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STEAM PRESSURE CONTROL IN MEXICAN GEOTHERMAL POWER PLANTS

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ABSTRACT

At present, each one of the mexican geothermal plants have a steam-pressure control system and protection devices so that safe and continuos operation is obtained. In this paper characteristics and arrangements of those systems, which have been modified in the new geothermal plants due to acquired operative experience from the first units of Cerro Yrieto geothermal field, are described.

INTRODUCTION

The geothermal plants in Mexico, as all over the countries where this energetic source is exploted, are fairly well handled as base charge plants. To assure continous operation and get high reliability in consecuence, the steam supply system embraces a regulator pressure system whose objective is to avoid the safety devices operation when decreasing loads are present handling without staff or equipment risk, the exceeding amount of steam allowing regain load once the disturbance has happened.

In this work pressure control and overpressure protection systems in the geothermal plants in Mexico, at present in operation, are described in simplified way.

CERRO PRIETO I

In April 1973, this plant began its operation with two 37.5 units. In 1979 had twice its initial capacity and finally reached 180 MW of total installed capacity with a new 30 MW turbogenerator in 1981.

In Fig. 1 the layout of the feeding steam lines is shown with its respectives control-pressure branches in the first two turbogenerator units. For units 3 and 4 this scheme is repeated with just three branches.

For units 1 through 4, each control pressure branch vent to the atmosphere through a silencer. Moreover, each line has its isolating and venting electric operated valves. Control valve regulation is by handy way and is carried out by the personnel in charge of handling the switch selector installed in the turbogenerator panel control where steam pressure collectors is monitored.

If a decreasing load ocurred and the opening regulation valve action by the operator is not done, the equipment and personnel protection concerns to the safety valve series installed in the collector located in the plant area. .If they don't, the rupture discs mounted on the dryers will act.

In unit 5 the first one in Mexico with double pressure, the regulation system has an adjustable control valve with neumatic actuator in each two feeding steam pressure levels. Besides, a pressure control valve sends middle pressure steam to low pressure system. See Fig. 2.

The adjustable valve opening is ruled automatically by the pressure controller installed in the turbogenerator panel where at the same time of operation valve, the'high pressure signal alarm is energized. In case of operator wanted to control it by hand there is a transfer switch.

In order to protect, another venting line with a butterfly valve that opens automatically when high pressure ocurres and the dryers rupture discs are available. Both valves adjustable and emergency were sized for handling the hundred percent of required flux through the pipe at whole load of 30MW.

In all the five units of Cerro Prieto I the opening of the control valves is not often, since turbines work at maximum load allowed by steam reliability. In other .hand it has been observed that load changes just modify pressure slightly and those variations are rapidly controlled by the installed control system.

CERRO PRIETO II AND III

In those plants there exist four 110MW turbogenerators and each unit has a control pressure arrangement as shown in Fig. 3.

The high and low pressure control in each one, realizes the opening butterfly valves adjust automatically by means of a controller installed in the control room.

In receiving the 3-15 psig neumatic signal the control valve mentioned is the first one to open, at the moment of control sign reaches 9 psig it is detected by the emergency valve also, which opens fully. The controller have a transfer switch that allows operators to regulate the control valves or to open the emergency ones by hand when in the pressure switch installed in the vapor header, very high pressure is detected. The control valves steam-pressure sensor is located in the nearest point to the entrance's turbine. Each control and emergency valve was sized to handle the total flux of the required steam at full load, i.e. 702 ton/h and 120 ton/h high and low steam pressure respectively.

Moreover, in both units of Cerro Prieto II and Cerro Prieto III, there is a connection valve between the high pressure header and the

low one. This self controlled valve is sized for handling a maximun flow of 30 ton/h equivalent to 25 percent of full load of low steam pressure.

If the opening of both control and emergency valves is hindered the system has safety valves located in the headers and rupture discs in the dryers in order to protect the equipment.

During the first months in operation was observed that the control valves were working with vibrations so that the positioners were out of adjust. Such a case was solved by modifying the pipe arrangement and changing the positioners. Beyond those troubles the pressure control for units of Cerro Prieto II and III has worked fairly well in automatic way leaving just for shutdown case the operator's mediation to avoid, functioning of the safety valves. It can be seen that control pressure systems in Cerro Prieto for the first four units are just for handly way operation while in unit 5 and the four turbines of Cerro Prieto JI and III an automatic control is already included.

TEJAMANILES

This plant located in Los Azufres geothermal field is fed by a 7.3 kg/cm^2g steam pressure to generate 50MW to be sent to the national network transmission system, where the system load therefore its operation, is steadier than the observed in Cerro Prieto.

