kishor pumps

Designed for processes, Made for people.

Welcome

Operation of pumps in parallel & benefits of using Variable Frequency Drives (VFD)

Webinar Series 2020

9 May 2020

Agenda

- What is parallel pumping & what are its benefits
- Working Philosophy of pumps in parallel running at constant speed
- Use of VFD in parallel pumping systems
- Case Studies
- Summary

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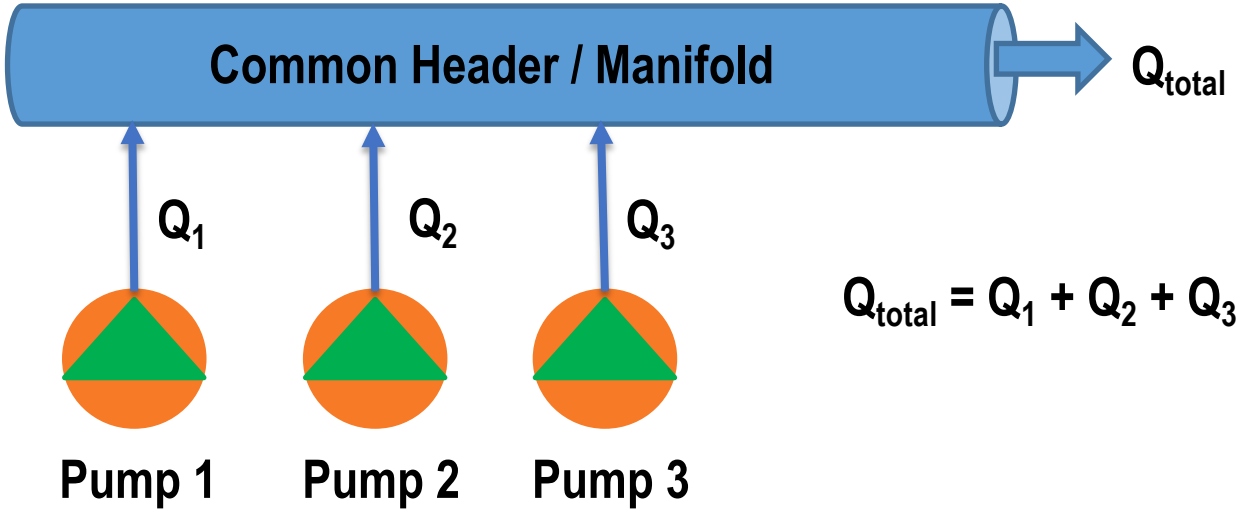
Operation of pumps in parallel & benefits of using Variable Frequency Drives (VFD)

What is parallel pumping & what are its benefits?

- A system wherein two or more pumps discharging the liquid into a common header / manifold
- Each pump adds to the total flow in the manifold which allows operators to achieve variable capacity requirements
- Parallel pumping system allows for incremental flow augmentation over time in industrial and municipal projects as the project capacity is increased
- It allows for redundancy in system and ensures flow continuity as and when pumps are needed to be taken out for repairs & maintenance



$$Q_{total} = Q_1 + Q_2 + Q_3$$

- Ideally, for stable operation all pumps should be identical; however, there have been instances where non-identical pumps are operated in parallel
- For stable operation, the pressure of all pumps operating in parallel should be same, even if pumps are not identical

What is parallel pumping & what are its benefits?

KISHOR make Horizontal end suction pumps
in parallel at a desalination plant near Chennai

What is parallel pumping & what are its benefits?

KISHOR make Horizontal end suction pumps
in parallel at a soda ash plant in Gujarat

What is parallel pumping & what are its benefits?

KISHOR make Vertical (VS4) pumps in parallel at a fertilizer plant in Goa

What is parallel pumping & what are its benefits?

KISHOR make Vertical Dry Pit Non-Clog pumps in parallel at a sewage pumping station in Vijayawada

What is parallel pumping & what are its benefits?

KISHOR make submersible non-clog wet pumps in parallel at
a sewage treatment plant in Aurangabad, Maharashtra

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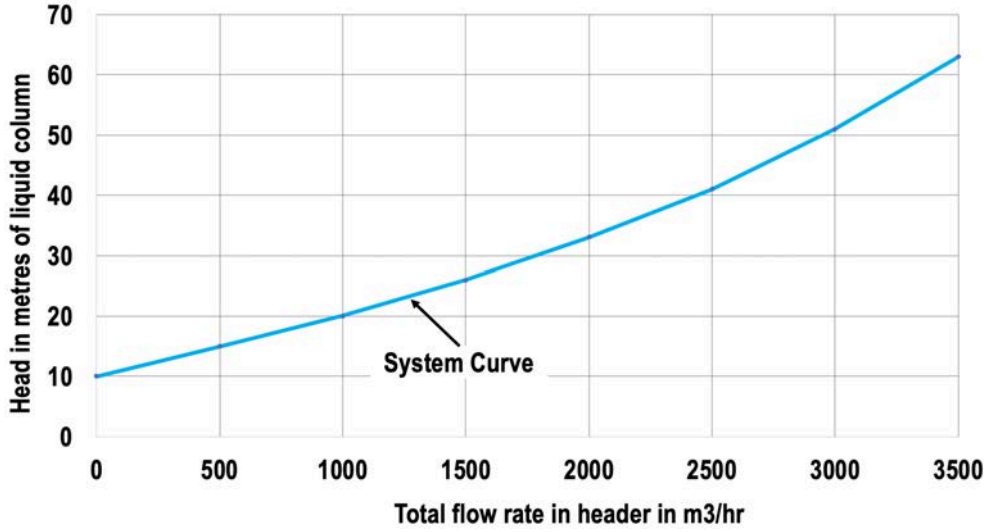
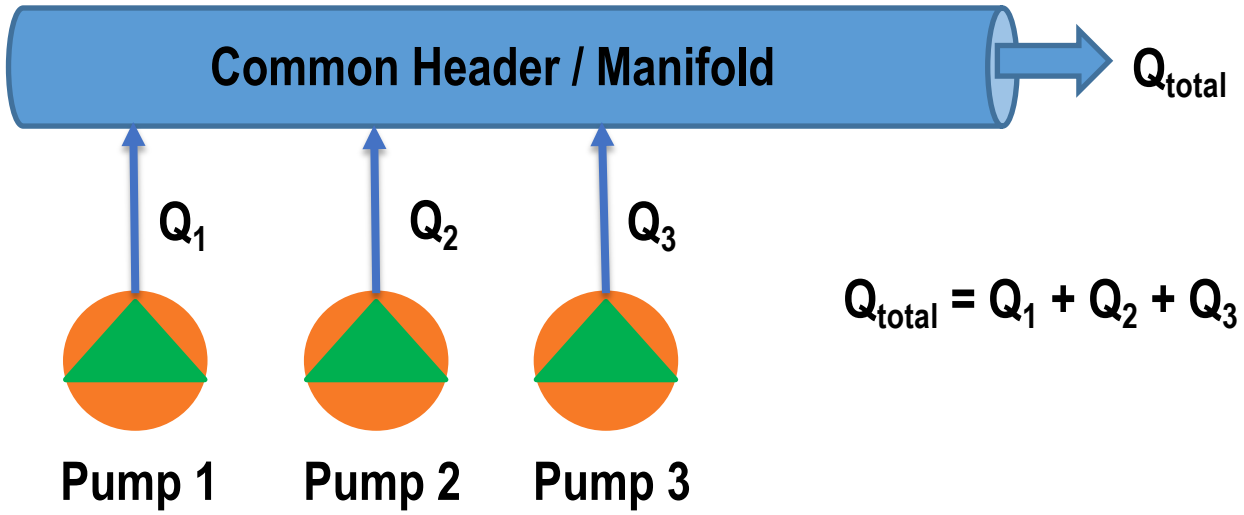
Working Philosophy of pumps in parallel running at constant speed





