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TEXASGULF'S NEWEST SULFURIC ACID PLANT - 3300 STPD

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SCOPE

In 1984, a Retrofit Energy Enhancement Project (REEP) was conducted at Lee Creek. Four sulfuric acid plants rated at a total of 7,675 STPD H_2SO_4 had their energy efficiencies improved from about 57.5% to over 70%. In order to convert the excess steam into electricity, a 40 MW turbogenerator was installed.

At that time, a 250,000 STPY P_2O_5 expansion was also initiated. With the shutdown of an older single absorption plant which ran at an average rate of 800 STPD, it was calculated that about 3300 STPD would be required from a new sulfuric acid plant. A new double absorption plant producing over 4 times the rate of the single absorption plant would still produce less stack emissions than the single absorption plant. Since the overall site's emissions would be decreased, it was possible to obtain environmental permits for the new plant.

Since Texasgulf had experience with a 3,100 STPD plant (the world's largest then), it was clear that a single train would be the preferred approach. Also, the turbogenerator was not operating at maximum rate; moreover, it was known that the machine could be rerated to about 46 MW. A new energy efficient acid plant would fit perfectly into that situation, meeting the fertilizer production requirements and closing the steam and electricity balances.

Following evaluation of competitive bids, Enviro-Chem was awarded the project in November of 1984. Enviro-Chem submitted a modern, innovative design, with energy efficiency approaching 70%. Internal energy consumption was also very low, resulting in a very high energy export and a good fit with the turbogenerator.

The original schedule called for a mid-February 1986 mechanical completion, and a March 1st start-up (Figure 1). This 15-month schedule would be a record for a grass-roots plant of this size.

PROJECT RESULTS

During 1985 there were indications that the investment tax credit could be deleted from the tax code. In July, Enviro-Chem reported that mechanical completion target had improved by a month, with start-up expected on February 1st, 1986. Around September of 1985, Texasgulf asked Enviro-Chem to shorten the remaining schedule and aim for a 1985 start-up. The mechanical completion target was now December 16, 1985, and start-up would be December 20, 1985. If successful, Texasgulf would be assured of the investment tax credit. Also, early depreciation and cash flow would enhance the project's profitability.

