

## SUMMARY OF TURBINE DESIGN FEATURES

**TURBINE NO.:** 198045

**INSTRUCTION BOOK NO.:** GEK 96709

**TURBINE TYPE:** SCSF DOUBLE AUTOMATIC EXTRACTION

**DRIVING:** 86,600 KVA, 13,800 Volts, 3 Phase, 60 Hz, Hydrogen Cooled

**NOTE:** The following summary lists the specific design features and components of the turbine.

Front standard type: FS180 with flexible support

### **PERFORMANCE**

Rating 72,690 kW

Design Steam Conditions:

Initial pressure 950 psig

Initial temperature 900 FTT

Back pressure 1.5 inches Hg Abs

Speed:

Rated 3600 rpm

Primary trip 3960 rpm

Emergency trip 4032 rpm

### **ELECTROHYDRAULIC UNITS**

Pre-emergency speed setting 3780 rpm

High-speed setting 3850 rpm

### **EXTRACTION AND ADMISSION**

Automatic extraction at design pressure 160 psig

Operating pressure range 176/144 psig

Automatic extraction at design pressure 45 psig

Operating pressure range 55/35 psig

### **THERMODYNAMIC DESIGN**

Nonreturn 14 inches in 7th stage shell

Nonreturn 30 inches in 10th stage shell

Exhaust red line set at 175 °F

### **MECHANICAL DESIGN**

Active thrust bearing: Tapered

Orifice size 11/16 inch

Inactive thrust bearing: Tapered

Orifice size 17/32 inch

No. 1 bearing: Elliptical

Orifice size 5/16 inch

Minimum bearing clearance .013 inch

No. 2 bearing: Elliptical

Orifice size 15/32 inch

Minimum bearing clearance .016 inch.

## **MECHANICAL DESIGN (Cont'd)**

Turning gear on turbine exhaust bearing

Nameplate language: English

Thermometers: Degrees Fahrenheit

Gages: English units

Accessory panels:

Hydrogen control cabinet

Provision for borescope inspection:

First stage

Eighth stage

Eleventh stage

Relief diaphragm

Fog nozzles

Turning gear motor 460 vac

Sight flow for the oil from the:

No. 1 bearing is located on front standard

No. 2 bearing is located on bearing bracket

Lifting devices:

Rotor lifting slings

Rotor lifting beam

Hydraulic jacks for initial opening of joint

Casing lifting slings

Weights:

Upper half H.P. head, exhaust casing including diaphragms, 65,248 lb

Turbine rotor 39,800 lb

Generator rotor 40,000 lb

## **TURBINE CONTROL SYSTEM**

Mark III Electrohydraulic Controls

## **EMERGENCY PROTECTION SYSTEM**

Stop valve (partial arc)

Primary trip

Emergency trip

Electrical trip

Primary overspeed trip

Emergency overspeed trip

Thrust failure trip

Low vacuum trip

Manual trip

Nonreturn valve trip device

Low lube oil pressure and level trip

Low hydraulic pressure and level trip

High exhaust temperature trip

## **LUBRICATION AND HYDRAULIC SYSTEM**

Oil cooler type: Shell and tube

Cooling water: Fresh

Oil tank size: OT12H

Oil tank capacity: 2,000 gallons

Oil level gage: Alarm contact

Low bearing oil pressure alarm switch: Closes at 10 psig; opens at 20 psig.

Low bearing oil pressure trip and alarm switch: Closes at 6 psig; opens at 16 psig.

Bearing oil pump 460 vac (2)

Pump test hand valve on oil tank

Emergency bearing and seal oil pump 120 vdc

Pump test hand valve on oil tank

Oil filter

Overflow sight

## **HYDRAULIC POWER UNIT**

Pump motors (2) 460 vac, speed 1200 rpm

Pump test hand valve

Resistance temperature detector

Pressure switches

Pressure transmitter: Electric

Fluid-level alarm switch: High and low

Low fluid-level trip and alarm switch

Low-hydraulic pressure alarm switch

Low-hydraulic pressure trip and alarm switch

Nonreturn valve trip relay

Electrical trip device (ETD)

Space Heaters

## **SHAFT SEAL AND VENT SYSTEM**

Steam seal regulator (Pneumatic)

Gland exhauster system: Separating tank and motor-driven air blower

## **STEAM VALVE SWITCHES**

Stop valve circuit breaker switch

Stop valve closed position switch

Stop valve test position switch

Stop valve open position switch

## **TEMPERATURE INDICATING DEVICES**

Dial thermometers on turbine for oil drains from:

Combined thrust

No. 1 bearing

No. 2 bearing

Temperature measuring devices for oil cooler:

Oil in - Tank

Oil out - Cooler

RTD's in bearings:

Upper half of active thrust bearing in babbitt (2)

Upper half of inactive thrust bearing in babbitt (2)

