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**Sustainable Competitiveness
For An Aluminium Foundry Through An
Environmental Management System,
In The United Kingdom**


by
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A Master's Thesis

Submitted in partial fulfilment of the requirement for the award of a degree
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Albert Einstein declared:

*" Une nouvelle façon de
penser est essentielle si
l'humanité doit survivre "*

Abstract

This thesis describes a research carried out into the introduction of an environmental management system (EMS) into an aluminium alloy foundry. The foundry, classified as a small and medium sized enterprise (SME), produces aluminium alloy castings by sand and gravity die casting processes. Its principal activities are the production of wood patterns, sand moulding, melting, machining and fettling processes. The company faces environmental pressure from government, customers and the local community. Manufacturing activities and products consume non-renewable resources and produce wastes, discharges and emissions. One way to manage those pressures and impacts is to introduce an environmental management system.

The research investigates the environmental performance and impacts on a UK SME namely Hadleigh Castings Ltd, of the existing and future environmental legislation and taxation applied to the aluminium foundry, and the steps taken to introduce the EMS. These steps include policy formulation, assessment of environmental impacts, planning the environmental programme, implementation of procedures, manual, training, projects and audit to the final step of EMS review.

The analysis highlights the benefits and problems arising from the introduction of an EMS. The commitment of resources was strongly dependent on external economic pressures. The preparatory review revealed non-compliance issues, which required solutions before implementation of the EMS could proceed. Achieving management commitment to change proved problematic in the face of production priorities and traditional attitudes. However, a number of benefits were

identified. These included an increase in employees' awareness of environmental issues, improved working practices, the initiation of cultural change through better management and assignment of responsibility and an improved relationship with regulators.

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1. Introduction and statement of the objectives

Manufacturing is a transformation process. It takes raw materials and, using energy and capital plant, transforms them into components and products. Unfortunately, the transformation is accompanied, directly or indirectly, by the production of waste and emissions. Whilst manufacturing creates economic wealth it impoverishes the environment. Concern for the environment has evolved slowly since the time of the industrial revolution and was preceded by concern for the health and safety of employees. Legislation developed to improve health and safety working conditions has been the precursor and basis to improve the environment. As we enter the twenty-first century, there is increasing concern about society's (human activity) impacts on the environment and a realisation as a global goal that control of the earth's ecosystem is imperative if the human race is to survive. We are now entering a time when the principle of sustainable development : "development which meets the needs of the present without compromising the ability of future generations to meet their own needs" is being accepted and promoted by international governments (World Commission on Environment and Development, 1987). This is now the basis of evolving legislation and economic instruments intended to transform the attitudes and practices of manufacturing, businesses and other human activities. One such instrument is the Environmental Management System (EMS) standard, which like Quality Management System standards, is intended to change the behaviour of businesses along the supply chain. This thesis considers the introduction of an EMS into a small and medium-sized enterprise (SME). The enterprise, based in Suffolk (UK), is Hadleigh Castings Ltd (HCL), a producer and processor of

aluminium alloy castings with concomitant impacts on the environment. The thesis reviews the historical context of environmental impacts and legislation in the UK; identifies impacts specific to the production of aluminium alloys and products; and describes how HCL has implemented an EMS to demonstrate its commitment to environment to its stakeholders, especially its employees, contractors, suppliers, neighbours and customers.

1.1. Environmental aspects of the Industrialisation of Britain

In the early years of industrialisation, industrialists were careless in their use of coal. Manchester, Sheffield, London and the Northeast of England, the locations for iron works, coal mining, pottery and manufacture were notorious for their smoky and cloudy atmosphere. The smoke was produced from boiler-chimneys, furnaces, gas works, railway engines and as a small percentage, from households. The use of steam driven machines that required the use of coal was the principal cause of carbon dioxide emissions. From the 1860's, the first body to be preoccupied by the good practices for stoking in order to improve the health and safety of stokers and to use the coal at its best efficiency was the 'Manchester Steam Users' association, which trained its subscribers to use boilers safely and efficiently. However, the directors preferred to employ uneducated stokers just able 'to do as they have been told'.

The phenomenon of Smog¹, resulting from a physico-chemical reaction, happens during exceptional cold weather conditions or fog. Water droplets, in the atmosphere, capture smoke particles to form a smoky cloud at ground level. Smog was an increasing cause of concern from the seventeenth to the twentieth century in industrial towns such as London, Manchester, Sheffield and Glasgow. The smog had adverse health impacts on the population resulting in increased bronchitis cases and mortality (Clapp B. W., 1994). Increased death rates due to bronchitis cases were measured after some notable fogs in 1880, 1891, 1892, 1918, 1921, 1924, 1935 and 1948. The worst case of fog in London, which made politicians and scientists react, was that of 1952, which increased death rate, due to bronchitis, by eight times, and mortality by 120 per cent compared to a normal winter (Clapp B. W., 1994). This catastrophic winter woke up the consciousness of those responsible to the importance of atmospheric pollution issues and resulted in the creation of internal committees of enquiry launched by the Minister of Health. For the first time the final report highlights "the principle that clean air was as important as clean drinking water and affirming that it would cost less to restore clean air than to allow pollution to continue"(Clapp B. W., 1994). This was a turning point and a mandatory structure was introduced to deal specifically with the quality of the atmospheric environment. This mandatory structure evolved from the smokeless zone policy to the Clean Air Act.

The foundry industry is now strictly controlled by the Environmental Protection Act Authorisations and the old image of a smoky industry is over.

¹ Smog was coined from the words smoke and fog as early as 1905, but did not become widely known until the great London fog of 1952 (Clapp B. W., 1994, p.43).

1.2. Environmental impacts of industrial activities

The smog effects were not the only environmental impacts of the industrial sector's activities. The economic activities of the entire industry largely contribute to the destruction of the biosphere with the production of greenhouse and acid rain gases. Higher concentrations of greenhouse gases such as carbon dioxide produce global warming; which could in turn lead to an increased potential for climatic incidents (including storms and droughts) and to rising sea levels when the warmer temperature causes the polar ice caps to melt. The emission of acid rain gases such as sulphur dioxide and nitrogen oxides contributes to forest, streams and lake destruction and increases asthma and pulmonary problems in the human population. The deterioration in atmosphere, soil and water quality has increased the rate of extinction of species. Industrial and household activities damage biodiversity and destabilise the equilibrium of the global ecosystem. Depletion of natural resources such as destruction of the rain forest, depletion of the ozone layer, increase of global warming, nuclear incidents and water pollution are damaging environmental impacts due to household, production, transport and other activities of the industrialised countries. These environmental impacts are proportional to three factors: the size of the population, the individual consumption mean and the nature of the technology (Bontems, P., Rotillon, G., 1998).

Most global environmental pollution is due to the consumption behaviour of the industrialised countries. On average a resident of the industrialised countries consumes nine times more fossil fuel energy, six times more beef and veal, twenty times more aluminium, sixteen times more copper, and two and half times more

wood than a resident of the developing countries (Bontems, P., Rotillon, G., 1998, p.11). This means that 70% of carbon dioxide (CO₂) and most of the chlorofluorocarbon (CFC) emissions are produced by the industrialised countries, which represent only 30% of the world's population (Bontems, P., Rotillon, G., 1998). The inequality between industrialised and developing countries raises the need for an international agreement on the integration of social and environmental criteria in global economic and political development.

Natural resources are currently managed individually instead of co-operatively and, due to the failure of the economic system to take into account the restoration cost after extensive use of natural resources (E.g. Deforestation, erosion of the soil), the non renewable natural resources are progressively disappearing (Michael Jacobs, 1990).

1.3. Sustainable Development

The first traces of ecological consciousness came from scientific and economic experts such as Barry Commoner, who criticised the anti ecological nature of technoscience in (Commoner B., 1969) and extolled a future revolution of the environment in 'The closing circle', l'Encerclement, Seuil, 1972 (Commoner B., 1972). Paul Ehrlich attributed the ecological crisis to the growth in global human population. Julian Huxley (1887-1975), ex director of UNESCO, was also a pioneer in the promotion of the international movement for the conservation of nature (Beaud C., Larbi Bouguerra M., 1993, p.30-31). There are a large number of pioneers for sustainable economic development from Vladimir Vernadsky (1863-1945) to Robin Clarke, a journalist for UNESCO, Aurelio Pecei, (1908-

1984), an Italian industrialist and Donella Meadows, writer of the Meadows Report. It is not intended to present an exhaustive listing of the first environmental pioneers but rather to highlight the names of those people without whom the first United Nations Conference on the Human Environment, in 1972 at Stockholm would never have taken place. The Stockholm conference represents the first formal sign of increasing international concern for environmental degradation on a global scale. It brought together for the first time scientific and economic experts to adopt three instruments:

- a declaration of 26 principles: the 1972 Stockholm Declaration (Declaration of Principles for the Preservation and Enhancement of the Human Environment);
- an Action Plan containing 109 recommendations and
- a resolution on institutional and financial arrangements.

It also ignited the wakening of community consciousness and the creation of Non Governmental Organisations (NGO), such as Friends of the Earth, which formed in 1969 in North America and spread all over the world. The second United Nations conference on the environment and development, held in Rio in 1992, established our duty toward the future generations, human rights and natural resource management. From this so-called North-South summit emerged the main question of how to promote the equity principle that all humans should enjoy the environment all over the world.

Now, international, governmental, regional and local politics set environmental targets in determining the acceptable level of pollution or resource consumption and choose the appropriate statutory instruments to apply to the commercial and/or domestic economic market. They highlight and promote the value of natural resources in launching regulations, directives, taxation, voluntary schemes, promotion campaigns and incentives for good industrial and household practices.

Furthermore, the global scale of environmental damage made international organisations, such as UNEFED, raise the importance of sustaining development whilst maintaining the social and environmental equity and equilibrium. The outputs of the United Nations Conference on Environment and Development (UNCED) were the multilateral treaties of 1983 and 1991, including 130 global agreements publicised by the Programme of the United Nations for the Environment (PUNE). These included : Convention on the Commercial International Treaty on the Endangered Species, (CITES), Convention of the United Nations on the right on the sea (1982), Convention of Vienna on the Ozone layer protection (1985), Montreal Protocol on the ozone depleting substances (1987), Convention of Basel on the control of the transboundary shipments of hazardous waste and its destruction (1989) and Conventions on climate change and biodiversity.

Subsequently, governments of industrialised countries, such as the United Kingdom, implemented environmental programmes to achieve the conference targets. The government enforces stringent authorisation processes, regulations, directives, taxation or promotes good practices and environmental incentives such as the environmental management system. Government and public rules are used to force industry and communities to be more aware and to control their environmental impacts. The sectors most affected by the legislation are logically those producing the most environmental pollution.

1.4. New legislation

In the twenty-first century, heavy industries such as the non ferrous sector will have to comply with stringent environmental legislation such as the European Integrated Pollution Prevention Control Directive, which will encompass a much wider range of environmental impacts from activities, products and services (e.g. control of energy consumption, raw material, waste management, environmental accidents preparedness, discharges to soil, to controlled water, river and aquifer, emissions to atmosphere and past land contamination). The replacement of the Environmental Protection Act 1990 by the Integrated Pollution Prevention Control Act 1999 (PPC), an application of the European Communities directive 96/61 on Integrated Pollution Prevention and Control (IPPC), will result 'in an increase in fees of 20% for the industrial sector (Ends report, Sep 1999, p.36.). Additional taxation, such as Climate Change Levy on energy and landfill or aggregates taxes will increase the production cost of the industrial sector. Heavy industry, such as the ferrous and non-ferrous foundry sectors will be particularly affected by such statutory measures.

1.5. Increased competitiveness

Competition has increased between companies, whether SME or multinational, and between industrialised and developing countries. On a global view, the West European market has to face the American, Asian and East European markets, some of which have lower labour costs and taxation.

The addition of environmental costs to those of production could adversely affect competitiveness when compared against developing countries where such environmental controls are not yet in place. However, this is a short-term and narrow-minded point of view. Forward-looking companies, which are at the leading edge of competitiveness, have introduced voluntary environmental management systems. Environmental awareness generates savings and bottom line improvements from raw material reduction and energy management. Companies make profits from managing their environmental impacts and reducing their risk of environmental accident by complying with their legislation requirements. A cultural change would also attract more motivated and involved employees to the workforce and management.

1.6. Environmental Management Systems (EMS)

Two voluntary EMS standards are available. BS EN ISO 14001: 1996 and Eco-Management and Audit Scheme (EMAS) are respectively International and European standards. An EMS is an economic instrument used to promote sustainability, a way to comply with stringent legislation and to answer to the public, a way to make savings on operating costs and to reduce both environmental risks and insurance expenditure.

Stringent requirements through the supply chain, government and neighbourhoods have pushed the aluminium industry to develop casting production which produces better quality products with controlled health, safety and environmental

factors. This means production with less smell and odour and less risk within the working environment.

By critically assessing environmental impacts such as raw material and utility consumption, process efficiency, waste production and disposal, most companies that improve their house keeping and the environmental awareness of all their employees could make savings on their purchasing.

When facing stringent and future legislation such as the Integrated Pollution Prevention Control directive, a proactive approach encourages the implementation of an EMS. Such systems will provide a tool enabling the company to deal with its environmental issues, comply with the actual environmental legislation and manage its environmental performance. To obtain such improvement, considerable commitment and effort must be put into management and marketing. However, this effort will be rewarded by sustainable competitiveness.

1.7. Project objective

This thesis presents and analyses the stages in the implementation of the BS EN ISO 14001: 1996 EMS standard in an SME aluminium foundry. A full-time employee, with a £ 40,000 budget undertook this two-year project. The objectives of the project were to obtain a formal certification to ISO 14001 BS EN: 1996 standard, to put in place work instructions, procedures, training and an awareness programme and to propose investment to improve production efficiency and reduce environmental impacts.

The different stages were:

- to undertake an environmental preparatory review ;
- to prepare and communicate the environmental policy ;
- to identify the environmental legislation requirements ;
- to assess the environmental impacts ;
- to set the environmental objectives and targets ;
- to manage environmental projects in order to achieve the associated targets ;
- to put in place work instructions and procedures ;
- to train and appraise personnel to environmental awareness & contingency issues ;
- to review the existing system and identify new investment projects and
- to complete the programme within specified budget and human resources.

2. The impacts of the aluminium foundry industry on the environment

2.1. The aluminium foundry market in context

According to the Environmental Technology Support Unit (ETSU) of the Department of Environment, Transport and the Regions, the 1996 output of non-ferrous castings in the UK amounted to approximately 150,000 tonnes of aluminium alloys and 30,000 tonnes of copper and copper-based alloy castings with a cost of £ 27 million (ETSU, Oct 1987).

In 1992, 67% of aluminium castings were used in transport applications, 14% in domestic and office equipment, 10% in electronic engineering, 6% in general engineering and 3% in the construction industry (in percentage per weight) (ETSU, Nov 1994).

Several processes are used to produce aluminium castings. Die casting processes (high, low pressure and gravity die processes) produce 80% of the overall weight of aluminium castings with the balance produced by sand mould processes. Specialist processes such as shell moulding, plaster casting and investment casting supply certain micro markets (ETSU, Nov 1994).

The aluminium foundry market increased by 25% between 1992 and 1996 and is predicted to increase to 200,000 tonnes of aluminium castings in 2000, in spite of the general manufacturing recession (ETSU, Nov 1994). In response to environmental and economical pressure, manufacturing engineers are now required not only to provide high quality and efficient production but to consider dismantling, reuse, recycling and disposal of their end-use products. The life cycle design of manufacturing products and processes is becoming increasingly important in certain sectors such as the automotive industry (Keoleian G. *et al.*, 1997). Aluminium has the important characteristics of being a light, resistant and recyclable material. The transport industry, which is under pressure to reduce engine fuel consumption and atmospheric emissions, and other manufacturing sectors have progressively substituted aluminium for iron castings.

The aluminium foundry must now demonstrate high quality with low environmental impact production and meet the delivery schedules of the customer. To harmonise their supplier quality, the Big Three (Ford, General Motors and Daimler Chryslers) automotive producers have pressurised their suppliers to achieve the QS 9000 standard. This requires 100% delivery performance to customer requirement, continuous improvement in quality, delivery and price. Over 10,500 manufacturing sites worldwide are registered under the third version of QS9000 : ISO/TS 16949 (Scrimshire D., Sep. 1999).

New environmental pressures create new products and services. Faced with the agreement on the non-depletion of the ozone layer, ozone-friendly aerosols were developed. Faced with the need to reduce emissions, the automotive industry has designed lighter engines that use lead-free petrol and, for the future, will improve the dismantling and material recovery of cars.

2.2. Environmental legislation & taxation applied to aluminium foundry

The main environmental legislation and taxation applied to a comprehensive aluminium casting manufacturing site, in the United Kingdom, such as Hadleigh Castings Ltd, related to the environment, health and safety issues, are listed in the following paragraphs.

2.2.1. Legislation

2.2.1.1. Current legislation

Legislation applied to the aluminium alloy industry (related to the environment, health and safety issues) is presented below per Act and Regulation.

- **Environmental Protection (Prescribed Processes and substances) Regulations 1991 (SI 1991/472), Environmental Protection Act (EPA) 1990 - Part I**

Processes authorisation from the Local Authority is required under the Local Authority Air Pollution Control (LAAPC) provision of the Environmental Protection Act (EPA) 1990 - Part I, for the Part B processes. This requires companies to hold an authorisation from the Local Authority for undertaking Part B non-ferrous melting processes on HCL's site. The two Process

Guidance notes that apply to the operations of a comprehensive aluminium foundry are:

- **PG 2/4 (96)** Iron, steel and non-ferrous metal foundry processes, covers all the ancillary operations including mould and coremaking, casting, and fettling operations ;
- **PG 2/6 (96)** Aluminium, magnesium and their alloys which covers the melting and holding of metal.

- **Environmental Protection Act 1990, part II**, also includes:
 - **Waste Management - the Duty of Care - A code of practice - Environmental Protection Act 1990 - section 34.** It requires the waste producer to keep records of the duty of care annual waste transfer notes.
 - **Environmental Protection (Duty of Care) Regulations 1991 and Waste Management Licensing Regulations - 1994, 1997 & 1998**, which set out the requirements for the management, characterisation, transport and disposal of waste.

- **Special Waste Regulations 1996**, which requires consignment notes to be recorded by the consignor and producer of special waste.

- **Health and Safety Legislation - Control of Substances Hazardous to Health Regulations 1999 within the Health and Safety at Work Act 1974.** These require companies to demonstrate that all risks induced by activities, including those related with the use, handling, storage or disposal of chemicals, are assessed, controlled and reduced to a minimum.

- **Water Resources Act 1991** where the controlled water must be protected from any poisonous, noxious or polluting substances - runoff from car park and introduction of polluting matter into the controlled water is covered.
- **The Producer Responsibility Obligations (Packaging Waste) Regulations 1997** place obligations on certain businesses to register with the Environment Agency or the Scottish Environment Protection Agency, to recover and recycle specific tonnage of packaging waste and to certify it (Department of the Environment, Transport and the Regions, July 1998).

2.2.1.2. Future legislation

- **EC Directive 96/61 on Integrated Pollution Prevention and Control (IPPC)**

The Pollution Prevention Control Act 1999 (PPC) enabled UK domestic legislation to be made in order to implement the requirements of the EC Directive 96/61 on Integrated Pollution Prevention and Control (IPPC) (EEF, 1999; EFF, Sep 1999).

The actual PPC Act will replace the Environmental Protection Act 1990, part I. Authorisations from the enforcement authorities (Local Authority or Environment Agency) will be required not on the base 'processes' but 'installations' undertaken on site.

Three different authorisation parts will be given (John Coleman, March 2000):

- (i.) The A1 installations will be enforced by the Environment Agency (Equivalent to the current Part A processes (Integrated Pollution Control - IPC) ;
- (ii.) The A2 installations will be enforced by the Local Authority (Equivalent to current Part B processes (Local Authority Air Pollution Control - LAAPC) ;
- (iii.) The B installations will be enforced by the Local Authority (Equivalent to current Part B processes - LAAPC).

The PPC scheme will consider a wider range of environmental impacts such as noise, use of raw materials, accident prevention, site restoration and energy efficiency.

According to the timetable of the fourth consultation for the implementation of IPPC, the 'foundries' sector will be brought under IPPC by 2002 for the A1 installations and 2003 for the A2 installations. The IPPC directive must be applied to existing and new installations in all industrial sectors by 2007.

2.2.2. Green taxation

Green taxation will bring thoughts of energy efficiency and sustainability to the forefront of industrial sectors. It will re-equilibrate and integrate the true cost of environmental damage due to industrial and societal activity into the economical system. The government is responsible for using such taxes for the benefit of the Environment.

2.2.2.1. Current taxation

- Landfill Tax Regulations 1996 (SI 1996 N. 1527)

The primary law on landfill tax is contained in the Finance Act 1996 Landfill tax order 1996 (sections 39 to 71 inclusive and schedule 5). From the 1st Oct 1996, the landfill tax applied to all waste disposed of by way of landfill, at a licensed landfill site, unless exempted. For landfill tax, material is disposed of as waste if, when disposing of it, or having it disposed of on his behalf, the producer intends to *discard or throw it away*.

There are two rates of landfill taxes (HM Treasury, June 1997):

- a lower rate of £2 per tonne applies to those inactive (or inert) wastes listed in the Landfill Tax (Qualifying Material) Order 1996 (E.g. Used furan sand from foundry, soil, bricks, stone, concrete from demolition, mineral dust...) and
- a standard rate of actually (April 2000-2001) £11 per tonne applies to all other taxable waste. (E.g. General waste, offices and kitchen wastes...). It is due to increase by £1/year until it raised to £15/tonne by April 2004.

2.2.2.2. Future taxation

- Climate Change Levy

The Climate Change Levy (CCL) is designed to encourage energy efficiency in business to help the UK meet its Kyoto targets on reduction of greenhouse gas emissions.

According to ETSU, the CCL will raise £ 1billion in its first full year. This will be recycled to business via a 0.3 percentage point reduction in employer s' National Insurance contributions and £ 150m additional support for energy efficiency measures (EEF East Anglia, Mar 2000).

The intended **Climate Change Levy** will be based on energy usage and will apply to all UK Businesses and the Public Sector. It is due to take effect from April 2001.

The government is currently involved in negotiations with energy intensive sectors, via trade associations. Discounts could be agreed for the sites where processes carried out will be either similar or regulated under Part A of the forthcoming Pollution Prevention and Control regulations.

Businesses not exempted from the tax will have to pay taxes based on energy usage rates shown in Table 1.

Table 1: Climate Change Levy rate

The climate change levy will be an extra rate on the existing energy rate of energy supplier (EEF East Anglia, Mar 2000).

<i>Energy Product</i>	<i>Rate (2001-02) extra pence/kWh</i>
Electricity	0.43
Coal	0.15
Natural Gas	0.15
Liquid Petroleum Gas	0.07

- Aggregates Tax

The extraction and transport of aggregates has significant associated environmental cost, including noise, vibration, loss of biodiversity, amenity and visual intrusion. According to the HM Treasury, the DETR commissioned research found that this average cost will be around £1.80 per tonne of aggregate (HM Treasury, Mar 2000).

The levy will take effect from April 2002, at a rate of £1.60 per tonne of sand, gravel and crushed rock extracted in the UK or its territorial waters. It will be around £380 million per year. To protect international competitiveness, the tax will be levied on imports only. Recycled aggregates will not be subject to the levy.

2.3. The environmental impacts of the Aluminium Foundry Industry

2.3.1. Energy usage

2.3.1.1. Introduction

After the world oil crisis of 1978, energy management was practised in order to reduce costs. In considering the recent fuel crisis in Europe, plus other growing environmental issues such as global climate change, atmospheric pollution and depletion of non-renewable resources, a new fervour for prudent and efficient energy management is advised. The aluminium foundry is considered to be heavy consumer of energy. In 1996, the UK non-ferrous industry amounted their output to approximately 150,000 tonnes of aluminium alloys and 30,000 tonnes of copper and copper-based alloy castings (Energy Technology Support Unit, Oct 1997).

2.3.1.2. Energy consumption facts and figures

Due to the large difference in unit price between electricity and gas, natural gas is widely used for melting furnaces although electricity is sometimes used for holding furnaces. The 1996 ETSU survey reported that the energy used in a typical aluminium foundry consisted of 62.5 % natural gas, 33.3% electricity and 4.2% propane and/or oil. Assuming that 150,000 tonnes of aluminium alloy castings were produced in 1996, this consumed 6.4 PJ of primary energy at a cost

of £19.5 million. The average energy consumption amounted to 42.6 GJ, costing £130, per tonne of good castings (ETSU, Oct 1997).

