# Significance of Systems Concept in Energy Conservation in Pumping

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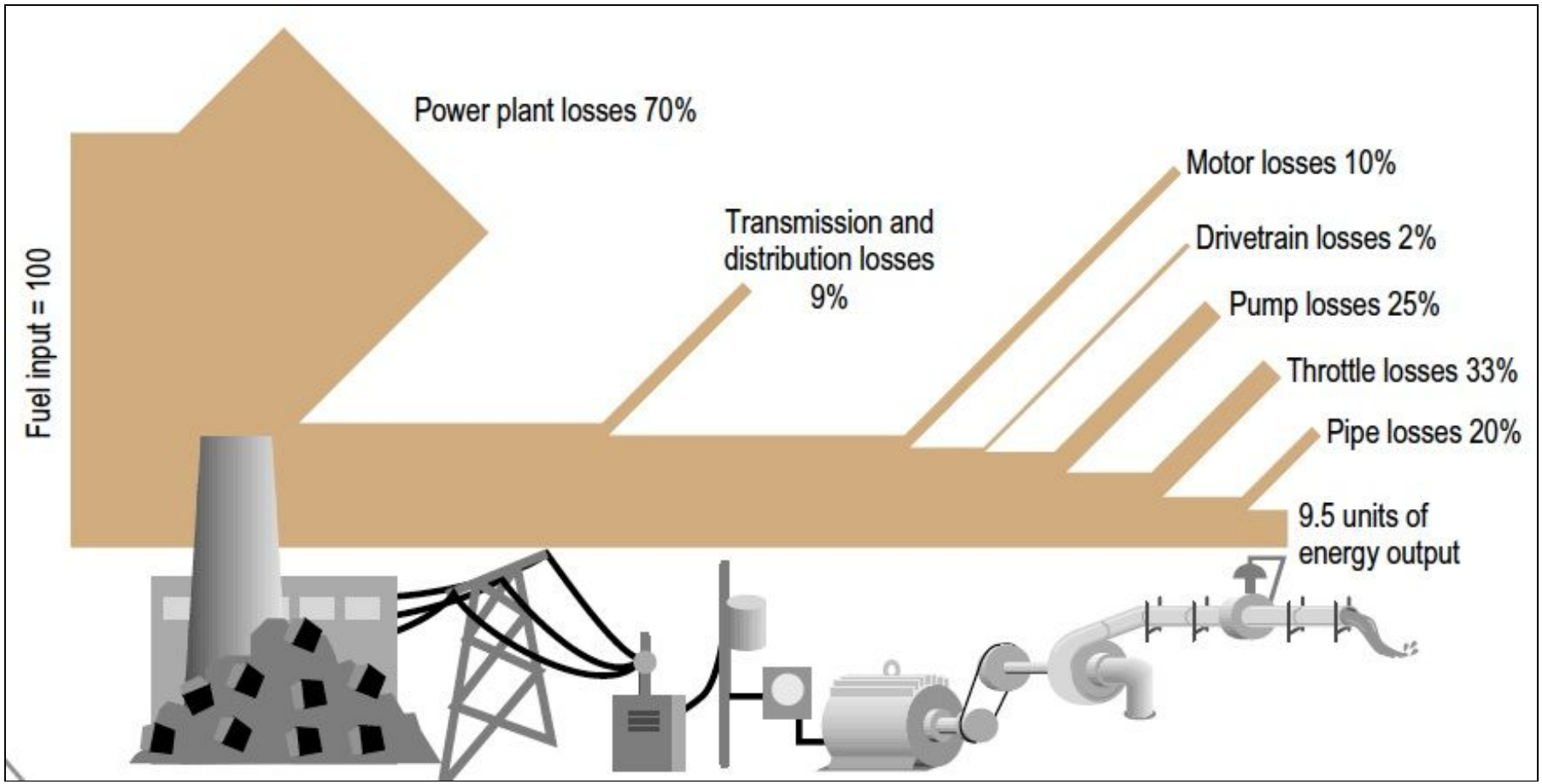
# Pumping Systems Concept
## Global Recognition; Indian Initiative

- www.pumpsystemsmatter.com
- PSAT of DOE of US
- EU Directive and EUROPUMP
- IS-10804
- PCRA, NABARD

# Thoughts with “Telling” Effect

- **10 Ways to murder a good pump**
- **Northwest Energy Efficiency Alliance, Portland, Oregon, US**

