Whit Ridgway showing off a scale model of a packaged power plant.

The Saga of GE's Gas Turbine Business

The evolution of the gas turbine industry and the career of Whitman Ridgway

First, some history of the gas turbine business: During World War I, General Electric was asked by the Army Air Corps to develop an exhaust-driven gas turbine supercharger for the Liberty engine. Dr. Sanford Moss was the leader of these efforts. This development was successful and, on the basis of small government appropriations, development work on turbo superchargers was continued through the intervening period up to World War II. Much pioneering work was done on high temperature materials.

At the end of World War II, at the request of the Air Force, all of GE's jet engine work was concentrated in a new aircraft gas turbine department at Lynn, Massachusetts, and Evendale, Ohio. GE decided that there was also a market for land-based versions of the jet engine and the gas turbine section of the steam turbine department was given responsibility for such products. Design was started on a 5,000 hp gas turbine suitable for locomotive drive or power generation. This design was first used on locomotives in 1948 on the Union Pacific Railroad. The first power generating gas turbine was shipped in 1949 to the Belle Isle Station of Oklahoma Gas and Electric Company.

In 1951, the company officially established the gas turbine business as a full-fledged department. It was thought that the department was well on its way, as orders in the 1950-51 period amounted to $30 million with a major portion of the units on order to be used for power generation applications.

It later became apparent, however, that having a gas turbine business was one thing and having a *profitable* gas turbine business was quite another. The basic strategy for the business at the time might be characterized as "trying to be all things to all people." In retrospect, we might have been much more selective in those early stages. Also, we might have been less optimistic about solving some of our technical and cost problems.

There is no doubt that this era was also one of significant progress in overcoming difficulties and in accumulation of operating experience which enabled us to move into the next period. This stage could be called one of growth, expansion and further development. During this time (which covered the years 1955 and 1956), orders totalled $51 million. It was also felt that the technical problems had largely been solved as complaint costs had dropped significantly.

Engineering set out to design three new units per year, manufacturing planned and partially installed large additions to factory facilities, and marketing increased activities to sell the new line of gas turbines. Sales were forecast to grow rapidly with increased customer acceptance of a broader line, and pricing strategy was implemented to meet competition throughout a ten-year period in any application where business had been forecast.

But what happened? Well, the business continued to operate at a loss. Unfortunately, the strategy ran afoul of a new rash of technical problems.

In August 1957, a failure of turbine buckets occurred during factory test of one of the new designs. Three months later, a turbine wheel broke up on a machine of similar design being readied for installation in a locomotive. These two problems got us even more deeply into the fields of metallurgy and vibration analysis before they were corrected. The solutions were very difficult and sophisticated in nature.

In the meantime, shipments were held up. These very late shipments and the failures themselves (widely known and discussed in customer circles) led to a "modest" drop in customer confidence. This "modest" drop in confidence was such that in the next 18 months only three orders totalling $3 million were obtained in a business geared to 15 times that.

In January 1960, I entered the picture. A few words of introduction may be in order.

After graduation from Princeton University with an MSEE I joined GE in Schenectady, New York on the test program in 1940. Following service in the USNR I rejoined GE and was transferred to San Francisco where I spent 15 very rewarding years, but since all good things must end I was transferred back to Schenectady in January 1960. There I accepted the position of marketing manager of the gas turbine department. This appointment was greeted by most of my friends with a certain lack of enthusiasm. After all, this department had never shown a profit and there were many who thought it never would. One letter from a friend in San Francisco said it was the worst job in GE (to paraphrase what he actually said).

There were some favorable aspects. Charlie Elston was general manager of the department and it was a pleasure to work for him. Throughout my 35+ years with GE I had the good fortune to work for many outstanding individuals. The ones who had the greatest influence on me were Art Bragg in San Francisco, Charlie Elston, Alan Howard, Don Craig and Tom Paine in the East.

Soon three crucial decisions were made. First, it was decided to concentrate our efforts on only two machines — the mechanical drive two-shaft unit and the single shaft locomotive unit for power generation.