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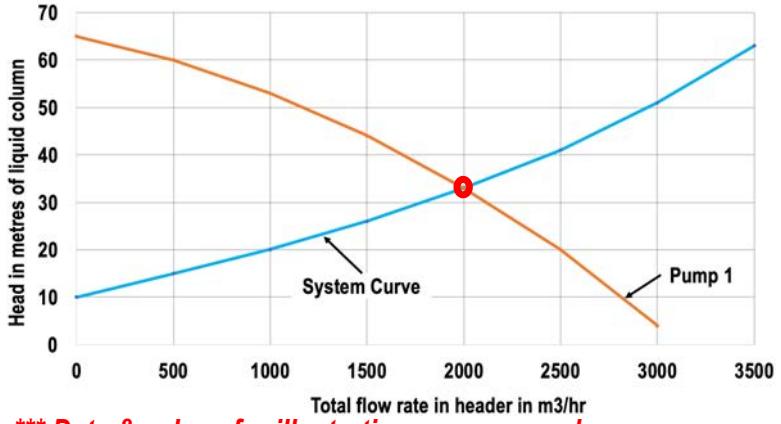
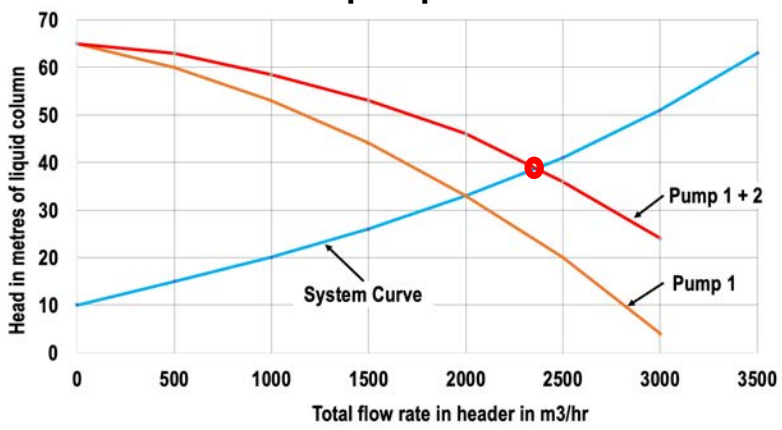
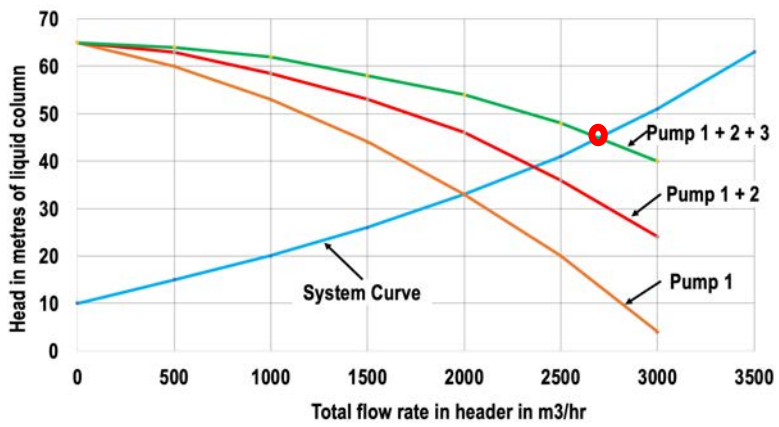
When 1st pump starts



