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BEST PRACTICE PROGRAMME

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# Good Practice – Case Study

## VARIABLE SPEED DRIVES ON WATER PUMPS

**Case Study Objective**
To demonstrate the cost and energy savings which can be achieved by using variable speed drives (VSDs) to control two water pumps serving the factory ring main.

**Potential Users**
Any user of pumps which require varying flow rates.

**Investment Cost**
£6,900 (1990 prices).

**Savings Achieved**
191,000 kWh (688 GJ)/year worth £5,910 (1990 prices).

**Payback Period**
1.2 years.

**Case Study Summary**
The process water distribution system at Creda consists of a 6 inch cast iron ring main which is fed from two sources. Severn Trent water (termed raw water) is pumped into the main from a storage tank. Creda also have their own borehole, from where water is pumped directly into the distribution main.

Mains pressure and flow rates produced by these pumps were mechanically controlled by a pressure relief valve and a throttling valve. This method of control caused high motor loadings.

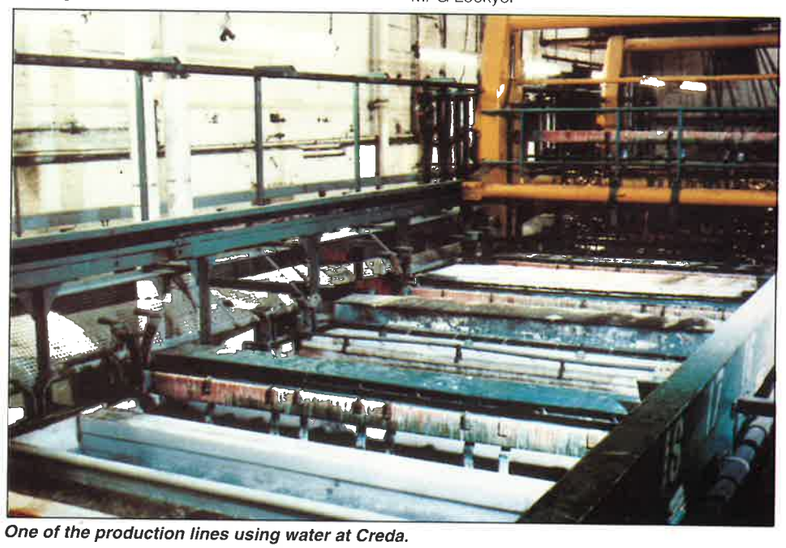
In an attempt to reduce electricity consumption these mechanical control methods were replaced by VSDs, enabling pressure and flow rates to be controlled by varying the speed of the pump motors.

This project has been a success; the equipment operated reliably and substantial energy savings were achieved.

**Host Organisation**
Creda Ltd
PO Box 5
Creda Works
Blythe Bridge
Stoke-on-Trent ST11 9LJ

**Monitoring Contractor**
FEC Consultants Ltd
Wellington House
63 Queens Road
Oldham OL8 2BA
Tel No: 061 652 5331
Mr D W Lowther

**Equipment Supplier**
Danfoss Ltd
Perivale Industrial Park
Horsenden Lane South
Greenford
Middlesex UB6 7QE
Tel No: 081 991 7000
Mr G Lockyer



*One of the production lines using water at Creda.*

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Energy Efficiency Office
DEPARTMENT OF THE ENVIRONMENT

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### Project Background

Creda Ltd have an ongoing commitment to energy efficiency. They have progressively reduced their overall energy consumption by implementing various energy saving schemes.

The factory produces domestic appliances on a number of production lines each of which have various requirements for process water.

As a part of Creda's commitment to energy efficiency, investigations were carried out into the possible reduction of the pumping costs associated with the process water used on site. These investigations led to the installation of a VSD on the borehole water pump. The success of this project prompted Creda to install an additional VSD in the raw water pump house.

### Water Distribution System

The process water distribution system consists of a 6 inch cast iron ring main. The ring main is fed from two sources, Severn Trent water and borehole water.

Severn Trent water is pumped from a 200,000 gallon (910,000 litre) storage tank into the ring main by one of two pumps, each driven by a 15 kW induction motor. The pumps are used on a duty/stand-by basis and both are capable of providing much higher pressures and flow rates than required.

Borehole water is pumped directly into the ring main by a borehole pump which is driven by a submersible 30 kW induction motor.

### Original Control Method

Control of both the ring main pressure and the pump flow rates was originally achieved by mechanical means.

Pressure in the ring main was controlled by a pressure relief valve which diverted excess water back into the storage tank. This system caused the raw water pump to be fully loaded at all times.

The allowable flow rate from the borehole pump is governed by the company's water abstraction contract. To maintain flow rates within this limit a partially closed valve between the pump and the ring main was used to throttle the flow. As the pump was working against a restriction the motor was subjected to high loading.