2.3.1.3. Heavy energy demand activities

The energy breakdown of an individual non-ferrous foundry depends upon many factors, including the casting manufacturing method and the amount of finishing (including heat treatment, machining and painting) carried out. Nevertheless, the following activities have been classified according to decreasing energy consumption.

1. **Melting and holding of aluminium at 710 to 780 C.** Theoretically, 310 kWh is required to melt one tonne of aluminium to 730°C, nevertheless according to ETSU 7,000 kWh is the average amount of energy used to produce 1 tonne of aluminium castings in gravity foundries (ETSU, Nov 1994).
2. **Moulding processes.** This includes die and ladle heating, for high pressure diecasting², low-pressure diecasting³; gravity die casting; sand distribution and reclamation, for greensand moulding⁴, Airset moulding⁵, Shell moulding⁶.

² High Pressure diecasting (HPDC): Metal is 'shot' into the die, usually horizontally, under pressures of 10 bar and above.

³ Low Pressure Diecasting (LPDC): Metal is force into the die, usually upwards, under pressure at about 2 bar.

⁴ Greensand moulding (GS): Metal is poured (usually under gravity) into a mould formed from clay-bonded sand.

⁵ Airset moulding (Airset): Metal is poured under gravity into a thin sand mould hardened by chemical reaction.

3. **Ancillary Processes**, all the manufacturing activities in areas other than that of metal supply. They could be CNC or conventional machining, fettling or pattern making, hot core making, and the use of electricity supplied to motors, drives, computers, compressed air or hydraulic power units (specific to HPDC).
4. **Office activities**, such as space heating, lighting, computers...

The findings of ETSU for a typical energy use in a foundry are presented in Figure 1.

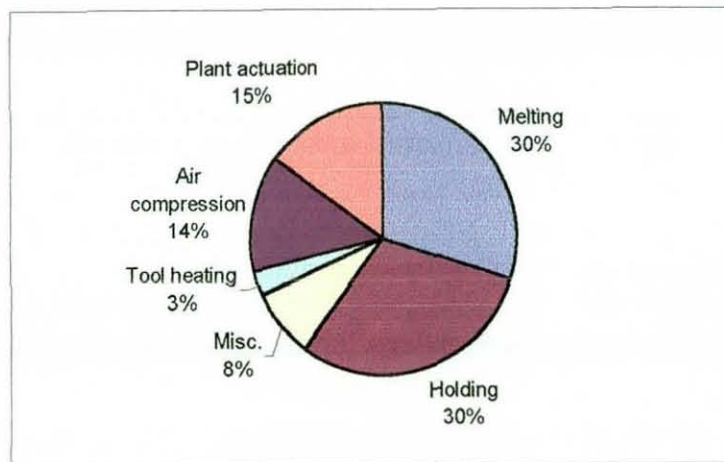


Figure 1: Typical energy use in a foundry (as kWh delivered) (Energy Technology Support Unit, Oct 1987)

⁶ Shell moulding: Metal is poured under gravity into a thin shell mould made from a thermosetting sand/resin mixture.

2.3.1.4. Environmental impacts from energy production

The operations of the energy sector (coal, oil, natural gas, fossil fuel, nuclear, hydraulic or renewable energy) in the UK, as elsewhere, can affect the environment in many different ways. Detrimental effects can result from energy exploration, production, transportation, storage, transformation, distribution, use and its associated waste disposal and storage.

According to the Department of Trade and Industry, the particular areas of potential environmental concern related to the energy sector are listed below.

- Ambient air quality ;
Electric power stations release CO₂ and SO₂ emissions, exploration, and production of oil and natural gas in the North Sea releases emissions of CO₂, CO, NO₂, SO₂ and Hydrocarbons.
CO₂, methane and NO₂ produce green house effects associated with a global warming of the atmosphere, a perturbation of climate and a potential rise in the sea level. The NO₂ and SO₂ are the main agents responsible for the acid rain, which falls on Germany and other parts of Europe.
- Acid deposition ;
- Coal mining subsidence ;
- Major environmental accidents ;
- Water pollution ;
- Maritime pollution ;
- Land use and siting impact ;
- Radiation and radioactivity ;
- Solid waste disposal ;
- Hazardous air pollutants ;
- Stratospheric ozone depletion and

- Climate change.

To implement the European Climate Change Directive, the UK government will be required to implement the Climate Change Levy on energy bills by April 2001. A factor of 2.84 will be applied to electricity. In other words, electricity will be 2.84 times more taxed than gas or fuel (Transco, 1998). This new taxation will increase the energy bills by 15 to 20%. It aims to encourage the heavy user industry sectors, such as the foundry sector, to operate in a more efficient and sustainable manner.

2.3.1.5. Good practices for energy management

Savings could be achieved by improving practices in melting and holding, metal distribution and handling, metal utilisation, and general energy use.

The purchase of a new efficient furnace is considered to be a good investment for reducing energy consumption, increasing production rate and improving quality. Many examples are presented in the ETSU literature such as Quinton Hazell Automotive Ltd, which invested in an energy efficient model of melting and holding furnaces with an investment of £ 11,200, which generated a total savings of £6,970/year and a pay back period of 1.6 years (ETSU, Dec 1996).

2.3.2. Raw material usage & resource depletion

The earth's resources such as oil, gas reserves and minerals are finite. Other materials are obtained from unique habitats such as wood from tropical

rainforests, and peat from moorlands. If exploited too far these resources will run out and the ecosystem will be destroyed.

The foundry industry produces castings using aluminium, iron moulds, silica sand and chemicals used for melting, coating, painting and lubrication. A simplified life cycle or "cradle to grave" assessment of the main raw materials used in the foundry industry is presented below.

2.3.2.1. Aluminium

Aluminium is a material that meets the complex ecological and technological requirements of our environmentally conscious society. Low weight, high strength, formability, corrosion resistance, recyclability and good conductivity of heat and electricity provide aluminium with a unique combination of attractive and versatile properties.

Aluminium metal is produced from aluminium oxide Al_2O_3 (alumina) contained in bauxite, which is found in Latin America, South America, Africa and Australia. According to the Aluminium Federation Ltd (Aluminium Federation Ltd, Jun. 2000), the world's known deposits of bauxite are sufficient to support 300 years of mining at the present consumption rate. UK aluminium smelters use aluminium oxide produced from bauxite mined in Australia and Jamaica. Mining activities are often responsible for deforestation; nevertheless, the environmentally aware company Alcoa won an award in 1990 under the United Nations Environmental Programme for its work in reforestation of bauxite mining areas in Australia (Aluminium Federation Ltd, Jun. 2000). The bauxite is transformed to aluminium oxide on the mining site through the Bayer method. The smelter obtains the primary aluminium after a hydroelectric separation. The foundry is then

considered as the secondary smelter. Approximately 70% of the end-of-life aluminium products used in electrical engineering, construction and transport are recycled.

2.3.2.2. Sand

Foundries require a durable refractory material for forming moulds that resist the heat of the metal. Silica sand, an industrial mineral that meets these requirements, has the following properties:

- 90 to 95% silica expressed as SiO_2 ;
- Round grains to maximise permeability to gases and minimise binder usage ;
- Narrow grain size distribution and
- Maximum purity, e.g. free as possible of clays.

Suitable silica sands can be found in Cheshire, Surrey, Kent, Bedfordshire, Norfolk, Nottinghamshire and several other places. The silica sand industry, sponsored by the DTI, has to regulate quarrying activity through mining planning in order to ensure a continuing long term and sustainable supply to industry (DTI, Dr J.N.S. Sibson, 1999).

The UK government will introduce, from April 2002, an Aggregates Levy at a rate of £1.60 per tonne of sand, gravel and crushed rock extracted in the UK or its territorial waters. This levy takes into account the true cost of environmental effects of quarrying activity on the price of quarried product. Waste sand disposal at a landfill is subject to a landfill tax. As it is classified as an inactive waste it is taxed at the lower rate of £2 /tonne.

Many sand foundries (such as Hadleigh Castings Ltd, J. Youle & Co Ltd and Joseph & Jesse Siddons Ltd) have introduced a mechanical and/or thermal reclamation system, which reduces the volume of sand purchased or disposed, thus reducing cost and environmental impacts (ETBPP, May 1999 ; ETBPP, August 1997 ; ETBPP, March 1998).

2.3.2.3. Chemicals for melting, painting, coating

Numerous chemicals are used within the foundry industry, they have different purposes. Chemicals are used for modification of metal during the melting processes, coating gravity dies, lubrication of machines used for machining and fettling and in binder systems used by sand foundries. All these chemicals pose environmental problems from their 'cradle to grave'. Production then storage, usage and disposal of their waste materials or containers causes health, safety and environmental risks. It is good practice to manage chemicals in order to reduce risks and minimise consumption. Communication, training and monitoring are three main elements for a successful management of chemicals (EBPP, Jan 1998).

2.3.2.4. Wood

Sand foundries produce and use wood patterns. Wood such as mahogany, meets the stringent requirements of wood patterns. This wood is supplied from Brazil and may be from the Amazonian forest so it could contribute to deforestation problems.

2.3.3. Atmospheric pollution

Atmospheric emissions from foundry activities are regulated under the Environmental Protection Act 1990 (EPA). Fluoride and chlorine from the melting practices, Volatile Organic Compounds and particulate from ancillary activities are the main pollutants emitted and monitored by the foundry industry. In October 1999, the Integrated Pollution Prevention and Control (IPPC) EC Directive was implemented by the UK government and is now progressively replacing the old Environmental Protection Act 1990. IPPC has been designed to prevent, reduce and eliminate pollution at source through the prudent use of natural resources. IPPC is concerned about a much wider range of environmental impacts than the EPA. The environmental impacts of the various atmospheric pollutants are presented below.

2.3.3.1. The Ozone Layer

Ozone is a gas. Some 30-40 km above the earth's surface is the stratosphere where ozone plays a beneficial role by absorbing damaging UVB - ultra violet rays from the sun. The absorption of these rays creates a source of heat. Ozone plays an essential role in the temperature control of our earth's atmosphere. At the planet surface, there is the troposphere. In the troposphere, ozone gas reacts strongly with other molecules to produce compounds harmful to crop production, forest growth and human health.

There are two separate environmental issues relating to ozone gas. There is concern about the Antarctic 'ozone hole'. Similar depletions in stratospheric ozone have been observed at other more populated regions on the earth. An increase in UVB radiation increases skin cancers and cataracts on the eyes, and decreases the growth rate of plants and forests. This ozone depletion is caused by releases into the atmosphere of certain chemicals containing bromine and/or chlorine. They are⁷:

- Chlorofluorocarbons (**CFCs**) used in products such as hair spray bottles ;
- **Halons** used in the past in refrigerants ;
- **Carbon Tetrachloride**, very toxic, used as a solvent ;
- **1,1,1 Tetrachloroethane** (Methyl Chloroform)- non-flammable solvent ;
- Hydrochlorofluorocarbons (**HCFCs**) used in solvents, refrigerants, foam blowing media, feedstock for chemical manufacturing, carrier gases for sterilisation and
- **Methyl Bromide**.

The second concern is the increased presence of ozone in the troposphere as this is a key component of Smog. Increasing levels have been observed in urban area especially in capital cities.

2.3.3.2. Global Warming

Certain natural gases in the atmosphere, notably water vapour, carbon dioxide (CO₂), methane (CH₄) and nitrogen oxides (NO_x), have the capacity to retain heat

⁷ Montreal Protocol Treaty 1987 obligated the 15 member states of the European Union to control both production and consumption of all known ozone depleting substances, apart from certain exemptions.

which reaches the earth from the sun to give a 'greenhouse effect'. They form an insulating blanket around the earth, which prevents the loss of the heat radiated back from the earth (and sea). The term 'greenhouse effect' is used to describe the 'global warming' phenomenon.

The problem is due to the additional man-made greenhouse gases such as the halocarbons (e.g. Chlorofluorocarbons...), and increased carbon dioxide, methane, nitrogen oxides from burning fossil fuels, generating electricity transport and factories which correspond to an addition (from the Industrial Revolution) of roughly 1 per cent⁸ of the energy, flowing through the global climate system (University Corporation for Atmospheric Research, 1997). It is predicted that this may cause a rise in sea levels of between 15 and 95 cm. and in a change in weather patterns (including storms and droughts).

The six main greenhouse gases are:

- Carbon Dioxide, CO₂ ;
- Methane CH₄ ;
- Nitrogen Dioxide NO₂ ;
- Sulphur Hexafluoride ;
- Hydrofluorocarbons (HFCs) and
- Perfluorocarbons (PFCs).

⁸ The difference is about 2.4 Watts per square meter of energy flow through the global climate system.

2.3.3.3. Acid Rain

Acid Rain is the acidification of rain by atmospheric pollutants such as sulphur dioxide (SO₂) and nitrogen oxides (NO_x), which combine with moisture in the air to increase the natural acidity of the rain. SO₂ and NO_x are emitted by power stations, industry and motor vehicles through the burning of fossil fuels, especially coal and oil. Acid Rain damages buildings and plants and is thought to contribute to the damage of forests, streams and lakes.

2.3.3.4. Smog

Smog is a mixture of pollutants, which form a haze over cities, particularly in summer time. This smog is formed by chemical reactions, which involve Volatile Organic Compounds (VOCs), and Nitrogen Oxides (NO_x) and produce ozone. Major sources include motor vehicles and petrochemical activities.

2.3.4. Waste production & beneficial reuse

2.3.4.1. Solid waste

The UK generates around 400 million of tonnes of solid waste each year and disposes of it by:

- landfill, which consists of burying waste in the ground and

- incineration, which consists of burning the waste and sometimes recuperating energy, for example in the generation of electricity (EEF, 1997).

Both of these solutions have environmental impacts, the former risks of leakage into aquifers and the latter an increase of atmospheric pollution.

To reduce our waste production, awareness of the population should be focused on waste management. (E.g. Four Waste Management Principles and hierarchy : Re-use, Repair, Recycle, and Disposal).

2.3.4.2. Waste management & beneficial reuse

The waste management hierarchy is:

1. Reduction ;
2. Reuse ;
3. Recycling and
4. Disposal.

Foundry activities produce a large amount of waste, the main types of waste are wasted sand, metal waste, special waste (waste oil, cutting fluids, old lubricant...) and others. Details are developed within the following subsections.

2.3.4.3. Wasted sand

Recently, constructive co-operation between the aggregate (especially cement and tarmac) and aluminium foundry industries has developed. The cement companies

reuse waste foundry sand. The foundry Industry benefits through a reduction in landfill tax and waste disposal costs and the cement industry benefits from the reduction in purchase costs of new sand (Briggs B., Apr 1999). The environment also benefits because there is less quarrying of new sand and less landfill disposal of waste sand. Many examples of co-operation for beneficial reuse are developing. An inhibiting factor is the distance between companies. The distance between the supplier and receiver of aggregates is important because the transport cost may offset any beneficial costs or environmental benefits.

2.3.4.4. Metal waste

Aluminium foundries produce metal waste in the form of scrap metal, swept floor flashes, dross with low aluminium content and irremediable metal loss, which is considered as 5% of the metal used in the foundries.

Dross is the mixture of metal at the surface of a crucible where the aluminium is oxidised and chemicals are accumulated. This dross can be treated to release aluminium by secondary smelters.

The swarf from machining and metallic dust from fettling activities can be recovered by smelters.

2.3.4.5. Other wastes

Other wastes resulting from office activity or building construction are generally disposed of by either landfill or incineration. Some office waste such as ink cartridges, paper, cardboard and glass can be recycled. Local Authorities and the Environment Agency monitor all controlled waste. All waste transfer must be accompanied by a fully completed transfer note or a special waste consignment note if the waste has a potential to cause harm to the environment or humans.

2.3.5. Discharge to water aquifer/ water contamination

Water is essential to life and there is a concern about pollutants from various sources that could be found in water. Any pollutant released to the atmosphere or land could be transported to aquifers, rivers, streams or the sea with the water cycle of the ecosystem (rain, absorption to soil, water to plants, evapotranspiration of plants). Such water sources must be protected, especially from chemical spillage.

2.3.6. Land & site contamination

The industrial evolution of Britain occurred without environmental controls. Pollution was regarded as a normal consequence of industrial activity. Over time,

solid and liquid waste, from a multitude of activities, was dumped into the ground. Such sites, where past contamination occurred, need now to be restored to a non-contaminated level.

A spillage of hazardous chemicals could not only cause a contamination of the soil but also of the water and aquifer. The contamination risk is decreased when the environmental issues of hazardous substances are managed properly through specific training and communication.

2.3.7. Statutory nuisances: noise, vibration and odour

Fettling and machining activities produce a large amount of noise. Melting processes also produce odours, which the company should control and prevent in order not to disrupt the surrounding environment. Health, safety and environmental legislation regulate noise, vibration and odour. Regular, systematic measurement and control and good communication with regulatory bodies and third parties provide a good basis for control of these statutory nuisances.

3. Environmental Management System

ISO 14001: a managerial tool in the Aluminium Foundry Industry

3.1. BS EN ISO 14001 principle and requirements

3.1.1. Definition

An environmental management system (EMS) integrates environmental issues into the management function of a business or organisation. An EMS is a practical tool, which guides an organisation in the implementation of policy and procedures that prevents pollution of the environment from its activities, products and services. In other words, it is a tool enabling a company:

- to comply with environmental legislation ;
- to improve its environmental performances via the reduction of its environmental impacts, e.g. control and management of its production efficiency, raw material, utility and waste ;
- to provide means to deal with potential liabilities (e.g. Spill clean-up) and
- to provide a framework to exploit environmental opportunities.

3.1.2. Historical background

The environmental management structure will provide targets and objectives against which the environmental programme will be set in order to achieve them.

Since 1994 until now, the EMS has become formalised ; the EMS recognised to be the more stringent is the European Eco-Management and Audit Scheme (EMAS). The other alternative is the international ISO 14001 EMS. The original British EMS BS 7750 standard was launched in 1994 but has now been replaced by the ISO standard.

The International Organisation for Standardisation was formed in 1947 by a group of 90 national standards bodies wishing to establish uniformity of standards to reduce the possibility that national standards would function as barriers to trade. According to D. Hortensius (Hortensius D., Barthel M., 1997), during the preparation of the 1992 United Nations Conference on Environment and Development (UNCED; The Earth summit), the Business Council for Sustainable Development (BCSD) and the COPOLCO⁹ agreed the need for harmonisation on an international level in Eco-labelling and environmental performances. They formed the Strategic Advisory Group on Environment (SAGE) which recommended the formation in 1993 of a Technical Committee (TC/207) to develop an environmental management tool. The final ISO14000 series was established in September 1996.

⁹ COPOLCO is the committee platform ISO, provided for consumer interest.

The ISO 14001 standard is based on a cycle of six core elements which are environmental policy, planning, implementation and operation, checking and corrective action, management review and continual improvement.

Appendix 1 presents the requirements of the ISO14001 standard.

3.2. Good EMS practices in the Aluminium Foundry Industry

The introduction of EMS by the aluminium industry happened slowly. Stringent environmental legislation and taxation such as IPPC, landfill and aggregate taxes have pushed the foundries to manage more prudently their raw materials, waste and atmospheric emissions.

3.2.1. Case study: RHP Bearings Ltd

The Environmental Best Practice Programme has published a good practice case study of RHP Bearings Ltd demonstrating the successful incorporation of environmental issues into an existing management system. They put in place an informal EMS. The total implementation costs were £153,925 for the environmental initiatives presented in the following table. The total annual savings were approximately £87,000. One example of improved environmental

performance was a reduction in waste cutting fluid of 54 500 litres/year. The environmental initiatives of RHP Bearings are summarised in Table 2.

Table 2: Environmental initiatives of RHP Bearings Ltd

Source: EBPP, 1996, Environmental Improvements Reduce Costs - A Good Practice Case Study at RHP Bearings LTD, GC 59.

Keys: ER: Environmental Review, Ci: Continuous Improvement, L: Legislation.

Initiative	How initiative identified	Implementation costs (£)	Annual Savings (£)
Installation of access floors in the sand recycling plant	ER, Ci	4 950	4 300
Implementation of a drum management system	ER, Ci	1 500	9 830
Improvements to handling and re-use of excess molten metal	Ci	1 200	2 761
Procedures for monitoring and cleaning lubricating oil	ER, Ci	1 800	6 180
Introduction of new cutting fluid and improvements in its use	ER	34 000	9 760
Modification to core box release agent application	Ci	375	7 680
Improvements to dry bag filter on the sand recycling plant	ER, L	110 000	4 608
Briquetting of machine shop swarf for re-use	Ci	100	41 600
Total		£153 925	£86 719

An environmental review was undertaken in 1993 to increase employees' awareness, identify the scope for environmental improvement and incorporate environmental aspects and practices into existing company policies and management. The existing systems, continuous improvement programme, quality, health, safety, and investments in people systems were extended in order to incorporate environmental responsibilities on procedures, training,

communication and audit issues. Another benefit to this integration of environmental issues was to provide a basis for a formal EMS.

3.2.2. Case study: Triplex Foundry Ltd

The case of Triplex Foundry Ltd (Tipton Works), a grey iron foundry, also demonstrates a successful implementation and certification of an environmental management system to BS EN ISO 14001 certification (Lyon, R., Feb 1999). After a feasibility study, they identified the environmental impacts and priorities at the beginning of 1997. Then a steering group, composed of employees working in key areas within the company (e.g. engineering, purchasing, production, quality, training, health and safety representatives) was formed to ensure the proper implementation of procedures, communication of relevant issues and *training on environmental impacts*. The environmental lead manager created an 'implementation team' composed of supervisors who cascaded the information to the shop floor. The implementation phase was composed of seven activities:

- awareness training at all levels ;
- setting up new systems such as environmental communications files ;
- making each employee aware of the specific environmental implications of their job ;
- researching suppliers' attitudes to environmental matters and duty of care licences ;
- establishing improvement targets and programmes ;
- establishing and testing emergency procedures and
- auditing and checking for compliance with legislation.

3.2.3. Key issues

After a literature review, the key issues for the successful implementation of an environmental management system are identified, they are :

- commitment from the top management to the shop floor ;
- feasibility study including provision of sufficient capital investment and employees' availability for environmental training and management ;
- appoint a lead manager and establish a steering group, or contract an environmental consultant ;
- setting an environmental programme with responsibilities, budget and timescale ;
- high level communication of objectives and targets from management to floor shop ;
- existing managerial framework ;
- existing good practices toward waste management and emission monitoring ;
- environmental review identifying environmental impacts and the associated legal requirements ;
- training and awareness programme ;
- implementation of environmental procedures ;
- monitor environmental indicators ;
- establishing an audit programme with responsibilities and timescale ;
- document the system in an effective and accurate manner ;
- establish a systematic method for identifying modification to legislation, activities or personnel which could affect the environmental impacts of the company and
- maintaining the system toward a continual improvement.

The Environmental Technology Best Practice Programme publishes a very useful *Good Practice Guide on Environmental Management Systems in Foundries and Metal Finisher Manufacturing* and provides free advice on environmental and energy issues (EBPP, Oct 1996).

The integration of different management systems is often advised once quality, health, safety and environment management systems are well established. Overlap between the different systems exists. An integrated management system is a way to reduce audits, duplication and bureaucracy. It provides simplicity and reduces running and external auditor costs.

4. Case study of Hadleigh Castings Ltd implementing an Environmental Management System

4.1. Introductory summary

Hadleigh Castings Ltd (HCL), with the support of Loughborough University, has implemented an informal environmental management system (EMS), based on the requirements of the ISO 14001 standard.

The long-term strategic aim of the top management is to be certified with the ISO 14001 standard in a few years time and then to integrate the health, safety and quality management systems.

An overall budget of £37 200 was allocated to the two-year project and this was used to employ the author as an environmental adviser and the consulting services of Loughborough University.

