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Reduction of Electricity Consumption and Water Cost in Pump Application

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Importance of saving energy for Albania

- Electric energy is produced on 100% from hydropower. Total dependence from weather
- Limited resource.
- No enough capacity to transmit energy from import.
- High price of imported energy.
- Increasing of electricity consume more than other energy.
- 24% of consumed electrical energy is losing.

Targets by NEEAP

Energy savings versus total consumption by 15% in 2030.
Reduction of green gases emissions versus total 11.5% in 2030

I. TARGET OF ENERGY SAVINGS (NEEAP)

Sector	Energy Savings (ktoe)		
	2018	Up to 2020	
Residential	10,6	37,43	
Services	6,27	16	
Industry	3,7	6,9	
Transport	14,2	49,49	
Agriculture	3,7	13,9	
Total savings potential	38,5	123,7	
Total savings potential (GWh)	447.8	1438.5	

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Replacement of 20% of low efficient electrical drives with energy efficient ones up to 2020

Situation of water sector in Albania

The total volume of water is obtained by 316 systems, 93 of them are of free flow, through which is produced on average 109 million m^3water/year, while 223 are of mechanical systems, through which is produced on average 160 million m^3water/year.

59% of the total volume of produced water is provided through the mechanical systems that are associated with energy consumption.

The energy consumption occupies 25% of total costs of produced water.

Performance Indicators Water Sector

Performance indicators	2018	2019	Trend
Water Supply %	77	77.2	↗
Sewer infrastructure %	52	52.9	↗
Operation & Maintenance Cost %	91.75	81.95	↘
Level of measurement %	74	77.5	↗
Water Without income %	63	63	=
Staff Efficiency	5.35	5.31	↘
Water Supply presence (Hour/Day)	12.7	13.2	↗

So, only 36 % of water is used efficiently and 63% of produced water is wasting.

Situation of water system in Lezha before

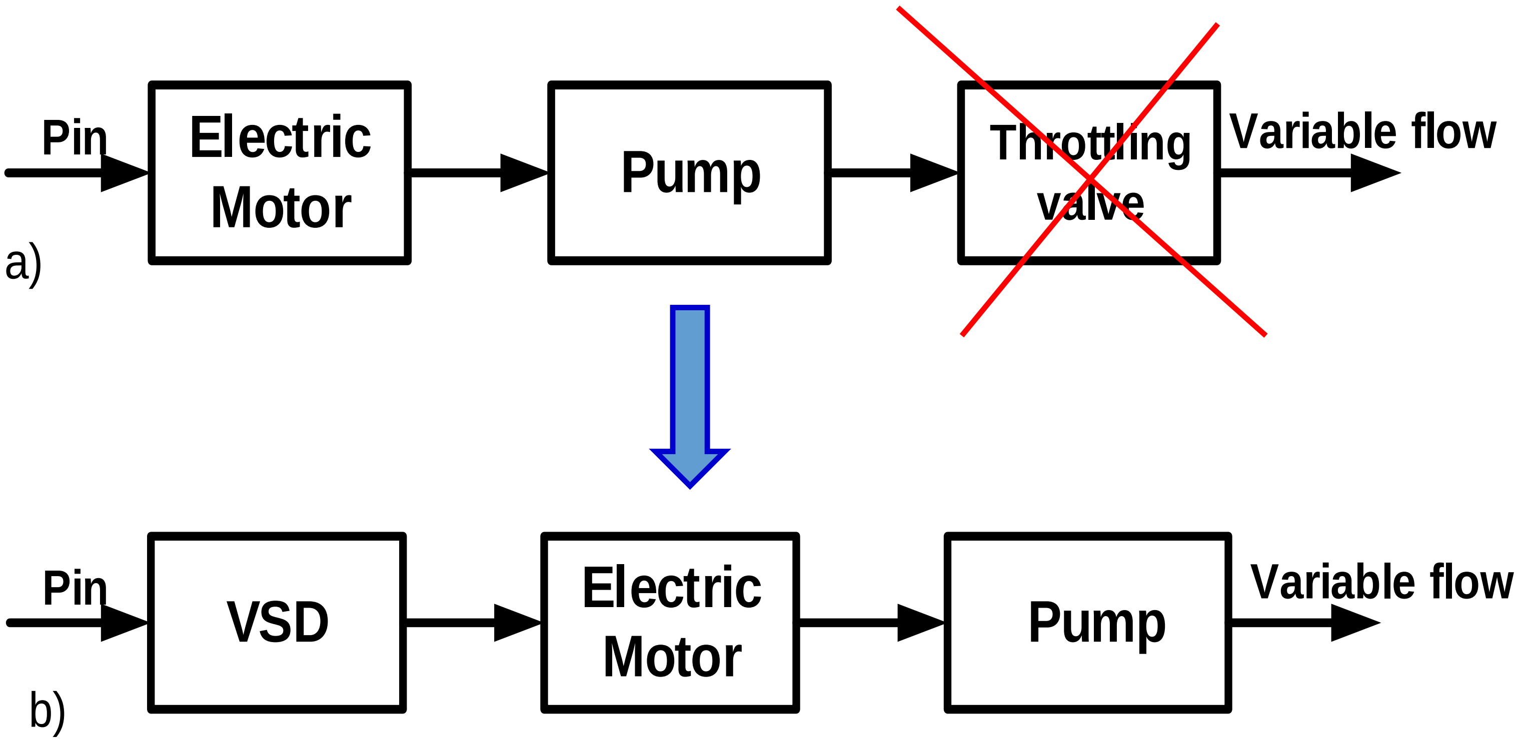
Fig. 1 The old pumping system

The existing water system had three wells with three individual pump application and throttling valve at the pump output.

