GPG 304

The purchaser's guide to energy-efficient buildings for industry

BEST PRACTICE PROGRAMME

ENERGY EFFICIENCY

EXECUTIVE SUMMARY

This Guide will assist in the specification and purchase of energy-efficient buildings for industry through encouraging an integrated approach to the building fabric and building services and by providing a checklist of energy-efficient options. The appraisal procedure for these options will show where it is cost-effective to improve energy efficiency above the minimum required by the Building Regulations.

Almost all energy use results in the production of CO_2, which is the main greenhouse gas contributing to climate change. This and other influences have caused an increasing realisation within industry, and the businesses that supply them with buildings and building services, that there are sound business and environmental reasons for reducing energy use.

The Guide provides purchasers with a systematic approach to be used with designers and contractors to quickly evolve cost-effective, energy-efficient designs. It is intended to be used in conjunction with its companion volume GPG 303 'The designer's guide to energy-efficient buildings for industry'. Within the context of this Guide, a designer is any building professional who is involved with the design, construction and handover of a building and its services, and includes architects, mechanical and electrical (M&E) consultants and specialist contractors/engineers with expertise in services including refrigeration and heating, ventilation and air-conditioning (HVAC).

The Guide will help purchasers in the development of a brief for designers and provides a list of questions for purchasers to put to designers to ensure that all the energy efficiency options have been considered and properly appraised. This appraisal process includes reference to the Climate Change Levy (CCL) and Enhanced Capital Allowances (ECAs), effective from April 2001.

The benefits of using the Guide include:

- quicker decision-making processes during the design stage
- better understanding of the benefits of energy efficiency, resulting in improved briefing of designers
- matching buildings to business needs, while improving comfort for occupants
- reduced environmental impact over the lifetime of the building
- lower operating costs for the building owner
- enhanced rent or resale value
- minimising the impact of the CCL
- maximising the benefits of ECAs.

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HOW TO USE THIS GUIDE

This Guide is to be used by purchasers when:

- developing a brief with designers, contractors, management and others who influence the decision-making process
- appraising energy-efficient options during the design process
- ensuring that energy-efficient options are implemented during construction and handover.

To obtain maximum benefit from this Guide, the purchaser should ensure that the designer/contractor is working from the companion guide GPG 303 'The designer's guide to energy-efficient buildings for industry'. A free copy can be obtained through the **Environment and Energy Helpline (tel 0800 585794)**. The Guides use the same colour coding for ease of reference. Both Guides consider the procurement process in three stages:

- the project brief
- option appraisal and selection
- construction to handover.

THE PROJECT BRIEF

The first step in establishing the brief is to define your usage requirements. GPG 303 contains a client requirement sheet that can be copied and used to collect information for each area of your proposed buildings.

You should set a target energy performance for the designer/contractor to achieve. Your designer can advise on achievable targets based on the good practice benchmark values which are published in GPG 303.

You should agree on the financial criteria that are to be used in assessing the energy-efficient options. Both this Guide and GPG 303 recommend that the benefits of energy-saving measures be assessed by calculating the net present value of the savings that will accrue in future years.

OPTION APPRAISAL AND SELECTION

This section of the Guide is arranged under generic headings such as heating systems, lighting, etc, which are colour coded in the same way as in GPG 303. Under each heading there is a list of key questions that should be put to the designer/contractor to ensure that all the energy-efficient options have been considered and properly appraised. GPG 303 contains the same questions backed up by technical fact sheets on the energy-efficient options, selection charts to help select the best options for your needs and running cost nomograms to indicate the cost of the options chosen.

CONSTRUCTION TO HANDOVER

Buildings will only perform to the design specification if they are constructed to a high standard, are properly commissioned and operated as intended to ensure that the benefits of energy efficiency measures are realised. Follow the guidance provided for monitoring construction, commissioning tests, operating and maintenance documentation and on-site training.

INTRODUCTION

This Guide is intended for anyone involved in the purchase and specification of buildings for industry and the buildings services required on industrial sites. It will assist them in the purchase of cost-effective and energy-efficient buildings and building services through encouraging an integrated approach to the building fabric and building services, and by providing a checklist of energy-efficient options. The appraisal procedure for these options will show where it is cost-effective to improve energy efficiency above the minimum required by the Building Regulations.