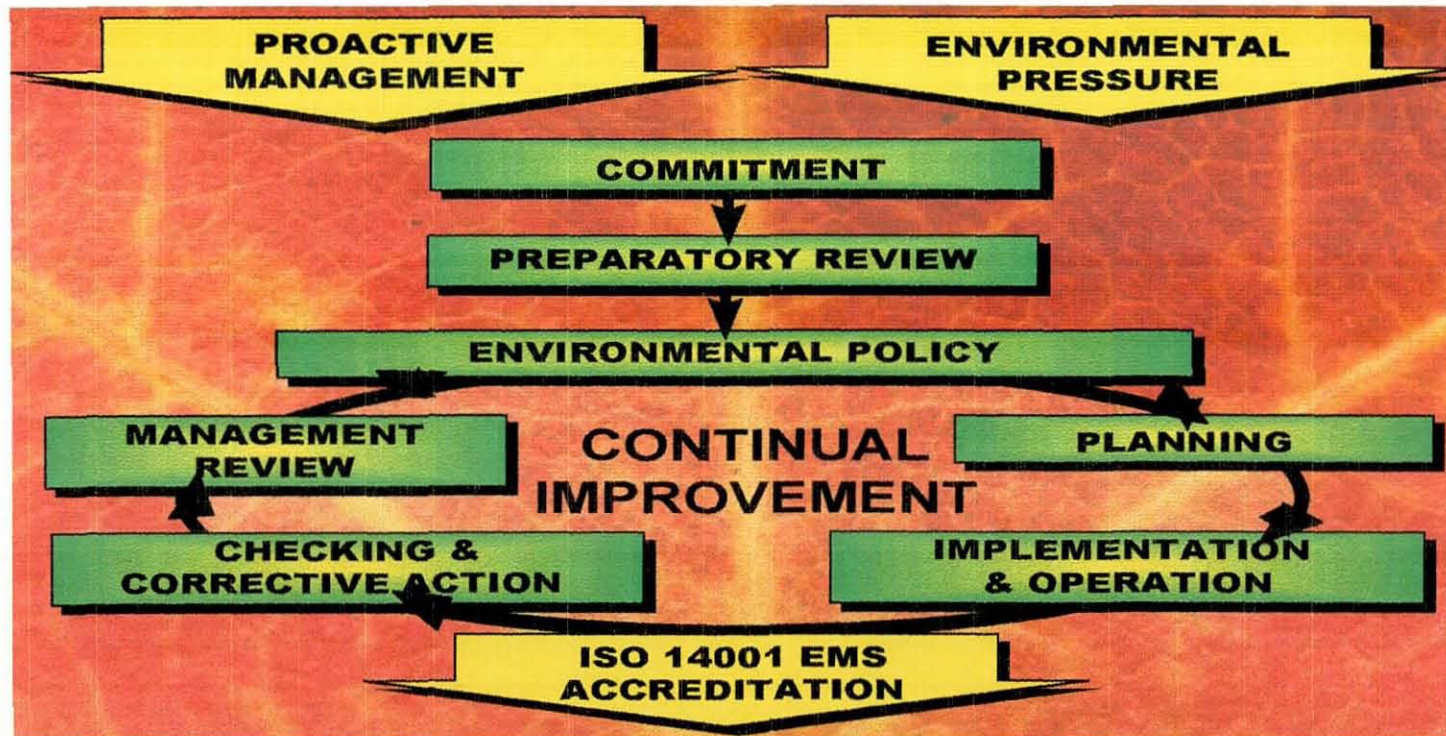
The two-year project of implementing an EMS is presented on, a step by step basis. This chapter outlines the major steps carried out in the case study of Hadleigh Castings Ltd under the following headings:

- feasibility study ;
- top management commitment ;

- initial preparatory review ;
- environmental policy statement ;
- planning ;
- implementation and operation ;
- checking and corrective action and
- management review.

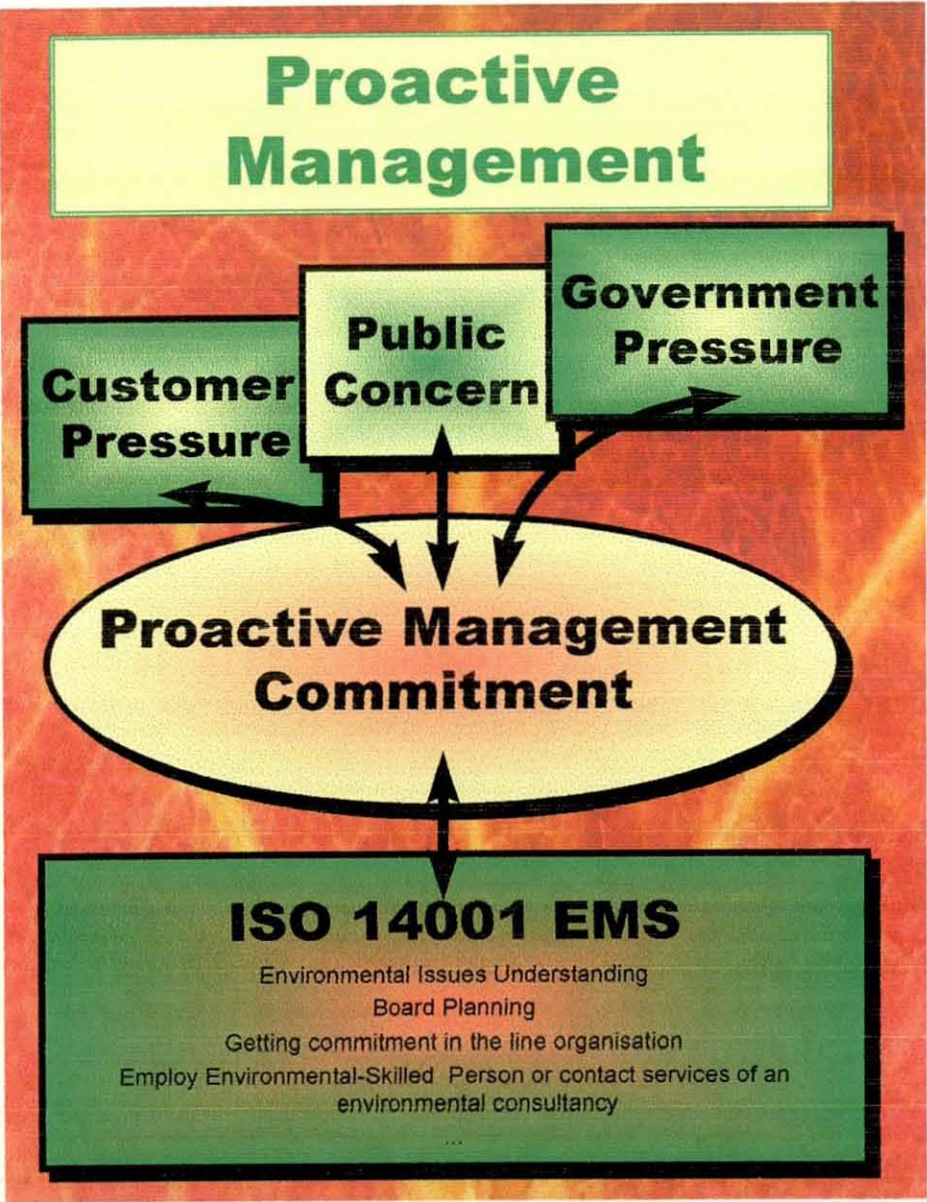
These steps were undertaken in a chronological order and will be developed with methodology and practical examples from HCL. A schematic cycle represents two factors, a proactive management and the increased environmental pressure from third parties, which induces the implementation of an EMS. The diagram of the continual improvement cycle of an EMS on a step by step basis is presented in Figure 2.

Figure 2: The continual improvement cycle of an Environmental Management System on a step by step basis.



A proactive management could be defined as a management taking into account the external pressure acting on its business and taking action to answer the needs and requirements of regulators, customers and the public. Figure 3 presents a schematic view of proactive environmental management.

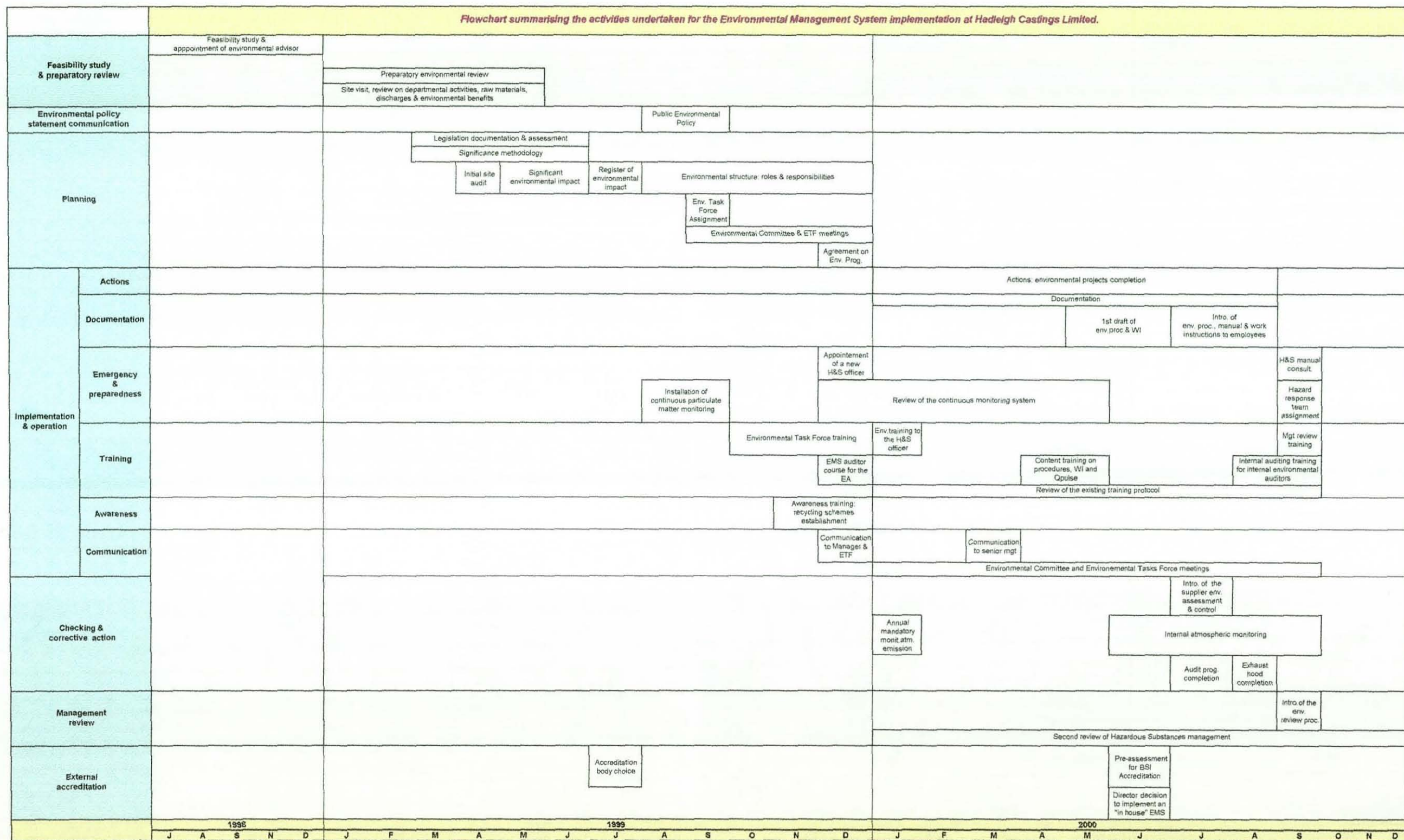
Figure 3: Schematic view of proactive environmental management.



A final certification to ISO14001 standard could be envisaged once the implemented EMS fulfilled the requirements of the standard. In HCL's case, the certification to ISO 14001 primarily targeted was put on hold until the 'in-house' EMS proved effective. Figure 4 presents a flowchart summarising the activities undertaken for EMS implementation at HCL.

Figure 4: Flowchart summarising the activities undertaken for EMS implementation at HCL.

See next page.



4.2. *Feasibility study*

Before undertaking a project that involves a large change to a business, a study should be undertaken in order to assess the feasibility and potential success of the proposed project.

The study could include a planning programme detailing the main steps of the project against a timescale, budget and human resources. The success of the overall project should be assessed against criteria, that are defined during the feasibility study. For a management system there will be internal criteria such as economical, quality, managerial (communication, documentation...) and cultural change (awareness, commitment...) benefits. The external criteria could include improved collaboration and relations with third parties such as regulators, professional bodies, neighbours, shareholders and customers...

Additional project costs could also be assessed & estimated such as initial investment, running, consultancy and cost savings. Initial investment could be related to changes required in order to comply with health, safety and environmental legislation. Running cost could be the time committed by environmental committee members and the additional costs could include special waste disposal & transport. Savings could arise from decreased cost for the consumption of raw materials, utilities and the disposal of wastes.

Other benefits, more difficult to evaluate in terms of cost, are the better relationships with local authorities, improved forecasting strategy, better Health & Safety (H&S) management, and an improvement in general management.

The introduction of an EMS at HCL commenced at the beginning of 1998 under the auspices of the Teaching Company Directorate, a governmental funded scheme developed to create links and partnerships between Universities and Small and Medium Sized Enterprises and to promote good practices and the use of new technological expertise.

The detailed process of the implementation of an EMS includes planning, communication, team building and distribution of rules and responsibilities phases and these require a clear strategy in order to ensure the full commitment of resources necessary for the success of the project.

An assessment of compliance has not been undertaken with environmental, health and safety regulations before the beginning of the programme. The project's tasks were broadly defined rather than specific to the site. Weaknesses in the existing health, safety and environmental issues within Hadleigh Castings Ltd were not considered.

4.3. Top management commitment

The company must ensure commitment from the top management. Commitment could be measured in term of resources available for the project.

Economical commitment is often covered and well defined. An estimated budget is allocated to the project.

Another resource, which is not so clear and covered, is the human resources and the availability of the top management for a project (£12,000 considered in supervision labour cost from Hadleigh Castings Ltd , 8 hours a week for 100 weeks). This time is easily determined for awareness training and other specific tasks but it is more difficult to estimate the time required from the top management to provide the information necessary for the initial preparatory environmental review and to fully participate as members of the environmental committee.

4.4. Initial preparatory review

The initial preparatory review provides the opportunity to take a 'snap shot' of the company's attitude to environmental issues and its actual performance, problems and opportunities.

The purpose of the initial preparatory review is:

- to identify the limit of the site and its history in terms of past & present contamination ;
- to identify the site operations, especially those, which could cause environmental damage ;
- to quantify emissions, discharges and material/utility usage ;
- to identify breaches (or potential breaches) to legislation ;
- to identify key areas for improving environmental performances and
- to prioritise projects for complying with legislation and/or decreasing environmental impacts and/or improving environmental performances.

A site, utility and departmental audits, on a process basis, were undertaken to identify activity, inputs/outputs & compliance issues at the primary site at Pond Hall Road. These were undertaken and reports prepared during the period from May to July 1999.

The information gathered during the initial preparatory review was used to undertake the environmental impact assessment at the planning phase of the EMS.

4.4.1. Site audit

A Site audit should include a contaminated land assessment. This will require a site visit, a definition of the boundaries and an investigation of the history of the site to examine potential past contamination.

The site audit of Hadleigh Castings Ltd. was undertaken from January to May 1999. Worksheet 3 'Documents needed for an initial review', worksheet 4, 'Initial review', from the Environmental Technology Best Practice Programme GG18 (Environmental Technology Best Practice Programme, Mar. 1998) were used to undertake the site audit.

The history of the primary site was investigated by interviewing the Managing Director and the site neighbours. Maps and information were gathered by contacting Anglia Water, the Babergh District Council and the Environment Agency. All the authorities, companies & charities consulted during the EMS implementation are cited in the Consultation List in Appendix 2.

A report, entitled 'Initial Site Audit Report' was produced in May 1999. Firstly, the privately owned primary site, Pond Hall Road, and the two rented secondary sites, were defined with their associated boundaries and activities. Maps of the sites are shown in Appendix 3.

The decision was made that the implementation of the environmental management system would only take place on the primary site. The reasons were firstly, that the secondary sites were temporary rented rooms, secondly the only activity undertaken during normal conditions was the storage of wood patterns and gravity dies, and thirdly no control of Health and Safety or any other managerial issues were undertaken on those sites.

The existing structure of the company was identified as a flat structure with few managerial levels. Business centres were identified to answer to the environmental activities listing. Appendix 4 presents the Business Centres and Activities Listing of Hadleigh Castings Ltd.

The responsibilities for environmental legislation compliance belonged to the Managing and Production Directors. Health and Safety management was characterised by important weaknesses in risk and Control of Substances Hazardous to Health assessments. Three points of no compliance to the Authorisation of Environmental Protection Act 1990 written in October 1993 were highlighted. Advice that immediate corrective action must be taken was provided.

The contaminated land assessment of the primary site did not identify past contamination.

A suggestion for further audits was given.

The following departmental audits identified, for each business division of the company, the inputs and outputs of activities and their associated environmental effects.

4.4.2. Departmental audits on activity, inputs/outputs & compliance

The objectives of the activity audit were:

- to identify the inputs, outputs and activities of the company under emergency, abnormal and normal operational conditions and
- to identify the key non-compliance and good environmental value issues.

Those information will be used for assessing the environmental impacts of Hadleigh Castings Ltd at the planning phase of the EMS.

The different steps of the methodology were:

1. Definition of the site boundary (information gathered during the site audit) ;
2. Definition of the activities, products and services undertaken at the defined site ;
E.g. Division of activities into departments or groups associated to the product life cycle (Design - Purchase - Production - Use - Maintenance - Decommission / Disposal) ;
3. Visit of each area with a checklist on what to look for (inputs, outputs, discharges, environmental key issues...) ;

4. Consultation of departmental expertise on the list of activities, inputs and outputs ;
5. Compilation of a register of activities, products and services on a departmental basis, undertaken on the defined site ;
6. Check of activities against abnormal, normal and emergency operational conditions and past contamination. Consultation with managers & directors (See Appendix 4) ;
7. Quantification of the inputs (Chemicals, raw materials, energy & water) and outputs (Extraction, fumes, waste & discharges to water) for each activity. This includes storage of chemicals and waste plus the drainage system ;
8. Identification of potential key areas for environmental & economic improvements and
9. Compilation of findings on synthetic reports identifying non-compliance & specific good environmental value issues.

Two reports were produced:

- the 'utility report', stating results from an energy audit and
- and the audit report of the activity of each department of Hadleigh Castings Ltd and the identification of the associated inputs, outputs and non-compliance issues.

The report findings were communicated to the managers and directors of the Company.

The initial environmental preparatory review took 5 months to complete. As environmental adviser, the author spent considerable time consulting the directors and managers, especially the Managing Director, to obtain information.

The activities of an SME are often based more on individuals than on a managerial structure, the ad hoc experience and information are not very well documented and the accuracy of the data required must be double checked.

Furthermore, an adaptation period is required when new personnel are appointed, to create a confidence between the environmental adviser/consultant (interviewer) and the top management and other employees of the company (interviewees).

To improve communication and interpersonal relationships, the environmental consultant should first of all provide an explanation of the reason for collecting information and the relevance of the accuracy of the information. An environmental consultant should always initially appraise the information provided by the interviewee and check its accuracy.

The findings of the initial preparatory review are reported in the following section.

4.4.3. Environmental performance of Hadleigh Castings Ltd

4.4.3.1. Summarised description of the site and its associated activities, inputs & outputs

Hadleigh Castings Limited was formed in 1969 under its earlier banner of Hadleigh Patterns Limited and initially gained its reputation by providing high quality wood patterns to the Foundry Industry. By 1972 its services were

expanded to include the complete manufacture of aluminium castings and this was followed a few years later by a further expansion into full machining services.

Since those early times the Company has steadily grown, and today it occupies a total factory area in excess of 3,716 square meters (40,000 square feet) on a site of 1.82 hectares (4½ acres). The Company uses precision sand¹⁰ and gravity die casting¹¹ methods to produce quality castings, which can also be machined and inspected using CNC¹² techniques before delivery throughout the UK and overseas.

¹⁰ Precision sand casting process: It uses sand as the primary mould material. The sand grains, mixed with small amounts of other materials to improve mouldability and cohesive strength, are packed around a pattern that has the shape of the desired casting. After the sand has been packed around it, the pattern must generally be removed to leave a cavity of desired shape. An opening, called *sprue hole*, is cut from the top of the mould through the sand and is connected to the mould cavity through a system of channels, called runners (DeGarmo E. P, Black J. T, Kohser R. A., 1988 p.237).

¹¹ Gravity die casting process or permanent – mould casting: Its feature is the use of a reusable mould, which is machined from grey cast iron (Hadleigh casting Ltd's case), steel, graphite or other material. The mould segments are hinged to permit accurate opening and closing. The mould is preheated and the molten metal (aluminium alloy in HCL's case) is poured in under the action of gravity alone. After solidification, the mould is opened and the product is removed. The mould is then removed, prepared and another casting is poured. Dimensional features of the casting are more precise than within the sand casting processes, nevertheless there are shape restrictions in using gravity die casting process (DeGarmo E. P, Black J. T, Kohser R. A., 1988, p.356).

¹² CNC stands for Computer Numerical Control. It is a concept by which a machine could be controlled by using numerical messages to the Machine Computer Unit. A CNC system is composed of one host computer communicating numerical tool machining specifications to several Machine Computer Units.

The site consists of buildings one and two, each divided into several departments, as shown in the map presented in Appendix 3.

The site was arbitrarily divided into 9 production-related departments which are production design, maintenance, pattern making, sand foundry, gravity die, fettling, machining, despatching/packaging, and quality/health and safety departments. Its facilities scope includes offices, pattern shop, coremaking and boxless moulding¹³ activities, gravity die department, a fettling¹⁴ shop, a CNC and conventional machine shop and a CAD-CAM¹⁵ system. Heat treatment¹⁶ and painting of the castings are subcontracted.

¹³ Coremaking and boxless moulding processes: During casting and moulding processes, molten metal is poured into a cavity. The metal retains the desired shape of the mould cavity after solidification. Sometimes cores are required to create crude shapes to castings (DeGarmo E. P, Black J. T, Kohser R. A., 1988, p.19).

¹⁴ Fettling shop includes manual machining and finishing processes. Machining is a machining process, by which the castings are either shaping, drilling, turning, milling, sawing, broaching and abrasive machining. Machining is aimed to remove selected area of a part of the casting in order to obtain a desired shape and finish. Finishing processes are cleaning, removing of burrs left by machining, or providing protective and /or decorative surfaces on workpieces. Surface treatment includes chemical and mechanical cleaning, deburring, painting, plating, buffing, galvanizing, and anodizing.

¹⁵ CAD-CAM system: It stands for the Computed Aided Design Computed Aided Manufacture. It is a numerical system enabling the designer and the producer to handle the same data from design manufacturing drawings to quality inspection.

¹⁶ Heat treatment is the heating and cooling of a metal for specific purpose of altering its metallurgical and mechanical properties.

Hadleigh Castings Ltd, through the engineering manufacturing processes of gravity die and sand foundry casting¹⁷, transforms raw material into finished products, by-products, waste and other discharges, whilst using energy.

The main raw materials are aluminium alloy ingots, chemically bonded sand, binders, wood, epoxy resins¹⁸, paints, lubricants, energy and water. By-products include aluminium scrap¹⁹, flashing²⁰, dross²¹ and swarf²², which are remelted by

¹⁸ Epoxy resins are a type of plastic polymers, which are used as material during manufacturing processes. This material is characterised with a good strength, toughness, elasticity, chemical resistance, moisture resistance and dimensional stability. It is generally used as adhesives, bonding agents, and coatings and in fibre laminates.

¹⁹ Aluminium scrap: It is aluminium alloy pieces left often the castings are cut off. or when castings are defective. It could also include unwanted castings. These aluminium alloy pieces are reused and melted again.

²⁰ Flashing: This is the metal melt that fills clearances between adjoining mould or die parts and is remelted.

²¹ Dross: During the melting processes, oxygen from air and molten metal often react to produce metal oxides, which can then be carried with the molten metal during pouring and filling of the mould. Known as *dross* or *slag*, this material can become trapped in the casting and can impair surface finish, machinability, and mechanical properties. Control of dross and slag can be achieved through special cautions during melting, pouring and the design of processes. Fluxes can be used to cover and protect molten metal from its surface interaction with the atmosphere (DeGarmo E. P, Black J. T, Kohser R. A., 1988, p. 313).

²² Swarf: Thin metal pieces, which are produced during machining processes. The aluminium alloy flashing has a high value due to the good metallurgical quality.

smelters into aluminium ingots. Aluminium dust from fettling processes is also sold to a smelter to be reused as finishing or sand blasting material. Atmospheric emissions of particulate matter, VOC²³, chlorine and fluoride are annually monitored and controlled against the statutory emission limits.

Wastes include general rubbish, special waste such as used oil, cutting fluids, surfactant liquids and Refractory Ceramic Fibres (RCF). Other discharges are effluents and runoff water. Appendix 3 presents the flow of waters within the site of Hadleigh Castings Ltd.

4.4.3.2. Turnover

In 1998 and 1999 the turnover was respectively £5,054,679 and £4,575,759. Between 1998 and 1999, the sale of castings fell by 9.5% in terms of weight. This could be explained by the increased competitiveness between the UK and worldwide aluminium industrial markets.

