A decision support framework for proactive maintenance of water and wastewater systems: Operational optimisation study

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Overview

- Monitoring of pumps and station performance
- How to tell if a pump is operating at its most efficient?
  - Can modifications be made?
- Optimisation of operational parameters

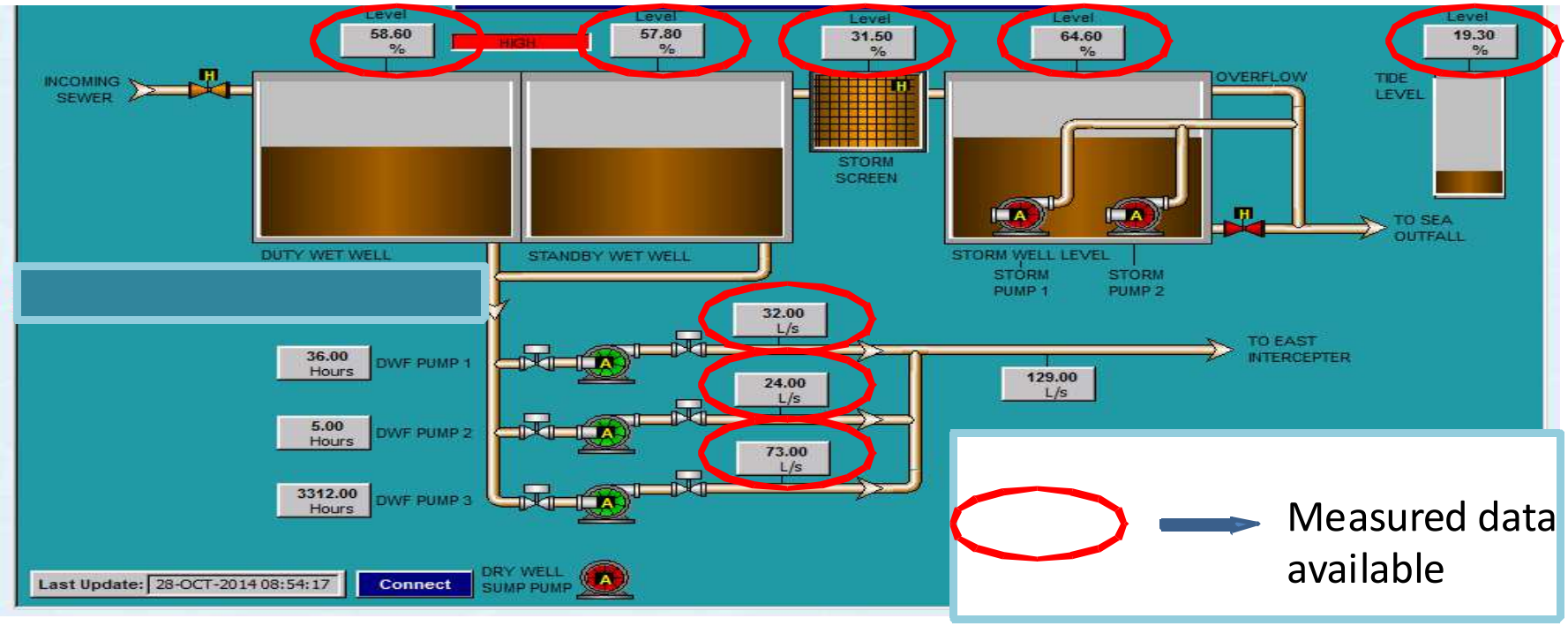
Site under examination

- Large wastewater pump station
- Three pumps
  - Duty, standby and spare
  - Switched on based on well level
- How can we optimise the pump operation regime?
  - Cost saving and load-distribution
  - Balance the risk of overflow with efficient use of pumps