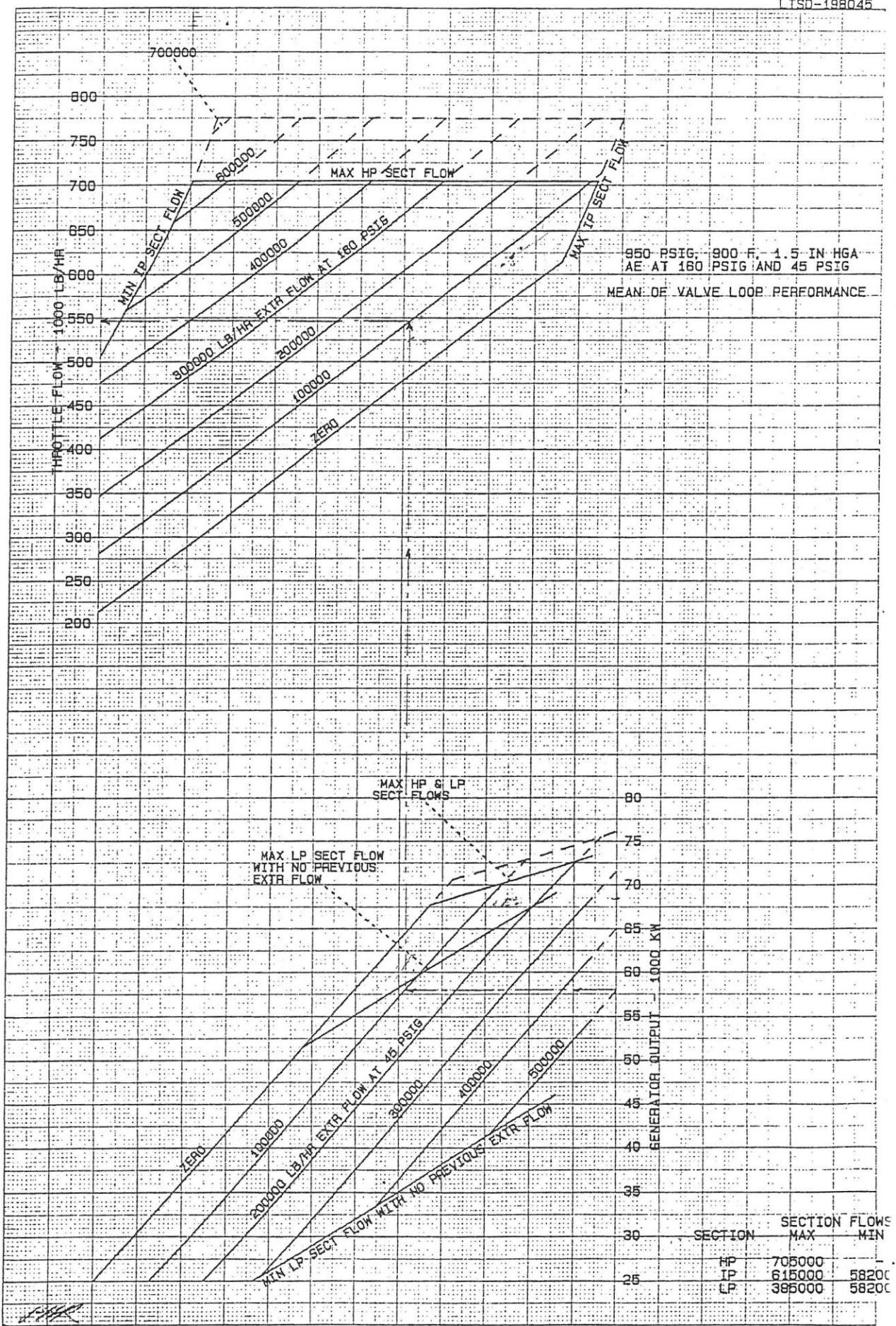
No. 1 bearing in babbitt

No. 2 bearing in babbitt

**TEMPERATURE INDICATING DEVICES (Cont'd)**

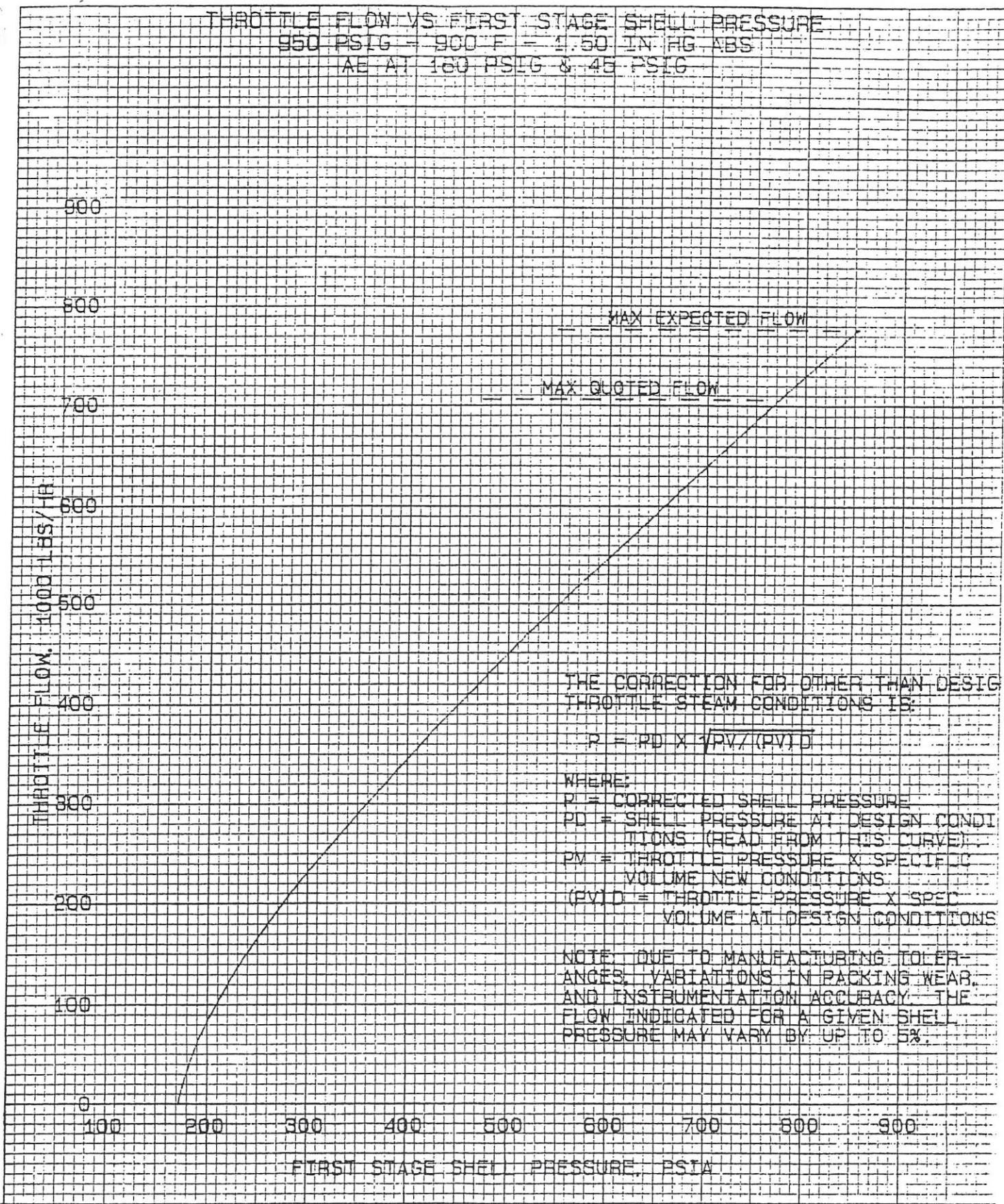
Temperature measuring device on turbine for steam in upper exhaust casing  
Temperature measuring device on turbine for steam in lower exhaust casing  
Remote temperature indication for steam in lower exhaust casing  
Exhaust temperature switch alarms at 175 °F and trips and alarms at 225 °F