4.4.3.3. Utilities

In 1998, utility consumption and metal purchase by HCL corresponded respectively to 1.6 and 11.5% of the turnover. The company consumed approximately 1,600 cubic meters of water (£1,665) and 5 million kWh of energy,

²³ VOC: Volatile Organic Compounds.

including 80% in natural gas and 20% in electricity (Total cost of £31,050 for natural gas and £48,546 for electricity).

In 1999, utility consumption of metal purchase of HCL corresponded respectively to 1.7 and 9.6% of the turnover. The company consumed approximately 1,700 cubic meters of water (£3,157 for water supply & sewerage) and 4 million kWh of energy (Total cost of £30,700 for natural gas and £44,722 for electricity).

4.4.3.4. Chemicals

The sand moulding process uses silica sand mixed with chemically bonded furan and phenolic chemical binders. In 1999, binder materials amounted to 39 tonnes of resin and 14 tonnes of catalysts. Chemicals used for the treatment of the aluminium amounted to 3 tonnes. The cost of binder materials and chemicals for metal treatment was £54,402 (1.2% of turnover). However, these were the most significant in term of cost and environmental impacts although other chemicals were used and recorded on site.

4.4.3.5. Sand

Hadleigh Castings Ltd was one of the pioneer aluminium foundries to invest in mechanical and thermal sand reclamation system, in 1991 and 1996 respectively. In 1999, the silica sand usage amounted to 3975 tonnes. The sand used consisted of 82% of mechanically reclaimed sand, 14% of thermally reclaimed silica sand and only 4% of new sand. The unit costs for new, thermally, mechanically

reclaimed and landfilled sand were respectively £42, £7, £4 and £ 9 per tonne. The overall cost for sand management was £ 25,400 for 1999, which represents around 0.5% of turnover.

4.4.3.6. Metal

The company purchased and melted aluminium alloys such as LM6, LM9, LM25 and LM4. During 1999, the company sold 344.937 tonnes of finished aluminium alloy castings. A 3.6 % of irremediable metal loss in metal was identified.

4.4.3.7. Wood

Different kinds of wood are used to produce wood patterns. These are normal wood, called Mahogany; laminated wood and ply wood. Approved supplier will supply all the wood. The Mahogany wood was supplied from Brazil.

4.4.3.8. Waste

During 1999, HCL produced 180 tonnes of landfilled general rubbish (considered as active waste), 205 tonnes of landfilled sand, (considered as inert waste) with disposal costs of £2,900 and £1,640 respectively.

Following the environmental preparatory review and the Control of Substances Hazardous to Health (COSHH) review, the environmental advisor and the H&S officer concluded that used cutting fluid from machining, oil from maintenance activities and Refractory Ceramic Fibres (RCF) from furnace linings and sleeves were required to be considered and treated as Special Waste. The estimated annual disposal quantity of cutting fluid and Refractory Ceramic Fiber were 10,000 litres and 36 m³ respectively. The overall annual cost for special waste disposal was estimated to be £3,000.

4.4.3.9. Effluents

Hadleigh Castings Ltd produced around 1,120 m³ of effluents in 1999 with a cost of £1,270. A drainage map, showing the water discharges, is presented in Appendix 2.

4.4.3.10. Atmospheric emissions

Atmospheric emissions such as Volatile Organic Compounds, Particulate Matters, chlorine and fluoride (as hydrogen fluoride) are produced on site. They are produced from furnaces in the foundry (VOC, CO₂), sand blasting and finishers (Particulate, VOC), sand distribution system including shake-out unit and all the exhaust points referenced in the EPA Authorisation (Particulate, VOC), core blower machine (VOC), painting activities in the pattern shop (VOC), incinerator use (CO₂, VOC).

Reports must be submitted to the Babergh District Council every six months and when abnormal or emergency activities occur.

- Approved contractor undertakes a non-continuous atmospheric emission monitoring, once a year. The results are communicated to the enforcement authority, the Babergh District Council.

Corrective Action is undertaken when the emissions are over the limit. Before reinstating the continuous monitoring of particulate matter and /or in order to demonstrate compliance with the EPA authorisation's emissions limit, external atmospheric emissions contractors measure the atmospheric emission at the exhaust point.

4.5. *Environmental policy statement*

After the preparatory review and the following consultation with managers and directors, an agreement was reached in September 1999 on the content of the public Environmental Policy Statement (see Figure 5).

Figure 5: Environmental policy statement of Hadleigh Castings Ltd

*'Respect for the Environment means
Sustainable Development
and Care for Future Generations'*

Hadleigh Castings Ltd recognises its responsibilities toward future generations.

The Company's commitments are:

- to comply with legislation and standards in respect of Quality, Health & Safety and Environment ;
- to assess, control and reduce its environmental impacts ;
- to prevent pollution ;
- to continually improve its environmental programme and performance ;
- to gain commitment from all employees through ongoing training, communication and awareness.

Hadleigh Castings Ltd. will monitor its activities and associated inputs and outputs under normal, abnormal and emergency conditions.

From the results of the environmental review, the Company will focus its resources to decrease raw material and utility usage, to minimise waste, to maintain good housekeeping and to minimise environmental accidents.

The Company will set environmental targets and objectives to improve its environmental performance by means of a systematic and documented environmental programme.

The use of 'economically viable application' of best available technology to improve the production efficiency will drive Hadleigh Castings Ltd. into a sustainable and competitive market.

The Company will promote a 'Green Culture' in its relationships with Customers, Suppliers, Contractors, Shareholders, Regulators and the Local Community through public communication of its Environmental Policy.

N E Warnes
Chairman & Managing Director

September 1999

4.6. *Environmental planning*

By July 1999, the legislation background and significant environmental impacts were identified and documented, the main inputs, outputs and emission discharges were reported during the initial preparatory review to provide a scope for assessing environmental impacts and for setting environmental objectives and targets.

The first part of the project mainly included desk-based activities with associated audit visits and interviews for the environmental advisor. In contrast, the second part of the project involved the integration of a company-wide environmental structure to Hadleigh Casting Ltd within team working activities. Management issues such as personnel management, existing managerial elements of the company including internal communication, authority sharing and documentation required considerable attention to ensure successful Environmental Management System integration.

Hadleigh Castings Ltd is a traditional foundry, in an industry sector which progresses slowly in comparison with high technology and communication sectors. The Company is based in rural Suffolk and a high proportion of the personnel has worked there for more than 10 years. Although the atmosphere is cheerful and very friendly, changing the culture of such an organisation could prove difficult.

Within the planning phase, a strategy for smooth change was required. The steps taken to ensure top management commitment and employees' awareness, through a communication campaign, and the choice of key-persons within the

environmental committee were critical. Key-persons should ideally be familiar with the company and characterised by their ability to motivate employees to improve their working practices and environmental commitment.

The planning phase should establish a team with defined rules and responsibilities then produces a programme with objectives and targets in order to reduce the significant environmental impacts. Additional requirements of the ISO 14001 standard are the registers of significant environmental legislation and impacts.

4.6.1. Environmental legislation & taxation

The main environmental regulations applied to a comprehensive aluminium casting-manufacturing site such as HCL, are presented in Appendix 8. The source of information is presented in the consultation list. (see Appendix 2). Details of environmental legislation & taxation are presented in the chapter two, section 2.2.

4.6.2. Significant environmental impacts

The initial preparatory review of the EMS provided information on the activities, inputs and outputs of HCL. Those information and the register of environmental legislation were used to complete a register of significant environmental impacts. The significant environmental impacts during normal, abnormal and emergency

conditions²⁴ were identified in June 1999, using a systematic methodology for the environmental impact assessment.

The register of activities, products and services on a departmental basis, compiled during the initial preparatory review was used to assess the environmental impacts. This systematic methodology for environmental impact assessment included for each activity the identification of the environmental effect followed by their assessment against criteria.

1. Compilation of an environmental effect identification sheet (see Appendix 5) ;
2. Identification of the environmental effect of each registered activity by using the effect identification sheet and information on activities, inputs and outputs, from the audit report of the initial preparatory review ;
3. Compilation of effects assessment sheet (see Appendix 6) ;
4. Assessment of the significance of the environmental aspects. Significance criteria depend on environmental, economical and compliance issues (see Appendix 6) ;
5. Ranking of the significance of environmental impacts via a statistical analysis (see Appendix 7) and
6. Compilation of a register of significant environmental impacts.

²⁴ Normal conditions: conditions of usual time where planned day-to-day activities occur (e.g. meting, machining...);

Abnormal conditions: conditions of unusual time where planned unusual activities occur (e.g. factory start-up after a holiday shutdown period, maintenance break for CNC machines) ;

Emergency conditions: conditions of unusual time where unplanned activities occur (e.g. incident, accident such as fire, chemical spillage, accidental damage...).

The three significant environmental impacts identified during **normal conditions** were:

- increase of Global Warming and acid rain with the emission of atmospheric pollutants including greenhouse gases such as CO₂ and Volatiles Organic Compounds (VOC), acid rain gases such as NO_x and SO₂. Those gases are produced from: furnaces in the entire foundry (VOC, CO₂), sand blasting and finishers (Particulate, VOC), sand distribution system including shake-out unit and all the exhaust points referenced in the Environmental Protection Act 1990 Prescribed Process Authorisation (Particulate, VOC), core blower machine (VOC), painting activities in the pattern shop (VOC), incinerator use (CO₂, VOC) ;
- use of limited natural resources such as energy, water, chemicals, sand, Brazilian wood and other raw materials and
- unsustainable management of waste due to the ineffective segregation of the waste stream into special waste, recoverable waste and controlled waste.

Two significant impacts were identified from activities under **abnormal and emergency conditions**, they are:

- land contamination risk from spillage of raw material and waste and
- global warming, local acid rain and controlled water contamination risks due to the release of chemicals or atmospheric emissions in case of fire or spillage of catalyst resin or other potential pollutants.

The three significant environmental impacts identified during **normal conditions** were:

- increase of Global Warming and acid rain with the emission of atmospheric pollutants including greenhouse gases such as CO₂, acid rain gases such as CO₂, and Volatiles Organic Compounds (VOC) . Those gases are produced from: furnaces in the entire foundry (VOC, CO₂), sand blasting and linishers (Particulate, VOC), sand distribution system including shake-out unit and all the exhaust points referenced in the Environmental Protection Act 1990 Prescribed Process Authorisation (Particulate, VOC), core blower machine (VOC), painting activities in the pattern shop (VOC), incinerator use (CO₂, VOC) ;
- use of limited natural resources such as energy, water, chemicals, sand, Brazilian wood and other raw materials and
- unsustainable management of waste due to the ineffective segregation of the waste stream into special waste, recoverable waste and controlled waste.

Two significant impacts were identified from activities under **abnormal and emergency conditions**, they are:

- land contamination risk from spillage of raw material and waste and
- global warming, local acid rain and controlled water contamination risks due to the release of chemicals or atmospheric emissions in case of fire or spillage of catalyst resin or other potential pollutants.

4.6.3. Environmental objectives, targets & programme

According to the Environmental Policy Statement, the Company is committed to mitigating its significant environmental impacts and to complying with legislation.

The organisation and implementation of an environmental programme with targets and objectives enables the company to tackle and reduce its environmental impacts.

Each environmental objective and target is titled, defined, and related to timescale and human and budget resources as far as possible. These objectives and targets are ranked in order of priority, with the first being the most important. The ranking system is based on the following principles:

- compliance with current legislation:
 - with the Environmental Protection Act 1990 Authorisation ;
 - with the COSHH, fire and emergency preparedness legislation.
- decrease of the most significant impacts through:
 - raw material and utility savings ;
 - waste disposal cost savings via better waste management ;
 - improvement of production yield.

Six main objectives were defined and ranked as follows:

1. to maintain compliance with the Environmental Protection Act Authorisation and with the Waste Licensing Regulation ;
2. to implement Emergency and Preparedness Responses ;
3. to implement work instruction and procedures according to the Company's environmental policy and BS EN ISO 14001:1996 standard requirements ;

4. to bring savings through better management of utilities ;
5. to improve waste management and
6. to improve production yield within foundry activities.

The environmental committee and task force were established in September 1999 (see section 4.7 implementation & operation phase). The environmental advisor proposed ranked objectives and targets, for discussion by the environmental committee meeting, at which timescales and individual responsibility for each objective were assigned. A £3,000 expenditure budget was provided for minor expenditure (Material, book purchase...). For large expenditure (> £500), the Managing Director was the approver of proposals.

Figure 6 presents Objectives of Hadleigh Castings Ltd.

Figure 6: Environmental objectives and targets

Objective Reference	Title/Definition	Time Scale	Human Resources	Investment
O1	Maintain compliance with the Environmental Protection Act 1990 Authorisation			
O1/T1	Regularisation of Metallic sodium Usage	Jun 00	PD	
O1/T2	Continuous Monitoring of Particulate Matters	Jun 00	EP&FM	Nil
O1/T3	Non Continuous VOCs Monitoring	Jun 00	EA	Nil
O1/T4	Wind Whipping Prevention	Jun 00	EP&FM	N/A
O1/T5	Preventive Maintenance On Sand Distribution & Venting Systems	Jun 00	PD	Nil
O1/T6	Non Continuous Monitoring of Chlorine and Fluoride	Sep 99	EA	Nil
O1/T7	Exhaust Air Flow Monitoring	Sep 99	EA	Nil
O1/T8	Inventory of Chemicals and Materials	Aug 00	BDM	Nil
O1/T9	Communication of EPA authorisation to employees as far as it affects their work	Feb 00	BDM	Nil

Abbreviations: BDM: Business Development Manager, BM: Building Manager, EA: Environmental Adviser, EP&FM: Engineering Projects & Foundry Manager, H, S & T O: Health, Safety & Training Officer, N/A: Not Available, PD: Production Director.

Figure 6: Environmental objectives and targets (continued)

Objective Reference	Title/Definition	Time Scale	Human Resources	Investment
O2	Implement Emergency and Preparedness Responses			
O2/T1	Chemicals management- Control Of Substances Hazardous to Health	Aug 00	HS&TO	Nil
O2/T2	Response to Health, Safety and Environmental Hazard	Jun 00	HS&TO	Nil
O2/T3	H&S Documentation Control	Aug 00	HS&TO	Nil
O2/T4	Bunded Storage Area for Hazardous Substances	June 00	EP&FM	N/A
O3	Implement work instruction and procedures according to company's environmental policy and BS EN ISO 14001:1996 standard requirements			
O3/T1	Implementation of procedures and work instructions	Jun 00	EC	Nil
O3/T2	Environmental Policy Statement Communication	Feb 00	BDM	Nil
O3/T3	Environmental Assessment of suppliers and contractors	Jun 00	BDM	Nil

Abbreviations: BDM: Business Development Manager, BM: Building Manager, EA: Environmental Adviser, EP&FM: Engineering Projects & Foundry Manager, H, S & T O: Health, Safety & Training Officer, N/A: Not Available, PD: Production Director.

Figure 6 : Environmental objectives and targets (continued)

Objective Reference	Title/Definition	Time Scale	Human Resources	Investment
O4	Bring savings through a management of utilities			
O4/T1	Energy Savings Save 5 % of energy on the basis of the previous year and relative to the rate production over the next two year	May 00/ May 02	EA	N/A
O4/T2	Breakdown Maintenance on Compressed air lines	Jun 00	BM	N/ A
O4/T3	Water Usage and Sewerage Reduction Reduction of 2 % of the consumption based on the previous year consumption on a two year timescale	May 00 May 02	BM	N/A
O5	Improve Waste Management			
O5/T1	Waste Management	Jun 00	EA	N/A

Abbreviations: BDM: Business Development Manager, BM: Building Manager, EA: Environmental Adviser, EP&FM: Engineering Projects & Foundry Manager, H, S & T O: Health, Safety & Training Officer, N/A: Not Available, PD: Production Director.

Figure 6 : Environmental objectives and targets (continued)

Objective Reference	Title/Definition	Time Scale	Human Resources	Investment
O6	Improve production yield within foundry activities			
O6/T1	House keeping Improvement	Jun 00	PD	Nil
O6/T2	Reduce our scrap rate by 5% within a three year timescale	Cancelled/Covered by Quality	PD	Nil
O6/T3	Melting Energy Saving	Jun 00	EA	N/A
O6/T4	Environmental Integration into Design, Production & Building Construction	Jun 00	EP&FM	Nil
O6/T5	Sand Management Maintain new sand input to a minimum of 5% of sand usage, over two years	Jun 00- Jun 02	PD	Nil

Abbreviations: BDM: Business Development Manager, BM: Building Manager, EA: Environmental Adviser, EP&FM: Engineering Projects & Foundry Manager, H, S & T O: Health, Safety & Training Officer, N/A: Not Available, PD: Production Director.

Each objective was planned according to the format in the following example.

Figure 7 : Example of Hadleigh Castings Ltd 's objectives format

Environmental Management Manual	
Section Title	Environmental Management Programme
Section Ref	Emp O3-T1 LR
Version No	1.0
Date	22.06.00
Issued by	L. Roumégas
Approved by	Env Com
Page 1	

Objective/Target O3/T1

Energy Savings

Save 5% of energy based on the previous year and relative to the rate of production and staffing levels over the next two years

Target Completion Date: May 2000 to 2002

Main Steps Involved:

1. Scope of energy consumption:
 - Define environmental indicator of energy/water usage ;
 - Analysis of the scope and implementation of advice ;
(E.G. Look at how to change heating in the building two, look at new lights with better efficiency...) ;
2. Report on:
 - Potential Savings Area ;
 - Proposals Development ;
 - Work Instruction ;
 - Monitoring procedure ;
3. Implement procedure, work instructions, projects (lighting change, melting project, compressed air monitoring...) Keep records of Energy Usage indicator.
4. Communicate and advise personnel on work instructions, the amount of energy usage, the target to achieve and the tips to decrease consumption.
5. Review of a melting investment project.
6. Audit utility monitoring procedure and work instructions and progress

Responsible: Environmental Advisor

Indicator: Electricity/Gas Monthly Data: kWh, £ (Not including VAT), kWh / (Weight of Castings Despatched (tonnes), staff number.

4.7. Implementation and operation

4.7.1. Environmental structure: the Environmental Task Force

An environmental structure has been in place since July 1999 to ensure that the environmental rules and responsibilities are communicated to the appropriate people. The focus of the environmental structure of Hadleigh Castings Ltd is the Environmental Task Force ; it includes the Managing Director, a steering committee called the Environmental Committee (6 people) and the Environmental Representatives of each department (9 people).

4.7.1.1. Managing Director

The Managing Director is responsible for the overall planning, implementation and review of the EMS, and will make decisions on environmental project proposals, documentation and expenditure. The Managing Director will be the person to finally accept any major documentation change (e.g. the environmental programme, manual and procedures) and will agree any amendments. In the event of breaches of environmental or health and safety legislation the Managing Director may be personally liable.

4.7.1.2. Steering group: Environmental Committee

The Environmental Committee (EC) includes 6 people and acts as a steering group. The EC's responsibilities include:

- the realisation and modification of the environmental manual and the EMS programme ;
- the implementation and modification of environmental procedures ;
- the implementation and modification of work instructions ;
- proposals, evaluation and recommendations for environmental project investments ;
- updating the EMS system (legislation and impact register, EMS programme, procedures, audit, training and communication) ;
- the amendment of environmental documentation and
- communicating any modification of relevant environmental issues and responsibilities (e.g., procedures, work instructions) to the environmental representatives.

The memberships rules and responsibilities for the Environmental Committee are shown in Table 3.

Table 3: Rules and responsibilities of the environmental committee

Environmental Advisor	Production Director	Health, Safety & Training Officer	Engineering Projects & Foundry Manager	Business Development Manager	Building Manager
Organisation of the EMS Policy Preparatory review Environmental regulation Environmental Impact Assessment Environmental Impact Register EMS planning (Programme, objectives and targets) EMS structure ISO14001 requirements Environmental Manual Progress vs. targets Audit programme ETF training Environmental Auditing Training Corrective action Review of the EMS EMS Records accuracy	Process authorisations Plant trials Raw materials (sand & metal) Policy Amendments Objectives/Targets Procedures/ Work Instructions Authority to factory employees Review of the EMS Communication to workforce	COSHH Determination of Special Waste Emergency Procedures Incidents/accidents Policy Amendments Objectives/Targets Procedures/ Work Instructions Review of the EMS Induction to new employees and contractors on site	BATNEEC, Designing new R&D Process authorisations Plant trials Raw materials (sand & metal) Policy Amendments Objectives/Targets Procedures/ Work Instructions Authority to factory employees Review of the EMS Communication to workforce	Training Communication Purchasing Supplier Evaluation Policy Amendments Objectives/Targets Procedures/ Work Instructions Review of the EMS	Policy Amendments Objectives/Targets Procedures/ Work Instructions Review of the EMS Drainage System Control Maintenance of site Water monitoring

4.7.1.3. The Environmental Representatives

The Environmental Representatives are as follows:

- Production Design Representative ;
- Site Maintenance Representative ;
- Pattern Shop Representative ;
- Sand Foundry Representative ;
- Gravity Die Foundry Representative ;
- Fettling/Cut Off Representative ;
- Machine Shop Representative ;
- Despatch Representative and
- Quality Department Representative.

Their rules and responsibilities are:

- to ensure that the environmental policy is understood, implemented and communicated at all levels within the company ;
- to suggest ideas for new opportunities ;
- to ensure that procedures and work instructions are implemented ;
- to monitor the environmental indicators and maintain records when required and
- to promote commitment to the EMS amongst all employees.

Each Environmental Task Force member was trained on environmental issues and BS EN ISO14001 requirements in accordance with the Environmental Procedure EP06 Training.

4.7.1.4. Other employees

Other relevant personnel had responsibility for a specific task related to the environmental procedures and work instructions. Where necessary, procedures included a section where responsibility for the task is detailed.

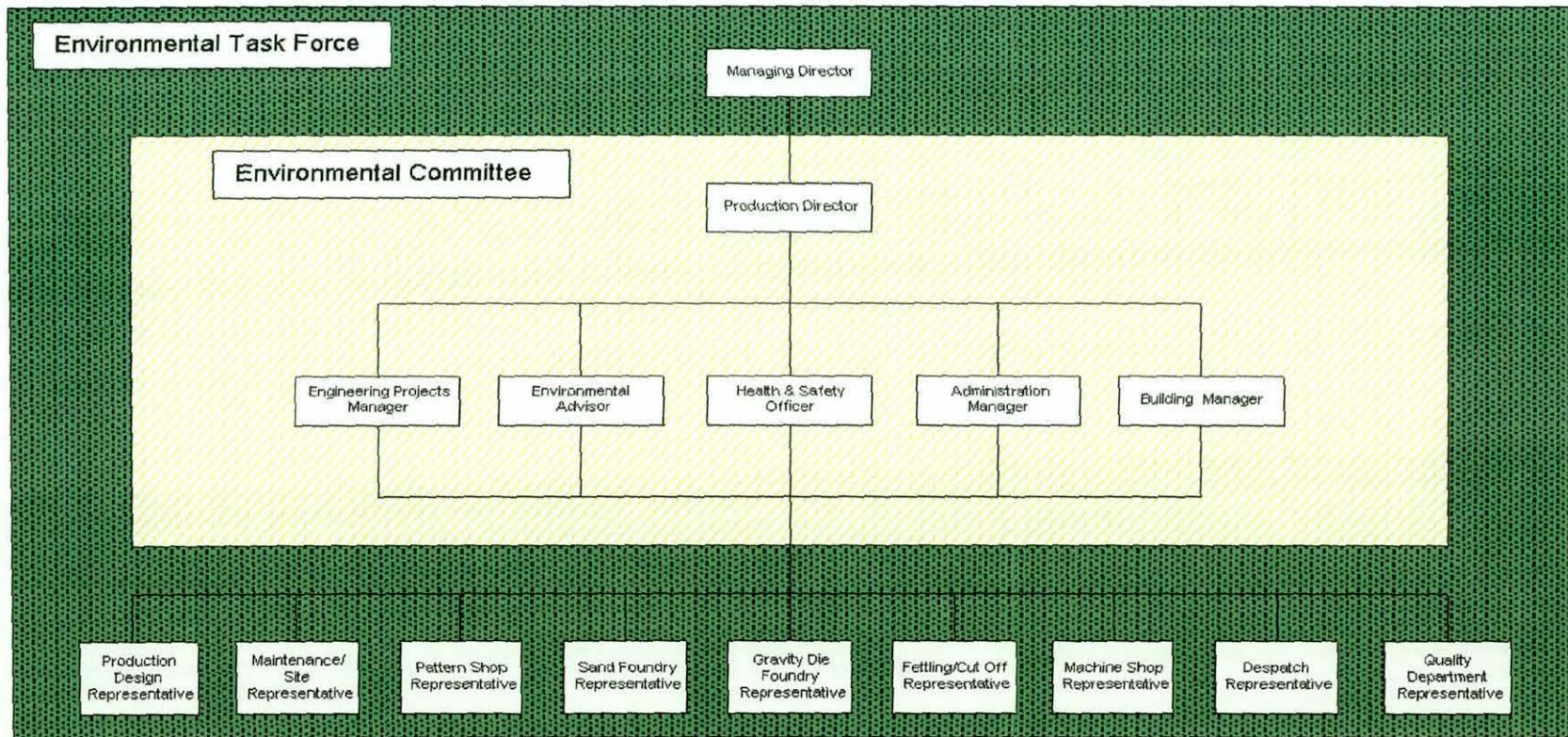
Managers were responsible for ensuring that the requirements of the standard were implemented and maintained.