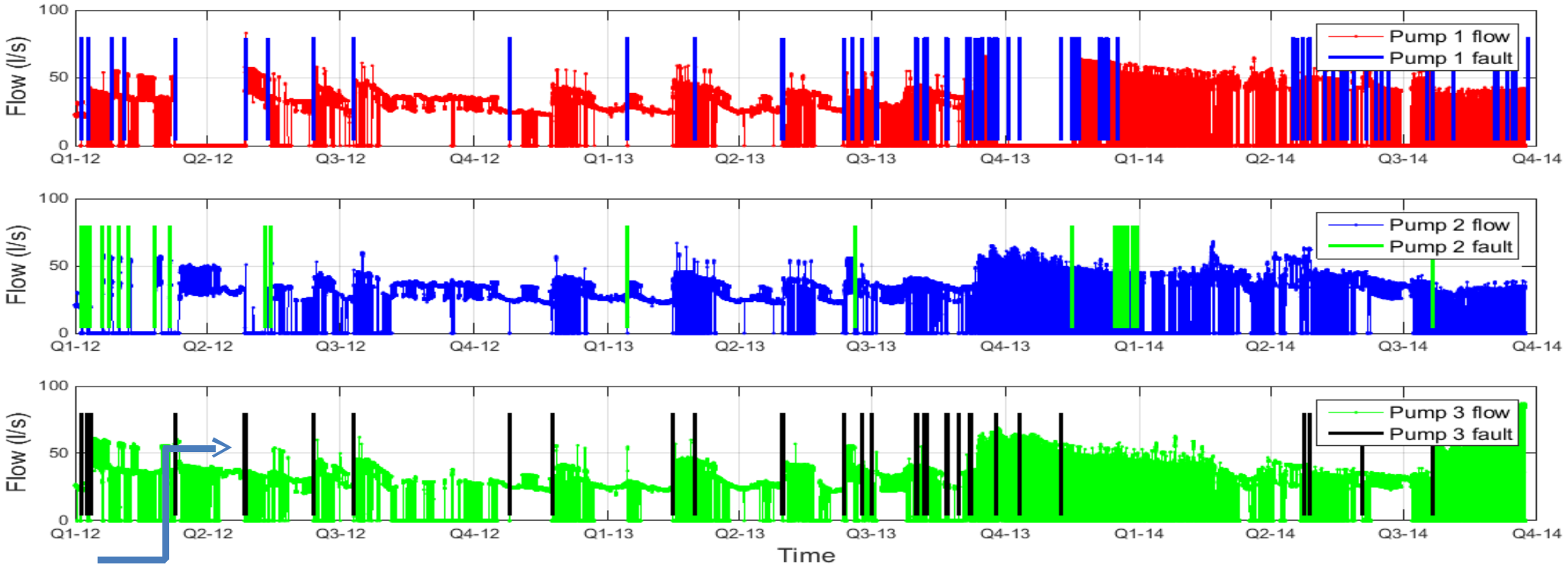
Pumps

- Same make and model, different age
- Fixed speed
- Fixed power
  - Ideally - same flow and power drawn
- But…performance *dependent* on wet well level, and which other pumps are running

Station schematic