LTSD-198045



REVISED 4-1-87 C133  
4/23/87 REVISED 4-18-87

L-1078421-198045-16



THE CORRECTION FOR OTHER THAN DESIGN THROTTLE STEAM CONDITIONS IS:

$$P = P_D \times \sqrt{P_V / (P_V D)}$$

WHERE:

P = CORRECTED SHELL PRESSURE

P<sub>D</sub> = SHELL PRESSURE AT DESIGN CONDITIONS (READ FROM THIS CURVE)

P<sub>V</sub> = THROTTLE PRESSURE X SPECIFIC VOLUME NEW CONDITIONS

(P<sub>V</sub>)<sub>D</sub> = THROTTLE PRESSURE X SPECIFIC VOLUME AT DESIGN CONDITIONS

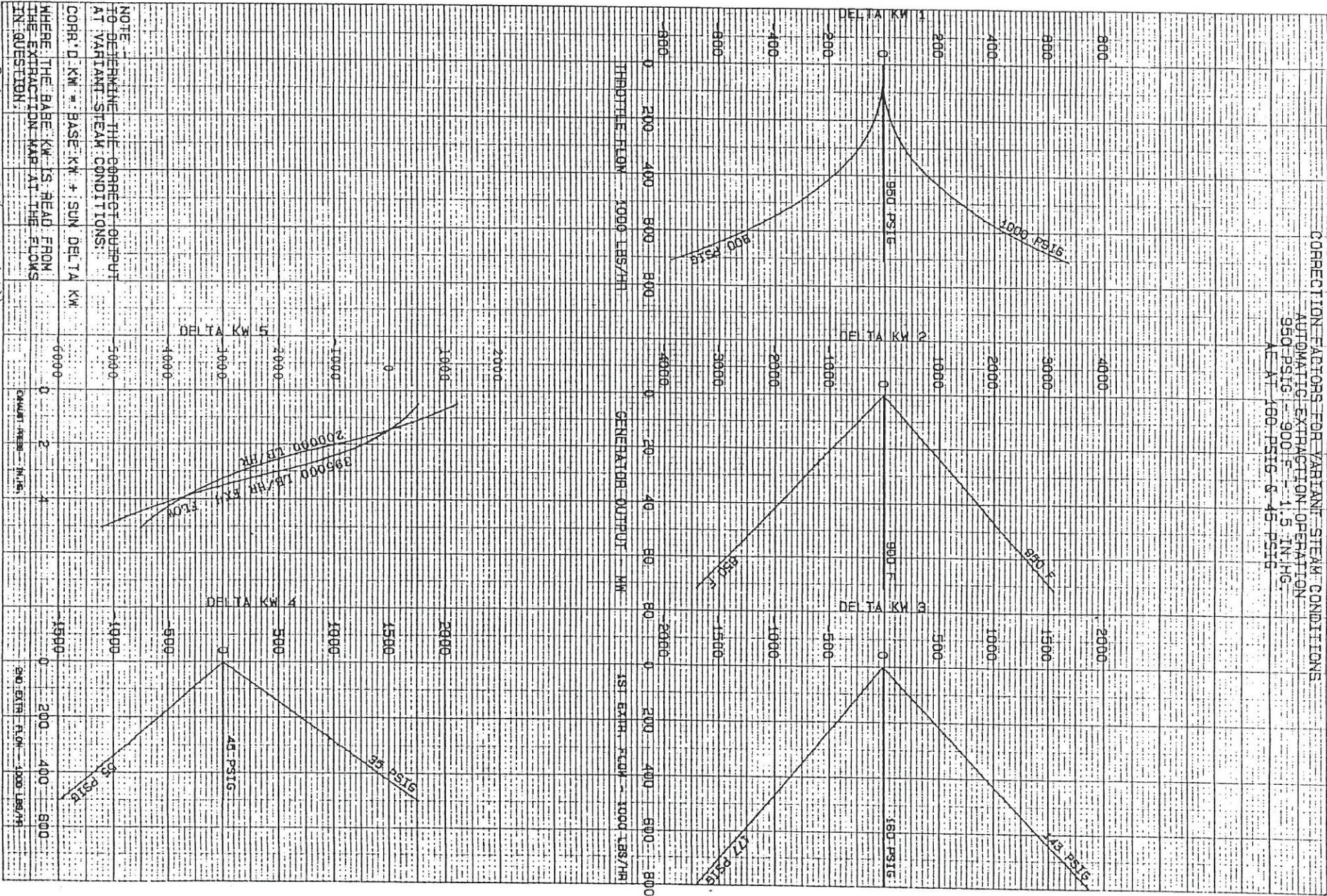
NOTE: DUE TO MANUFACTURING TOLERANCES, VARIATIONS IN PACKING WEAR, AND INSTRUMENTATION ACCURACY, THE FLOW INDICATED FOR A GIVEN SHELL PRESSURE MAY VARY BY UP TO 5%.

