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AUTH. NAME AUTHOR AFFILIATION
HAYNES, J. G. Arizona Nuclear Power Project (formerly Arizona Public Serv
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SUBJECT: Forwards second corrected copy of Section 5 of O&M Manual, "Periodic Testing," expanding testing regime for hydrogen recombiners.

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CORRECTED ATTACHMENTS

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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2 and 3
Docket Nos. STN 50-528 (License NPF-41)
STN 50-529 (License NPF-51)
STN 50-530 (License NPF-65)
Additional Information - T.S. Amendment 4.6.4.2
File: 87-005-419.05; 87-A-056-026

References: 1) Letter from J. G. Haynes (ANPP) to G. W. Knighton (NRC) dated January 23, 1987 (PP39831). Subject: Technical Specification Amendment-Section 4.6.4.2.

2) Telecon on March 2, 1987, between Manny Licitra (NRC) and Peggy Nelson (ANPP). Subject: Technical Specification Amendment - Section 4.6.4.2.

Dear Sir:

The reference (1) letter transmitted a request for proposed changes to PVNGS Units 1, 2 and 3 Technical Specifications, to expand the testing regimen for the hydrogen recombiners. The reference (2) telecon requested that ANPP provide Section 5, "Periodic Testing", of the hydrogen recombiner O&M Manual, to facilitate NRC review of this amendment request.

Since the O&M Manual for the hydrogen recombiners is designated "Proprietary", it was necessary to obtain vendor permission to release this information.

Attached please find Section 5, "Periodic Testing", of the O&M Manual for the hydrogen recombiners. Also attached is correspondence between ANPP and the vendor, modifying portions of the periodic testing section.

A001
1/1

If you have any questions or require additional information, please call Peggy Nelson at (602) 371-4252.

Very truly yours,

J. G. Haynes
Vice President
Nuclear Production

JGH/PGN/rw
Attachment

cc: O. M. De Michele
E. E. Van Brunt, Jr.
G. W. Knighton
E. A. Licitra
J. B. Martin
R. P. Zimmerman
A. C. Gehr

SECTION 5

PERIODIC TESTING

GENERAL. This section contains the procedures and requirements for periodic adjustments and testing of the Thermal Hydrogen Recombiner System. Included is the time table for periodic testing to ensure system readiness.

5-1. PERIODIC TEST TIME TABLE.

5-2. COLD TEST (LOW-LEVEL TEST). A cold test is to be performed every 6 months, in accordance with the procedures and requirements of this section.

5-3. HOT TEST (HIGH-LEVEL TEST). A hot test is to be performed every 18 months, in accordance with the procedures and requirements of this section. The hot test is to be performed immediately following a biannual cold test.

5-4. PERIODIC TEST PROCEDURES.

NOTE

It is assumed, for the purposes of periodic testing, that the Thermal Hydrogen Recombiner System is permanently installed at the owner's facility. Therefore, items such as facility electrical service requirements (voltage, frequency, and phasing), recombiner skid inlet and outlet piping connections, airblast heat exchanger inlet and exhaust connections, and power/control cabinet to recombiner skid interconnecting cable connections are not covered in this section. Refer to Section 2 (Installation) and Section 3 (Initial System Setup and Calibration) for details of these subjects.

5-5. EQUIPMENT REQUIRED. The following equipment is required to perform periodic testing on the Hydrogen Recombiner System:

a. Calibration and test panel assembly (CTPA), part number 280000035-01

b. Thermocouple simulator, Type K

c. Resistance measurement bridge (±0.05% accuracy)

d. Ammeter, clamp-on type, range 0 to 100 A (meter movement preferred, digital-type acceptable)

e. Thermometer, range up to 150°F (indication only)

f. Water manometer, 0 to 50 in. of water (graduation accuracy shall be ±0.2%)

g. Pneumatic pressure source and pressure regulator to provide 0 to 60 in. of water.

h. Multipen temperature recorder and cabinet interface plug P111AM for continuous recording of six (6) Type K thermocouples (optional, see Figure 5-1)

i. Megohm bridge, or insulation resistance test set.

NOTE

Test equipment voltage must be adjustable between 500 ± 50 Vdc and 1000 ± 100 Vdc and current must not exceed ±5 mA with terminals shorted.

