



A BRIEF WRITE UP ON ELECTRO-HYDRAULIC ACTUATORS FOR MAIN STEAM VALVES FOR 660/800 MW RATING STEAM TURBINE SETS

Status:	Released
Protection class:	Confidential

Rev.	Date	Issue resp./ Modification	Office	Prepared by	Reviewed by
00	27.08.2016	First issue	STE, CIE	Lakhmi Singh (STE-TG) Nitin (CIE)	Rajeev Rawat (STE-TG) Sheetal Singh (CIE)



A BRIEF WRITE UP ON ELECTRO-HYDRAULIC ACTUATORS FOR MAIN STEAM VALVES FOR 660/800 MW RATING STEAM TURBINE SETS

1 INTRODUCTION:

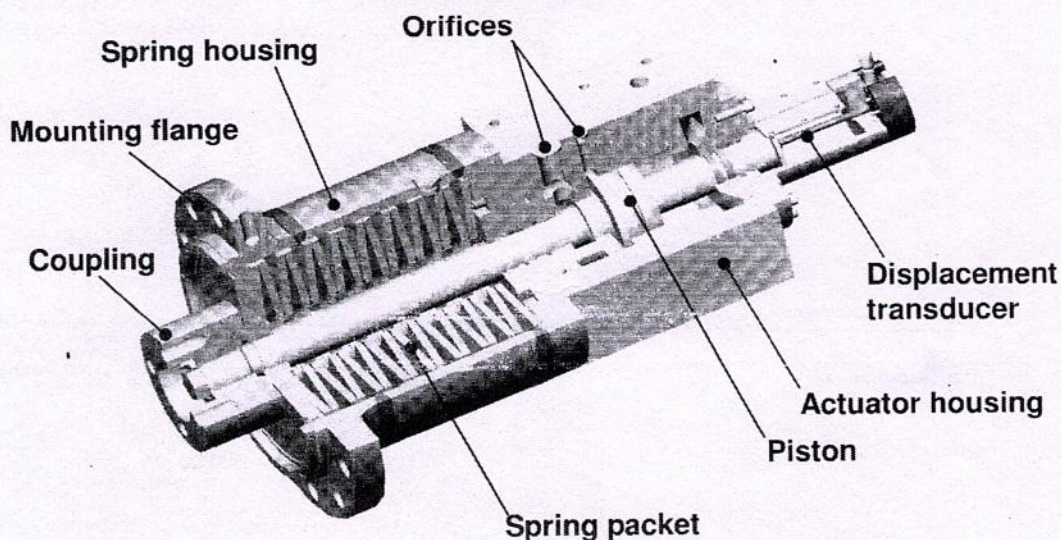
The steam turbine output is controlled by adjusting steam mass flow rate by turbine valves. There are total 9 nos. turbine valves viz. 2 nos. HP stop valves, 2 nos. HP control valves, 2 nos. IP stop valves, 2 nos. IP control valves and 1 no. overload control valve. These turbine valves are hydraulically actuated. In the case of a turbine trip, turbine valves interrupt the steam flow into the turbine instantly.

There is dedicated Electro-hydraulic actuator for each turbine stop and control valve. Hence total 9 nos. actuators are envisaged. All the actuators are operated with 160 bar high pressure fire resistant fluid supplied from centralized Hydraulic Power Supply Unit (HPSU).

Electro-hydraulic actuators mainly consists of Hydraulic pistons, Disc spring, Servo valves, Pilot valve, Trip solenoid valve, Cartridge valve, Check valves, Filter etc. Servo valve/Pilot valve transmit the electrical input signal of the turbine controller output into a hydraulic signal and amplify it, guide the control fluid flow to the hydraulic actuators so that the required steam flow rate can be regulated/stopped.

Cartridge valves mounted on the control blocks of actuators assemblies takes care that hydraulic actuators can close the steam valves within a very short time.

A typical cross section drg. of actuator is shown below.



BHEL HARIDWAR

Transmittal, reproduction, dissemination and/or editing of this document as well as utilization of its contents and communication thereof to others without express authorization are prohibited. Offenders will be held liable for payment of damages. All rights created by patent grant or registration of a utility model or design patent are reserved.