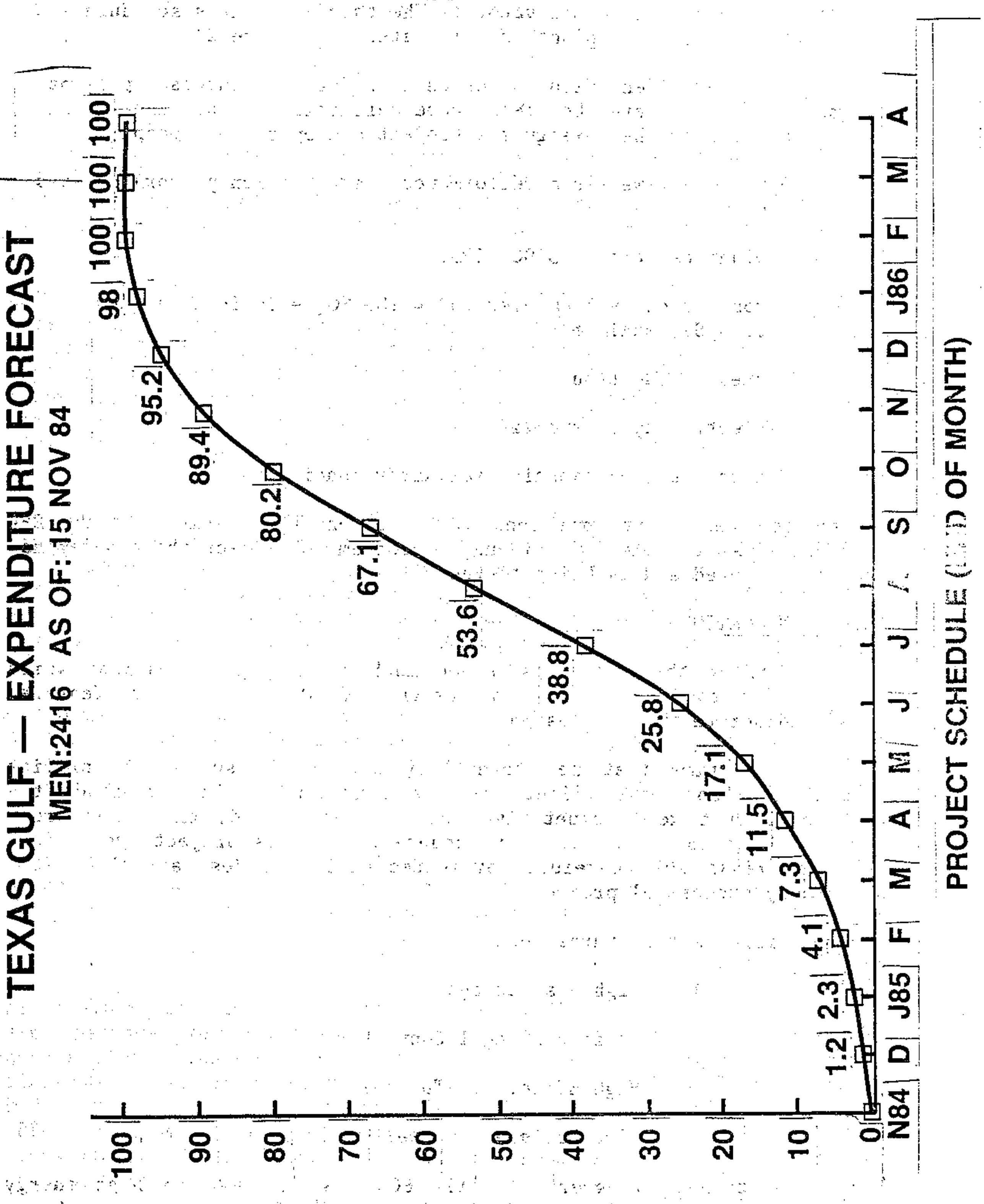

FIGURE 1. TEXASGULF 3300 STPD H_2SO_4 (PLANT 6) PROJECT - ORIGINAL SCHEDULE

The final schedule was met with about 45 minutes to spare. We made acid at 11:15 p.m., December 20, 1985. Not to be at the plant for Christmas and New Year was a great motivator!! The thirteen months schedule was the shortest ever for a plant of this category (Figure 2).

Among the factors identified as responsible for this success, perhaps the most important were the clear scope definition by the client, and close support from the Texasgulf's Project and Operations people.

After the Holidays, we ran a performance test. Design performance was verified for:

- plant capacity - 3300 STPD.
- conversion 99.7% minimum or 4 lb. SO_2 emissions per ton of H_2SO_4 maximum.
- steam production.
- electricity consumption.
- excess blower capacity for dirty conditions.

During the test mist emissions (0.15 lb/ton H_2SO_4) exceeded the EPA allowance. At the time of writing, a program to correct the problem has been implemented and is being tested.

DESIGN INNOVATIONS

The success of the project depended much on design innovations which were the key to a cost-effective design. About 20 innovative features were incorporated in the design.

At the same time that new technology adds risk, such risks provide rewards for both the client and the contractor. On one hand, the contractor must keep competitive, on the other hand, the client must keep its position as a low cost producer. In this project, we believe that the risks were carefully evaluated on both sides, and the result was a very successful project.

The most important features were:

1. High Gas Strength
2. Stainless Steel Converter
3. High Efficiency Turbine
4. High Efficiency Towers

High gas strength (higher than 11% SO_2) is the key to high energy efficiency. For example, a 10% SO_2 plant handles 10% more volume than a 11% SO_2 plant, and consumes typically 25% more energy assuming same gas velocities. This point is clearly made when examining the steam consumption figures below.