Visualising the raw data for each pump



Trips and faults overlaid

Cumulative Distribution Functions for flow rate analysis

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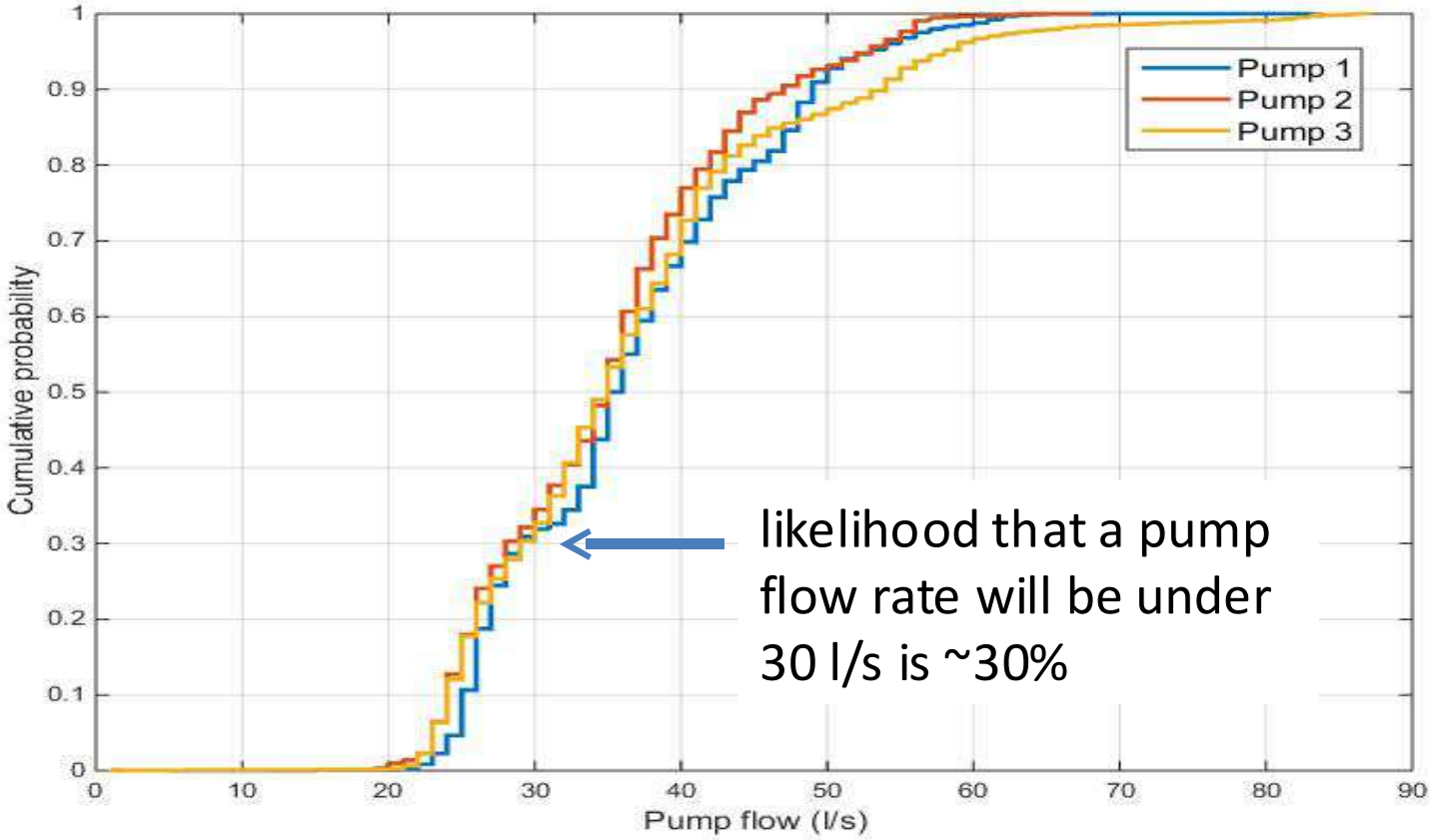
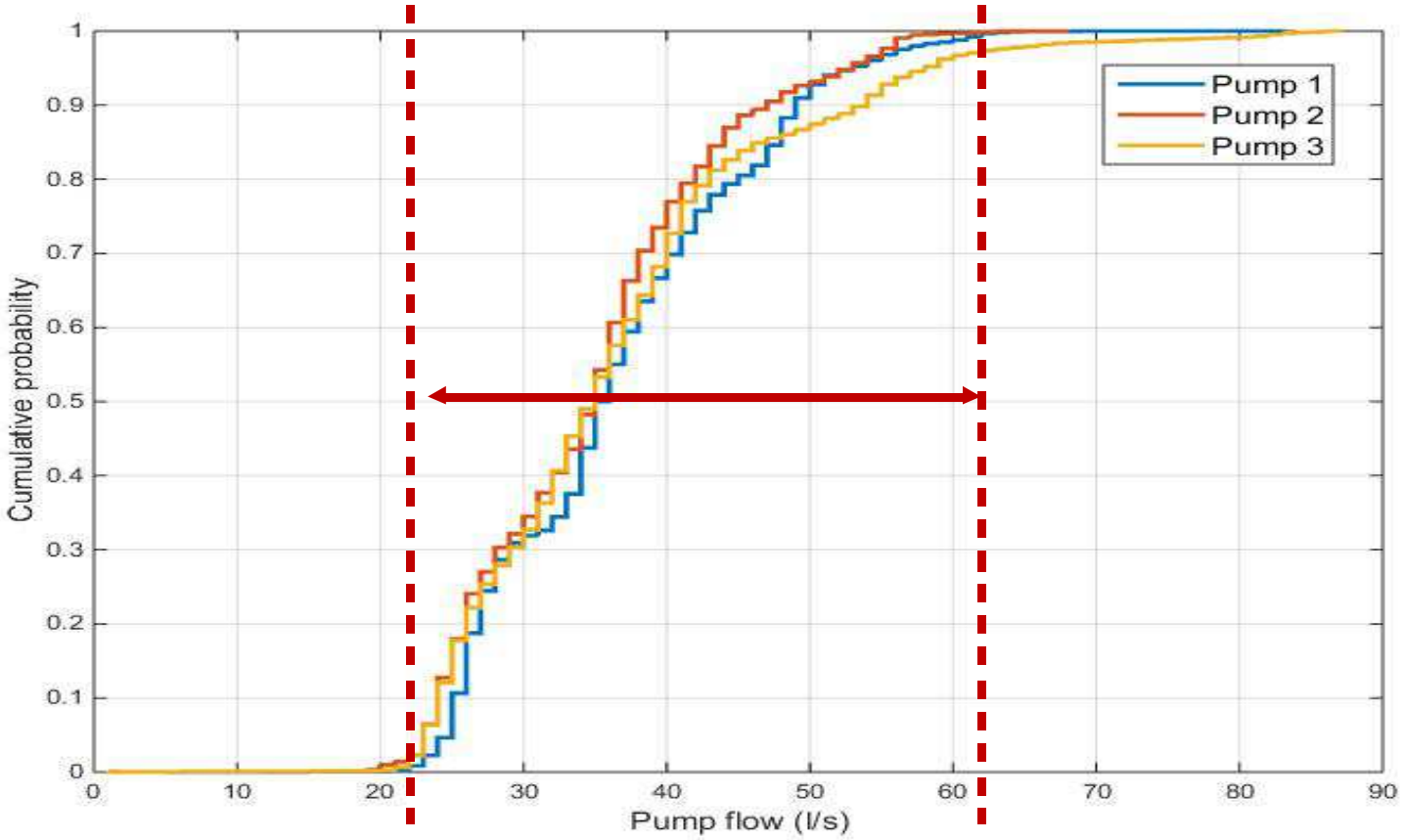
CDF of flow rates for all

