Case Study 136

Cost and energy savings achieved by improvements to a compressed air system

Product testing

Savings Achieved (1991 Prices)

Phase 1: 160,693 kWh/year (578 GJ/year) worth £6,749

Phase 2: 110,497 kWh/year (398 GJ/year) worth £4,641

Total Savings: 271,190 kWh/year (976 GJ/year) worth £11,390

Payback Period

Phase 1: 2.4 years

Phase 2: 1.7 years

Total Payback: 2.2 years

Potential Users

Any compressed air user, particularly those:

- whose compressed air system has evolved over a long period;

and/or

- who are preparing for compliance with the Pressurised Systems and Transportable Gas Regulations;

and/or

- who require only parts of their system to be charged with compressed air at particular times of day.

Host Organisation

Creda Limited
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Monitoring Contractor

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Case Study Objectives

To demonstrate the cost and energy savings which can be achieved through the following improvements to a compressed air system:

- rationalising the distribution pipework and compressor usage;
- zoning individual areas by installing solenoid-operated valves.

Case Study Summary

Creda Ltd carried out a survey into compressed air generation at its Blythe Bridge factory. As a result of the survey, improvements to the compressed air system were carried out in two phases. The first phase was the rationalisation of the distribution pipework and compressor operation. The second phase involved the installation of solenoid-operated valves, controlled by the existing building energy management system, in each of the ten main production lines.

The first phase will make it easier for Creda to comply with the parts of the Pressurised Systems and Transportable Gas Regulations which come into effect in 1994.

Electrical energy savings of 7.4% were achieved after Phase 1 improvements, with a further 4.8% saving after Phase 2.

Investment Costs (1991 Prices)

Phase 1: £16,500

Phase 2: £8,000

Total Cost: £24,500

BEST PRACTICE PROGRAMME

ENERGY EFFICIENCY

"It is now our intention to move forward into monitoring and targeting of the Production Cost Centres to increase awareness of the costs involved in generating compressed air"

Background

Creda Ltd carried out a survey into compressed air generation and distribution at its Blythe Bridge factory as part of its on-going commitment to energy efficiency. The survey showed that compressed air was being used to operate small hand tools and as a power source in the operation of various plant items.

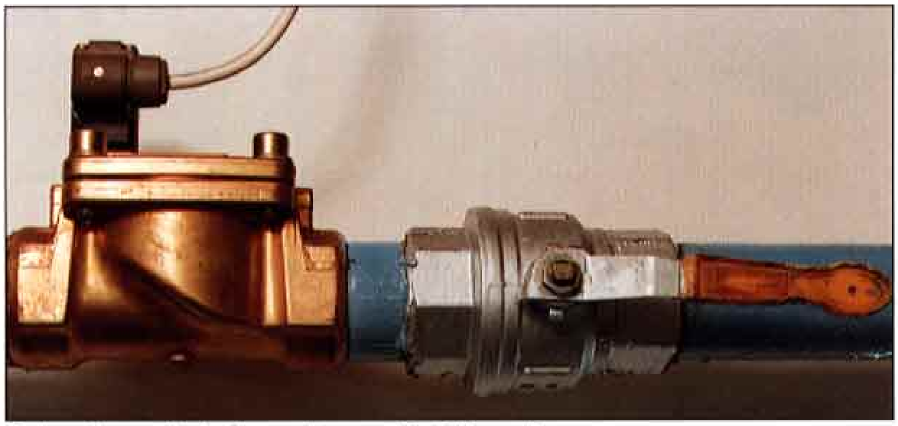
The compressed air system, having evolved over a long period, contained blanked-off sections of pipework and disused couplings. This meant that there were many areas where leaks could occur. Also, the distribution network was complicated because some production lines were supplied with compressed air via branches from other production lines.

All the available compressors, four reciprocating (nominally 2,000, 1,100, 1,000 and 600 cfm) and one centrifugal impeller (nominally modulating between 1,620 and 1,800 cfm) were operated irrespective of demand. It was decided that, as there was no suitable alternative to compressed air as a power source, improvements to the system should be made. These improvements were carried out in two Phases.

Phase 1

In order the comply with the parts of the Pressurised Systems and Transportable Gas Regulations which come into effect in 1994, Creda needed to map out its compressed air network so that the necessary maintenance schedules could be produced. It was recognised that this operation provided Creda with an opportunity to rationalise their system, by removing all unnecessary pipework and couplings, and to provide each production line with a single air supply fed directly from the ring main.

Cost savings were achieved not only by reduced leakage but also because the process of producing and working to the new maintenance schedules was simplified. A further advantage of the rationalisation was that correct pipework sizing reduced pressure drops to critical plant thus improving reliability.



Solenoid-operated valve and manual isolating valve

At this stage compressors were manually controlled so that only the compressors necessary to meet the expected demand were run.

Phase 2

During night shifts or overtime working the whole of the system had to be charged with compressed air. Although leakage was reduced in Phase 1, it is not possible for a system to be completely airtight so wastage, due to leaks, occurred even in those areas where no production was taking place. Phase 2 improvements solved this problem by the installation of ten solenoid-operated zone valves in the main supply to each production area. The valves are controlled via the building energy management system which has the capacity to control other utilities.

