D. RATES OF CARBON FORMATION EXPERIMENTAL PROGRAM

1. Description of Experimental Equipment

During the period July - September, 1977, the design of the multiple fixed-bed reactor system was completed (see Figure IV-D-1 and IV-D-2). Equipmemt was ordered and a fabricator was commissioned to construct the reactor unit. The reactor design incorporates a removable, sectional catalyst basket which can be positioned inside the reactor tube. The baskets contain provisions for a central thermowell. The thermowell contains three stationary thermocouples for zone temperature controllers in addition to the traveling thermocouple necessary for the temperature profile.

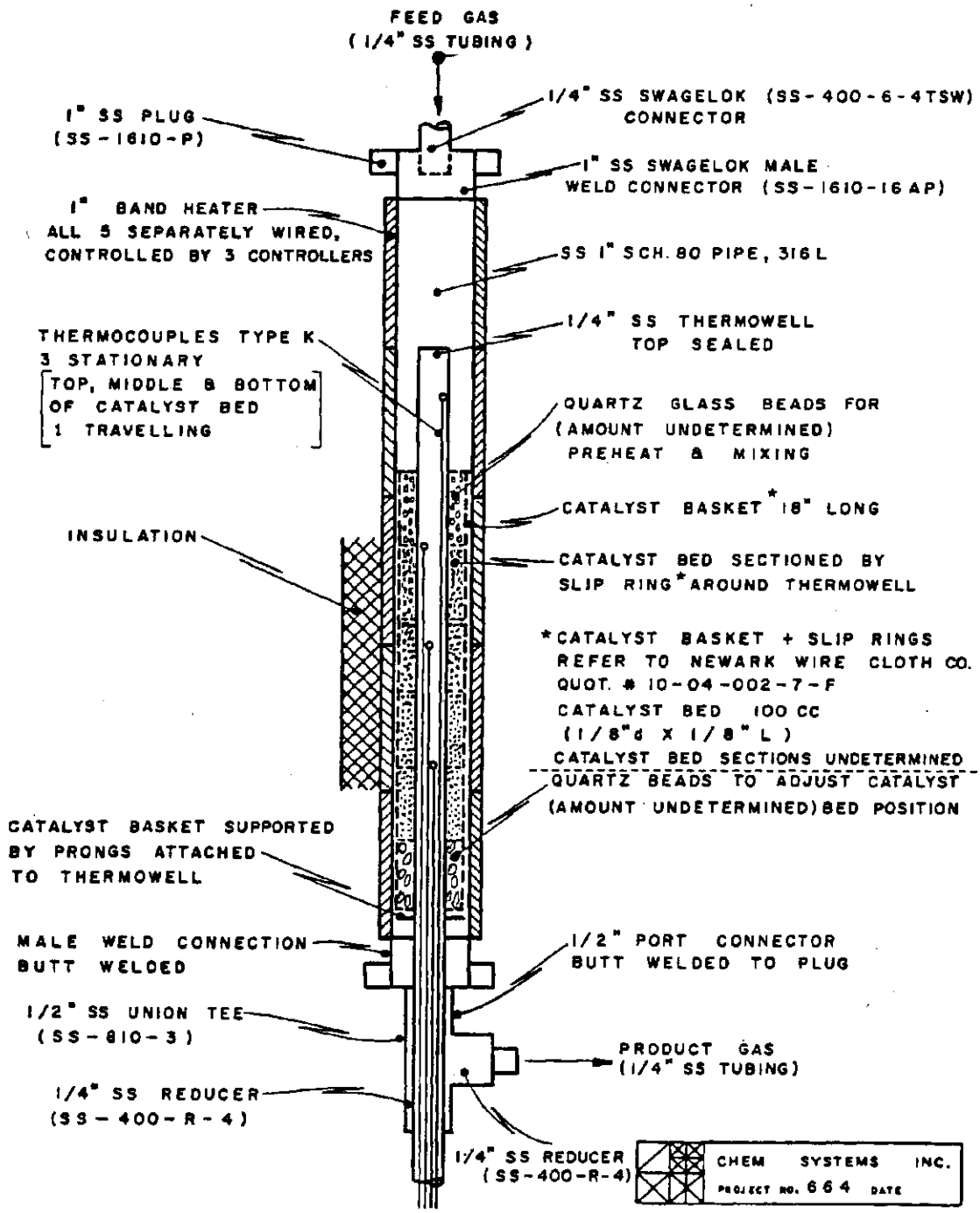
Construction of the test unit assembly (support structure and piping) started in October, 1977. The overall dimensions are 19 ft. long, 4 ft. wide, and 7 ft. high. It is subdivided into five identical units, one for each reactor system, and a master control panel to hold the temperature indicator and recorder.

