Results of the Demonstration Power Plant on the Pleasant Bayou Geopressured Resource

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Pleasant Bayou Power Plant

Overview:

* Nominal 1 MW hybrid cycle power plant
* Built in late 1980s to run on brine and gas from Pleasant Bayou Well No. 2
* Start-up & testing Oct-Dec 1989
* Demonstration run Jan-May ’90

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Overview: (cont.)

* 10,000 BBL/day brine at 290 F
* 22 SCF/BBL gas (87% CH_4, balance mostly CO_2)
* Half the total flow of the well
* Generated 980 kW total (690 kW from gas engines + 535 kW from binary cycle turbine – 270 kW parasitic load)

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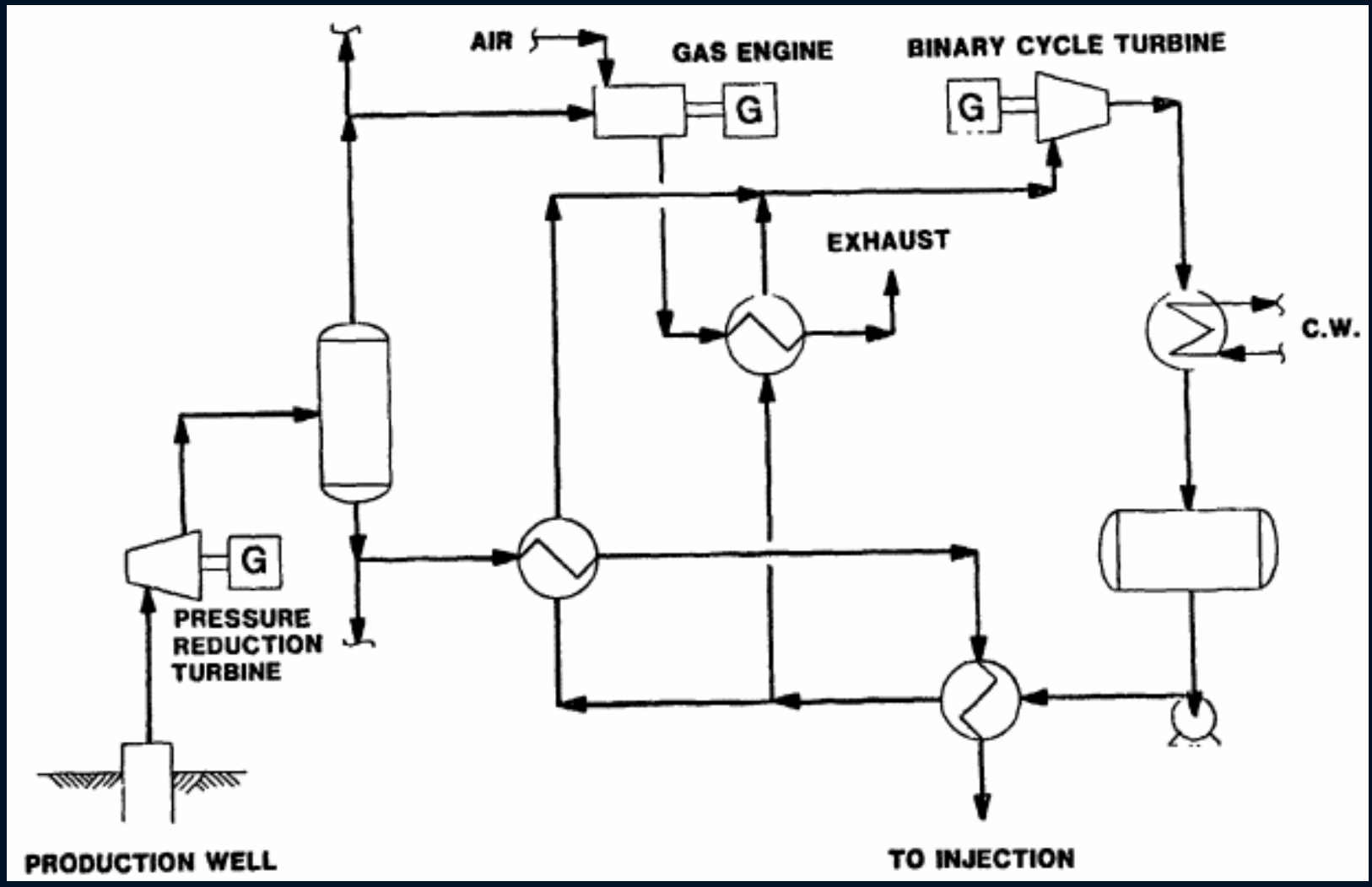
Participants:

- Funding by US DOE and EPRI
- Well drilling and rework by Eaton Operating Company
- Fluid handling by Institute of Gas Technology
- Power plant by Ben Holt Company

Pleasant Bayou Power Plant



Hybrid Cycle Flow Diagram

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Hybrid Cycle:

- Operates on two different fuels
- Integrated operation to get optimum use of both fuel sources
- Studies funded by EPRI show that efficiencies for optimized hybrid cycles are much higher than for power plants operating on the two fuels independently

