

STATUS AND APPLICABILITY OF SOLID POLYMER ELECTROLYTE TECHNOLOGY
TO ELECTROLYTIC HYDROGEN AND OXYGEN PRODUCTION

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PRESENTATION SUMMARY

The General Electric Company solid polymer electrolyte (SPE) water electrolysis technology is presented as a potential energy conversion method for wind-driven generator systems. Under development since 1967, this technology is relatively new, and further significant improvements are projected over the next 5 to 15 years. Electrolysis life and performance data are presented from laboratory-sized single cells (7.2 in² active area) with high cell current density selected (1000 ASF) for normal operation.

The SPE water electrolysis technology has the following inherent design capabilities as a candidate energy conversion technique in either small or large scale wind-driven generator systems:

- (1) Long life capability to reduce refurbishment costs, with increased reliability
- (2) High current density capability to reduce cell capital costs and size
- (3) High-pressure capability for hydrogen transmission by pipe line or storage
- (4) Minimum power input requirement to reduce operating costs and generator electrical capacity

Performance data with demonstrated life to approximately 9000 hours at current densities between 1000 and 1400 ASF are presented. High-pressure life data up to 3000 psi are also presented at the selected nominal design condition. Based on current technology, projections of cell life as a function of operating temperature are made which are supported by life data to 29,000 hours. For the selected design point of 1000 ASF at 180° F, a 60-cell module is sized to produce 5 pounds of hydrogen per hour with a power input of 112 kilowatts. The module would weigh 135 pounds and be approximately 16 inches in diameter by 8 inches thick. Present capital cost for a total water electrolysis system is estimated to be \$3000 per pound per hour of hydrogen capacity.

Based on continued development, projected energy and capital cost improvements are presented up to the year 2000. Energy requirements

of 18 to 20 kilowatt-hours per pound of hydrogen are projected for the 1985 to 1990 period, dropping to as low as 15 kilowatt-hours per pound hydrogen by the year 2000. A capital cost of \$785 per pound hydrogen per hour capacity is considered obtainable for the 1985 period, with reduction to \$250 to \$350 per pound hydrogen per hour by the year 2000.

DISCUSSION

- Q: I am very curious of these electrolysis systems. What does the quality of the water have to be, and what effect does the quality of the water have on the expected life of the membrane?
- A: As I mentioned before, we do use an iron exchange membrane principle. This is used in other applications to remove contaminants, for example, remove iron from water. So any sort of iron that would tie up the sites within the membrane would affect the performance. The performance would decrease, or the voltage go up. Its life would remain the same as long as that contaminant level doesn't increase with life.
- Q: Is iron the only contaminant? What about salts?
- A: We have demonstrated chlorine generators, just putting plain salt water into the system.
- Q: Do you have to use distilled water?
- A: Yes, you have to use water maybe of the order of 500,000 iron centimeters.
- Q: This is high quality water. If we're considering a wind generator in an isolated site, it's like a water treatment factory. It's just a consideration. I'm not unfamiliar with the system.
- A: Yes. That should be considered in any trade-off study, too.
- Q: You mentioned you have some modern metals. What is it you have?
- A: Our anode catalyst is a proprietary type catalyst. It does have platinum in it. On the cathode side it's a straight platinum catalyst. The loadings are down around 2 to 4 milligrams per square centimeter, very low loadings, so that we are now, rather than trying to reduce the catalyst loading to get the cost down, attacking the problem from the high current density point of view to keep the size of the cell down. We have somewhat reached the limit on the present catalyst systems.