**http://www.nwalliance.org/research/documents/MicroFabtechArticle.pdf**



# Energy Flow Diagram

**Fuel**

- Mining or Extraction
- Coal is pulverised and washed
  Oil is refined
  Nuclear Fuel is enriched
- Fuel is transported to utility

Power

- Generated
- Transformed
- Distributed

Usage

- Switches, Starters, Regulators
- Appliances
- End Use Optimization
  **1 kWh**

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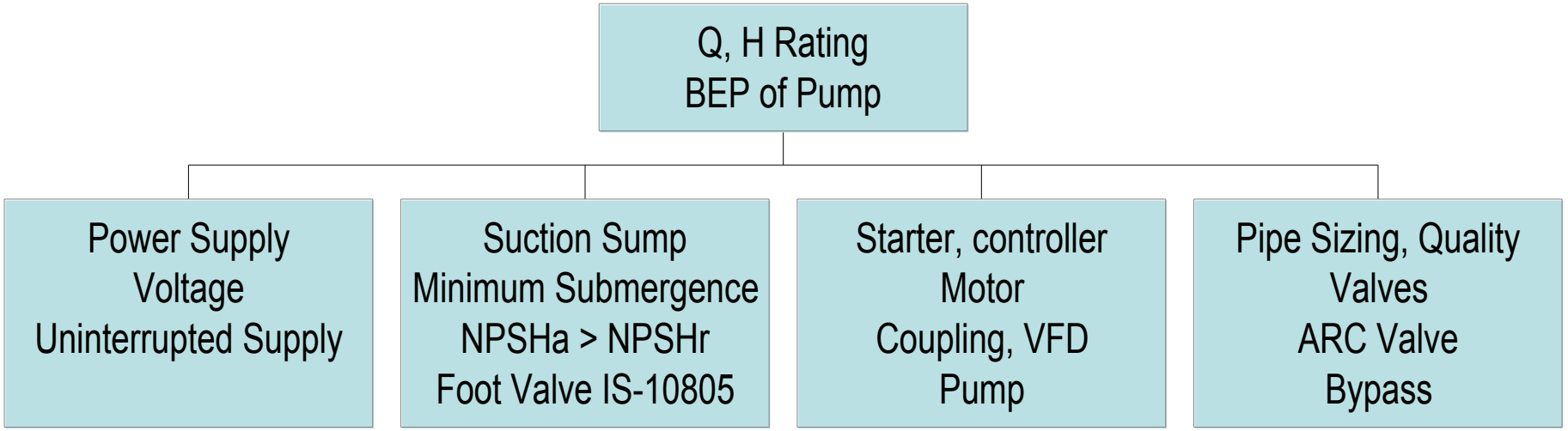
## Pump and its System

- Q, H Rating
  BEP of Pump
  - Power Supply
    Voltage
    Uninterrupted Supply
  - Suction Sump
    Minimum Submergence
    NPSHa > NPSHr
    Foot Valve IS-10805
  - Starter, controller
    Motor
    Coupling, VFD
    Pump
  - Pipe Sizing, Quality
    Valves
    ARC Valve
    Bypass

