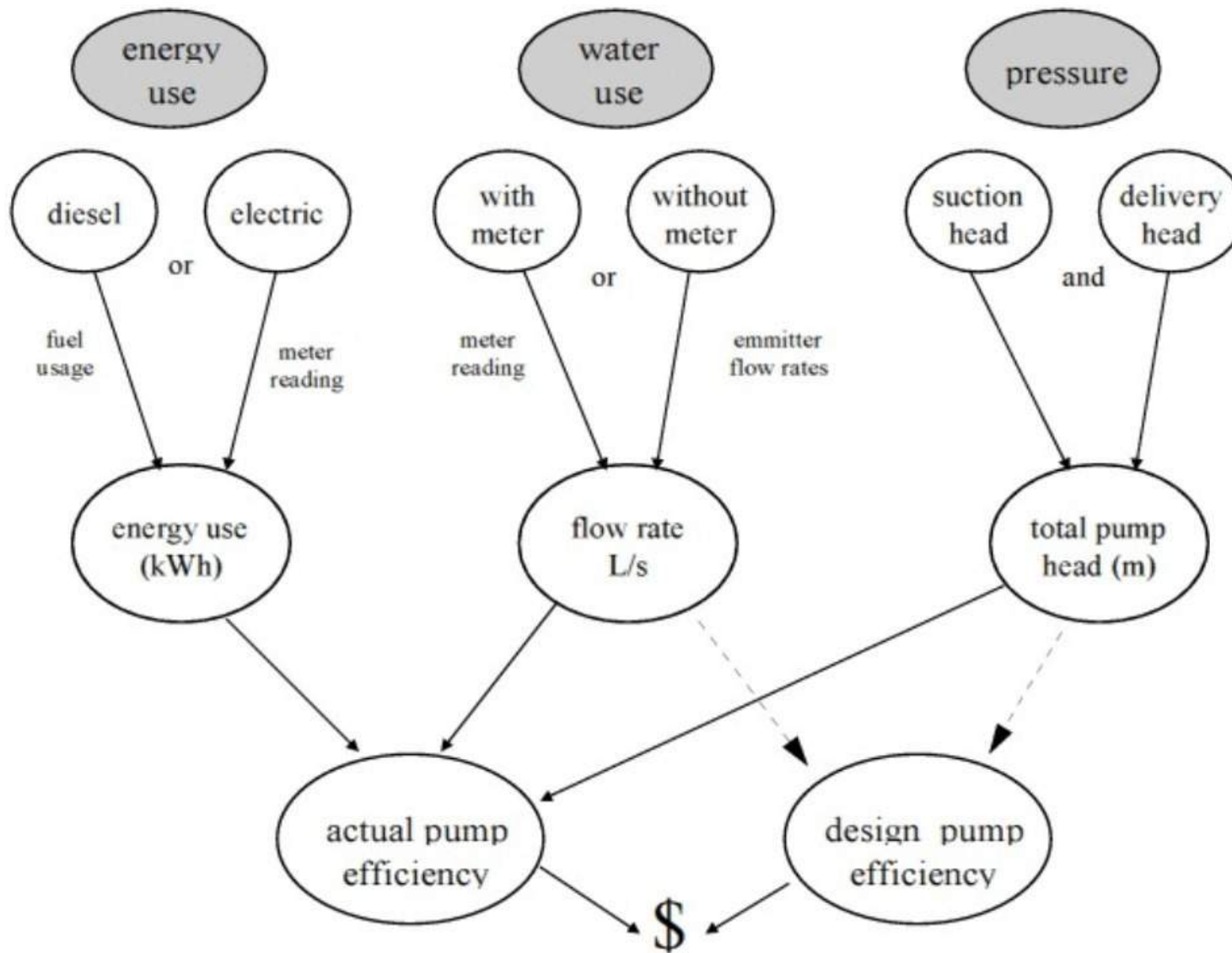




Irrigation Design can  
impact on Energy,  
Water, Nutrient  
inputs and  
Production



## Pump Efficiency Evaluation



# The Importance of Planning

- Soil types & drainage
- Climatic conditions (Peak ET & Rainfall)
- Water supply quantity and location
- Power supply capacity and distance
- Area to be Irrigated
- Peak crop demand
- System Design Capacity
- Potential Managed System Capacity
- Return on Investment

## *Top reasons for poor irrigation performance*

- *System design capacity is too low or hard to manage.*
- *Pump system duty is not matched to the duty.*
- *Instantaneous rate of application exceeds soil infiltration limits.*
- *Pressure at the spray or dripper emitter is too low or too high.*
- *Spray nozzles and ground clearance is variable.*
- *Poor Filtration system*

# Double ring Infiltrrometer



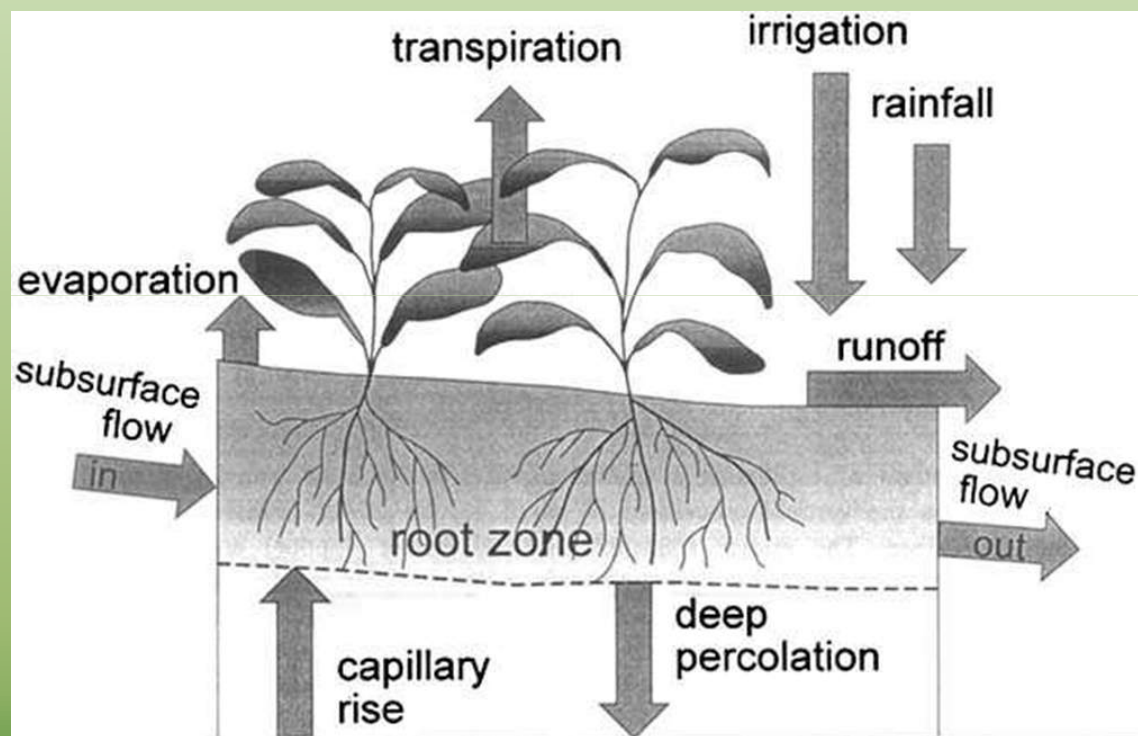
# Infiltration testing



Soil type	Constant infiltration rate [mm/h]
Sand	< 30
Sandy loam	20 - 30
Loam	10 - 20
Clayey loam	5 - 10
Clay	1 - 5







## Design System Capacity

- The maximum application rate (mm/day)

Based on water supply limits and  
Electricity Tariff restraints

Flow/Area/Time

# Potential Managed System Capacity

- ❑ PUR ( Pump Utilisation Ratio)
  - Water supply roster
  - Ground water depletion
  - Electricity tariff
  - Wind conditions
  - Life style
- ❑ Application efficiency of the system

# Typical planning schedule

Plant Cane	Days	Kc	Evaporation potential	Application Eff	average rain	Water Requirement mm	ML
20% 7.88 Ha	40	0.5	5	1.05	0.37	2.23	7.02
	60	0.75	9	1.05	1.6	6.2	29.31
	220	1.2	8	1.05	2	8.08	140
	45	0.4	5	1.05	3.3	0	0
Ratoon Cane	Days	Kc	Evaporation potential	Application Eff		Water Requirement mm	ML
80% 31.52Ha	40	0.5	5	1.05	0.37	2.23	28.1
	50	0.75	9	1.05	1.6	6.2	97.7
	180	1.2	8	1.05	2	8.08	458.4
	95	0.4	5	1.05	3.3	0	0