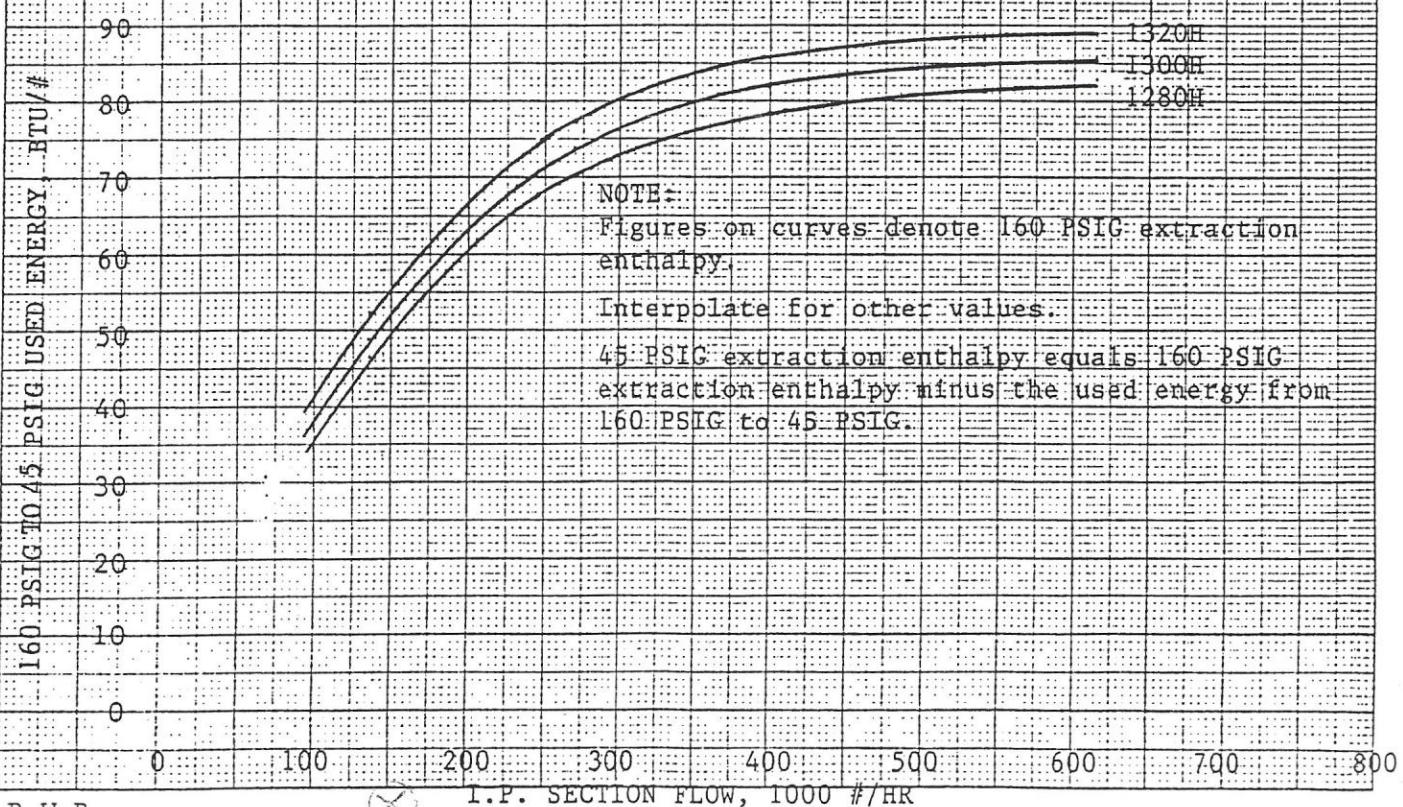
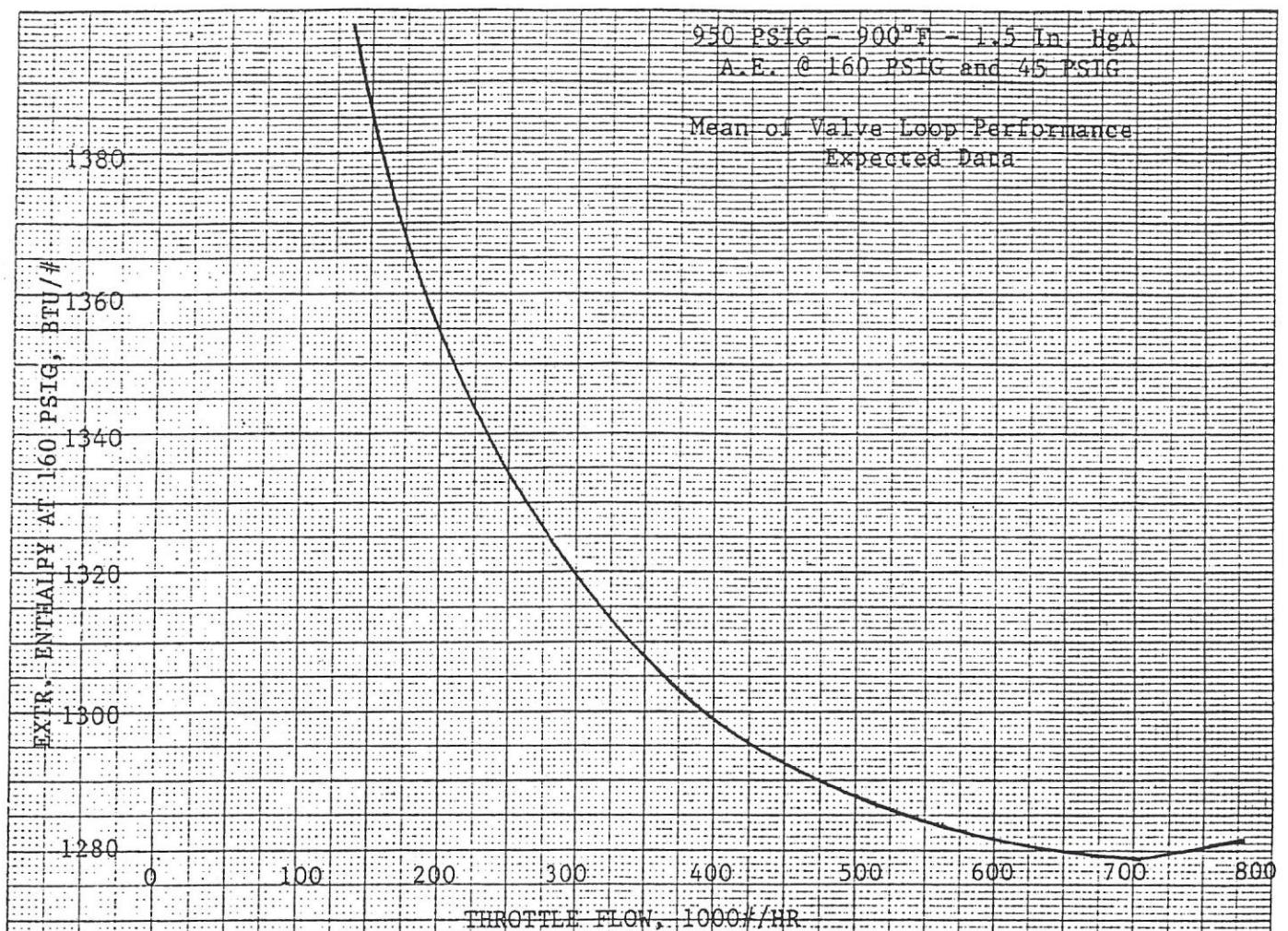
CORRECTION FACTORS FOR VARIATION STEAM CONDITIONS