For all above and considering the experience attained from Cerro Prieto control pressure systems in this plant there are a modulating and an emergency independent systems to blow off the steam as shown in Fig.4.

The pressure control is automatic and has two butterfly valves arranged to open consecutively in accordance with the output signal of the panel mounted controller. Each control valve was sized to handle just 20 percent of the required flux at full load (90 t/h) when the pressure at the receiver is 8 kg/cm^2g. With this capability is provided a good control loop stability over the expected range of system operating conditions.

The emergency system has two servo-operated 24" diameter vent valves that are arranged to open in sequence according to the remoted action of the operator in the control room. These valves open in emergency or when the plant is shut down, each one blow off 50 percent of the required steam for normal full performance with a maximum capacity of 225 t/h.

The control and emergency valves prevent the receiver safety valves lifting and the operation of the rupture disc mounted in the steam dryer.

WELLHEAD UNITS

There are six wellhead units at Los Azufres geothermal field, the six turbogenerators are single pressure noncondensing 5 MW in size.

The arrangement of the pressure control system as shown in Fig. 5 has a butterfly valve hydraulically operated. The valve open when the pressure rise above 9 kg/cm^2g to blow off the whole of the steam in case of the turbine trip or discharge the steam in excess in disturbed conditions.

If the control valve is hindered there are safety valve and a rupture disc to protect tne personnel and equipment againsr over pressure under transient conditions or a turbine trip.

Due that the regulating valves in all the control systems of mexican geothermal power plants are sited in the plant limits, they have a simple proportional control. The steam silencers were designed to limit the maximum noise lebel to 90 dbA at a distance of 3 meters from the control system when the total steam flow is discharged.

CONCLUSIONS

1. The steam pressure control systems in mexican geothermal power plant have changed from hand controlled valves in Cerro Prie to I to automatic regulated valve in Cerro Prieto 11, III and in Los Azufres.

2. Adequate steam pressure control has been obtained with all the installed systems. The moderated disturbances are corrected automatically and only with major disturbances or a turbine trip is necessary to complete the automatic control with manual action of the operators to drive the turbines on safe condition.

ACKNOWLEDGEMENTS

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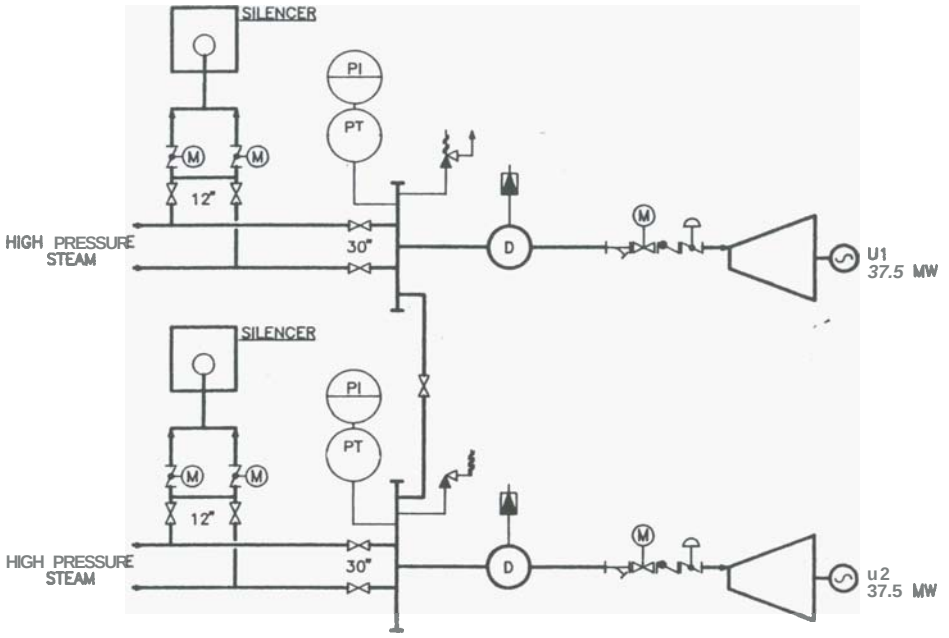


Figure 1
Steam pressure control Cerro Prieto I Units 1, 2.