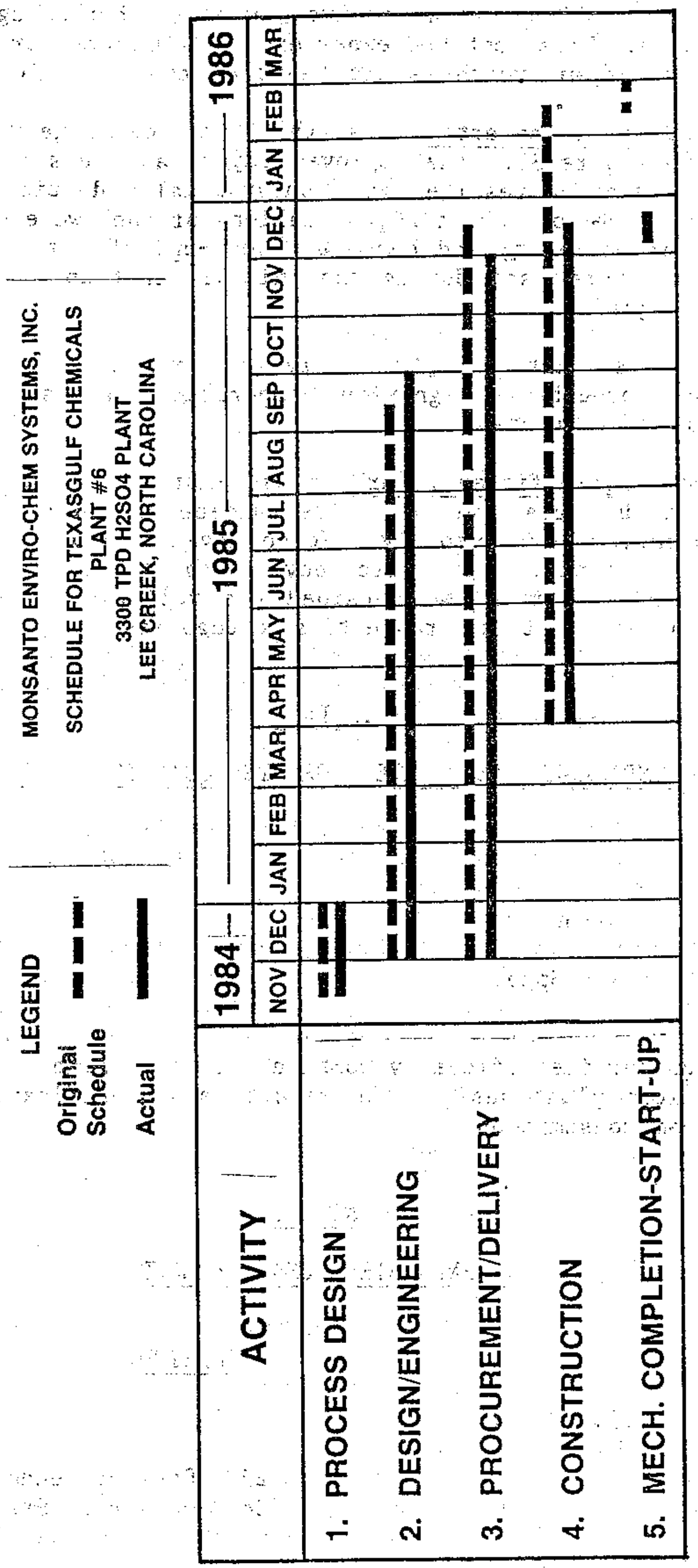

FIGURE 2. FINAL PROJECT SCHEDULE - TEXASGULF PLANT 6

It gives comfort to the customer to know that the contractor is also the world's leading sulfuric acid catalyst supplier when using the high gas strength design. This combined experience is critical for the design of the converter system, which is the heart of the sulfuric acid process.