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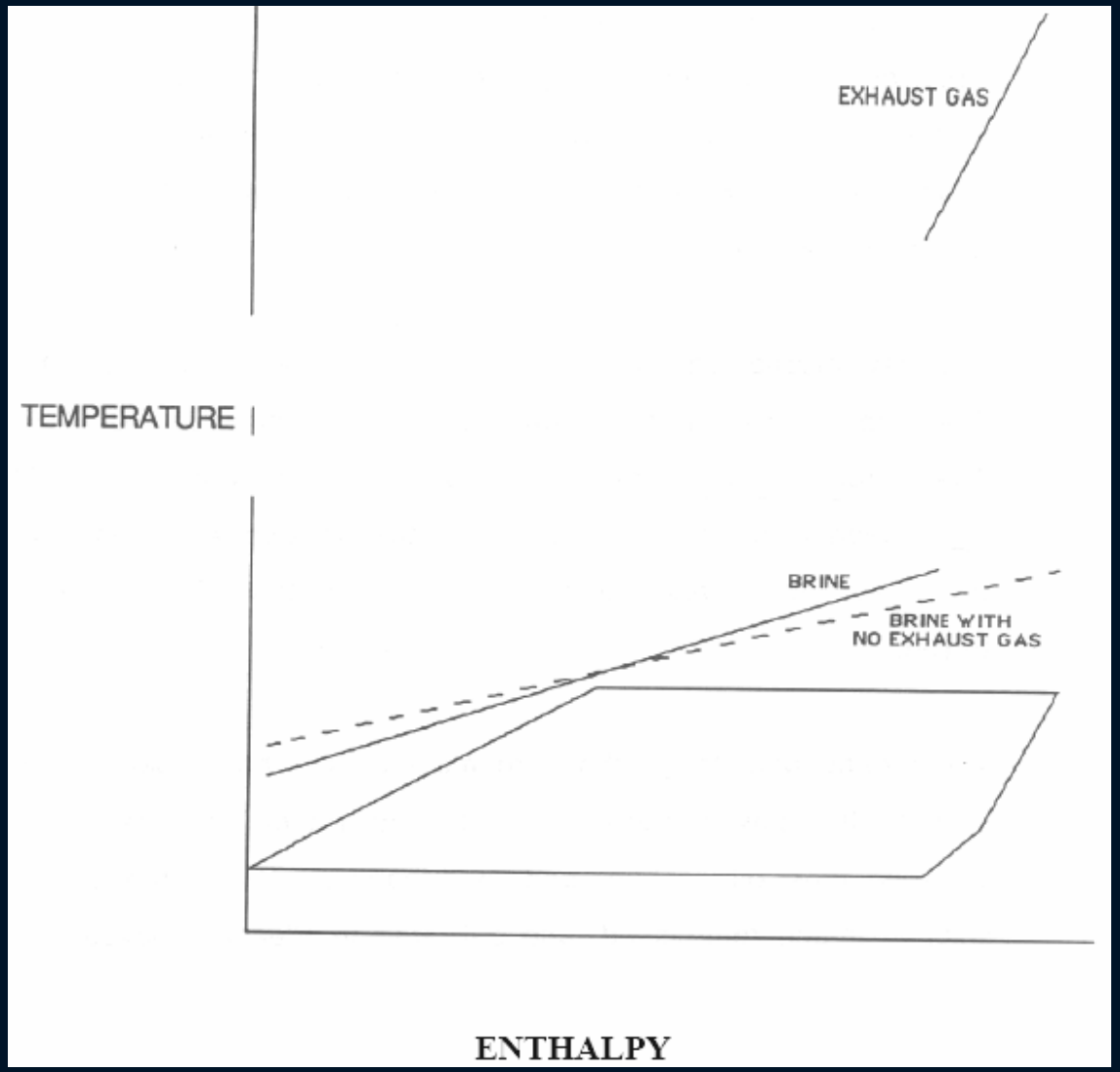

Hybrid Cycle Temperature-Enthalpy Diagram

Major Equipment

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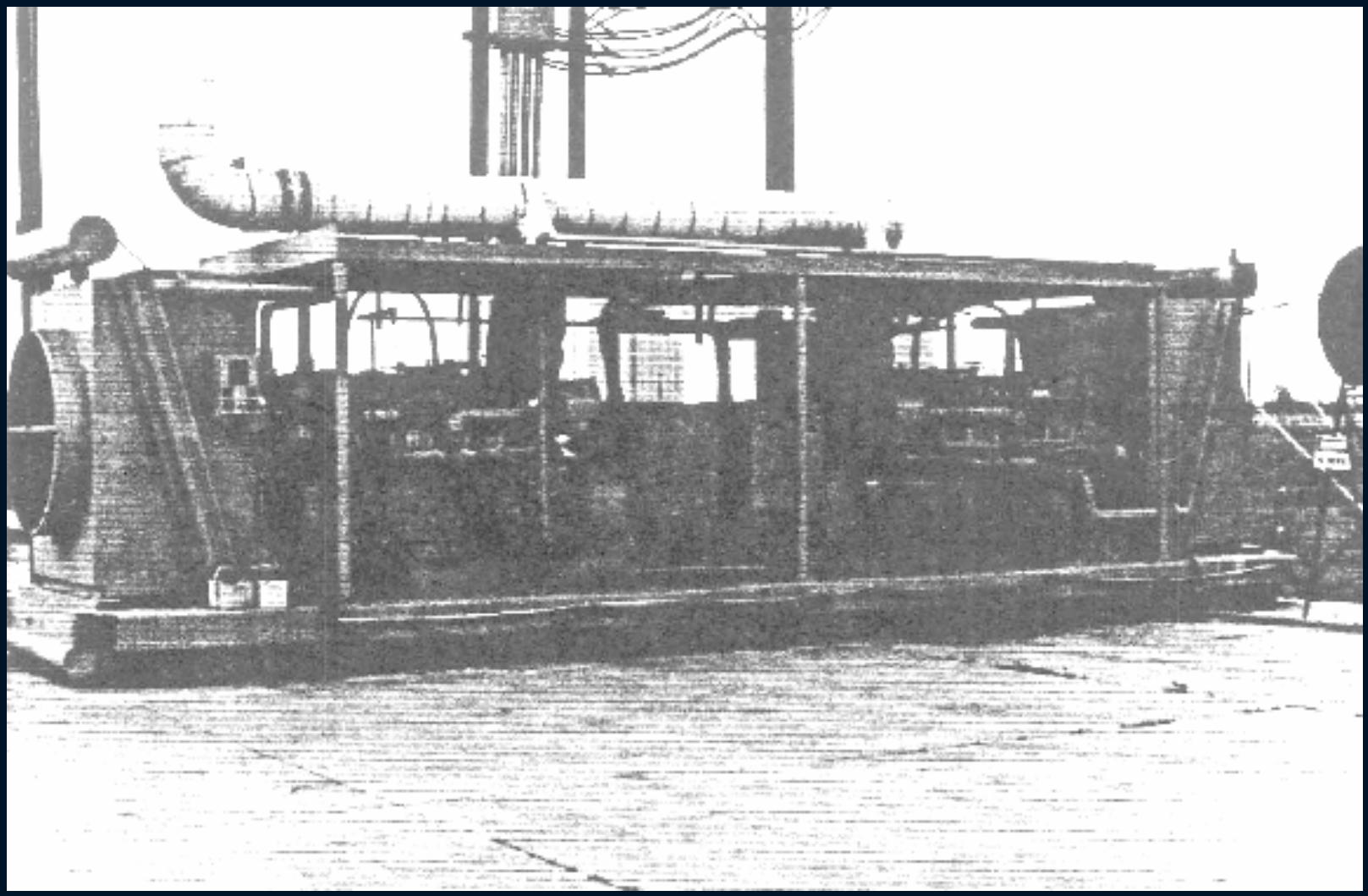

