CADDET energy efficiency
IEA
OECD

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Cost reduction for compressed air users

Compressed air costs reduced by automatic control system

Summary

Installing a computerised compressor control system has reduced compressed air generation costs by 18.5 % at Land Rover, without disrupting production schedules. The overall costs for the system produced a payback of 16 months which could be replicated on most compressed air systems using three or more compressors.

Further savings of 20 % were obtained by repairing compressed air leaks. This potential exists for most compressed air users and represents an immediate cost saving opportunity. It was highlighted at Land Rover by the new control system, which quantified the amount of air being used outside normal production hours.

Highlights

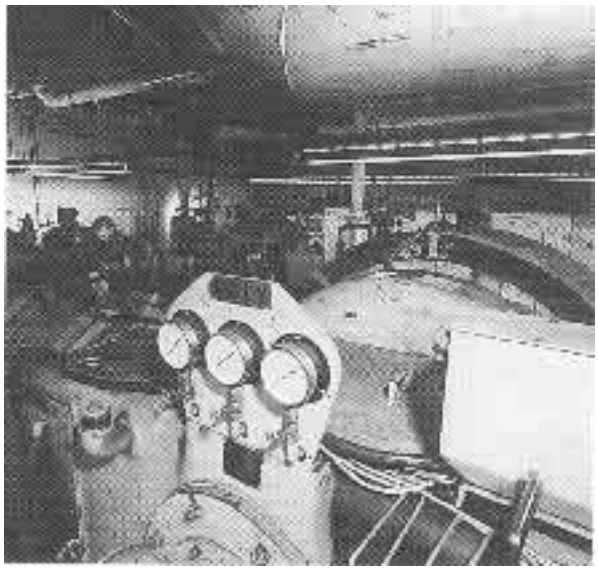
- **Payback of 1.3 years**
- **Savings of 600,000 kWh worth GBP 24,000/year**
- **Compressed air generation costs reduced by 18.5 %**

Vehicle production line.

Aim of the Project

This project shows some of the energy and cost savings that are possible from installing an automatic system to control the operation of air compression equipment. Air compressors have high levels of electricity consumption and those on the Solihull site are typically driven by some of the largest motors in the plant. As less than 10 % of the energy they consume is converted into useful work, compressed air provision is their most expensive form of energy. So methods of reducing energy were examined.

View across the compressor house.



The Principle

The main features of the new control system are pressure, time and remote control.

Pressure control
Generation pressure is regulated in response to a pressure transducer placed at the end of the air distribution network. Demand is determined by monitoring the rate of change in pressure. This enables the new control system to determine whether a machine should be started or stopped. Responding to demand changes overcomes the need for set pressures for individual machines.

By observing pressure changes, the new system can predict how long it is likely to be before a compressor is needed and hence shut the compressor off, avoiding idling losses. This is known as predictive switching.

Time control
Land Rover's new control system has six different time/pressure bands to ensure that the lowest possible generation pressure is achieved. These time periods and pressure bands can be set on a seven-day clock.

Remote control
The new system has a remote control unit based on a computer terminal which enables all pressure settings to be adjusted in the engineers' workshop and allows continuous maintenance surveillance of the compressors. There is also a comprehensive logging facility which records hours run, time on/off load, number of starts, etc. for each compressor.

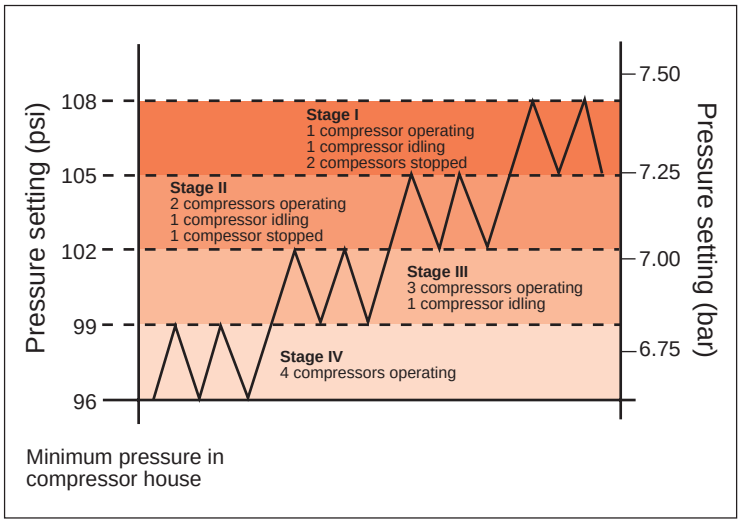
The Situation

Most of the hardware was installed while the compressors were running on their existing control system and the link up to the automatic control was carried out over a bank holiday weekend. Wiring had to be installed to connect the remote terminal in the engineers' workshop to the compressor house and end pressure point sensor. These links were approximately 500 m and 1,100 m respectively.

