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THE OMNIUM-G HTC-25 TRACKING CONCENTRATOR

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ABSTRACT

On May 3, 1978, OMNIUM-G installed its first point focusing, two axis-tracking, high concentration ratio parabolic reflector. Since then, OMNIUM-G has delivered and installed thirteen additional concentrators throughout the world. As a result of these initial installations, field data has been plentiful and the data has given OMNIUM-G the ability to invoke design refinements in several areas. The improvements have manifested in a design that is economic in the areas of manufacturing, packaging, delivering, installing, and commissioning the system into operation.

OMNIUM-G's unique field experience coupled with engineering improvements is paving the way for long life, highly reliable, and economic fields of point focused distributed receiver solar thermal power systems.

This paper deals specifically with OMNIUM-G's model HTC-25 Tracking Concentrator, the initial problems and their subsequent solutions. These solutions have guaranteed the continued success in dramatically reducing the costs of the concentrator to the extent that large field applications may now be realized economically and to a high degree of reliablility. The HTC-25 Tracking concentrator has found applications in educational institutions because of its ability to operate at extremely high focal point temperatures in excess of 4000°F. When the HTC-25 is operated as the nucleus of a solar thermal power system, the ability to operate water-to-steam converters at 1100°F and air converters at temperatures of 1800°F has opened the door to applications as electrical power generation, enhanced oil recovery, and water purification and desalination to the extent that these applications may be served more economically than from any other means of solar thermal technology.

SOME WORDS ABOUT THE PRODUCT

In mid 1973, OMNIUM-G began design of the model HTC-25 Tracking Concentrator. This device, a two-axis tracking, imaging, high concentration ratio reflector is the nucleus product of OMNIUM-G. This product is embellished with two types of converters (receivers). One is a direct water-to-steam converter operating at 1100°F with pressures of up to 3000 psia at rates from between 47-74 pounds per hour with a nominal thermal power input to the fluid of 21 KW_t

In the case of air, air can be moved through the converter at pressures of up

to three atmospheres at temperatures from 800-1800°F at rates from between 37-85 cfm also with a nominal thermal power input to the air of 21KW$_t$. These converters serve a multitude of application areas at temperatures and pressures heretofore deemed impractical and perhaps even impossible. With the innovation of the hot-air converter, applications requiring either buffering or storage may now be economically served. OMNIUM-G continues to provide thermal storage modules, converters, and prime movers to serve customers requiring complete turn-key solar thermal power systems.

THE CONCEPT BEHIND THE HTC-25 TRACKING CONCENTRATOR

Choice of Concentration Ratio

A peak concentration ratio of 10,000:1 was chosen for the initial design goal. The primary reason was for the total reduction of thermal losses due to convection cooling due to wind. The only loss at this high of concentration ratio would then be attributed to only the losses expected due to radiation. Early studies showed that concentration ratios in excess of 3,000:1 had the unique property of being insensitive to wind and subject only to minor radiation losses particularly advantageous when desiring to operate at extremely high temperatures of 1100-1800°F.

Although OMNIUM-G was confident that this design goal had been met by virtue of being able to maintain this parameter in our factory environment, field results indicated that such a concentration ratio had not been maintained. As the field data was reported back to OMNIUM-G it became clear that the early units sufferred from wind buffeting, man-handling, and misalignment. Steps were taken within the factory to improve the wind buffeting problem and subsequent systems were modified as well as those in the field. The alignment problem stemmed from the fact that alignment was done with near field optical techniques that introduced intolerable error. Alignment techniques are now done swiftly in the evening using far field optical sources which has proven to improve the system efficiency dramatically. Man-handling continues to be the major problem and to this extent, the converters have been slightly modified with a larger aperature of 7-8 inches from the ideal size of 4 inches. The new generation converters now match the proper volume to the new aperature size. The instantaneous average concentration ratio still measures over 4000:1 which results in a performance unmatched in the commercial market place.

