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THE SMALL COMMUNITY SOLAR THERMAL POWER EXPERIMENT

The Small Community Solar Thermal Power Experiment had its beginnings in 1977 when Congress, in response to strong and continuous community pressure, sought to provide alternative electric power supplies which demonstrated reduced dependence on non-renewable sources. To help meet this problem, Congress appropriated funds for a five-megawatt solar thermal demonstration, but the proposed plant was reduced in size to one megawatt when it was decided that this smaller facility provided a valid model at lower cost. The technical programs undertaken at JPL were augmented by market and commercialization studies to establish cost goals to which engineering decisions and achievements could be compared.

To insure that all solar thermal technology options would be considered, a concept definition phase was initiated in which competitive studies were to be performed in each of three categories. These categories were:

Category A	General (to include, but not be limited to, central receiver and line focusing systems).
Category B	Point-focusing, distributed collector, central power conversion.
Category C	Point-focusing, distributed collector, power conversion at the collector.

A multiphase approach was adopted as the best means of meeting the objectives of the experiment in the shortest period of time. Phase I addressed the problem of exploring all competitive technologies for this application and recommended those which should be studied in greater detail. Competitive bids were received in each of the above listed categories, and awards were made on the basis of merit. One contractor was selected in each category.

Within Phase I the contractors were asked to develop a preferred system concept, to perform sensitivity analyses, and to outline recommended approaches for the follow-on Phase II design program.

The systems recommended by the contractors in each of the categories were:

McDonnell-Douglas Astronautics Company: Central tower with field of south-facing heliostats.

General Electric Company: Field of parabolic dishes with steam piped to a central turbine-generator unit.

Ford Aerospace and Communications Corporation: Field of parabolic dishes with a Stirling cycle engine/generator unit at the focus of each dish.

A brief description of each of the proposed experimental plants follows:

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A. McDonnell-Douglas Astronautics Company (MDAC)

The system proposed by MDAC is similar in principal to the 10 MW central tower solar plant now being constructed near Barstow for Southern California Edison, but the plant and tower are smaller in size, and the field of heliostats is distributed south of the tower, rather than surrounding it as it does in the Barstow plant. The tower assembly is a guy-wire supported lattice structure 131 feet high supporting the receiver as well as the thermal transport fluid (HITEC) riser and downcomer.

Steam produced from the steam generator drives a steam Rankine cycle turbine which in turn drives an electrical generator to produce electricity. A power plant building contains the entire power conversion subsystem with the exception of the cooling tower and waste water pond. The balance of plant equipment employs state-of-the-art equipment and techniques.

B. General Electric Company (GE)

The General Electric concept was derived in great part from the plant being designed by them as a total energy system for the Bleyle plant at Shenandoah, Georgia. This design makes use of a field of G.E. Low Cost Concentrators to generate steam which is then transported through low loss piping to a central steam turbine generator unit. The collector field is split into two parts: those dishes which carry saturated steam and those which extend the heating into the superheat range. The central steam turbine and balance of the plant are adaptations of existing, well proven components.

C. Ford Aerospace and Communications Corporation (FACC)

The system concept selected by Ford Aerospace and Communications Corporation in the Phase I study is composed of multiple dish concentrators employing a Stirling cycle heat engine with direct-coupled AC generators for power conversion at the focal point of each concentrator. Each module includes the parabolic concentrator and a cavity receiver with an integral sodium pool boiler, the sodium thermal transport hardware, and the engine/generator assembly. The proposed parabolic dish concentrator is a front-braced design with an Az-El mount and tripod structure with a reflector surface composed of back-surfaced, high-reflectivity drawn fusion glass mirror segments.

Soon after the completion of the Phase I studies, the Department of Energy directives and ongoing technical studies at JPL and elsewhere resulted in the decision to employ Category C, parabolic dishes with distributed generation for this experiment. This decision meant that Ford, the successful contractor in this category, was to continue in Phase II. On the basis of energy cost, the energy conversion subsystem recommended by Ford made use of the Stirling cycle, with the Rankine cycle engine ranked second. In the light of ongoing engine studies at Lewis Research Center and at JPL, (which indicated that Stirling engine technology was not yet ready for field experiments) it was decided to incorporate the Rankine cycle engine in the configuration selected for design and test in Phase II and III.

Also, budget constraints combined with promising and timely results in the Point-Focus Distributed Receiver Technology (PFDRT) development program forced the decision that subsystem development within the experiment be minimized. Instead, designs for appropriate subsystems were to come from ongoing development work or from other existing sources. The G.E. Low Cost Concentrator was thought to be the most promising candidate for use with the experiment.

In August 1979, a sole source RFP was issued to Ford Aerospace and Communications Corporation soliciting its participation to act as system contractor for Phase II of the experiment. The contractor was asked to conduct a preliminary design, component and subsystem development, subsystems and system level verification testing, and detailed design. Ford was also asked to complete the plans for site preparation and hardware implementation. As indicated above, the technology was restricted to distributed energy conversion using the Rankine cycle.