### VSD Installation and Commissioning

Installation of the borehole pump VSD was carried out in March 1986. The aim of this installation was to control the flow rate of water by controlling the pump speed, thus removing the need for the throttle valve, and thereby reducing the load on the motor.

The VSD installed is a pulse amplitude modulated (PAM) frequency converter rated at 27 kW output. This unit was selected as it was envisaged that motor loadings would not exceed 27 kW when operating under the new regime. Speed control of the pump is achieved by manual adjustment of a potentiometer which provides the VSD with a signal representing the desired pump speed, and hence gives the required flow rate.

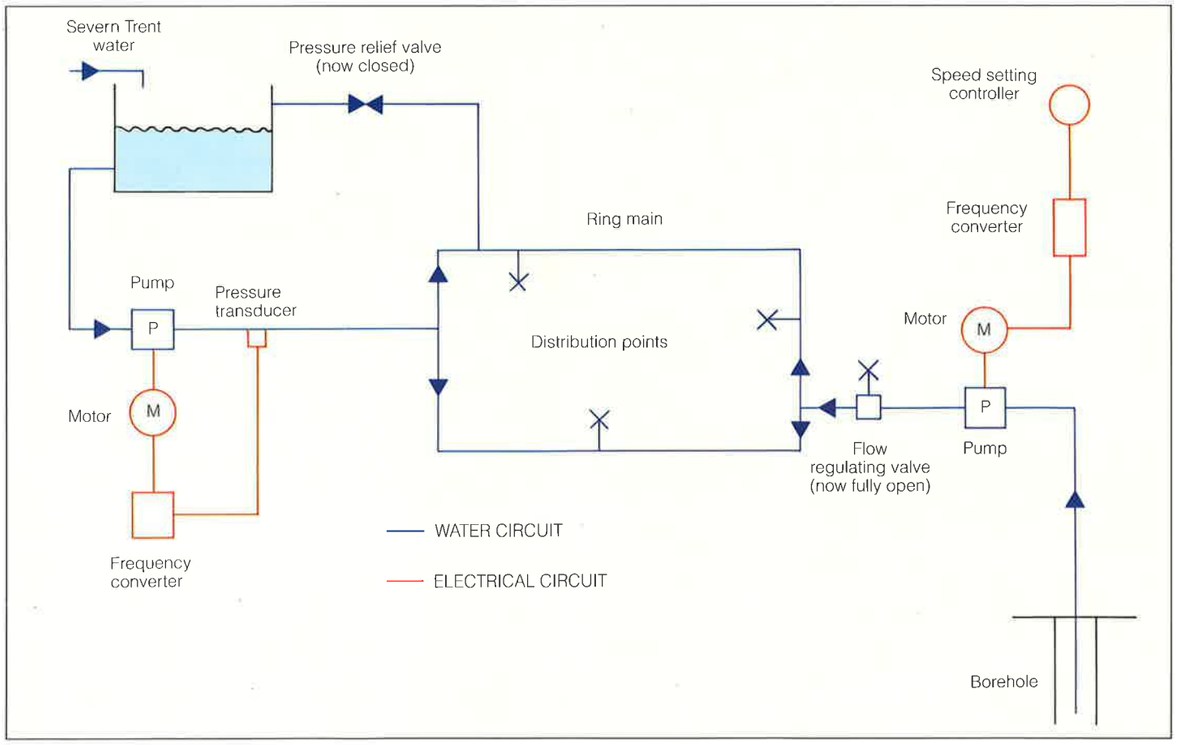
Automatic control of flow rate was considered and then rejected as being unnecessary; changes in pump speed are only required to compensate for pump wear or to meet new abstraction allowances.

Installation and commissioning could have been achieved within one day, but was performed by Creda's own staff over a weekend period to avoid affecting production. The installation of the unit was uncomplicated. The wiring of the unit was straightforward; the three phase supply was connected to the unit's input terminal block, the three phases to the motor were connected to the unit's output terminal block and the signal potentiometer was wired to the appropriate terminal block.

The raw water pump VSD was installed to control mains pressure by controlling the pump speed. The unit was installed in August 1990 and is a voltage vector control (VVC) frequency converter (an improvement on PAM), with a rated output of 15 kW, which is equal to that of each of the raw water pumps.

Control of the ring main water pressure is achieved by varying the speed of the pumps in response to a signal from a pressure transducer which is fitted in the ring main. This pressure transducer was fitted along with the VSD as a complete package to enable automatic control to be achieved.

Again the installation and commissioning was uncomplicated being carried out by Creda staff over a weekend period.