Each employee of Hadleigh Castings Ltd was aware of their environmental impacts and committed to comply with the Environmental Policy statement and legislation. Each employee was aware and trained where necessary on any task which may cause a significant impact on the environment (e.g. Segregation of waste).

This environmental structure also enabled two-way communication between Management and the production workforce.

Figure 8 shows the organisational chart of the Environmental Task Force.

Figure 8: Organisational chart of the Environmental Task Force



4.7.2. Training and competencies

According to the BS EN ISO 14001: 1996 standard, a company has to identify its training needs, especially 'for all the personnel whose work may create a significant environmental impact upon the environment'.

For the purpose of the Environmental Management System, an environmental training procedure referred to the actual training protocol of Hadleigh Casting Ltd and described the specific environmental training and associated responsibilities in regard to the significant environmental impacts.

The Business Development Manager was responsible for managing all the training within the company. This encompassed the process of providing and updating the training procedure and of keeping documented records.

The personnel responsible for ensuring that training is identified, undertaken and reviewed are the directors, managers, environmental advisor and health, safety & training officer.

This training protocol was developed in 1998 by the Human Resources Manager to introduce a systematic approach to training. Appraisals took place to identify the competencies of employees and their associated training needs. The training protocol was reviewed in 2000 for fulfilling the additional requirements of the quality, health & safety and environmental management system.

The training protocols were addressed to directors, managers and supervisors for them to answer the needs for internal and external training. The first phase of the

training record required a training description & approval form to be completed, where the initiator identified the training requirements, objectives, trainer need, name of the trainees, cost of the training in terms of external consultancy and internal labour costs (see Appendix 9). Additional features were the training approval signed by the Managing Director and the training agreement between the company and the trainee. Then an evaluation form was filled in to evaluate the competencies of the trainees to complete their work and the relevance of the training and the competencies of the trainer. A further record form was collected by different departments within the company ; the Training officer, the directors and managers, supervisors and initiators of the training demand are responsible for initiating and controlling training forms.

Within the environmental training procedures three specific types of training were considered : the process, content and awareness training. The training needs of the employees were addressed during the Planning (Consultation for the compilation of Activity, environmental legislation and impacts register, and for setting the environmental objectives and targets), the Implementation and Operation (Authority, advisor & operator rules), the Checking and Corrective Action and Management Review stages of the Environmental Management System. The training took a number of forms including meetings, seminars, notices and other methods as considered appropriate.

4.7.2.1. Process training

This is training for employees involved in the actual stages of the leading, planning, checking, corrective action and management review of the Environmental Management System.

In Hadleigh Castings Ltd's case, these are Task force, Environmental Impacts Assessment, Legal and other requirements and internal environmental Auditing training.

For the Environmental Task Force training, the Environmental Advisor identified the training needs of the Environmental Task Force, comprising the Environmental Committee members and the Environmental Representatives. Each stage such as the planning, implementation and operation, checking and corrective action and management review of HCL's Environmental Management System, was explained during three training sessions.

Environmental Task Force members were trained to understand their role in preventing pollution by HCL.

For the Environmental Impacts Assessment, legal and other requirements training, the environmental advisor trained staff on how to compile the activity and environmental impacts and legislation register. The competencies of the environmental advisor were demonstrated by the implementation of the methodology for the environmental impact assessment of HCL and by the completion of a Master of Science degree in Environmental Impact Assessment and Auditing.

For the Internal Environmental Auditor Training, the Environmental Advisor, as Lead Environmental Auditor, was trained in December 1999 by an approved environmental consultancy on environmental auditing.

The training was approved and recorded by the Institute of Environmental Assessment and Management.

In august 2000, the Environmental Advisor as Lead Environmental Auditor trained the selected internal auditors to manage and conduct audits with impartiality and effectiveness.

For the Management Review Training, the Environmental Advisor ensured that adequate training was provided to enable senior management to conduct impartial management reviews in accordance with the provisions of ISO 14001.

4.7.2.2. Content training

This is training for employees requiring knowledge in order for them to carry out their duties effectively to comply with the requirements of the EMS work instructions and procedures during normal, abnormal and emergency operational conditions.

This training was required to meet the gap in knowledge and skills and enable personnel to undertake specific environmental responsibilities related to procedures and work-instructions such as atmospheric emissions, water, waste, energy, raw material management and preventive maintenance.

4.7.2.3. Awareness training

This provides general environmental awareness for all employees to enable them to understand their general roles and responsibilities in terms of the environmental

policy, impacts & management system as required under the EMS implementation.

General awareness training encompasses induction training for new employees and awareness training for existing employees.

A Training Plan Matrix was drawn up to group the training requirements stated in the procedures against the trainee (see Appendix 10).

4.7.3. Communication & awareness

Communication and awareness are essential elements of management. When properly managed and controlled they enable a business to operate effectively and efficiently.

In the context of an Environmental Management System, the awareness goes hand with hand with the communication of the company's environmental policy, impacts, good practices and performances to its personnel.

The awareness of environmental issues can be developed by encouraging the voluntary participation of employees in recycling scheme that benefit the community. This can ignite and develop cultural change.

Within Hadleigh Castings Ltd, a recycling scheme organised for the benefits of a charity MENCAP and a school, reduced pollution and increased environmental

awareness. Two recycling centres for employee use were introduced in December 1999.

A procedure for the communication of environmental issues was integrated within the Company's practices. Details on actions and responsibilities for this matter are shown in Table 4.

Table 4: Table of communication issues for HCL's employees

Communication Items	Timings	Who communicates	To whom	The need to communicate	How
Environmental Policy Changes.	At the launch of the EMS programme.	Directors.	All Employees.	To strengthen the commitment to improve environmental performance. To meet the initial requirements of the ISO14001	Board Meetings Management Meetings Department briefings Notice Boards Metal Mouth Newsletter Individual handouts Company Handbooks
Hadleigh Castings Activity List Consultation & modification communication.	When or before that new or different activities occur ; When Project Development is planned.	Directors, managers & supervisors.	Environmental Committee ; Environmental representatives ; Health, safety & training officer ; Environmental Lead Manager.	To modify the activity and review the associated Environmental Management System elements.	E-mails & Memos.

Table 4: Table of communication issues for HCL's employees (continued)

Communication Items	Timings	Who communicates	To whom	The need to communicate	How
Environmental Impacts Maintain & update Register of Environmental Impacts and Legislation.	At regular intervals when necessary to advise of specific issues as they arise.	New legislation identified by the environmental committee members and by managers & directors. New significant environmental impacts identified by the Environmental Lead Manager and Advisor.	All Employees as general awareness and those, whose work is directly affected.	To reduce environmental impacts and make employees aware of their roles and responsibilities and the consequences of not adhering to requirements.	Management Meetings Departmental briefings Presentations Notice Boards Metal Mouth newsletter Environmental Procedures Work Instructions
Planning, Implementation and operation of EMS. Responsibilities within: objectives and targets, procedures, work instructions, monitoring of environmental performances.	At regular intervals when necessary to advise of specific issues.	Directors and Senior Management Supervisory Staff Environmental Committee.	All employees affected by the Environmental Procedure.	To make employees aware of their roles and responsibilities for achieving the company objectives & integrating the EMS practices.	Management Meetings Department briefings Notice Boards Metal Mouth newsletter Environmental procedures Work instructions Training Appraisals

Table 4: Table of communication issues for HCL's employees (continued)

Communication Items	Timings	Who communicates	To whom	The need to communicate	How
Subcontractors and suppliers assessment. Third party communication of environmental policy	As and when required	Business Development Manager on the behalf of HCL	Actual and future subcontractors and suppliers	To inform subcontractors and suppliers on the EMS of HCL's and of it's environmental policy; To assess the environmental performances of the suppliers and sub-contractors	Letters, e-mails, audit visits
Internal & external Complaints	As and when complaints raised	External Parties	Environmental Lead Manager QPulse Administrator All employees affected by the environmental complaints	To inform on complaints. To change environmental practices, procedures and work instructions due to corrective action.	Letters, Facsimiles Q-mail, E-mails, Memos.
Environmental Audits, Results of audits, Corrective actions.	When audits completed. (Once to twice audits per month).	Internal auditors, Lead Environmental auditor, Lead Environmental Manager.	Directors, managers, supervisors and employees affected by the findings	To provide feed back from the audit To undertake corrective actions.	Audit visits, Q-mail, e-mail, memos, Departmental meetings and briefings Notice Boards Environmental Review Training Appraisals

Table 4: Table of communication issues for HCL's employees (continued)

Communication Items	Timings	Who communicates	To whom	The need to communicate	How
Preparation for Environmental Management Review	Once each three-four months	Environmental Lead Manager; Communication of date of meeting, agenda and required data. All employees involved in the collection, analysis of environmental performances.	Senior Management, All Employees affected by the collection, monitoring and analysis of environmental performances as stated within the environmental procedures.	To review the entire Environmental Management System - evaluate, revise systems, procedures and commitment to continual improvement.	E-mail, Memos, Q-mails, Environmental committee meetings Environmental task force meetings, Minutes of meetings Department briefings Notice Boards
Findings from environmental review, audits	As environmental review meetings and audits occur.	The directors, senior management and QPulse administrator	Environmental task force members Directors, managers All employees as affected by the findings	To communicate corrective actions and environmental performances ; To undertake corrective actions and changes to the EMS system.	Environmental Management Review minutes, Departmental meetings, Notice board, Q-mail, E-mail, memos.

4.7.4. Operational procedures & work instructions

The environmental manual, procedures & work instructions represent the intent of the environmental management system. They should not be seen as an additional administration burden but as the means to improve business performance and reduce costs. The procedures and work instructions should then be created only if necessary and be very well targeted and promoted throughout the company.

Within Hadleigh Castings Ltd., each procedure was identified and written using a standard format, included sections in respect of objectives, responsibility, timescale, targets, training needs when appropriate, and was cross-referenced to environmental records. The entire list of procedures was documented in Appendix 11.

Hadleigh Castings Ltd met all objectives and targets of the Environmental Programme by the means of project management, procedures and work instructions.

The procedures and work instructions were introduced to Hadleigh Castings Ltd's practices in March 2000, after decision making and consultation processes. The listing of procedures are presented in appendix 12. An example of procedure is given in Appendix 13 such as the Environmental Procedure 10 – Water Management.

Procedures resulting in a significant improvement for business and a reduction in environmental damage are:

- those focusing on internal practices such as the raw material management procedure, which includes hazardous substances management ;
- and those focusing on the quality of subcontracted services such as the procedures titled supplier environmental assessment and control of activities of contractors.

4.7.4.1. Hazardous substances disposal

Hazardous substance management was reorganised following the appointment in December 1999 of a new Health, Safety & Training Officer.

The actual procedure relating to the issue enabled the company to register the hazardous substances brought on the premises, control the storage, usage and disposal of the hazardous substances.

The following flow diagrams in Figures 9 & 10 summarise the hazardous substance management and the special waste assessment processes. Figure 9 describes the flow of information on raw material, especially hazardous substances. New product on delivery were automatically check and enter on Hazardous substances register, if adequate. Their end-of-life were also assessed and identified. This procedure enabled to control raw material and special waste on site. Figure 10 describes the Special Waste Assessment Process and identifies chemicals' end-of-life.

Figure 9: Flow diagram of hazardous substance management process

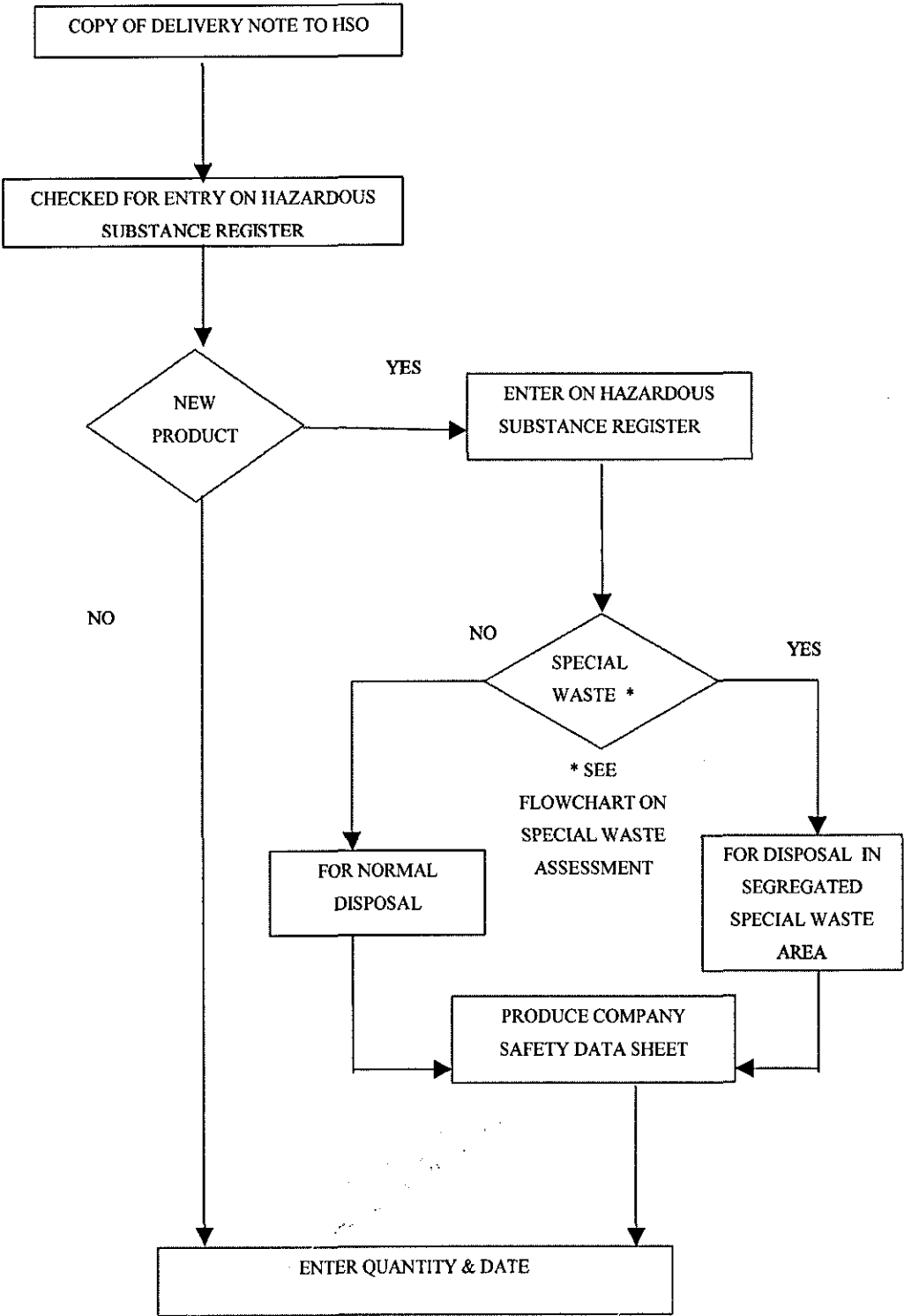
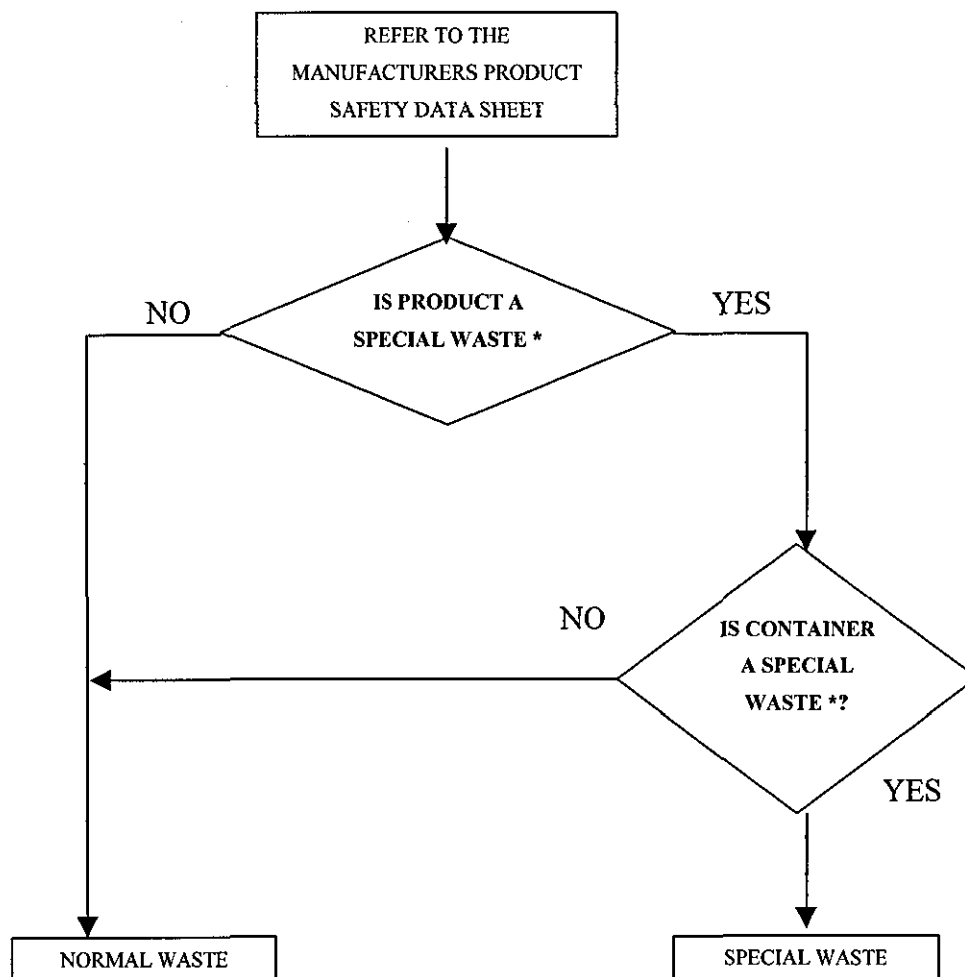


Figure 10: Flowchart on Special Waste Assessment process



*: Special Waste is defined in the Environmental Agency Leaflet titled "Classification of Special Waste"(Environmental Agency, 1996).

The company's position on Health and Safety improved with the completion of the Health and Safety Manual, agreed issue due in September 2000, and the creation of a Hazard Response Team and communication to directors and managers also due in September 2000.

4.7.4.2. Supplier & sub-contractor control

Another significant improvement was the introduction of procedures to control and assess the activities on-site and offsite of suppliers and contractors. This procedure included registered supplier auditing process with an audit checklist. The supplier Environmental Assessment and Control procedure was agreed and implemented at the end of August 2000.

4.7.5. Documentation & document control

According to the subchapters A.4.5, A.5.3, 4.4.5, document control and 4.5.3 records of the BS EN ISO14001: 1996 standard, the environmental documents and records could be controlled within a documentation system.

In other words, the document and record control ensured that Hadleigh Castings Ltd created and maintained documents in a manner sufficient to implement and review the Environmental Management System.

All records and documents of HCL's EMS were stored and handled via QPulse Gael software²⁵, the existing Quality documentation system. All the documents

²⁵ Qpulse Gael software is an interactive database system. It provides a comprehensive control and cost effectiveness maintenance of the BS/EN/ISO 9000 (Quality Management System). It contains 11 interlinked modules (Document & data control, training, equipment, customers, corrective/preventive action, audit, suppliers, administration, performance & cost review, workload and view message). Qpulse software links to existing file formats (Microsoft, AUTOCAD) (E.G. Manuals, procedures, work instructions, drawings, health and safety data sheet,

(Excel spreadsheets, Power Point presentation training, Word documents) were linked to QPulse.

The main advantage is in the preparation for a future integration of all the systems of management (Quality, Health, Safety & Environment) into one management system database.

A QPulse Gael training course was provided to ensure the effective use of the database system software. The QPulse access was restricted to identified administrators and users. These were the Environmental Advisor, the Health, Safety and Training Officer, the QPulse Administrator and the Business Development Manager.

The collection, entering and maintaining of the data within the system were the Qpulse administrator's tasks.

The environmental records and associated documentation were collected , entered on QPulse software, approved and updated. The tasks and responsibilities were assigned.

Table 5 presents the record sheet including the main records and documents of the Environmental Management System of Hadleigh Castings Ltd.

audits, training records, corrective action record, messages...). It could also be used for an health, safety & environmental management system. The 2000 costs vary from £749 to £4 500, for 1 to 15 user network version respectively.

Table 5: Environmental documentation & records sheet

Document / Records	Proc. Ref.	Where is it?	Approver	Update Responsible	Last Update Date	Next Update Due to
Audit records						
- Programme						
- Checklist						
- Report of results & non-conformances						
Communication records						
- External						
- Mail/ e-mail/fax						
- Complaints						
- Suppliers Questionnaires						
- Quotation						
- Minutes						
- Internal						
- Q-mail, e-mail, memos, mail, fax						
- Minutes						
Environmental manual						
Project Management Traceability						
Environmental procedures						
Environmental work instructions						
Registers						
- Environmental impacts						
- Environmental Legislation						
Contractor/Supplier approved list						
Training records						
Monitoring records						

Data security and integrity was ensured through a tape backup policy executed by the IT Department.

4.7.6. Emergency preparedness & response

To demonstrate that it has not been negligent in its legal responsibilities, a company must demonstrate that it has properly assessed and prepared for the risk of hazardous substance spillage. The company must maintain documented risk assessments and records of the training provided.

Emergency preparedness within an Environmental Management System fulfils this requirement. Spillage and fire prevention plans must be regularly tested and documented.

During the environmental impacts assessment exercise at Hadleigh Castings Ltd, two significant impacts were identified from activities under **abnormal and emergency conditions**:

- land contamination risk from spillage of raw material and waste and
- Global warming, local acid rain and controlled water contamination risks due to the release of chemicals or atmospheric emissions in case of fire or spillage of catalyst resin or other potential pollutants.

To mitigate these impacts, the company has invested in the construction of bunded areas to store hazardous substances (E.g. swarf bags, catalyst and resins tanks, lubricants, maintenance oil...).

The quantities of all chemicals received and waste disposed are now recorded, thus Hadleigh Castings Ltd had control over the hazardous substances coming in and going out of its site.

Disposal of old chemicals and newly identified special waste were organised in accordance with the waste management procedure. The waste contractor was required to provide its controlled waste carrier authorisation from the Environmental Agency and its waste management licence from Local Authorities.

A Hazard Response Team of five people has been appropriately trained to control emergencies, use and test the Hazard Response Kit to prevent human and environmental accidents (Spillage of chemicals to controlled water via the drainage system, fire and breakage of crucibles).

A Health & Safety training and awareness campaign has been planned for the end of 2000.

A review of chemical assessment commenced in January 2000 and was due for completion by the end of 2000.

This area represents one of the most significant improvements resulting from the implementation of an Environmental Management System within Hadleigh Castings Ltd.

4.8. Checking and corrective action

4.8.1. Monitoring & measurements

The environmental indicators (e.g. energy, water, sand, metal, waste, atmospheric emission discharges, and special waste) were measured and monitored. Water, energy, sand and LM6 aluminium alloy consumption was targeted.

Procedures EP09 Atmospheric Emissions Management, EP10 Water Management (see Appendix 13), EP11 Waste Management, EP13 Energy Management and EP14 Raw Material Management contained explanations on responsibilities, records, training and communication for monitoring and measurement of environmental indicators.

4.8.2. Records

The Environmental Records described in Section 4.7.5 and Table 8 are managed using the Qpulse software.

4.8.3. EMS audit

The company has a programme for regular audits to determine whether or not the Environmental Management System:

- conforms to planned arrangements ;
- complies with ISO 14001 requirements ;
- has been properly implemented and maintained and
- provides information on the results of audits to management.