It is applicable to both new buildings and major refurbishment of existing buildings. The Guide should be used whether the purchase is from external suppliers or from an in-house design or services department. An essential part of this process is to ensure that energy efficiency is included in the brief from the outset, and that the implications of design decisions on the energy costs of operating the building are fully considered at each stage of the design and carried through to construction, commissioning and handover.

Most purchasers of industrial buildings will not be experts in building design and there is no reason why you should acquire such expertise when it is not part of your mainstream business. This Guide will provide you with a brief non-technical review of all the issues you need to address to ensure that the buildings or services you purchase meet your requirements, while achieving low running costs for the life of the building through reduced energy consumption. Once a building has been completed, it will generally only be possible to improve its energy performance to any significant amount through costly major refurbishment.

The purpose of this Guide, and its companion volume for designers, Good Practice Guide (GPG) 303, is to provide a systematic approach within a common framework for both purchasers and designers to quickly evolve a cost-effective energy-efficient design. Within the context of the Guides, a designer is any building professional who is involved with the design, construction and handover of a building and its services. This includes architects, mechanical and electrical (M&E) consultants and specialist contractors/engineers with expertise in services including refrigeration and heating, ventilation and air-conditioning (HVAC).

Benefits of using this Guide

By using this Guide in collaboration with your designer/contractor you can achieve the following benefits:

- quicker decision-making processes during the brief and design stages
- better understanding of the benefits of energy efficiency, resulting in improved briefing of designers
- better understanding between clients and designers
- matching buildings to business needs, which improve comfort for occupants
- reduced environmental impact over the lifetime of the building
- lower operating costs for the building owner
- enhanced rent or resale value
- minimising the impact of The Climate Change Levy (CCL)
- maximising the benefits of Enhanced Capital Allowances (ECAs).

WHY IS ENERGY EFFICIENCY IMPORTANT?

Almost all energy use results in the production of CO_2, which is the main greenhouse gas contributing to climate change. This and other influences have caused an increasing realisation within industry, and the businesses that supply them with buildings and building services, that there are sound business and environmental reasons for reducing energy use. A reduction in energy consumption brought about by improvements in efficiency will reduce running costs and hence raise competitiveness and increase profits.

The government is introducing a package of measures to encourage better use of energy and reduce carbon emissions. These include the CCL, which is a new tax on energy use by industry, commerce, agriculture and the public sector. Also ECAs, which will allow 100% capital allowance against tax in the first year for 'eligible' plant and equipment.

INTRODUCTION

Public awareness of environmental issues has also heightened and businesses are coming under increasing pressures from their customers and from central government to improve and report on their environmental performance. The energy used within buildings for heating, lighting, cooling, etc, accounts for more than 40% of the CO_2 released to the atmosphere in the UK.

All energy costs money. At the time of writing energy prices are rising. As oil and gas stocks diminish, fuel prices are likely to continue to rise at a rate above inflation for the short/medium term. Furthermore, all energy bills are set to increase with the introduction of the CCL. Such pressures to improve energy efficiency are likely to be augmented by further legislation.

INDUSTRIAL BUILDINGS AND ENERGY USE

Industrial buildings typically require large areas for storage and production, with the level of building services required for each activity varying dramatically across industrial classifications. The buildings often have high ceilings and high ventilation rates. Usually there will be further 'social' space in areas such as offices, and in many cases the building will include canteens or kitchens. Some of these characteristics have exceptional energy requirements that present designers with particular challenges.

Industrial buildings are required to serve many purposes, the principles and benefits of improved energy efficiency remain the same, and this Guide aims to ensure that opportunities to save energy are not overlooked during the design of industrial buildings.

THE DESIGN PROCESS

The project brief

Defining usage requirements
Setting a target energy performance
Defining financial criteria

Option appraisal and selection

The building
Heating systems
Hot and cold water
Pipe insulation
Lighting
Power options
Ventilation systems
Cooling and refrigeration

Construction to handover

Quality during construction
Commissioning
Maintenance documentation

THE DESIGN PROCESS

There are three main stages in implementing the design and construction to handover. These are:

- the project brief
- option appraisal and selection
- construction to handover.