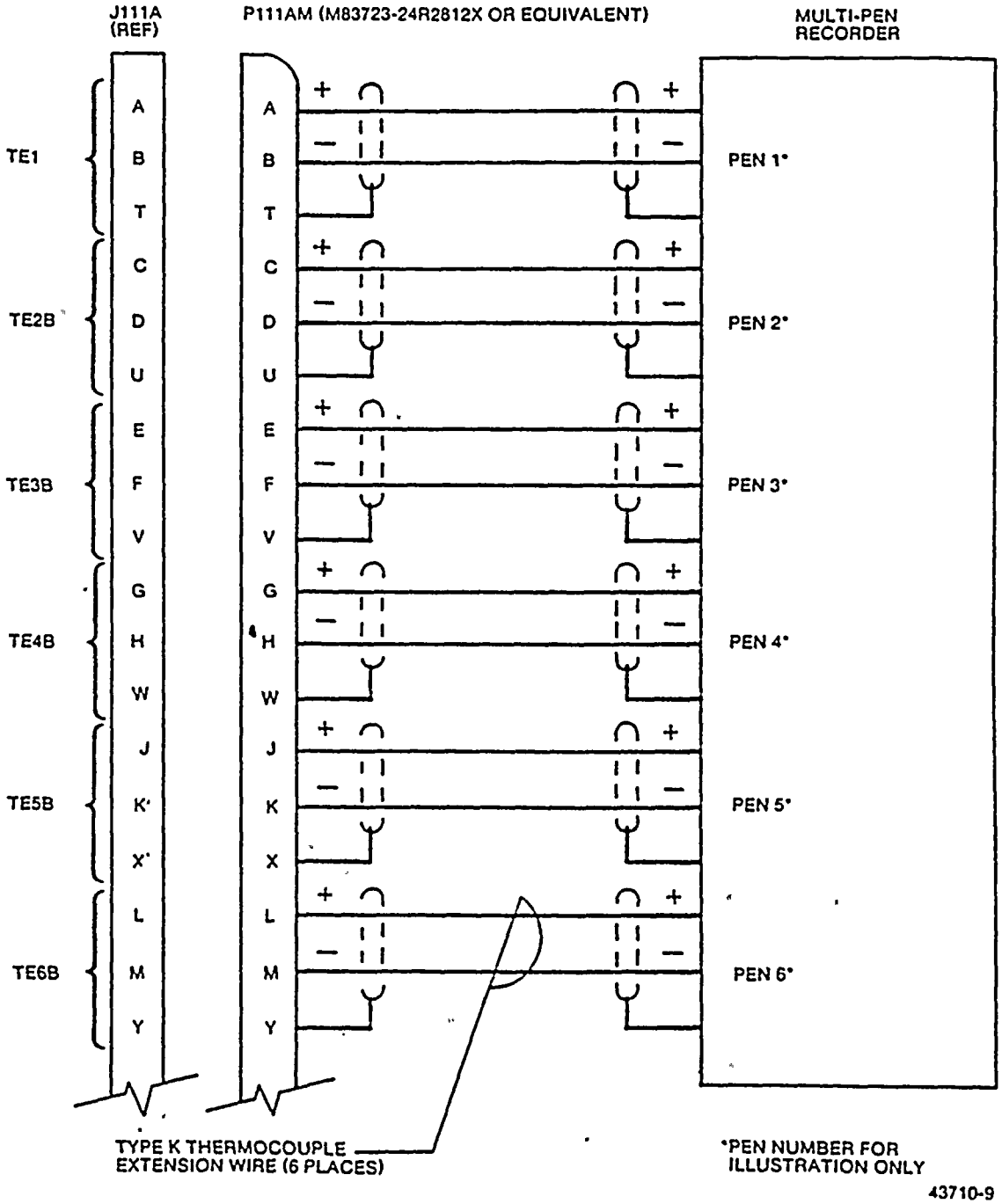

Figure 5-1. Multipen Recorder Attachment (Optional)

5-6. RECORDING DATA. All pertinent test data, as required by this procedure, shall be recorded on data sheets (sample data sheets at the end of this section). The data sheets shall be kept as permanent record as proof of compliance with the requirements of the Periodic Test Time Table, Paragraph 5-1. Record general data on Data Sheet 5-1.

5-7. TEST SETUP. Connect test equipment as follows:

a. Turn facility power OFF.

b. Open power/control cabinet front access door.

c. Remove and retain power/control cabinet gamma shield door bolts. Open power/control cabinet gamma shield door.

d. Remove and retain screws holding temperature controller TIC4/TSL4 swing panel in place. Swing temperature controller TIC4/TSL4 outward.

e. Set all equipment controls as specified in Table 5-1, Column 1. Apply power to test equipment. Allow 15-min warmup time (minimum).

f. Disconnect the following power/control cabinet mating plug and receptacle:

P103A from J103A
P105A from J105A
P112A from J112A

TABLE 5-1

TEST EQUIPMENT AND POWER/CONTROL CABINET INSTRUMENT SETTINGS

	Column 1	Column 2
CTPA switch		
Power	On	-
Display check	Normal	-
S3	Off	-
S4	Calibrate	Read
R1	Max CCW	Max CCW
R2	Max CCW	Max CCW
Power/control cabinet TIC4/TSL4		
Gain	7.5 divisions	-
Reset	Max CCW(1)	-
Rate	Max CCW	-

(1) "Click" off at max CCW.

g. Disconnect the following recombiner skid mating plug and receptacle:

P106 from J106
P107 from J107
P108 from J108
P101 from J101

h. Connect the calibration and test panel assembly (CTPA), part number 280000035-01, as follows:

CTPA P201 into CTPA J201
CTPA P202 into CTPA J202
CTPA P203 into CTPA J203
CTPA P105AT into power/control cabinet J105A
CTPA J105AT into power/control cabinet P105A

CTPA J112AT into power/control cabinet P112A
CTPA P112AT into power/control cabinet J112A
CTPA P111AT into power/control cabinet J111A

i. Connect the thermocouple jumper assemblies to the CTPA as follows:

CTPA jack TE2 to CTPA jack TSH2
CTPA jack TE3 to CTPA jack TSH3
CTPA jack TE4 to CTPA jack TIC4/TSL4
CTPA jack TE5 to CTPA jack TSH5
CTPA jack TE6 to CTPA jack TSH6

j. Connect the water manometer, pneumatic pressure source, and pressure regulator to the flow transmitter, FT1, located on the recombiner skid, as shown in Figure 5-2. Close valves V1 (high pressure), V2 (low pressure), and V13 (bypass). Zero (0) air pressure (0 in. of water column) shall be applied.

NOTE

Use care to keep all recombiner skid and test equipment pneumatic lines clear of debris.

5-8. COLD TEST PROCEDURES (LOW-LEVEL TESTS). The following measurement, instrument set point adjustments, and operating tests comprise the COLD TEST (LOW-LEVEL TEST). It is recommended that the tests be performed in the order given below.

5-9. RESISTANCE MEASUREMENTS. The following resistance measurements shall be performed to verify that all heater elements on the recombiner skid are within design limits:

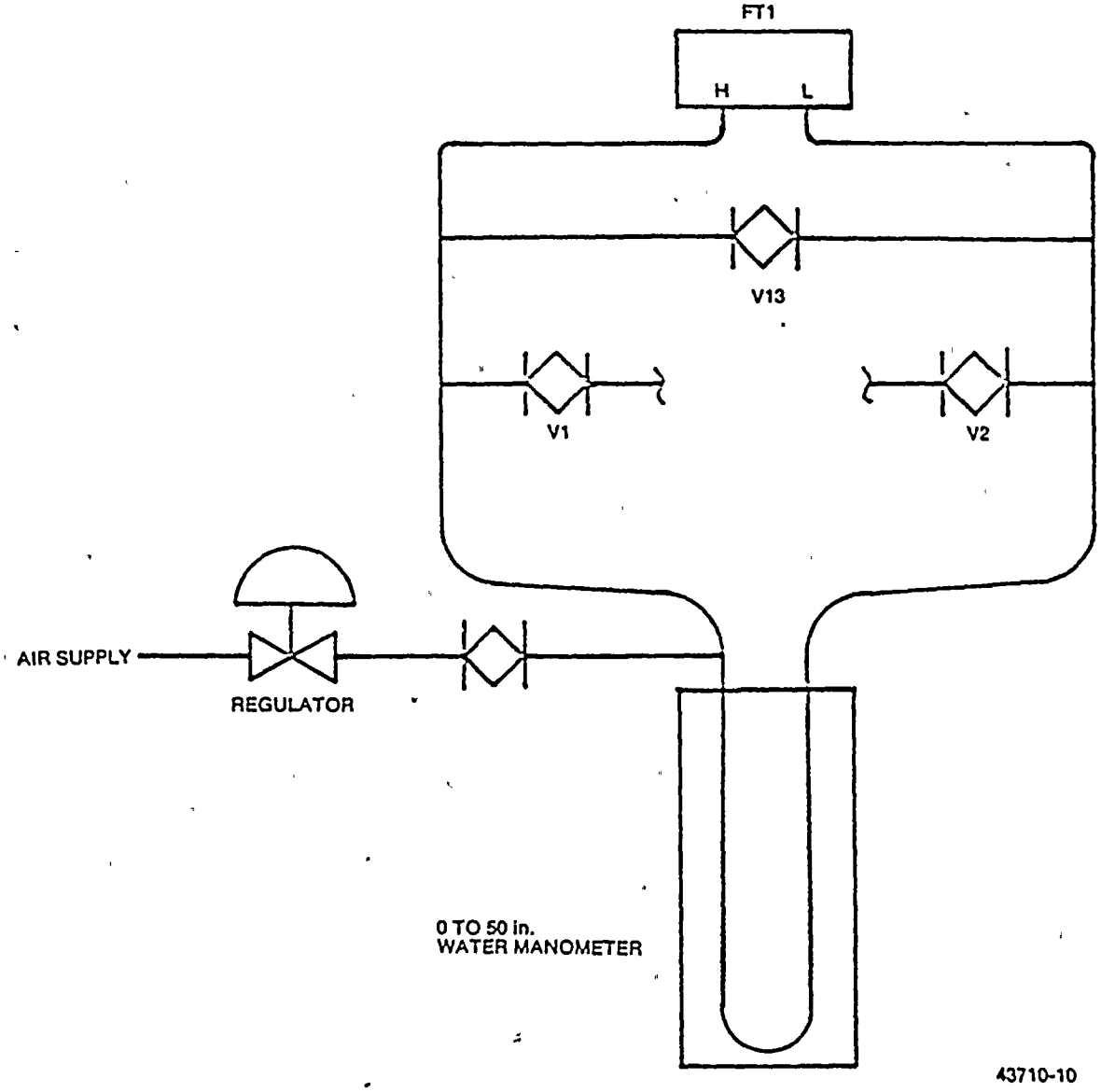

Figure 5-2. Transmitter Connections

a. Measure and record on Data Sheet 5-2 the resistance value of the recombiner skid trickle heaters, the blower motor trickle heater, and the airblast fan motor trickle heater. The resistance values measured shall be within the range specified in Table 5-2.

TABLE 5-2

TRICKLE AND PROCESS HEATER RESISTANCE VALUES

	Ohms
Trickle heater resistance values	
Recombiner skid trickle heater(1) resistance range	54.7 to 60.5
Recombiner skid trickle heater parallel(2) resistance range	18.2 to 20.2
Blower motor trickle heater resistance range	432 to 530
Airblast fan motor trickle heater resistance range	432 to 530
Process heater resistance values	
Process heater phase-to-neutral(3) resistance range	6.08 to 6.72

(1) Individual heater resistance range.
(2) Three (3) heaters in parallel.
(3) Five (5) heaters in parallel.

NOTE

Temporarily disconnect trickle heat power plug P109, located on the recombiner skid, prior to making any resistance measurements. Motor trickle heaters and indicating lights (DS4) must be disconnected from the trickle heater wiring for a correct reading. Reconnect wires and trickle heat power plug, P109, after resistance measurements are made.

b. Measure and record on Data Sheet 5-2 the total resistance of each phase of the wye-connected process heaters located on the recombiner skid. The resistance values measured shall be within the range specified in Table 5-2.

5-10. INSULATION RESISTANCE MEASUREMENTS. The following insulation resistance measurements shall be performed to verify the integrity of the insulation system of various components on the recombiner skid:

a. Perform a resistance-to-ground test at terminal 317 in the blower motor junction box. Apply test voltage (1000 ± 100 Vdc) until the resistance value stabilizes, or for 1 min, whichever occurs first. Record resistance value on Data Sheet 5-3. Verify that the resistance value recorded is not less than 100 megohms. Close and secure blower motor junction box cover.

b. Perform a resistance-to-ground test at terminal 302 in the airblast fan motor junction box. Apply test voltage (1000 ± 100 Vdc) until the resistance value stabilizes, or for 1 min, whichever occurs first. Record resistance value on Data Sheet 5-3. Verify that the resistance value recorded is not less than 100 megohms. Close and secure airblast fan motor junction box cover.

c. Perform a resistance-to-ground test at terminal TB6-A in the process heater junction box. Apply test voltage (1000 ± 100 Vdc) until the resistance value stabilizes, or for 1 min, whichever occurs first. Record resistance value on Data Sheet 5-3. Verify that the resistance value recorded is not less than 1 megohm.

d. Perform a resistance-to-ground test at pins A, C, E, G, J, K, N, S, V, Y, and b at thermocouple terminal box receptacle, J101, located on the recombiner skid. Apply test voltage (500 ± 50 Vdc) until the resistance value stabilizes, or for 1 min, whichever occurs first. Record resistance value on Data Sheet 5-3. Verify that the resistance value recorded is not less than 100 megohms. Reconnect recombiner skid mating plug and receptacles P101 and J101.

5-11. INSTRUMENT SET POINT VERIFICATION/ADJUSTMENT. Perform the following setup procedures prior to performing the instrument set point verification/ adjustment:

a. Connect power/control cabinet mating plug and receptacle P103A and J103A.

b. Turn facility power ON.

c. Power/control cabinet SYSTEM READY light will be ON.

d. Depress and release power/control cabinet START switch. Power/ control cabinet TRIPPED status light and LOW recombination temperature light will be ON. Power/control cabinet cooling fans (FAN1, FAN2, FAN3, and FAN4) will be ON.

NOTE

Power has now been applied to power/control cabinet instrumentation. Allow 15 min for the circuitry to stabilize.

5-12. TEMPERATURE SWITCHES. Perform temperature switch set point adjustments for TSH2, TSH3, TSH5, and TSH6, located in the power/control cabinet, as follows:

a. Remove the thermocouple jumper from the CTPA jack listed in Table 5-3 for the temperature switch being adjusted.

b. Connect thermocouple simulator output to the CTPA panel jack.

c. Adjust the thermocouple simulator output to a temperature 50°F below the set point temperature listed in Table 5-3 for the temperature

TABLE 5-3
TEMPERATURE SWITCH SET POINTS

Temperature Switch	Set Point (°F)	CTPA Jack
TSH2	1357	TSH2
TSH3	1300	TSH3
TSH5	1385	TSH5
TSH6	146	TSH6

switch being adjusted. The indicating light on the front of the temperature switch shall be ON.

d. Slowly increase the thermocouple simulator output until the indicating light goes OFF. Record the temperature in the "Tripped" column of Data Sheet 5-4 for the temperature switch being adjusted. If the trip temperature is out of the range of T $\pm$ 5°F (where T is the set point temperature listed in Table 5-3 for the temperature switch being adjusted), perform temperature switch adjustments as specified in 5-12.d substeps 1 through 5. Then continue set point verification from 5-12.c. If the temperature switch cannot be properly adjusted after performing 5-12.d substeps 1 through 5, recalibrate the temperature switch in accordance with the manufacturer's instructions contained in Appendix E.