The feed gas lines from the trailer to the reactor skid were completed in October. Construction began on a single prototype unit of the reactor system to study the feasibility of several instrument and piping arrangements. The remaining four units were later duplicated from this one.

During November, 1977, the reactor skid housing five individual reactor units was completed. Construction of a modular unit for two gas booster compressors, as shown in Figure IV-D-3, was also finished except for electrical wiring. Construction of a prototype of a single reactor system neared completion. The layout of the control panel of the prototype is shown in Figure IV-D-4.

FIGURE IV-D-1

SCHEMATIC DIAGRAM OF REACTOR ASSEMBLY CARBON FORMATION STUDY IN METHANATION



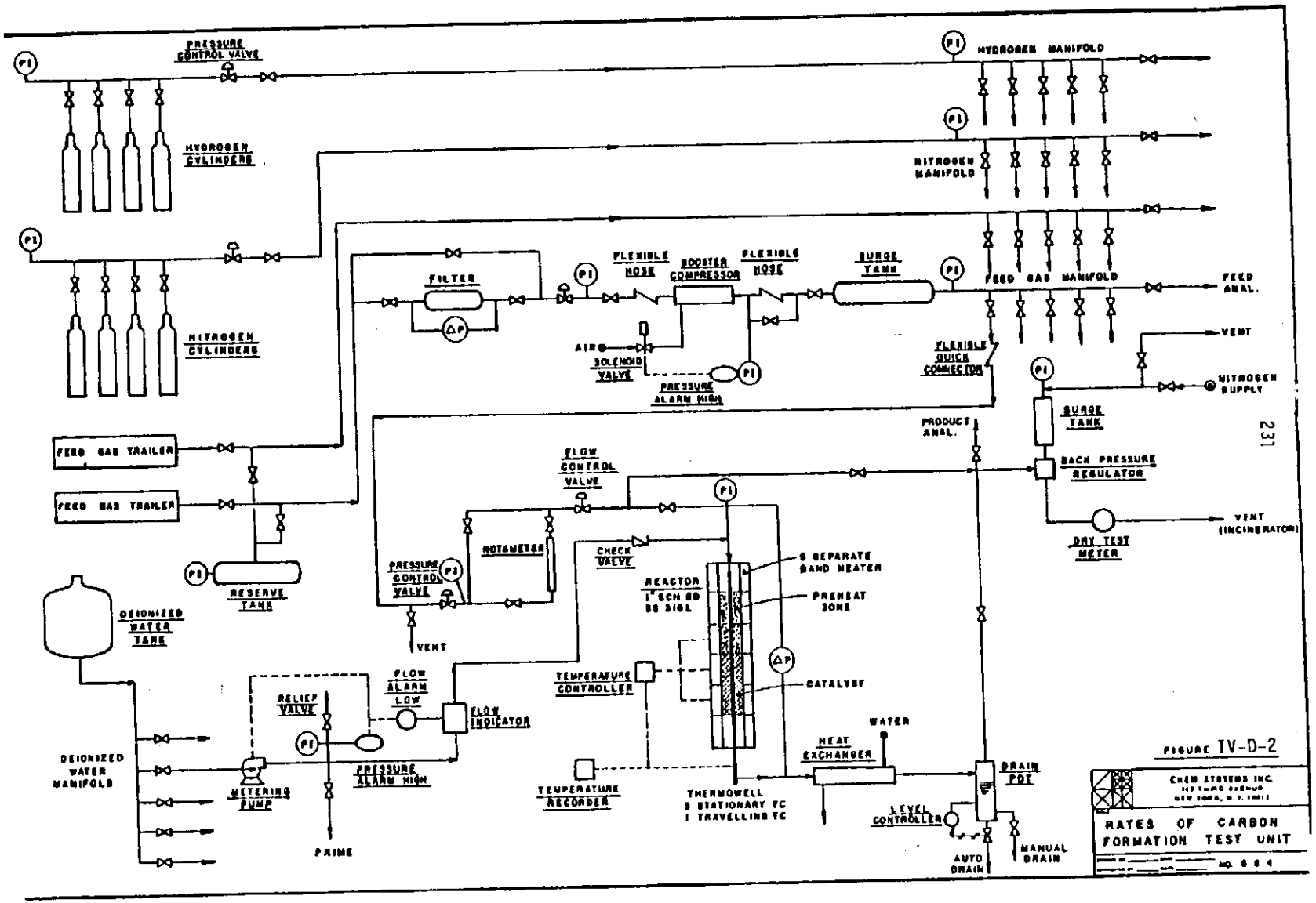

PRESSURE CONTROL VALVE
HYDROGEN CYLINDERS