Each stage is considered under generic headings, as illustrated opposite. The same colour coding is used in both Guides for ease of referencing.

Important issues arise at each stage, which must involve both the designer and the purchaser.

Note that while the three key stages are sequential, you must expect to revisit the project brief regularly to ensure that its requirements are being met in practice and/or to modify any parts which are proving to be untenable.

THE PROJECT BRIEF

The starting point for purchasing any building or building services should be the project brief. You may need to work with your designers and contractors to develop the brief so that it clearly defines your requirements. It is most important that you take an integrated approach to the building fabric and building services, which includes energy efficiency from the very outset of preparing the brief. Decisions taken at this stage can reduce the running costs over the whole life of the building or service plant without necessarily increasing the capital cost.

The three-step process illustrated on the previous page will assist you in developing the project brief.

DEFINING USAGE REQUIREMENTS

The activities carried out within an industrial building can be very varied and you should start by considering all the activities that will take place. In general, a factory takes in materials and/or components, carries out a process which adds value and then dispatches the products. There will, therefore, be areas for goods inward, essentially stores, possibly a number of process areas, possibly inspection and packaging areas and a dispatch function. In addition, there will be admin functions which will be carried out in offices, either within the same building shell, or in a separate office block. There might be kitchens and canteens and other amenity areas. It will be apparent that these activities require very different types of spaces and building services.

One particular problem in industrial buildings is the impact of the process on the building environment. The process may produce fumes or other noxious materials which require specialist building services to maintain a safe working environment. On the other hand, clean processes may provide opportunities for heat recovery, thus reducing the demand on the heating system.

An integrated design approach is essential in these circumstances. It is, therefore, important for you to define your requirements at a very early stage of drawing up the brief and to check at each stage of the design that the proposed design will fulfil these requirements.

GPG 303 contains a double-sided loose leaf briefing sheet, which can be used to collate the information required.

You may be undertaking a speculative development where the ultimate occupier and end use are unknown at the time of drawing up the brief and going through the design process. This should not inhibit you from completing the briefing sheets with your designer or contractor, as there will still be a need to define the range of end uses that are to be accommodated by the design.

SETTING A TARGET ENERGY PERFORMANCE

The Energy Efficiency Best Practice programme has published a number of Energy Consumption Guides (ECONs) containing performance indicators/benchmark values relevant to the activities found on industrial sites. If your designer or contractor does not have these they can be obtained free of charge through the Environment and Energy Helpline.

With the information you have provided on the briefing sheets, your designer will be able to calculate a performance indicator for your proposed building. The value of the performance indicator, either for existing buildings which are being improved or for new buildings, will be indicative of what should be readily achievable through good design for the mix of activities in the proposed building. Recent case studies show that with new technologies for insulation, heating, lighting, etc, consumption values in new buildings can be significantly below the new build benchmark. It is, therefore, recommended that you agree with your designer a target energy performance, in kWh per m^2, which is lower than the indicative value based on the new build benchmark. How much lower depends on your commitment to energy efficiency, but a value 10% lower would not be unreasonable. During 2001, revised benchmarks will be published which will allow energy performance targets to be based on current good practice.

DEFINING FINANCIAL CRITERIA

Ideally, the financial case for an energy-efficient building should be based on whole life-cycle

costing of the building. This allows the benefits of lower running costs for an energy-efficient building to be offset against any additional capital investment in energy-saving measures. Unfortunately, the budget holder for capital projects is often not the person who will be responsible for the running costs of the building once completed. Nevertheless, by considering energy efficiency in the brief and design process, lower running costs can be achieved for little or no additional investment. It will certainly be much more expensive to reduce running costs once the building is complete.

Policy and legislative background

Before developing the financial case, you need be aware of government policies and legislation, both existing and pending, which are intended to encourage investment in energy-saving measures.

Building Regulations set minimum requirements for insulation, lighting efficiency, controls, etc, while other legislation sets minimum efficiencies for boiler manufacturers to achieve. The legislation is periodically reviewed and at each review the requirements for energy efficiency have been increased. For example, the levels of insulation required for walls, roofs and floors have been dramatically increased and further revisions to the Regulations are expected to continue this trend.