AUTOMATIC EXTRACTION OPERATION

950 PSIG = 900°F = 1.5 INHG

A = AT 100 PSIG & 45 PSIG

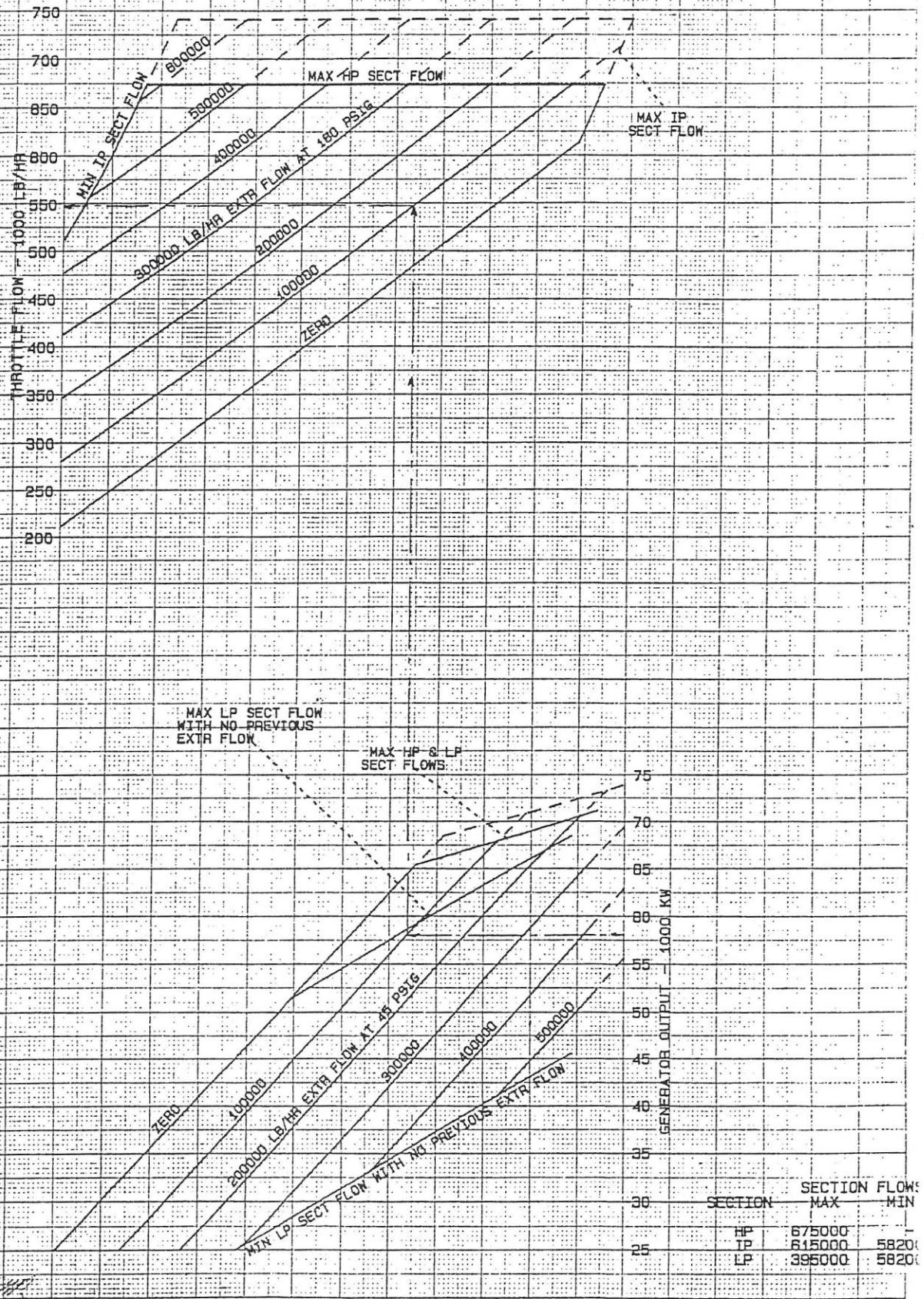




LTSO-198045

910 PSIG, 900 F, 1.5 IN HGA  
AE AT 180 PSIG AND 45 PSIG

## MEAN OF VALVE LOOP PERFORMANCE



ISS 4-28-P7(c13)

4/22/87

L-1078421-198045-19

DESIGN DATA  
GENERATOR

ATB-2; Wye Connected; 86,600 KVA; 3,600 RPM; 13,800 VOLTS; 0.85 PF; 30 PSI at 40C H<sub>2</sub>

Total Temperature at Rating Guaranteed not to Exceed: 100 C on Armature by Detector  
125 C on Field by Resistance

	<u>Rating</u>	<u>Capability</u>	<u>Capability</u>
Gas at 98% Purity (psig) . . . . .	30	15	5
KVA . . . . .	<u>86,600</u>	<u>77,940</u>	<u>64,950</u>
Armature Amps . . . . .	<u>3,623</u>	<u>3,261</u>	<u>2,717</u>
Armature Volts . . . . .	<u>13,800</u>	<u>13,800</u>	<u>13,800</u>
Field Amps . . . . .	<u>671</u>	<u>619</u>	<u>544</u>
Exciter Volts . . . . .	<u>375</u>	<u>375</u>	<u>375</u>
Power Factor. . . . .	<u>0.85</u>	<u>0.85</u>	<u>0.85</u>
Max. KVA, One Cooler Out of Service	<u>69,280</u>	<u>62,352</u>	<u>51,960</u>

No-Load Field Current . . . . . 240 Amperes

COLLECTOR AND BRUSH DATA

Collector Brushes, 26 Per Set . . . . . Recommended Grade, National Carbon 634  
Collector Minimum Safe Operating Diameter . . . . . 12.5 inches  
Shaft Grounding Brushes, 4 Per Set . . Recommended Grade, National Carbon 634  
If Brushes Spark or Chatter, Refer to . . . . . GEK-35474

GAS COOLER DATA

Inlet Water Temperature 80 F.  
Head Loss Through Cooler 8.1 Ft.H<sub>2</sub>O  
Gas Space in Generator 1150 Cu. Ft.