1) Set thermocouple simulator output to ambient temperature (°F).

2) Turn the temperature switch ZERO and UPPER potentiometers fully counterclockwise (CCW). The indicating light on the front of the temperature switch shall be ON.

3) While observing the indicating light, turn the ZERO potentiometer clockwise (CW) until the indicating light goes OFF, then turn the ZERO potentiometer CCW until the indicating light just comes ON.

4) Set the thermocouple simulator output to the set point temperature listed in Table 5-3 for the temperature switch being adjusted. The indicating light shall go OFF.

5) Turn the UPPER potentiometer CW until the indicating light comes ON, then turn the UPPER potentiometer CCW until the indicating light just goes OFF.

e. Slowly reduce the thermocouple simulator output until the indicating light comes ON. Record the temperature in the "Reset" column of Data Sheet 5-4 for the temperature switch being adjusted.

f. Repeat 5-12.d and 5-12.e one (1) more time. Record data on Data Sheet 5-4.

g. Remove thermocouple simulator from CTPA jack. The temperature switch indicating light shall be OFF.

h. Replace thermocouple jumper in CTPA jack. The temperature switch indicating light shall be ON.

5-13. FLOW SWITCH. Perform flow switch set point verification/adjustment for FSL1, located in the power/control cabinet, as follows:

a. Turn CTPA potentiometer(s) R1 and/or R2 CW to obtain a milliampere indication on CTPA meter M4 of 0.50 mA above the set point listed in Table 5-4 for FSL1. The indicating light on the front of the flow switch shall be ON.

TABLE 5-4
FLOW CIRCUIT SET POINTS

Flow Switch	Set Point (mA)	
FSL1	5.70	
Flow Transmitter	Water Column (in.)	Signal (mA)
FT1	1) 0.0	4.00
	2) 5.0	8.00
	3) 10.0	12.00
	4) 15.0	16.00
	5) 20.0	20.00

b. Slowly decrease the milliampere signal by turning CTPA potentiometer(s) R1 and/or R2 CCW until the indicating light goes OFF. Record the milliampere value, as indicated on CTPA meter M4, in the "Tripped" column of Data Sheet 5-5 for FSL1. If the tripped value is out of the range of A $\pm$ 0.10 mA (where A is the set point listed in Table 5-4 for FSL1), perform flow switch adjustment as specified in 5-13.b substeps 1 through 3. Then continue set point verification from 5-13.a. If the flow switch cannot be properly adjusted after performing 5-13.b substeps 1 through 3, recalibrate the flow switch in accordance with the manufacturer's instructions contained in Appendix E.

1) Adjust CTPA potentiometer(s) R1 and/or R2 to obtain a milliampere indication on CTPA meter M4 of A $\pm$ 0.05 mA (where A is the set point listed in Table 5-4 for FSL1).

2) Turn the flow switch UPPER potentiometer fully CW. The indicating light on the front of the flow switch shall be OFF.

3) While observing the indicating light, turn the UPPER potentiometer CCW until the indicating light comes ON, then turn the UPPER potentiometer CW until the indicating light just goes OFF.

c. Slowly increase the milliampere signal by turning CTPA potentiometer(s) R1 and/or R2 CW until the indicating light comes ON. Record the milliampere value, as indicated on CTPA meter M4, in the "Reset" column of Data Sheet 5-5 for FSL1.

d. Repeat 5-13.b and 5-13.c one (1) more time. Record the data on Data Sheet 5-5.

e. Adjust CTPA potentiometer(s) R1 and/or R2 to achieve an indication of 4.00 $\pm$ 0.05 mA on CTPA meter M4. CTPA meter M2 shall indicate V $\pm$ 0.10 volts (where V is equal to one-half the indication on CTPA meter M4). Record data on Data Sheet 5-5.

f. Adjust CTPA potentiometer(s) R1 and/or R2 to achieve an indication of 12.00 $\pm$ 0.05 mA on CTPA meter M4. CTPA meter M2 shall indicate V $\pm$ 0.10 volts (where V is equal to one-half the indication on CTPA meter M4). Record data on Data Sheet 5-5.

g. Adjust CTPA potentiometer(s) R1 and/or R2 to achieve an indication of 19.99 $\pm$ 0.05 mA on CTPA meter M4. CTPA meter M2 shall indicate V $\pm$ 0.10 volts (where V is equal to one-half the indication on CTPA meter M4). Record data on Data Sheet 5-5. Adjust CTPA potentiometer(s) R1 and/or R2 to achieve an indication of 8.00 $\pm$ 0.50 mA on CTPA meter M4.

NOTE

Meter M4 display will blank at 19.99 mA.

5-14. FLOW TRANSMITTER. Perform flow transmitter verification/adjustment for FT1, located on the recombiner skid, as follows:

NOTE

The flow transmitter ZERO and SPAN potentiometers are located beneath the transmitter nameplate. Loosen the nameplate screws and slide it upward to expose the potentiometers. When all adjustments are complete, slide the nameplate down and tighten the nameplate screws.

a. Set the CTPA switches as specified in Table 5-1, Column 2.

b. Apply air pressure equal to W $\pm$ 0.1 in. of water column (where W is the value of inches of water column listed on Line 1 of Table 5-4 for FT1) to flow transmitter FT1. Record the milliampere value indicated on CTPA meter M4. If the milliampere value is out of the range of A $\pm$ 0.15 mA (where A is the milliampere signal value listed on Line 1 of Table 5-4 for FT1), perform flow transmitter adjustments as specified in 5-14.b substeps 1 through 3. Then continue flow transmitter verification from 5-14.c. If the flow transmitter cannot be properly adjusted after performing 5-14.b substeps 1 through 3, replace the flow transmitter.

1) With zero (0) air pressure (0 in. of water column) applied to flow transmitter FT1, adjust the flow transmitter ZERO potentiometer to achieve an indication of 4.00 $\pm$ 0.05 mA on CTPA meter M4.