From April 2001, the government is introducing a **Climate Change Levy (CCL)**, which effectively increases the cost of energy, and hence improves the financial case for energy efficiency measures. Some sectors of industry qualify for a rebate on the CCL, but only if they enter into a negotiated agreement to reduce their energy consumption.

Also from April 2001, the government is introducing **Enhanced Capital Allowances (ECAs)**, which will allow 100% capital allowance against tax in the first year for 'eligible' plant and equipment. Initially, ECAs will apply to:

- 'quality' combined heat and power (CHP)
- boiler plant and equipment
- motors
- variable speed drives
- lighting
- pipe insulation
- refrigeration equipment
- thermal screens (for horticulture).

Full details of the current eligibility criteria can be found on the Government's website 'The Enhanced Capital Allowance Scheme – Eligibility Criteria' at **www.eca.gov.uk**

Some sectors of industry carrying out prescribed processes are subject to the EU **Integrated Pollution Prevention and Control (IPPC)** regulations which started to come into effect from October 1999. These now make the efficient use of energy one of the requirements for granting a site operating licence.

Putting the financial case to your board or financial director

The financial case that you present to your board or financial director needs to be set in the context of the legislative and policy framework as set up by government and outlined above. The financial case for certain measures, such as CHP and variable speed drives, has become strengthened by the introduction of the CCL and ECAs. It is also apparent that the difference between the requirements for energy efficiency contained in the Building Regulations and good practice is becoming less, so that the on-costs of good practice energy efficiency measures will be lower.

The recommended method of appraising the financial viability of an energy efficiency measure is to calculate the net present value (NPV) of the savings acccruing over the lifetime of the measure. You are probably familiar with this method, which is described in GPG 165 and CIBSE CA1 (see box overleaf). The method allows you to assess the return on an investment by discounting savings made in future years to take account of the reduced value of those savings compared to income in the current year. For convenience, the method is illustrated by an example from Good Practice Case Study (GPCS) 390 based on a building management system (BMS) installed at Shell UK Expro.

THE PROJECT BRIEF

For more information on economic assessment techniques refer to:

Good Practice Guide 165 'Financial aspects of energy management in buildings' CIBSE CA1 'Approving Energy Conservation Investments Using Discounted Cash Flow Techniques'

When carrying out a NPV calculation it is important to include all relevant costs over the lifetime of the project. In 1983, Shell Expro wished to upgrade their building controls and compared the costs of continuing to use standard controls with those of installing a BMS. Continuing to use standard controls was estimated to require capital investment of £330 000 for replacement units, while a new BMS was estimated to cost an additional £470 000. However, the BMS was forecast to reduce costs through better energy management and also to reduce running costs through lower manpower and maintenance requirements. The actual savings arising from replacing standard controls with the BMS are given in the table below, which illustrates that over the lifetime of the BMS, energy savings combined with reduced running costs generate a net present value of over £1 000 000, thus justifying the higher capital cost of the BMS. In fact the system has been so successful that it has been upgraded and extended (see GPCS 390).

The benefit of the NPV calculation is that it allows different types of measures with different lifetimes to be compared. For example, the NPV of the BMS illustrated below could be compared with the NPV from investment in production plant and machinery. The same discount rate should be used for both calculations. In this way it is possible to rank projects for investment purposes in order to make best use of the company's capital resources.

Where applicable, the effect of the CCL and ECAs should be built into the calculations. It is important to realise that ECAs do not apply to measures that are required by the Building Regulations. However, if the NPV for additional measures is greater than that for doing the minimum required by the Regulations, then there is a sound financial case for the measures.

GPG 303 contains selection charts and running cost nomographs that will help you to work with your suppliers to assess the economic costs/benefits of energy-efficient design options. They can also be used to support your recommendations to your board.