Gas Engines

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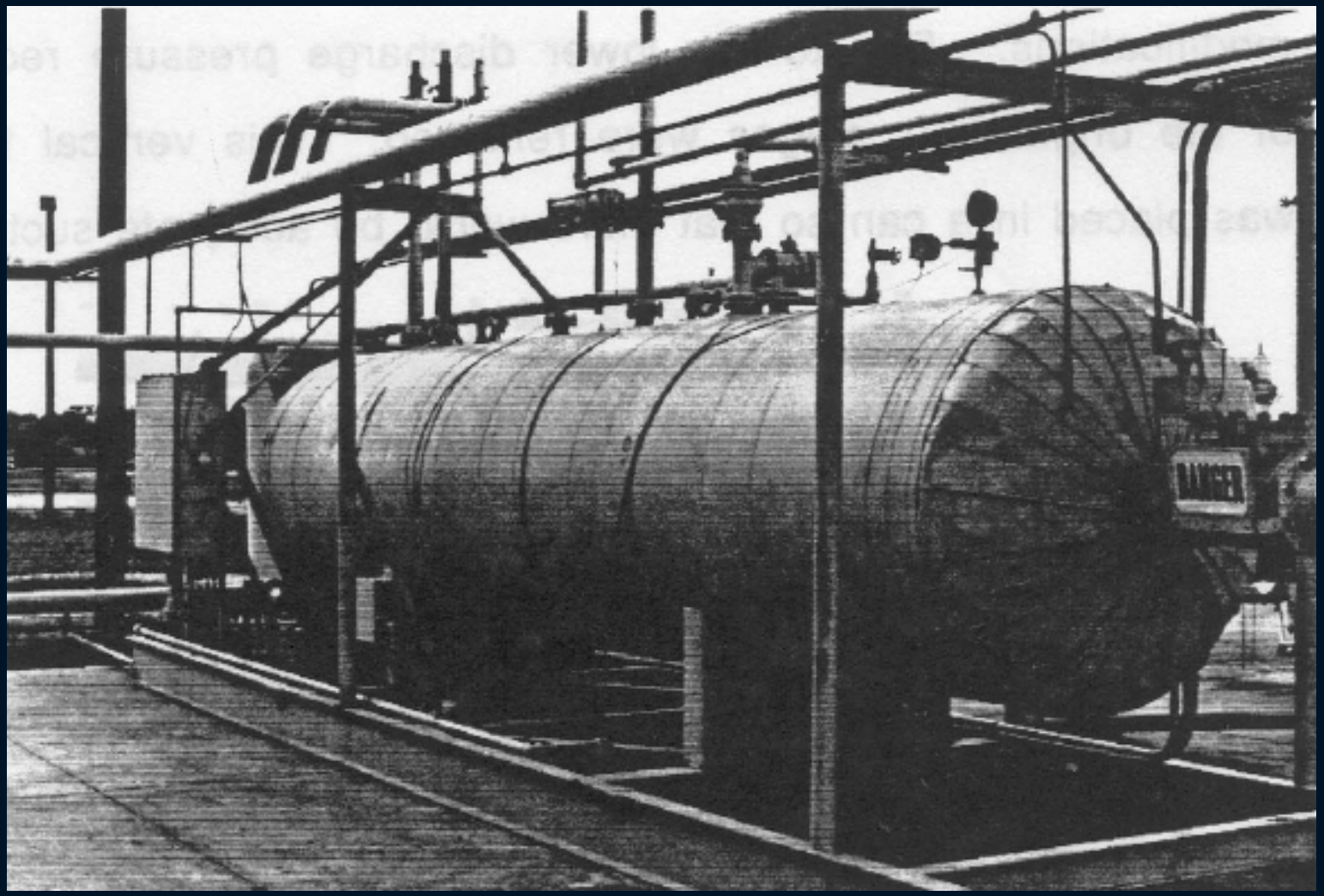