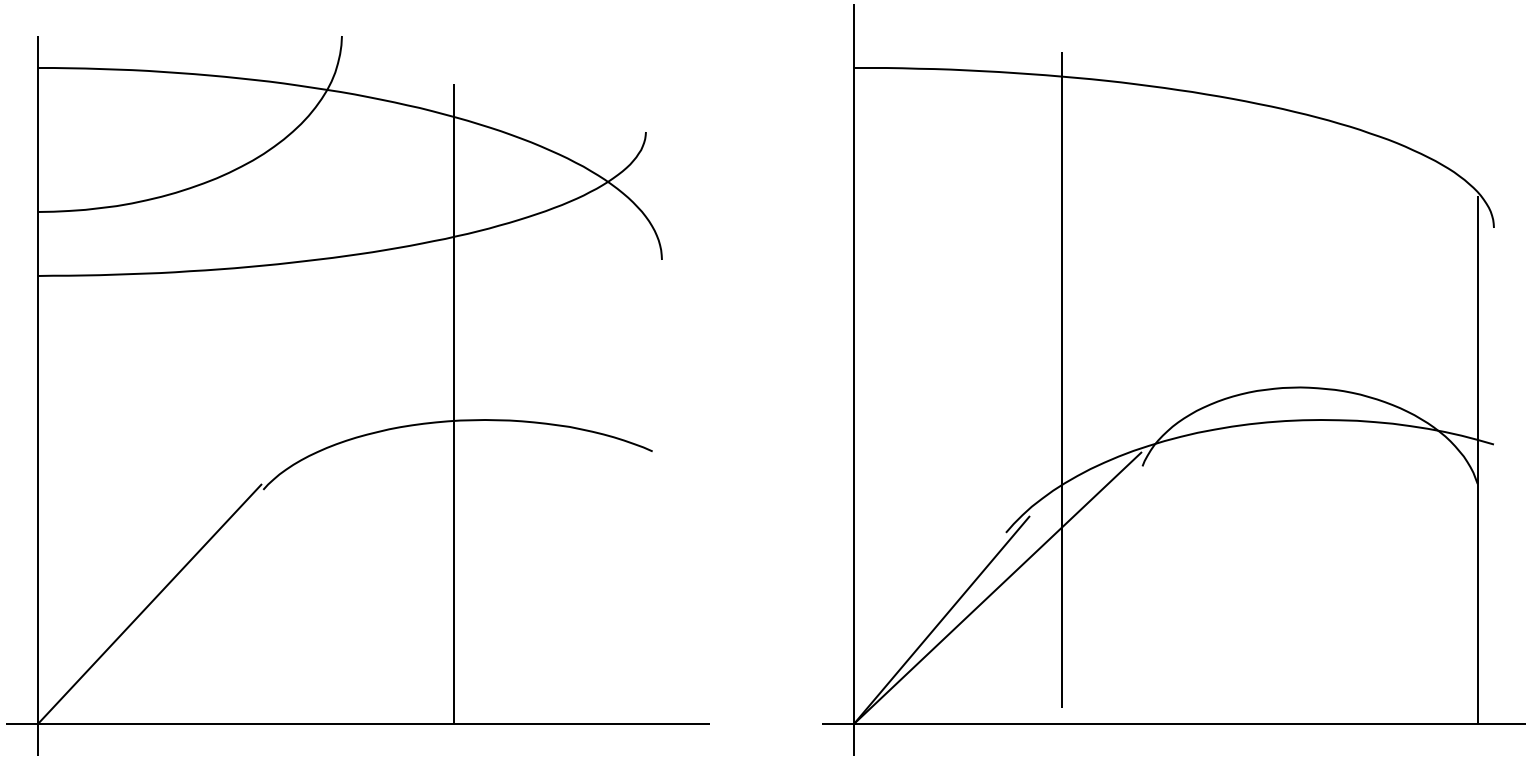
# Pump and its System




BEP is only one point on Pump's Curve

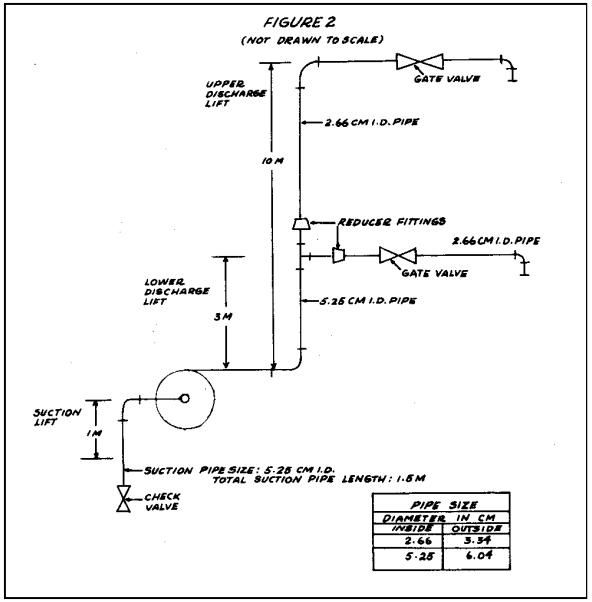
Design Efficiency of Motor is limited by band of supply voltage