# Return on investment

## Set up cost

- Planning cost
- Earth works
- Water purchase
- Power service connection
- Irrigation system (pump, mainline, irrigator and scheduling equipment) 15 years
- Water cost (\$/ML)
- Electricity cost per ML (Kwh/ML)
- Maintenance
- Finance cost
- Labour cost

## Yield & Residual value

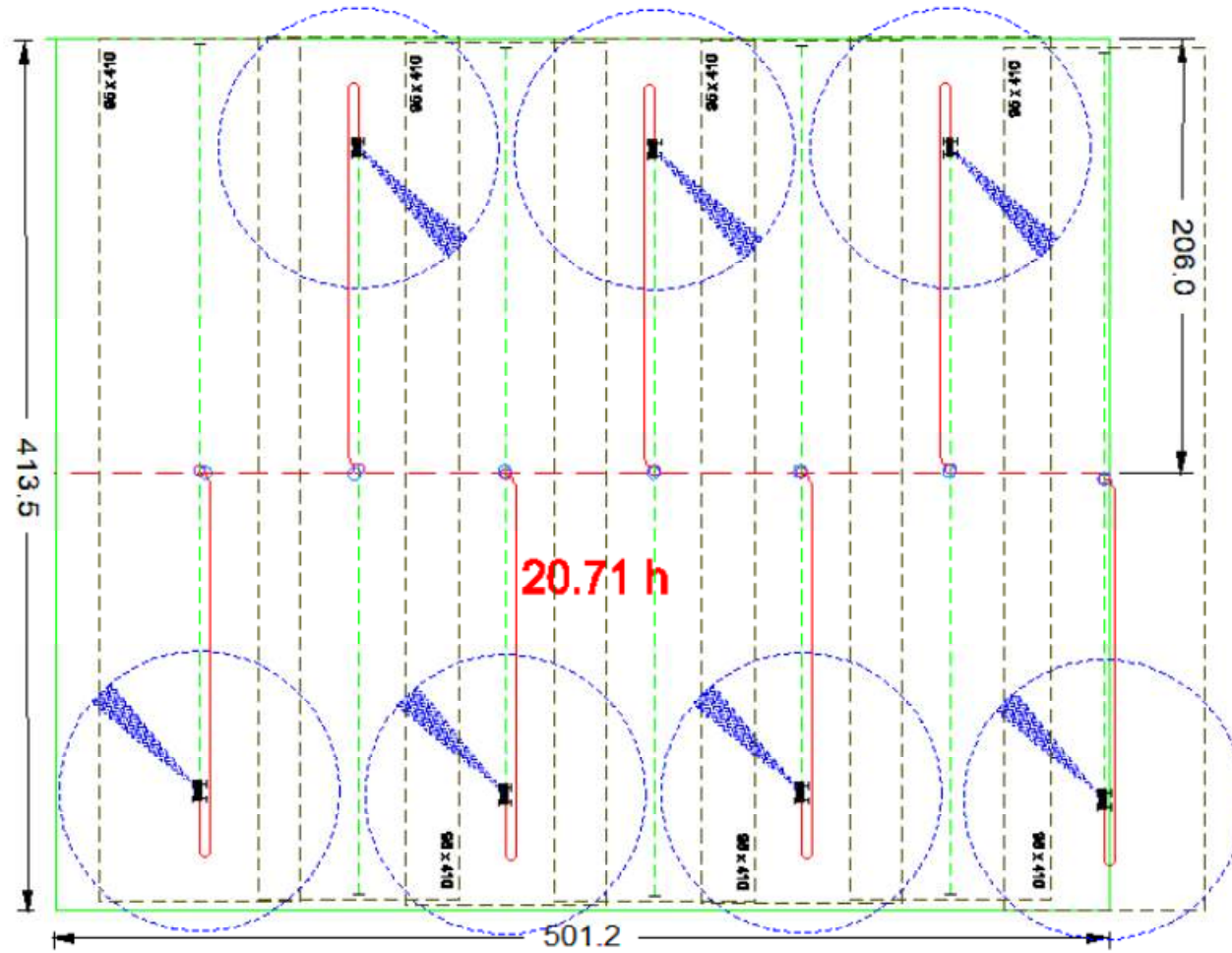
- Tonnes & value of production (\$/T)
- Value of equipment

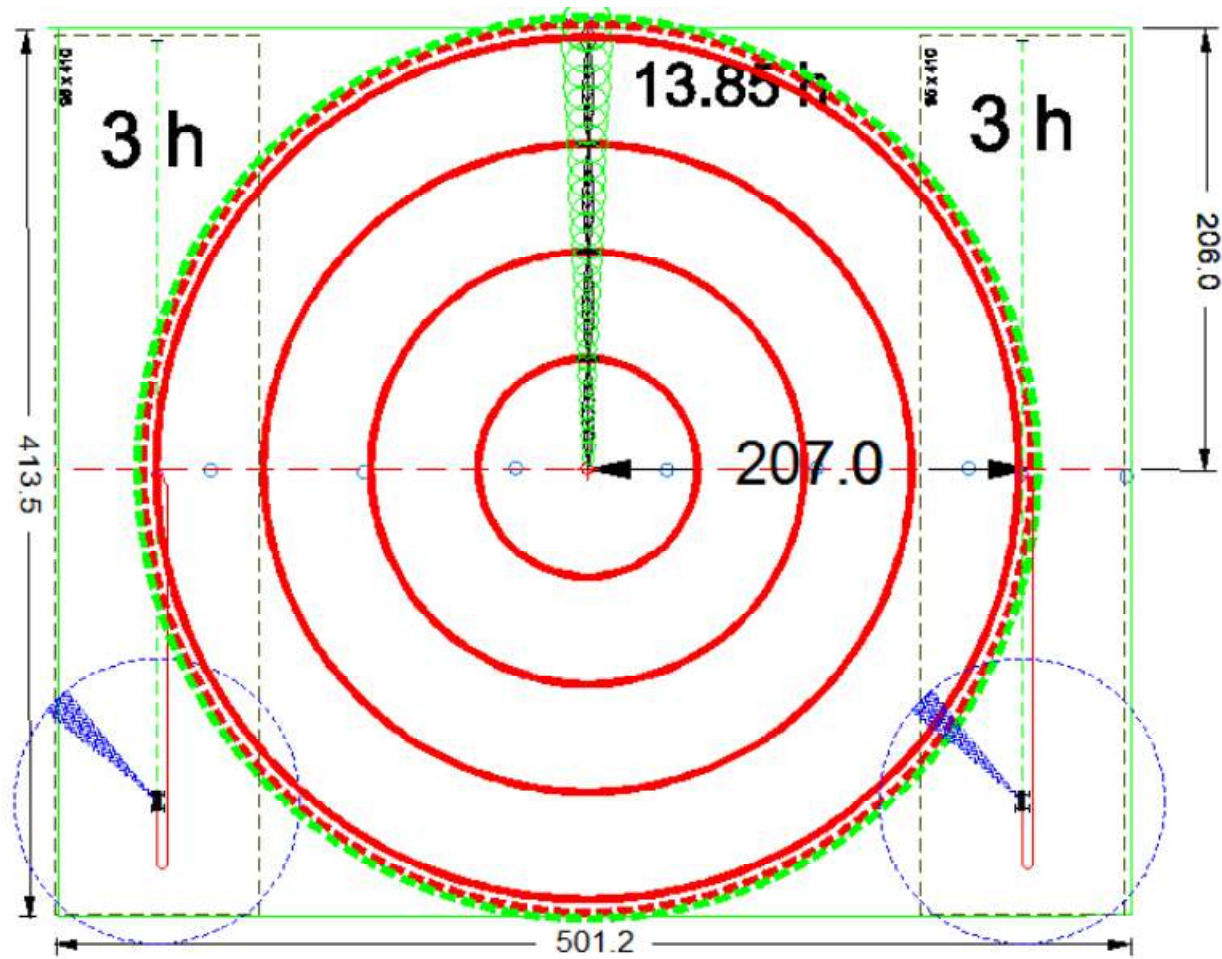


# Enjoy Lunch

Next session how you can better understand cost on  
your own irrigation system







Irrigator	Traveller(28L/S @100 Psi) 7 x 12 hours	Centre Pivot (10.65L/S @40Psi)7 x 22hours
	Existing	Proposed
Centre Pivot		13.85
Traveller	20.71	6
Water use	103.55ML	99.25ML
Effect of Irrigation on Production @ 10t /HA/ ML (sugar cane)		
Traveller @ 5 ML/H app eff 70%	724.85t	
Centre Pivot @ 5 ML/H app eff 95%		833.25t
Capital per year (15yr)	\$2,300.00	\$4933.00
Irrigation pumping cost	\$9,157.96	\$5,957.87
Maintenance	\$1,700.00	\$898.00
Labour	\$3,800.00	\$1207.00
Total cost	<b>\$16,957.96</b>	<b>\$12,995.87</b>
Production @ \$30 t sugar cane	\$21,745.00	\$24,997.00
Margin	<b>\$4,787.04</b>	<b>\$12,001.13</b>