Accumulator

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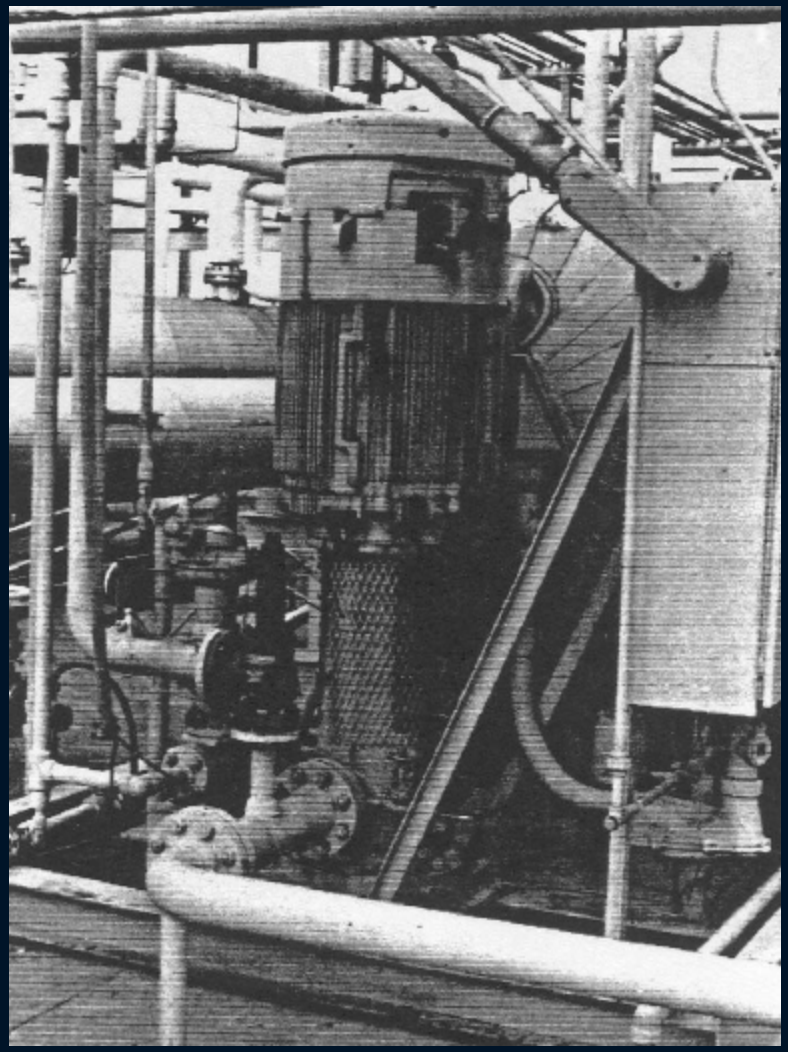

Isobutane Circulating Pump

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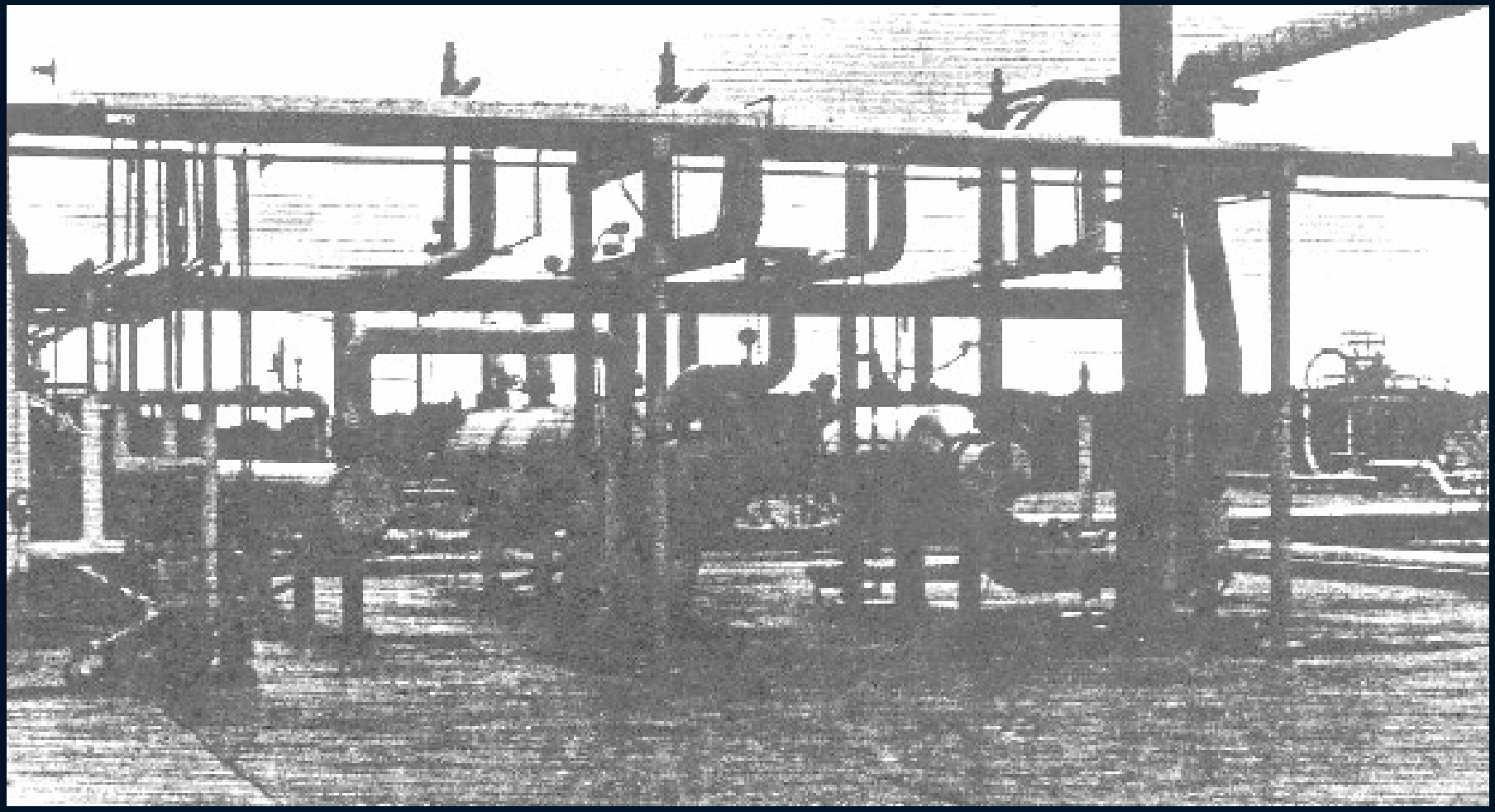