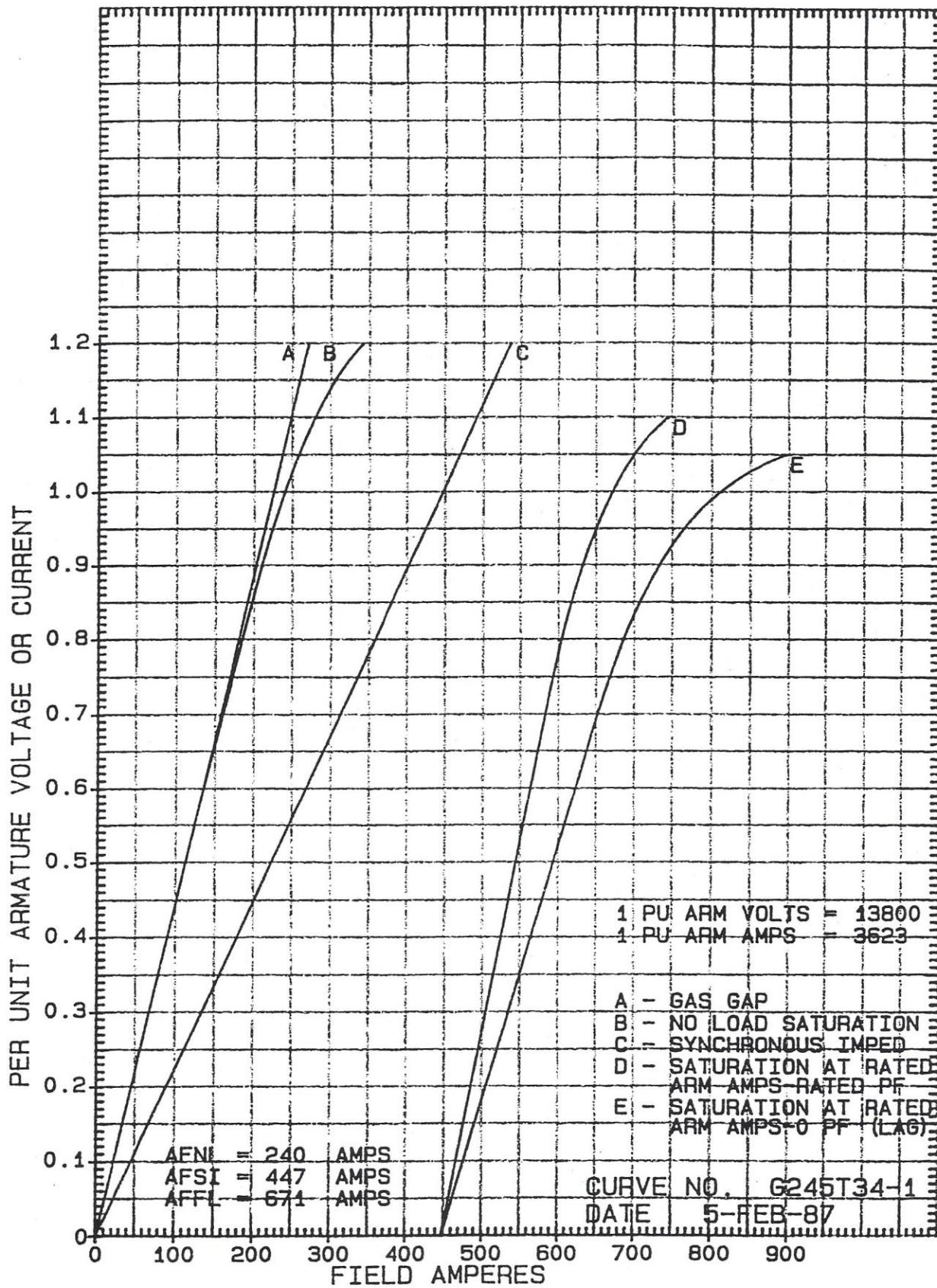
Water Flow at Rated Load 620 GPM  
Gas Flow Through Generator 46,355 CFM

AIR FILTER

Type of Air Filter . . . . .	<u>FARR</u>
Size of Air Filter . . . . .	<u>20X30X2</u>
Number of Air Filters. . . . .	<u>1</u>

ESTIMATED SATURATION AND SYNCHRONOUS IMPEDANCE CURVES  
86600 KVA - 3600 RPM - 13800 VOLTS - 0.85 PF  
0.53 SCR - 30 PSIG H<sub>2</sub> - 375 FLD VOLTS