Traveller	Hours off peak	Hours peak	T62	T65	T66	T22	Daily service	Other
30KW	84		\$41.77 ML/\$99.80 ML				\$5.11	
	84			\$51.88ML/\$94.15 ML			\$5.11	
	84				\$49.3 ML		\$11.28	\$51.68
	84					\$56.65 ML/\$76.59 ML	\$10.81	
Centre Pivot	84	70	\$18.38 ML				\$5.11	
4KW	84	70		\$14.01 ML			\$5.11	
	84	70			\$12.39 ML		\$11.28	\$2.70
	84	70				\$26.63 ML	\$10.81	
18	July 22, 2012	Footer text here						

# Under standing & reducing Energy

- Pipes
- Valves & Fittings
- Filters
- System type
- Cost over life of system
- Checking your system

# Pipe Type & how there measured

• UPVC	Nominal Bore
• PVC	Nominal Bore
• Ductile Iron	Nominal Bore
• Asbestos	Nominal Bore
• Polythene High density	Out side
• Polythene Med density	Nominal Bore
• Polythene Low density	Nominal Bore
• Galvanized carbon steel	Nominal Bore
• Galvanized roll formed steel	Nominal Bore
• ABS	Nominal Bore
• Concrete	Nominal Bore

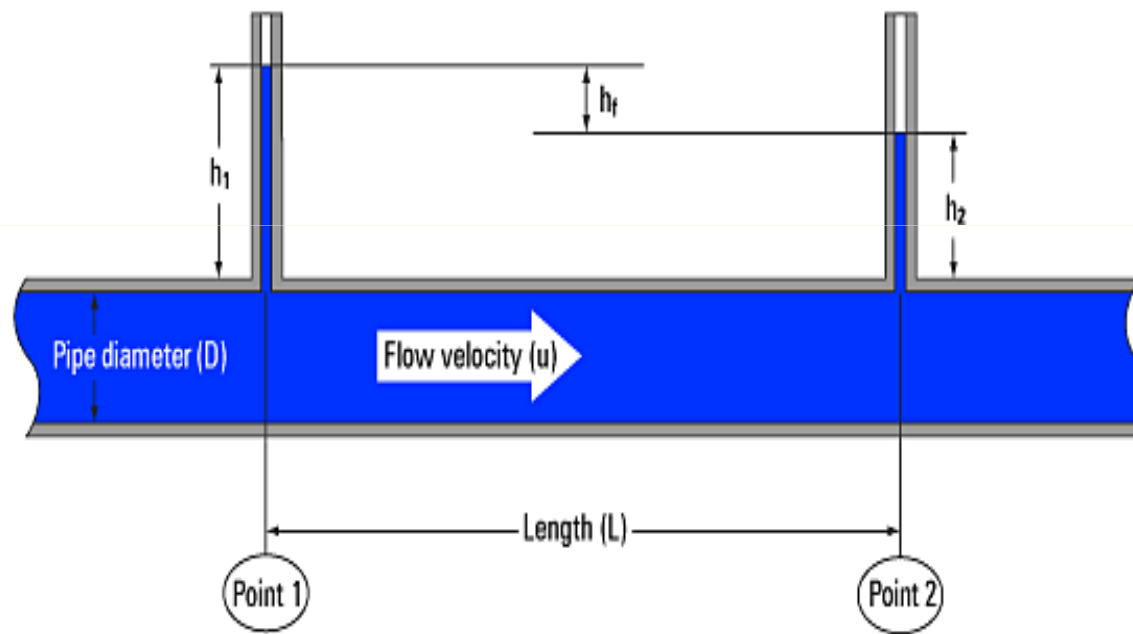
# Class of pipe that relates to pressure rating

◆ Class 4.5	=	450 KPA (65 PSI)
◆ Class 6	=	600 KPA (87 PSI)
◆ Class 9	=	900 KPA (130 PSI)
◆ Class 12	=	1200 KPA (175 PSI)
◆ PN 6.5	=	650 KPA (94 PSI)
◆ PN 8	=	800 KPA (116 PSI)
◆ PN 10	=	1000 KPA (145 PSI)
◆ PN 12.5	=	1250 KPA (181 PSI)
◆ PN 16	=	1600 KPA (232 PSI)

# Old Class method

◆ Class A	=	400 KPA (58 PSI)
◆ Class B	=	600 KPA (87 PSI)
◆ Class C	=	900 KPA (130 PSI)
◆ Class D	=	1200KPA(175 PSI)
◆ Low Density	=	350 KPA (50 PSI)
◆ Micro	=	200 KPA (29 PSI)

# Pressure loss in pipe



## **Conversions**

**1 Metre head = 9.789 Kpa**

**1 Metre head = 1.42 Psi**

**1 Psi = .703 Metre head**

**1 L/S = 792 Gallons per hour**

**1 ML = 1million litres**

# Burning Energy

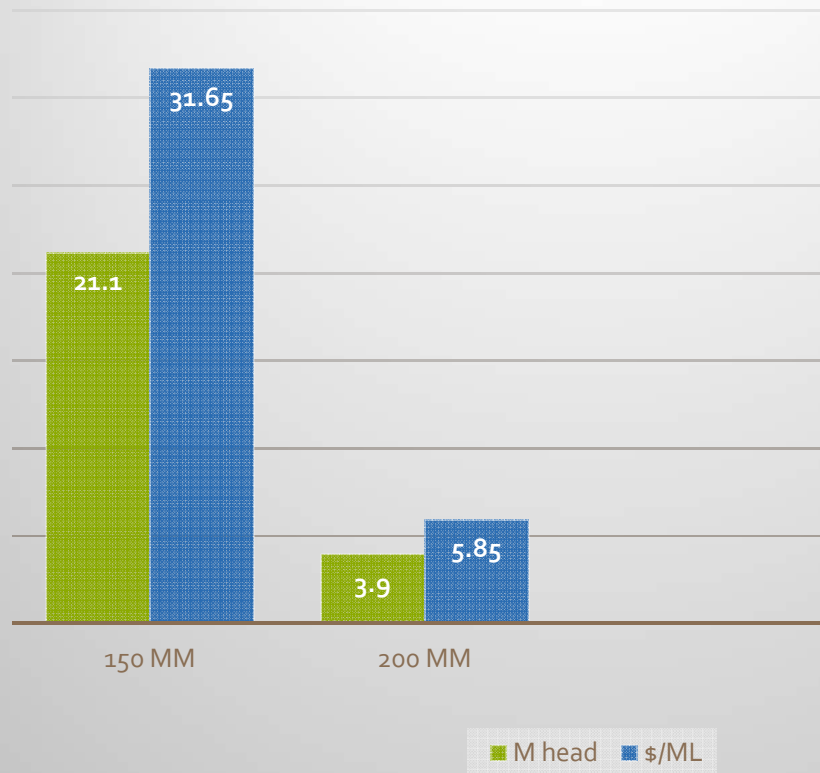
Pressure cost \$1.67/M, \$1.64 /10 Kpa  
\$1.17/Psi/ML

- Static Head
- Pipe Friction Loss
- Bends, Elbows, Tees & Reducers
- Valve Friction Loss
- Filter Friction Loss
- Operating Pressure