The electric utilities' need for peaking power had been recognized for many years. The second decision was to approach this potential market with a packaged power plant based on the locomotive design offering shipment of a factory assembled unit requiring minimum site preparation and field labor. We would build in advance of orders to be able to short shipments.

The third decision was to expand our already active export market.

At this point a diversion from our basic decisions occurred. An order was taken by the steam turbine division to supply a combined cycle plant to the Oklahoma Gas and Electric Company on a turnkey basis for their Horseshoe Lake station. Our department was committed to build a new large unit to support this effort.

Charlie Elston moved on to be the general manager of the large steam turbine generator department and Alan Howard came back from Lynn to replace Charlie. He had been one of the pioneers in the work to bring the jet engine technology down to earth.

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Meanwhile, the markets for our other products were non-existent. By mid-1961, we had not received a single unit order. In June, Mr. Ralph Cordiner who recently had been appointed chairman of the board, came to Schenectady for a business review with us. It was now a go-no-go situation. The first thing he said when he entered the room was, "Why shouldn't we close the gas turbine department?"

You can appreciate his concern and the concern of all of us, since about $80 million had been put into the gas turbine business between 1948 and 1960 — and we hadn't made a nickel. Utilities showed little or no interest in gas turbines and staying in this business took considerable perseverance and business guts. However, time had just about run out.

Fortunately for us we were given a reprieve through the persuasiveness of Clarence Linder, Charlie Elston and Alan Howard who advocated continuing the business in support of ongoing combined cycle activities. Also, I was asked to present a forecast of potential orders for the balance of 1961. Despite the dismal performance to date, I was able to develop a list of prospects which would support a total of $25 million in unit orders by year end. Mr. Cordiner received this presentation with the comment, "Young man, I admire your enthusiasm but I must question your judgment." The upshot of all this was what I considered a reprieve until year end.

However, the commitment for the orders was realized. The OG&E combined cycle continued to a technically successful conclusion if not an economic one and the fortunes of the department turned around. The decisions arrived at in 1960 proved to be the turning point in the business.

The Turnaround — The decision which contributed most immediately to turning the business around was to build the packaged power plant for the utility industry. It was rated at 11,250 kW at the time time of its introduction in 1961. The first unit under this concept was assembled and shipped to the South Carolina Electric & Gas Company. It was easy and inexpensive to install; it started quickly and could be operated automatically or remotely; and it did not require any water supply. In short, it was an ideal, completely self-contained peaking unit for utilities, ready for installation anywhere on a system. Our sales increased steadily, but mostly in foreign markets. Units that we turned out were ideal for many foreign areas, and the price was right. Most important of all, our "off-the-shelf" shipments proved to be a life saver to many foreign customers. At one time we had 22 units in various stages of production, without orders.

The gas turbine business has always done well abroad; at that time one out of every four units we had shipped went overseas — to 40 countries. We were fully competitive with foreign manufacturers in the truly free-trade areas of the world.

Beginning in 1959, we developed a method of penetrating markets previously closed to us by tariff barriers or nationalistic leanings. We arranged manufacturing agreements with nine strong overseas companies in countries where we had sold few, if any, Schenectady-made units.

Under these arrangements, we build the hot gas path parts while the associate builds the stationary parts and assembles and tests the complete machine to specifications. It is a mutually profitable arrangement.

The business prospered. We showed a profit in 1962 for the first time and began to repay our debt to the company's treasury.

By 1964, our unit had been uprated to 15,000 kW (a 33% increase) and our cost reduction program had been very successful. For bulk peaking, we conceived a multiple arrangement of four units with a single control called "power block," rated at 60 MW. Two such arrangements were supplied to Consolidated Edison Company on barges moored in New York Harbor.

Orders really began to roll in. Our domestic utility orders increased steadily.

A large portion of our orders increase in 1965 and 1966 should

(continued on page 100)

(continued from page 22)

be attributed to the Northeast Blackout and its impact on utilities. But, we really started our upward trend *prior* to the Blackout. In fact, I have always believed that the Blackout was a misfortune for us. It created a surge in demand beyond our ability to respond. Pratt & Whitney with their aircraft engine design had been a minor supplier until then. After we ran out of capacity they received substantial business and continued as a more active competitor. However, we were able to maintain our number one position.