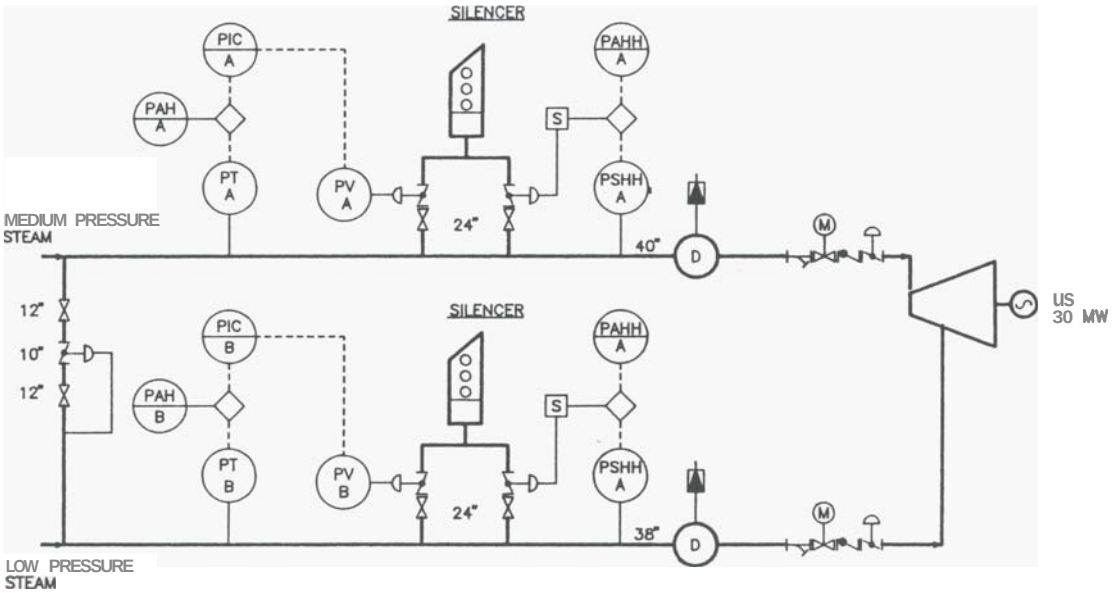


Figure 2
Steam pressure control Cerro Prieto I Unit 5.

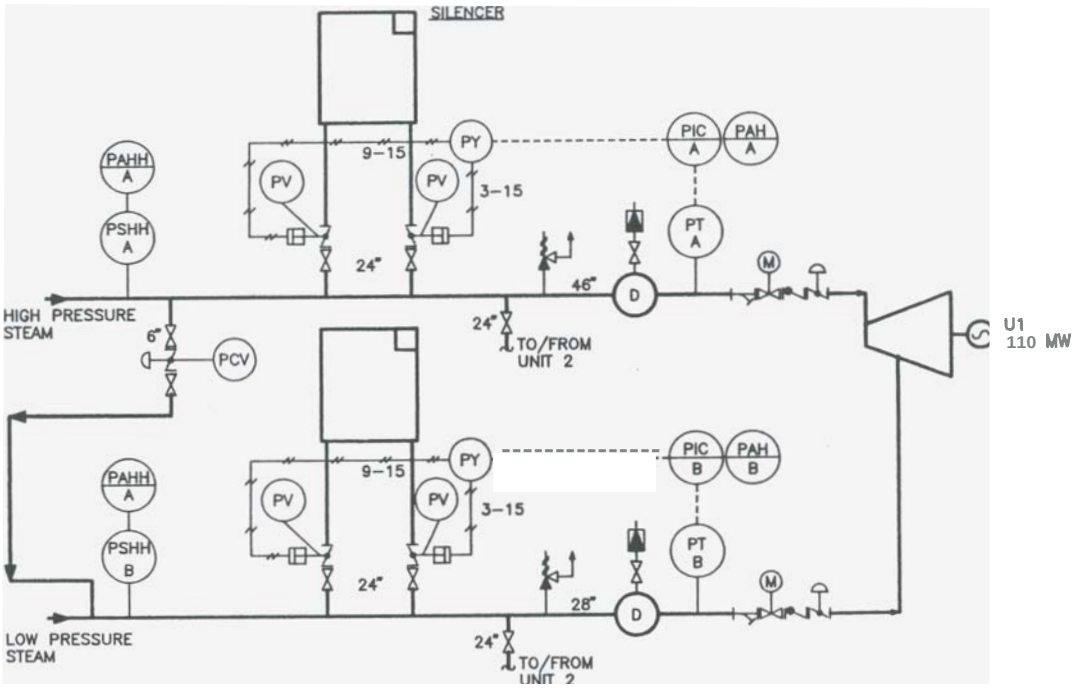


Figure 3
Steam pressure control Cerro Prieto II Unit 1.