When 2 pumps start



When all 3 pumps start



*** *Data & values for illustration purposes only*

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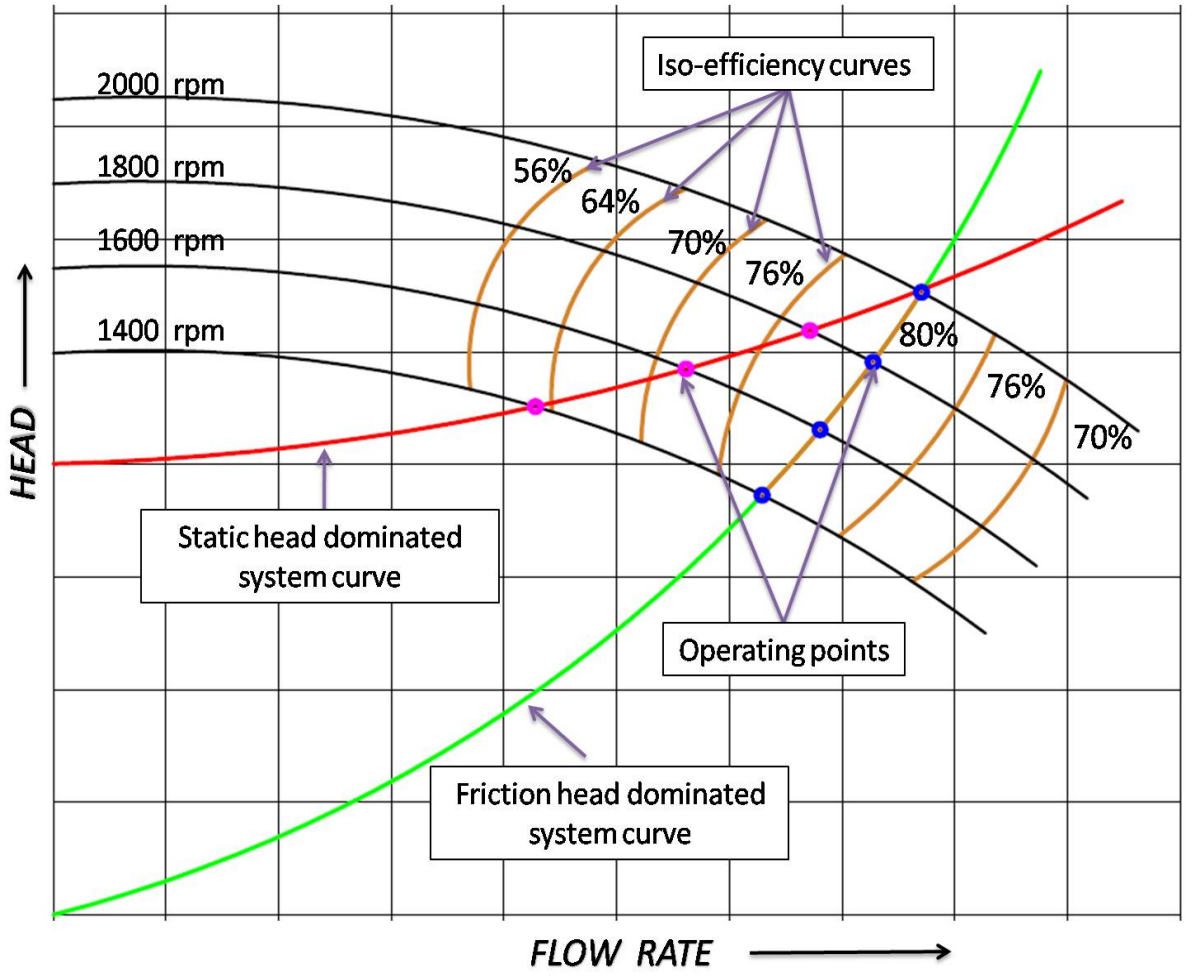
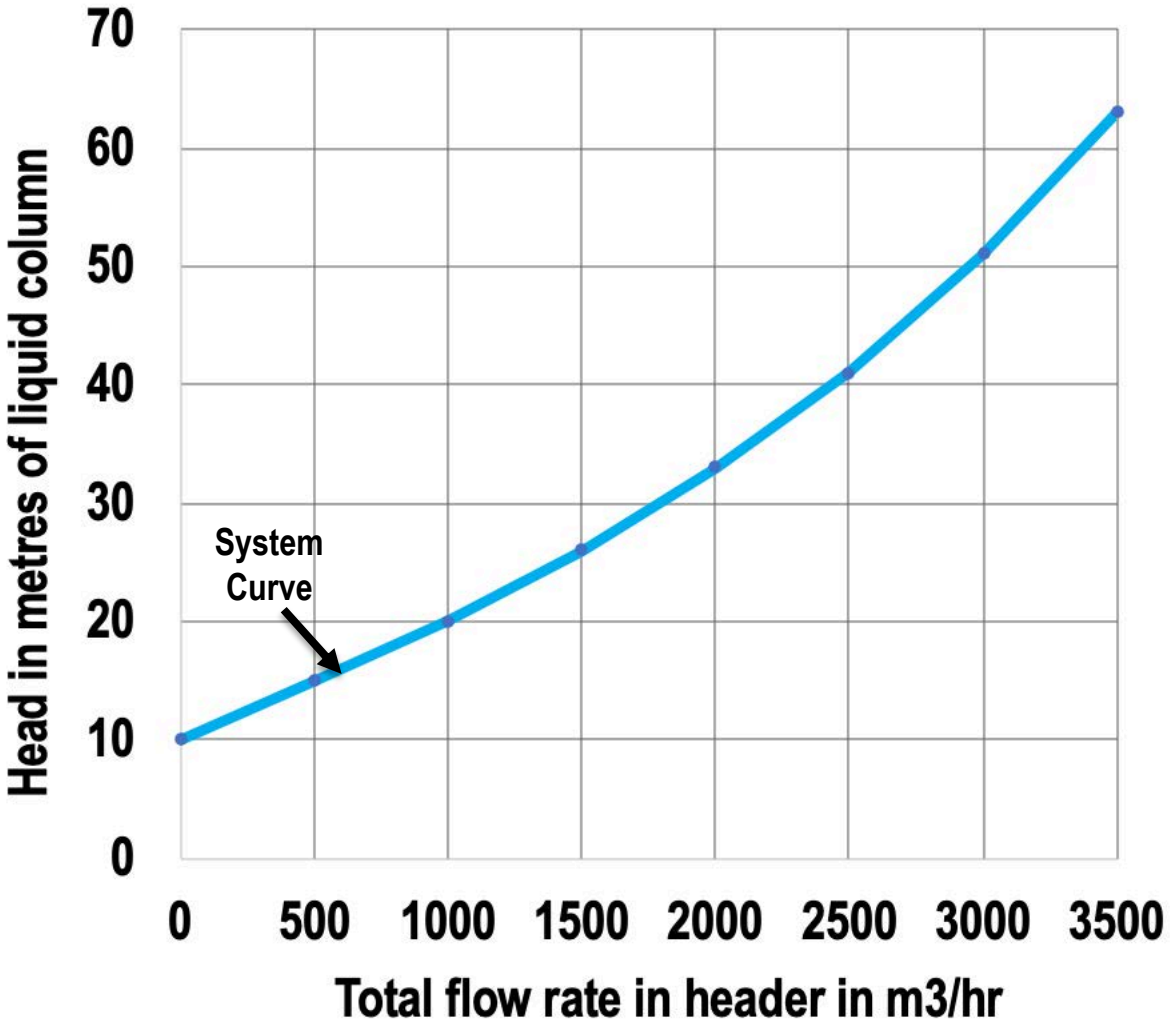
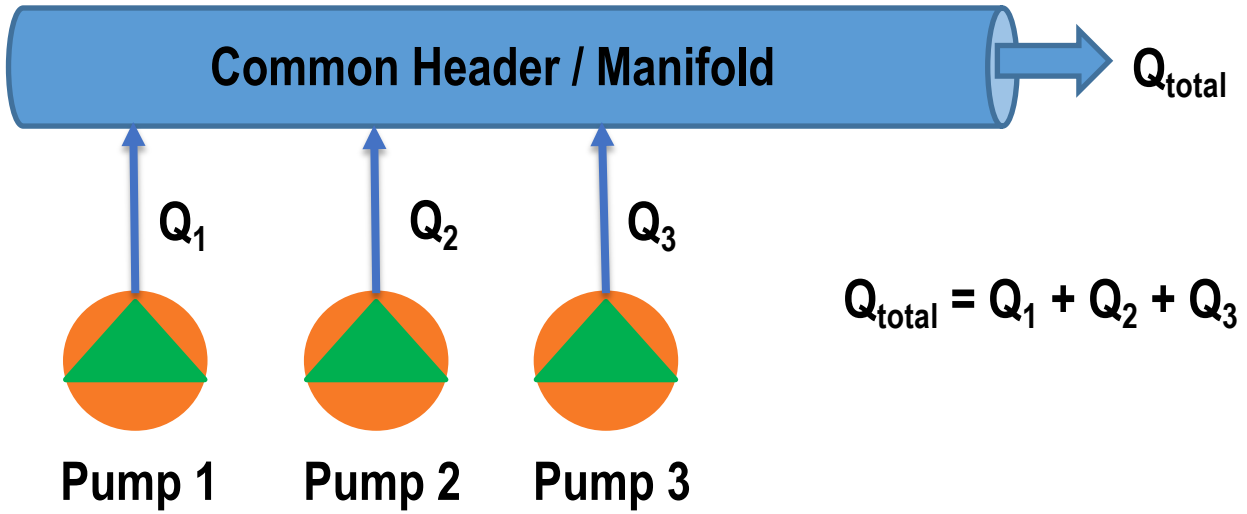
Use of VFD in parallel pumping systems

