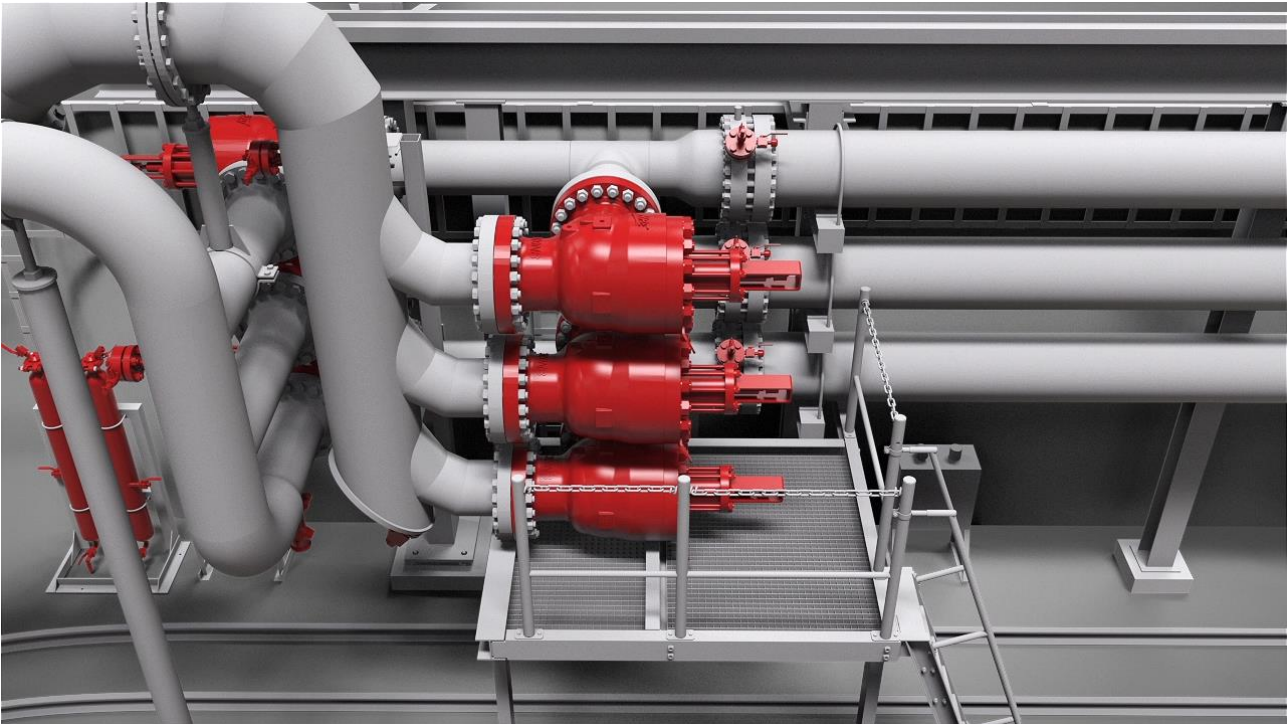


P.I. 001

3 CHAMBER PIPE SYSTEM (3CPS)



PURPOSE

The purpose of a 3 Chamber Pump System, 3CPS, (also known as the 3 Chamber Pipe Feeder System) is to recover the gravitational potential or pressure energy of the water entering a mine and use it to pump water out of the mine. Unlike a Pelton wheel turbine energy recovery device, the 3CPS also pumps the water out of the mine allowing the conventional de-watering pumps to be switched off for prolonged periods of time. This translates into significant energy and maintenance cost savings.

DESCRIPTION

The 3 Chamber Pump System consists of three chambers, valves, a PLC and typically, two low-pressure pumps. The system connects to the supply and dewatering high-pressure pipe columns of a mine. The is also connected to the low-pressure piping to and from the level dams.

Examples of installed 3CPS Systems:

- Masakhane shaft (Driefontein 1#) 3CPS (1917 at 240l/s) on 24 level
- Hlanganani shaft (Driefontein 5#) 3CPS (988m at 380l/s) on 42 level
- Ikamva shaft (Kloof 4 shaft) 3CPS (985m at 385l/s) on main shaft IPC

FEATURES

3CPS control valves.

A typical 3CPS comprises of three chambers each of 5-10 cubic meters and completes a full cycle in about 60 seconds which means that each valve opens and close approximately 40 000 times per month.

3CPS Control system.

The control program consists of real time calculations to determine the scheduling and timing of the high pressure and low-pressure valves. This program enables the 3CPS to pump out the hot water with the pressure of the chilled water by minimizing the mixing ratio.

ECONOMIC PERFORMANCE

The efficiency of the overall system depends on the pressure drop in the system, which is dependent on the flow rate and the diameter and length of the pipe columns feeding to and from the system. The power saved depends on the flow rate, pressure and efficiency.

The energy saved per year depends on the total volume pumped, pressure and efficiency. The volume pumped depends on the water used by the mine and the operational availability of the unit.

The capital cost of the system is dependent on the pressure rating and flow rate capacity of the system.

The operating costs are made up of the booster and filling pump electricity costs and the pump and valve maintenance costs.

The 3CPS uses very little electrical power compared to conventional de-watering pumps. Furthermore, because the valves are only cycled at intervals, there is significantly less wear and maintenance costs are low compared to conventional de-watering pumps. This is how the 3CPS achieves significant savings in electricity and maintenance.

Additional savings or cooling benefits are incurred by the fact that energy recovered (from the hydrostatic pressure in the incoming water to pump water out of the system) means that energy is not dissipated resulting in minimal Joule-Thompson heating. Normally dissipation of the pressure energy results in the water temperature rising 2.3 deg C per 1000m depth. Avoiding this temperature rise by recovering the energy, translates into a saving on the refrigeration load for a given cooling effect in the mine and better temperatures in the mine for a given refrigeration input on surface.

Further capital cost savings can be made by reducing the standby pump capacity for the conventional de-watering pumps as these pumps are now not required to operate as many hours per year if there was no 3CPS.

The pay-back period is equal to the capital cost divided by the net savings generated by not having to operate conventional de-watering pumps.

The pay-back period is reduced if the real cost of electricity increases and the volume of water that would otherwise have to be pumped by conventional de-watering pumps is increased.

A 3CPS does not replace conventional de-watering pumps as these have to be available in the event of the following:

- 3CPS not operational
- Not able to bring water into system when it is necessary to pump water out
- Not able to pump water out of system when it is necessary to bring water in

Fissure water or water that does not enter the mine via the 3CPS cannot be pumped from the mine by the 3CPS. This will have to be pumped conventionally.

The savings are generated by not having to operate the conventional de-watering pumps for prolonged periods of time.

TECHNICAL SPECIFICATIONS

Mine	Masakhane (Driefontein 1#)	Hlanganani (Driefontein 5#)	Ikamva (Kloof 4#)
Level installed	24 level	42 level	Main IPC level
Part Number	ED1 1000	ED5 1000	EK4 1000
Max design flow rate (l/s)	240	380	380
Operating pressure (MPa)	22	10	10
Depth below supply dam (m)	1917	985	988
Top booster pump fitted	Yes	Yes	Yes
Chamber pipes	400NB Sched 160	450NB Sched 120	450NB Sched 120
Supply columns	1 x 300NB	1 x 300NB	2 x 300NB
Delivery column	1 x 300NB	2 x 400NB	2 x 400NB
Flange Type	Client Specific	Client Specific	Client Specific
Pre-opening	Client Specific	Client Specific	Client Specific
Solenoid Voltage	24v	24v	24v