Modular, High-efficiency, Energy Storage System For Industrial Power Plants - Solar, Fossil and Nuclear - Increases Energy Independence & Creates Jobs

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Announcement:

The City University of New York (CUNY) has filed multiple patent applications and is seeking partners interested in utilization of a new, modular, high-efficiency, energy storage system for industrial power plants. This new system works with solar, fossil and nuclear plants and can help mitigate grid fluctuations. This new system enables us to better and more efficiently meet present and future energy needs while also helping the transition to a greener energy system; and it creates jobs!

Background:

The United States needs more electric generating capacity to meet current and future demand. At present, conventional power plants are usually driven to capacity during time of peak loads. These peak loads put strain on the grid. This situation gets even worse as we add the output of highly variable solar and wind power plants. Yet we need to incorporate these green energy sources into the mainstream.

In fact, this heavy peak loading and load variability can tax the grid to or beyond the danger point. Large-scale energy storage is part of the solution, but conventional storage systems are not reliable enough, nor available at reasonable cost, so as to adequately address this serious problem. We need much better industrial-sized energy storage that can improve conventional power generation and can enable 24/7 solar power generation -- while at the same time enabling better grid management.

To this end, Dr. Reuel Shinnar, Distinguished Professor Emeritus of Chemical Engineering, City College of New York (CUNY), has developed a new energy storage system for large power installations. This practical system provides improved and reliable industrial-sized energy storage. This new system is low-tech and can be used on most gas or steam turbine-based industrial power plants to increase their capacity, cost-effectively, while at the same time enabling 24/7 solar power plants. The system enables provision of dispatchable energy, whether simply for more output or to use for load-leveling and to reduce stressful fluctuations on the grid. CUNY has applied for patent protection and is offering the CUNY storage technology for license to industry worldwide.

Details:

The Innovation: This new energy storage system enables highly efficient storage of heat when the heat source (“furnace”) is not at full capacity, such as at night. For solar applications, the result is 24/7 solar power. For conventional power plants, this stored heat is retrieved for power generation when demand is high and when the main furnace system is already at maximum output. The storage system is also easily controlled. The result is a cost-effective and easily controlled source of energy to help meet global power demands. A modular design reduces costs and simplifies field installation and operation.

Operation: It is a common design where a power plant uses heat to drive a turbine for electrical power generation. When the plant is not operating at maximum capacity, the new storage system uses this heat -- usually as a superheated gas or steam -- as a heat transfer fluid (HTF). The HTF is used in a manner that creates a very steep front as the heat energy is deposited on a cool heat storage medium of special design. This storage process is reversed when superheated HTF is needed for power generation, wherein cool HTF flows through the storage medium and is heated along a sharp front to generate the required superheated gas or steam, which in turn enables driving a turbine (either the original system turbine or an additional turbine) to generate electricity. The heat energy is stored and retrieved at 95% or greater efficiency.

Cost-Benefit: In practice, our new storage system is added to an existing furnace/turbine system (the most-expensive part of the installed base) so that increased output from storage is obtained substantially beyond the peak capability of the pant, and at relatively low additional cost. The system increases the output of a power plant by driving a second turbine in a conventional plant or by driving the main turbine at night in a solar plant -- and all without the need for an additional furnace.

The Grid: In addition to increasing the capacity of an existing power plant, this new storage system addresses the grid utilization and management problems that can be aggravated by green power fluctuations. Therefore, while this system adds capacity for meeting of peak loads, it also provides dispatchable energy that can be readily used for grid management. These features are critical for control of grid-based stresses and fluctuations, which is an increasingly serious problem with the addition of green power sources.

Modular Design & Low Tech Construction: Low-tech modular system components are design to be manufactured in a factory and are scaled for shipping on a flat bed truck. Assembly of modules on-site is simplified. Operation is straight-forward. The modules are air-cooled. A single module enables self-contained 50-KW system (micro-plant) for distant locales, while assembly of 20 modules enables 1-GW power plant for major sunbelt users.

Why This Storage System? The practicality of this new storage system design, compared to more expensive and more complex conventional storage systems, readily distinguishes this new innovation. The innovation is cost-effective, practical and low tech, with a simplified modular design that is easy to operate and regulate in the field. There is no alternative storage system for large power generation that can make this claim. This system is the best bet for meeting our power generation needs.

Applications:

Solar: This new energy storage system can be used for solar power plants to enable 24/7 power delivery for the big sunbelt utilities. Energy storage is not new, but our new storage system makes it practical and near-term. It enables today the transition from fossil fuel plants to large solar plants in high intensity solar regions. Installations can range from a single air-cooled storage module for a remote sun-driven 50-KW system (e.g., arid, Third World installations), to assembly of 20 such modules for a 1-GW solar power plant in the sunbelt. (See recent DOE grant, commencing January 2009 at CUNY.)

Conventional: But just as important, effective output capacity of conventional industrial power plants, wherever located, can be greatly increased with this new storage innovation because stored energy will be available on demand to drive a second turbine in addition to the system's maxed-out primary turbine. Conventional power plant output capacity improvement is estimated at: 40% for conventional gas/coal-fired, 75% for integrated gasification combined cycle (IGCC), and 100% nuclear power plants. Furthermore, by adding this increased capacity to our installed base, the very difficult parcel assembly and approval process for a new site and new construction, not to mention large capital costs, can be deferred for decades!

Energy Independence And Jobs: Our licensed factory will produce modular system components that are scaled to be shipped on flatbed trucks. The design simplifies field assembly. The innovation provides good jobs while helping solve the global energy problem.

Commercialization: Our growing patent portfolio is available for license to industry partner(s).

Biography of the Principal Innovator: Professor Reuel Shinnar is a distinguished Professor (Emeritus) of Chemical Engineering at CUNY's City College of New York (ret.), where he taught for 40 years, after 20 years in industry, and he has continued to consult in the oil and chemical industry, and for DOE and EPRI. He has published over 100 papers in many areas of Chemical Engineering and has participated in over 30 patents.

Professor Shinnar's work has been well recognized by the profession, both nationally and internationally, and he has received numerous awards, including the prestigious Founder's Award of the American Institute of Chemical Engineers. In 2004, Industrial and Engineering Chemistry published a special issue (Festschrift) in his honor. In 1985 Professor Shinnar was elected as a member of the National Academy of Engineering, where he was cited for the breadth and quality of his research in reactor design, control theory, chemical kinetics, statistical analysis and process economics. He is listed in Who is Who in the World, Who is Who in the U.S., and Who is Who in Science and Engineering.

Dr. Shinnar's research has changed the design methodology of chemical processes, as well as their control. He is also an author or co-author of over thirty patents several of them in large-scale use (e.g., drastically reduced the cost and improved the yield of the old Fischer Tropsch process for diesel production and being implemented by Shell, SASOL, and Exxon).

Dr. Shinnar has developed a powerful method for economic evaluation of new processes and technologies, based on differential comparison with similar processes, which allows evaluation of the ultimate potential and cost of a proposed process even prior to complete data collection. With this, he demonstrated, contrary to DOE and majority opinion, that indirect liquefaction of coal was superior to direct liquefaction. On a second occasion he showed that generation of H_2 from high temperature nuclear is inherently inferior for H_2 production-generating electricity from the same reactor followed by electrolysis, in a study contributing to the termination of a seven billion dollar research program that should never have been started. Recently a study specially made to be submitted to a committee of the National Research Council on the H_2 economy significantly contributed to the conclusion that the H_2 economy is not ready for implementation in the near future, and requires a long-range exploratory research program, at which later time it might be reconsidered.

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