- VFDs widen the operating range of each pump, enhancing the overall flexibility of the parallel system
- Flexibility of flow and head from each pump over a wide range, instead of changing the impeller
- Ideal for trial & error, when user is not sure of the exact duty points.
- Number of spare pumps can be reduced (cost savings!) by using VFD for meeting lean, average or peak flow.
- If identical pumps are used with VFD, additional saving on spare parts is achieved.
- Power saving for less flow requirement using VFD, compared with throttle valve regulation.
- Variable Speed Pumps remains efficient even at low flow rates



Use of VFD in parallel pumping systems





$$Q_{total} = Q_1 + Q_2 + Q_3$$

Affinity laws for centrifugally operated pumps:

Provided impeller diameter is constant, as speed changes:

1. Flow rate $\propto$ rpm
2. Head $\propto (rpm)^2$
3. Power $\propto (rpm)^3$

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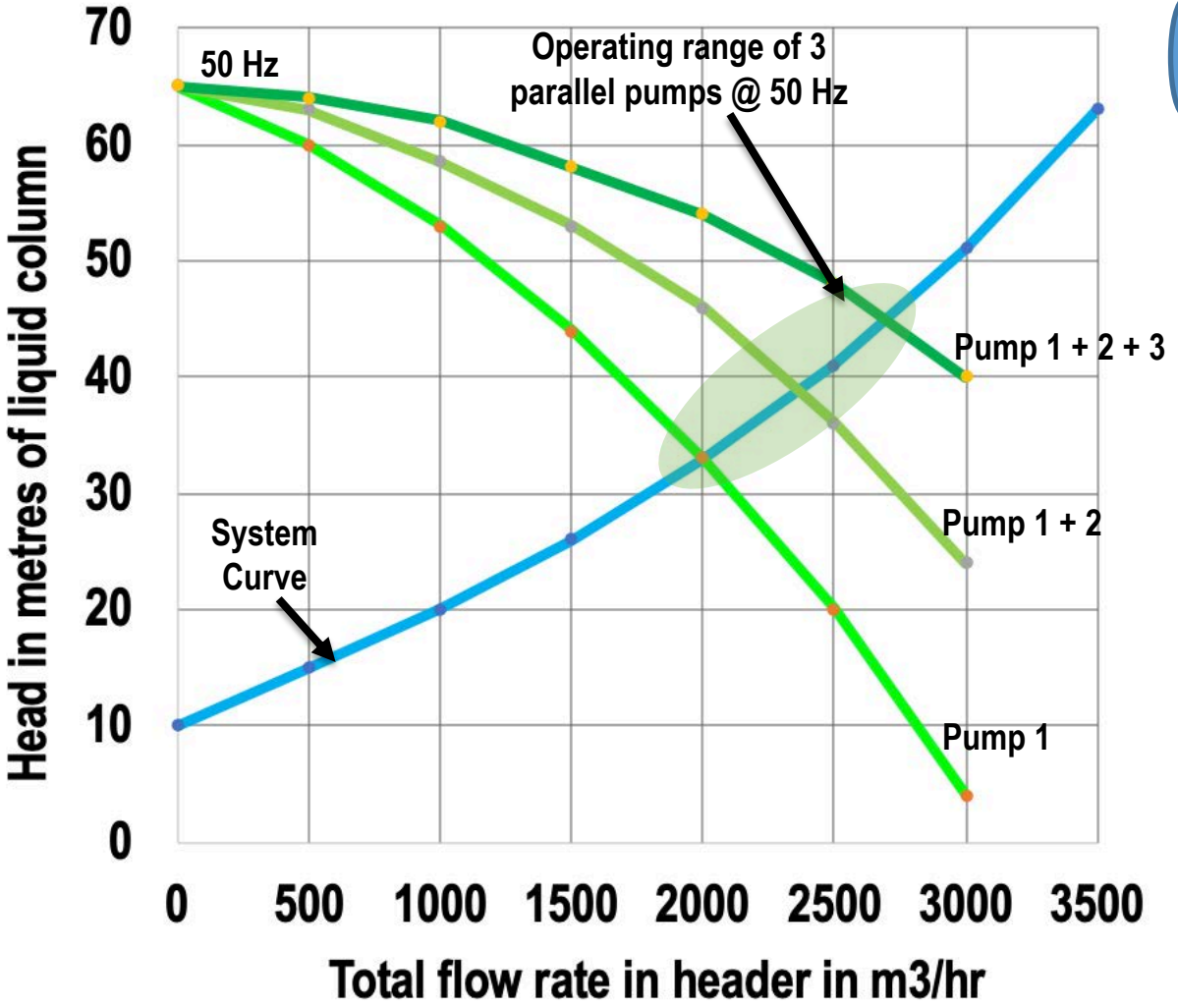
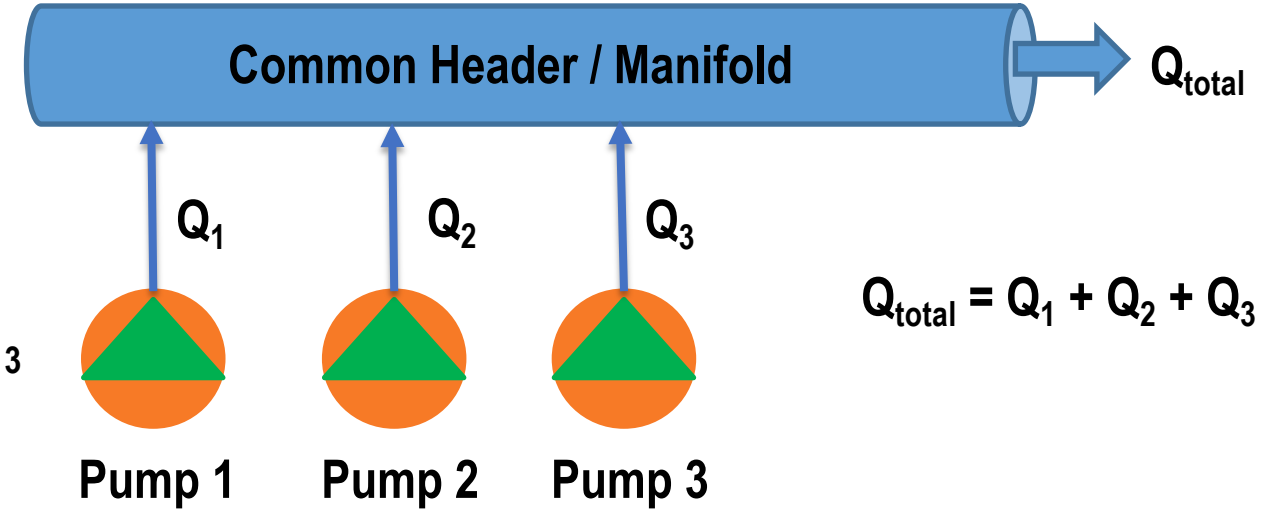
Use of VFD in parallel pumping systems