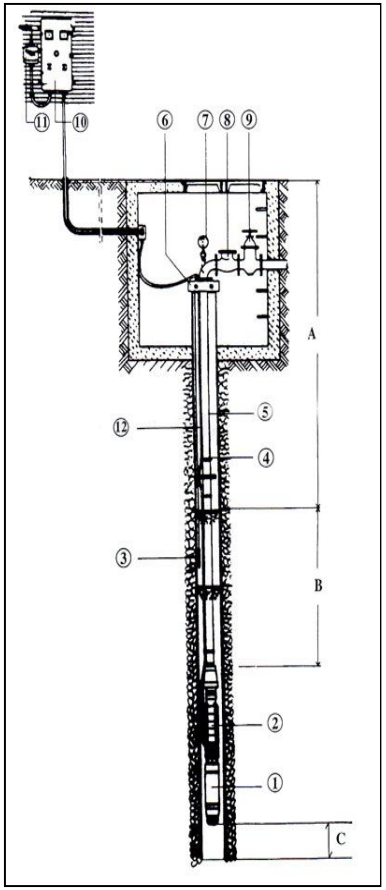
# BEP is only one point on Pump's Curve

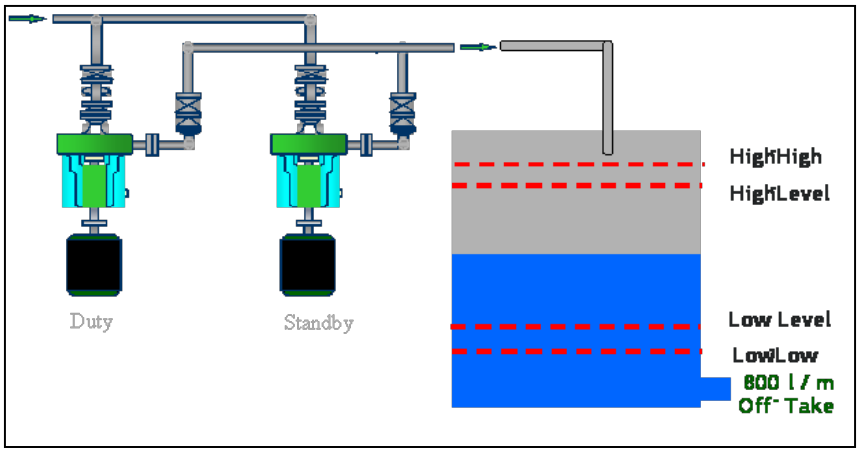


# Components of a Pumping System - Suction Side

- Suction
  - Foot valve
  - Priming
  - Strainer
  - Bell-mouth
  - Bends and isolation valves

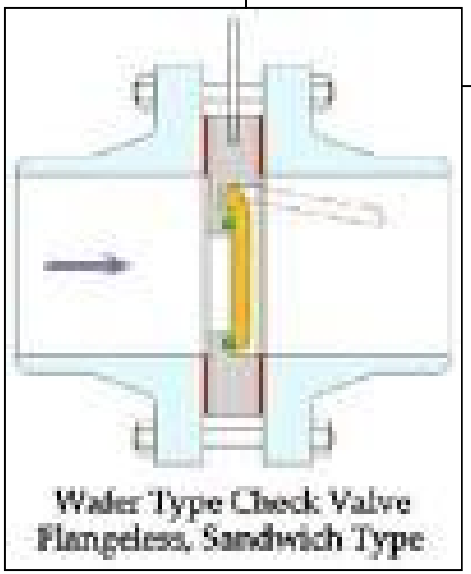


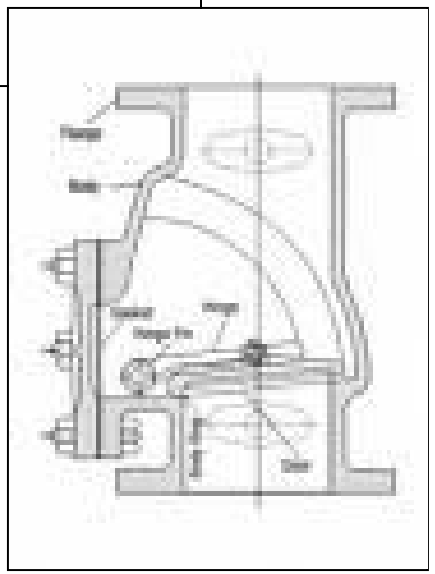




# Components of a Pumping System - Delivery Side

- Delivery
  - Non-return valve
  - Flow-regulation valve
  - Bends and isolation valves
  - Main Header and branch Pipes
  - Safety Valve
  - Bell-mouth, Jet nozzles, Spray nozzles



# 7 Ways to Reduce Energy Consumed in Pumping

(Ref.:- www.pumps.org)