2) Apply air pressure equal to W ± 0.1 in. of water column (where W is the value of inches of water column listed on Line 5 of Table 5-4 for FT1) to flow transmitter FT1. Adjust the flow transmitter SPAN potentiometer to achieve an indication of 19.99 ± 0.05 mA on CTPA meter M4.

NOTE

Meter M4 display will blank at 19.99 mA.

3) Repeat 5-14.b substeps 1 and 2 until no further adjustments are necessary. If the flow transmitter cannot be properly adjusted after repeating 5-14.b substeps 1 and 2, replace the flow transmitter.

c. Apply air pressure equal to W ± 0.1 in. of water column (where W is the value of inches of water column listed on Line 2 of Table 5-4 for FT1) to flow transmitter FT1. The milliampere value, indicated on CTPA meter M4, shall be A ± 0.15 mA (where A is the milliampere signal value listed on Line 2 of Table 5-4 for FT1). Record the data on Data Sheet 5-5.

d. Repeat 5-14.c for the values listed on Lines 3, 4, and 5 of Table 5-4 for flow transmitter FT1. Record data on Data Sheet 5-5. Reduce air pressure to zero (0).

5-15. TEMPERATURE CONTROLLER. Perform temperature controller verification/adjustment for TIC4/TSL4, located in the power/control cabinet, as follows:

a. Remove the thermocouple jumper from the CTPA jack TIC4/TSL4.

b. Connect thermocouple simulator output to CTPA panel jack TIC4/TSL4.

c. Set thermocouple simulator output to T (where T is the thermocouple simulator output value listed in Table 5-5, Line 1, for TIC4/TSL4). TIC4/TSL4 display shall indicate T $\pm$ 20°F. Record data on Data Sheet 5-6. If the TIC4/TSL4 display indicates beyond the range of T $\pm$ 20°F, recalibrate temperature controller TIC4/TSL4 in accordance with the manufacturer's instructions contained in Appendix E.

TABLE 5-5
TEMPERATURE CONTROLLER TIC4/TSL4 SET POINTS

Display Check	Simulator Temperature (°F)
TIC4/TSL4	1) 600
	2) 1000
	3) 1400
Instrument	**Set Point (°F)**
TIC4	1300
TSL4	1255

d. Repeat 5-15.c for the values listed on Lines 2 and 3 of Table 5-5 for TIC4/TSL4. Record data on Data Sheet 5-6.

e. Increase the thermocouple simulator output to a temperature 50°F above the set point temperature listed in Table 5-5 for TSL4. The red indicating light on the temperature controller and the power/control cabinet NORMAL recombination temperature light shall be ON. The power/control cabinet LOW recombination temperature light shall be OFF.

f. Slowly decrease the thermocouple simulator output until the red indicating light goes OFF. The red indicating light on the temperature controller and the power/control cabinet NORMAL recombination temperature light shall be OFF. The power/control cabinet LOW recombination temperature light shall be ON. Record the temperature in the "Tripped" column of Data Sheet 5-6 for TSL4. If the trip temperature is out of the range of T $\pm$ 20°F (where T is the set point temperature listed in Table 5-5 for TSL4), perform temperature controller adjustments as specified in 5-15.f substeps 1 through 3. If the temperature controller cannot be properly adjusted after repeating 5-15.f substeps 1 through 3, recalibrate temperature controller TIC4/TSL4 in accordance with the manufacturer's instructions contained in Appendix E.

1) Set the thermocouple simulator output to the set point listed in Table 5-5 for TSL4.

2) Turn the temperature controller ALARM potentiometer fully CW. The red indicating light on the temperature controller shall be OFF.

3) While observing the red indicating light on the temperature controller, turn the ALARM potentiometer CCW until the indicating light comes ON, then turn the ALARM potentiometer CW until the indicating light just goes OFF.

g. Slowly increase the thermocouple simulator output until the red indicating light comes ON. The red indicating light on the temperature controller and the power/control cabinet NORMAL recombination temperature light shall be ON. The power/control cabinet LOW recombination temperature light shall be OFF. Record the temperature in the "Reset" column of Data Sheet 5-6 for TSL4.

h. Repeat 5-15.f and 5-15.g one (1) more time. Record data on Data Sheet 5-6.

i. Set thermocouple simulator output to 800°F. The red indicating light on the temperature controller and the power/control cabinet NORMAL recombination temperature light shall be OFF. The power/control cabinet LOW recombination temperature light shall be ON.

j. Remove thermocouple simulator from CTPA jack. The temperature controller display shall indicate -1. The red indicating light on the temperature controller and the power/control cabinet NORMAL recombination temperature light shall be ON. The power/control cabinet LOW recombination temperature light shall be OFF.

k. Replace thermocouple jumper in CTPA jack. The red indicating light on the temperature controller and the power/control cabinet NORMAL recombination temperature light shall be OFF. The power/control cabinet LOW recombination temperature light shall be ON.

l. Adjust temperature controller TIC4/TSL4 set point thumbwheels to 1300°F. Adjust the thermocouple simulator output to achieve an indication of 12.00 $\pm$ 0.10 mA on CTPA meter M1.

m. Remove thermocouple simulator from CTPA jack. The CTPA meter M1 shall indicate 4.00 mA. Record data on Data Sheet 5-6.

n. Replace thermocouple jumper in CTPA jack. The CTPA meter M1 shall indicate 12.00 $\pm$ 1.00 mA. Record data on Data Sheet 5-6.

5-16. LOW-LEVEL POWER TESTING. Perform the following setup procedures prior to performing low-level power testing:

a. Remove the test equipment attached to the flow transmitter in 5-7.j (water manometer, pneumatic pressure source, and pressure regulator). Open valves V1 (high pressure) and V2 (low pressure); valve V13 (bypass) shall remain closed.

NOTE

Use care to keep all recombiner skid and test equipment pneumatic lines clear of debris.

b. Connect the following recombiner skid mating plug and receptacle:

P106 into J106
P107 into J107
P108 into J108

c. Disconnect CTPA plug P111AT from power/control cabinet receptacle J111A. (Do not disconnect CTPA plug P111AT from power/control cabinet receptacle J111A if optional multipen recorder is not used.)

d. Connect multipen recorder plug P111AM (optional, see Figure 5-1) to power/control cabinet receptacle J111A. Record on Data Sheet 5-7 the pen color which corresponds to the thermocouple being monitored. Turn multipen recorder ON. Allow time for circuit stabilization/warmup as recommended by manufacturer. Lower multipen recorder pens to chart paper. Set chart paper advance system for 1/0 in./min.