During commissioning the actual generating capacity of each compressor was measured. This calibration exercise enabled the control system to choose the most efficient compressor. The actual generation capacities of the compressors varied between 3 % and 10 % from their design output.

No problems were encountered during commissioning and the system was ready for automatic control on the target date.

The original manual control system remains in place to eliminate the possibility of lost production if a problem occurs. All automatic control system features can be overridden to manual control; this happens automatically if the new control system or sensor communication fails. The control settings for the new system were tuned over 5-10 weeks.



Conventional compressor cascade control system.

Initially only two time bands were chosen: weekdays and weekends (excluding Saturday morning). The weekday minimum control setting at the end-user was gradually reduced in 0.07 bar (1 psi) stages from 6.2 bar (90 psi) to 5.8 bar (84 psi). This corresponded to a compressor house pressure reduction from 6.9 bar (100 psi) to 6.5 bar (94 psi), simply achieved by typing in the new figures at the central control. These pressures compare with a constant 7.2 bar (104 psi) at the compressor house of the original cascade control system (i.e. a 10 % reduction in generating pressure).

The weekend minimum control pressure was gradually reduced to 5.4 bar, corresponding to a compressor house pressure below 6.2 bar. This compares with a pressure of around 7.2 bar (104 psi) with the conventional control system, i.e. a 20 % reduction in generating pressure.

Further refinements were introduced by increasing the number of time bands to cater for lunch-times and Friday night/Saturday morning, during which weekend pressure settings of 5.4 bar were used.

The Company

Land Rover is part of the Rover group, Britain's largest motor manufacturer. Export markets account for 70 % of the output at the Land Rover factory in Solihull. The site covers about 120 hectares (300 acres), and is where the full range of Land Rover models is produced, as well as engines, transmissions and components.

Economics

The annual direct savings at the time this case study was published were projected to be worth GBP 24,000. (This compares with a pre-installation estimate of GBP 25,000/year.)

Indirect savings, through the elimination of leaks, were worth an additional GBP 21,000/year. The system achieved energy and cost savings as follows:

- Weekday - the average reduction in weekday electricity use was from 10,900 kWh to 9,100 kWh, a reduction of 16.5 %, equivalent to GBP 360/ week.
- Weekend - the average reduction for the whole weekend was from 14,000 kWh to 10,500 kWh, a reduction of 25 %, equivalent to GBP 140/ week.

A breakdown of the GBP 31,700 cost for the supply and installation of the new control system is presented in Table 1. Based on direct savings of GBP 24,000/year, the simple payback period is 16 months.

The monitoring of compressed air flow rate alerted staff to the large offtake outside normal

Table1: Capital cost breakdown.

Item	Cost (GBP)
• Controller plus 2 transducers	9,900
• Installation	8,500
• Compressor link units	4,900
• Installation	2,500
• Flow measurement and reporting system	5,400
• Commissioning	500
Total	**31,700**

production hours. This represented 0.85 m^3/s, approximately 40 % of production usage. Major leaks were quickly remedied, resulting in a further electricity saving of GBP 21,000/year.

Thus the savings were almost doubled, and the payback halved, through stopping the compressed air leakage identified by the system.

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* IEA: International Energy Agency
OECD: Organisation for Economic Co-operation and Development

IEA

The IEA was established in 1974 within the framework of the OECD to implement an International Energy Programme. A basic aim of the IEA is to foster co-operation among the 23 IEA Participating Countries to increase energy security through energy conservation, development of alternative energy sources, new energy technology, and research and development (R&D).

This is achieved, in part, through a programme of energy technology and R&D collaboration currently within the framework of 36 Implementing Agreements, containing a total of more than 75 separate collaboration projects.

The Scheme

CADDET functions as the IEA Centre for Analysis and Dissemination Demonstrated Energy Technologies for all IEA CADDET member countries.

This project can now be repeated in CADDET member countries. Parties interested in adopting this process can contact their National Team or CADDET.

Demonstrations are a vital link between R&D or pilot studies and the end-use market. Projects are published as a CADDET 'Demo' or 'Result' respectively, for on-going and finalised projects.

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