Heat Exchangers

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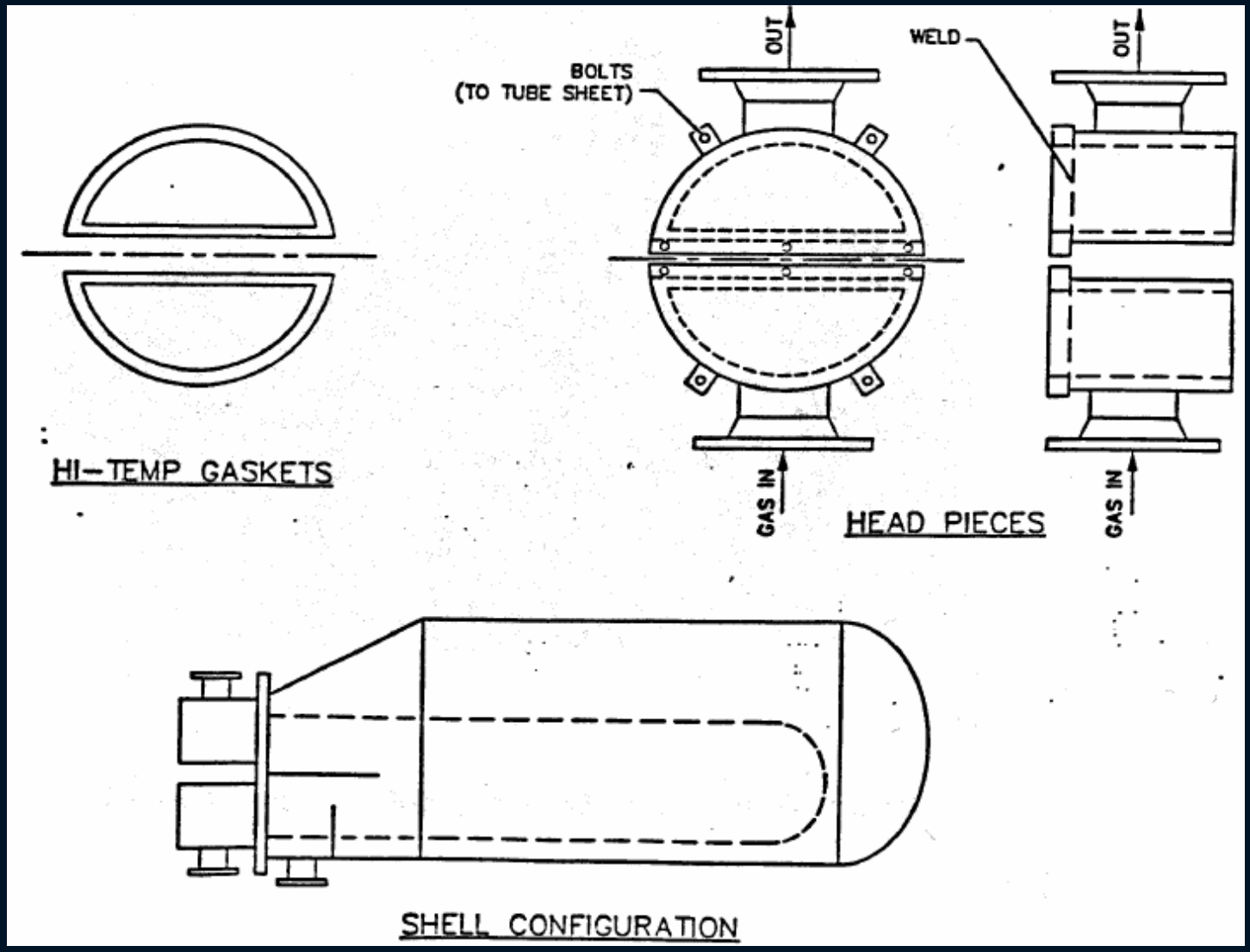