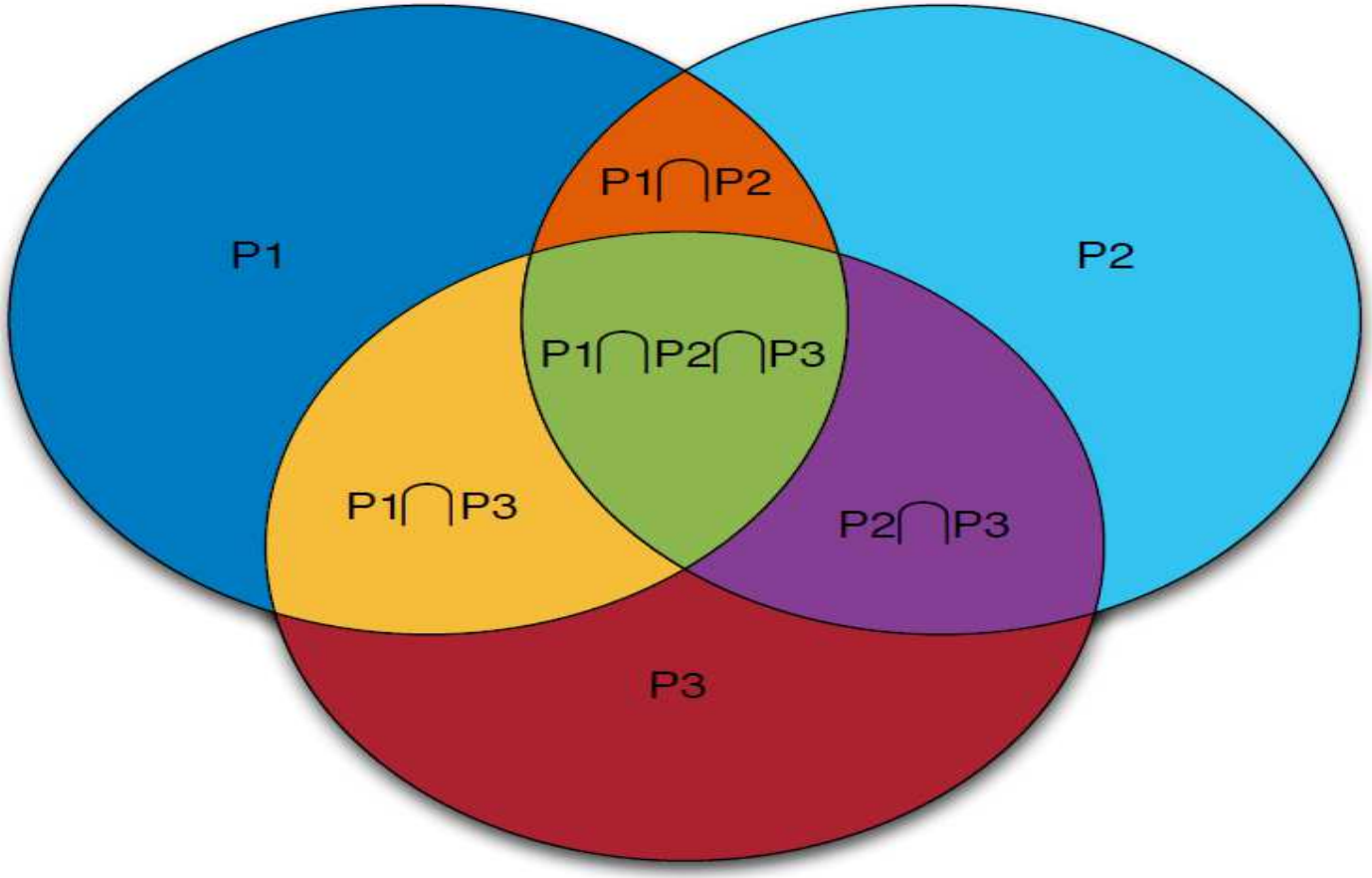


Wide distribution of flow

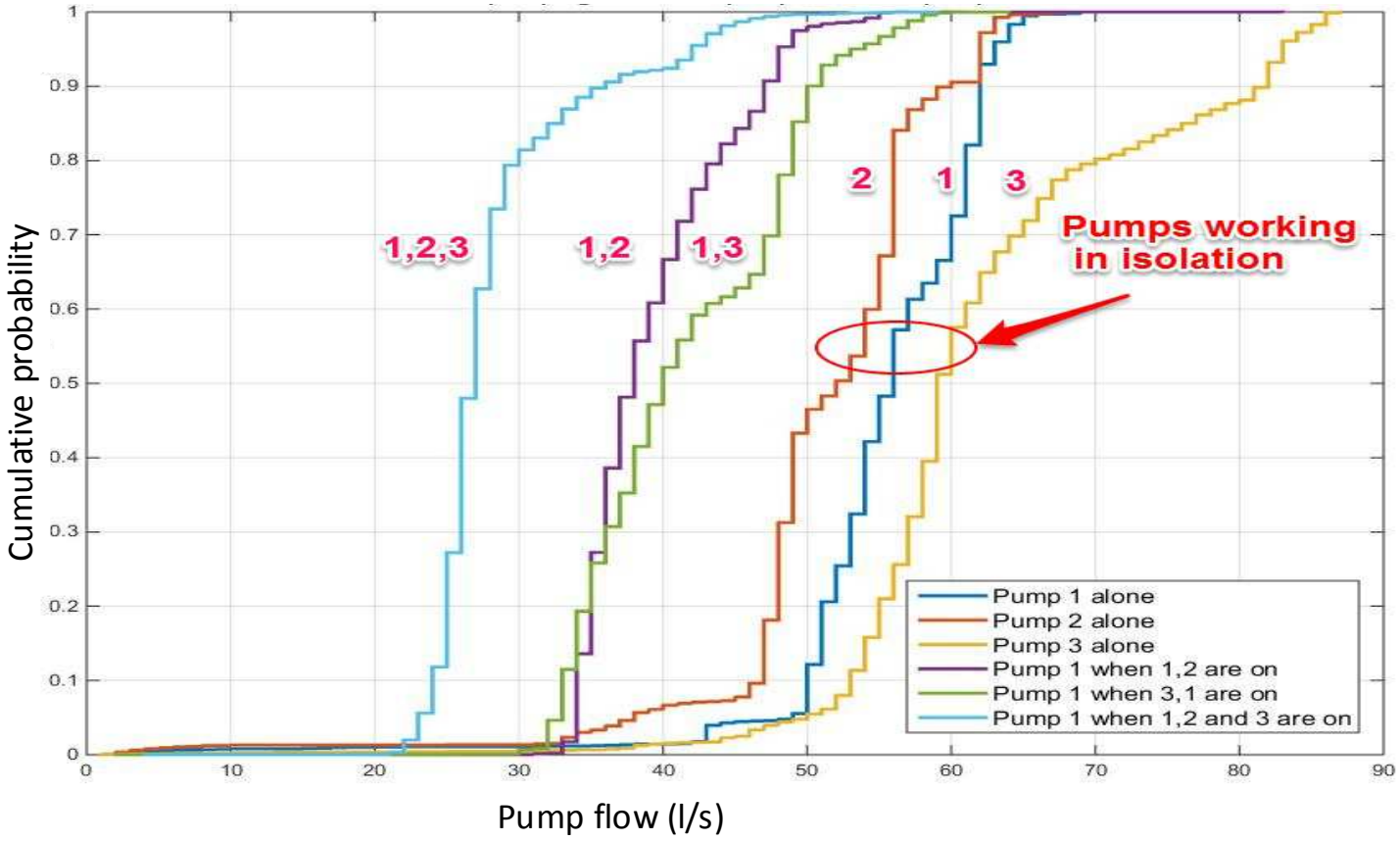
-



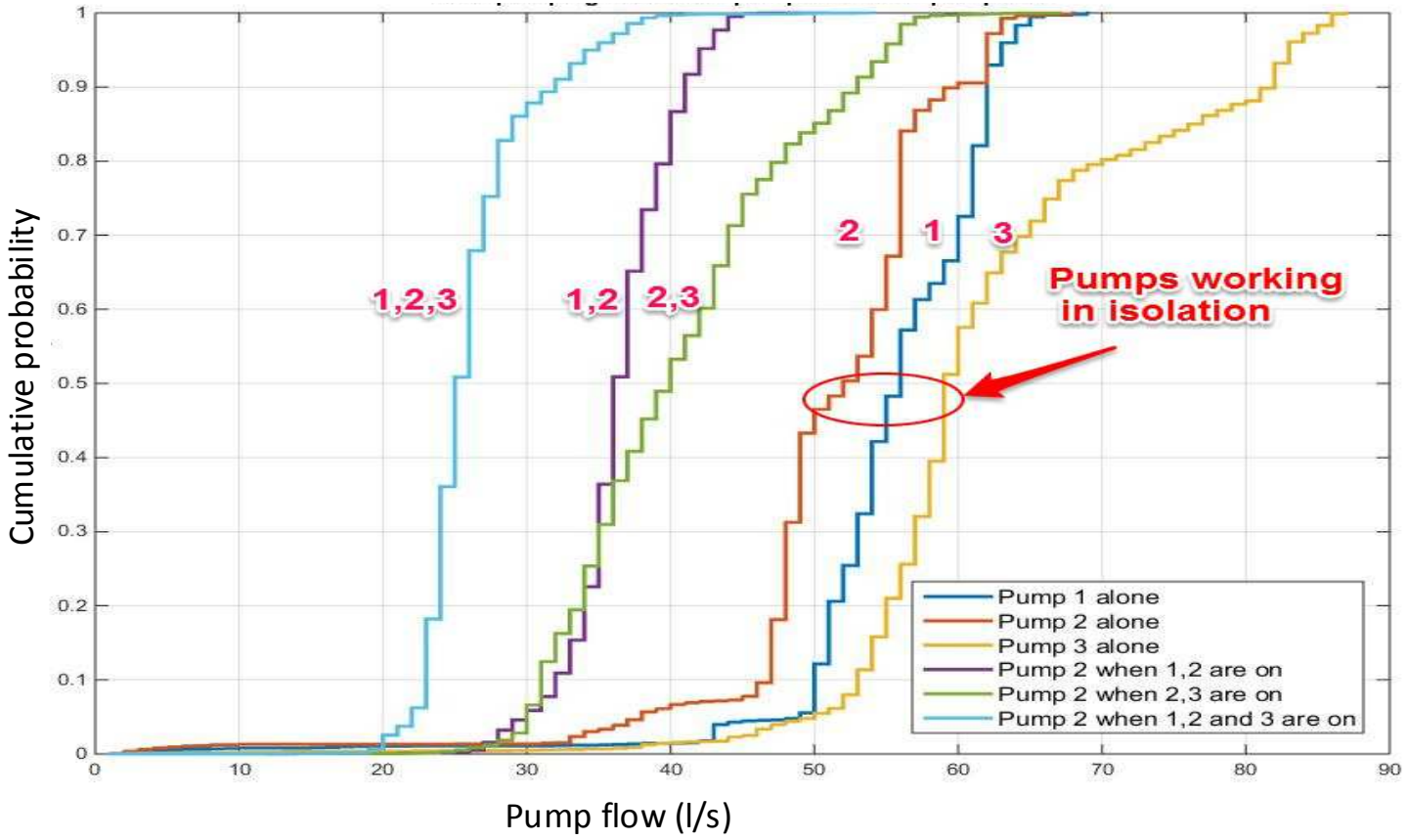
