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SUBJECT: Tentative Turbine Generator Test Procedure
HRT Test V A 1

TO: R. Van Winkle

FROM: H. K. Search

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To: R. Van Winkle

From: H. K. Search

Attached is a tentative turbine generator test procedure. The procedure outlined is for the purpose of obtaining data on the turbine alone. Generator characteristics and condenser performance have not been included.

The first test can be started as soon as (1) the work outlined in a memorandum to J. J. Hairston, dated February 7, 1956, is completed on the steam system, (2) the electrical work is completed on the generator and (3) instruments are obtained, calibrated and installed.

The second test can be run as soon as all reactor electrical components are in operation.

One or more shake-down runs will have to be made before the test run in order to check out equipment and instruments and to provide a "dry run" test for test personnel to acquaint them with the test procedure.

TENTATIVE TURBINE GENERATOR TEST PROCEDURE
HRT Test V A 1

A. Introduction

The HRE steam turbine has a nameplate rating of 250 Kw and was designed to operate with saturated steam over a throttle pressure range of 65 to 290 psia and exhausting to the condenser at 2-in. Hg absolute.

This unit has a capability of 980 Kw when supplied with 265 psia steam and exhausting to a condenser at 8-in. Hg absolute. The steam consumption for these conditions is 21,000 lb/hr.

The unit will be operated with steam at 265 psia and exhausting to a condenser at 16 psia. It will drive the HRE generator which has been rewound for 440-volt operation and has a capacity of 345 Kw. The steam flow for these conditions will be 9,250 lb/hr.

The principal reason for operating the turbine generator is to provide a source of stand-by power sufficient to carry the electrical requirements of the HRT if the TVA source is interrupted. For low reactor power levels, building steam will be used and at high (above approximately 2.5 Mw) power levels, sufficient reactor steam will be available to carry the reactor auxiliary load.

At low reactor power levels, two methods of operation are possible: (a) operate the turbine generator at light load (70 Kw) with building steam, (b) operate the turbine generator at a capacity (approximately 250 Kw) sufficient to carry reactor auxiliary load with building steam.

The economics of operation is in favor of the first method but may not be desirable as it depends upon the ability of the turbine generator to pick up load on loss of TVA power without serious drops in voltage and frequency. If sufficient steam is available from the building steam system, no operating difficulties should be encountered with the second method of operation.

At high reactor power levels, the turbine generator can be operated at maximum capacity to utilize the unit at its maximum "steam killer" capability.

B. Purpose of Test

Two tests appear to be necessary to demonstrate the ability of the turbine generator to satisfy the above requirements:

1. Operate the turbine generator at various loads from 50 Kw to maximum generator capacity using building steam and a back-pressure of 16 psia. This test will (a) make certain the unit is operating satisfactorily, (b) refine operating procedures, (c) demonstrate the ability of the unit to operate at 16 psia back-pressure, (d) provide performance data at various loads, (e) demonstrate light load operation, (f) determine whether full load can be attained using building steam, (g) check instrumentation, (h) provide conditions for checking condenser, hot-well pump, generator and exciter operation, and (i) determine "steam killer" capacity of unit.

This test can be performed just as soon as all work is completed on the turbine, generator, exciter, and condenser.

2. Operate the turbine generator at light load (70 Kw) with building steam and tied in with TVA with all reactor electrical equipment in service (approximately 250-Kw load). Open the TVA breaker and observe ability of the turbine generator set to pick up reactor electrical load without serious drops in voltage and frequency.

This test should be performed when the maximum amount of reactor electrical equipment is in service prior to the addition of soup to the system.

C. Test Procedure

The general test procedure for the first test will be as follows:

1. Bring turbine generator up to speed, synchronize with TVA system and apply 50-Kw load.

2. Increase load in 50-Kw intervals to full load. After each load change, allow 1/2 hour for temperatures, pressures, etc., to stabilize. Take 4 sets of readings 10 minutes apart for each load. (This may have to be revised slightly depending upon conditions desired for condenser, generator, exciter, etc., tests).

3. Adjust cooling-water flow to condenser to maintain 16 psia exhaust pressure. Keep condenser vent valve partially open to remove non-condensible gases.

4. During the test, governor and voltage regulator operation will be observed. Some adjustments may be required which may delay the testing program.