Exhaust Gas-to-Isobutane Boiler Design

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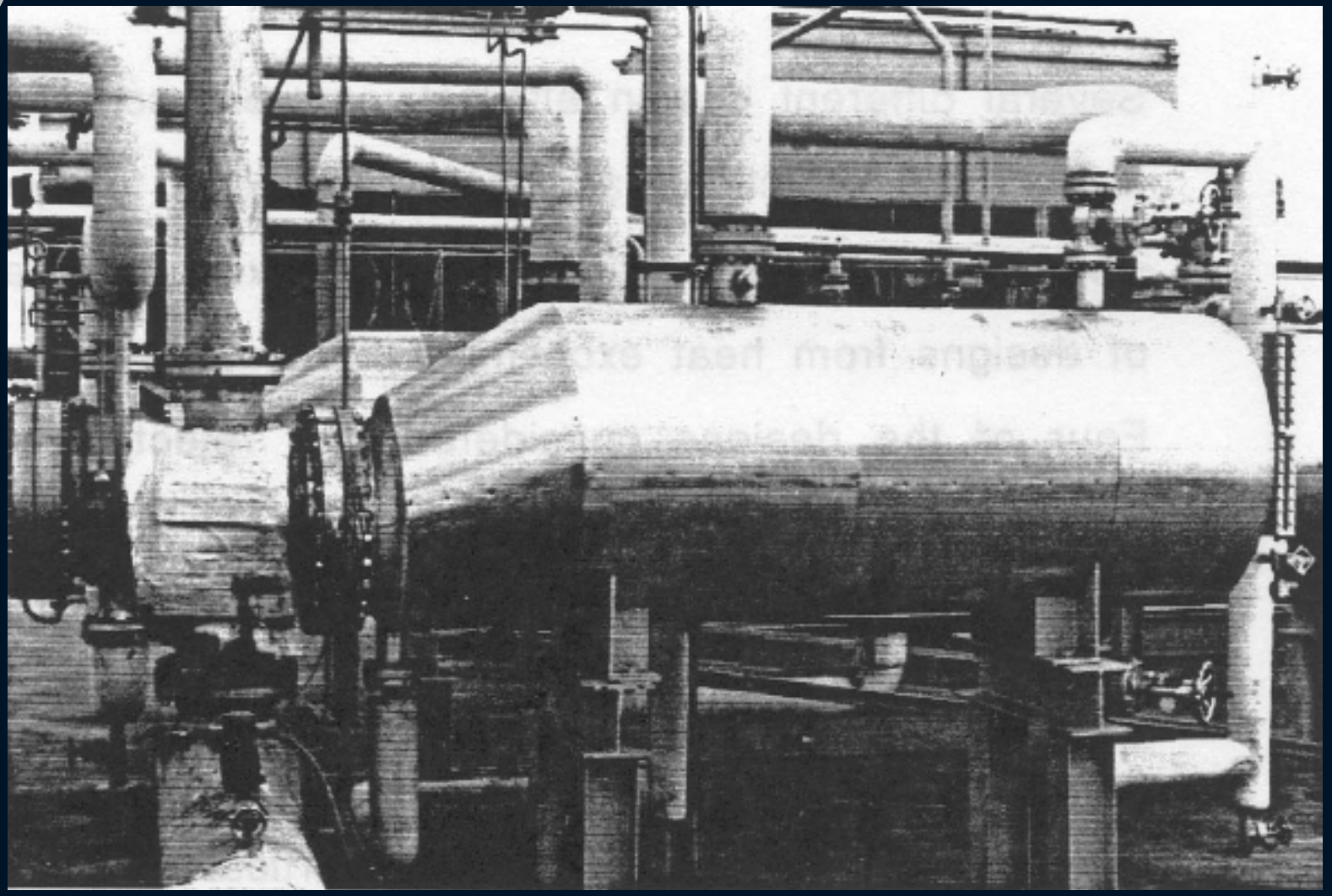

Exhaust Gas-to-Isobutane Boiler, E-3-N

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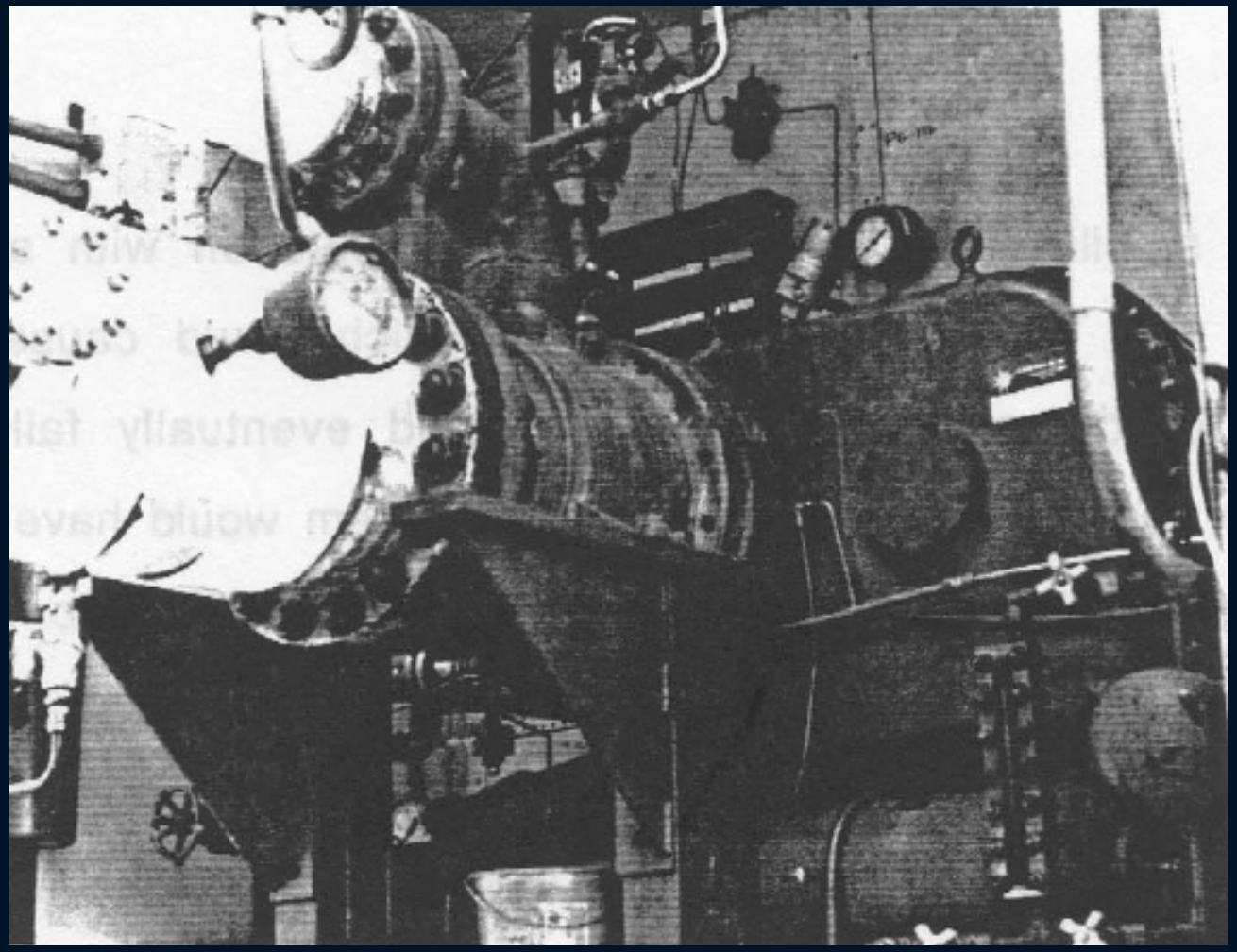

