%	100%	Maybe	Yes	Yes	No
Large Solar	24%	77%	No	No	No	Yes
Rooftop Solar	19%	45%	No	No	No	Yes
Wind	33%	30%	No	No	No [3]	Yes
Storage	N/A	100%	Yes	No	Maybe	Yes
Gas Peaker/CT	10%	100%	Yes	Yes	Yes	No
Gas Combined Cycle	65%	100%	Yes	Yes	Yes	No

[1] Energy efficiency is not traditionally measured as a capacity factor resource, and savings varies widely by application and use.

[2] Demand response programs generally have low capacity factors due to typical usage limits of 100 hours or less per year.

[3] Some renewable energy sources, notably wind, actually require additional VAR support.

A "missing" line from the CEC/CPUC resource matrix is stationary fuel cell technology and moreover fuel cell "TIGER Stations" (described further on Page 3 in this brief).

Fuel cell power stations located in close proximity to the impacted substations in the LA basin have the capability of providing or bettering the attributes listed under Combined Heat and Power (CHP) (especially reactive power support (VAR)), offering a comparable GHG profile, and the added benefits of near zero criteria pollutants of NOx, SOx and particulates, and having siting advantages of low noise, low profile, low water use and no need for emissions permits in South Coast Air Quality Management District (SCAQMD).

Similarly, fuel cell power stations, with a proven scalability of 1 MW to >50 MW, offer the best attributes of Gas Combined Cycles, yet with the ability to be located adjacent to or in close proximity to the impacted substations. No type of Preferred Resource can offer the combination of key attributes and low GHG impact of a fuel cell power station.

Commercially available multi-MW fuel cell power stations are in many ways an "ideal" distribution level generation technology serving load constrained urban areas.

STATIONS ARE A COMMERCIALLY AVAILABLE RESOURCE AT SCALE

Presently, FuelCell Energy power stations are on–line or under construction in the US and Korea with capacities of 10 to 59 MW. These power stations range from simple cycle 47% LHV efficiency (10 MW and 11 MW systems in Korea), to the 50% efficient Combined Cycle 15 MW in Bridgeport, Connecticut (using Organic Rankine Cycle (ORC) heat recovery for power augmentation), to 70% CHP efficiency at the largest 59 MW fuel cell power station in Korea. In addition to these, 58+% Combined Cycle electric efficiencies are available thru an integrated fuel cell and unfired turbine hybrid plant. This system has been demonstrated in an operating 300 kW power station at a customer site, achieving 58% electrical efficiency. A straightforward scale up is all that is needed to provide MW-scale hybrid systems with this high efficiency. The only barrier to deploying this combined system at a larger scale is a market need for a solution valuing the combination of attributes and high efficiency (resulting in low GHG profile).

LOWER GHG AND CRITERIA EMISSIONS

Fuel cell based generation located in the impacted areas offers a compelling resource that balances capacity and availability with lower GHG emissions criteria pollutant emissions than any mix of Preferred Resources.

An advanced fuel cell power station of a 1-10 MW (distribution voltage scale) at 58% efficiency emits CO_2 at a rate of 770 lb/MWh. While traditional generation utilizing high-efficiency Combined-Cycle power plants operate at just below 60-percent electrical efficiency, this is true only of high capacity plants in the 300 MW and larger range. Similarly, while renewable resources in a discrete application are zero GHG, modeling conducted by the University of California at Irvine using a CEC-funded HiGRID model indicate a grid resource portfolio with fuel cells has a GHG impact lower than a portfolio of renewables and traditional generation.

FUEL CELL REACTIVE POWER (VAR) SUPPORT IS UNMATCHED

The direct-current (DC) power produced by fuel cells is converted to alternating-current (AC) power by power conversion inverter systems before insertion into the grid. Inverter-based fuel cell generation enhances end-user and local grid power quality through its ability to provide or

absorb VARs (reactive power). Also, by contributing very low frequency distortion and fault current, fuel cells can provide voltage support for weak areas of the distribution system.

SITING VALUE IN THE IMPACTED AREAS

A 2.8 MW fuel cell power station occupies an area less than 4,000 square feet (less than 1/10th of an acre). A 15 MW station is less than 25,000 square feet (approx. ½ acre). By virtue of their compact footprint and quiet operation, fuel cell power station can be located nearly anywhere throughout the impacted areas in close proximity to electric power consumers and impacted substations. All of the power generated will be available near point of need (none is lost in transmission), and any heat by-product is available for CHP or for additional power in a combined cycle.

TIGER STATIONS OFFER A UNIQUE PILOT RESOURCE

Fuel cell power stations having the attributes cited above take on a valuable perspective when recognized as a "Transmission Integrated Grid Energy Resource", or TIGER Station.

The concept of a TIGER Station, developed by the National Fuel Cell Research Center (NFCRC), is a strategy to provide local grid support by the electric utility at key points in the distribution system.

The most suitable location for the TIGER Station is the distribution substation where voltage is transformed from transmission to distribution levels. Typically this would be a 220 kV to 66 kV substation or an "A" substation. While the TIGER station was conceived as a worldwide solution where there is a desire for power resources that need to balance environmental and grid reliability issues, the concept has a direct application to the issues facing the southern California basin as a result of SONGS and OTC.

Locating TIGER Stations at or in close proximity to the identified distribution substations has the advantages of:

- Available real estate (e.g., under circuits associated with the substation)
- Access to an electric utility control center
- Access to dependable and cost effective natural gas supply
- Deployment of an environmentally sensitive technology (virtually zero emission of criteria pollutants, acoustically benign), with an unusually high fuel-to-electrical efficiency.
- Receptive permitting in SCAQMD
- Ability to operate on directed biogas, or locally sourced biogas (e.g., the Southern California Ellis A Substation adjacent to the Orange County Sanitation District) and thereby generate renewable power 24/7.

REQUEST

For the reasons cited in this brief, fuel cell power stations, and more specifically TIGER stations, should be given a priority consideration in the Living Pilot and Preferred Resource selection process.