GENERAL ELECTRIC

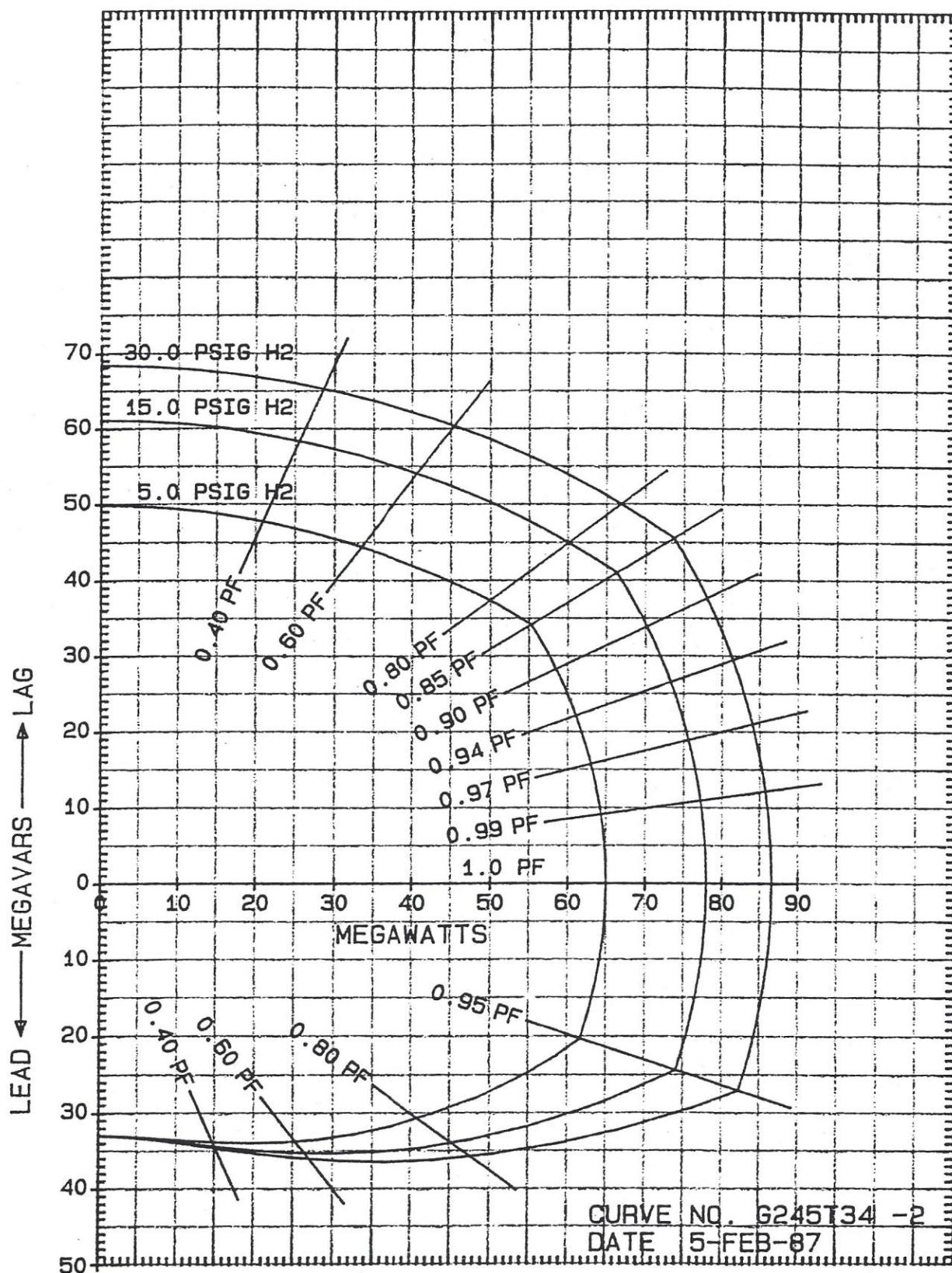


ESTIMATED REACTIVE CAPABILITY CURVES

86600 KVA - 3600 RPM - 13800 VOLTS - 0.85 PF

0.53 SCR - 30 PSIG H<sub>2</sub> - 375 FLD VOLTS

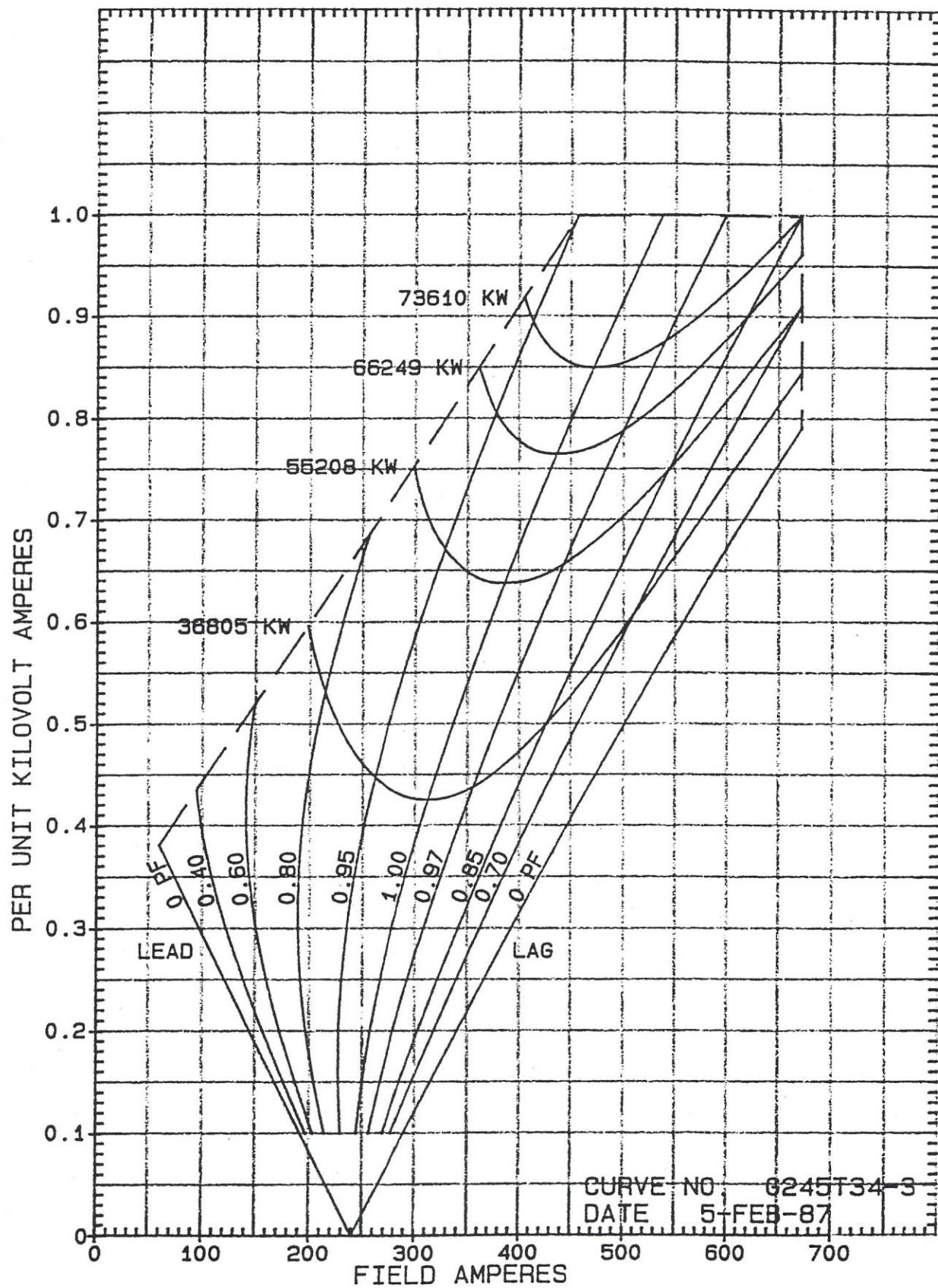
GENERAL ELECTRIC

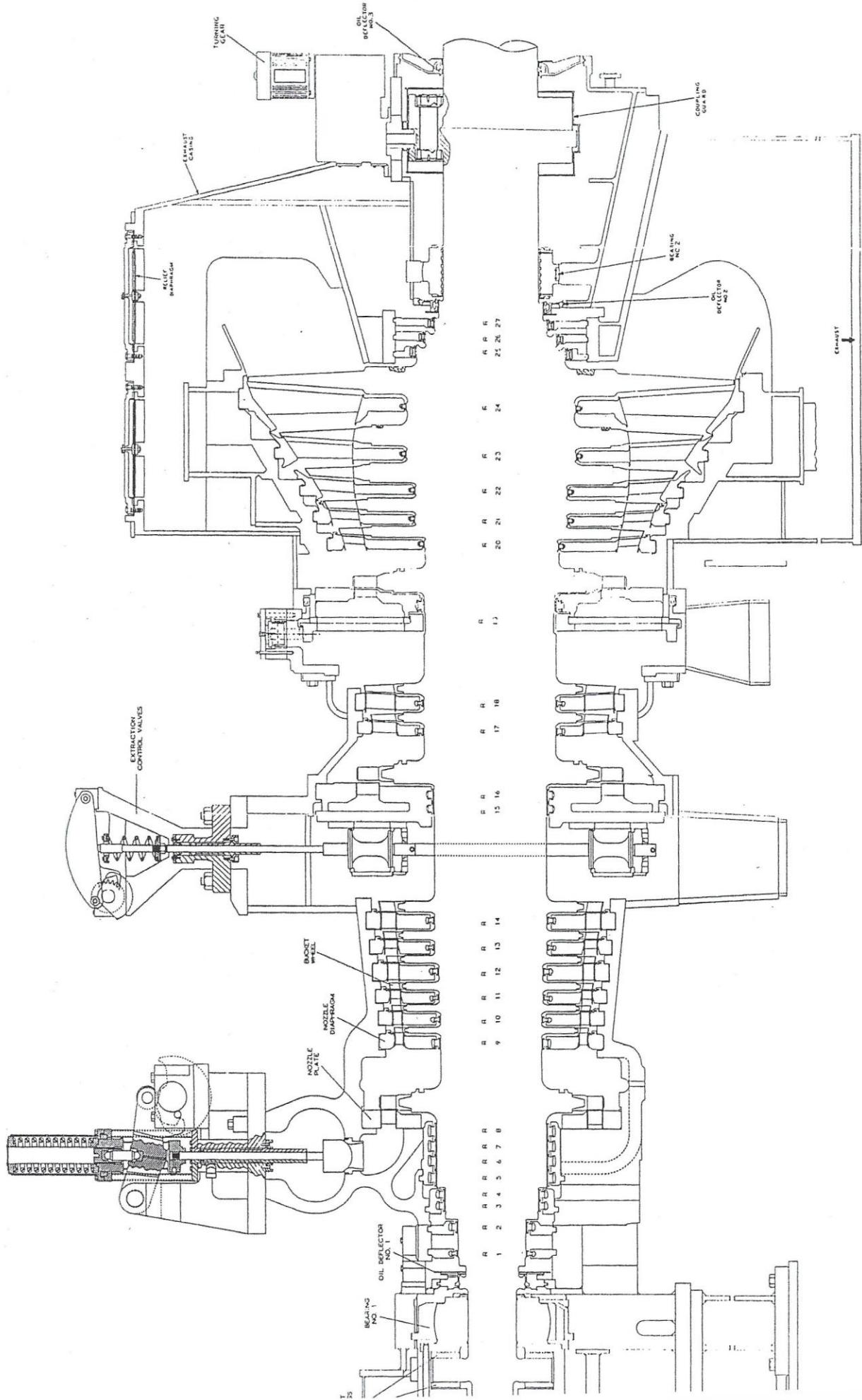


GENERAL ELECTRIC

# ESTIMATED EXCITATION V CURVES

86600 KVA - 3600 RPM - 13800 VOLTS - 0.85 PF  
0.53 SCR - 30 PSIG H<sub>2</sub> - 375 FLD VOLTS







## SURFACE CONDENSER SPECIFICATIONS

User: Ref. No.: 135BOS86  
Location: Date: 1/27/87 (6/24/11)  
Item: Turbine Surface Condenser Engineer: LEW/JED (CBD)

## PERFORMANCE

Absolute Pressure @ Steam Inlet (in.HgA).....	1.75
Steam Condensed (lb./hr.).....	395,000
Heat Rejected (Btu/hr.).....	375,249,900
Circulating Water (gpm).....	37,500
Water specific gravity / specific heat (Btu/lb F). .	1.0 / 1.0
Water Inlet / Outlet (deg.F).....	65 / 85
Water Pressure Loss : (ft.Water / psi).....	22.1/ 9.6
Percent Clean.....	85
Tube Velocity (fps).....	8.00

## DESIGN

	MODEL :	TB/TD
