

Most valving on main steam turbines are operated by hydraulic actuators. Spool type servo valves positioned by either an electric motor or mechanical means direct oil to the cylinders. The oil source is obtained from the turbine's lubrication system. Most of the actuation and related equipment are pre-1970 designs. Although the control is adequate, maintenance costs are high, replacement parts are difficult to obtain and tuning is tedious and time consuming. In addition, the ability to implement advanced control strategies is impossible.

A number of companies have introduced improved controls which include electronic speed sensors and digital processing. Not only are the major turbine manufacturers, such as General Electric and Westinghouse, involved in these upgrades, but also smaller, more innovative control companies. A common requirement for all the schemes is improved operation of the Final Control Element. High resolution, self contained independent hydraulic system, compact size and very fast trip speed are features required of such an actuator. The Xpac is uniquely suited to perform this critical application.

Utility turbines will usually have three major valves, Stop (GE)/Throttle (W), Control (GE)/Governing (W) and Intercept or Reheat. These valves are an integral part of the turbine. In order to increase reliability, most installations have redundant valving.

### **Main Steam Inlet Valve**

#### **Stop (GE)/Throttle (W)**

Remains full open during normal operation. Modulating capabilities are required to pre-warm the valve chest and initial rollup. In addition, these valves will close rapidly on a turbine trip. Only servo valve control is practical.

Thrust: 400 lbs  
Stroke: 1"-1.5"  
Quantity: 2 to 4 - typical  
Speed: 10-20 seconds - normal  
<0.25 seconds - trip; high speed trip may not be required.  
Resolution: 0.5%  
Actuator: L2000-2-B-E;  
redundant construction is usually not required

### Steam Control Valve Control (GE)/Governing (W)

Located downstream of the Stop/Throttle valves and controls the speed/load of the turbine by modulating incoming steam. Under normal conditions, very high resolution and modest speeds are required. A turbine trip requires high speed closure.

General Electric turbines incorporate two basic arrangements of Control Valves: Shell Mounted and Chest Mounted. Shell mounted control valves are attached to the turbine shell and are modulated by a rack and cam arrangement. The rack is positioned by the main hydraulic cylinder which is controlled by a servo valve. The Xpac would be connected directly to each individual valve.

If less extensive modifications are desired, a servo valve control upgrade may be accomplished with the Xpac.

	Servo Valve	Main (Shell Mounted)
Thrust:	400 lb	10000 lb
Stroke:	1"-1.5"	4"-6"
Quantity:	1-2	4-8
Speed:	5-15 seconds - normal <0.25 seconds - trip	5-15 seconds - normal <0.5 seconds - trip
Resolution:	0.1%	0.1%
Actuator:	L2000-2-2BR*-E	L10000-6-D-E or Depends upon the size of the turbine

\*R Construction: 90% redundant; typically not required on turbines that have multiple valving.

Chest mounted control valves are installed on a separate enclosure from the turbine. Control is performed by a complex series of levers and hydraulic amplifiers. The Xpac would modulate the servo of each of the main hydraulic pistons.

Thrust:	1000 lbs
Stroke:	2"-3"
Quantity:	4
Speed:	5-10 seconds - normal <0.25 seconds - trip
Resolution:	0.1%
Actuator:	L4000-4-C-E; redundant construction is usually not required

Westinghouse turbines have an actuator for each Governor valve. Operation is by a traditional servo valve/cylinder arrangement. Depending upon the installation, either a servo valve upgrade or complete actuator replacement may be suitable.

	Servo Valve	Main (Shell Mounted)
Thrust:	400 lbs	10000 lb
Stroke:	1"-1.5"	6"-10"
Quantity:	4 -12	4-12
Speed:	5-15 seconds - normal <0.25 seconds - trip	5-15 seconds - normal <0.5 seconds - trip
Resolution:	0.1%	0.1%
Actuator:	L2000-2-B-E	L10000-11-D-E Depends upon the size of the turbine