The stainless steel converter is at the center of large improvements in plant layout (Figure 3). The improved layout and less mass to heat-up for initial operation resulted in a substantial reduction in fuel consumption for start-up. About 20,000 gallons of fuel were used for brick curing, boiler boil-out, and converter heat-up. For the same purpose, 30,000 gallons were used during the initial start-up in the 3100 STPD plant at Texasgulf.

A record was estabished in that only one dry blow was used and the converter was brought to ignition temperature in less than 24 hours after the blow dry started.

A high-speed, high-efficiency turbine was installed. This was a 11,000 rpm machine with a gear reducer. The turbine proved to be a precision machine, operating very smoothly. Noise levels are lower than those of conventional turbines. The efficiency of the turbine is what made it attractive. For example, we obtained the following figures for high quality turbines in their respective categories, and similar blower duties.

TABLE 1

COMPARABLE STEAM RATES FOR HIGH QUALITY TURBINES

	lb/h/HP
Low-Speed	15.65
High-Speed	14.75

When the high turbine efficiency combines with the high gas strength and energy-efficient plant design, the result is a significant reduction in internal steam consumption.

TABLE 2

INTERNAL STEAM USAGE (BLOWER)

	lb/h/STPD
Typical 10.5% SO_2 Plant	36.2
New Plant	29.5 Design, Vendor Guarantee 26.0 Measured, Start-Up