HYDROGEN MANIFOLD
NITROGEN MANIFOLD
NITROGEN CYLINDERS
FILTER
FLEXIBLE HOSE
BOOSTER COMPRESSOR
FLEXIBLE HOSE
SURGE TANK
FEED GAS MANIFOLD
FEED ANAL.
VENT
AIR
SOLENOID VALVE
PRESSURE ALARM HIGH
FLEXIBLE QUICK CONNECTION
NITROGEN SUPPLY
SURGE TANK
PRODUCT ANAL.
BACK PRESSURE REGULATOR
FEED GAS TRAILER
FEED GAS TRAILER
FLOW CONTROL VALVE
ROTAMETER
CHECK VALVE
6 SEPARATE BAND HEATER
PREHEAT ZONE
CATALYST
VENT (INCINERATOR)
DRY TEST METER
RESERVE TANK
PRESSURE CONTROL VALVE
VENT
REACTOR 1" SCH 80 SS 316L
DEIONIZED WATER TANK
FLOW ALARM LOW
RELIEF VALVE
FLOW INDICATOR
TEMPERATURE CONTROLLER
WATER
HEAT EXCHANGER
DEIONIZED WATER MANIFOLD
METERING PUMP
PRESSURE ALARM HIGH
PRIME
TEMPERATURE RECORDER
THERMOWELL 5 STATIONARY TC 1 TRAVELLING TC
DRAIN POT
LEVEL CONTROLLER
AUTO DRAIN
MANUAL DRAIN
CHEM SYSTEMS INC.
RATES OF CARBON FORMATION TEST UNIT
NO. 6 6 4