2. Design systems with lower capacity and total head requirements. Do not assu

3. Avoid allowing for excessive margin of error in capacity and/or total head.

5. Despite the tendency to emphasize initial cost, you will save in the long run by

6. Use two or more smaller pumps instead of one larger pump so that excess pu

7. Use variable-speed drives to avoid losses from throttle valves and bypass line

8. Use pumps operating as turbines to recover pressure energy that would other

9. Maintain pumps and all system components in virtually new condition to avoid

## HI Recommendation # 1

## Design systems with lower capacity and

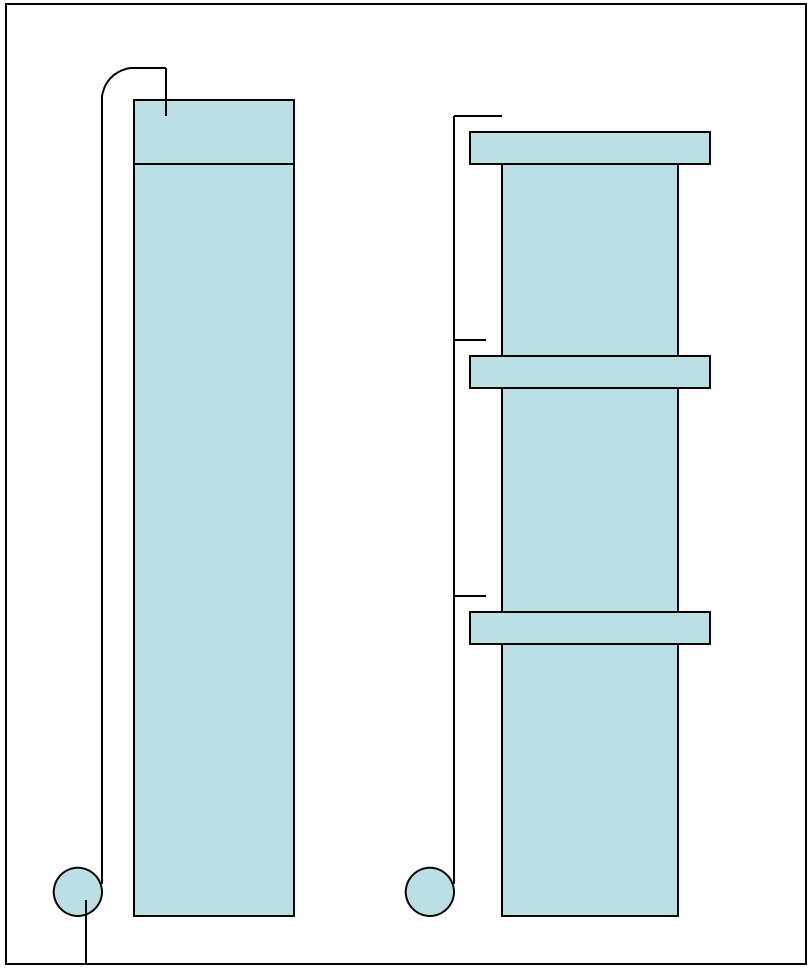
***Do not assume***

***these requirements are fixed***

**Pumping in multi-storey**

**High Rise Buildings**

# Pumping in Multi-storey Buildings



- Usual system for Q*H
- With 2 intermediate tanks

Q/3*H/3 + Q/3*(2H/3) +Q/3*H = 6/9 Q*H

- **33% Energy Saving Potential !!**
- Hydro-pneumatic Systems?