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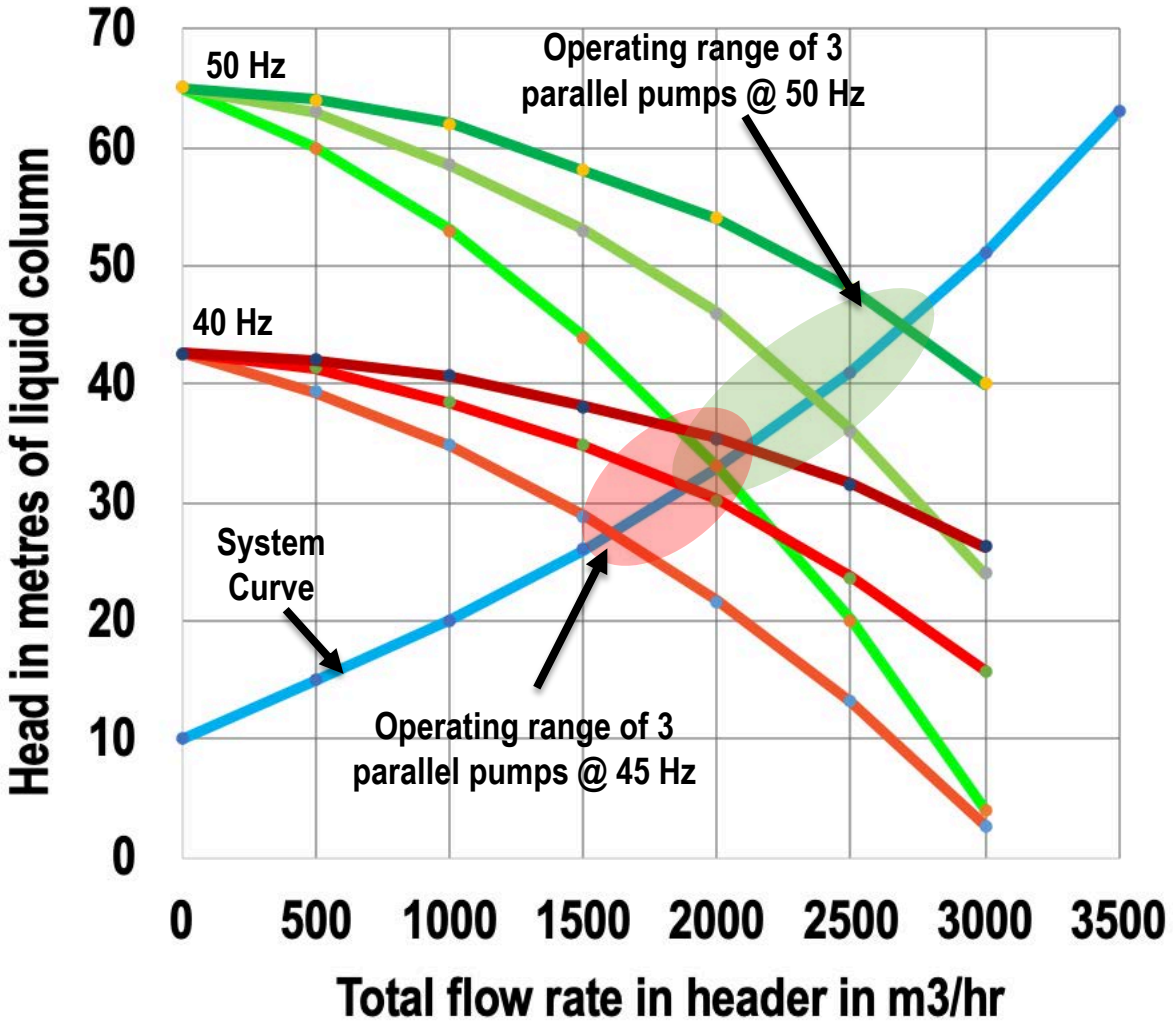