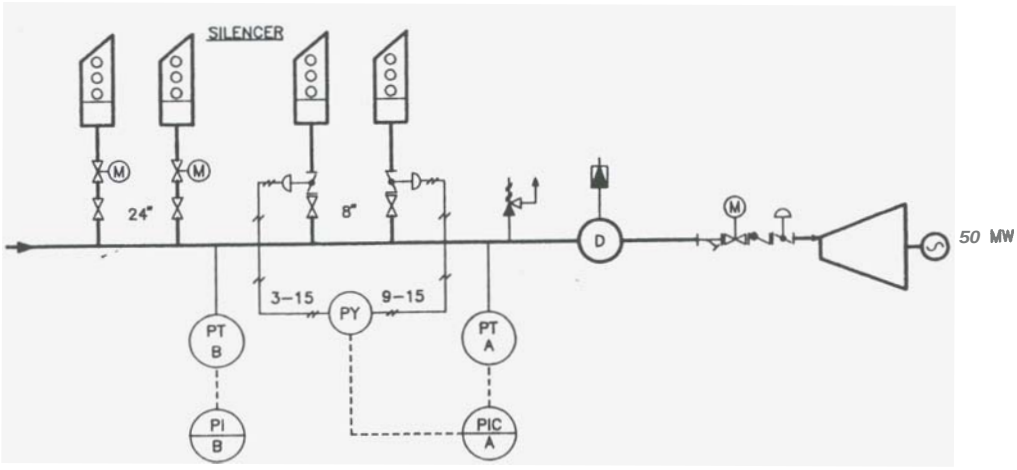


Figure 4
Steam pressure control in Tejamaniles Los Azufres.