Operating pump combinations



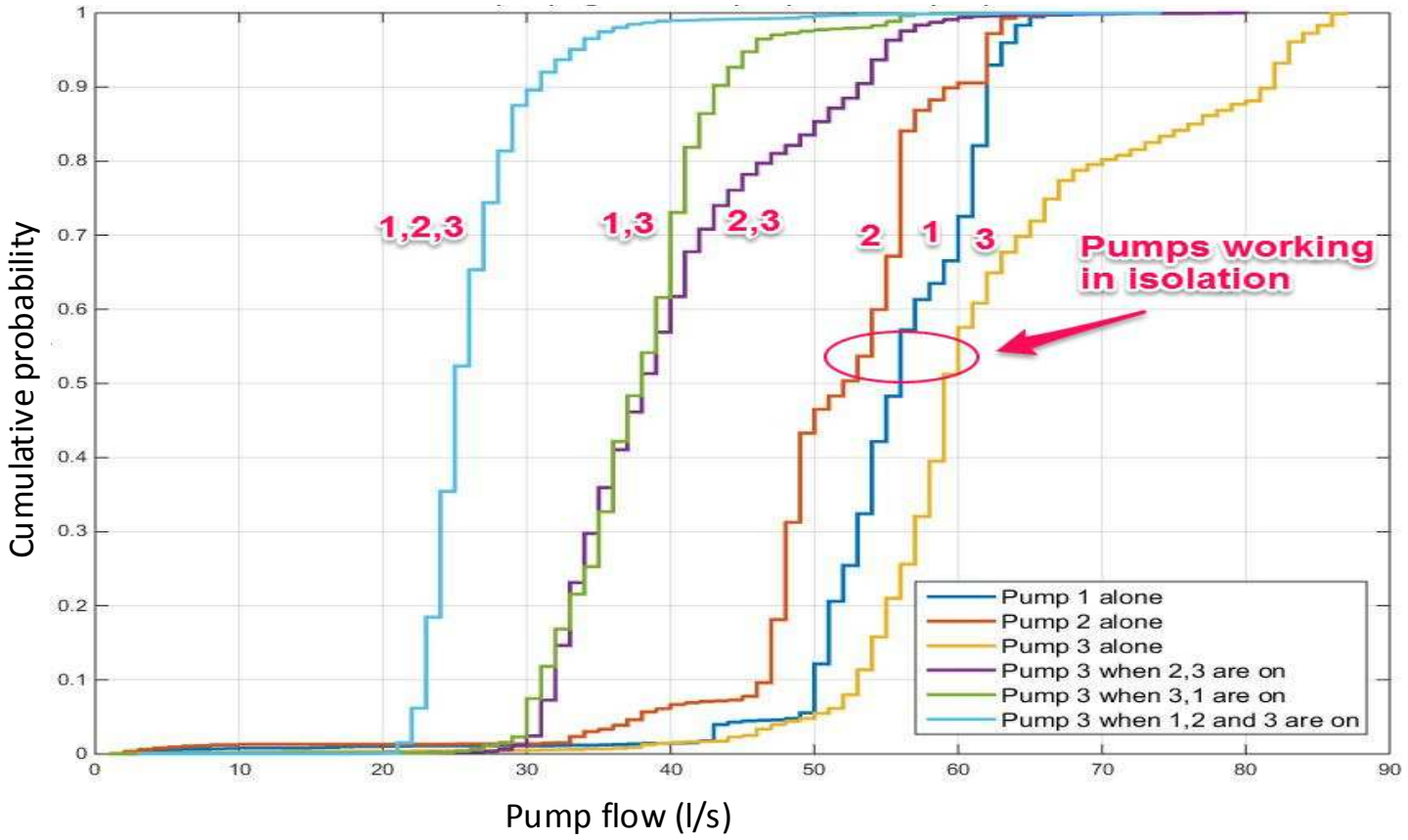
CDF of flow rates for pump 1 vs other pumps