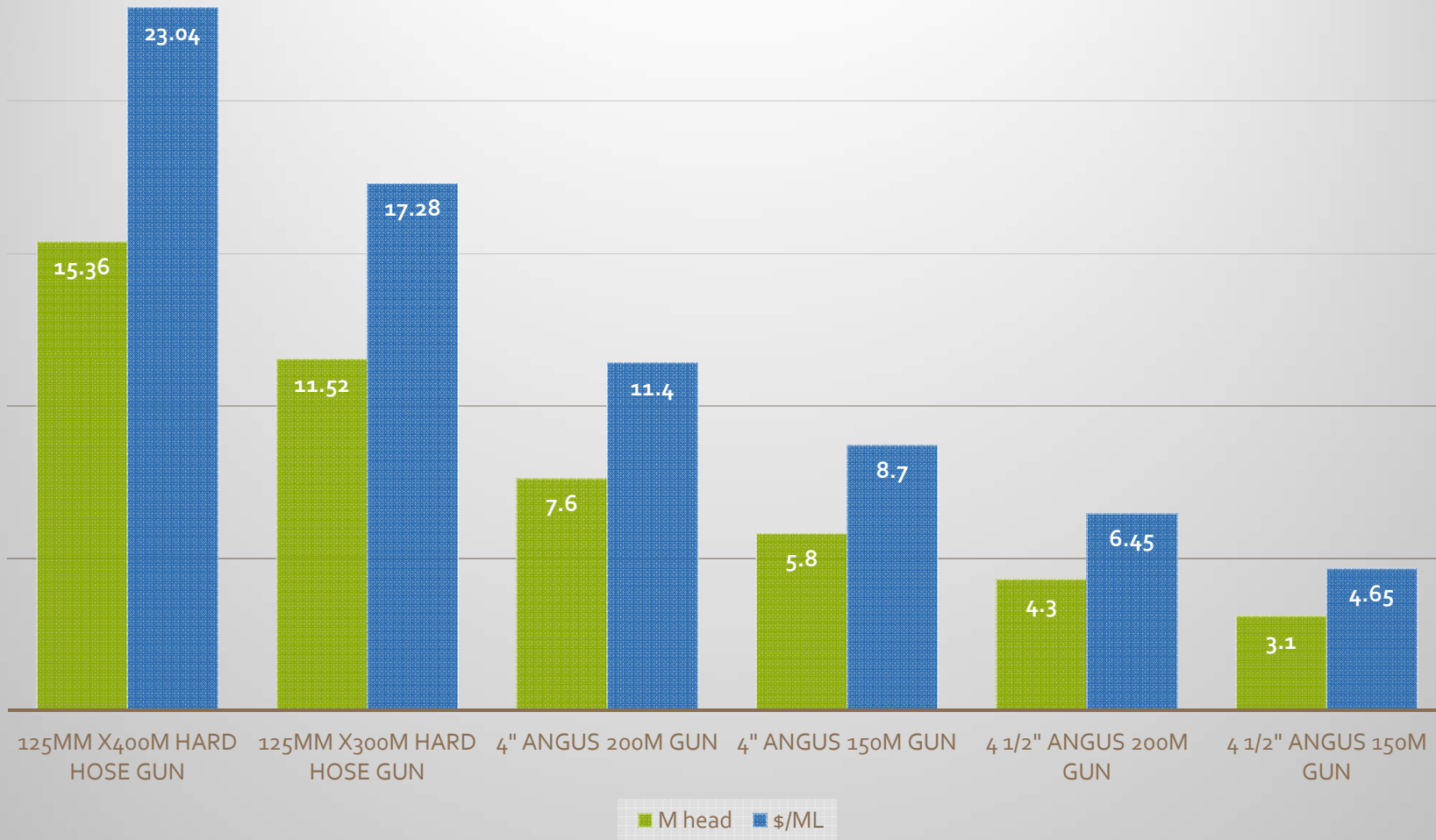
# Examples of energy use

**150mm V 200mm PVC pipe @  
50L/S x 500 Mtr long**

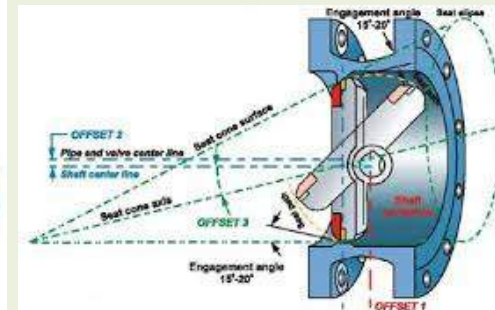
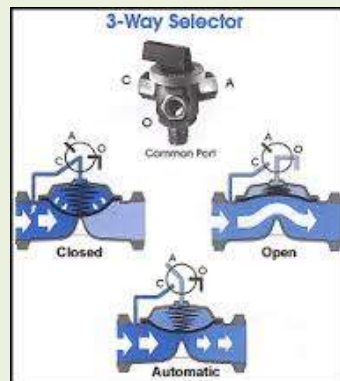
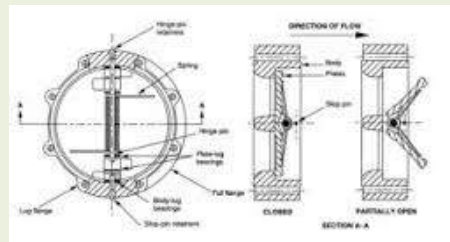
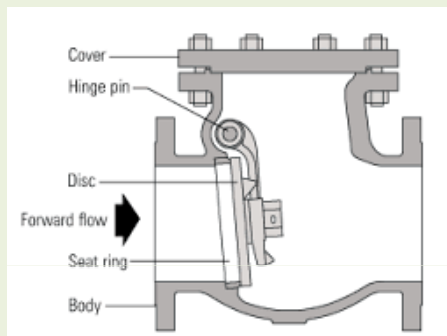
Pipe friction