Energy Efficient Electric Drives

Saving energy factor	Average Energy saved
Energy Efficient Motor (EEM)	2% - 8%
Size Correction	1% - 3%
Repairing of EEM	0.5% - 2%
Variable speed Drive (speed control)	10% - 50%
Optimizing of load	2% - 10%
Quality of electric energy	0.5% - 3%
Maintenance	1% - 5%

Energy Efficient Electric Drives



1. Block diagram of variable flow pumping application a) IM constant speed by throttling valve, b) Control of IM speed and flow regulation by a VSD [12]

Energy Efficient Motor

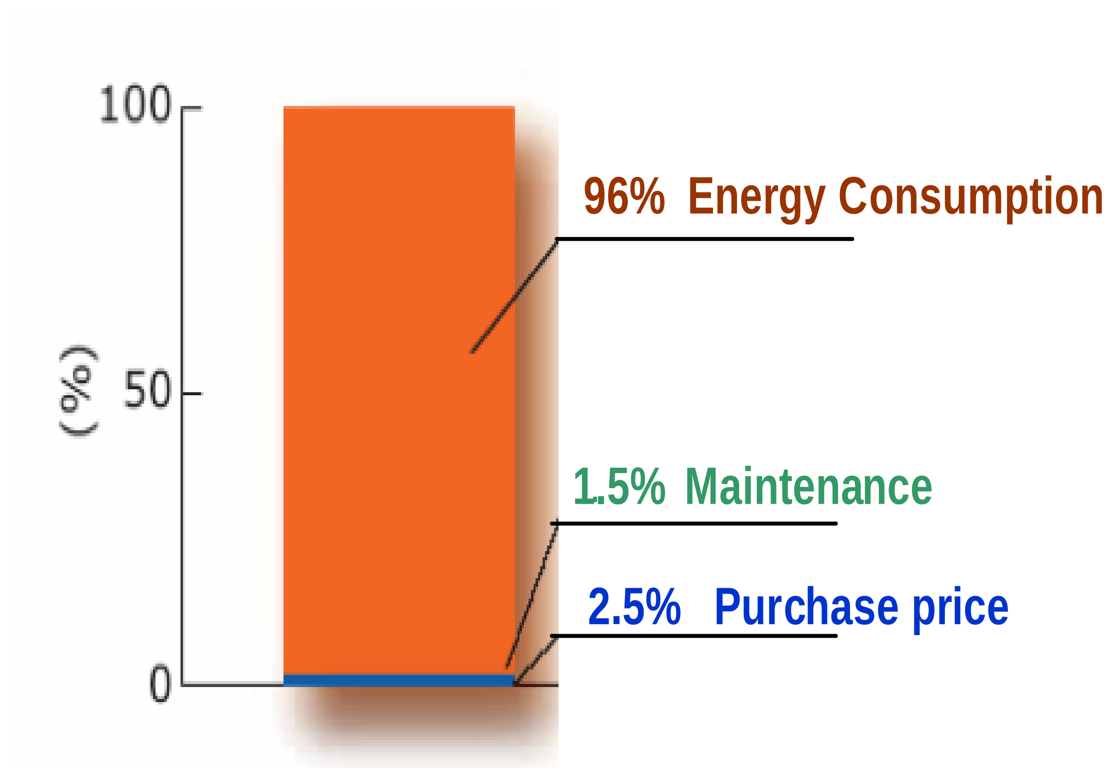


Fig. 2. Life cycle Cost of induction motor

Energy Efficient Motor

Standard IEC 60034-30:2008 defines the efficiency classes for low voltage three-phase motors with a power range from 0.75 kW to 375 kW.