***Water distribution system with VSD control.***

***Borehole pump VSD with former throttling valve.***

Reliability and performance has been good with only one fault occurring. This was caused by a faulty circuit board on the more recently installed raw water unit. The fault was quickly diagnosed and promptly repaired under warranty.

### Energy Saving

Monitoring was performed with the system operating under the original conditions and then under VSD control.

Recordings of energy consumption from the monitoring programme revealed that substantial energy savings had been achieved by each of the installations.

The borehole pump showed a reduction in unit consumption of 79,300 kWh/year which is equivalent to a 29.7% saving.

The raw water pump produced even larger savings of 111,750 kWh/year corresponding to an 88.2% reduction in consumption.

A combined saving from the two installations of 191,050 kWh/year was therefore achieved. This is equivalent to an overall reduction in consumption of 48%.

These large savings have been possible through both improved utilisation of the motors and a reduction of the motors' loading to more closely match the requirements of the water distribution system.

***Raw water pumphouse with wall mounted VSD.***

### Economic Analysis

Savings achieved by the installation of the two VSDs at Creda have been substantial, resulting in short payback periods.

Installation of the borehole VSD cost £4,100 at 1990 prices. The energy saving achieved is worth £2,450/year resulting in a simple payback for this installation of 1.7 years.

The raw water pump VSD cost £2,800. Comparing this capital cost against savings of £3,460 achieved by the installation gives a simple payback of 10 months.

The combined project therefore had a total cost of £6,900 based on 1990 prices. Setting this against the total annual savings made at 1990 prices of £5,910/year gives an overall payback period of 14 months.

### Future Potential

The installation of VSDs at Creda has demonstrated that substantial savings can be achieved. Capital costs were moderate, enabling the investment to be recovered relatively quickly. This is in addition to the simple installation, minimal maintenance and good reliability making it an attractive option for reducing running costs of pumped systems.

Excellent control of pressure and flow rate has also been demonstrated by the installation.

As the use of motors spreads across every sector of industry the potential market for VSDs is huge. Any company operating motors which are artificially loaded to restrict performance would benefit from the installation of variable speed drives, although the economics of individual installations will vary.

**Comments from Creda Ltd**

The installation of VSDs on our mains water pumps is one of numerous energy saving projects undertaken by our Works Engineering Department to reduce running costs on our Blythe Bridge site.

The use of VSDs has been particularly successful with approximately 20 installations completed and several others planned. Pilot scheme results have proved theoretical energy savings, as well as highlighting important but unquantifiable environmental and maintenance benefits. The "soft start" facility (ramp up time) is useful in preventing "water hammer" in our ageing six inch cast iron ring main. Other noticeable advantages include reduced noise levels, lower motor operating temperatures, and extended bearing and pump life.

The ease of installation and operation of the latest generation of frequency converters makes them ideal for retrofitting to existing plant, and we feel confident that similar savings are easily attainable on many other sites in Great Britain.

Mr D A Paterson
Assistant Managing Director
Creda Ltd

**Creda Ltd, Blythe Bridge**

Creda Ltd is one of the biggest and most successful names in the UK domestic electric appliance industry. Its history goes back to the turn of the century and the company has played a pioneering role in the development of electrical appliances for the home.

Skilled workers keep pace with the latest high technology products and manufacturing techniques at the Creda headquarters at Blythe Bridge, Stoke-on-Trent, and at a supporting manufacturing plant at Yate, near Bristol.

Creda's product range is one of the most advanced and comprehensive in Europe. It provides a wide and varied choice of cooking, laundry and heating appliances that offer quality, reliability and value for money. Its chief markets are the UK, France, Germany, Scandinavia, Holland, Belgium, USA, Canada and Africa.

As a member company of a joint venture agreement between GEC and GE, Creda is part of a world-scale appliance manufacturing group with ambitions for dynamic growth in Europe.

*The installation described here was selected as an example of Good Practice, which is one element of the Energy Efficiency Office's (EEO) Best Practice programme, an initiative aimed at advancing and promoting ways of improving the efficiency with which energy is used in the UK.*

**For further information on this or other industrial projects, please contact the Energy Efficiency Enquiries Bureau, Energy Technology Support Unit (ETSU), Building 156, Harwell Laboratory, Oxon OX11 0RA. Tel No: 0235 436747. Telex No: 83135. Fax No: 0235 432923.**

**For further information on buildings-related projects, please contact The Building Research Energy Conservation Support Unit (BRECSU), Building Research Establishment, Garston, Watford WD2 7JR. Tel No: 0923 664258. Telex No: 923220. Fax No: 0923 664097.**

**Information on participation in the Best Practice programme and on energy efficiency generally is also available from your Regional Energy Efficiency Office.**