5. Measure steam flow to the turbine by two methods: flow meter and weighed condensate. (Note--Flow-meter errors are expected due to wet steam.) Determine steam quality with calorimeter. Read header, throttle, steam chest, governor valves, stages and exhaust pressures. Read throttle, steam chest and exhaust temperatures.

6. Read generator indicated load, Kw hours, a-c voltage, a-c amperes, d-c voltage, d-c current and power factor. The throw-over test from TVA to turbine generator power supply will not require a special test procedure at this time.

The sensitivity of each reactor electrical component with respect to voltage and frequency fluctuations and the response time of the turbine governor and generator voltage control systems are not known. The simplest test procedure under such conditions would be to open the TVA breaker and then make a note of all equipment malfunctions that occur.

A set of sample log sheets are attached to this report for recording readings during the test.

D. Instrument Requirements

A turbine test instrumentation diagram is attached to this report showing the location of instruments and Table I lists the instruments by function and type.

All instruments should be calibrated by the Instrument Department before and after the test. Instrument calibration data should be provided by the Instrument Department before the test.

E. Personnel Requirements

Personnel required to operate the equipment and take the data are listed below:

1 - Test Supervisor
1 - Turbine and Generator Operator to set and maintain test conditions on equipment and take calorimeter readings.
1 - Technician to take temperature, pressure and flow readings at turbine.
1 - Technician to take electrical readings in control room and electrical equipment room.
2 - Technicians to weigh condensate in catch tank.

6 - Total personnel requirements.

H. K. Search
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TABLE I

Instrument Requirements

A. Turbine

(1)	Header Pressure	*Bourdon Pressure Gauge	0-300 psi
(1)	Throttle Pressure	*Bourdon Pressure Gauge	0-300 psi
(1)	Steam Chest Pressure	Bourdon Pressure Gauge	0-300 psi
(5)	Governor Valve Pressure	Bourdon Pressure Gauge	0-300 psi
(5)	Stage Pressure	Bourdon Pressure Gauge	To be determined after shakedown run
(1)	Exhaust Pressure	Compound Pressure Gauge	30-in. Hg-0-30 psi
		30-in. U-tube Hg Manometer	(as needed)
(1)	Barometric Pressure	Hg Manometer at X-10 Steam Plant	
(1)	Steam Quality	Calorimeter complete with pressure gauge and thermometers	
(1)	Steam Flow	D/P Cell and Pressure Gauge with calibration curve and correction factors	
(1)	Header Steam Temperature	Iron--constantan thermocouple	
(1)	Steam Chest Temperature	Iron--constantan thermocouple	
(1)	Exhaust Temperature	Iron--constantan thermocouple	
(1)	Potentiometer and Selector Switch for above thermocouples		
(1)	Weigh Tank and Platform Scales		