Year	Continue with standard controls		Install BMS		Operating and energy savings	8% discount rate	Discounted saving	Cumulative discounted saving
	Operating costs (£,000)	Energy costs (£,000)	Operating costs (£,000)	Energy costs (£,000)	(£,000)		(£,000)	(£,000)
	(Capital cost of replacement units £330k)		(Capital cost £800k)					
1983	588	621	486	599	124	0.926	115	115
1984	588	656	486	630	128	0.857	109	224
1985	588	682	486	550	234	0.794	186	410
1986	588	682	486	550	234	0.735	172	582
1987	588	694	486	560	236	0.681	161	743
1988	588	707	486	573	236	0.630	149	892
1989	588	720	486	586	236	0.584	138	1030
1990	588	733	486	598	236	0.540	128	1158
1991	588	746	486	611	236	0.500	118	1276
1992	588	767	486	631	238	0.463	110	1386
1993	588	756	486	626	232	0.429	100	1486
1994	588	759	486	627	235	0.397	93	1579
1995	588	763	486	630	235	0.368	86	1665
1996	588	766	486	633	235	0.341	80	1745
NET PRESENT VALUE (cumulative savings less additional £470 000 capital)								**1275**

NPV for BMS at Shell Expro

OPTION APPRAISAL AND SELECTION

Having drawn up the brief and appointed the contractors, you should be prepared to enter into an iterative process with them to reach the optimum design that will fulfil your requirements. One of these requirements should be to ensure the energy consumption targets you have set are realised in the most cost-effective manner, taking into account both initial capital investment and running costs.

This Guide, and GPG 303, assume that your suppliers are fully competent in the design of buildings and services. GPG 303 provides designers with a framework and procedure for considering the energy-efficient options for all aspects of your building fabric and the services within the building. However, contractors will often eliminate energy-saving measures in the belief that the contract will be awarded to the lowest price tender, regardless of the implications for the future running costs of the building. More often than not, any additional costs associated with energy-saving measures will be a very small fraction of the total cost and will be recovered through lower running costs in a relatively short time.

It is, therefore, recommended that you take an active part in appraising and selecting energy-saving measures. The simplest way to do this will be to ask your designer/contractor to follow the guidelines laid down in GPG 303. If, however, you suspect that the designer has not considered all the options, then this section lists a number of key questions you should ask. These questions also appear in GPG 303 along with fact files giving simple guidance on the energy-efficient options available. The fact files also identify the energy-saving measures which qualify for ECAs.

By ensuring the design fulfils the eligibility criteria for ECAs you will improve your cash flow and save money.

The key questions are listed under generic headings and are colour coded to enable you to refer quickly to the section of interest.

- The building
- Heating systems
- Hot and cold water
- Pipe insulation
- Lighting
- Power options
- Ventilation systems
- Cooling and refrigeration

IMPORTANT

The procedure laid down here is to assist you in working with your designer/contractor to reach an optimum design that will fulfil your requirements with a minimum of effort on your part. You should be very clear that it is not a substitute for your designer/contractor carrying out full design studies and you should ask your designer/ contractor for evidence of the design calculations to justify any claims they make for the performance of the building based on their design.

KEY QUESTIONS – THE BUILDING

A building's form and constructional details can have a major impact on its energy use. Time spent optimising the design will be well spent. Remember that it will be much harder to improve the building's thermal performance once it has been built.

Is the building correctly orientated with regard to the prevailing wind and sun directions?

Are internal areas arranged to minimise energy requirements?

Fact file B1
Building orientation and layout (GPG 303 page 20)

Have you optimised the insulation to roofs, walls and floors for the fuel and heating system to be used?

Fact file B2
Insulation (GPG 303 page 21)

Have windows been selected to provide the optimum compromise between daylighting and heat loss?

Fact file B3
Glazing (GPG 303 page 23)

Have appropriate steps been taken to minimise air ingress through goods and personnel doors?

Fact file B4
Doors and entrance lobbies (GPG 303 page 25)

KEY QUESTIONS – HEATING SYSTEMS

Industrial buildings offer unique challenges when trying to select an effective and efficient heating system. The designer may be faced with high ceilings, intermittent occupancy patterns and processes which give off large quantities of waste heat or require substantial ventilation rates. A wide range of heating plant has been developed in response to these challenges and their correct selection, along with appropriate control systems, can lead to substantial reductions in energy usage.