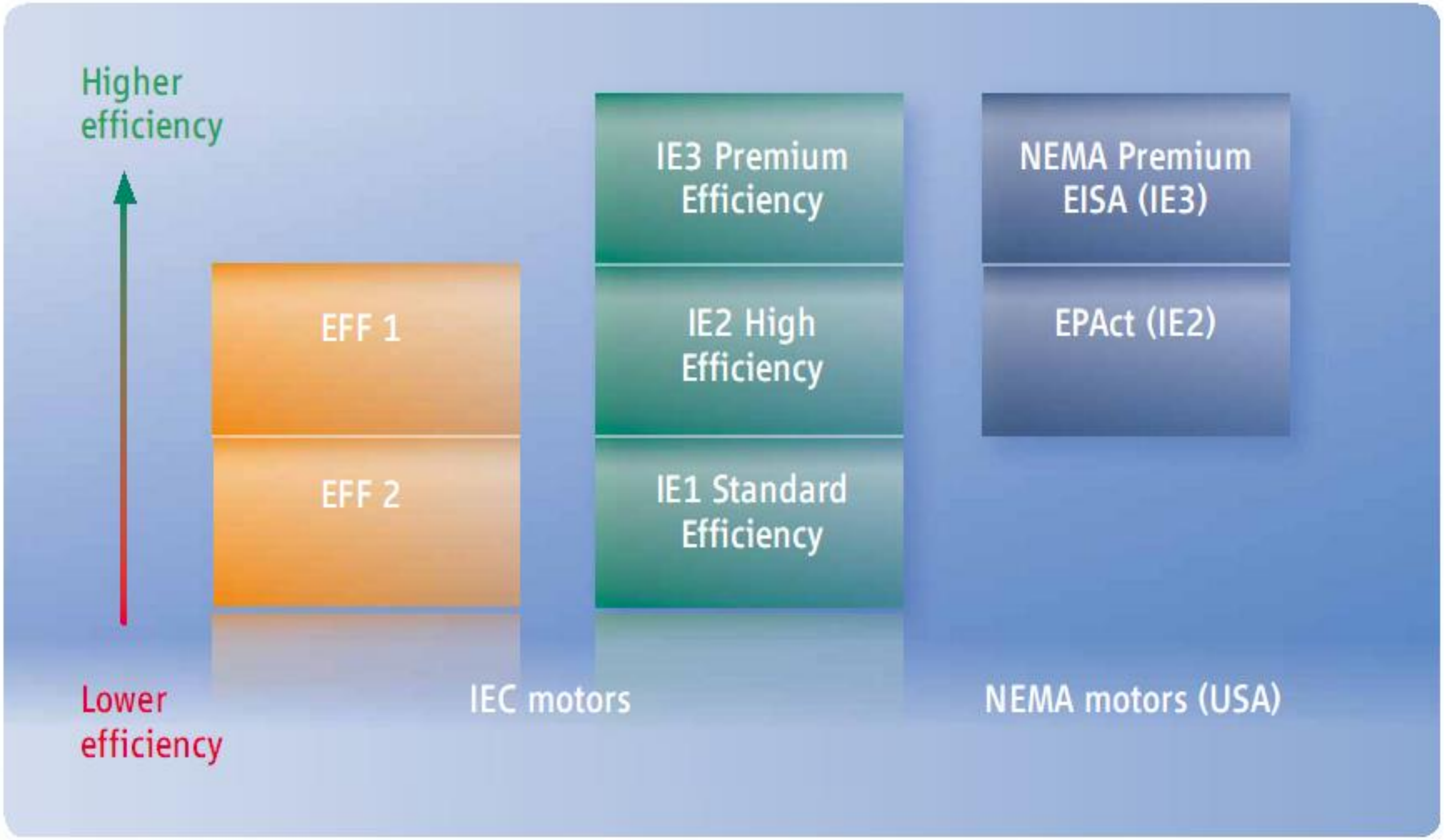


Fig. 3. New Efficiency Classes

Advantages of Energy Efficient Motor

- Lower energy cost.
- Higher power factor.
- Energy efficiency motors tend to run cooler,
- Longer life of the motor.
- Smaller, less expensive power factor correction.
- Noise reduction.
- Reduced ventilation is required.
- Lower maintenance costs and improvement of operations in industry due to robustness and reliability.
- Increasing the productivity.
- Efficiency at reduced load increase, due to the reduced non-load losses.
- Ability to handle overload conditions improves.
- Improved work to abnormal operating conditions.
- Advantages in application with supply coming from inverters.

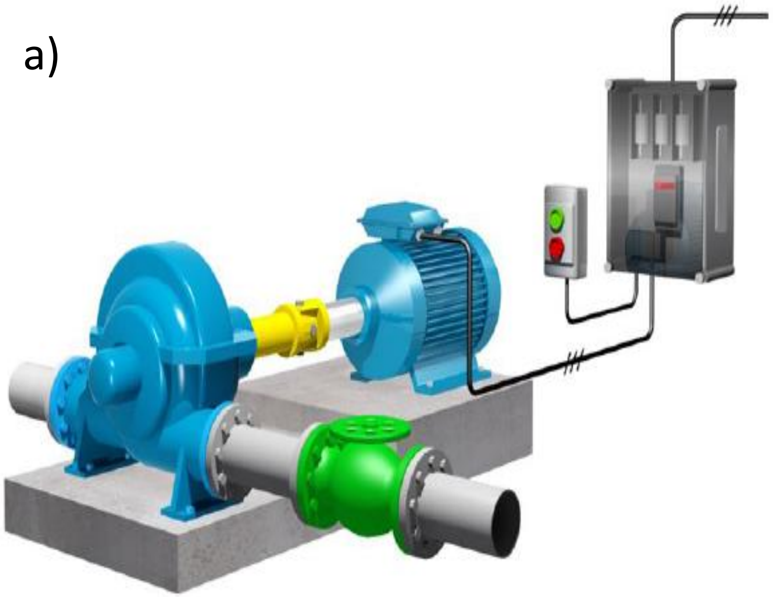
Energy and Economic Savings

Energy and economic savings by replacement of low efficiency motor with proper sized EED one.