NOTE

This is a suggested setting only. The chart paper advance system can be adjusted as required to obtain a suitable temperature profile.

e. Set CTPA switch S3 to position 4.

f. Set temperature controller TIC4/TSL4 set point thumbwheels to 800°F.

g. Depress and hold power/control cabinet START switch or owner remote START switch. Release after 10 s. Power/control cabinet OPERATING status light and LOW recombination temperature light shall be ON.

NOTE

The system is now in automatic startup and will stabilize the reaction chamber gas temperature at or near 800°F.

5-17. SCR POWER CONTROLLER. Perform SCR power controller verification/adjustment for JC1, located in the power/control cabinet, as follows:

a. Record the settings of the RATE and RESET controls, located on temperature controller TIC4/TSL4, on Data Sheet 5-8.

b. Turn the RATE control full CCW.

c. Turn the RESET control full CCW to "click" off.

d. Adjust thermocouple simulator output to TIC4/TSL4 to obtain an indication of 19.99, +0.00, -0.10 mA on CTPA meter M1. Verify with a clamp-on ammeter that the current in wires 92, 93, and 108, in the heater junction box located on the recombiner skid, is continuous and equal within 10%. Record data on Data Sheet 5-8.

NOTE

Meter M1 display will blank at 19.99 mA.

e. Adjust the thermocouple simulator output to TIC4/TSL4 to obtain an indication of 4.00, +0.10, -0.00 mA on CTPA meter M1. Verify with a clamp-on ammeter that the current in wires 92, 93, and 108 is zero (0). Record data on Data Sheet 5-8.

f. If the proper current values cannot be obtained on the clamp-on ammeter (i.e., continuous current and zero current), perform the following adjustments to the BIAS and GAIN potentiometers, located in the power/control cabinet:

1) Loosen BIAS and GAIN potentiometer locknuts.

2) Adjust thermocouple simulator output to TIC4/TSL4 to obtain an indication of 19.99, +0.00, -0.10 mA on CTPA meter M1.

NOTE

Meter M1 display will blank at 19.99 mA.

3) Adjust the GAIN potentiometer to just achieve a continuous current in wires 92, 93, and 108, as observed on the clamp-on ammeter.

4) Adjust thermocouple simulator output to TIC4/TSL4 to obtain an indication of 4.00, +0.10 -0.00 mA on CTPA meter M1.

5) Adjust the BIAS potentiometer to just achieve a continuous zero (0) current in wires 92, 93, and 108, as observed on the clamp-on ammeter.

6) Repeat 5-17.f substeps 2 through 5 until no further adjustments are necessary.

7) Tighten BIAS and GAIN potentiometer locknuts finger tight + 1/4 to 1/2 turn. Repeat 5-17.f substeps 2 through 5 to verify that tightening of locknuts did not alter potentiometer settings.

g. Remove thermocouple simulator from CTPA jack and replace thermocouple jumper.

h. Return temperature controller TIC4/TSL4 RATE and RESET controls to the settings recorded on Data Sheet 5-8.

5-18. HOT TEST PROCEDURES (HIGH-LEVEL TESTS). The following measurements and operating tests comprise the HOT TEST (HIGH-LEVEL TEST). It is recommended that the tests be performed in the order given below.

5-19. HIGH-LEVEL OPERATION. Perform the high-level operation checks as follows:

NOTE

The process variable (PV) referred to in the following steps is the temperature measured by TE4B and the interpretation of PV (above/below set point, stable or oscillating) shall be from the temperature profile produced by TE4B on CTPA meter M3 or the optional multipen recorder.

a. Set temperature controller TIC4/TSL4 set point thumbwheels to 1200°F.

NOTE

The red indicating light on the temperature controller and the power/control cabinet NORMAL recombination temperature light shall be OFF. The power/control cabinet LOW recombination temperature light shall be ON.

b. Allow the PV to stabilize at or near the 1200°F set point (temperature profile should have little or no oscillations). The temperature indicated on TIC4/TSL4 display shall be 1200 ± 20°F. Allow the system to operate at the 1200°F set point for approximately 4 h.

NOTE

Periodically check the temperature profile for stable operation.

c. Set temperature controller TIC4/TSL4 set point thumbwheels to 500°F. Verify decreasing temperatures on the temperature profile.

d. Remove the thermocouple jumper from CTPA jack TSH4.

e. When all temperatures on the temperature profile are between 300 to 400°F (TE2, TE3, TE4, TE5, and TE6, as indicated on the multipen recorder or on CTPA meter M3 with switch S3 rotated to positions 2, 3, 4, 5, and 6, respectively), press the power/control cabinet STOP SWITCH. The SYSTEM READY light on the power/control cabinet shall be ON, and all other lights shall be OFF.

f. Turn facility power OFF.

5-20. TEST EQUIPMENT TEARDOWN AND SYSTEM RESET. The following test equipment teardown and system reset check list is provided to reestablish the ready mode of the Thermal Hydrogen Recombiner System.

5-21. TEST EQUIPMENT TEARDOWN. Perform the following:

a. Turn off power to all test equipment.

b. Disconnect multipen recorder plug P111AM (optional) or CTPA plug P111AT from power/control cabinet receptacle J111A. Replace J111A receptacle cover.

c. Disconnect the thermocouple jumper assemblies from the CTPA as follows:

CTPA jack TE2 from CTPA jack TSH2
CTPA jack TE3 from CPTA jack TSH3
CTPA jack TE4 from CTPA jack TIC4/TSL4
CTPA jack TE5 from CTPA jack TSH5
CTPA jack TE6 from CTPA jack TSH6

Stow the thermocouple jumper assemblies in the CTPA case upper storage area.

d. Disconnect the CTPA as follows:

CTPA P201 from CTPA J201
CTPA P202 from CTPA J202
CTPA P203 from CTPA J203
CTPA P105AT from power/control cabinet J105A
CTPA J105AT from power/control cabinet P105A
CTPA J112AT from power/control cabinet P112A
CTPA P112AT from power/control cabinet J112A

Replace all plug and receptacle covers. Stow the cable assemblies in the CTPA case upper storage area.

e. Connect the following power/control cabinet mating plug and receptacle:

P105A into J105A
P112A into J112A

f. Remove clamp-on ammeter from the heater junction box located on the recombiner skid. Close and secure heater junction box door.

h. Remove all tools from the power/control cabinet interior.