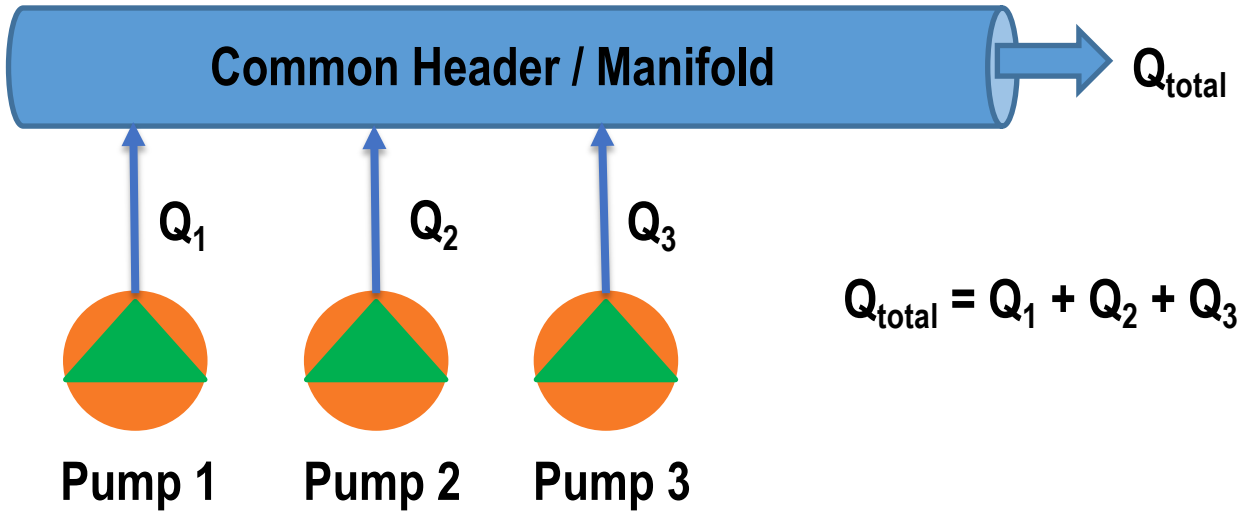

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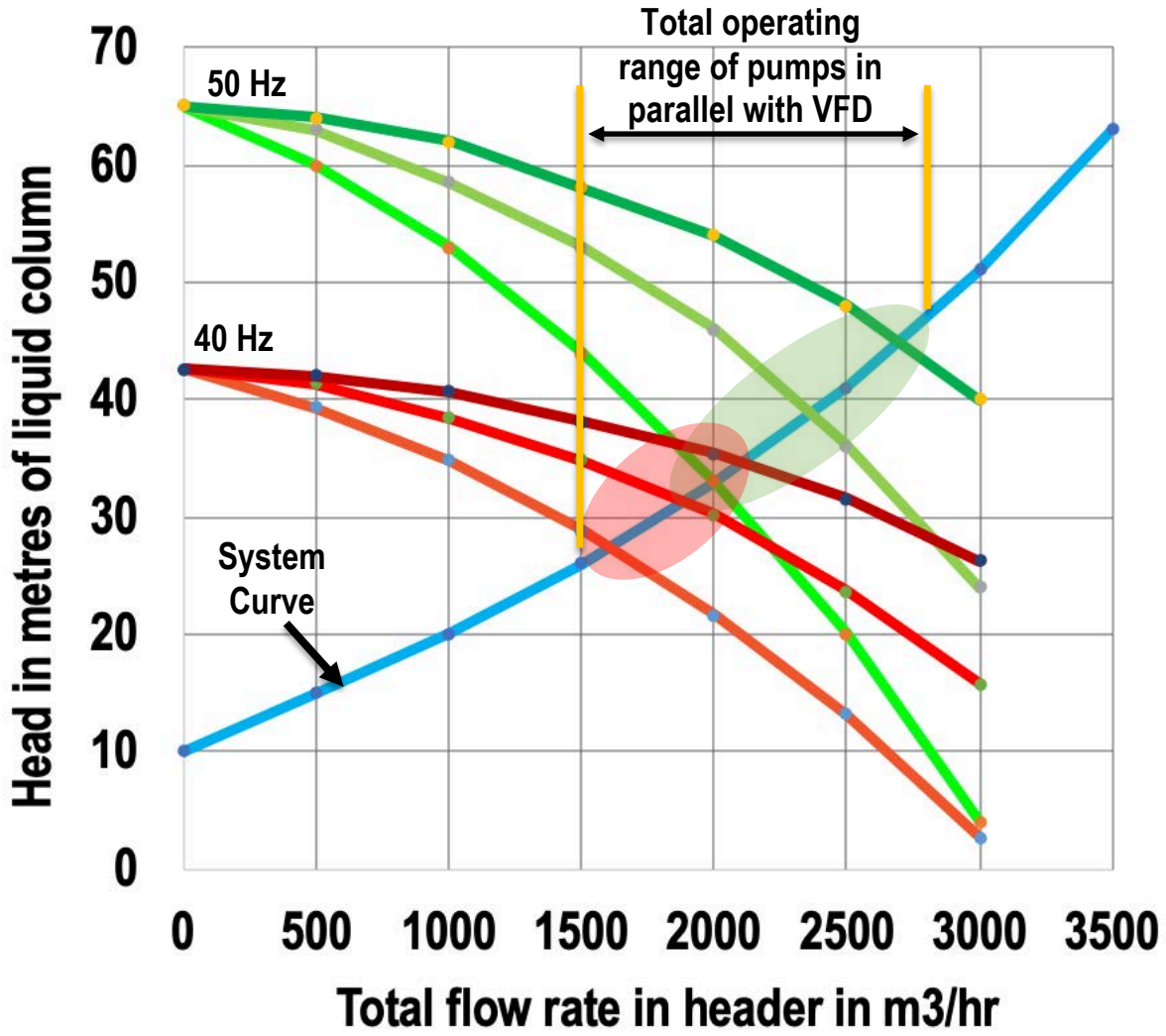

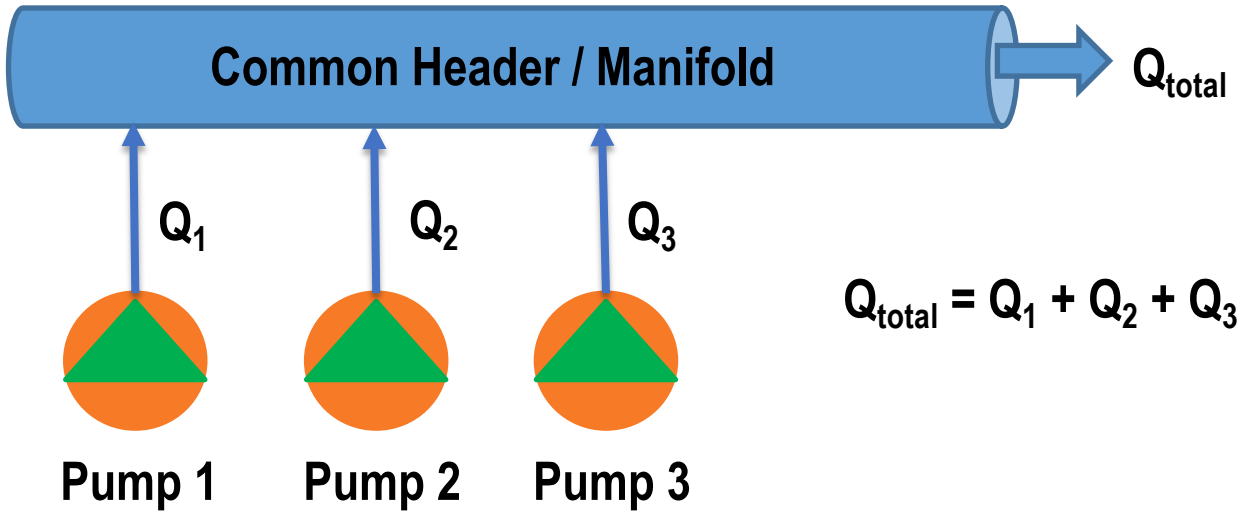

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Case Study 1: Pune Cantonment Board (PCB) 20 MLD Sewage Treatment Plant

- The site is situated in densely populated area with limited space
- SBR basins were planned one above the other in a two storeyed structure, the first of its kind in India
- Raw sewage pumps were expected to operate at two different heads for two basins (peak flow 1875 m^3/hr @ 28 m head for upper basin & 1875 m^3/hr @ 17.1 m head for lower basin)
- The same pumps were to handle lean & avg flow of both basins
- We selected a single pump model rated at 625 m^3/hr @ 28 m head
- For lower basin, pumps were operated at much reduced frequency to develop 17.1 m. head, & for upper basin, pumps were operated at near to rated frequency to develop 28 m head.
- This plant operation is controlled through PLC panels.
- This scheme is operating satisfactorily for 24 months.