Efficiency Class	EFF3	IE2	TOTAL
Motor rated power (kW)	225	190	
Annual working hours (h)	3285	3285	
Efficiency (%)	90	95	
Power factor	0.75	0.79	
Active energy consumed (kWh/y)	615937	492750	
Differential Cost (€)	10000	10000	
Price of active power (€) [16]	0.1	0.1	
Price of active power (€) [16]	0.015	0.015	
ENERGY AND ECONOMIC SAVINGS			
ENERGY SAVINGS (KWH/Y)		123187	369561
ENERGY SAVINGS (€/Y)		12318	36956
ENERGY SAVINGS (KVARH/Y)		160790	482370
ENERGY SAVINGS (€/Y), REACTIVE POWER		2412	7236
CO_2 emission reduction (0.4 KG/KWH) (KG)		49274	147824
Simple payback periods (y)		0.81	
Net present value for 25 years (€)		297968	893906

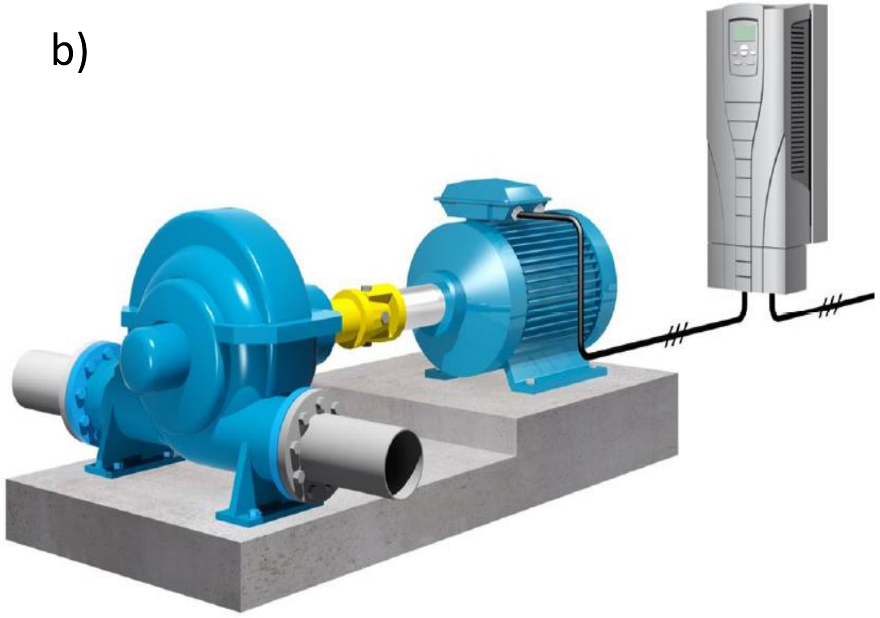
2. VSD in pumping application

a)



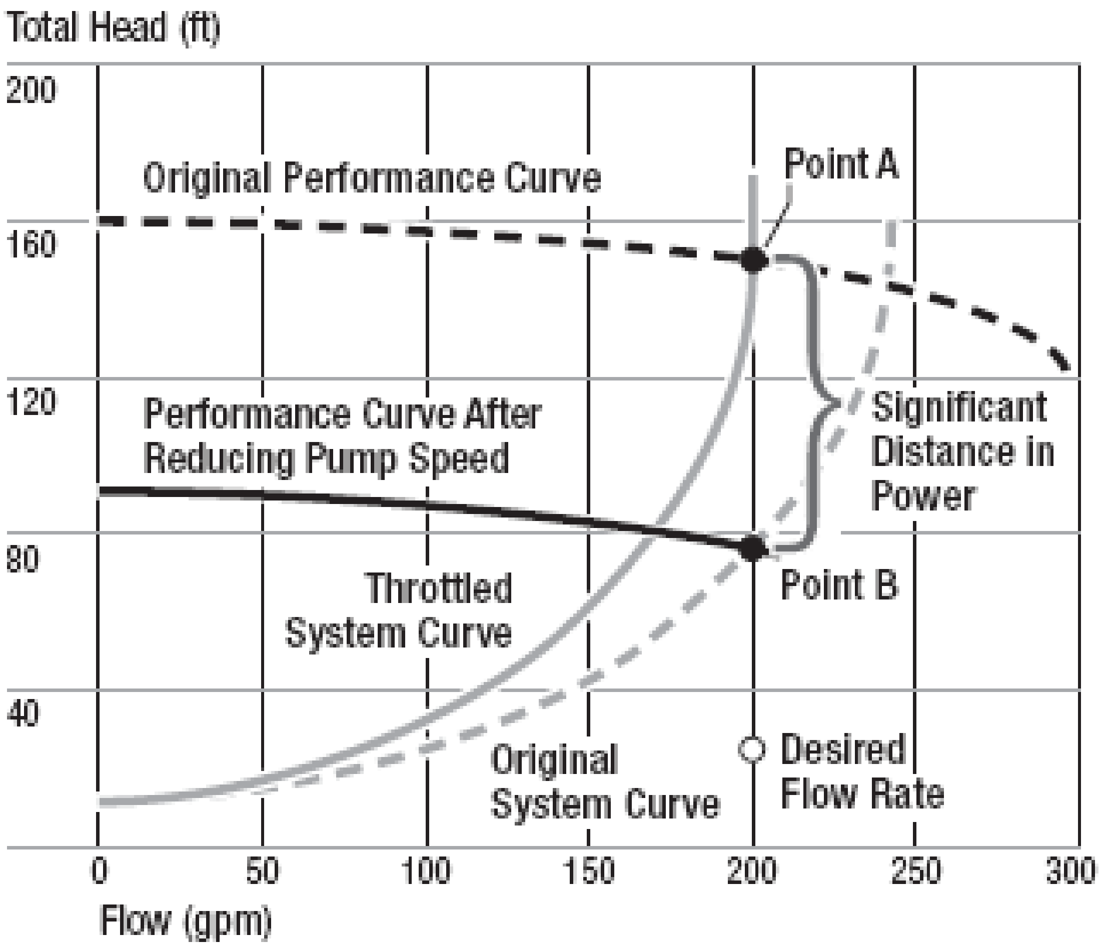
a) Starting by inductive reactors and flow control by mechanical valve.