## Hose Friction 20 L/S

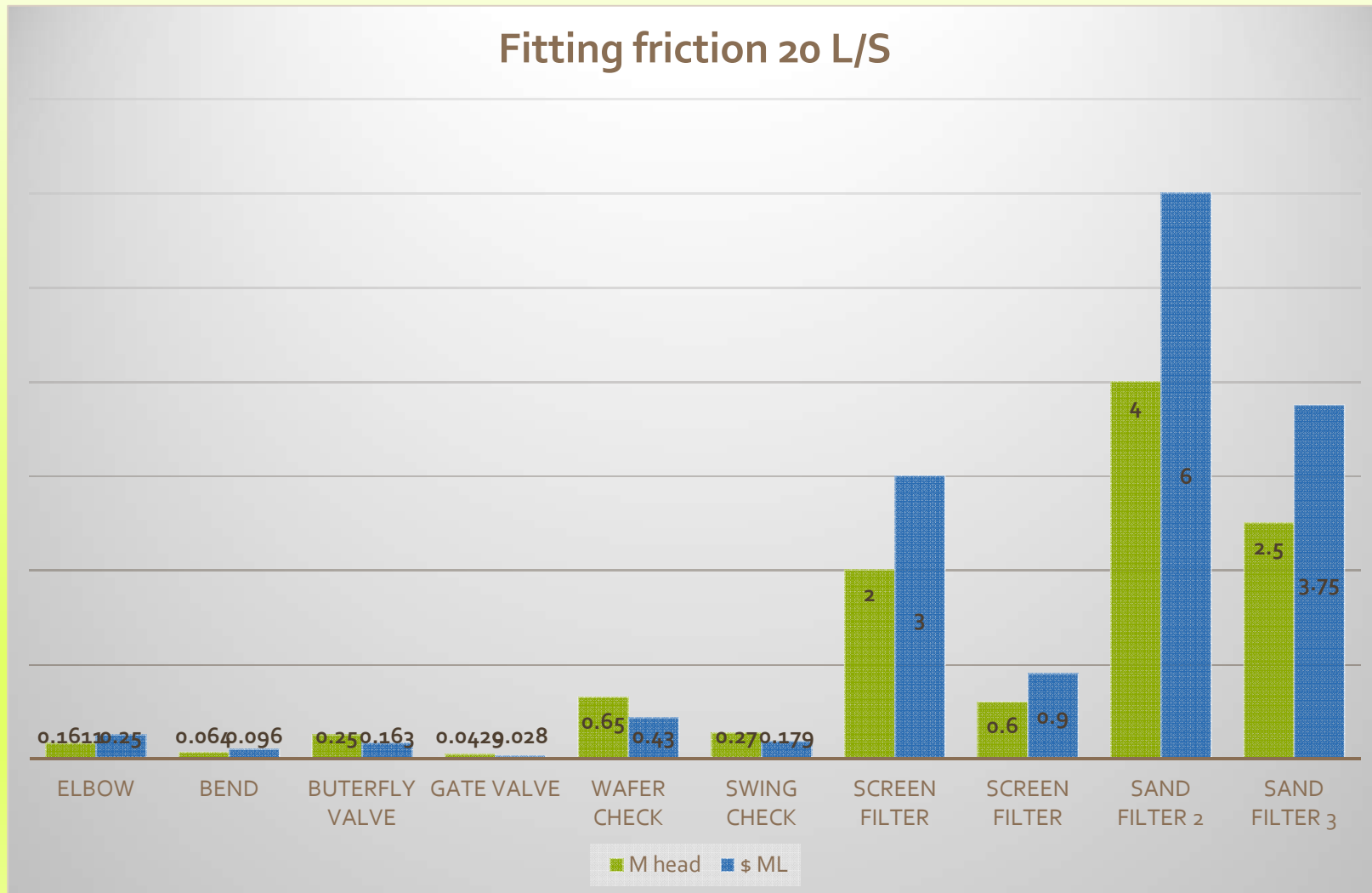


# Valve loss



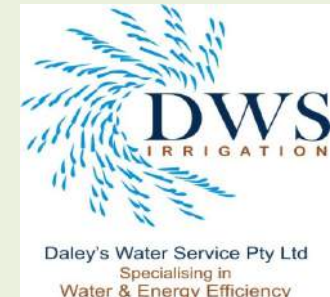
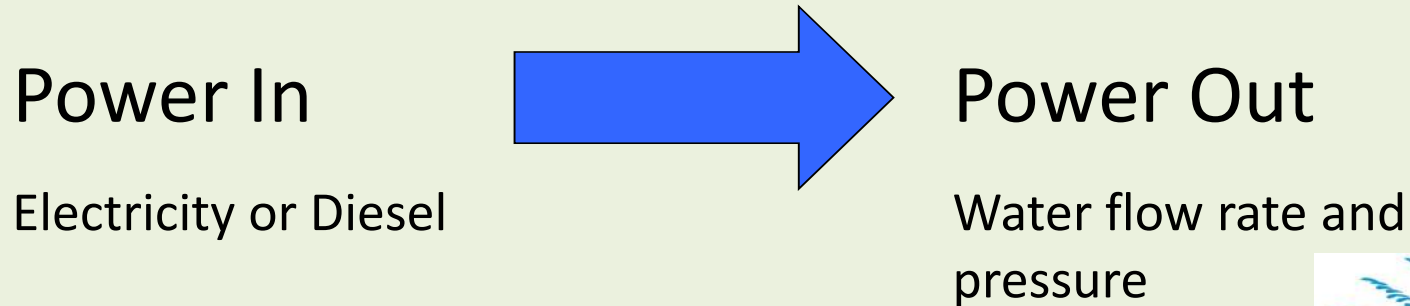
# Bends & Elbows Valves

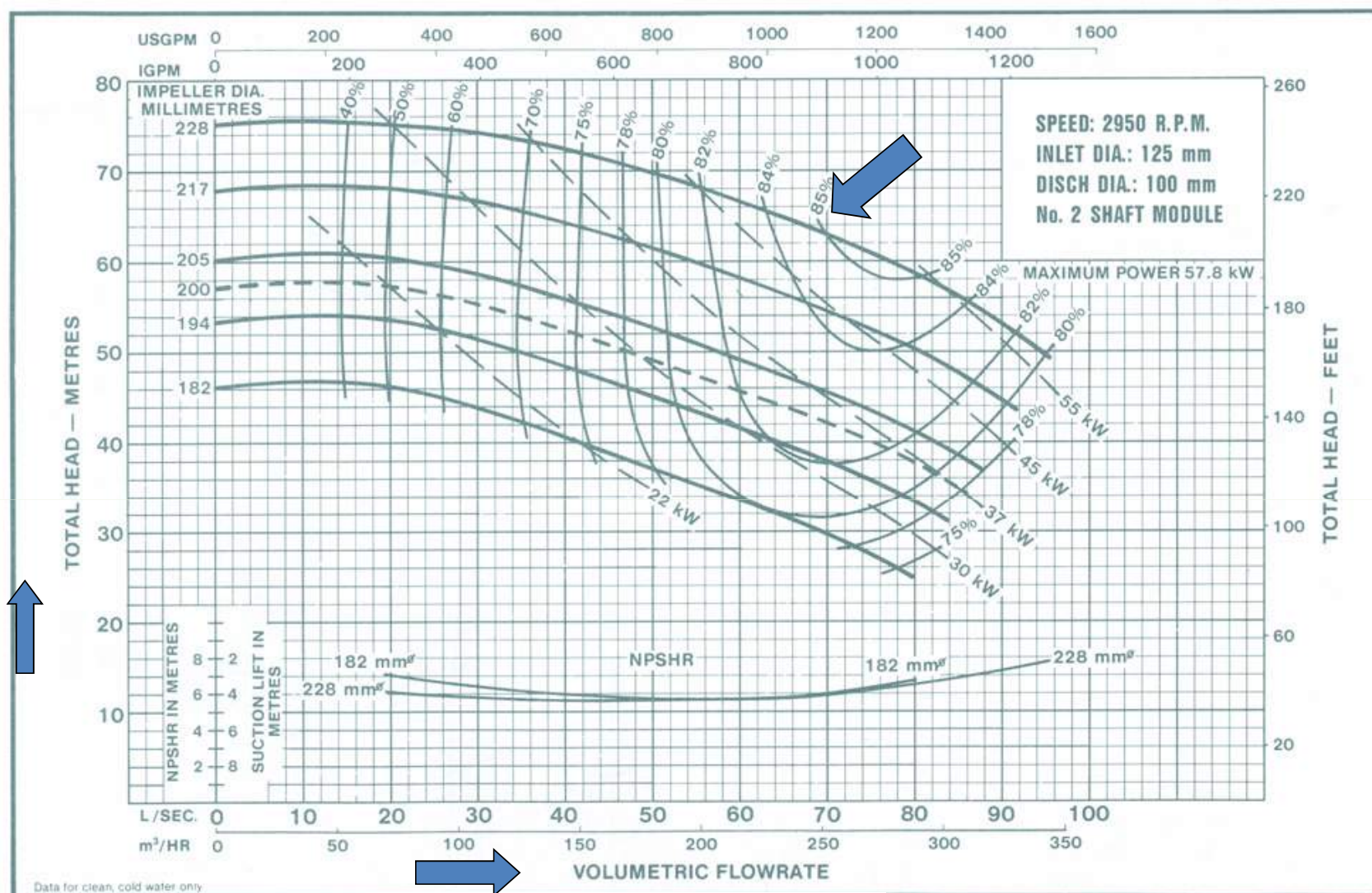
Fitting friction 20 L/S

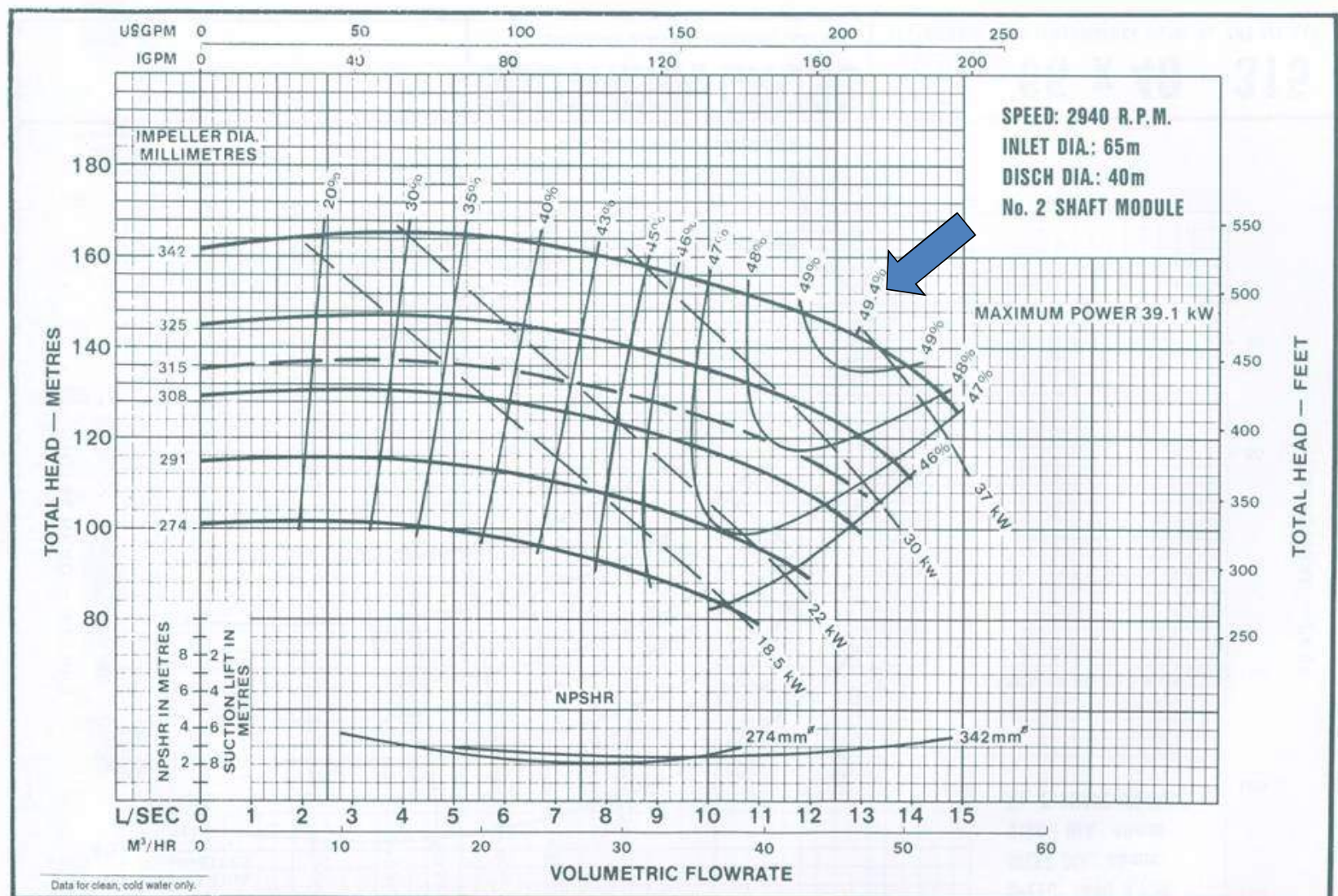


# What is Pump Efficiency?

It is a measure of pressure and flow delivered by the pump compared to the power delivered to the pump shaft.