B. Generator

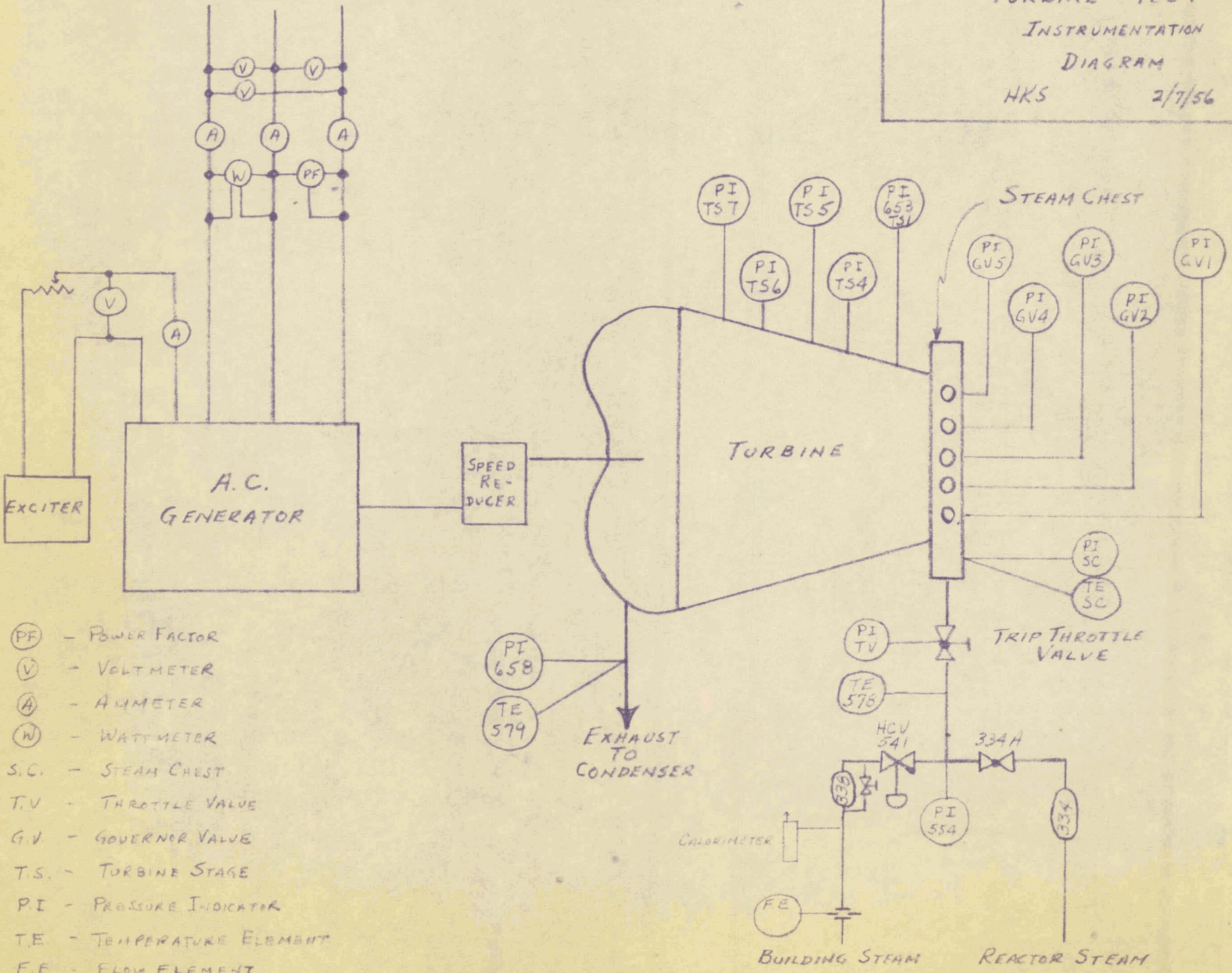
Use existing instruments on control room and electrical equipment room control panels. Test instruments may be required if panel instruments cannot be calibrated or are not reliable.

For more accurate Kw-hour readings, a counting device may be needed to count the disc revolutions of the Kw hour meter.

*Duplicated on control-room panel.

Turbine Test Instrumentation Diagram

HKS 2/7/56



(PF) – Power Factor
(V) – Voltmeter
(A) – Ammeter
(W) – Watt Meter
S.C. – Steam Chest
T.V – Throttle Valve
G.V – Governor Valve
T.S. – Turbine Stage
P.I – Pressure Indicator
T.E – Temperature Element
F.E – Flow Element

TURBINE TEST DATA

Steam Pressures

Date _____

Run No.	Reading No.	Time	Header psig	Throttle psig	Steam Chest psig	Governor Valves					Turbine Stages				7th psig	Exhaust psig	Barometer "Hg
						No.1 psig	No.2 psig	No.3 psig	No.4 psig	No.5 psig	1st psig	4th psig	5th psig	6th psig			
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TURBINE TEST DATA

Date ____________________

Electrical Data

			Exciter—DC		Generator—AC									
			Potential	Current	A Phase Current	B Phase Current	C Phase Current	A-B Potential	B-C Potential	A-C Potential	KwH Meter Reading	Disc Revolution KwH Meter	Indicated Load (Control Panel)	Power Factor
Run No.	Reading No.	Time	Volts	Amps	Amps	Amps	Amps	Volts	Volts	Volts	Kw	Revolutions	Kw	%

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TURBINE TEST DATA

Date ____________

Run No.	Reading No.	Time	Flow Rates				
			Pressure Differential D/P Cell Psi	Flow Rate (Uncorrected) Lb/hr	Flow Rate (Corrected For Press. & Temp.) Lb/hr	Collecting Tank Weight Lb	Flow Rate Lb/hr

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TURBINE TEST DATA

Date____________

Run No.	Reading No.	Time	Temperatures		
			Throttle °F	Steam Chest °F	Exhaust °F

TURBINE TEST DATA Date ______________

				Calorimeter Data		
			Header Steam Pressure	Header Steam Temperature	Calorimeter Steam Temperature	Quality (From Chart)
Run No.	Reading No.	Time	psig	°F	°F	%

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