Have you chosen the right fuel?	**Fact file H1** **Choice of fuel (GPG 303 page 28)**
Have you selected the most efficient form of heating for your application?	**Fact file H2** **Choice Convective systems (GPG 303 page 30)** **Fact file H3** **Radiant systems (GPG 303 page 32)**
Have you located the heating plant in the best position(s)?	**Fact file H4** **Centralised vs decentralised systems (GPG 303 page 34)**
Do you really need to provide flues for your heating appliances?	**Fact file H5** **Flued vs unflued appliances (GPG 303 page 35)**
Have you considered the cost-effectiveness of more efficient boiler plant and equipment?	**Fact file H6** **Boiler plant and equipment (GPG 303 page 36)**
Have you designed in adequate facilities for pipework cleaning and subsequent water treatment?	**Fact file H7** **Water treatment (GPG 303 page 38)**
Have the benefits of using destratification fans been assessed?	**Fact file H8** **Destratification fans (GPG 303 page 39)**
Are you proposing to use waste heat recovered from other plant or processes?	**Fact file H9** **Use of waste heat (GPG 303 page 40)**
Are you specifying the most appropriate control systems?	**Fact file H10** **Controls (GPG 303 page 42)**

KEY QUESTIONS – HOT AND COLD WATER

The costs associated with hot and cold water usage are often much lower than those associated with other aspects of building energy use. It is therefore easy for the designer to become complacent about hot and cold water services and for simple efficiency improvements to be overlooked.

Have you selected the most appropriate means of generating hot water, including heat recovery from the process when practicable?

Fact file W1
Hot water generation (GPG 303 page 46)

Have you specified the most appropriate controls, particularly at the point of water use?

Fact file W2
Controls (GPG 303 page 47)

Have you considered what impact your design will have on the building's water and sewerage tariffs?

Fact file W3
Water, effluent and sewerage tariffs
(GPG 303 page 48)

KEY QUESTIONS – PIPE INSULATION

When considering energy efficiency measures, pipe insulation ranks with some of the very best options for both financial and environmental benefits. Temperature gradients handled are often amongst the largest in the built environment and the materials typically used for pipes are excellent thermal conductors.

BS 5970, together with BS 5422 (1990) and its subsequent revisions, are key standards in defining the most appropriate pipe insulation levels in industrial buildings.

Have you minimised your requirement for pipe runs in the building by assessing the energy efficiency of alternative system configurations?

Fact file PW1
Minimising pipe runs (GPG 303 page 52)

Have you sized the pipes correctly for the flow of fluid anticipated in the system?

Fact file PW2
Sizing of pipes (GPG 303 page 53)

Have you selected the most appropriate pipe insulation material for your application?

Fact file PW3
Selection of materials (GPG 303 page 54)

Have you selected the most appropriate thickness of pipe insulation material for your application?

Fact file PW4
Thickness requirements (GPG 303 page 55)

Have you assessed whether your current selection could still give you further cost-effective environmental benefits?

Fact file PW5
The bigger picture – CO_2 emissions
(GPG 303 page 56)

KEY QUESTIONS – LIGHTING

Industrial buildings impose particular demands on the lighting designer to provide lighting that contributes to a safe and productive workplace.

Lighting requirements, eg illuminance, colour appearance and rendering, contrast, type of visual environment, etc, vary according to the visual task(s) in, and/or the general usage of, each area to be lit. Additionally, the designer must fulfil these requirements in the most energy-effective manner practical.

Have you specified, or designed for, the optimum lighting requirements?

Fact file L1
Getting the basics right (GPG 303 page 60)

Have you selected the most efficient type of lamp suitable for the application?

Fact file L2
Lamp types (GPG 303 page 62)

Have you chosen the most efficient type of luminaire suitable for the application?

Fact file L3
Luminaire types (GPG 303 page 64)

Have you determined, and allowed for in the calculations, an appropriate maintenance schedule?

Fact file L4
Maintenance matters (GPG 303 page 65)

Are you sure that the general lighting installation is as efficient as is practical?

Fact file L5
Installed load efficacy (GPG 303 page 66)

Have you ensured that the switching arrangements match the operating needs of the building and the availability of daylight?

Fact file L6
Switching and circuit configuration
(GPG 303 page 68)

Are you making the best use of manual and automatic lighting controls?