Choice of Reflecting Material

The reflecting material used by OMNIUM-G still continues to be ALZAK, a registered electro-polished annodized aluminum process from Alcoa. Choosing front surface reflecting material in lieu of glass is still considered optimum by OMNIUM-G based on the concentrators 20 year projected life. Factors include availability, cost, ease of handling, ease of maintaining, and its ever so slight and graceful degradation from maximum efficiency to 90% over its 20 year life.

Reflector Material Problems

Although several processes and materials have emerged for front surface reflecting techniques, ALZAK continues to be the best but does have its own problems.

The most severe problem with the material is in the basic milling process. Since this material is produced to serve a market that has very relaxed specifications on specular reflectivity, the average sheet falls below OMNIUM-G's minimum acceptable criteria. As such the rejection factor holds at about 60%. As OMNIUM-G continues to grow, plating facilities will be installed that will serve a two-fold purpose. One purpose will be to realize a dramatic increase of reflector efficiency, and secondly, a substantial reduction in manufacturing costs will also be realized.

Mirror Fabrication

In 1977 OMNIUM-G finalized its manufacturing development of the petals and their field success has been very exciting. In 1978, refinements were made to the process which lead to some field failures. Since petal fabrication is clearly the critical path of the system manufacturing process, any reduction in man-hours and total elapsed time is a significant factor in the goal of ultimately reducing manufacturing costs.

In experimenting with time reduction techniques and simultaneously meeting customer delivery requirements, several petals were shipped to site that appeared to have sustained factory testing yet failed in the field. Failures in the field were delamination of the aluminum from its substraight and creeping creases. Since the factory keeps a comprehensive record of each petal made whether shipped or not, it was an easy matter to precisely trace the location of the fabrication process attributing to the petal's ultimate failure.

OMNIUM-G has gained incredible insight in the petal fabrication process and has clear visibilty of how the ultimate costs of this process will lessen. Since this area of the concentrator represents a significant cost factor, it is mainly in this process that enables OMNIUM-G to offer its concentrator today at a quantity purchase price to the end user of $14,000. In fact the improvements in manufacturability have maintained the cost of the HTC-25 at virtually the same cost over the last two years in view of our current inflationary crisis.

TRACKING

Early problems associated with tracking accuracy were attributed to relaxed specifications on the electrical components themselves. All such electronically related problems have been solved in the field in both the open and closed loop modes of operation.

There have been subtle tracking problems that have resulted due to installation related activities. Though the system design is quite forgiving because of dimensional inaccuracies in fabrication, installation, especially in levelness, does play a significant role in the system's ultimate operation. Sloppyness of installation has the effect of causing the system to break into tracking oscillations both in the azimuthal and elevation planes.

Most of the significant design improvements have been in the elevation gimbal axis. The system's tolerance to high velocity wind buffeting and its virtual non-susceptability to mechanical gear backlash has improved the overall performance of the system significantly.