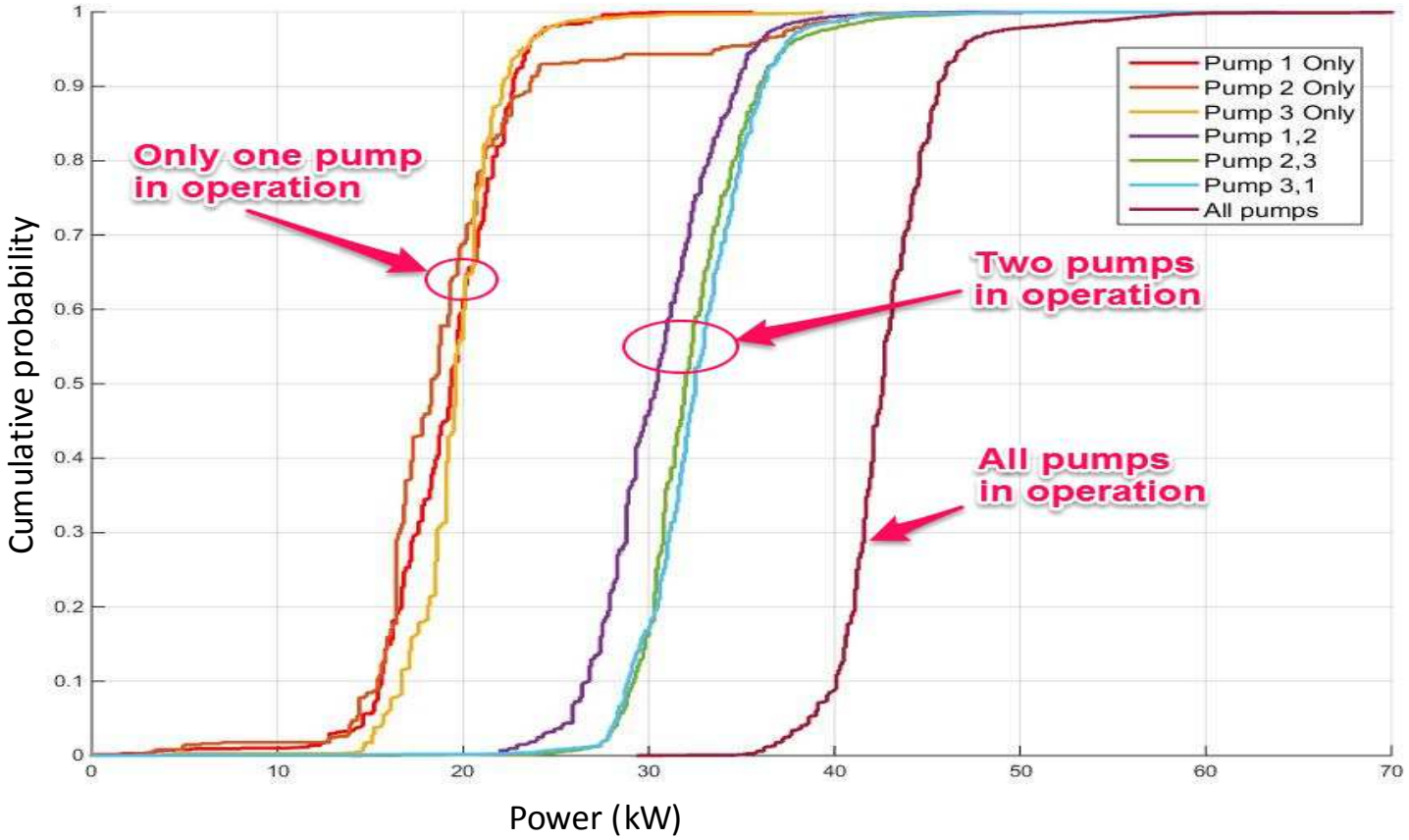
CDF of flow rates for pump 2 vs other pumps