Surface Area (sq.ft.) Total / Effective.....	39,240 / 38,736	
Number of Water Passes.....		2
Number of Tubes.....		5,710
Outside Tube Diameter (in.) - BWG.....	0.875 - 22 ave.	
Total Tube Length (ft.).....		30
Design / Test Pressure (psig) : Shell.....FV&	15 /	
	125 /	
Design Temperature (deg.F) : Shell.....	250	
	150	
Hotwell : bathtub .....supply (min.).....	2	
Steam Inlet Diameter (in.).....	80.75 X 182.75	
Water Connections (in.).....	(4)- 36	
Condensate Outlet (in.).....	(1)- 16	
Vapor Outlet	(1)- 4	

## MATERIALS

Shell	Welded Steel Plate
Water boxes (Divided) Neoprene lined	Welded Steel Plate
Water box covers Neoprene lined	Steel Plate
Baffles Steel Plate	Steel Plate
Tubes (Welded)	Titanium B-338 GR 2
Tube sheets	Titanium Clad on Steel Plates
Gaskets - Shell side Canvas with red lead oil, Tube side Cloth Inserted Rubber	

Remarks : Design per HEI  
Shell expansion joint included. Zinc anodes in water boxes. Manways in  
Water box covers. 2 1/2" Hotwell fill connection. Design is suitable for  
Brush cleaning system. Tubes are seal welded to tubesheets.