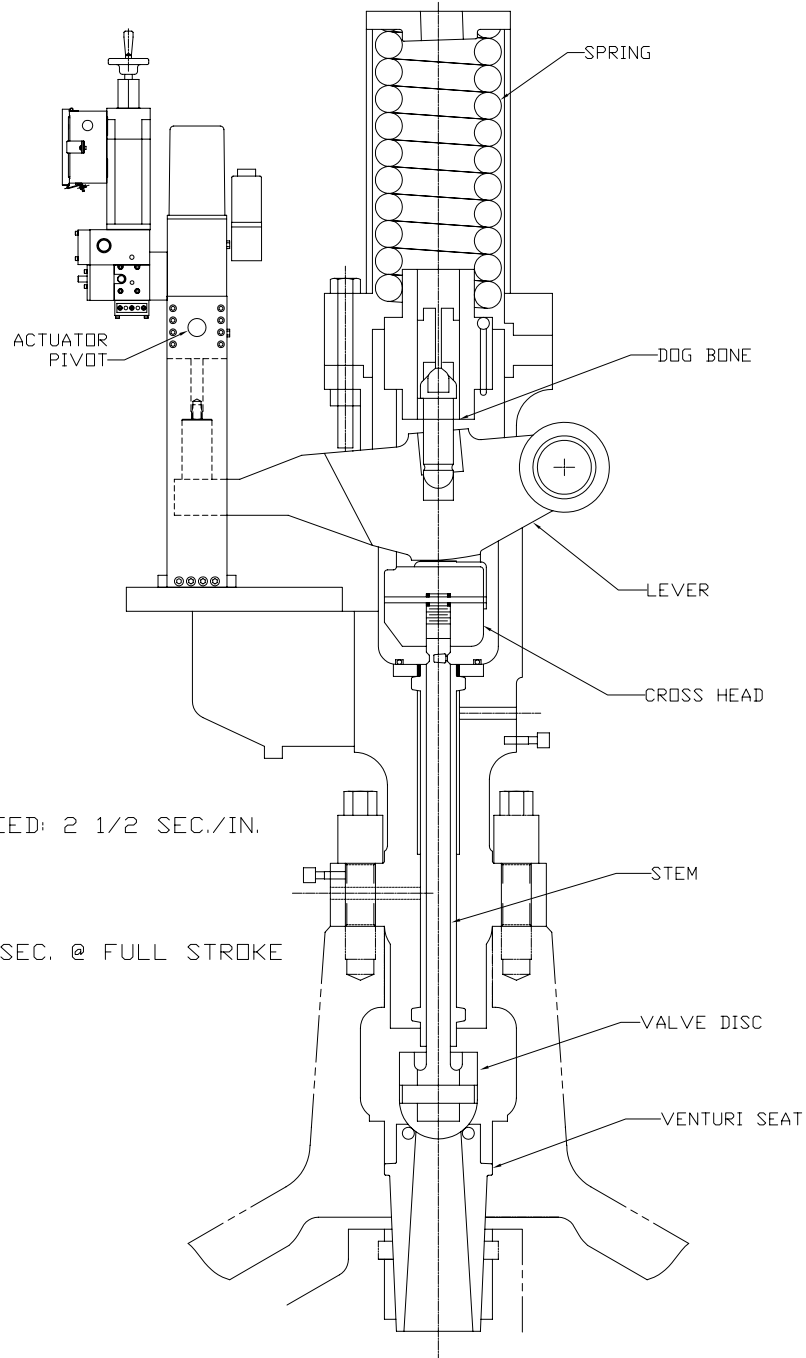
### **Reheat Steam Inlet Valve** **Reheat Stop or Intercept**

Remains full open during normal operation. Modulates to control an overspeed condition and closes rapidly on a turbine trip. There may be more than one reheat section. Actuator requirements are the same as for the Stop (GE)/Throttle (W) valves.

Quantity: 2 to 8

XPAC  
MODEL L10000-6-D-P

ORIGINAL GE COMPONENTS

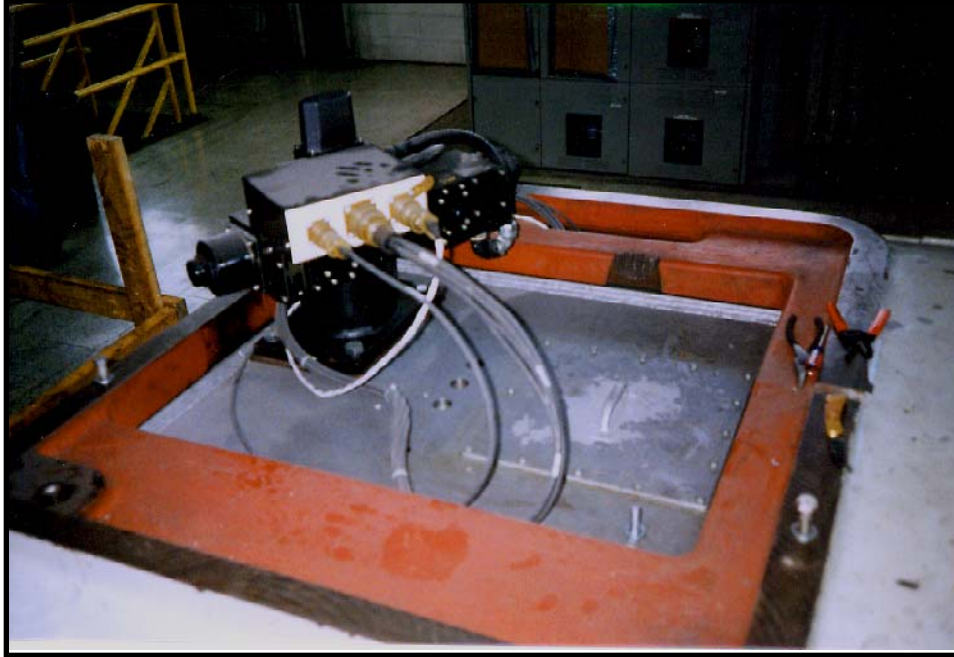


MODULATING SPEED: 2 1/2 SEC./IN.