Fact file L7
Automatic controls (GPG 303 page 69)

KEY QUESTIONS – POWER OPTIONS

With day-rate electricity costs being typically five times as high as gas or oil, electrical plant is likely to have the greatest impact on the building's energy running costs. Careful design of the supply infrastructure and associated plant is, therefore, essential.

Have you got the supply infrastructure right, including issues such as supply capacity, supply voltage and power factor?

Fact file P1
Supply infrastructure (GPG 303 page 72)

Have you considered the benefits of on-site generation, either using CHP plant, or by using standby generators for 'peak lopping'?

Fact file P2
On-site generation (GPG 303 page 74)

Have all opportunities been taken to optimise compressed air generation and usage (in line with its high cost as a utility)?

Fact file P3
Compressed air (GPG 303 page 76)

Has advantage being taken of the benefits offered by higher-efficiency motors and variable speed drives?

Fact file P4
Motors and drives (GPG 303 page 78)

KEY QUESTIONS – VENTILATION SYSTEMS

Ventilation rates within industrial-type buildings are often much higher than found elsewhere.

This ventilation may be required to remove process heat or to provide dust and fume control. In either case, these high ventilation rates will lead to excessive heat loss (and hence energy usage), unless appropriate measures are incorporated within the design.

Has every opportunity been taken to make use of natural ventilation strategies?

Fact file V1
Natural ventilation (GPG 303 page 82)

Have mechanical ventilation systems been designed to provide the required air change rates with minimum energy use?

Fact file V2
Mechanical ventilation (GPG 303 page 83)

Have make-up air systems been specified to provide the optimum building pressure balance?

Fact file V3
Make-up air and pressure balance (GPG 303 page 84)

Is the heat contained within any exhaust air being recovered for reuse?

Fact file V4
Heat recovery (GPG 303 page 85)

Have variable speed or other advanced control techniques been adopted?

Fact file V5
Controls (GPG 303 page 87)

KEY QUESTIONS – COOLING AND REFRIGERATION

Cooling in industrial buildings may be required by the process, or it may be provided for the comfort of the occupants. Where the manufacturing process requires close control of air temperatures, for example to prevent the thermal degradation of produce, then inevitably some form of cooling plant will be required with potentially high energy consumption. By comparison, the need for comfort cooling may be avoidable through attention to the design of the building, but where this is not possible the required cooling can often be provided by simple mechanical ventilation.

Have you considered all means of reducing heat gains and cooling loads, in order to lessen the need for cooling?

Fact file C1
Reducing heat gains (GPG 303 page 90)

Have you selected the most energy-efficient means of cooling, and considered the use of 'free cooling'?

Fact file C2
Methods of providing cooling (GPG 303 page 91)

Have you considered opportunities for recovering the heat given off by a cooling system for re-use elsewhere?

Fact file C3
Heat rejection (GPG 303 page 94)

Have you specified the most efficient controls for all components in the cooling system?

Fact file C4
Controls (GPG 303 page 96)

CONSTRUCTION TO HANDOVER

Buildings will only perform well if they are constructed, commissioned and operated to a high standard. Less than 10% of heating and ventilation systems are properly controlled – the other 90% are either badly commissioned or poorly maintained. To avoid such problems, you should closely monitor the construction and commissioning of your building and insist on having a full set of operating and maintenance (O&M) documentation.

MONITORING CONSTRUCTION

The purchaser should set up procedures to ensure that the building construction or refurbishment is carried out to the full design specification. There may be benefit in appointing a clerk of works. Points to watch for are:

- structure is airtight as far as practicable
- insulation is installed to the thickness specified, with no gaps or thermal bridges
- plant specifications are not changed, leading to undersizing or oversizing
- energy-saving measures are not omitted to reduce costs
- control strategies are not compromised.

COMMISSIONING

Commissioning must include comprehensive testing to demonstrate that all elements of the building are performing to the design requirements. The designer must clearly define what performance standards are required – for example where air extraction is critical, then the volume flow rates must be clearly and unambiguously stated.

The commissioning engineer should be instructed to produce documentary records of all tests and, once again, these should form part of the final O&M documentation. Building occupiers or nominated representatives should witness these tests.