# Cost of Efficiency

- Pump one is 85% efficient.(70L/S @ 650Kpa)
- Total Kilowatts used per Mega litre of water pumped = 226.25  
(@ \$0.25 = \$56.56 per ML)
- Pump two is 49% efficient.(13L/S @ 1450Kpa)
- Total Kilowatts used per Mega litre of water pumped = 875.65  
(@ \$0.25 = \$218.91 per ML)

# Pumping Energy

	<u>6.7</u>	<u>4.5</u>
•Centre Pivot	\$46.90	\$27.00
•Lateral Move	\$67.00	\$36.00
•Solid Set	\$69.00	\$36.00
•Side Roll	\$74.15	\$40.50
•Hand shift	\$78.40	\$49.50
•Boom Soft hose	\$78.56	\$40.50
•Big Gun soft hose	\$98.50	\$58.50
•Big Gun Hard hose	\$116.58	\$81.00
•Flood (Control)	\$26.80	\$18.00
•Micro spray	\$40.20	\$27.00

# Energy

KWh/ML/M

or

Units of energy/ Water volume/Pressure

The average for the state is 6.7 KWh/ML/M

@ \$0.25 per KWh this is \$1.67/ML/M

The top 10% for the state is 4.5 KWh/ML/M

@ \$0.25 per KWh this is \$1.12/ML/M



# The Ugly

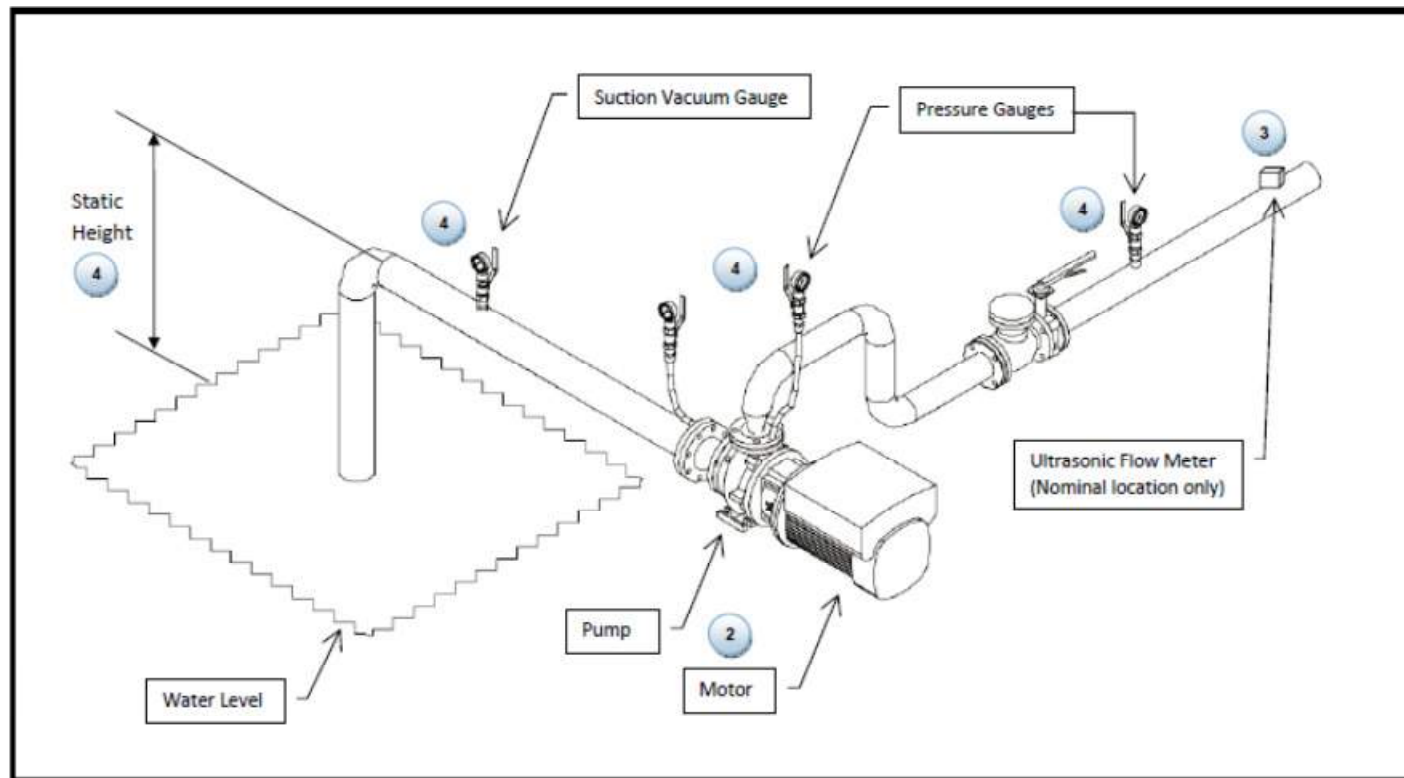




Daley's Water Service Pty Ltd  
Specialising in  
Water & Energy Efficiency



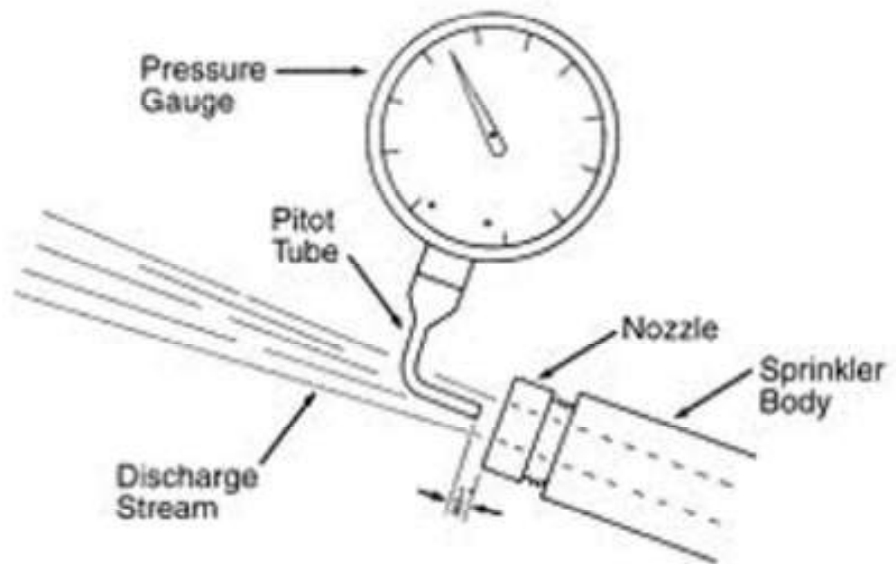
## PUMP TEST PROCEDURE TYPICAL PUMP ARRANGEMENT



Note: If an Ultrasonic Flow Meter is unavailable undertake the following steps:

- Record Flow Meter reading prior to Pump Starting
- Record length of time for Pump Test
- Record Flow Meter reading at conclusion of Pump Test