The EMS Audit Programme is a process whereby departmental and procedure related audits are planned.

The Audit contents are the details of the audited departments, documents, sub-clauses of ISO 14001 requirements, product or service and the Audit checklist(s).

Each audit is recorded with the associated non-conformances, the auditor's name and the audit status. The documents are recorded under the Audit module of QPulse software to ensure a traceability and a follow-up of the preventive and corrective actions.

There are 9 internal auditors including Environmental Committee members and Environmental Representatives. Should the internal Environmental Auditors raise non-conformances, the managers and directors, with the approval of the Environmental Committee will organise adequate corrective action which will be undertaken on a departmental basis. Further details on internal auditing can be found in Appendix 11.

4.8.4. Non conformance, corrective and preventive action

A procedure has been established to define responsibilities for initiating and completing corrective and preventive action.

If a non-conformance is raised as a result of an internal audit, a day to day observation or event or an EMS review, the cause of the problem must to be investigated and appropriate corrective and preventive action must be scheduled and undertaken.

All non-conformances and requests for preventive and corrective actions are documented on QPulse software.

4.9. *Management Review*

The Management review meeting was not held during the two year project due to time pressures, nevertheless this last step of the EMS system was integrated and described within procedures.

The Management Review will be used to address the possible need for changes to policy, objectives and other elements of the Environmental Management System, in the light of audit results, changing circumstance or as a commitment to continuous improvement.

All the Directors, Managers and members of the Environment Committee were expected to attend the EMS review.

The Agenda of these meetings were programmed as follows:

- review of changing circumstances ;
- review of corrective action request and completion ;
- review of policy, programme, targets ;
- review of the monitoring and analysis of the environmental indicators against targets ;
- review on the implementation of work instructions and procedures ;
- review of the Environmental Task Force Structure ;
- review of commitment and awareness ;
- review of continual improvement of the EMS ;
- internal certification and
- dates and requirements for the next BSI visit.

A corrective and preventive action request may be raised by a review, which will then be followed within the Environmental Management System. Prior to an Environmental Review, information related to indicator monitoring and measurement, training, non conformances, follow up of corrective actions, and to other elements of the system has to be made available to the attendants of the environmental review meeting.

5. Problems and benefits raised by the implementation of an Environmental Management System within a traditional aluminium foundry

5.1. Introduction

The overall project has been of significant benefit to Hadleigh Castings Ltd. The Company's environmental performance improved, the top management was aware of existing and future environmental legislation and taxation and was prepared for the enforcement of the Integrated Pollution Prevention Directive. The benefits were not as tangible as production issues, but the EMS implementation induced legislation compliance and the beginning of a cultural change amongst personnel. The overall Environmental Management System provided a tool for a systematic continual improvement for the reduction of significant environmental impacts.

The remaining task was the review of the Environmental Management System. This did not take place due to timetable and practical reasons. The awareness and commitment of all the employees must be pursued in order to integrate an environmental consciousness within their day to day tasks and to improve the existing cultural change.

The following paragraphs consider the Hadleigh Castings Ltd's case study within the wider context of the implementation of an Environmental Management System within aluminium foundry SMEs. Firstly, the problems raised during the project will be exposed and compared to other cases. Then a cost analysis is presented, followed by the benefits to Hadleigh Castings Ltd.

5.2. Problems confronted during the implementation of an Environmental Management System

5.2.1. Difficulties on the access and accuracy of information required for the preparatory environmental review

Information management in SMEs is often on an ad hoc basis and depends strongly on individuals. Two limiting factors for accessing the information are the accuracy of the data and the low availability of the personnel handling and providing data.

The initial preparatory review in Hadleigh Castings Ltd was a time-consuming task, undertaken from January to May 1999. Difficulty was encountered in defining the boundaries and the flow of waters within the site. It took considerable time to collect the existing plans, Planning authorisations; agreements and

conveyances were internally confidential documents held by the senior management. For example, the sewers and storm water plans, when identified, did not always represent the full reality. During previous constructions, sewers were built differently from plans and the sewer plans were not systematically updated with the changes. The building manager was not too sure of the locations of the sewers & storm waters evacuations.

Sufficient time must be allocated to gather information for the initial preparatory environmental review. As required by good environmental auditor practices, the accuracy of internal data must be double-checked.

The existence of two regulatory bodies dealing with environmental issues, was sometimes confusing. For the case of aluminium foundry SMEs, the Environmental Agency deals with the pollution of controlled waters, land and management of special waste while local authorities deal with atmospheric emissions control arising from prescribed processes.

5.2.2. Existing non-compliance to Environmental, Health and Safety Regulations

A significant challenge to EMS implementation was the discovery of non-compliance to health, safety & environmental legislation²⁶. The existing health,

²⁶ During the preparatory review, the Control of Substances Hazardous to Health Regulation 1999, the Environmental Protection Act 1990 Authorisation, the Water Resources Act 1991, other environmental legislation stated in the legislation register and the six packs of the Health and

safety and environmental practices were not in control. The top management, even if aware of the issues, was not dealing with them due to their low priority when compared to production issues. The main issues were the non-compliance within the Environmental Protection Act 1990 and the inconsistency of the chemical assessment and inventory within the company.

The strategy after the environmental review was to appoint a new Health, Safety and Training officer in December 1999 and to comply with health, safety and environmental legislation when setting the environmental targets, objectives and programme.

For most companies, the first step is to comply with legislation and then to put a system in place in order to reduce the risk for environmental liabilities and to create some cost benefits by controlling raw material, processes and discharges.

An even more challenging project is to put in place an Environmental Management System firstly to correct existing non-compliance issues and secondly to integrate environmental tasks, procedures and work-instructions within the day-to-day manufacturing production and decision making processes.

Safety regulations (Management of Health & Safety at Work Act 1999, Manual Handling Operations Regulation 1992, Personal Equipment at Work 1992, Health Safety & Welfare 1992, Health & Safety Display Screen Equipment 1992, Provision & Use of Work Equipment 1998) were checked for compliance.

5.2.3. Absence of strong top management commitment and support

Within Hadleigh Castings Ltd, the integration of the Environmental Management System included the initial preparatory review, planning, implementation and review of the system in itself (see Figure 4, p.60).

The initial preparatory review mainly involved the environmental advisor, interviewing and collecting information, internally from the senior management, shop floor and externally from the Local Authorities and the Environment Agency. It took from January to May 1999 to be completed.

The planning, implementation & review of the Environmental Management System, was a team based exercise in which the Environmental Task Force (see Figure 8) and all company employees were involved. These tasks were critical for raising the involvement and commitment of employees and key-personnel such as the Environmental Committee Members for the EMS.

In September 1999, the Environmental Task Force was established. Regular Environmental Committee (once, twice a month) and three Environmental Task Force meetings were held to present:

- the EMS principle ;
- the reasons for implementation ;
- the findings from the initial preparatory environmental review ;
- the environmental programme ;
- the distribution of tasks related to the environmental procedures ;

- the work-instructions and manual and to undertake a systematic review of activities against the environmental objectives and targets.

Three months were needed for the Environmental Committee to agree on the first environmental programme with assigned responsibilities and deadlines. Then the environmental advisor distributed individual environmental tasks for each Environmental Committee member. By mid-June 2000, the first draft of all the environmental procedures was completed by the Environmental Committee and the environmental manual was compiled by the environmental advisor.

At the end of June 2000, the environmental projects such as the installation of an extract hood, of the bunded areas for chemical and waste storage, the wind whipping prevention for skips and special waste disposal were half completed and deadlines for the environmental programme were delayed.

At the same time, the pre-assessment for the BSI accreditation was programmed and it occurred. The project of EMS accreditation arrived at a too early stage for the Company, considering that it was not even complying with Environmental, Health & Safety Legislation. The BSI external auditor reported compliance issues between HCL's environmental documentation & ISO14001 standard but it also revealed some weaknesses for the uncontrollable maintenance and building activities.

Faced with the unsuccessful pre-assessment for the BSI accreditation, the Managing Director changed strategy. The new strategy being to implement an 'in company' EMS and to rearrange the EMS documentation (procedures & manual). The environmental project progress was effectively suspended.

In spite of efforts from the environmental advisor, certain Environmental Committee members gave low priorities to their environmental duties and did not exercise their responsibilities, as lead environmental manager and administrator. Being a SME, the Environmental Task Force (ETF) members were the critical central core of senior and middle management staff that kept the company viable. Thus the additional work commitment of the ETF was an extra duty on top of high work schedule.

The senior management failed to exercise commitment and authority to involve employees in environmental tasks. The initial driving forces were firstly to improve melting processes and secondly to implement an EMS. The effort to gain accreditation were underestimated by the senior management. this resulted in insufficient inputs from the Environmental Task Force. Nevertheless, shop floor personnel, via the Environmental Representatives, were committed and generated good ideas through the Environmental Task Force.

For Hadleigh Castings Ltd's case, a number of factors had a major impact on EMS implementation. According to a good practice, such as the case study at Wolstenholme International Ltd (Environmental Technology Best Practice Programme, 1996), the key factor for implementing an Environmental Management System at a medium-sized manufacturing company was the strong commitment and support shown by senior management and the training awareness briefings, which involved all employees in the EMS to ensure broad ownership of the system. The implementation of the BS 7750 EMS at Wolstenholme International Ltd. took four years from the establishment of the Environmental Council to the BS 7750 certification in March 1995. It should also be noted that this company was much larger in size than Hadleigh Castings Ltd (260 people). Thus the number of staff available to be involved in the Task force, the working

pressures they were under and greater formal working practices gave them advantages over small companies such as HCL.

5.2.4. Economical disadvantages for smaller quantities of waste

The 1999 and 2000 contexts were not favourable to the accreditation. The initial timetable attributed to the project was not achievable in this SME. Difficult economical conditions, recruitment and production problems occurred during late 1999 and early 2000.

Generally, SMEs have the problem that, due to the small scale of their activities, costs of certain activities such as special waste disposal are higher than those for a large company, in proportion to turnovers. The main reason is that SMEs are not in a strong position for negotiating a lower price due to their low quantity of special waste to be disposed of and transported. Co-operation between a group of SMEs could be a solution to reduce the primary cost such as the transport cost. However, the mentality of SMEs is often to avoid the communication of indices on production, which could give advantage to their potential competitors.

5.2.5. Traditional attitude against cultural & practice change

5.2.5.1. Introduction

Hadleigh Castings Ltd is a traditional aluminium foundry in which some employees have worked for ten or twenty years. The environmental advisor was welcomed providing that supplementary tasks were not involved or required from the day to day activities of each employee.

The culture of SMEs such as HCL, means many aspects of company work effectively on an informal and ad hoc basis. Thus the formality of ETF and the need for adherence to regulations and guidelines was new to the company.

Changing the daily practices of employees is a challenge that goes hand in hand with the employee's involvement and commitment. It requires a cultural change within an organisation.

5.2.5.2. Definition of cultural change

Cultural change takes place slowly within an organisation. Culture can be compared to an iceberg, M. Halme (Halme M., 1997) states:

Organisational culture has been compared to an iceberg. Parts of it, such as symbols, customs, and traditions are visible, but most of it remains

below the surface. Such elements include assumptions, beliefs, values, and norms that direct the participants' decision-making and behaviour, often unconsciously.

Furthermore Gersick, (Gersick C., 1991), sees change beginning and growing slowly from a nucleus rather than instantly converting an organisation. A cultural change could be compared with a chemical reaction depending on the existing equilibrium and its key-components, inhibitors & catalysts. We can now define the favourable environment to cultural change.

5.2.5.3. Favourable environment for cultural change

A large amount of literature can be found on the subject. According to Halme and Jones (Halme M., 1996 ; Jones D. R., 1995), the pre-requisite for environmental change can be:

- openness and interaction with various other actors and organisations of the society, allowed within an organisation and
- the allowance of alternative opinions and ways of thinking, as well as acting upon them.

Weick (Weick K., 1995) also argues that the greater the variety of thinking and beliefs the organisation has in its basket, the more fully a situation could be seen, solved and modified. Multi-way of thinking within an organisation is then a determinant factor for cultural change and strategic flexibility to new market.

Callenbach et al, (Callenbach *et al.*, 1993), also argue that a flat, non-hierarchical organisation structure is more likely to encourage the flow of ideas and information and then promote cultural change.

5.2.5.4. Approaches for environmental change

There is a need to determine the way to create and maintain environmental commitment within an organisation and to complete an adapted environmental awareness campaign.

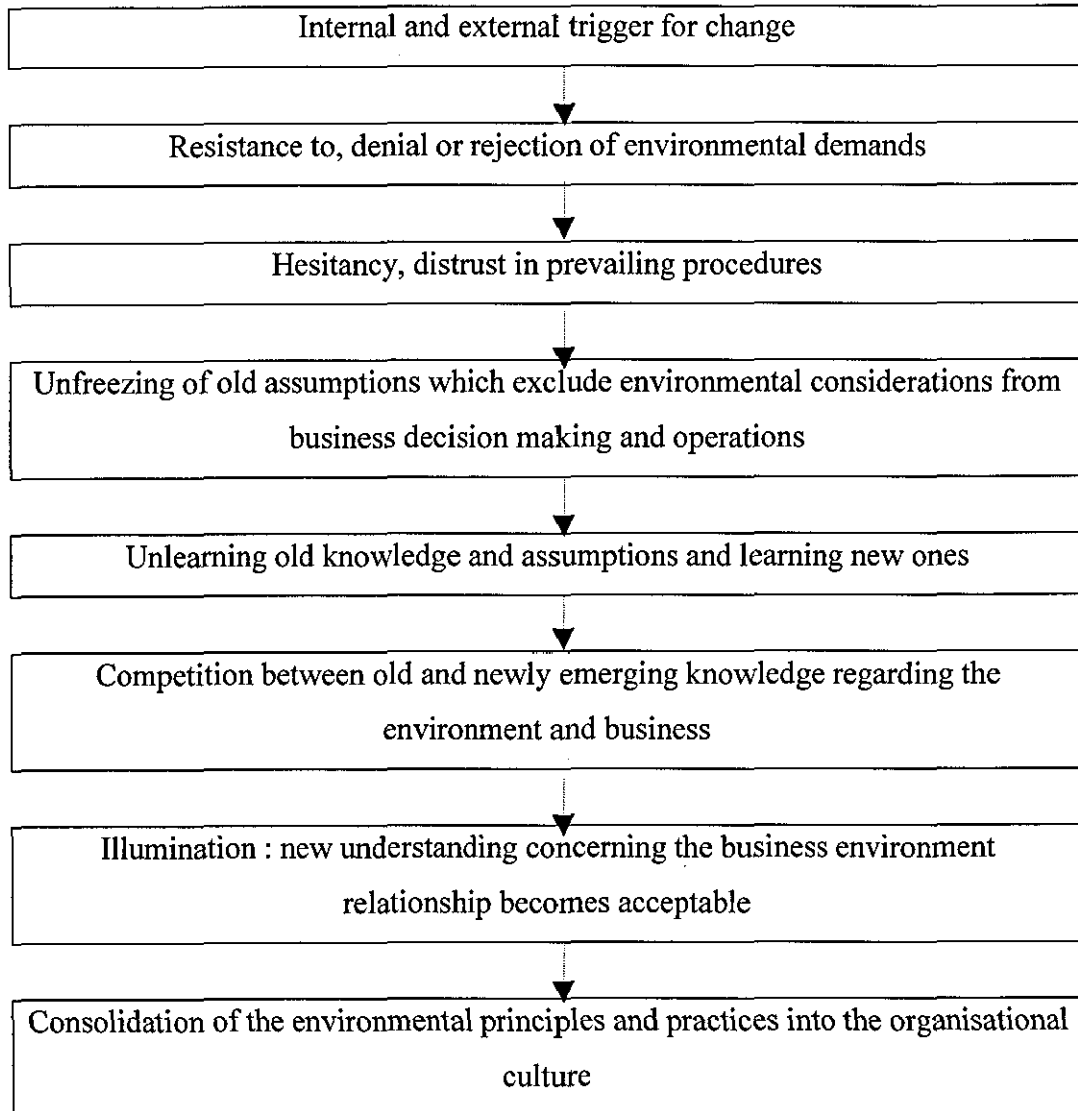
This includes the delicate choice of the environmental representatives and the communication projects. The literature defines several models such as the top down, the bottom up and, alternatively, the middle up-down approach that combines co-operative relationships between top, middle and lower managers.

According to Nonaka (Nonaka I., 1994), the middle management has the advantage to work as a bridge between the visionary ideals of the top and the often chaotic reality of the frontline of business.

In the case of Hadleigh Castings Ltd an approach of middle up-down was implemented with the environmental advisor and the representatives being team supervisors, managers and directors. After several awareness and environmental communication sessions, the stages of environmental change defined by Halme, Jose and Wuori were observed, as described in Figure 11.

Figure 11: Phases of environmental cultural change

Source: Halme M.,1996 ; Jose D. R.1995, and Wuori M. 1995



All the environmental representatives became motivated and interested by environmental issues. However, some Environmental Committee members, who were responsible for undertaking projects, had significant production pressures

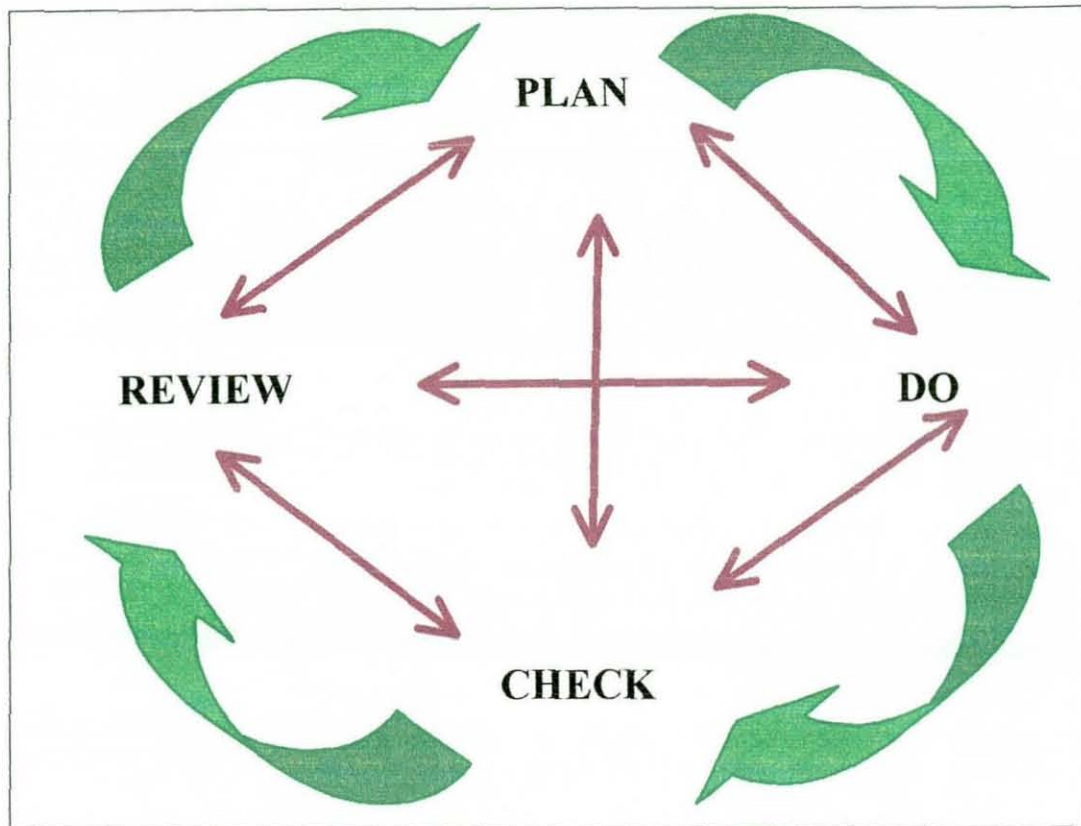
which were seen as more significant to HCL, and gave environmental responsibilities low priority and in certain cases EMS work was neglected and not carried out. The design of engineering projects was thus delayed and conducted without consultation resulting in inadequate outcomes. This had a negative impact on the motivation of the environmental representatives and shop floor personnel. Top management commitment was needed, but at that time environmental issues were not considered a priority. Senior personnel must keep track with group motivation. This could be achieved by increasing interactive relationships through team work on projects, task related training and learning, and reiterating the tangible benefit of EMS implementation.

Cultural change is all about people and their psychology management or manipulation. Figure 12 displays the need for interaction and exchange of expertise, ideas and points of view between the personnel working in the planning, implementation, checking and review phases of the project management system.

Creative thinking sessions could provide a good commitment and involvement from employees and could certainly be used for the environmental issues. With good communication tools and a top-down management approach to environmental change²⁷, the ownership of the environmental issue is widely distributed throughout the organisational structure.

²⁷ According to a top down view of environmental change in an organisation, top management decides to incorporate environmental consideration into the corporate strategy, it establishes an environmental policy, guidelines, and principles, and these are pushed down the organisation.

Figure 12: Environmental change management cycle and personnel interaction



Legend:



: Interaction and exchange of ideas of employees within the planning, implementation, checking and review phases of the Project Management of commitment and awareness campaign.



: Arrow of the management system in itself.

5.2.5.5. Evaluation criteria for environmental change

The evaluation of cultural change is difficult to determine due to its subjectivity. In the case of Hadleigh Castings Ltd, one of the first project undertaken after the planning phase was the organisation of two in-house recycling centres where some items were collected for the benefit of charities. Its aims were firstly to improve employee awareness of recycling and wider environmental issues and secondly to reduce the amount of waste being landfilled. The amount of money collected by recycling and donated to the Mencap charity was an indicator for cultural change. Other criteria for cultural change could be associated with success criteria of project, such as the environmental objectives (E.g. Utility consumption decrease, achievement of building work, compliance with legislation...).

Most of the time those criteria depend on several factors (cultural change, resources...). On a wider context, there is still a large amount of work required to provide good practices for measuring environmental criteria for cultural change.

5.3. *Cost analysis*

5.3.1. *Hadleigh Castings Ltd cost analysis*

The benefits and savings achieved from the integration of the Environmental Management System into Hadleigh Castings Ltd are difficult to quantify. Firstly, due to the early stage of the EMS, savings on raw material and energy have not been achieved yet. Secondly, the cultural change, compliance with environmental legislation and impacts on employees' behaviour are benefits much more difficult to quantify due to their subjectivity and perceptive nature. An analysis of costs is displayed in Table 6.

Table 6: Cost analysis

All costs exclude VAT and numbers between brackets are percentage of turnover.

		1998	1999	2000
Turnover		5,054,679	4,475,759	N/A
Castings tonnage sold		381	337	N/A
Aluminium alloy cost		581,288 (11.5)	430,568 (9.62)	
Insurance cost ²⁸		N/A	60,000 -Mar 99-00-(1.3)	
Waste cost		2,916 (0.05)	6,066 (0.1)	N/A
Chemical ²⁹ cost		N/A	54,402 (1.2)	N/A
Utility		81,261 (1.6)	78,580 (1.7)	N/A
Sand cost		N/A	23,780 (0.5)	N/A
Labour costs	Teaching Company Scheme Project Environmental advisor budgets	37,200 (Sep 98-Sep 00)		
	Pre audit assessment by BSI	Null	Null	850
Equipment budget: Building of bunded storage areas, Building of wind whipping prevention, QPulse training, Hazard Response Kit and other equipment...		3,800 (Sep 98-Sep 00)		

Aluminium alloy and utility costs have decreased since 1998 mainly due to the decrease in sale and partially due to environmental savings. Waste cost has increased due to the additive cost for special waste disposal and transport. Within the EMS implementation, new data were available such as the sand, insurance and chemical costs, proving the improvement of management.

²⁸ Overall insurance cost includes insurance for: cars, vans, construction equipment, consequential lost, fire, floods & other accidents, employee liabilities, product public liabilities, engineering inspection, computer, travel, marine cargo and office liability.

The unquantified benefits are that the company now complies with the Duty of Care and Special Waste Regulation 1996 and has a systematic procedure for identifying all the special waste.

5.3.2. Financial criteria against environmental risks

Successful financial management is the principal objective for directors. In SMEs, directors do not consider the compliance with regulatory requirements to be a boardroom issue unless it involves significant expenditure.

David Shillito (Shillito D., 1997) states:

Questions of importance to high-level environmental management usually come down to only three groups of factors:

- *Unwelcome surprises: unexpected and unplanned liabilities, whether from accidents or incidents of omission ;*
- *Opportunities for improvement of operational efficiency and cost-reduction ;*
- *Threats and opportunities created by innovation in the marketplace.*

These three factors are all involved with financial 'risk' for capital expenditure:

- financial risk due to environmental emergencies for the first point ;
- financial risk linked to cultural change within the integration of environmental proactive practices to reduce operational costs for the second point and

²⁹ Chemicals accounted are the metal treatment and sand binder system chemicals only.