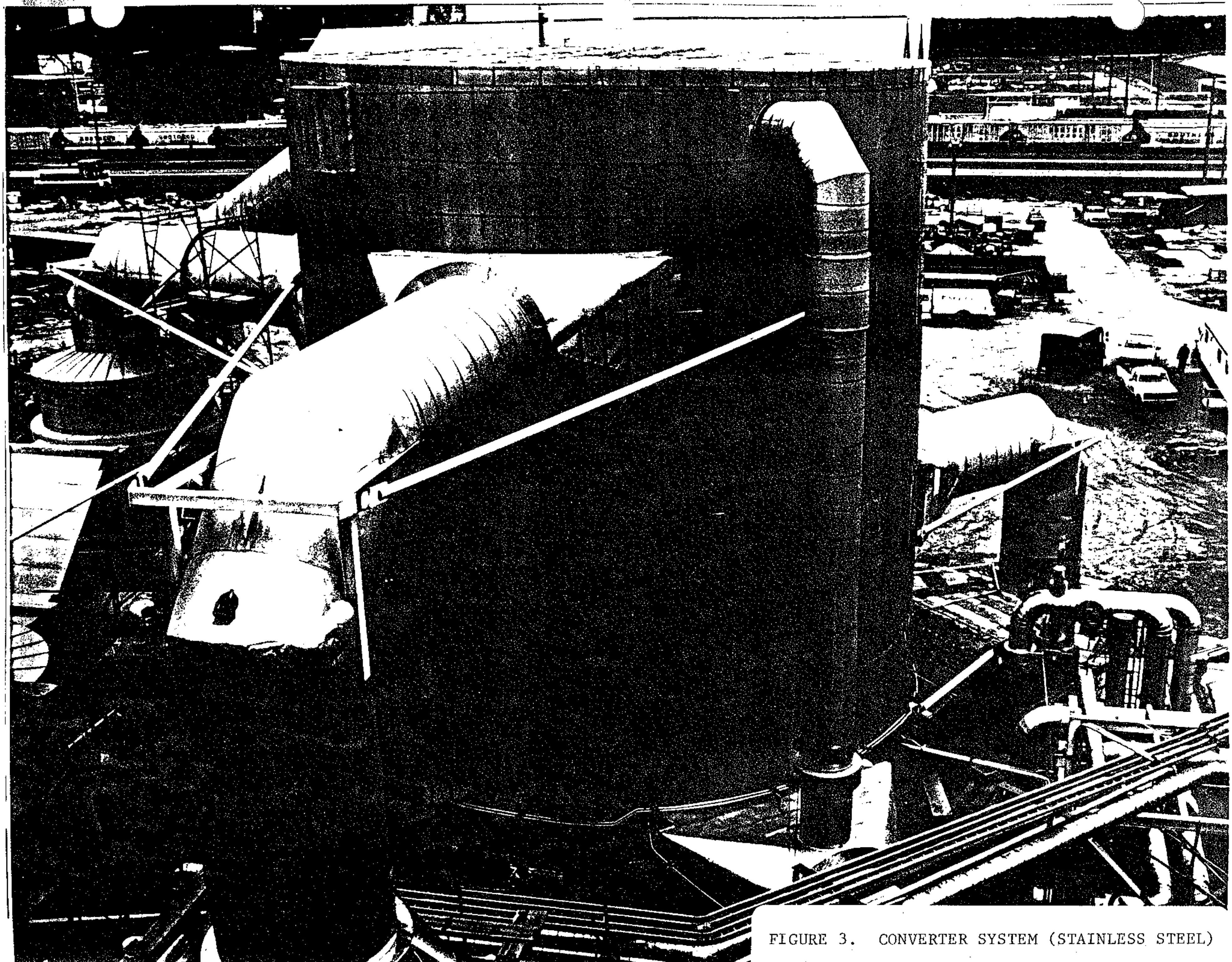

FIGURE 3. CONVERTER SYSTEM (STAINLESS STEEL)

We are not sure the measured steam consumption does not contain measurement errors typical of steam instrumentation. However, it is clear that a high-efficiency turbine can pay-out into higher steam export rates.

This mechanically efficient design was also found in the acid and water systems. For example, electrical power consumption was measured at 7.6 kWh/ton H_2SO_4. The key to the low pumping energy design are the high-efficiency towers. These towers combine with a new pump tank design to produce a compact acid system with very low acid pump discharge pressure (Figure 4).

The absorption performance of the towers was as predicted (Table 3).

TABLE 3

ABSORPTION EFFICIENCY OF HIGH-EFFICIENCY TOWERS

	Absorption Efficiency, %	
Tower	Design	Actual
Drying	99.85	99.85+
Interpass	99.96	99.99+
Final	99.98	99.96+

Other innovations include selected stainless steel vessels and ducts (in addition to the converter), Fisher PRoVOX instrumentation, automatic conversion control, and others, too numerous to discuss in this paper.

Although the plant was very cost competitive, it still contained quality features such as the high energy efficiency, stainless steel converter, high-speed turbine, low plant pressure drop, and so on.

Last, but not least, we were proud to complete the project without a lost time accident.

SUMMARY AND CONCLUSIONS

1. Texasgulf and Enviro-Chem embraced substantial innovations in the design and construction of the world's largest single train sulfuric acid plant.

2. The result was a cost-effective, high-performance design. Thermal efficiency approached 70%, and mechanical efficiency was 20% better than conventional designs.

3. The schedule was shortened to thirteen months for year-end completion with significant positive impact on the project's cash flow and profitability.