b)



b) Starting and flow & speed control by VSD

2. VSD in pumping application



$$\frac{Q_1}{Q_2} = \frac{n_1}{n_2}$$

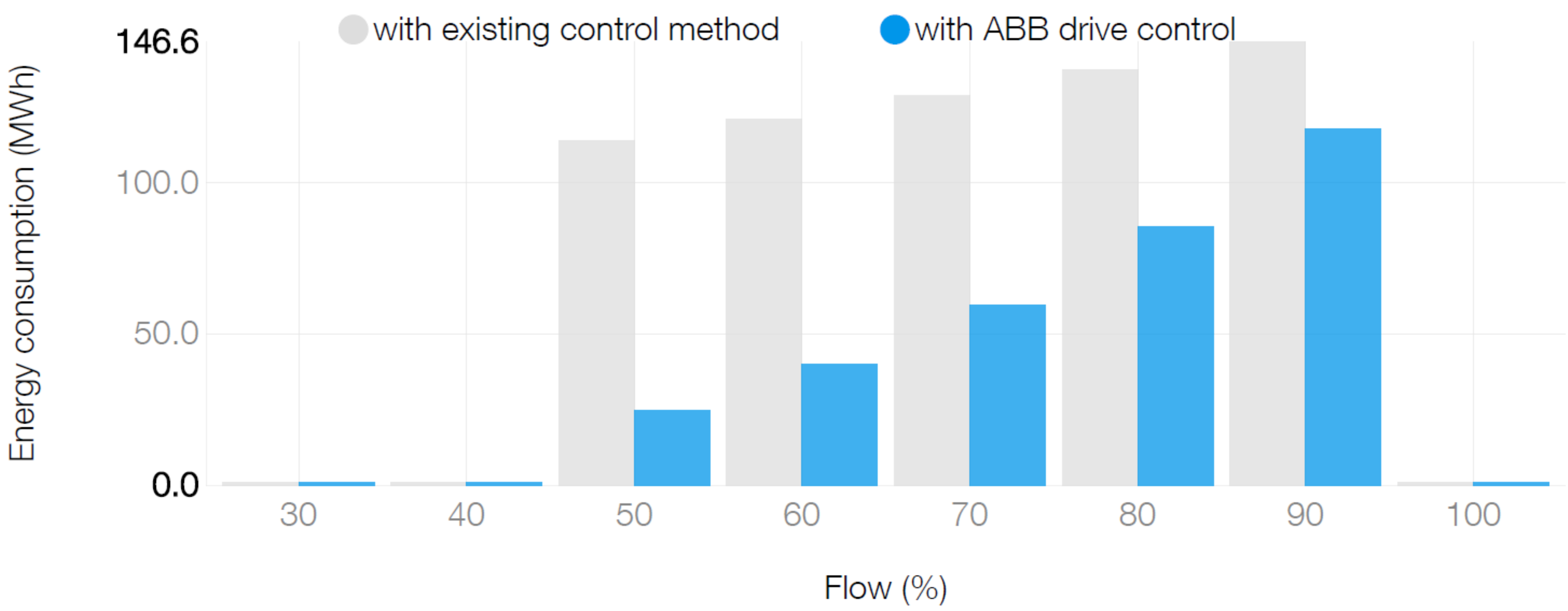
$$\frac{H_1}{H_2} = \left(\frac{n_1}{n_2}\right)^2$$