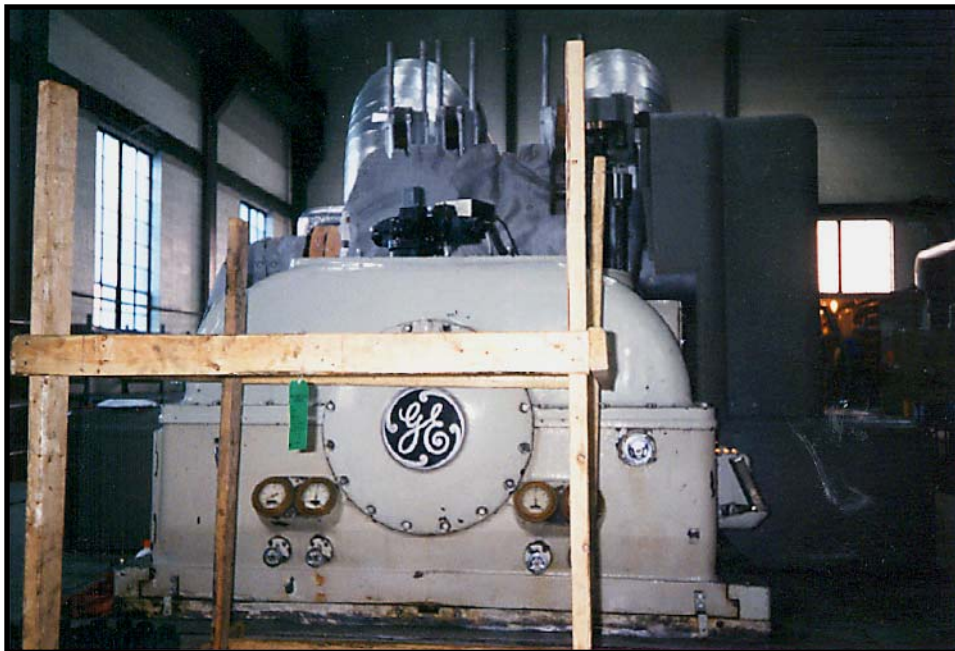
TRIP SPEED: < 1 SEC. @ FULL STROKE

UNLESS OTHERWISE SPECIFIED				CONTRACT No. PROPOSAL		REXA W. BRIDGEWATER, MASSACHUSETTS	
DIMENSIONS ARE IN INCHES				PREP SCOTTY 080800	GENERAL ELECTRIC STEAM TURBINE SHELL MOUNTED CONTROL VALVE ACTUATOR		
X.	.X	.XX	ANGLES	CHKR ALEITCH 080800			
±.5	±.25	±.12	±2°	APVD M.B. 080800			
				APVD			
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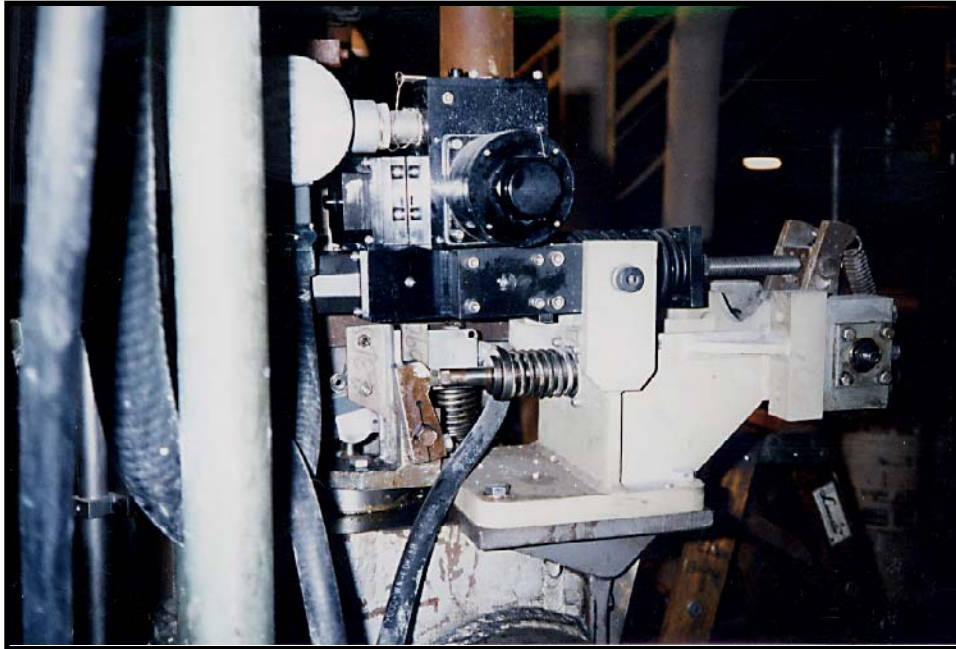
## SERVO POSITIONING OF THE STEAM CONTROL VALVES



L2000-2-2B-E  
100 Msec trip, 2 inch stroke, .1% resolution



## SERVO CONTROL OF STOP VALVE



L2000-2-B-E  
1 sec trip, 2 inch stroke, .1% resolution