**HI Recommendation # 2**
**Avoid allowing for excessive margin of error in capacity and/or total head**

Boiler Rating 150 TPH, 110 Bar

BF Pump Rating

205 klph, 165 Bar

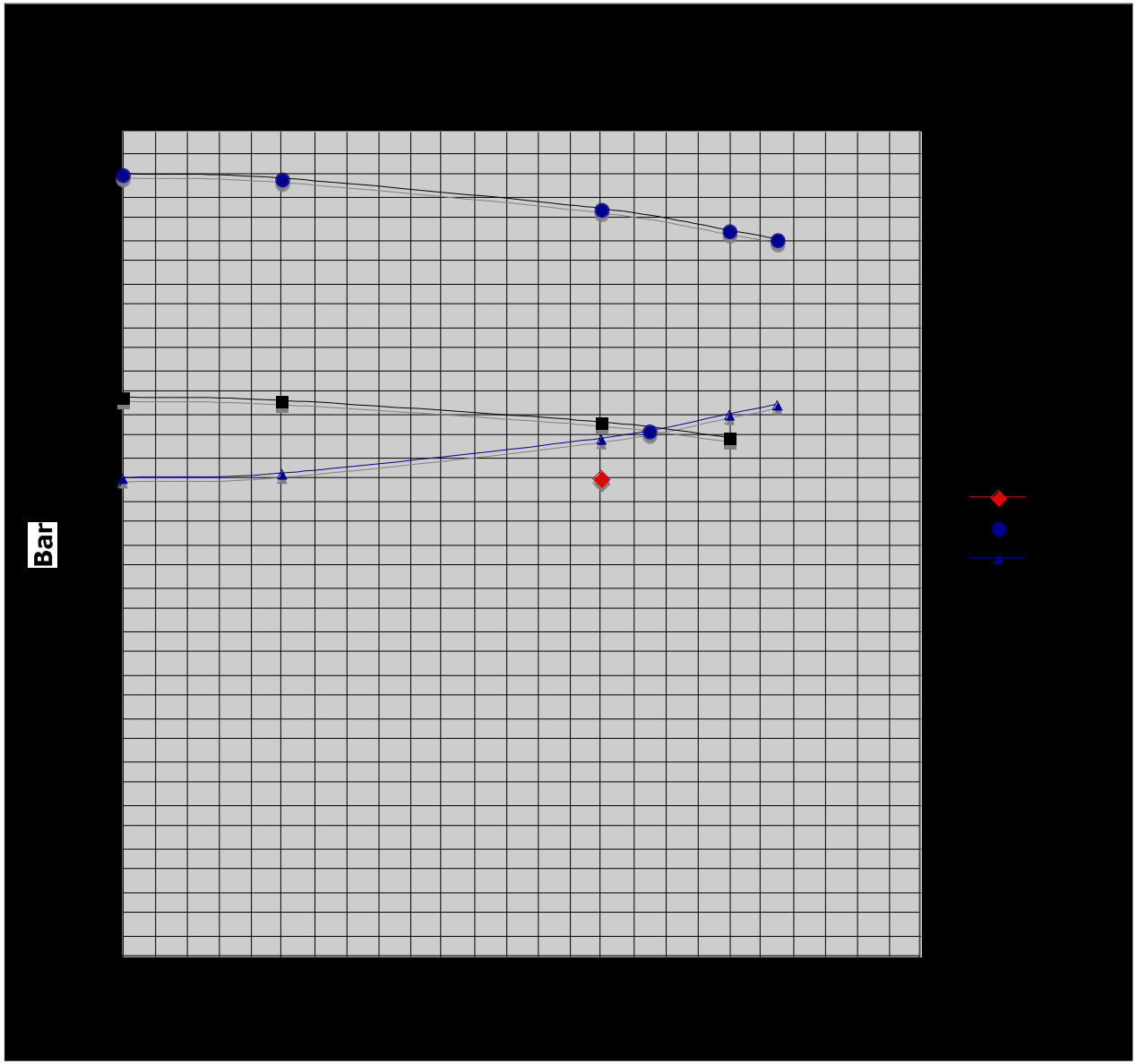
2 Pumps with 1200 kW Motor

2 Pumps with 1400 kW Motor

**Boiler** Rating 150 T/hr, 110 bar

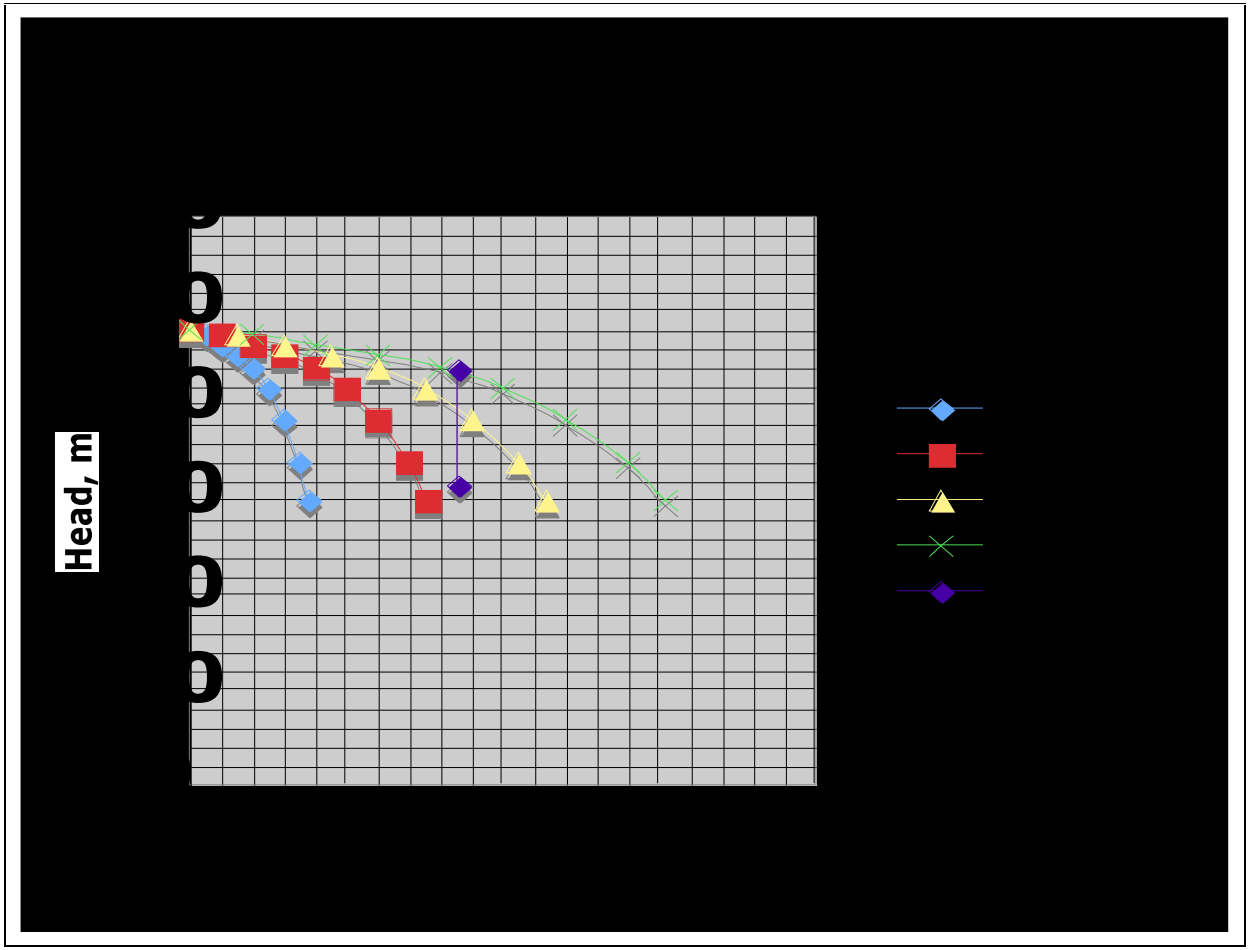
BF Pump Rating
205 klph 165 bar
2 Pumps 1200 kW motors
2 Pumps 1400 kW motors

**Impeller** trim ratio 0.845
Reduction in Power 0.603
Saving in Power 49.7%
At least 40%!



# Case Study in HVAC Sector

- Chiller Pumps at Ramco, Chennai
- 4 Pumps in //
  - 21.5 m3/h, 43m, 20 HP each
- One Pump
  - 84 m3/h, 33 m, 50 HP



# IS - 14536 and IS:9694 Parts 1 to 4
## Codes of practice for Selection, Installation, Operation & Maintenance of Pump Sets

- Selection
  - BEP and Operating range
  - Pump Q < 85% of yield of well
    - Tenders for 20,000 pumps w/o duty-ratings?
- Installation
  - Well dia. / Pump OD
  - Vertical and parallel bore or inclined and taper bore?
  - Voltage drop in cable >< IE Rule - No DOL above 5 HP
- Operation
  - Actual voltage ? Efficiency of Submersible motors

# Frictional Head, Hf

- $Hf = 4\ f\ L\ V^2/2gd$
- $Hf = 4\ f\ L\ (Q/A)^2/2gd$
- $Hf = 4\ f\ L\ Q^2/(\pi/4\ d^2)^2\ /2gd$
- $Hf = 4\ f\ L\ Q^2/(\pi/4)^2\ /2gd^5$
- $Hf_{40}\ /\ Hf_{50} = (5/4)^5 = 3125\ /\ 1024$

Note L is ΣL

- **IS-10805**
- **R1, R2, R3, R4**

***Thank You !!!***