$$\frac{P_1}{P_2} = \left(\frac{n_1}{n_2}\right)^3$$

2. Energy and economic savings

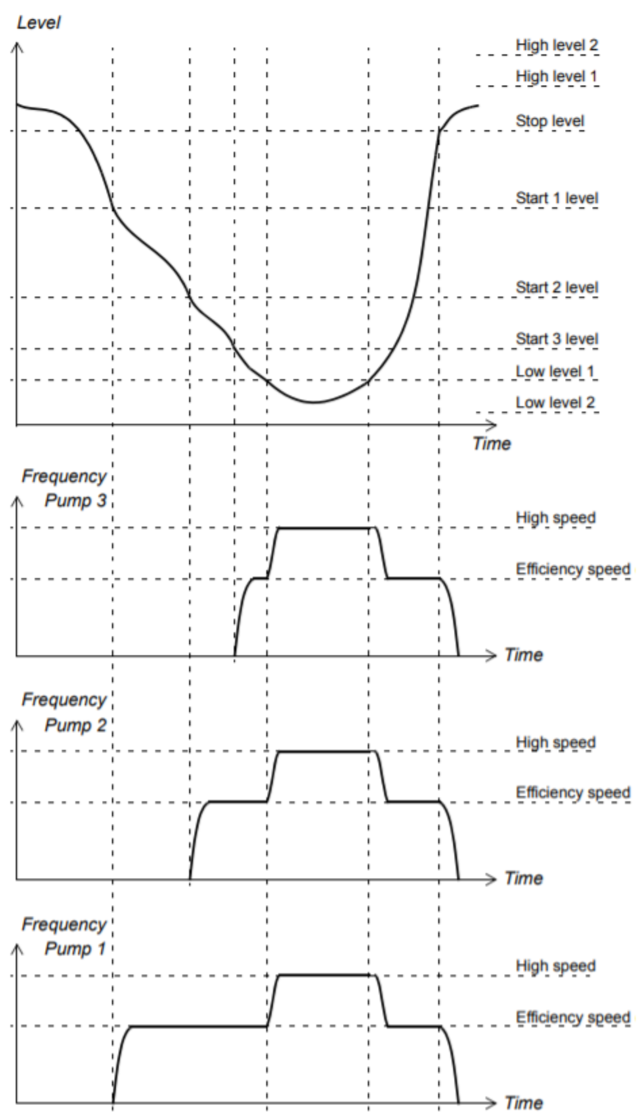
With throttling valve	Running cost
Motor annual energy cost (€/y)	49275
Working hours per year (h/y)	3285
With VSD	
Price of VSD and installation cost (€/y)	22000
Motor speed down in % (2100 – 2900 rpm)	12
Revised energy cost with VSD (€)	35499
Energy savings (€/y)	13776
Energy savings (%)	28
Simply payback period (y)	1.6
Net savings for 10 years (€)	115718
Total net saving for three pumping systems (€)	347155

2. Energy and economic savings



3. VSD in parallel pumps control

Fig. 4 illustrates the operation of three parallel pumps controlled by VSD, in Lezha pumping station depend from the required flow