FIGURE IV-D-2

FIGURE IV-D-3

CARBON FORMATION BOOSTER CONTROL PANEL

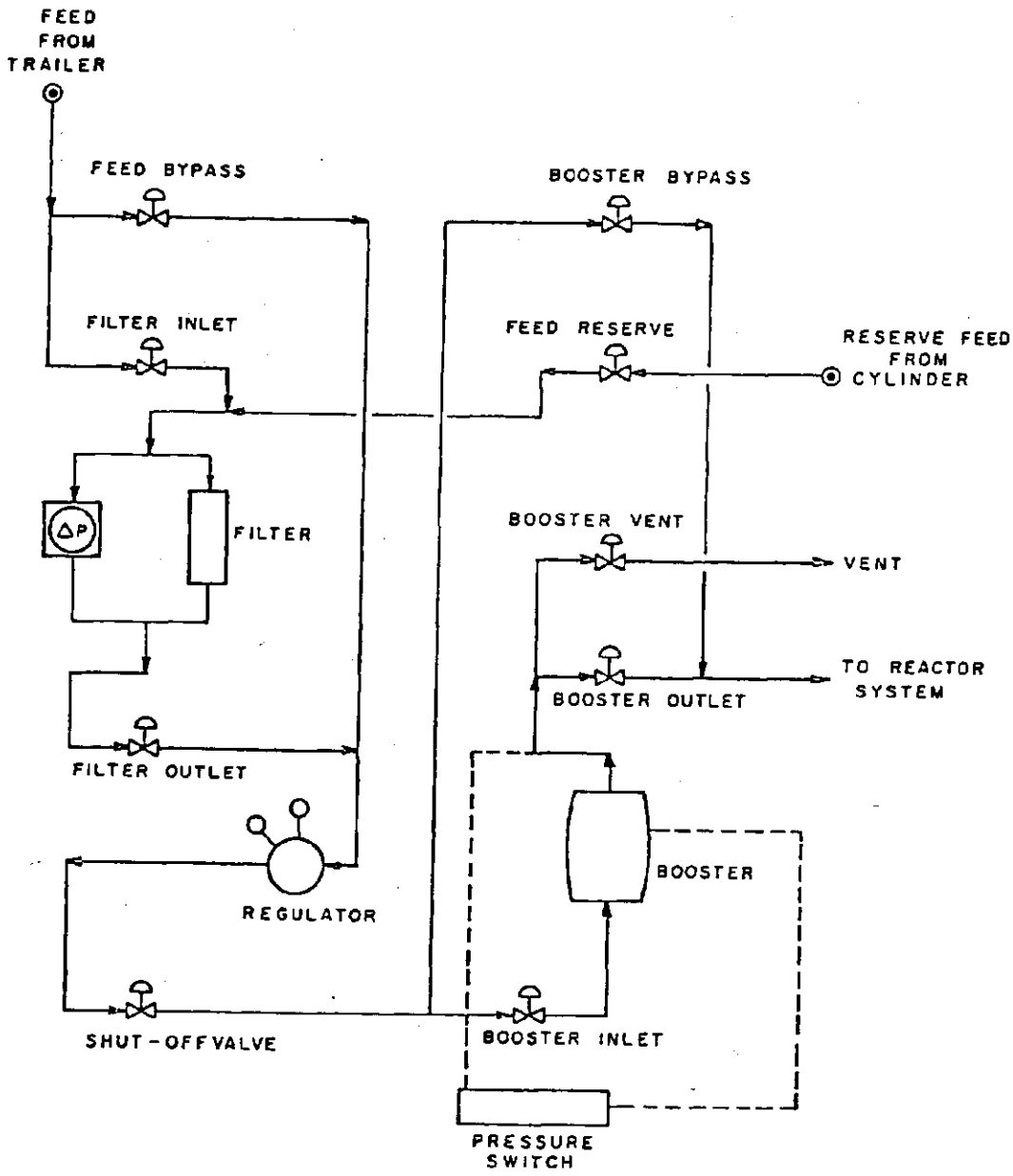
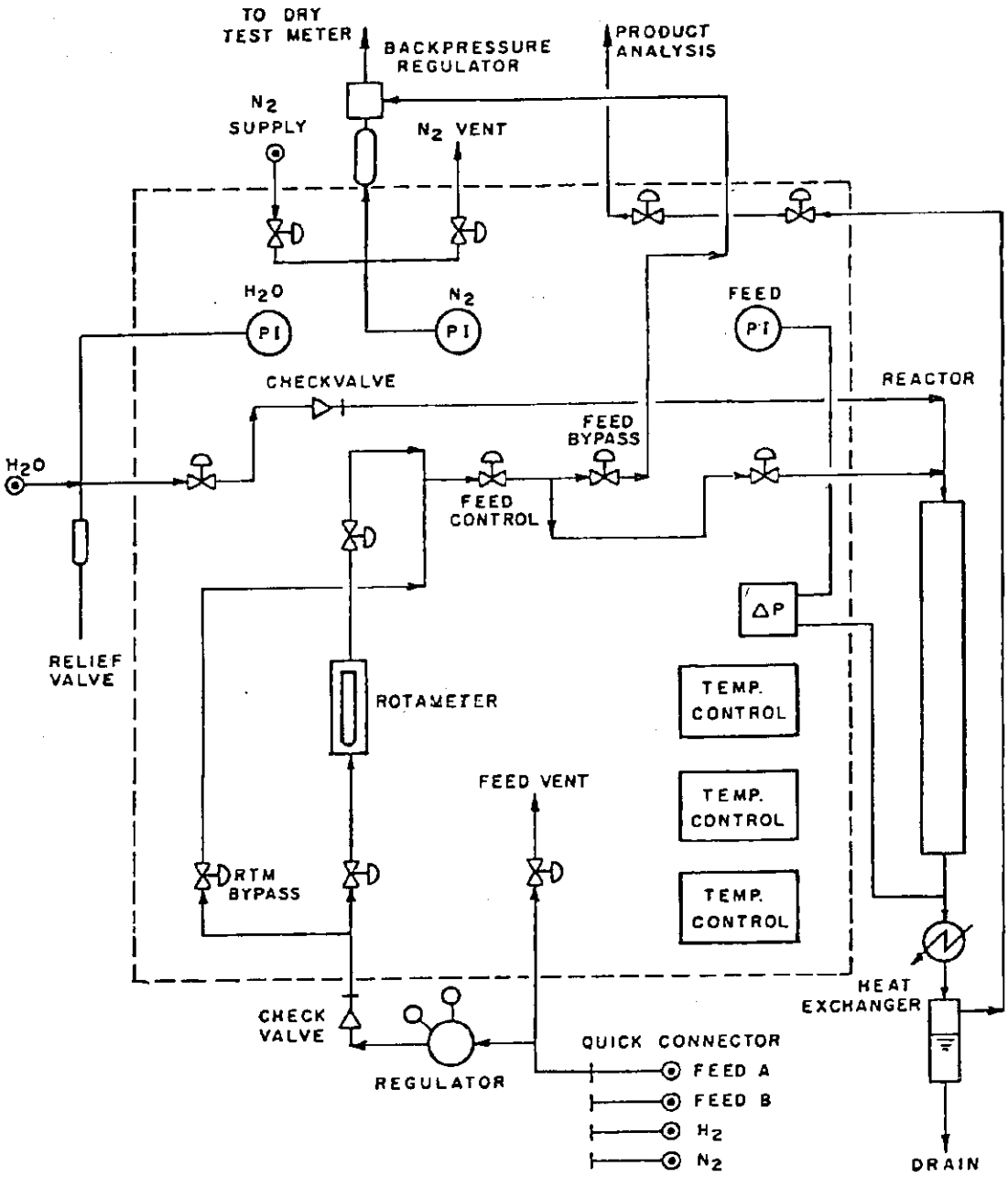


FIGURE IV-D-4

CARBON FORMATION REACTOR SYSTEM CONTROL PANEL



By the end of November, 1977, all of the long-lead delivery items were received except the high pressure rotameters and drain tanks. High pressure metering pumps had been calibrated at both 500 and 1000 psi operating conditions. The gas chromatograph recorder was found defective and returned for repair.

The high pressure rotameters were received and installed in December, 1977. Electrical wiring of heater, temperature indicator, thermocouple assembly, controller and recorder was also completed. The four duplications of the prototype single reactor unit were also completed in December.

The construction of the analytical unit adjacent to the reactor skid started in December, 1977. The vent and drain lines were installed. The thermocouple wells were fabricated with the attachment to hold the catalyst basket in the reactor.

During January, 1978, the high-pressure drain tanks were received and installed. Electrical wiring of five reactor units on the skid were completed, and construction of the analytical system was nearly finished.

By early February, 1978, both electrical and analytical systems were complete. Each component was then carefully checked for leaks and malfunctions, prior to any experimental work.