- financial risk in the face of planned environmental changes required by the introduction of new legislation or innovation technologies.

Other financial aspects are included in the assessment of the environmental impacts and then budgets, when adequate to the financial policies of SMEs, are attributed to environmental projects to achieve environmental objectives and targets.

In the case of Hadleigh Castings Ltd, a budget of £ 6,000 was initially attributed to the environmental management system. Internal financial rules within Hadleigh Castings Ltd are based on board agreement on financial proposals coming from management. Additional budget was proposed to replace electric furnace, but the senior management preferred strategically to focus their resources toward new CAD-CAM facilities.

On a more general basis, senior management, after financial criteria, next consider the product and services liabilities as relevant criteria for success and customer satisfaction. One of the benefits of the environmental management system is the reduction of environmental liabilities by the preparation of arrangements or emergency plans. This should reduce significantly any financial liabilities from accident incidents and reduce the damage to the company's reputation.

5.4. Benefits gained from the project

5.4.1. Environmental awareness within the workforce

In the preceding sections, the importance of cultural change was developed. Within the case of Hadleigh Castings Ltd, even if the pressure put on employees from the Senior Management was low, there was evidence of cultural change developed during the two years of the Environmental Management System implementation.

The initiatives inducing cultural change were:

- the organisation of Environmental Task Force sessions, which stimulated creative thinking and willingness from the shopfloor ;
- the organisation of recycling centres to make employees conscious of the waste quantity, its disposal cost and its environmental impacts ;
- the assignment of responsibilities to supervisors, which provided a certain ownership by the shopfloor of the environmental issues and ;
- the reduction of environmental risks through the compliance with legislation from the building of new exhaust hoods and banded storage which also improved the working environment for employees.

5.4.2. Reduction of environmental liabilities

The integration of the Environmental Management System required undertaking and maintaining the assessment of environmental impacts on a regular basis. Those assessments take into account the risk of accident and other regular activities against legislation, environmental damage, production efficiency and reputation criteria.

The control of environmental risk through the control of the most significant environmental impacts goes hand in hand with planning and taking action in order to comply with legislation and to prevent accidents. This covers the objectives and targets of the environmental management programme.

In the case of Hadleigh Castings Ltd weaknesses and non-compliance in environmental, health and safety issues were detected and a systematic approach to environmental risk related to chemical management was installed. A major development was the appointment of a Health and Safety (H&S) Officer to implement an comprehensive in-house H&S system. The company has improved its management of emergency preparedness by providing bunded areas for chemicals & special wastes and with the purchase of a Response to Hazard Kit for chemical spillage and other accidents. In the future a work instruction on emergency preparedness, the training of a hazard response team and the review of the bunded area shall also contribute to this improvement in environmental liabilities reduction.

According to D. Shillito, risk assessment³⁰ cannot be really separated from accident prevention and emergency preparedness. A response or preparedness to accident should be systematically and very carefully tested. He stated the example of a small manufacturing company, with conventional industrial facilities, which had to improve chemical spillage preparedness after a check on interceptors and bunds. The corrective actions taken included the implementation of a systematic maintenance procedure on old interceptors with a 'leak before failure' check and a hydrostatic pressure test of the bund.

The existing preparedness measures and bunds may afford far worse protection than a flawed insurance policy by creating a sense of false security and by increasing risks. The bund may hide tanks and interceptors, inhibiting the maintenance necessary to reduce risk.

Risk assessment must be assessed before, during and after the construction of bunds. The design is a critical step, where consultation of the builder, user, delivery men, environmental advisor and H&S officer are required.

³⁰Definitions from the Royal Society's 1992 report *Risk: Analysis, Perception and Management* stand as (Royal Society, 1992):

Hazard: a property or situation that in particular circumstances could lead to harm.

Probability: the probability, or frequency, of occurrence or a defined hazard in a given period, usually presented as the mathematical expression of chance (for example 0.25, equivalent to a 25% or one in four chance). Where this is not possible more qualitative descriptions are used.

Consequences: the adverse effects or harm as the result of realising a hazard in the short or long term. (This has also been referred to 'as hazard effect'.)

Risk: a combination of the probability, or frequency, of occurrence of a hazard and the magnitude of the consequences of the occurrence.

$$\text{Risk} = \text{Probability} \times \text{Consequence}$$

This example illustrates that the risk assessment cannot really be separated from accident and emergency preparedness. Furthermore, ill-considered and inadequate emergency preparedness could result in higher risks.

Hadleigh Castings Ltd benefited from the integration of the environmental management system through the reduction of its environmental risks and liabilities failure.

5.4.3. Improved working practices

The integration of an Environmental Management System improved working practices in both the production and administration departments.

Significant benefit was the regularisation of the usage of metallic sodium for aluminium modification treatment in the gravity die foundry. The initial preparatory review revealed non-compliance to the Environmental Protection Act Authorisation due to the use of metallic sodium on furnaces where no evacuation of fume could take place. The senior management decided in May 2000 to install an exhaust hood in order to use metallic sodium in two furnaces located in the gravity die cell. This project is still being developed. This was one of the most important improvements in working practices. After revealing a breach of legislation, corrective action was prioritised.

In the gravity die department, a melting project highlighted the opportunities for improvement in the control of the melt temperature. This resulted in an energy survey that provided data for melting costing, a change of practices within the uptake of a work instruction to close the lid of furnaces more systemically and in

an energy saving. A systematic lining of furnaces with Refractory Ceramic Fibre was undertaken and future investment has been planned for thermocouples.

Regular utility monitoring is now practised as a result of the EMS. It provides a basis for cost management. It also has the benefit of providing information on water or other pipeline leaks, which could bring an extra cost to the company.

Hadleigh Castings Ltd now benefits from a better knowledge of its site boundaries, and water flows. This will provide a better control of contamination of controlled water if a chemical spillage should occur. The drainage plan has to be studied by the Hazard Response Team during training and is available in the Hazard Response Kit.

A major improvement was made on special waste management. By restoring the Chemical Safety Data Sheet collection, an additional section on waste consideration for containers and contents was developed to identify, via a systematic approach, the Special Wastes. This resulted in compliance with the Special Waste Regulation 1996.

Other benefits have arisen from the integration of in house Health & Safety issues, as discussed in section 5.4.2. This project needed to progress further in order to comply with the existing Health & Safety legislation.

5.4.4. Improved image with customers

Since July 1999, approximately 25 customers have requested and received the Environmental Policy Statement and other complementary information on Hadleigh Castings Ltd. According to the Sales Director, customers expressing an interest on environmental management system are quite rare ; they represent less than 10 % of HCL's customers. As more companies in the foundry and automotive industry sector implement an Environmental Management System they will be required to encourage third parties and contractors to demonstrate environmental awareness. HCL's environmental awareness, proactive image and perception by customers have improved.

5.4.5. Improved relationship with regulators and professional trade associations

At the beginning of the year 2000, an environmental consultant visited Hadleigh Castings Ltd to undertake an annual mandatory monitoring of atmospheric emissions (Particulate Matter, Volatile Organic Compounds, chlorine and fluorine). After a review of the required tests and exhaust points, the environmental advisor and the consultant realised that the actual Environmental Protection Act 1990 authorisation enforced by the Local Authorities had not been updated to the last process guidance. A change in legislation texts occurred from the 1992 to 1996 Process Guidances PG 2/4(96) Iron, steel and non-ferrous metal foundry process, and PG 2/6 (96) Aluminium, magnesium and their alloys. The Environmental Advisor and the Managing Director organised a consultation

meeting between the Local Authorities, the environmental consultant, and the Foundry Manager of Hadleigh Castings Ltd. This resulted in the removal of conditions on the annual atmospheric emissions monitoring of the core blower exhausts. By controlling its environmental legislative issues, Hadleigh Castings Ltd gained from adequate conditions on its Environmental Protection Act 1990 Prescribed Process Authorisation.

6. Overview & conclusions

6.1. Overview

This thesis has reported research into 'the Sustainable Competitiveness for an Aluminium Foundry through an Environmental Management System in the United Kingdom'.

It presented the environmental, legislative and economical backgrounds of the Aluminium Foundry Industry sector in United Kingdom, followed by the impacts of the Aluminium Foundry Industry on the environment. The international EMS standard ISO 14001, a managerial tool for good environmental practices in the aluminium foundry industry, and the Hadleigh case study on integrating an EMS were described and discussed.

Faced with increased environmental pressures from regulators, shareholders & customers, Hadleigh Castings Ltd, made the decision to move firstly for an 'in-house' Environmental Management System and, in the future, to seek certification for the international Environmental Management System Standard BS EN 14001: 1996. The decisive driving forces for implementing the EMS were to comply with environmental legislation and improve its business performance. The main steps of the EMS implementation within HCL, follow:

- Feasibility study of an EMS implementation ;
- Top management commitment ;
- Initial environmental preparatory review ;

- Communication of environmental policy statement ;
- Environmental planning, with the establishment of an Environmental Task Force, and environmental objectives, targets and programme, the compilation of a register of environmental legislation and impacts ;
- Environmental implementation & operation with the compilation & implementation of the manual, procedures & work instructions ;
- Checking and corrective action, including the measurement and monitoring of environmental indicators, the establishment of an auditing programme identifying Non Conformances and requests for Corrective & Preventive Actions against the existing intend of HCL's EMS and
- Environmental Review.

6.2. *Conclusions*

Hadleigh Castings Ltd. benefited from the implementation of an Environmental Management System (EMS) in the following ways.

Small companies seeking to comply with legislation may not always be up to date. Weaknesses on compliance were identified at Hadleigh Castings Ltd. and changed by the integration of a systematic approach to environmental compliance review and by an appointment of a full-time Health, Safety and Training officer. The overall employees of HCL, especially the Environmental Task Force members made a large effort to implement the 'in-house' EMS.

The EMS documentation including the environmental policy statement, register of legislation, register of environmental aspects, site and water flow plans, programme, objectives and targets, rules and responsibilities, approved supplier database, environmental manual, procedures, work instruction, audit programme and results, corrective action, environmental indicators monitoring, training records, complaints records, and other documents, must be controlled and maintained. At HCL, the use of a software primarily used for Quality Management System, reduced the bureaucracy and provided a single database for Quality and Environment, facilitating a future integration of Management Systems.

The company benefited from a better control of its environmental impacts and of its emergency preparedness.

HCL had a better understanding of monitoring & managing its utility and raw material consumption, which provided improved information for budgeting and account management (E.g. Green taxation, Raw material management, melting costing...). This improved the effectiveness of the management of the company and should generate long term cost benefits.

In the future the company will be looking for better ways of doing things, by promoting BATNEEC (Best Available Technology Not Entailing Excessive Cost), by investing in new equipment (furnaces, lighting...) and by handling project management in taking into account financial, manufacturing, Health & Safety and environmental criteria during the decision making process.

Despite not having continuous commitment and time from the Senior Management, Hadleigh Castings Ltd.'s awareness success has been to organise an Environmental Task Force, where members have been chosen through a voluntary recruiting campaign to ensure that they would be motivated and would communicate their commitment to all employees.

Consultation with the regulatory bodies, the Environmental Agency and the Babergh District Council decreased the suspicion barrier between regulators and the Senior Management of SMEs in the Aluminium Foundry Industry sector. HCL benefits from the removal of one condition and several modifications of its Environmental Protection Act Prescribed Processes Authorisation, by reviewing and comparing it against the actual legislation texts.

This project improved the environmental performances of an aluminium foundry SME and provided a case study for promotion and communication to third parties.
Hadleigh Castings Ltd Case Study - Implementing an environmental management

system within a traditional aluminium casting manufacturing SME was presented as part of the 'Manufacturing for the Environment' module at Loughborough University in May 2000. Further papers were presented to conferences (Roumégas L. *et al.* , June 2000; Roumégas *et al* L., Sep 2000). These communications have promoted sustainable development to the Industry sector.

6.3. *General advice for SMEs*

A comprehensive initial preparatory review enables SMEs to estimate the extent of resources required for implementing an Environmental Management System. This provides a snap shot of environmental performances, potential past contamination of the soil and breaches to environmental legislation by the company. This step should be exhaustively undertaken.

One key success issue is to generate cultural change within a company. This environmental cultural change is operating when mind-thinking directs working practices. This evidently takes place when there is strong top management commitment, resources, a voluntary scheme, early awareness and a communication campaign. It also requires time. The success of an integration of environmental awareness to working practices is all about people, the involvement of an enthusiastic and conscientious workforce is an absolute requirement for improving processes (Reid C., Nov. 1999).

Ensuring a strong senior commitment, involving the right project co-ordinators to champion the philosophy and bringing external expertise in appointing an environmental consultant will provide the forces to drive employees toward a sustainable competitiveness and a continual improvement (Mitchell C., Dec 1999).

7. Suggestions for further work

The environmental pressures on industry will increase due to the enforcement of green taxation, the implementation of the European Integrated Pollution Prevention Directive and the uptake of EMS standards by customers of the aluminium foundry industry such as the automotive and petrochemical sectors.

At Hadleigh Castings Ltd, there is a need to undertake a systematic Environmental Management System review meeting. The maintenance of the system will be essential. It will require considerable teamwork; Senior Management commitment, awareness and communication need to be reinforced. A major clean up and control of the building and maintenance activities are required before any new arrangement is made for ISO 14001 Standard Certification with the British Standard Institute. Furthermore work instructions and procedures must be fully implemented and stringently controlled to ensure conformity between the existing 'in-house' EMS and the requirements of the BS EN ISO 14001 standard. The certification to ISO 14001 will depend on the auditing process and on the efficiency of undertaking corrective and preventive actions. It will also involve the demonstration of continual improvement, which is to be reviewed in each environmental review meeting.

With these requirements in place, Hadleigh Castings Ltd could become a BS EN ISO 14001 certified aluminium foundry.

In the future, Hadleigh Castings Ltd. should combine the three management systems: Quality, Health & Safety and Environment into a single Integrated

Management System. The major benefits will be the decrease in administrative tasks and costs of external certification.

There is considerable scope for environmental improvements within industrial sectors. They would be achieved through the introduction of a formal or informal environmental management system. As with the Environment Agency's draft technical guidance on IPPC and the government's practical guide, EMSs get strong endorsement and enable the practice of Best Available Technology (BAT) (Ends, Aug 2000).

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Appendices

Appendix 1: BS EN ISO 14001 standard

See next page.

**Implementation of
ISO 14001 : 1996**

**Environmental management
systems —**

**Specification with guidance
for use**

The European Standard EN ISO 14001 : 1996 has the status of a
British Standard

ICS 13 020

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee ES/1, Environmental management systems, upon which the following bodies were represented:

AEA Technology
 Association of British Certification Bodies
 Association of County Councils
 Association of Environmental Consultancies
 BEAMA Ltd.
 British Cement Association
 British Chemical Engineering Contractors' Association
 British Coal Corporation
 British Gas plc
 British Iron and Steel Producers' Association
 British Railways Board
 British Standards Society
 Chartered Institute of Environmental Health
 Chemical Industries Association
 Confederation of British Industry
 Consumer Policy Committee of BSI
 Department of the Environment (Environmental and Energy Management Directorate (EEMD))
 Department of the Environment (Environmental Protection and Industry Division)
 Department of Trade and Industry
 Electricity Association
 Engineering Employers' Federation
 Environment Agency
 Environment Council
 European Resin Manufacturers' Association
 Federation of the Electronics Industry
 Federation of Small Businesses
 Institute of Environmental Assessment
 Institute of Wastes Management
 Institution of Chemical Engineers
 Laboratory of the Government Chemist
 Lighting Industry Federation Ltd.
 London Chief Environmental Health Officers' Association
 Loss Prevention Council
 METCOM
 Paper Federation of Great Britain
 Power Generation Contractors' Association (PGCA (BEAMA Ltd.))
 Royal Society of Chemistry
 Society of Chemical Industry
 Society of Motor Manufacturers and Traders Limited
 Trades Union Congress
 United Kingdom Accreditation Service
 United Kingdom Petroleum Industry Association Ltd.
 Water Services Association of England and Wales

Co-opted members

This British Standard, having been prepared under the direction of the Management Systems Sector Board, was published under the authority of the Standards Board and comes into effect on 15 September 1996

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Amendments issued since publication

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National foreword

This British Standard has been prepared by Technical Committee ES/1 and is the English language version of EN ISO 14001 : 1996, *Environmental management systems — Specification with guidance for use* published by the European Committee for Standardization (CEN). It is identical with ISO 14001 : 1996 published by the International Organization for Standardization (ISO). It supersedes BS 7750 : 1994 which will be withdrawn on 31 st March 1997.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

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ICS 13.020

Descriptors: Environments, environmental protection, management, environmental management, creation, implementation, coordination, generalities

English version

Environmental management systems — Specification with guidance for use

(ISO 14001 : 1996)

Systèmes de management environnemental —
Spécification et lignes directrices pour son
utilisation
(ISO 14001 : 1996)

Umweltmanagementsysteme —
Spezifikation mit Anleitung zur Anwendung
(ISO 14001 : 1996)

This European Standard was approved by CEN on 1996-08-21. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

The text of the International Standard ISO 14001 : 1996 has been prepared by Technical Committee ISO/TC 207, Environmental management, in collaboration with CEN/CS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 1997, and conflicting national standards shall be withdrawn at the latest by March 1997.

According to the CEN/CENELEC Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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Introduction

Organizations of all kinds are increasingly concerned to achieve and demonstrate sound environmental performance by controlling the impact of their activities, products or services on the environment, taking into account their environmental policy and objectives. They do so in the context of increasingly stringent legislation, the development of economic policies and other measures to foster environmental protection, and a general growth of concern from interested parties about environmental matters including sustainable development.

Many organizations have undertaken environmental "reviews" or "audits" to assess their environmental performance. On their own, however, these "reviews" and "audits" may not be sufficient to provide an organization with the assurance that its performance not only meets, but will continue to meet, its legal and policy requirements. To be effective, they need to be conducted within a structured management system and integrated with overall management activity.

International Standards covering environmental management are intended to provide organizations with the elements of an effective environmental management system which can be integrated with other management requirements, to assist organizations to achieve environmental and economic goals. These Standards, like other International Standards, are not intended to be used to create non-tariff trade barriers or to increase or change an organization's legal obligations.

This International Standard specifies the requirements of such an environmental management system. It has been written to be applicable to all types and sizes of organizations and to accommodate diverse geographical, cultural and social conditions. The basis of the approach is shown in figure 1. The success of the system depends on commitment from all levels and functions, especially from top management. A system of this kind enables an organization to establish, and assess the effectiveness of, procedures to set an environmental policy and objectives, achieve conformance with them, and demonstrate such conformance to others. The overall aim of this International Standard is to support environmental protection and prevention of pollution in balance with socio-economic needs. It should be noted that many of the requirements may be addressed concurrently or revisited at any time.

There is an important distinction between this specification which describes the requirements for certification/registration and/or self-declaration of an organization's environmental management system and a non-certifiable guideline intended to provide generic assistance to an organization for implementing or improving an environmental management system. Environmental management encompasses a full range of issues including those with strategic and competitive implications. Demonstration of successful implementation of this International Standard can be used by an organ-

ization to assure interested parties that an appropriate environmental management system is in place.

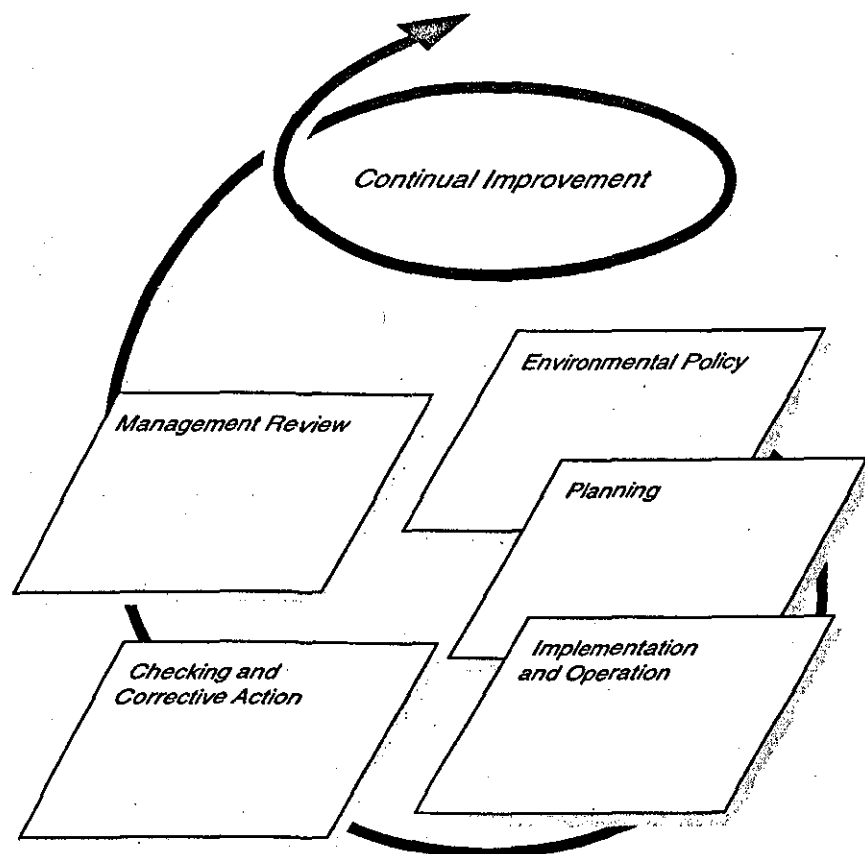


Figure 1 — Environmental management system model for this International Standard

Guidance on supporting environmental management techniques will be contained in other International Standards.

This International Standard contains only those requirements that may be objectively audited for certification/registration purposes and/or self-declaration purposes. Those organizations requiring more general guidance on a broad range of environmental management system issues should refer to ISO 14004:1996, *Environmental management systems — General guidelines on principles, systems and supporting techniques*.

It should be noted that this International Standard does not establish absolute requirements for environmental performance beyond commitment, in the policy, to compliance with applicable legislation and regulations and to continual improvement. Thus, two organizations carrying out similar activities but having different environmental performance may both comply with its requirements.

The adoption and implementation of a range of environmental management techniques in a systematic manner can contribute to optimal outcomes for all interested parties. However, adoption of this International Standard will not in itself guarantee optimal environmental outcomes. In order to achieve environmental objectives, the environmental management system should encourage organizations to consider implementation of the best available technology, where appropriate and where economically viable. In addition,

the cost effectiveness of such technology should be fully taken into account.

This International Standard is not intended to address, and does not include requirements for, aspects of occupational health and safety management; however, it does not seek to discourage an organization from developing integration of such management system elements. Nevertheless, the certification/registration process will only be applicable to aspects of the environmental management system.

This International Standard shares common management system principles with the ISO 9000 series of quality system Standards. Organizations may elect to use an existing management system consistent with the ISO 9000 series as a basis for its environmental management system. It should be understood, however, that the application of various elements of the management system may differ due to different purposes and different interested parties. While quality management systems deal with customer needs, environmental management systems address the needs of a broad range of interested parties and the evolving needs of society for environmental protection.

The environmental management system requirements specified in this International Standard do not need to be established independently of existing management system elements. In some cases, it will be possible to comply with the requirements by adapting existing management system elements.

Environmental management systems — Specification with guidance for use

1 Scope

This International Standard specifies requirements for an environmental management system, to enable an organization to formulate a policy and objectives taking into account legislative requirements and information about significant environmental impacts. It applies to those environmental aspects which the organization can control and over which it can be expected to have an influence. It does not itself state specific environmental performance criteria.

This International Standard is applicable to any organization that wishes to

- a) implement, maintain and improve an environmental management system;
- b) assure itself of its conformance with its stated environmental policy;
- c) demonstrate such conformance to others;
- d) seek certification/registration of its environmental management system by an external organization;
- e) make a self-determination and self-declaration of conformance with this International Standard.

All the requirements in this International Standard are intended to be incorporated into any environmental management system. The extent of the application will depend on such factors as the environmental policy of the organization, the nature of its activities and the conditions in which it operates. This International Standard also provides, in annex A, informative guidance on the use of the specification.

The scope of any application of this International Standard must be clearly identified.

NOTE—For ease of use, the subclause of the specification and annex A have related numbers; thus, for example,

4.3.3. and A.3.3 both deal with environmental objectives and targets, and 4.5.4 and A.5.4 both deal with environmental management system audit.