A BRIEF WRITE UP ON ELECTRO-HYDRAULIC ACTUATORS FOR MAIN STEAM VALVES FOR 660/800 MW RATING STEAM TURBINE SETS

2 STOP VALVE ACTUATOR (HP, IP):

The stop valve actuator is an Electro-Hydraulic Actuator with control fluid supply from HPSU. The actuator comprises an operating cylinder, control unit & valve position transmitter to monitor the opening and closing of the actuator/valve. Turbine stop valve is coupled with control piston of power cylinder. The control piston which is pressure loaded in opening direction and pressure relieved on the opposite side, moves in power cylinder. The closing force is supplied to the control piston by a cup – spring stack housed inside the actuator. The actuator is connected to the HPSU through control fluid supply and return lines. A filter along with D.P. switch is fitted in pressure line (upstream side) to prevent ingress of contamination from the pipe lines. A terminal box is also provided for wiring purpose.

2.1 CONTROL UNIT (MANIFOLD):

The control unit is mounted on the power cylinder and comprises of the Pilot valve, Trip solenoid valves, cartridge valves, check valves and orifices. All these control elements are connected via a control plate to the power cylinder through internal fluid ducts.

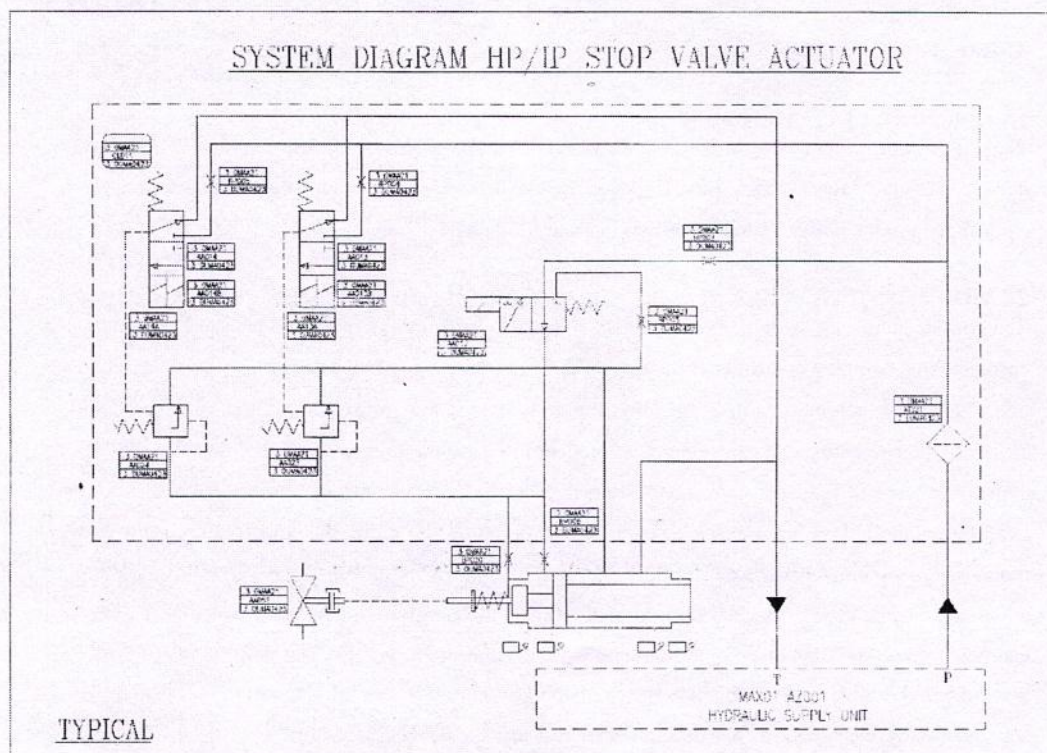
2.2 MODE OF OPERATION:

The trip solenoid valves (with double coils for redundancy) are energized with the help of output current signal from the controller for the opening of turbine stop valve. The fluid is fed to the power cylinder and pushes the piston in opening direction against the spring force. Stop valve is rapidly closed by de-energizing the trip solenoid valves, in that case the pressure over the discs of the logic cartridge valves is reduced, causing these valves to be opened by the pressure from the power cylinder being applied beneath the discs, thereby initiating the rapid closure of valve. Pilot valve remains in de-energized state during opening/rapid closing of the turbine stop valve. Pilot valve is energized only in case of normal closing of the turbine stop valves, keeping trip solenoid valves in energized state. The flow of oil to the actuator is realized through orifices. The sizing of these orifices is done based on the closing time of actuator. A leakage sensor is also provided in the leakage tray of actuator. It gives the signal to control room in case of leakage through actuator.