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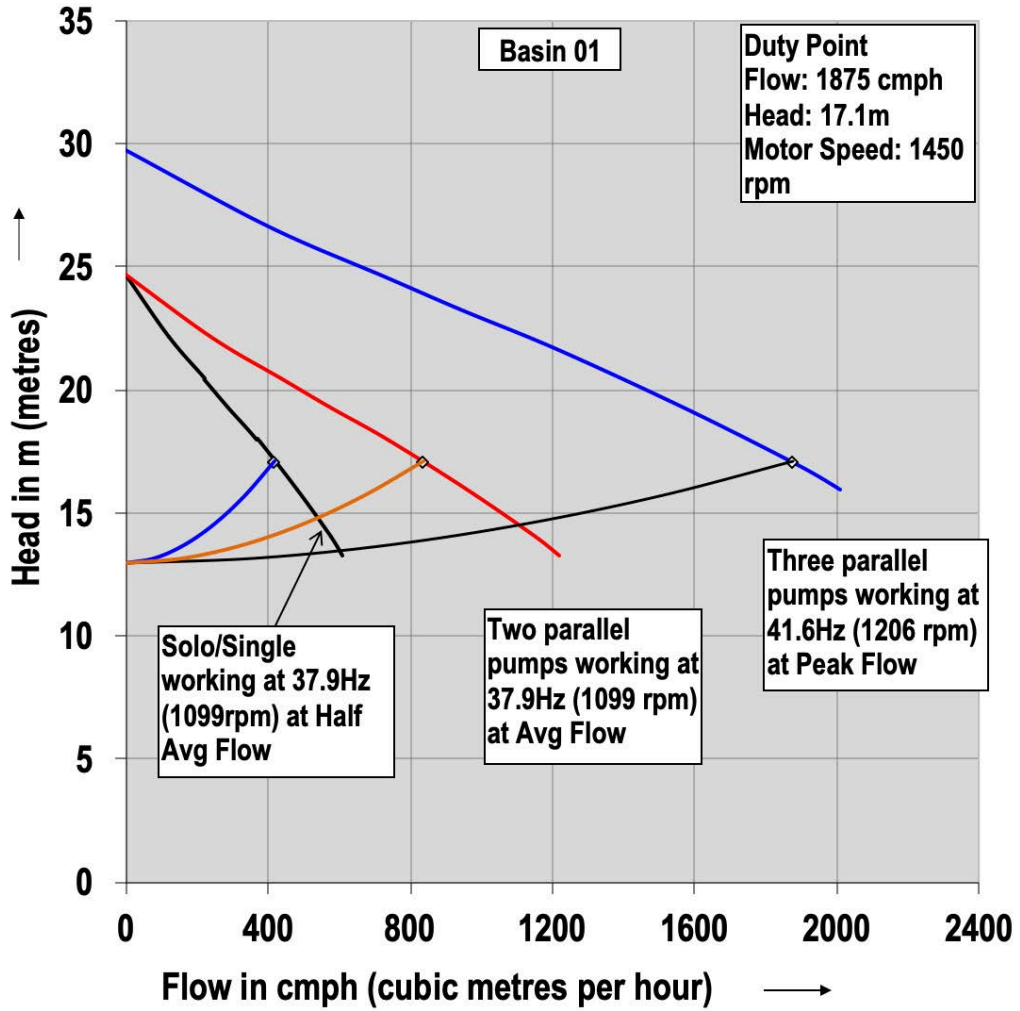

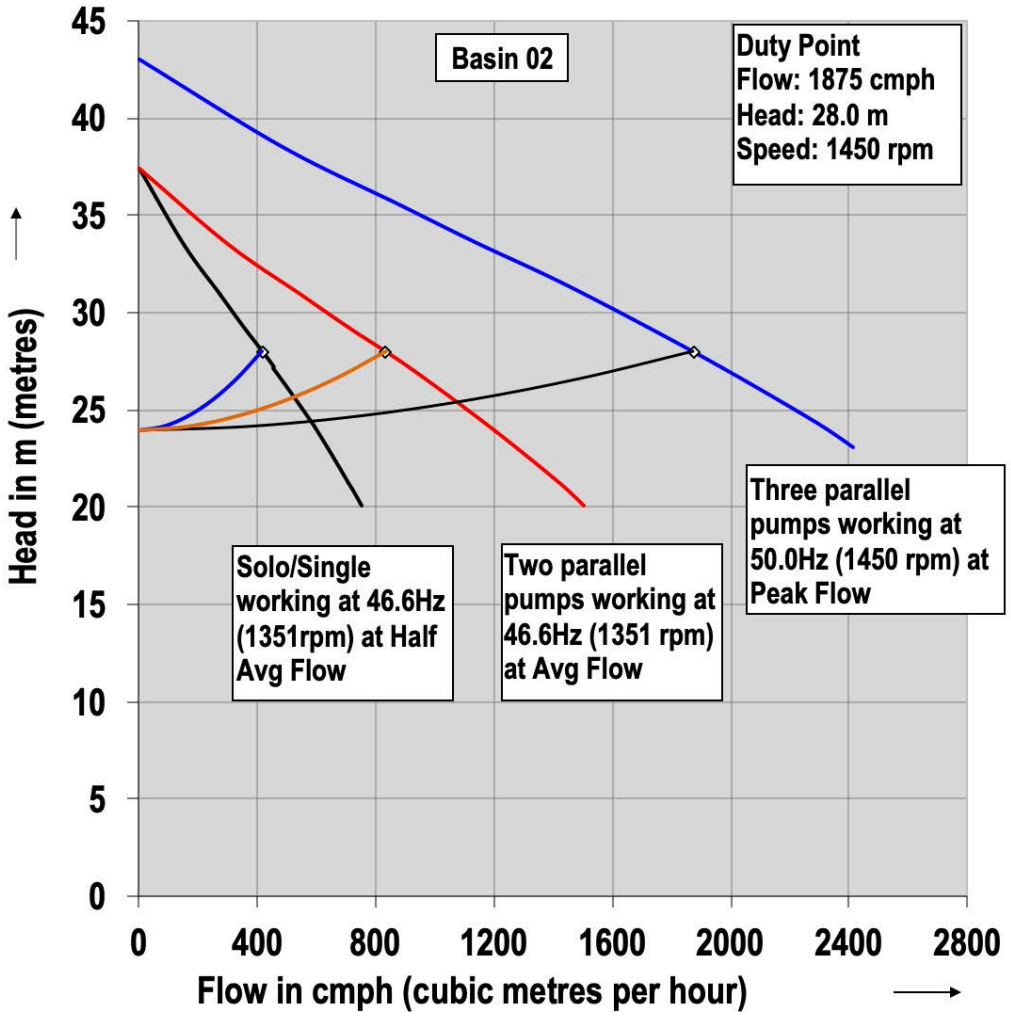

Case Study 2: Intermediate Sewage Pumping station with high friction head

- The system called for 4 pumps running in parallel at peak flow of 5,500 m^3/hr @ 57 m head, whereas for lean flow, the duty condition was 1230 m^3/hr @ just 39 m head. This clearly indicated that there was a large component of frictional head in the total dynamic head.
- Using VFDs it was possible to select 4 pumps of same duty condition i.e. 1385 m^3/hr @ 57 m head.
- A detailed operational philosophy was developed to operate 1 pump at lean load, 2 pumps average load (both at reduced frequencies) and 4 pumps at peak load (at full frequency of 50 Hz)
- With VFD operated system, it is always possible to take care of any fluctuating load. This is all controlled through PLC panels