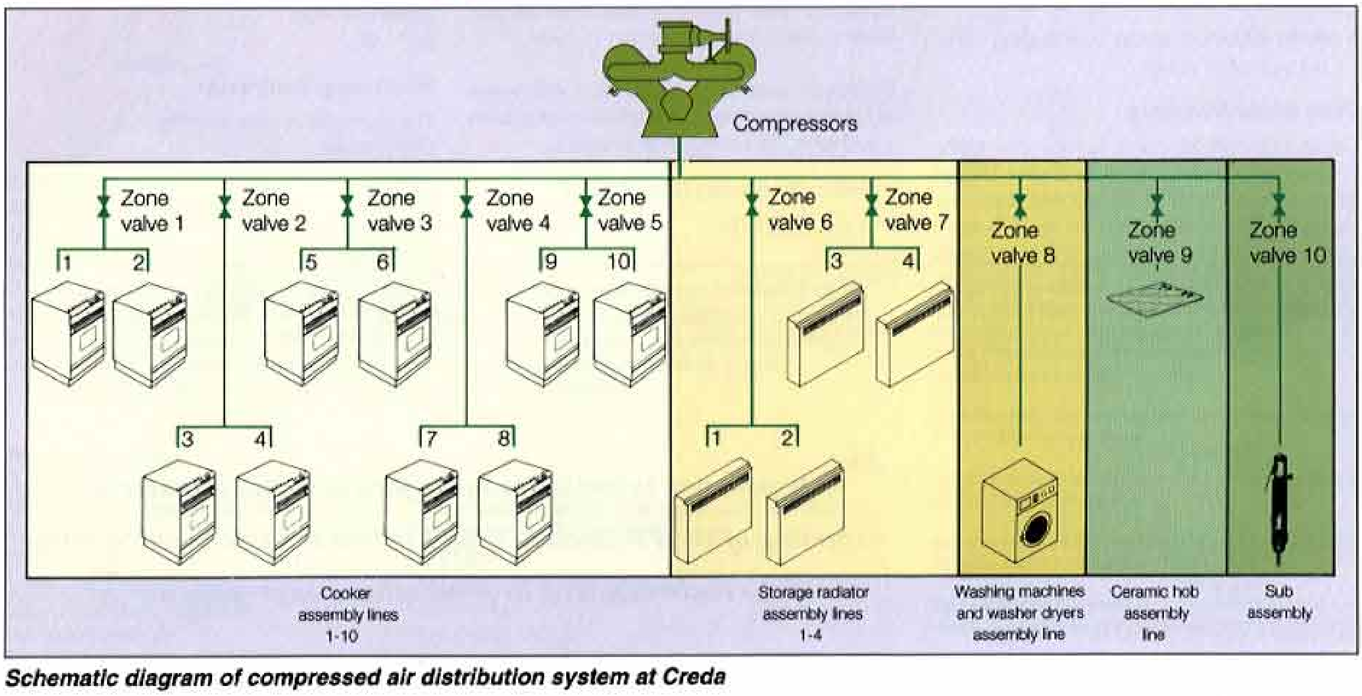
Compressed air can now be supplied as and when required to each production area. Changes and alterations to schedules in any of the areas can be easily and immediately accommodated via the computer keyboard. In an emergency, the valves can be opened or closed manually.

Zone Valves Installation

Generally, installing zone valves involves fitting a suitable solenoid-operated valve to the compressed air line which supplies a particular production process or area. A manual isolating valve should be fitted upstream to allow maintenance work to be carried out on the zone valve without the whole system having to be depressurised. Installation of the valve requires the system to be completely closed down, unless there are suitable isolating valves already installed.

Control signals to open and close zone valves can be derived from a range of sources such as timeclocks, interlocks or manual switches. These options may be less expensive than control by the building energy management system method used by Creda.

Some rationalisation may be required in order to define a usable zone. For example, before Creda's system was rationalised, compressed air supplies to some production lines were taken from the distribution for adjacent lines. This meant that if Phase



Schematic diagram of compressed air distribution system at Creda

1 had not been undertaken an appreciable part of the system would have remained pressurised, even after zoning, just to maintain one line in production.