2. VSD in pumping application

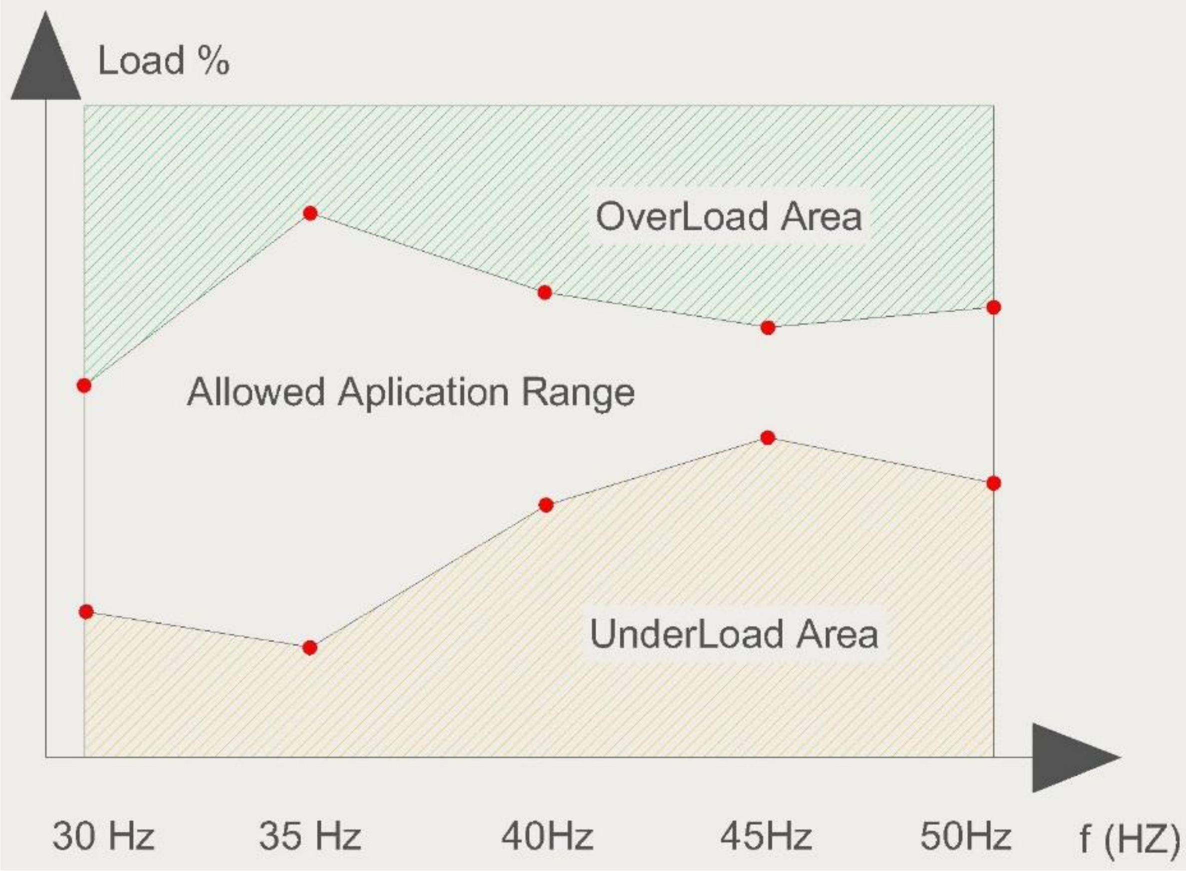


Fig.5. VSD used to optimised operating area.

Load Curve

Each curve is presented by five points that represent torque as a function of frequency.

A fault can be set up to occur when the curve is exceeded. The upper boundary (overload curve) can also be used as a torque limiter.

2. VSD in pumping application

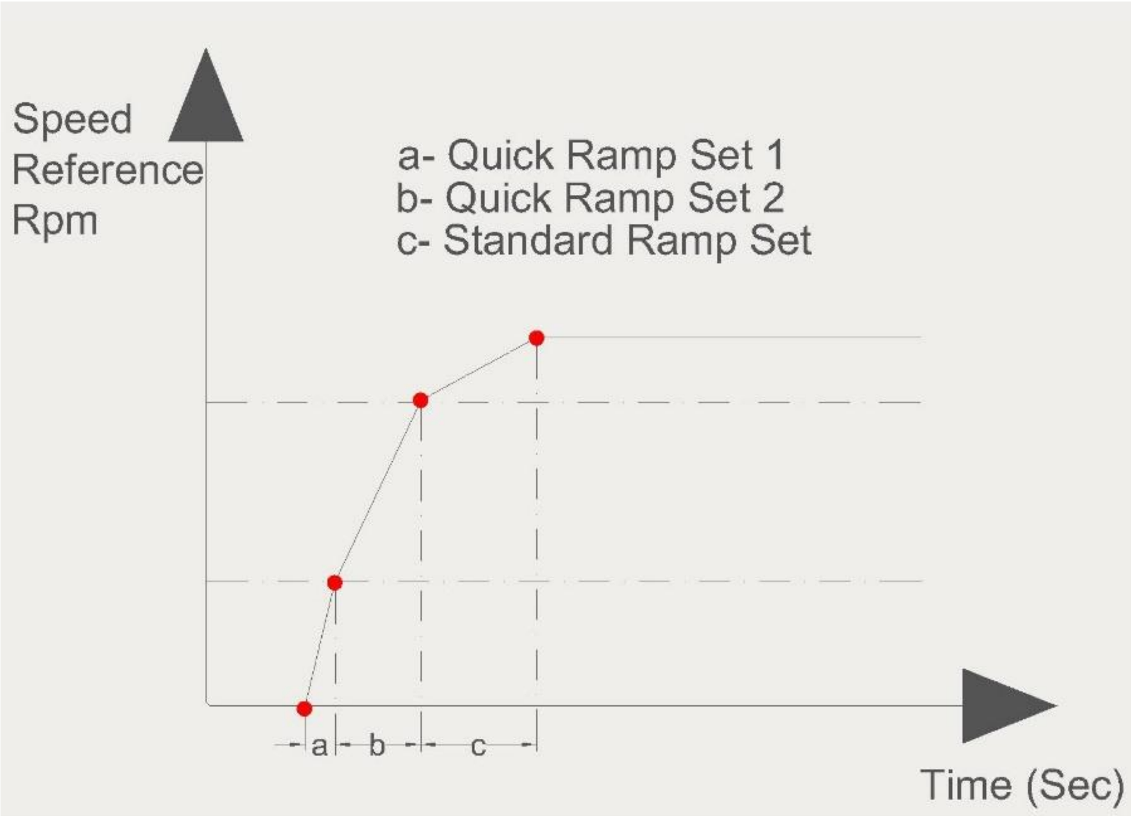


Fig.6. VSD used to have fast starting to BEP.

Quick ramp mode
Ramp mode allows the application to define multiple ramp sets to accelerate or decelerate the pump.

A quicker ramp time used to accelerate the pump to a certain speed 0-25Hz, after which a slower standard ramp time is used to control the process in normal operation.