During the so-called heat wave in the summer of 1966, a 4-unit power block came on line for a Midwest utility and performed so well that one of the utility officials commented that it was "the only thing keeping us going." The gas turbine was here to stay.

Tragically, Alan Howard died from a massive heart attack that year. In due course, I was appointed to be his successor as general manager.

Our prosperity continued, and we could see the possibility of repaying the company's $80 million investment (without interest). The slogan "across the line in '69" was created. The goal was realized and celebrated with some fanfare.

The simple cycle gas turbine was an inefficient machine. However, generating steam from the exhaust heat and making electrical power in a conventional steam turbine generator set resulted in a combination with respectable efficiency. Such arrangements were known as combined cycles. We promoted this concept with considerable success under the acronym "STAG" (Steam And Gas). Thus we graduated to base load applications.

There was a continuing demand for larger unit size even though our basic unit was rated at nearly 17 MW. Our engineers were asked what was the maximum size unit that could be designed to be shipped as a single unit. The answer was 37 MW. They were given the go-ahead. At the same time it was apparent that a large increase in manufacturing capacity was required to meet our steadily increasing orders.

We entered the company's appropriation request routine and came out with $53 million to purchase a 200-acre site in Greenville, South Carolina and build and equip a 300,000 square foot plant designed to manufacture, test and ship this larger unit. By the time the first unit was shipped in 1969 the rating had grown to about 50 MW.

The new unit and the new plant were extremely successful. So successful in fact that our orders received in 1970 were 2.5 times the 1968 level. Another appropriation request was approved to double the Greenville plant capacity.

Our burgeoning size resulted in the evolution of the gas turbine department into the gas turbine products division which was the ultimate in component size within the company. I was appointed vice president and general manager of the division.

The business continued to prosper until the Yom Kippur War broke out in the Middle East with the resultant oil embargo and skyrocketing oil prices. Domestic utilities refused to commit to any generation equipment burning oil. This resulted in an immediate and severe impact on the results in our short cycle business.

The situation was ameliorated somewhat by the negotiation of the largest single order ever received by the company up to that time. It was over $252 million and covered about 100 gas turbine units complete with centrifugal compressors to power a major new gas pipeline in Russia. That all started back in 1969 when we held a technical seminar on gas turbines with 50 or so of their engineers in Leningrad. After a reciprocal meeting in Schenectady, we signed a technical exchange agreement. These exchanges continued and we established our position in their eyes as the world leader in gas turbine technology. Through discussions with their gas ministry, it was evident that their requirements for gas turbines for pipeline pumping far exceeded their production capabilities. This potential market was, of course, what we were after from the beginning. Most of our manufacturing associates participated in the supply of equipment to fulfill their order.

I left the company at about the time the order was completed. It turned out to be the most profitable order we ever received.

The spectacular success of the business was obviously the result of the professional skill and dedication of innumerable people. These people, GE associates, customers and overseas manufacturing associates gave me the wonderful memories I have. They made every minute of it rewarding and fun. Neither my letter-writing friend in 1960 nor I had any idea of what would happen.

But the story is far from over. The gas turbine with its dubious future in 1960 has grown into the cornerstone of the most efficient and arguably acceptable power generation plant available today. I'm told that you can order a single combined cycle power plant today having an output of 240 MW with an efficiency of 52.9%! Figures we only dreamed of in the early 1970s. Truly, anything is possible.■

Biography

Whitman Ridgway is a life member of the IEEE and a professional engineer in the state of California. Upon retiring from General Electric in 1976, he was appointed chief of the Bureau of Power, Federal Power Commission, Washington, D.C. Later he became president of Turbonetics Corporation, the centrifugal compressor subsidiary of Mechanical Technologies Inc., Latham, New York and the Carrier Corporation. His last position was as president of Intermagnetics General Corporation, Guildenland, New York, a designing and manufacturing firm of superconducting materials and devices. He is now retired except for limited civic activities.

Editor's Note:

***Heritage** is a feature of the magazine which recognizes individuals who have made significant contributions to the gas turbine industry. If you, our readers, know of someone you think would make a worthy subject for **Heritage**, please contact us.*