The following inspections and demonstrations should be performed:

- building infrared thermography
- boiler efficiency
- controls
- ductwork and pipework
- water treatment.

Further information is contained in GPG 303.

OPERATING AND MAINTENANCE DOCUMENTATION

The purpose of O&M documentation is to inform the occupants how their building and its services are designed to operate. This might need to be referred to in an emergency, or because the occupants want to understand how their systems work. In either event, it should be a clear and comprehensive document, and not just a collection of commissioning and installation certificates, equipment data sheets, maintenance schedules, and 'as fitted' drawings.

Historically, the 'operating' components of the O&M manuals have been simply limited to how to turn the plant on and off. What are needed, however, are clear instructions on how to operate the building and its services in an energy-efficient manner. This information should include reference to the energy targets that were set during the early stages of the design, and suggested procedures for monitoring and targeting, so that any adverse energy performance is promptly identified.

No matter how thorough the documentation, it is important to specify that the contractor must provide on-site training on energy-efficient plant operation for the building's occupiers and maintenance staff.

A management system is required to keep a careful record of changes to control settings and the reasons for those changes if controls are to succeed in operating as proposed during the design stages.

FURTHER INFORMATION

The Chartered Institution of Building Services Engineers

Delta House, 222 Balham High Road, Balham
London SW12 9BS
Tel 020 8675 5211. Fax 020 8675 5449

British Standards Institution

389 Chiswick High Road, London W4 4AL
Tel 020 8996 9001. Fax 020 8996 7001

- BS 5422 – Method for specifying thermal insulating materials on pipes, ductwork and equipment (in the temperature range –40°C to +700°C)
- BS 5970 – Code of practice for thermal insulation of pipework and equipment (in the temperature range –100°C to +870°C)

Environment and Energy Helpline

The Environment and Energy Helpline provides free information and advice to businesses on all energy efficiency and environmental issues. Smaller companies may be eligible for a counselling visit.
Tel 0800 585794

ENERGY EFFICIENCY BEST PRACTICE PROGRAMME DOCUMENTS

The following Best Practice programme publications are available from the BRECSU Enquiries Bureau. Contact details are given below.

Energy Consumption Guides

18 Energy efficiency in industrial buildings
19 Energy use in offices
75 Energy use in Ministry of Defence establishments

Good Practice Case Studies

388 Energy-efficient design of new industrial buildings – a step-by-step approach by Process Combustion Ltd
390 Building management system in multi-site commercial and industrial buildings. Shell UK Exploration and Production – Aberdeen
391 Energy-efficient refurbishment of industrial buildings – a strategic management approach by Marconi Applied Technologies

Good Practice Guide

303 The designer's guide to energy-efficient buildings for industry

This Guide is based on material drafted by Briar Associates and Colin Lillicrap Associates under contract to BRECSU for the Energy Efficiency Best Practice programme.

The Government's Energy Efficiency Best Practice programme provides impartial, authoritative information on energy efficiency techniques and technologies in industry and buildings. This information is disseminated through publications, videos and software, together with seminars, workshops and other events. Publications within the Best Practice programme are shown opposite.

Visit the website at **www.energy-efficiency.gov.uk**

For further information on:

Buildings-related projects contact:
Enquiries Bureau
BRECSU
BRE
Garston, Watford WD25 9XX
Tel 01923 664258
Fax 01923 664787
E-mail brecsuenq@bre.co.uk

Industrial projects contact:
Energy Efficiency Enquiries Bureau
ETSU
Harwell, Oxfordshire
OX11 0RA
Tel 01235 436747
Fax 01235 433066
E-mail etsuenq@aeat.co.uk

Energy Consumption Guides: compare energy use in specific processes, operations, plant and building types.

Good Practice: promotes proven energy-efficient techniques through Guides and Case Studies.

New Practice: monitors first commercial applications of new energy efficiency measures.

Future Practice: reports on joint R&D ventures into new energy efficiency measures.

General Information: describes concepts and approaches yet to be fully established as good practice.

Fuel Efficiency Booklets: give detailed information on specific technologies and techniques.

Introduction to Energy Efficiency: helps new energy managers understand the use and costs of heating, lighting, etc.