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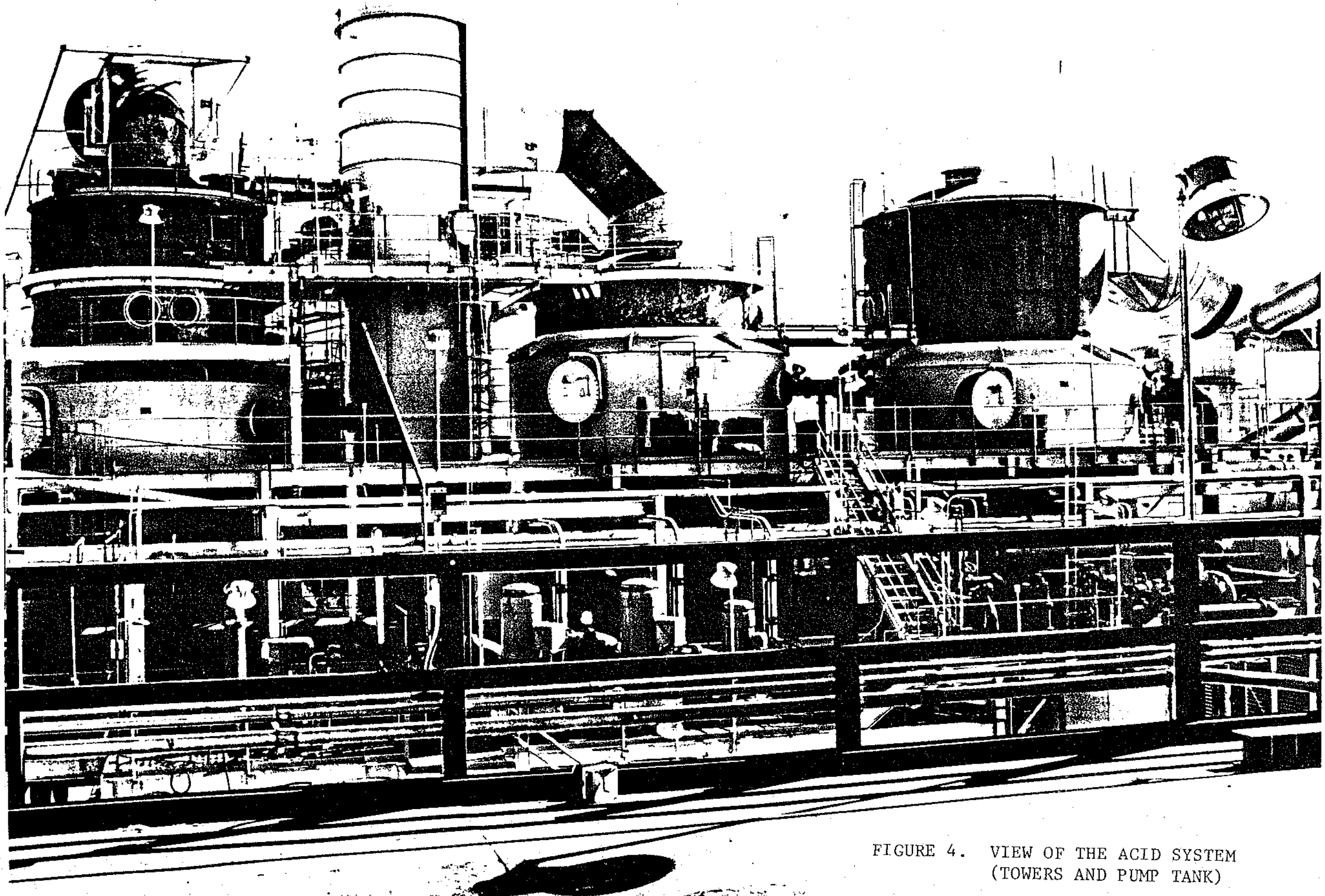

FIGURE 4. VIEW OF THE ACID SYSTEM
(TOWERS AND PUMP TANK)

ABOUT THE AUTHORS

Peter Peng was Enviro-Chem's Senior Process Design Specialist and lead process design engineer for the Texasgulf Project. He is an "old fertilizer man" having worked for Davy in Lakeland. Peter is currently Area Sales Manager for Enviro-Chem products covering Canada and South America from St. Louis. He is a graduate of Georgia Tech (MS and PhD in ChE).

David Hill was Texasgulf's Project Engineer in charge of the Sulfuric Acid expansion. David is a Process Engineer in Texasgulf's Acid Production Department, operating 11,000 STPD of sulfuric acid capacity, a 46 MW turbogenerator and extensive water treatment plants. Dave is a chemical engineer, having graduated from the North Carolina State University.

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