5-22. SYSTEM RESET. Perform the following to reestablish the system ready mode:

a. Reset temperature controller TIC4/TSL4 set point thumbwheels to 1300°F.

b. Return temperature controller swing panel to normal position. Torque 19 to 24 in.-lb.

c. Close power/control cabinet gamma shield door. Torque to 55 ± 5 ft-lb.

d. Close and latch power/control cabinet front access door.

e. Turn facility power ON (or OFF), as required by the facility operating procedures.

6140F/slw

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DATA SHEET 5-1

GENERAL DATA

1) Recombiner skid serial number..... _____

2) Power/control cabinet serial number..... _____

3) Date test started..... _____

4) Date test completed..... _____

5) Ambient temperature (°F)..... _____

6) Remarks:

Test Technician (sign) _____ Date _____

Quality Assurance (sign) _____ Date _____

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DATA SHEET 5-2

RECOMBINER SKID HEATER RESISTANCE

1) Trickle heater resistance (parallel)(1) _____ ohms

OR

Trickle heater resistance (individual)(2) _____ ohms
_____ ohms
_____ ohms

2) Blower motor trickle heater resistance(3) _____ ohms

3) Airblast fan motor trickle heater resistance(4) _____ ohms

4) Process heater resistance(5): Phase A-to-neutral _____ ohms
Phase B-to-neutral _____ ohms
Phase C-to-neutral _____ ohms

Test Technician (sign) _____ Date _____

Quality Assurance (sign) _____ Date _____

(1) Measure at trickle heat junction box, between terminals TB1-53 and TB1-54.
(2) Measure at trickle heat junction box, by removing the appropriate wires (53 and 54) for the heater to be measured.
(3) Measure at blower motor junction box, between terminals TB4-53 and TB4-54.
(4) Measure at airblast fan motor junction box, between terminals TB3-53 and TB3-54.
(5) Measure at heater terminal box, between terminals TB5-92 and TB6-A for Phase A; TB5-93 and TB6-A for Phase B; and TB5-108 and TB6-A for Phase C.

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DATA SHEET 5-3

INSULATION RESISTANCE

1)	Blower motor (terminal 317-to-ground)	_____ megohms
2)	Airblast fan motor (terminal 302-to-ground)	_____ megohms
3)	Process heaters (terminal TB6-A-to-ground)	_____ megohms
4)	Thermocouples (J101-A-to-ground)	_____ megohms
	(J101-C-to-ground)	_____ megohms
	(J101-E-to-ground)	_____ megohms
	(J101-G-to-ground)	_____ megohms
	(J101-J-to-ground)	_____ megohms
	(J101-K-to-ground)	_____ megohms
	(J101-N-to-ground)	_____ megohms
	(J101-S-to-ground)	_____ megohms
	(J101-V-to-ground)	_____ megohms
	(J101-Y-to-ground)	_____ megohms
	(J101-b-to-ground)	_____ megohms

Test Technician (sign) _____ Date _____

Quality Assurance (sign) _____ Date _____

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DATA SHEET 5-4

TEMPERATURE SWITCH ADJUSTMENTS

1) Ambient temperature (from Data Sheet 5-1) _____ °F

2) Trip and reset data:

Instrument		Tripped	Reset
TSH2	1)	_____ °F	_____ °F
	2)	_____ °F	_____ °F
TSH3	1)	_____ °F	_____ °F
	2)	_____ °F	_____ °F
TSH5	1)	_____ °F	_____ °F
	2)	_____ °F	_____ °F
TSH6	1)	_____ °F	_____ °F
	2)	_____ °F	_____ °F

Test Technician (sign) _____ Date _____

Quality Assurance (sign) _____ Date _____

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DATA SHEET 5-5

FLOW CIRCUIT ADJUSTMENTS

1) Trip and reset data:

Instrument		Tripped	Reset
FSL1	1)	_____ mA	_____ mA
	2)	_____ mA	_____ mA

2) Flow check:

		Meter M4	Meter M2
FSL1	1)	_____ mA	_____ V
	2)	_____ mA	_____ V

3) Adjustment and verification data for FT1:

a) Linearity check:

	Water Column	Meter M4
Table 5-4, Line 1	_____ in.	_____ mA
Table 5-4, Line 2	_____ in.	_____ mA
Table 5-4, Line 3	_____ in.	_____ mA
Table 5-4, Line 4	_____ in.	_____ mA
Table 5-4, Line 5	_____ in.	_____ mA

Test Technician (sign) _____ Date _____

Quality Assurance (sign) _____ Date _____

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DATA SHEET 5-6

TEMPERATURE CONTROLLER ADJUSTMENTS

1) Display data:

Instrument	Simulator Temperature	Display Temperature
TIC4/TSL4	600°F	_____ °F
	1000°F	_____ °F
	1400°F	_____ °F

2) Trip and reset data:

Instrument		Tripped	Reset
TSL4	1)	_____ °F	_____ °F
	2)	_____ °F	_____ °F

3) Adjustments:

Simulator Output	Meter M1
_____ °F	_____ mA
Removed	_____ mA
Replaced	_____ mA

Test Technician (sign) _____ Date _____

Quality Assurance (sign) _____ Date _____

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DATA SHEET 5-7

THERMOCOUPLE/PEN RECORDER IDENTIFICATION

Thermocouple	Pen Color
TE1	_____
TE2B	_____
TE3B	_____
TE4B	_____
TE5B	_____
TE6B	_____

Test Technician (sign) _____ Date _____

Quality Assurance (sign) _____ Date _____

N1390MM230002

DATA SHEET 5-8

SCR POWER CONTROLLER ADJUSTMENTS

1) TIC4/TSL4 settings:

Rate....._____

Reset...._____

2) Continuous and equal current:

Wire 92 _____ A
Wire 93 _____ A
Wire 108 _____ A
Meter M1 _____ mA

3) Zero current:

Wire 92 _____ A
Wire 93 _____ A
Wire 108 _____ A
Meter M1 _____ mA

Test Technician (sign) _____ Date _____

Quality Assurance (sign) _____ Date _____

ATTACHMENT TO
161- 00216

Arizona Nuclear Power Project
P.O. BOX 52034 • PHOENIX, ARIZONA 85072-2034

May 15, 1986

Mr. Hank Yabbs
Rocketdyne Division
Rockwell International
6633 Canoga Avenue
Canoga Park, California 91304

Dear Mr. Yabbs,

Concerning our telephone conversation of April 3, 1986 we agreed that the following operation of the hydrogen recombiner would be considered within the expected parameters for normal operation.

On initial startup of the recombiner when the temperature heats up to the setpoint, an overshoot transient of 50° F. could be possible. This 50° cycle should decay away within three cycles to a steady state operation of ± 20° F of the setpoint.