Turbine-Generator

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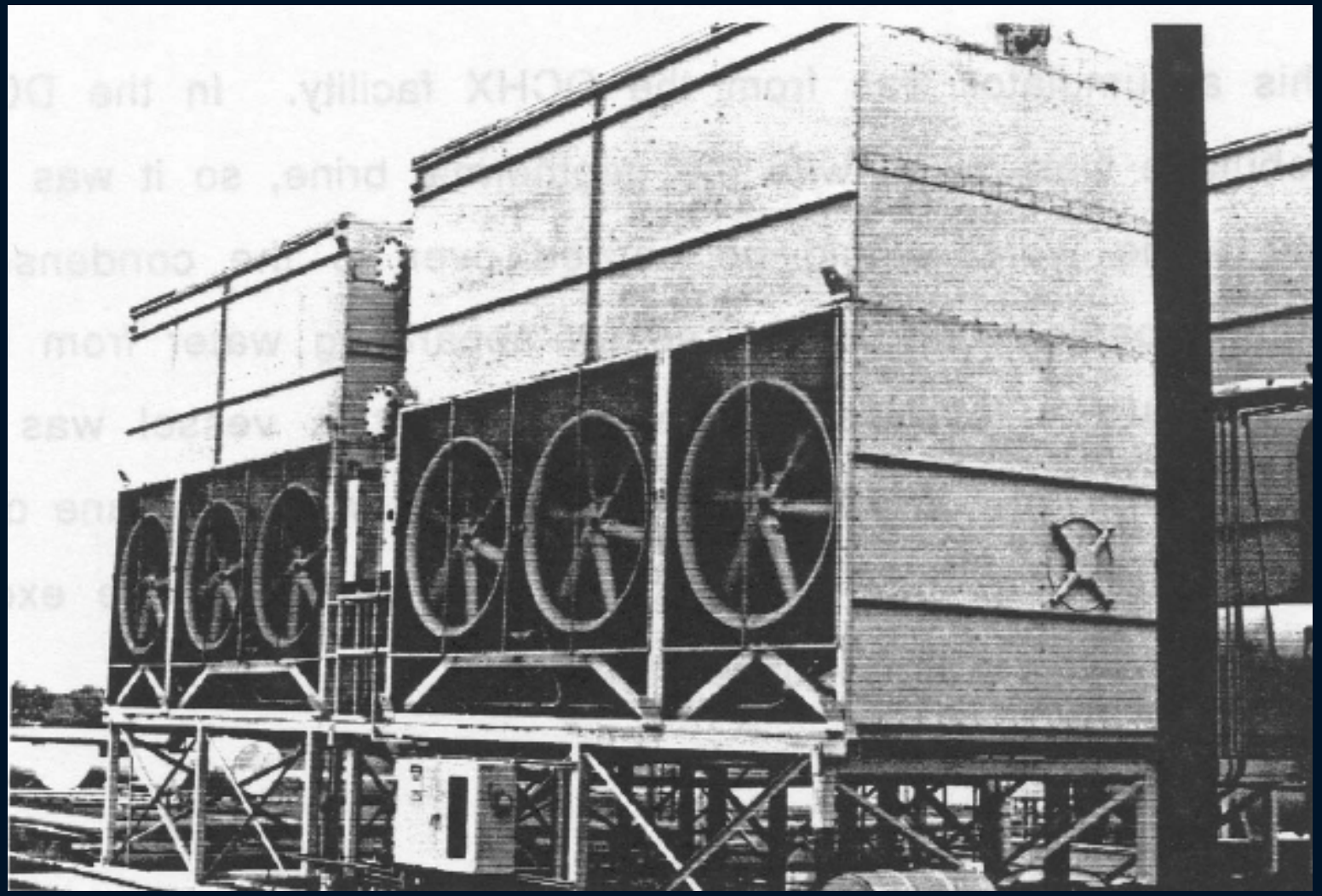