POSITION MONITORING:- 2 no. Position Transmitters and Limit Switches for Open and Close position of the valve are provided in each actuator.



A BRIEF WRITE UP ON ELECTRO-HYDRAULIC ACTUATORS FOR MAIN STEAM VALVES FOR 660/800 MW RATING STEAM TURBINE SETS





A BRIEF WRITE UP ON ELECTRO-HYDRAULIC ACTUATORS FOR MAIN STEAM VALVES FOR 660/800 MW RATING STEAM TURBINE SETS

3 CONTROL VALVE ACTUATOR:

The control valve actuator is an Electro-Hydraulic Actuator with control fluid supply from HPSU. The actuator comprises an operating cylinder, control unit and valve position transmitters. Turbine control valve is coupled with the control piston of power cylinder. The control piston which is pressure loaded in opening direction and pressure relieved on the opposite side, moves in power cylinder. The closing force is supplied to the control piston by a cup – spring stack housed inside the actuator. The actuator is connected to the HPSU through control fluid supply and return lines. A filter along with D.P. switch is fitted in pressure-line (upstream side) to prevent ingress of contamination from the pipe lines. A terminal box is also provided for wiring purpose.

3.1 CONTROL UNIT (MANIFOLD):

The control unit comprises of servo valve, trip solenoid valves, cartridge valves, check valves and orifices. In addition a filter along with D.P. switch is also fitted to the pilot control of servo-valve. All these control elements are connected via a control plate to the power cylinder through internal fluid ducts.

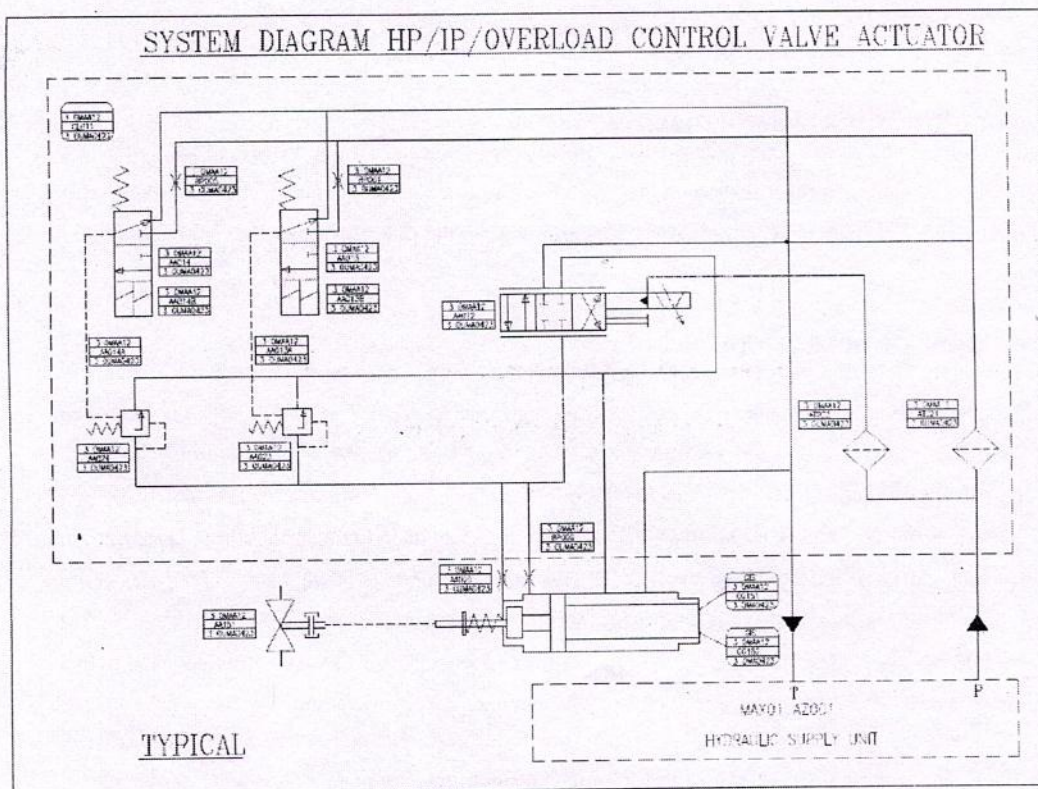
3.2 MODE OF OPERATION:

The servo valve is a high grade continuously operating directional control valve with particularly good steady state and dynamic characteristics and high amplification. Servo valve which is controlled through a position controller, controls the flow of fluid to both sides of the control piston as a function of the output signal from the controller, thereby positioning the actuator. The analog position of the actuator is feedback to the controller by position transmitters. In the event of rapid closure, trip solenoid valves are de-energized and thus the pressure over the discs of the logic cartridge valves is reduced, causing these valves to be opened by the pressure from the power cylinder being applied beneath the discs, thereby initiating the rapid closure of valve. The cartridge valves operated by the trip solenoid valves (with double coils for redundancy) are opened with minimum travel time and the piston chamber is connected to the drain. The flow of oil to the actuator is realized through orifices. The sizing of these orifices is done based on the closing time of actuators. A leakage sensor is also provided in the leakage tray of actuator. It gives the signal to control room in case of leakage through actuator.

POSITION MONITORING:- 2 no. Position Transmitters are provided in each actuator.



A BRIEF WRITE UP ON ELECTRO-HYDRAULIC ACTUATORS FOR MAIN STEAM VALVES FOR 660/800 MW RATING STEAM TURBINE SETS





A BRIEF WRITE UP ON ELECTRO-HYDRAULIC ACTUATORS FOR MAIN STEAM VALVES FOR 660/800 MW RATING STEAM TURBINE SETS

4 SCOPE OF SUPPLY PER TG SET:

Sl. No.	Item description	Quantity per TG set
4.1	ELECTRO-HYDRAULIC ACTUATORS:	
4.1.1	STOP VALVE ACTUATORS WITH COMPLETE CONTROL BLOCKS (TYPE: SVA-250-98-352) FOR HP STOP VALVES (HORIZONTALLY MOUNTED VALVE)	2 NOS. (ARRANGEMENTS WILL IN MIRROR IMAGE)
4.1.2	CONTROL VALVE ACTUATORS WITH COMPLETE CONTROL BLOCKS (TYPE: CVA-200-80-347) FOR HP CONTROL VALVES (HORIZONTALLY MOUNTED VALVE)	2 NOS. (ARRANGEMENTS WILL IN MIRROR IMAGE)
4.1.3	STOP VALVE ACTUATORS WITH COMPLETE CONTROL BLOCKS (TYPE: SVA-560-208-92) FOR IP STOP VALVES (VERTICALLY MOUNTED VALVE)	2 NOS. (ARRANGEMENTS WILL IN MIRROR IMAGE)
4.1.4	CONTROL VALVE ACTUATORS WITH COMPLETE CONTROL BLOCKS (TYPE: CVA-500-170-104) FOR IP CONTROL VALVES (HORIZONTALLY MOUNTED VALVE)	2 NOS. (ARRANGEMENTS WILL IN MIRROR IMAGE)
4.1.5	CONTROL VALVE ACTUATOR WITH COMPLETE CONTROL BLOCK (TYPE: CVA-125-50-324) FOR OVERLOAD CONTROL VALVE (HORIZONTALLY SUSPENDED VALVE);	1 No.
4.2	SPECIAL TOOLS AND TACKLES FOR ASSLY & DIS-ASSLY. FOR ACTUATORS	1 SET
4.3	COMMISSIONING SPARES	1 SET
4.4	TRAINING & SUPERVISION DURING ERECTION & COMMISSIONING AT SITE:	REQUIRED FOR EACH SET

MANUFACTURER'S NAME AND ADDRESS			STANDARD QUALITY PLAN				TO BE FILLED BY BHEL		TO BE FILLED BY BHEL				
BHEL	VENDOR'S NAME	ITEM		QP NO.									
				DATED									
		DRG. NO.	AS PER PO										
		SPEC.	AS PER PO										
		REV				Page 1 of 1							
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	D	S	B	C	11

		LEGEND:	FOR CUSTOMER USE	
MANUFACTURER/SUBCONTRACTOR		! RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.		APPROVED BY
		S: MANUFACTURER / SUBCONTRACTOR B: BHEL / NOM. INSPECTION AGENCY C: CUSTOMER INDICATE 'P' PERFORM 'W' WITNESS AND 'V' VERIFICATION		
		ALL 'W' INDICATED IN COLUMN 'N' SHALL BE 'CHP' OF CUSTOMER		