CDF of flow rates for pump 3 vs other pumps

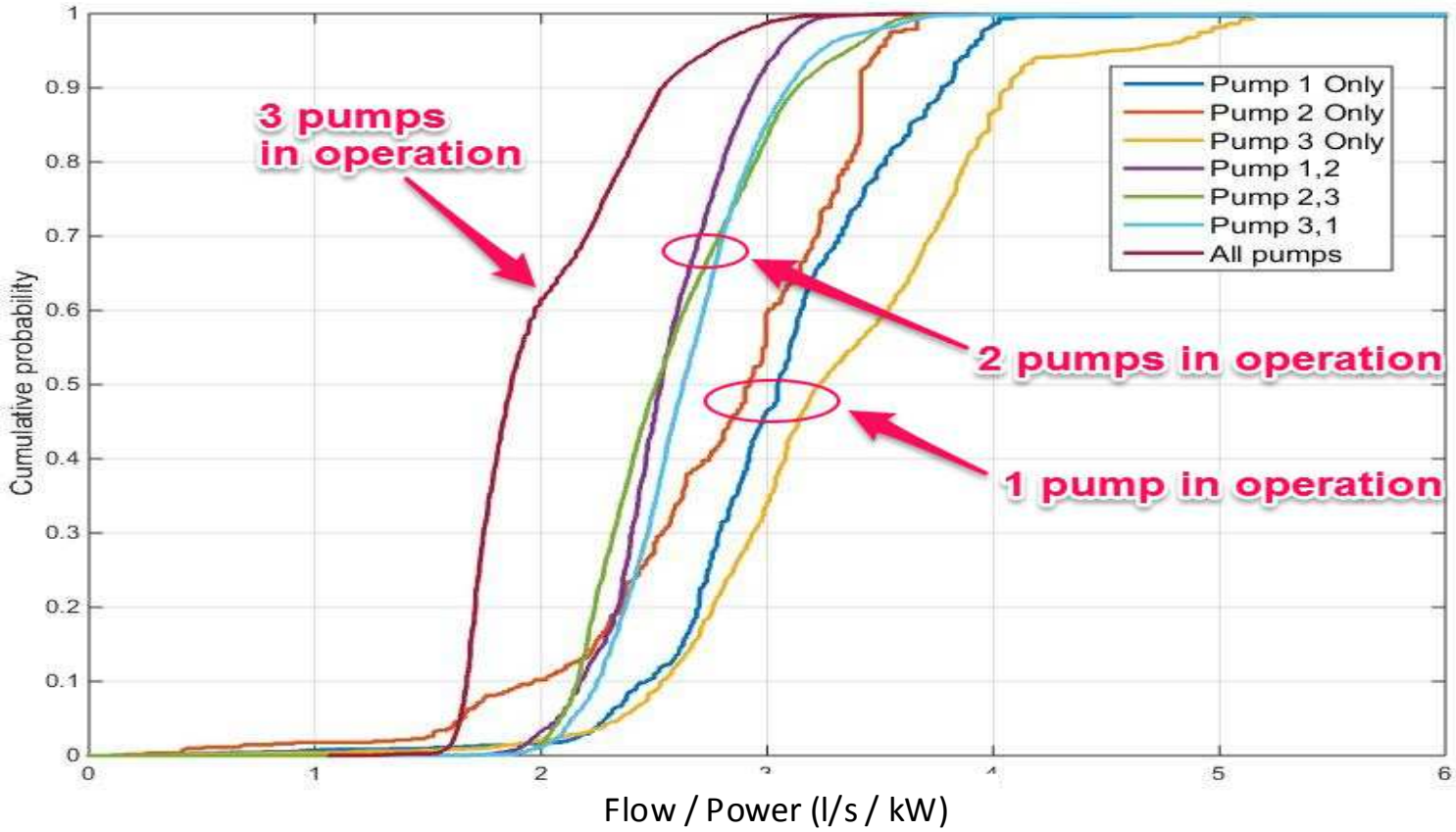


How many pumps should be used?