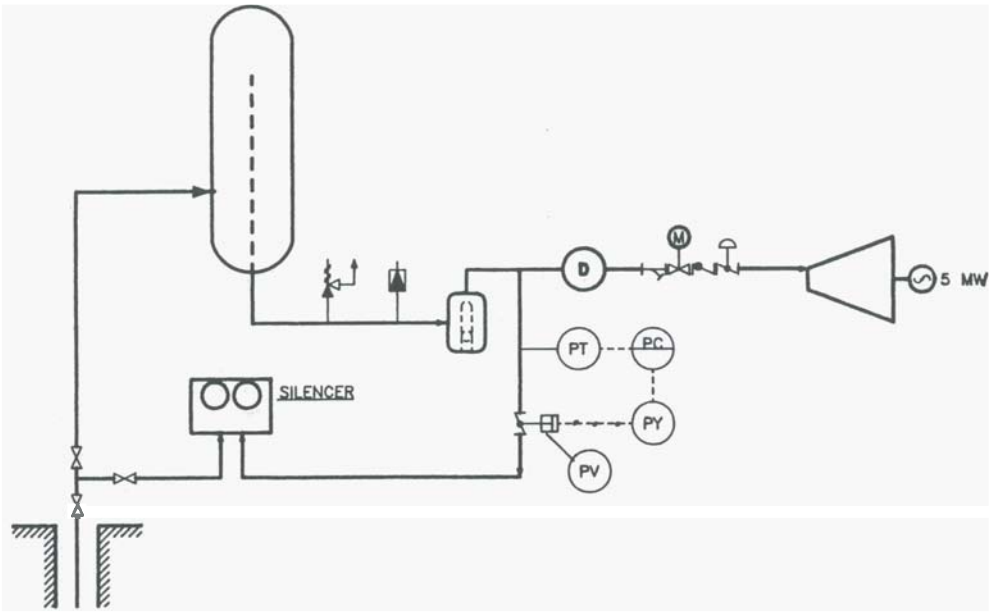
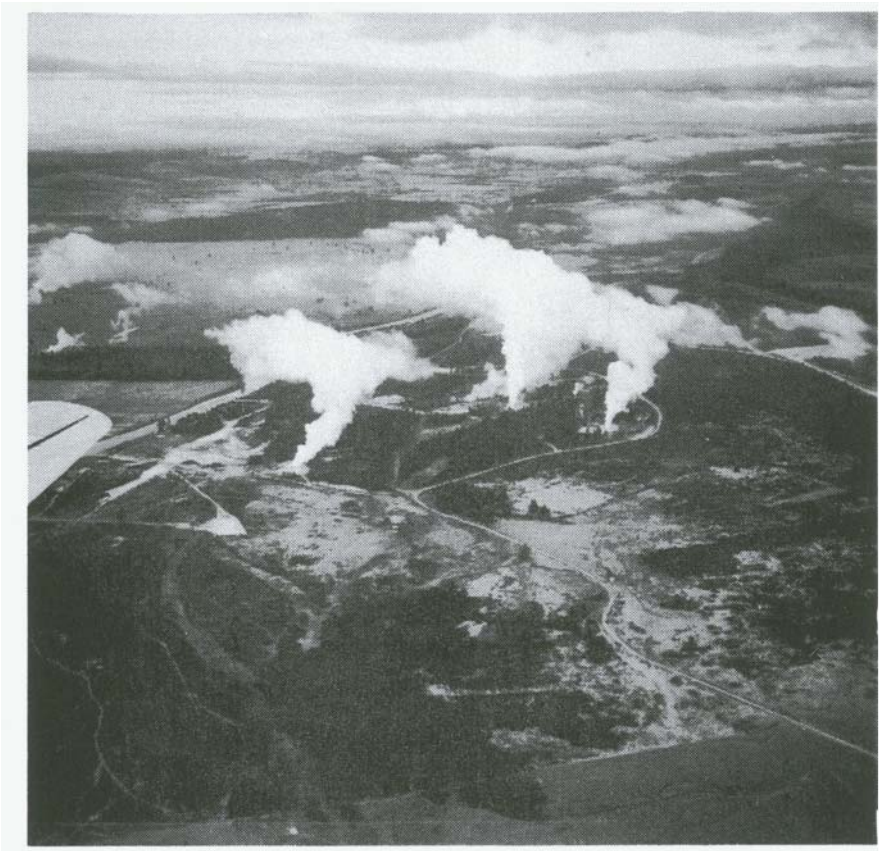
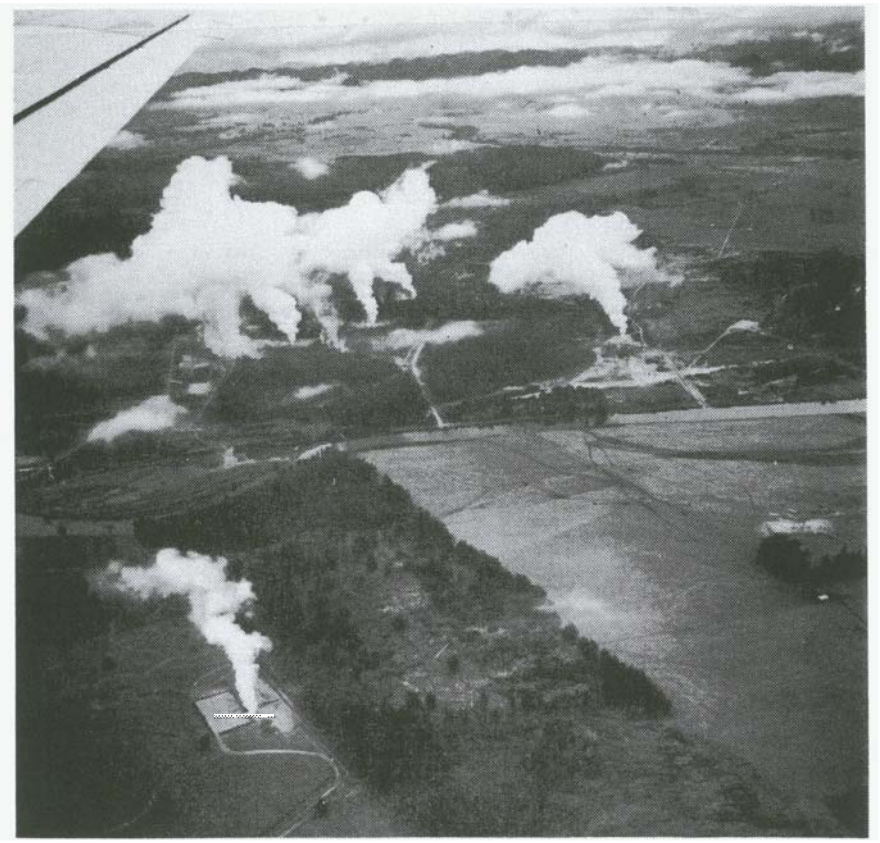


Figure 5
Steam pressure control in Wellhead Units.



SOUTHEAST VIEW OF OHAAKI. SITE OF Br12 CLOSEST TO AIRCRAFT Br 3 DISCHARGING NEARBY; 1972. Photo: D. L. Homer, NZ Geological Survey.



VIEW WEST OVER OHAAKI; Br14 IN LOWER LEFT; 1972. Photo: D. L. Homer, NZ Geological Survey.