## Pitot Gauge






# Disc Meters



## Ultrasonic Flow Meter





# Selecting pumps that match the job

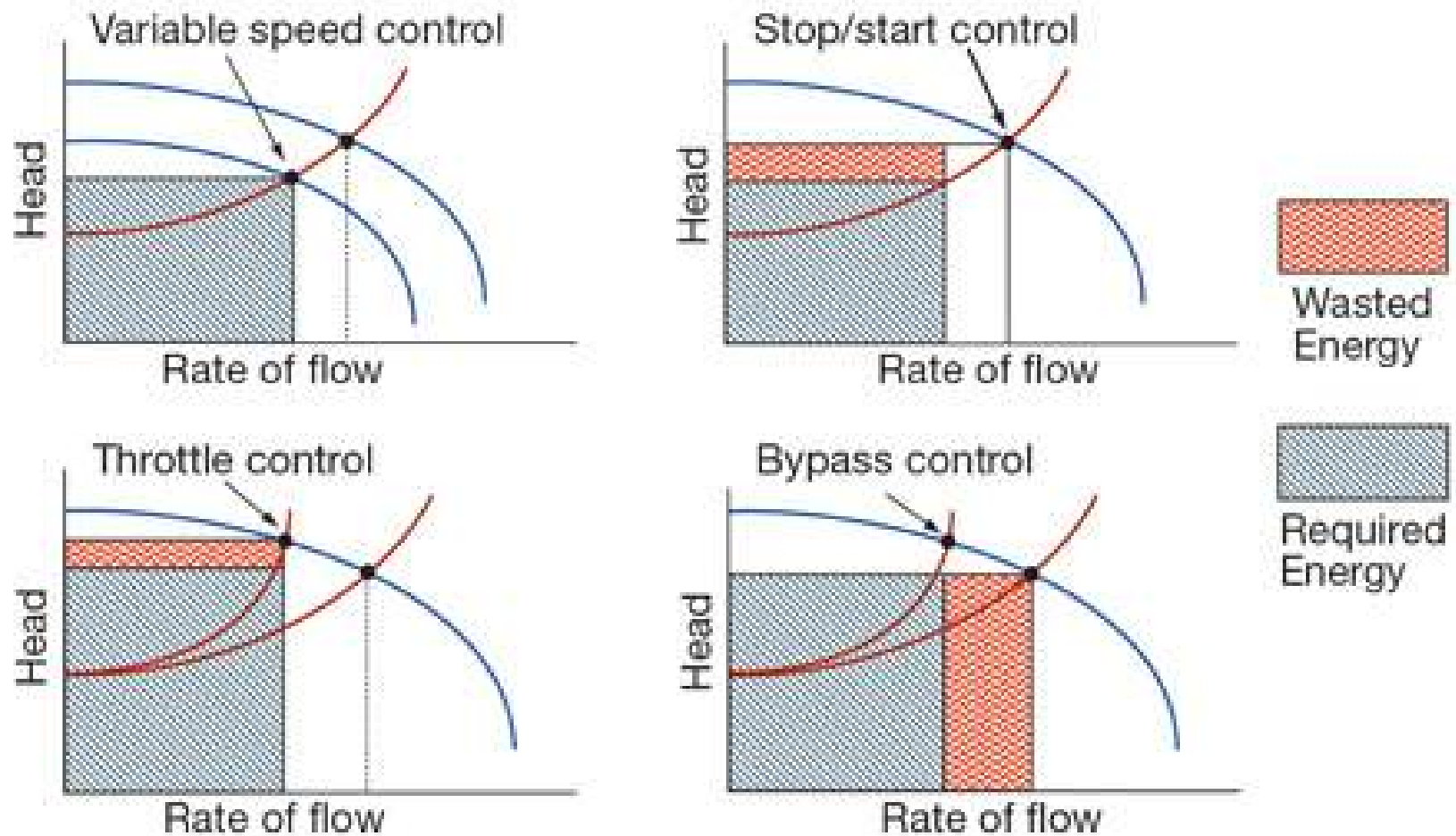
Next  
Joe Foley



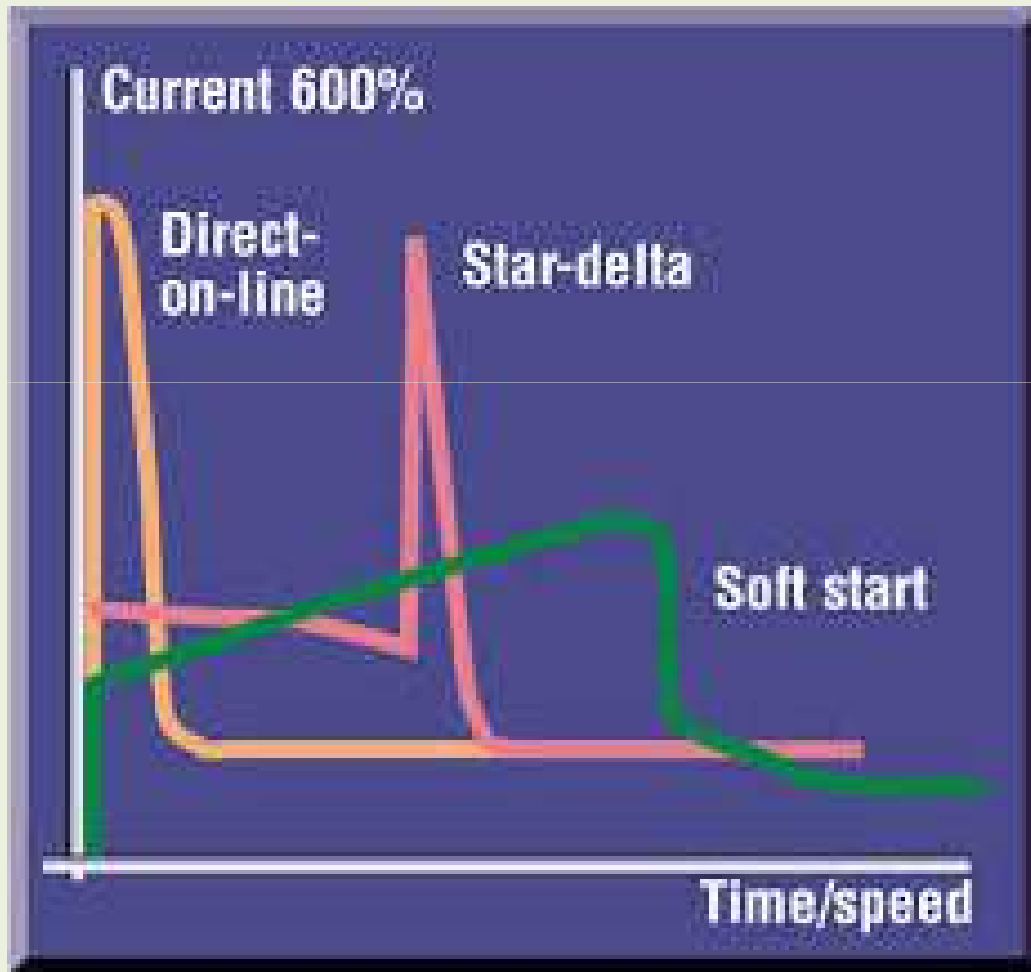
# Pump Controls

- VFD (Variable frequency drive)
- Soft start

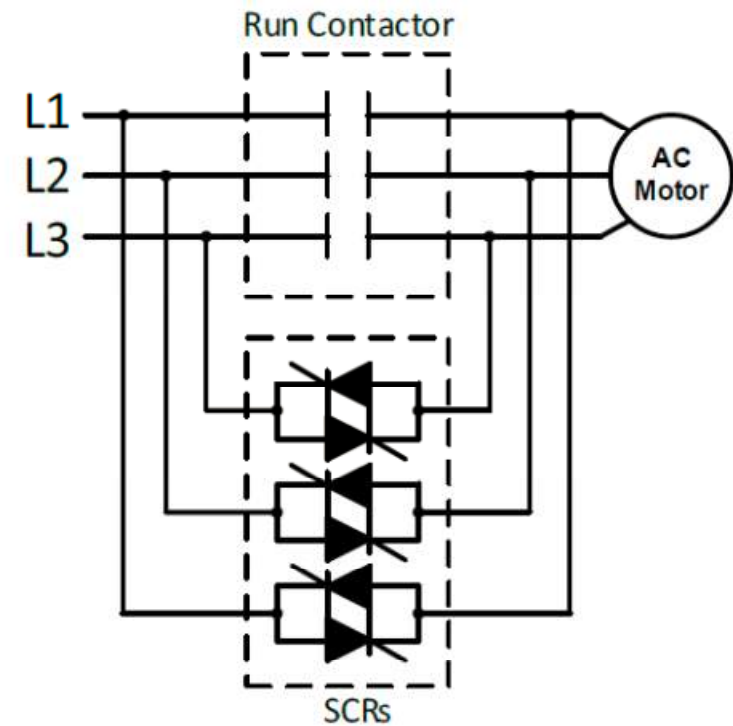
# What is the benefit



# Soft Starter



Simplified One-line of a Solid State Reduced Voltage Soft Starter



# VFD

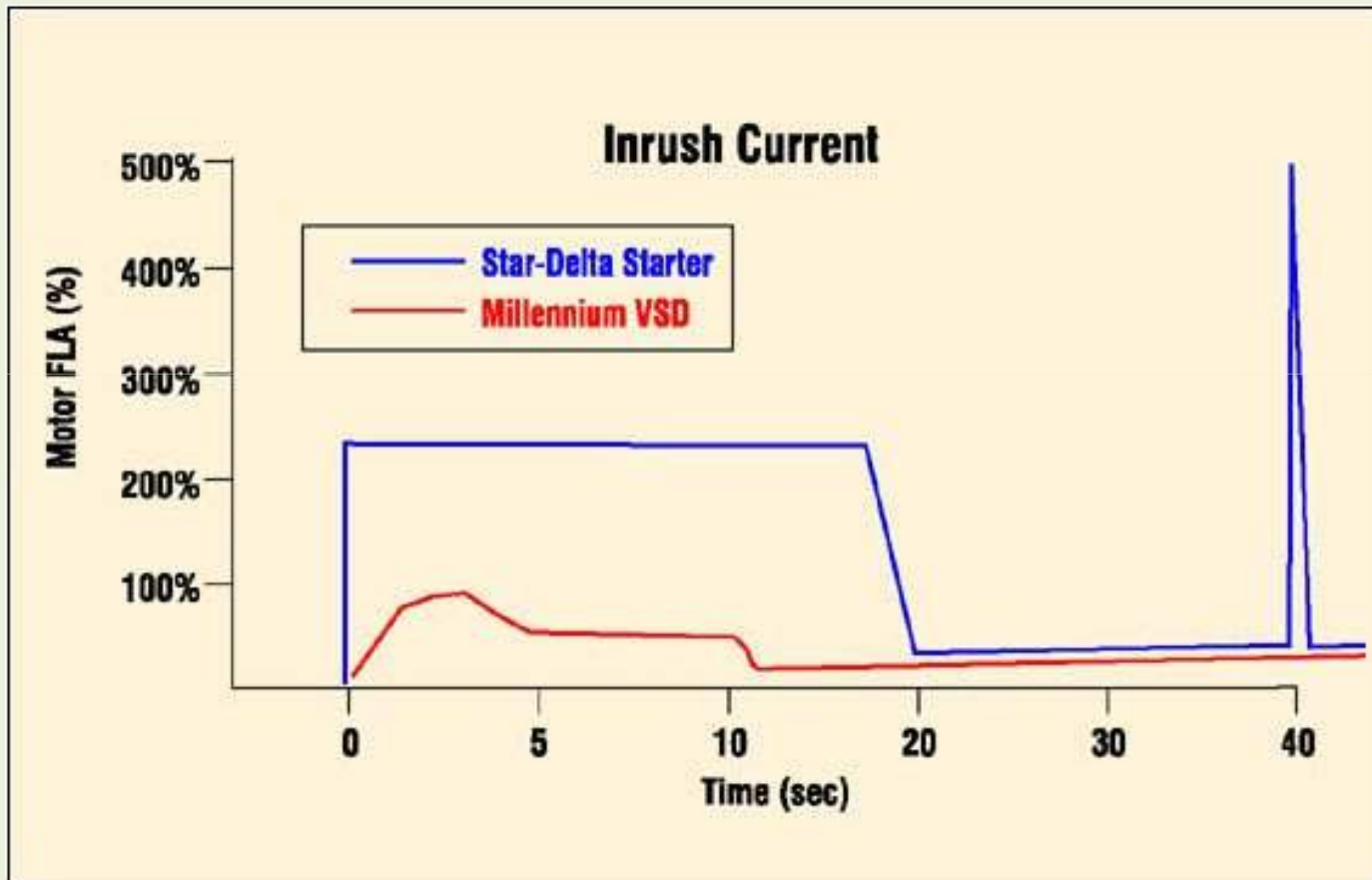
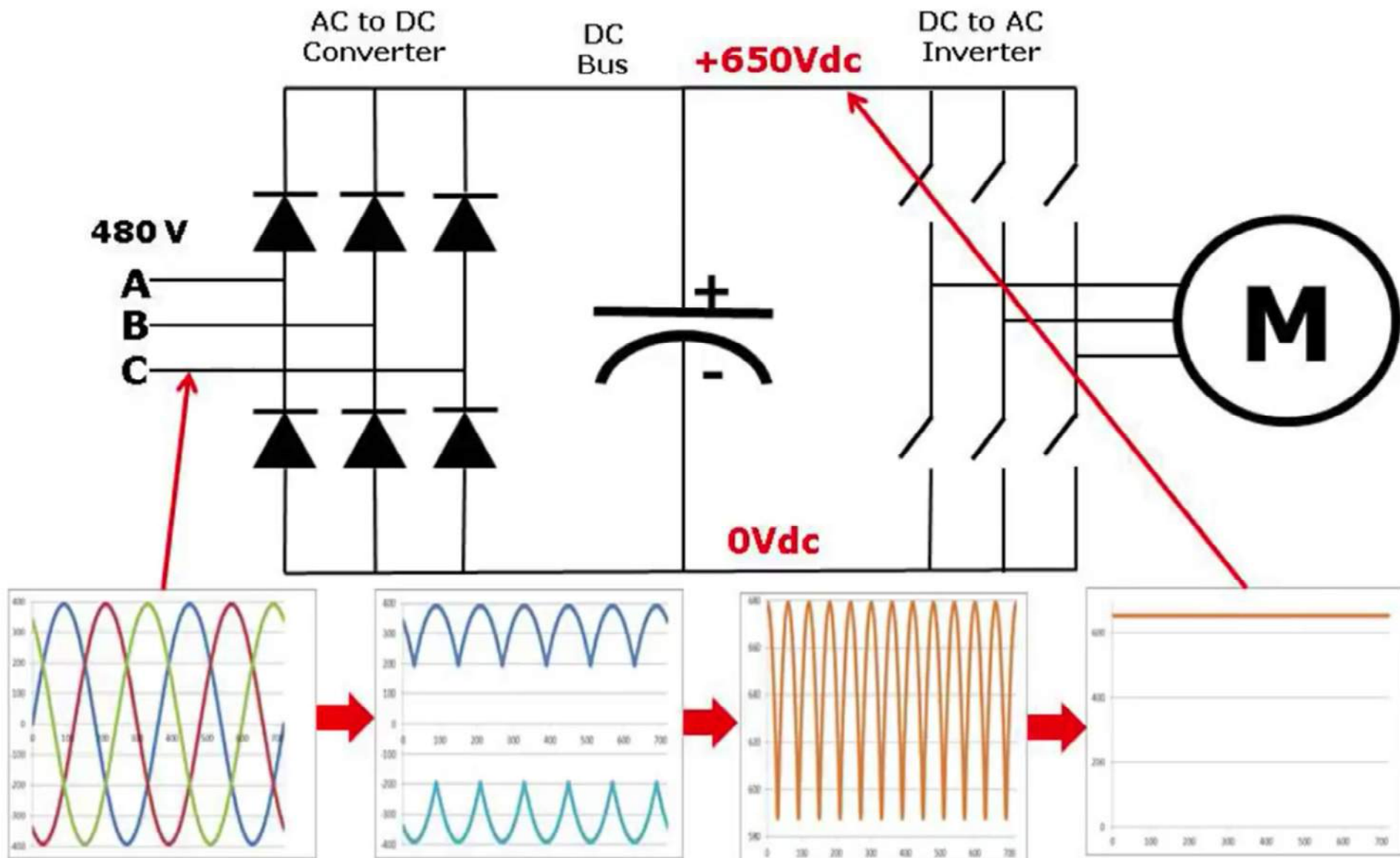


Figure 5 : Starting characteristics of VSD





Rated output kW	Minimum efficiency %			
	2 pole	4 pole	6 pole	8 pole
0.73	78.8	80.5	76.0	71.8
0.75	78.8	80.5	76.0	71.8
1.1	80.6	82.2	78.3	74.7
1.5	82.6	83.5	79.9	76.8
2.2	84.1	84.9	81.9	79.4
3	85.3	86.0	83.5	81.3
4	86.3	87.0	84.7	82.8
5.5	87.2	87.9	86.1	84.5
7.5	88.3	88.9	87.3	86.0
11	89.5	89.9	88.7	87.7
15	90.3	90.8	89.6	88.9
18.5	90.8	91.2	90.3	89.7
22	91.2	91.6	90.8	90.2
30	92.0	92.3	91.6	91.2
37	92.5	92.8	92.2	91.8
45	92.9	93.1	92.7	92.4
55	93.2	93.5	93.1	92.9
75	93.9	94.0	93.7	93.7
90	94.2	94.4	94.2	94.1
110	94.5	94.7	94.5	94.5
132	94.8	94.9	94.8	94.8
150	95.0	95.2	95.1	95.2
< 185	95.0	95.2	95.1	95.2



# Thank You

Pat Daley