INSTALLATION AND MAINTENANCE

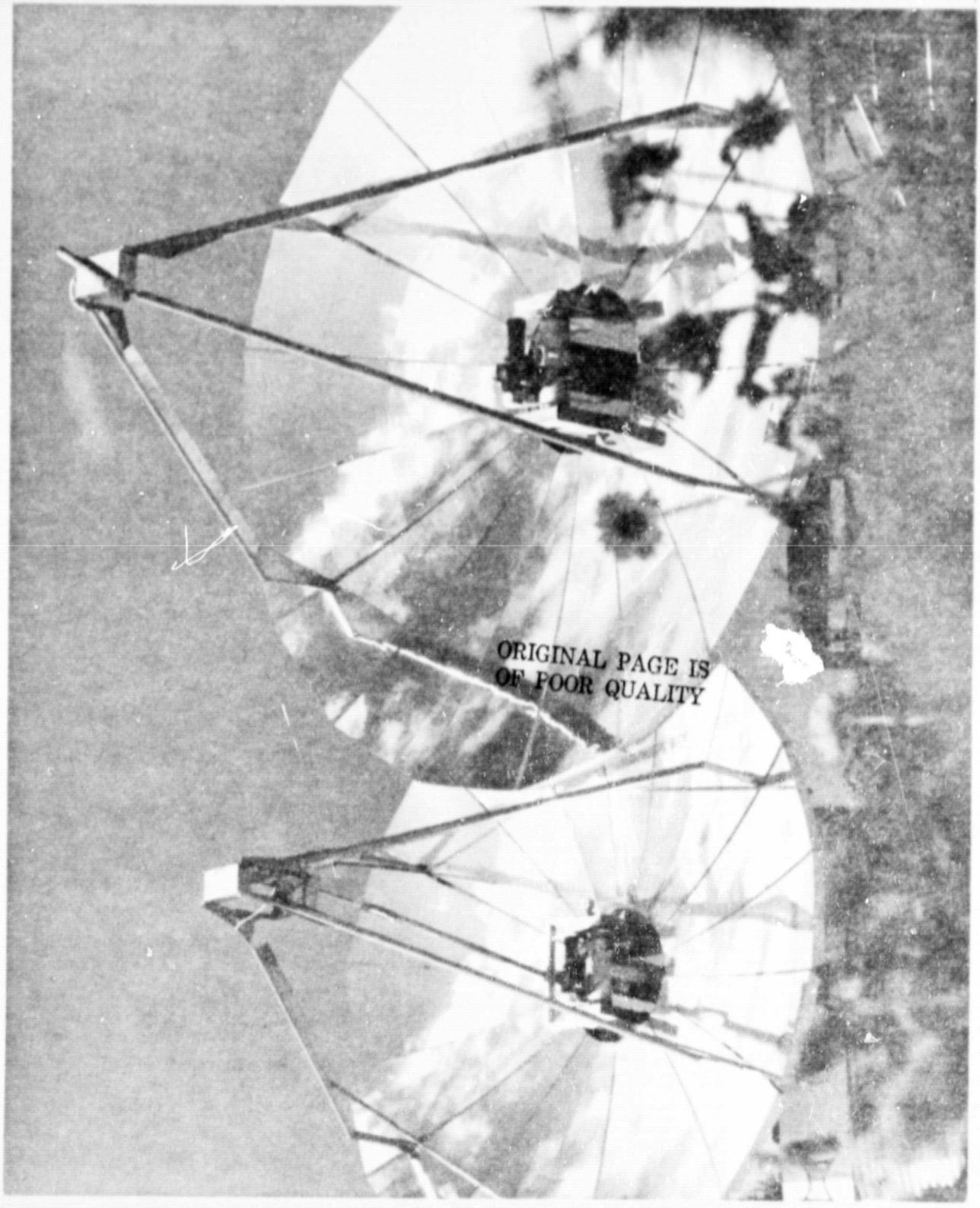
Installation of the tracking concentrator has become a routine function here at OMNIUM-G. A concentrator is deemed commissioned on Wednesday noon if installation begins on Monday morning. Installation costs and site preparation costs are considered minimum and OMNIUM-G does foresee common labor having the ability of completely assembling and commissioning a unit virtually in hours. Factory attention is focusing on installation equipment and tools to ease installation and design modifications are usually intended now for the ultimate swiftness of installation. Maintenance of the concentrator is minimal for perhaps periodic cleaning and lubrication. Although several concentrators of been installed in extremely harsh environments, no device today has sufferred a catastrophic failure once properly mounted and secured.

THE FUTURE

OMNIUM-G is solely dedicated to the fostering of solar energy. Without incentive other than self motivation, OMNIUM-G has taken the complete brunt of having to design, build, install, and maintain what it claims to be a commercially available off-the-shelf item. Our customers have been our most valuable asset in fostering a close working relationship and the valuable reporting of data and problems. None of the initial systems delivered by OMNIUM-G were without some operational problems. By our customer's dedication to the advancement of solar energy, we have continued to grow and perhaps some day may even prosper. OMNIUM-G is expanding its manufacturing facilities and is delighted to have played a role in point focusing development.

SUMMARY

Fourteen concentrators have been installed and virtually all field related and environmental problems encountered to date solved. As more field data is received and improvements designed, OMNIUM-G will continue to up-grade its systems in the field along with producing and delivering the most economic and efficient concentrator in the world today.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