Condensers

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Major Technical Concerns at Time of Design:

* Corrosive brine (1000 mils/yr)
* Scaling (130,000 ppm TDS)
* Engine operation on impure gas
* Turbine reliability (had failures at DCHX)
* Differential thermal expansion in exhaust gas to isobutane heat exchanger

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Discussion of Major Technical Concerns:

* Corrosion inhibitors worked: no failures in 16 Ga. carbon steel tubes.
* Scaling inhibitors worked well
* Engines operated well, next slide shows fouling due to carbon deposits
* Binary cycle turbine had no wheel failures (used Finite Element Analysis)
* Split channel in E-3-N solved differential thermal expansion problem

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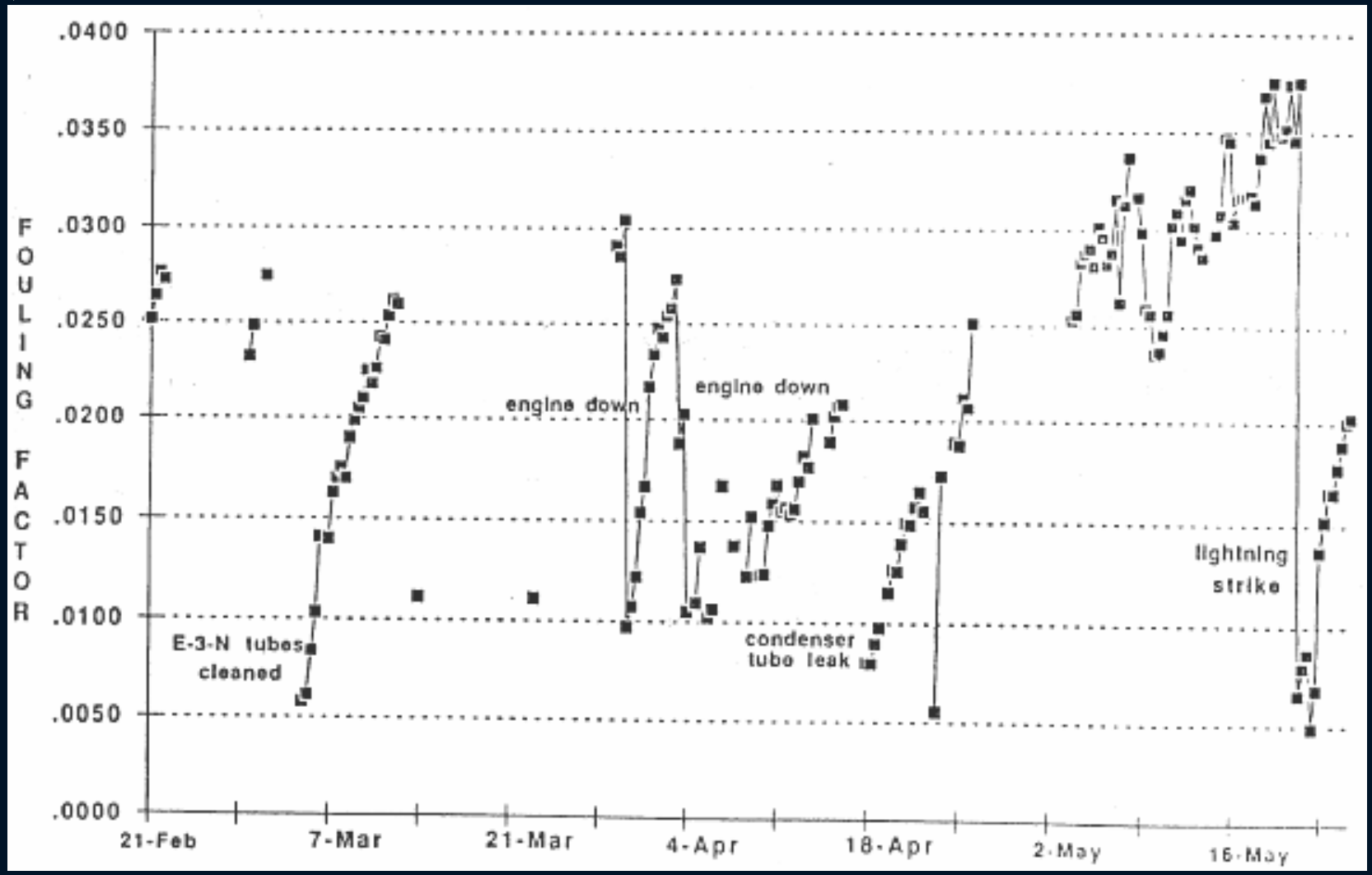

E-3-N Fouling vs. Time (hr-sq ft-deg F/Btu)

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Overall Results:

* 97.5% Availability
* Effective demonstration of hybrid cycle
* Effective demonstration of power generation on geopressured resource
* No major technical problems
* Only significant operating problem was carbon deposit in exhaust gas heat exchanger—easily removed

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DOE Program Discussion:

* Currently talk of DOE geothermal program being eliminated in 2007
* This power plant shows the value of DOE program because it demonstrated that a power plant could be successfully operated on a resource with unknowns such as scaling and corrosion

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DOE Program Discussion (cont.):

* Private contractors, banks, and developers are reluctant to take such risks, but with DOE's involvement the risks were shown to be small
* This is a major contribution DOE has made and can continue to make
* It would be a **BIG** mistake for the DOE geothermal program to be eliminated

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Overall View from Fire Water Pond

THE END