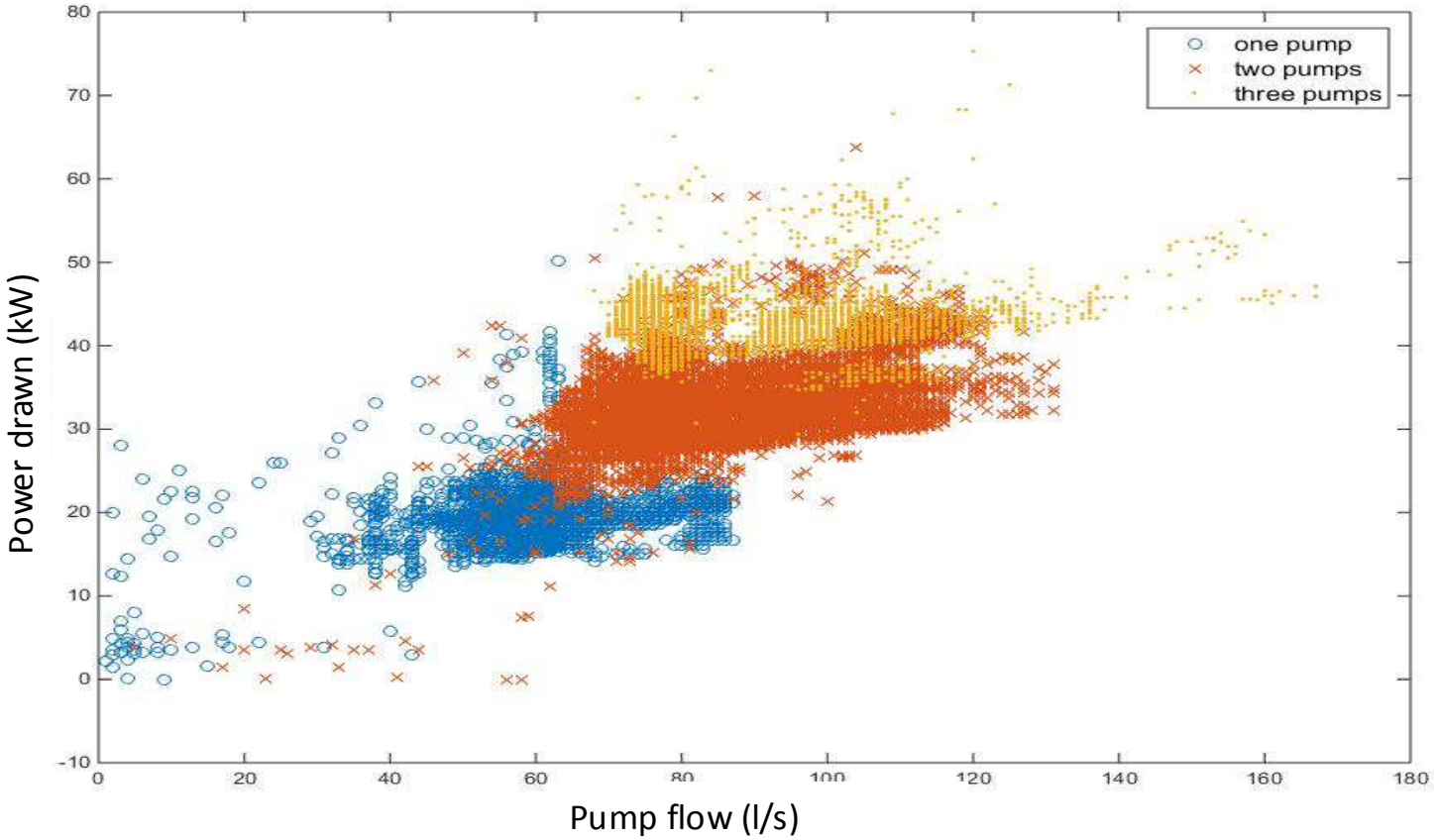


Site load power is divided into periods where pump 1,2,3 are working in isolation and combinations of 1, 2, 3 pumps.

Efficiency measures – making the best use of available pumps



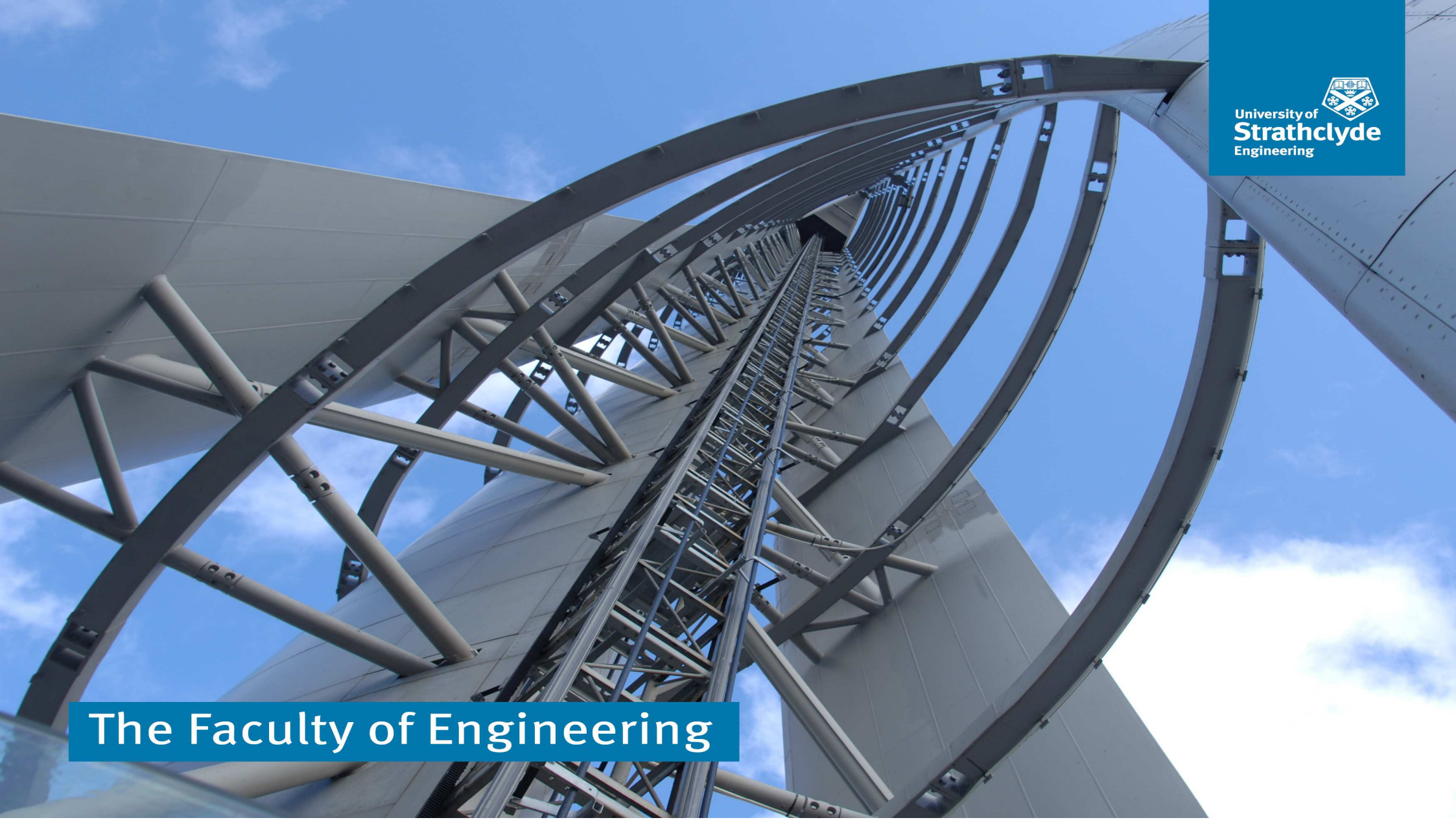
Power drawn for different combinations of pumps



Pump		
1	2	3
o		
	o	
		o
x	x	
	x	x
x		x
•	•	•

Summary

- Individual ‘identical’ pumps do not exhibit identical behaviour
- Efficiency can vary widely depending on exact operation conditions
- Operational optimisation possible
  - pump selection and switch-on conditions



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