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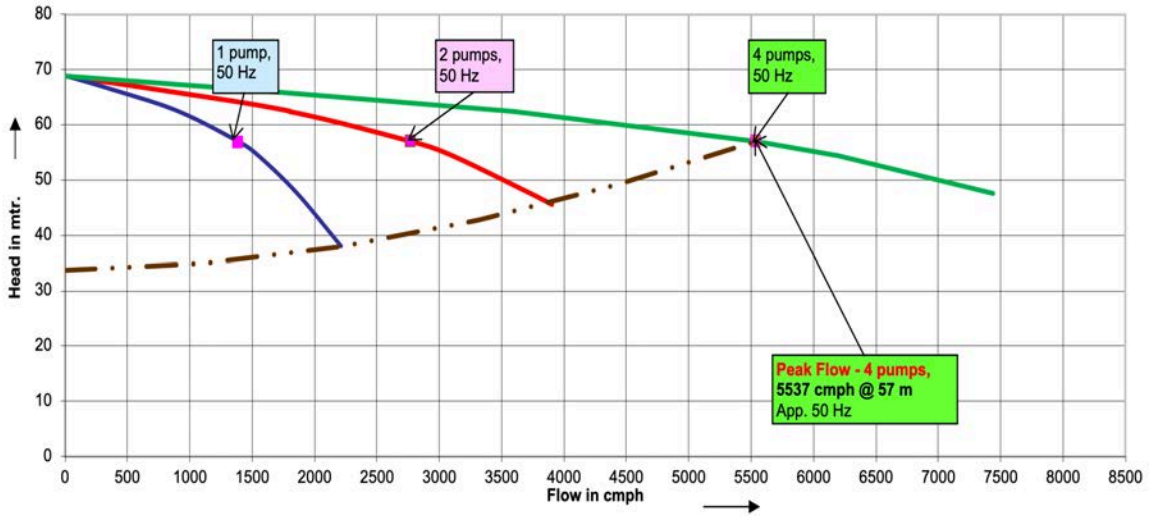
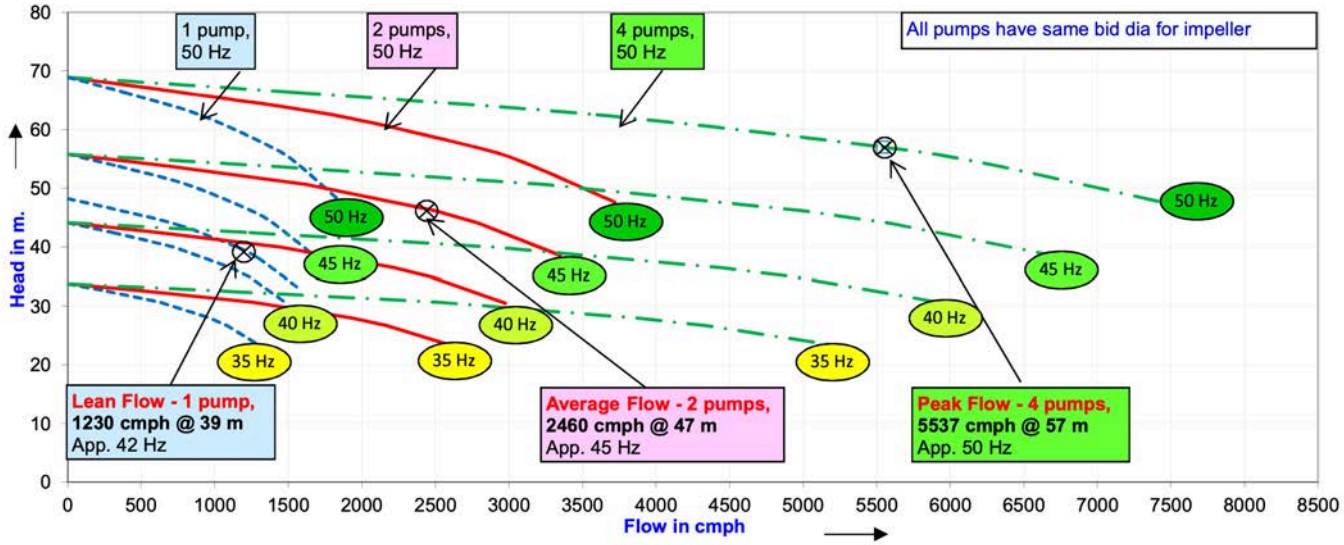
Parallel pump operation at constant speed



Parallel pump operation with variable speed (VFD)



Case Study 3: Limitations of not considering VFD for varying loads

- In one prestigious plant in south India, the tender specification called for 4 pumps running in parallel rated at 46 m head. The tender did not ask for VFD compatibility and were designed to run on ATS starter.
- When the plant was put in operation, based on the load conditions, only two pumps were expected to operate since the max flow rates were designed considering 10-15 years in the future.
- After starting, both the pumps were giving troubles. The electric current drawn by the pumps were substantially more than the rated current at the duty point.
- After thorough study at the site conditions, it was observed that the actual head at site was around 37 m only (instead of designed head of 46 m), therefore the pumps were running at near run out condition drawing more electric current.
- Had VFD been considered, it would have been possible to alter the frequency depending upon the load conditions and
- In this case, the user finally had to buy two new impellers to suit actual site head. The impellers were changed and then pumps worked satisfactory. But in future when the head could be more, they will have to once again change the impellers originally supplied.

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- In a parallel pump system two or more pumps discharge the liquid into a common header / manifold, wherein each pump adds to the total flow in the manifold which allows operators to achieve variable capacity requirements
- Parallel pumping system allows for incremental flow augmentation over time in industrial and municipal projects as the project capacity is increased & provides redundancy in system for flow continuity during pump downtime.
- For stable trouble-free operation in a parallel system, identical pumps operating at same head should be installed
- VFDs provide more flexibility for parallel pumps and widen the operating range of each pump, enhancing the overall operating range of the parallel system
- VFDs can provide stable operation when a plant is commissioned since the design flow rates may not be available at the start of the project, and as the flow rate increasing, VFDs allow the same pumps to be scaled up
- With growing space constraints, parallel pumps with VFD can offer opportunities for multi-storey pumping stations with same size of pumps which otherwise was so far not possible.

Thank you for your time & attention