2. VSD in pumping application

Electrical Medium-Voltage and Hydraulic Room before intervention

Electrical Medium-Voltage and Hydraulic Room after intervention

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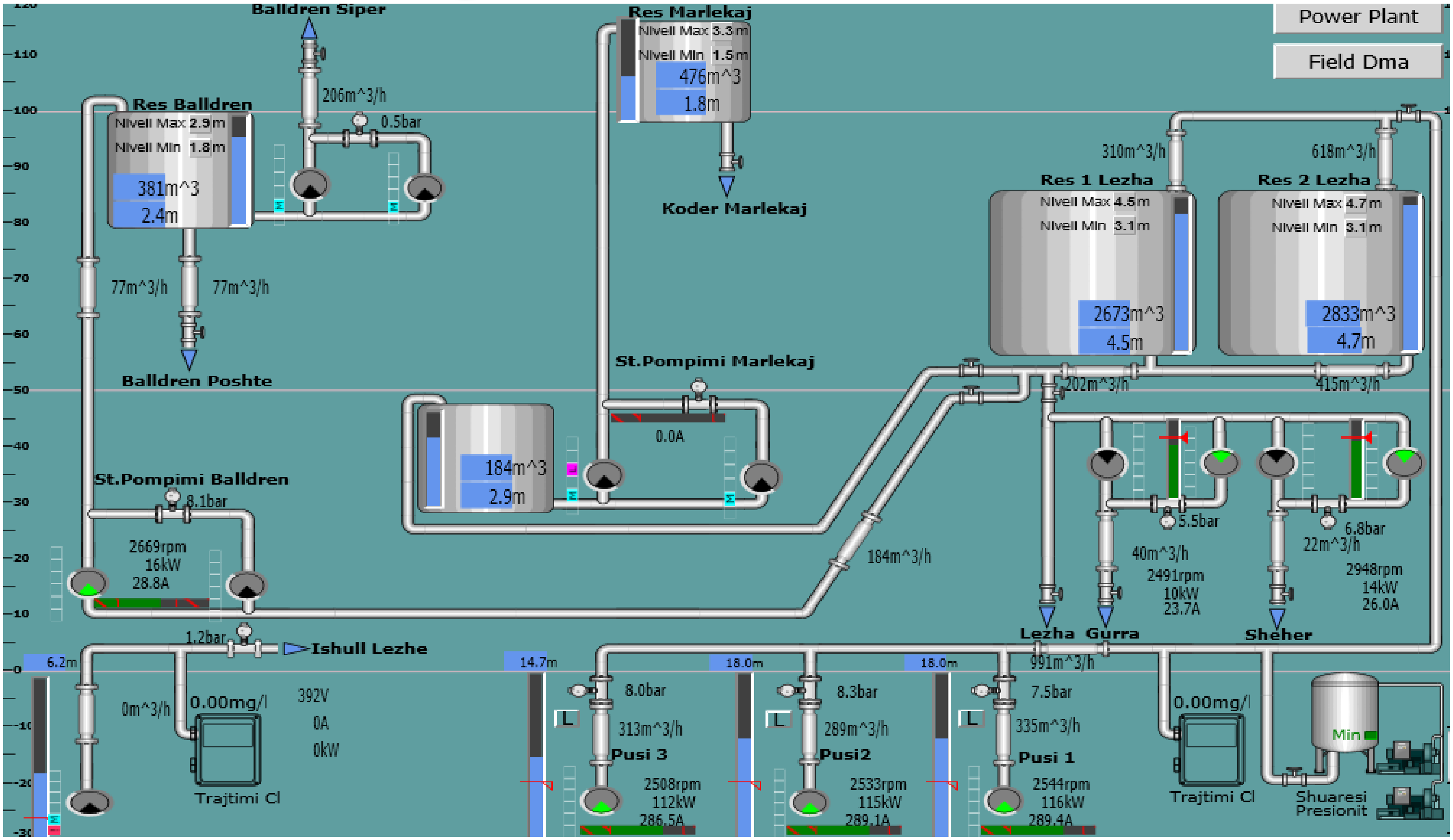
3. SCADA system for better control and management of water flow



Using of SCADA system in Lezha pumping station

- ✓ Underground water saving as the SCADA system optimized overfilling of reservoirs into Lezha.
- ✓ Ensuring a sustainable underground earth structure around wells. SCADA system monitors the underground water level by controlling static underground water level and protecting against underground dynamic water level.
- ✓ Electrical energy saving consumed from mains high pressure pumps (when the reservoirs are full pump stops saving energy and pumps consumed less).
- ✓ Monitoring of water level into Lezha Deposits, gives the possibility for further optimizing of drinkable water distribution into the city and surroundings.

Conclusions

High efficiency drives used in water pumping application bring:

- Potential energy savings, from 20%-50% when electric drive works:
  - using efficient motor instead of standard one,
  - proper sized efficient motor
  - using VSD to control speed
  - using parallel pumps with VSD control,
  - improve pump reliability by selecting the most suitable control scheme.
- Improving finance situation and stability of water company
- Better management of water resources
- Contributing in environmental protection
- Reduction of CO_2 emission, etc.
- A more effective management of the costs.
- Longer hours supply to consumers up to 21 hours.

Using high efficient drives on pump application will bring: potential energy and economic savings, better management of water resources and environmental protection.

Thank You!