

MADA POWER LLC'S PROPOSAL FOR SCE'S PREFERRED RESOURCE LIVING PILOT PROGRAM

SUMMARY: MADA Power LLC offers very attractive energy storage systems that can provide most of the attributes needed to manage LCR reliability for SCE as set forth in the objectives of its Preferred Resource Pilot Program. MADA's compact, scalable Liquid Air Energy Storage (LAES) technology uses no water, produces no emissions, can be located virtually anywhere due to minimal land requirements, and can efficiently store almost any source of electricity and/or thermal energy for dispatch as required. Its design enables energy from virtually any source (electrical or thermal) to be dispatched both into and out of storage (Double-Dispatched) in the most cost-effective manner. MADA calls its technology Double-Dispatch LAES. (See attached Technology Diagram)

Double-Dispatch LAES provides increased operational flexibility over that of pumped hydro without pumped hydro's land, environmental, geographic, size, transmission, and time constraints. Importantly, MADA Power project cost per kWh, adjusted for round-trip efficiency, is projected to be lower than that of pumped hydro.

MADA POWER BACKGROUND: The founders of MADA Power are Arnold Goldman and Charles Ricker. Arnold Goldman is the solar power visionary who founded and served as Chairman of Luz International, the first company to prove the commercial viability of solar power. Subsequently, Arnold founded and served as Chairman of BrightSource Energy, one of the leading solar thermal power companies in the world. Charles Ricker was the first US employee of BrightSource and served as its Senior Vice President of Business Development. Both Arnold and Charlie retired from BrightSource in 2013.

PROPOSAL: MADA Power would like the CPUC and SCE to consider its low cost, grid-scale storage as part of the SCE's Preferred Resource Living Pilot Program. The MADA's system design is based on proven liquid air energy storage technology combined with traditional thermal energy storage, heat exchangers, turbines, and centrifugal compressors. MADA's design goal was to provide increased functionality and cost effectiveness over that of new variable speed pumped hydro storage, including flexible charging and ramping capabilities, without pumped hydro's size, geographic, and environmental limitations.

MADA's Double-Dispatch LAES storage is packaged in standard 50 MW modules, although it can be sized as small as 20 MW and is easily scalable to 500MW or more. Systems can be designed for six hours or more of generation and can store up to twice its rated output, i.e. a 50 MW system can store 100 MW of energy. MADA's Double-Dispatch LAES energy storage is charged by electricity and (optionally) waste heat. Electricity from the grid is stored as high temperature, cryogenic thermal energy in the form of liquid air. When discharging, the liquid air is pumped through the thermal energy storage system to produce high temperature, high pressure air which is used to drive a conventional turbine generating electricity at high efficiency. All of the system's components are in extensive use world-wide and are produced in large volumes by major manufacturers. MADA Power will utilize a major EDC contractor to build all of its projects and provide completion and performance assurances.

MADA Power would propose to locate a 50MW (or 20MW) Double-Dispatch LAES system at or near either the Johanna or the Santiago substation. The system could be on line eighteen to twenty months after the completion of permitting, which should take less time than permitting a CCGT. MADA's system would provide real time demand reduction of up to twice the rated capacity, or 100 MW for 50 MW of generation, for 6 hours or more. It can be placed on automatic activation and will use telemetry that allows for both four second and five minute activation. In addition, the project can help with high-use scheduled load reduction by providing six hours or more of generation on a daily basis to complement demand reduction efforts and minimize the need for gas fired resources. MADA's storage system can be cycled multiple times per day at a round-trip efficiency of approximately 70% for thirty+ years with availability comparable to that of a combined-cycle gas turbine power plant.

MADA DOUBLE-DISPATCH LAES SYSTEM ATTRIBUTES MEET PILOT PROGRAM OBJECTIVES: MADA's Double-Dispatch LAES systems can provide almost all of the attributes needed to manage LCR reliability, as identified for the SCE Preferred Resources Living Pilot Program:

Attribute Class A - Firm Load Reduction: MADA's energy storage systems can provide virtually any amount of reliable, dispatchable power for six hours or more during summer peak periods.

Attribute Class C - Real-Time Demand Reduction: MADA's energy storage systems can provide annual availability with fully charged storage upon CAISO request more than 60 times per year and meet the four second and five minute telemetry and triggering mechanism requirements.

Attribute Class D.1, 2 & 3 - Scheduled Load Reduction (Low Use / Medium Use / High Use): MADA's energy storage systems can provide dependable capacity and energy for six hours or more during summer peak periods at least 40 times per year and meet the triggering mechanism requirement.

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MADA POWER DOUBLE-DISPATCH LAES SYSTEM