Project Monitoring

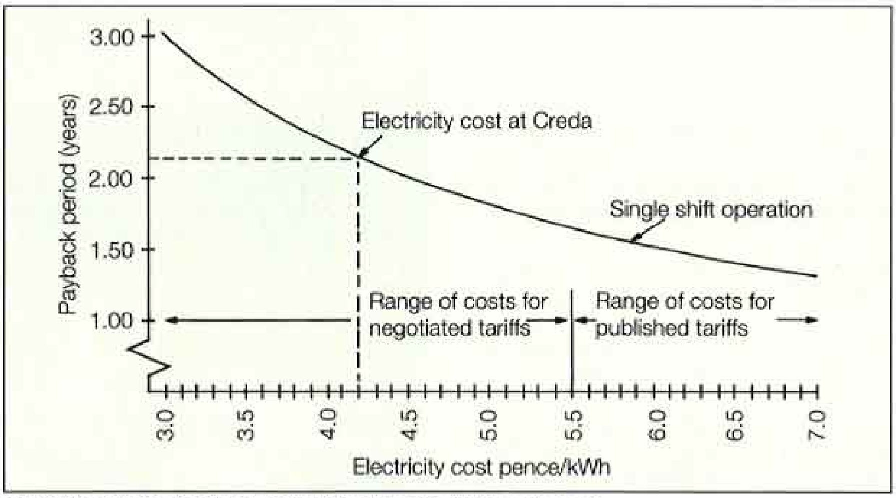
In order to assess the benefits and savings resulting from the implementation of each Phase of the project and to verify that these gave an acceptable payback on the capital expenditure, a full monitoring exercise was undertaken before and after each Phase. The monitoring, which involved measuring energy usage and compressed air generation, took place during three separate weeks which had similar production patterns.

Monitoring Results

Each set of results covered one production week, with measurements being taken from Monday morning until Friday evening, a weekly total of 109.25 hours. In each case the maximum daily demand for compressed air was from approximately 0745 h until 1630 h with a reduced demand during the evening and overnight. The pattern of production was for the assembly lines to work a day shift from 0745 h until 1630 h with the component preparation shops operating for 20 hours/day.

Monitored Results

	Compressed air generated (m^3)	Energy used (kWh)
Original system	431,600	46,188
After Phase 1	375,800	42,769
After Phase 2	347,600	40,418



Variation of payback period with average kWh unit cost

Options For Potential Users

		Capital cost (£)	Compressed air saving (m^3/year)	Energy saving (kWh/year)	Cost saving (£/year)	Payback (years)
Option 1	Rationalise distribution **only**	16,500	2.6×10^6	160,693	6,749	2.4
Option 2a	Zone valves **only** controlled by a building energy management system	8,000	3.0×10^6	214,278	9,000	0.9
Option 2b	Zone valves **only** controlled by a simple control system	3,400	3.0×10^6	214,278	9,000	0.4
Option 3a	Rationalise distribution **and** install zone valves controlled by a building energy management system	24,500	3.9×10^6	271,190	11,300	2.2
Option 3b	Rationalise distribution **and** install zone valves controlled by a simple control system	19,900	3.9×10^6	271,190	11,390	1.7

Cost and Energy Savings

The annual energy savings achieved at Creda as a result of Phase 1 improvements are 160,693 kWh (578 GJ) worth £6,749, and for Phase 2 improvements, 110,497 kWh (398 GJ) worth £4,641. These savings have been evaluated assuming production takes place for 47 weeks/year and using the average cost of electricity supplied to Creda which was 4.2 p/kWh (£11.67/GJ). The savings resulting from Phase 2 improvements include an adjustment to reflect the lower cost of electricity during the off-peak night time period.

Payback Periods

Creda is able to negotiate an advantageous rate for the electricity it uses, which reduces the value of the savings from the project. Potential users may not be in a position to negotiate such favourable terms and therefore the payback period for the same project would be shorter. The graph indicates how payback would reduce for less favourable tariff terms.

Potential users should consider whether it is best for them to rationalise their system, use zone valves or do both. When both measures are implemented, the lower leakage rates achieved through rationalisation will reduce the potential for savings using zone valves. A further consideration is whether or not to use a building energy management system to switch the zone valves or to use a simpler, less costly form of control.

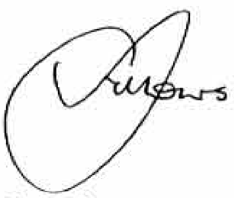
The table shows the options which were implemented by Creda and, although they chose to maximise overall savings, other options with shorter payback periods may be more attractive to potential users.

Comments from Creda Ltd

A recent energy survey and audit at Creda Ltd highlighted the generation of compressed air as a major user of electricity and indicated that significant savings could be made by rationalising the distribution network, by better usage of the available compressors and by eliminating losses, particularly at night, by installing electrically-operated solenoid valves to those areas not working 24 hours/day.

An energy saving project was therefore initiated and the first two Phases have been monitored on behalf of the Energy Efficiency Office by the Dyer Warner Partnership. The monitoring showed that significant energy savings have been achieved, particularly at night when the main production areas are not working but when compressed air still needs to be generated for the support operations.

It is now our intention to move forward into monitoring and targeting of the Production Cost Centres to increase awareness of the costs involved in generating compressed air and then to install a compressor management system to select automatically the right compressor mix to meet the required demand level.



Mr A Fellows
Manufacturing Director
Creda Limited

Creda Ltd, Blythe Bridge

Creda Ltd

Creda Ltd, part of a joint venture between GEC of the UK and GE of the USA, is based at Blythe Bridge in Staffordshire. The Company employs 2,000 people in the manufacture of electric cookers, ceramic hobs, washing machines, washer dryers and storage radiators.

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