Essentially, the problems we have had concerning the parameters to use for the recombiner were semantic, as we had not differentiated between transient and steady state operation of the system. From my experience operating the system here at Palo Verde, we should have no problem with a transient overshoot allowable of 50° and a steady state operation of ± 20°F.

We also discussed the operation range where recombination is taking place in the recombiner. This range begins at 1150°F which is the "auto ignition point" for hydrogen within the recombiner. As the temperature increases to the set point of 1300° F, the efficiency of the recombiner improves until the design recombination is taking place. Any temperature above 1300 would not deter the recombination, but would also not improve it, assuming the 50 CFH flow rate. Of course if the temperature climbs too much, the trip point is reached and the unit automatically shuts down, as designed.

Any information concerning the design flow/temperature curves that show the expected design recombination efficiency of this unit that you could send us would be appreciated, in addition to a formal letter stating that a transient overshoot of 50° and a steady state operation of ± 20° F is allowable when starting up the recombiner. We will use this as a guideline when writing the new site Technical Specification for calibrating and testing the new recombiner system.

Sincerely,

William Stasek

Arizona Nuclear Power Project
P.O. Box 52034
Phoenix, Arizona 85072-2034
Station 6296
Attn: Bill Stasek

ATTACHMENT TO
161- 00216

Rocketdyne Division
Rockwell International Corporation
6633 Canoga Avenue
Canoga Park, California 91304

Telex: 698478
ROCKETDYN CNPK

Rockwell International

June 9, 1986

In reply refer to 86RC07838

Mr. William K. Stesch
Arizona Nuclear Power Project
Post Office Box 620034
Phoenix, Arizona 86072-2034

Reference: ANP Letter Dated May 15, 1986
William Stesch to H. Yobs

Subject: Palo Verde Hydrogen Recombiners
Recombiner Start-up Operations

Dear Mr. Stesch:

The following information is provided in response to the referenced letter. During the initial start-up of the recombiner when the system is in the heat-up mode and the process gas temperature heats up to the set point, an overshoot transient of 50° F. can be expected. The overshoot should decay within three cycles to a steady state operation (± 20° F. of the set point).

This condition is considered normal for recombiner start-up operation. If however, decay to set point ± 20° F. does not occur, adjustment of the temperature controller settings will be necessary to achieve the normal operating parameters.

Attached is a curve reflecting the residence time vs temperature for recombination of hydrogen in air at various flow rates (provided for information only).

Very truly yours,

R. Cardenas

R. J. Cardenas
Recombiner Staff

Attachments: a) ANP 5/15/86 referenced letter.

b) Residence time vs temperature for Hydrogen Recombination Curve.

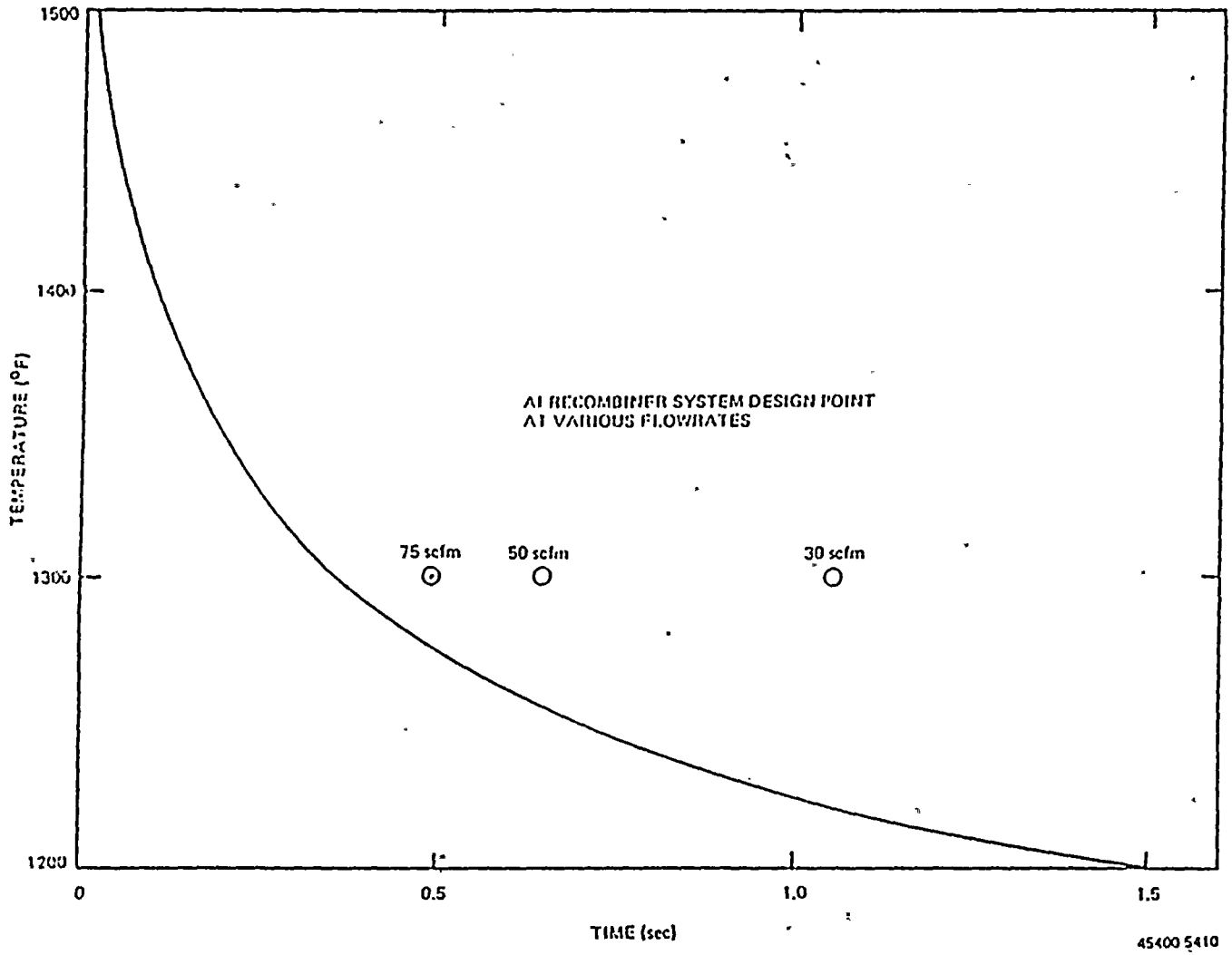

Figure 1. Residence Time vs Temperature for Essentially Complete Recombination of Hydrogen in Air