2 Normative references

There are no normative references at present.

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1

continual improvement

process of enhancing the environmental management system to achieve improvements in overall environmental performance in line with the organization's environmental policy

NOTE — The process need not take place in all areas of activity simultaneously.

3.2

environment

surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation

NOTE — Surroundings in this context extend from within an organization to the global system.

3.3

environmental aspect

element of an organization's activities, products or services that can interact with the environment

NOTE — A significant environmental aspect is an environmental aspect that has or can have a significant environmental impact.

3.4
environmental impact

any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products or services

3.5
environmental management system

the part of the overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy

3.6
environmental management system audit

a systematic and documented verification process of objectively obtaining and evaluating evidence to determine whether an organization's environmental management system conforms to the environmental management system audit criteria set by the organization, and for communication of the results of this process to management

3.7
environmental objective

overall environmental goal, arising from the environmental policy, that an organization sets itself to achieve, and which is quantified where practicable

3.8
environmental performance

measurable results of the environmental management system, related to an organization's control of its environmental aspects, based on its environmental policy, objectives and targets

3.9
environmental policy

statement by the organization of its intentions and principles in relation to its overall environmental performance which provides a framework for action and for the setting of its environmental objectives and targets

3.10
environmental target

detailed performance requirement, quantified where practicable, applicable to the organization or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives

3.11
interested party

individual or group concerned with or affected by the environmental performance of an organization

3.12
organization

company, corporation, firm, enterprise, authority or institution, or part or combination thereof, whether incorporated or not, public or private, that has its own functions and administration

NOTE — For organizations with more than one operating unit, a single operating unit may be defined as an organization.

3.13
prevention of pollution

use of processes, practices, materials or products that avoid, reduce or control pollution, which may include recycling, treatment, process changes, control mechanisms, efficient use of resources and material substitution

NOTE — The potential benefits of prevention of pollution include the reduction of adverse environmental impacts, improved efficiency and reduced costs.

4 Environmental management system requirements

4.1 General requirements

The organization shall establish and maintain an environmental management system, the requirements of which are described in the whole of clause 4.

4.2 Environmental policy

Top management shall define the organization's environmental policy and ensure that it

- a) is appropriate to the nature, scale and environmental impacts of its activities, products or services;
- b) includes a commitment to continual improvement and prevention of pollution;
- c) includes a commitment to comply with relevant environmental legislation and regulations, and with other requirements to which the organization subscribes;
- d) provides the framework for setting and reviewing environmental objectives and targets;
- e) is documented, implemented and maintained and communicated to all employees;
- f) is available to the public.

4.3 Planning

4.3.1 Environmental aspects

The organization shall establish and maintain (a) procedure(s) to identify the environmental aspects of its activities, products or services that it can control and over which it can be expected to have an influence, in order to determine those which have or can have significant impacts on the environment. The organization shall ensure that the aspects related to these significant impacts are considered in setting its environmental objectives.

The organization shall keep this information up-to-date.

4.3.2 Legal and other requirements

The organization shall establish and maintain a procedure to identify and have access to legal and other requirements to which the organization subscribes, that are applicable to the environmental aspects of its activities, products or services.

4.3.3 Objectives and targets

The organization shall establish and maintain documented environmental objectives and targets, at each relevant function and level within the organization.

When establishing and reviewing its objectives, an organization shall consider the legal and other requirements, its significant environmental aspects, its technological options and its financial, operational and business requirements, and the views of interested parties.

The objectives and targets shall be consistent with the environmental policy, including the commitment to prevention of pollution.

4.3.4 Environmental management programme(s)

The organization shall establish and maintain (a) programme(s) for achieving its objectives and targets. It shall include

- a) designation of responsibility for achieving objectives and targets at each relevant function and level of the organization;
- b) the means and time-frame by which they are to be achieved.

If a project relates to new developments and new or modified activities, products or services, programme(s) shall be amended where relevant to ensure that environmental management applies to such projects.

4.4 Implementation and operation

4.4.1 Structure and responsibility

Roles, responsibility and authorities shall be defined, documented and communicated in order to facilitate effective environmental management.

Management shall provide resources essential to the implementation and control of the environmental management system. Resources include human resources and specialized skills, technology and financial resources.

The organization's top management shall appoint (a) specific management representative(s) who, irrespective of other responsibilities, shall have defined roles, responsibilities and authority for

- a) ensuring that environmental management system requirements are established, implemented and maintained in accordance with this International Standard;
- b) reporting on the performance of the environmental management system to top management for review and as a basis for improvement of the environmental management system.

4.4.2 Training, awareness and competence

The organization shall identify training needs. It shall require that all personnel whose work may create a significant impact upon the environment, have received appropriate training.

It shall establish and maintain procedures to make its employees or members at each relevant function and level aware of

- a) the importance of conformance with the environmental policy and procedures and with the requirements of the environmental management system;
- b) the significant environmental impacts, actual or potential, of their work activities and the environmental benefits of improved personal performance;
- c) their roles and responsibilities in achieving conformance with the environmental policy and procedures and with the requirements of the environmental management system, including emergency preparedness and response requirements;
- d) the potential consequences of departure from specified operating procedures.

Personnel performing the tasks which can cause significant environmental impacts shall be competent on

the basis of appropriate education, training and/or experience.

4.4.3 Communication

With regard to its environmental aspects and environmental management system, the organization shall establish and maintain procedures for

- a) internal communication between the various levels and functions of the organization;
- b) receiving, documenting and responding to relevant communication from external interested parties.

The organization shall consider processes for external communication on its significant environmental aspects and record its decision.

4.4.4 Environmental management system documentation

The organization shall establish and maintain information, in paper or electronic form, to

- a) describe the core elements of the management system and their interaction;
- b) provide direction to related documentation.

4.4.5 Document control

The organization shall establish and maintain procedures for controlling all documents required by this International Standard to ensure that

- a) they can be located;
- b) they are periodically reviewed, revised as necessary and approved for adequacy by authorized personnel;
- c) the current versions of relevant documents are available at all locations where operations essential to the effective functioning of the environmental management system are performed;
- d) obsolete documents are promptly removed from all points of issue and points of use, or otherwise assured against unintended use;
- e) any obsolete documents retained for legal and/or knowledge preservation purposes are suitably identified.

Documentation shall be legible, dated (with dates of revision) and readily identifiable, maintained in an orderly manner and retained for a specified period. Procedures and responsibilities shall be established and maintained concerning the creation and modification of the various types of document.

4.4.6 Operational control

The organization shall identify those operations and activities that are associated with the identified significant environmental aspects in line with its policy, objectives and targets. The organization shall plan these activities, including maintenance, in order to ensure that they are carried out under specified conditions by

- a) establishing and maintaining documented procedures to cover situations where their absence could lead to deviations from the environmental policy and the objectives and targets;
- b) stipulating operating criteria in the procedures;
- c) establishing and maintaining procedures related to the identifiable significant environmental aspects of goods and services used by the organization and communicating relevant procedures and requirements to suppliers and contractors.

4.4.7 Emergency preparedness and response

The organization shall establish and maintain procedures to identify potential for and respond to accidents and emergency situations, and for preventing and mitigating the environmental impacts that may be associated with them.

The organization shall review and revise, where necessary, its emergency preparedness and response procedures, in particular, after the occurrence of accidents or emergency situations.

The organization shall also periodically test such procedures where practicable.

4.5 Checking and corrective action

4.5.1 Monitoring and measurement

The organization shall establish and maintain documented procedures to monitor and measure, on a regular basis, the key characteristics of its operations and activities that can have a significant impact on the environment. This shall include the recording of information to track performance, relevant operational controls and conformance with the organization's environmental objectives and targets.

Monitoring equipment shall be calibrated and maintained and records of this process shall be retained according to the organization's procedures.

The organization shall establish and maintain a documented procedure for periodically evaluating compliance with relevant environmental legislation and regulations.

4.5.2 Nonconformance and corrective and preventive action

The organization shall establish and maintain procedures for defining responsibility and authority for handling and investigating nonconformance, taking action to mitigate any impacts caused and for initiating and completing corrective and preventive action.

Any corrective or preventive action taken to eliminate the causes of actual and potential nonconformances shall be appropriate to the magnitude of problems and commensurate with the environmental impact encountered.

The organization shall implement and record any changes in the documented procedures resulting from corrective and preventive action.

4.5.3 Records

The organization shall establish and maintain procedures for the identification, maintenance and disposition of environmental records. These records shall include training records and the results of audits and reviews.

Environmental records shall be legible, identifiable and traceable to the activity, product or service involved. Environmental records shall be stored and maintained in such a way that they are readily retrievable and protected against damage, deterioration or loss. Their retention times shall be established and recorded.

Records shall be maintained, as appropriate to the system and to the organization, to demonstrate conformance to the requirements of this International Standard.

4.5.4 Environmental management system audit

The organization shall establish and maintain (a) programme(s) and procedures for periodic environmental

management system audits to be carried out, in order to

- a) determine whether or not the environmental management system
 - 1) conforms to planned arrangements for environmental management including the requirements of this International Standard; and
 - 2) has been properly implemented and maintained; and
- b) provide information on the results of audits to management.

The organization's audit programme, including any schedule, shall be based on the environmental importance of the activity concerned and the results of previous audits. In order to be comprehensive, the audit procedures shall cover the audit scope, frequency and methodologies, as well as the responsibilities and requirements for conducting audits and reporting results.

4.6 Management review

The organization's top management shall, at intervals that it determines, review the environmental management system, to ensure its continuing suitability, adequacy and effectiveness. The management review process shall ensure that the necessary information is collected to allow management to carry out this evaluation. This review shall be documented.

The management review shall address the possible need for changes to policy, objectives and other elements of the environmental management system, in the light of environmental management system audit results, changing circumstances and the commitment to continual improvement.

Annex A (informative)

Guidance on the use of the specification

This annex gives additional information on the requirements and is intended to avoid misinterpretation of the specification. This annex only addresses the environmental management system requirements contained in clause 4.

A.1 General requirements

It is intended that the implementation of an environmental management system described by the specification will result in improved environmental performance. The specification is based on the concept that the organization will periodically review and evaluate its environmental management system in order to identify opportunities for improvement and their implementation. Improvements in its environmental management system are intended to result in additional improvements in environmental performance.

The environmental management system provides a structured process for the achievement of continual improvement, the rate and extent of which will be determined by the organization in the light of economic and other circumstances. Although some improvement in environmental performance can be expected due to the adoption of a systematic approach, it should be understood that the environmental management system is a tool which enables the organization to achieve and systematically control the level of environmental performance that it sets itself. The establishment and operation of an environmental management system will not, in itself, necessarily result in an immediate reduction of adverse environmental impact.

An organization has the freedom and flexibility to define its boundaries and may choose to implement this International Standard with respect to the entire organization, or to specific operating units or activities of the organization. If this International Standard is implemented for a specific operating unit or activity, policies and procedures developed by other parts of the organization can be used to meet the requirements of this International Standard, provided that they are applicable to the specific operating unit or activity that will be subject to it. The level of detail and complexity of the environmental management system, the extent of documentation and the resources devoted to it will be dependent in the size of an organization and the nature of its activities. This may be the case in particular for small and medium-sized enterprises.

Integration of environmental matters with the overall management system can contribute to the effective implementation of the environmental management system, as well as to efficiency and to clarity of roles.

This International Standard contains management system requirements, based on the dynamic cyclical process of "plan, implement, check and review".

The system should enable an organization to

- a) establish an environmental policy appropriate to itself;
- b) identify the environmental aspects arising from the organization's past, existing or planned activities, products or services, to determine the environmental impacts of significance;
- c) identify the relevant legislative and regulatory requirements;
- d) identify priorities and set appropriate environmental objectives and targets;
- e) establish a structure and (a) programme(s) to implement the policy and achieve objectives and targets;
- f) facilitate planning, control, monitoring, corrective action, auditing and review activities to ensure both that the policy is complied with and that the environmental management system remains appropriate;
- g) be capable of adapting to changing circumstances.

A.2 Environmental policy

The environmental policy is the driver for implementing and improving the organization's environmental management system so that it can maintain and potentially improve its environmental performance. The policy should therefore reflect the commitment of top management to compliance with applicable laws and continual improvement. The policy forms the basis upon which the organization sets its objectives and targets. The policy should be sufficiently clear to be capable of being understood by internal and external interested parties and should be periodically reviewed and revised to reflect changing conditions and information. Its area of application should be clearly identifiable.

The organization's top management should define and document its environmental policy within the context of the environmental policy of any broader corporate body of which it is a part and with the endorsement of that body, if there is one.

NOTE — Top management may consist of an individual or group of individuals with executive responsibility for the organization.

A.3 Planning

A.3.1 Environmental aspects

Subclause 4.3.1 is intended to provide a process for an organization to identify significant environmental aspects that should be addressed as a priority by the organization's environmental management system. This process should take into account the cost and time of undertaking the analysis and the availability of reliable data. Information already developed for regulatory or other purposes may be used in this process. Organizations may also take into account the degree of practical control they may have over the environmental aspects being considered. Organizations should determine what their environmental aspects are, taking into account the inputs and outputs associated with their current and relevant past activities, products and/or services.

An organization with no existing environmental management system should, initially, establish its current position with regard to the environment by means of a review. The aim should be to consider all environmental aspects of the organization as a basis for establishing the environmental management system.

Those organizations with operating environmental management systems do not have to undertake such a review.

The review should cover four key areas:

- a) legislative and regulatory requirements;
- b) an identification of significant environmental aspects;
- c) an examination of all existing environmental management practices and procedures;
- d) an evaluation of feedback from the investigation of previous incidents.

In all cases, consideration should be given to normal and abnormal operations within the organization, and to potential emergency conditions.

A suitable approach to the review may include checklists, interviews, direct inspection and measurement,

results of previous audits or other reviews depending on the nature of the activities.

The process to identify the significant environmental aspects associated with the activities at operating units should, where relevant, consider,

- a) emissions to air;
- b) releases to water;
- c) waste management;
- d) contamination of land;
- e) use of raw materials and natural resources;
- f) other local environmental and community issues.

This process should consider normal operating conditions, shut-down and start-up conditions, as well as the realistic potential significant impacts associated with reasonably foreseeable or emergency situations.

The process is intended to identify significant environmental aspects associated with activities, products or services, and is not intended to require a detailed life cycle assessment. Organizations do not have to evaluate each product, component or raw material input. They may select categories of activities, products or services to identify those aspects most likely to have a significant impact.

The control and influence over the environmental aspects of products vary significantly, depending on the market situation of the organization. A contractor or supplier to the organization may have comparatively little control, while the organization responsible for product design can alter the aspects significantly by changing, for example, a single input material. Whilst recognizing that organizations may have limited control over the use and disposal of their products, they should consider, where practical, proper handling and disposal mechanisms. This provision is not intended to change or increase an organisation's legal obligations.

A.3.2 Legal and other requirements

Examples of other requirements to which the organization may subscribe are

- a) industry codes of practice;
- b) agreements with public authorities;
- c) non-regulatory guidelines.

A.3.3 Objectives and targets

The objectives should be specific and targets should be measurable wherever practicable, and where appropriate take preventative measures into account.

When considering their technological options, an organization may consider the use of the best available technology where economically viable, cost-effective and judged appropriate.

The reference to the financial requirements of the organization is not intended to imply that organizations are obliged to use environmental cost-accounting methodologies.

A.3.4 Environmental management programme(s)

The creation and use of one or more programmes is a key element to the successful implementation of an environmental management system. The programme should describe how the organization's objectives and targets will be achieved, including time-scales and personnel responsible for implementing the organization's environmental policy. This programme may be subdivided to address specific elements of the organization's operations. The programme should include an environmental review for new activities.

The programme may include, where appropriate and practical, consideration of planning, design, production, marketing and disposal stages. This may be undertaken for both current and new activities, products or services. For products this may address design, materials, production processes, use and ultimate disposal. For installations or significant modifications of processes this may address planning, design, construction, commissioning, operation and, at the appropriate time determined by the organization, decommissioning.

A.4 Implementation and operation

A.4.1 Structure and responsibility

The successful implementation of an environmental management system calls for the commitment of all employees of the organization. Environmental responsibilities therefore should not be seen as confined to the environmental function, but may also include other areas of an organization, such as operational management or staff functions other than environmental.

This commitment should begin at the highest levels of management. Accordingly, top management should establish the organization's environmental policy and ensure that the environmental management system is implemented. As part of this commitment, the top management should designate (a) specific management representative(s) with defined responsibility and authority for implementing the environmental management system. In large or complex organizations

there may be more than one designated representative. In small or medium sized enterprises, these responsibilities may be undertaken by one individual. Top management should also ensure that appropriate resources are provided to ensure that the environmental management system is implemented and maintained. It is also important that the key environmental management system responsibilities are well defined and communicated to the relevant personnel.

A.4.2 Training, awareness and competence

The organization should establish and maintain procedures for identifying training needs. The organization should also require that contractors working on its behalf are able to demonstrate that their employees have the requisite training.

Management should determine the level of experience, competence and training necessary to ensure the capability of personnel, especially those carrying out specialized environmental management functions.

A.4.3 Communication

Organizations should implement a procedure for receiving, documenting and responding to relevant information and requests from interested parties. This procedure may include a dialogue with interested parties and consideration of their relevant concerns. In some circumstances, responses to interested parties' concerns may include relevant information about the environmental impacts associated with the organization's operations. These procedures should also address necessary communications with public authorities regarding emergency planning and other relevant issues.

A.4.4 Environmental management system documentation

The level of detail of the documentation should be sufficient to describe the core elements of the environmental management system and their interaction and provide direction on where to obtain more detailed information on the operation of specific parts of the environmental management system. This documentation may be integrated with documentation of other systems implemented by the organization. It does not have to be in the form of a single manual.

Related documentation may include

- a) process information;
- b) organizational charts;

- c) internal standards and operational procedures;
- d) site emergency plans.

A.4.5 Document control

The intent of 4.4.5 is to ensure that organizations create and maintain documents in a manner sufficient to implement the environmental management system. However, the primary focus of organizations should be on the effective implementation of the environmental management system and on environmental performance and not on a complex documentation control system.

A.4.6 Operational control

Text may be included here in a future revision.

A.4.7 Emergency preparedness and response

Text may be included here in a future revision.

A.5 Checking and corrective action

A.5.1 Monitoring and measurement

Text may be included here in a future revision.

A.5.2 Nonconformance and corrective and preventive action

In establishing and maintaining procedures for investigating and correcting nonconformance, the organization should include these basic elements:

- a) identifying the cause of the nonconformance;
- b) identifying and implementing the necessary corrective action;
- c) implementing or modifying controls necessary to avoid repetition of the nonconformance;
- d) recording any changes in written procedures resulting from the corrective action.

Depending on the situation, this may be accomplished rapidly and with a minimum of formal planning or it may be a more complex and long-term activity. The associated documentation should be appropriate to the level of corrective action.

A.5.3 Records

Procedures for identification, maintenance and disposition of records should focus on those records needed for the implementation and operation of the

environmental management system and for recording the extent to which planned objectives and targets have been met.

Environmental records may include

- a) information on applicable environmental laws or other requirements;
- b) complaint records;
- c) training records;
- d) process information;
- e) product information;
- f) inspection, maintenance and calibration records;
- g) pertinent contractor and supplier information;
- h) incident reports;
- i) information on emergency preparedness and response;
- j) information on significant environmental aspects;
- k) audit results;
- l) management reviews.

Proper account should be taken of confidential business information.

A.5.4 Environmental management system audit

The audit programme and procedures should cover

- a) the activities and areas to be considered in audits;
- b) the frequency of audits;
- c) the responsibilities associated with managing and conducting audits;
- d) the communication of audit results;
- e) auditor competence;
- f) how audits will be conducted.

Audits may be performed by personnel from within the organization and/or by external persons selected by the organization. In either case, the persons conducting the audit should be in a position to do so impartially and objectively.

A.6 Management review

In order to maintain continual improvement, suitability and effectiveness of the environmental management system, and thereby its performance, the organization's management should review and evaluate the environmental management system at defined intervals. The scope of the review should be comprehen-

sive, though not all elements of an environmental management system need to be reviewed at once and the review process may take place over a period of time.

The review of the policy, objectives and procedures should be carried out by the level of management that defined them.

Reviews should include

a) results from audits;

- b) the extent to which objectives and targets have been met;
- c) the continuing suitability of the environmental management system in relation to changing conditions and information;
- d) concerns amongst relevant interested parties.

Observations, conclusions and recommendations should be documented for necessary action.

Annex B
(informative)

Links between ISO 14001 and ISO 9001

Tables B.1 and B.2 identify links and broad technical correspondences between ISO 14001 and ISO 9001 and *vice versa*.

The objective of the comparison is to demonstrate the combinability of both systems to those organizations already operating one of these International Standards and which may wish to operate both.

A direct link between subclauses of the two International Standards has only been established if the two subclauses are largely congruent in requirements. Beyond that, many detailed cross-connections of minor relevance exist which could not be shown here.

Table B.1 — Correspondence between ISO 14001 and ISO 9001

ISO 14001:1996		ISO 9001:1994	
General requirements	4.1	4.2.1 1st sentence	General
Environmental policy	4.2	4.1.1	Quality policy
Planning			
Environmental aspects	4.3.1	—	
Legal and other requirements	4.3.2	— 1)	
Objectives and targets	4.3.3	— 2)	
Environmental management programme(s)	4.3.4	—	
	—	4.2.3	Quality planning
Implementation and operation			
Structure and responsibility	4.4.1	4.1.2	Organization
Training, awareness and competence	4.4.2	4.18	Training
Communication	4.4.3	—	
Environmental management system documentation	4.4.4	4.2.1 without 1st sentence	General
Document control	4.4.5	4.5	Document and data control
Operational control	4.4.6	4.2.2	Quality system procedures
	4.4.6	4.3 3)	Contract review
	4.4.6	4.4	Design control
	4.4.6	4.6	Purchasing
	4.4.6	4.7	Control of customer-supplied product
	4.4.6	4.9	Process control
	4.4.6	4.15	Handling, storage, packaging, preservation and delivery
	4.4.6	4.19	Servicing
	—	4.8	Product identification and traceability
Emergency preparedness and response	4.4.7	—	
Checking and corrective action			
Monitoring and measurement	4.5.1 1st and 3rd paragraphs	4.10	Inspection and testing
	—	4.12	Inspection and test status
	—	4.20	Statistical techniques
Monitoring and measurement	4.5.1 2nd paragraph	4.11	Control of inspection, measuring and test equipment
Nonconformance and corrective and preventive action	4.5.2 1st part of 1st sentence	4.13	Control of nonconforming product
Nonconformance and corrective and preventive action	4.5.2 without 1st part of 1st sentence	4.14	Corrective and preventive action
Records	4.5.3	4.16	Control of quality records
Environmental management system audit	4.5.4	4.17	Internal quality audits
Management review	4.6	4.1.3	Management review

1) Legal requirements addressed in ISO 9001, 4.4.4.

2) Objectives addressed in ISO 9001, 4.1.1.

3) Communication with the quality stakeholders (customers).

Table B.2 — Correspondence between ISO 9001 and ISO 14001

ISO 9001:1994		ISO 14001:1996	
Management responsibility			
Quality policy	4.1.1 — — 1) — 2) —	4.2 4.3.1 4.3.2 4.3.3 4.3.4	Environmental policy Environmental aspects Legal and other requirements Objectives and targets Environmental management programme(s)
Organization	4.1.2	4.4.1	Structure and responsibility
Management review	4.1.3	4.6	Management review
Quality system			
General	4.2.1 1st sentence 4.2.1 without 1st sentence	4.1 4.4.4	General requirements Environmental management system documentation
Quality system procedures	4.2.2	4.4.6	Operational control
Quality planning	4.2.3	—	
Contract review	4.3 3)	4.4.6	Operational control
Design control	4.4	4.4.6	Operational control
Document and data control	4.5	4.4.5	Document control
Purchasing	4.6	4.4.6	Operational control
Control of customer-supplied product	4.7	4.4.6	Operational control
Product identification and traceability	4.8	—	
Process control	4.9	4.4.6	Operational control
Inspection and testing	4.10	4.5.1 1st and 3rd paragraphs	Monitoring and measurement
Control of inspection, measuring and test equipment	4.11	4.5.1 2nd paragraph	Monitoring and measurement
Inspection and test status	4.12	—	
Control of nonconforming product	4.13	4.5.2 1st part of 1st sentence	Nonconformance and corrective and preventive action
Corrective and preventive action	4.14	4.5.2 without 1st part of 1st sentence	Nonconformance and corrective and preventive action
	—	4.4.7	Emergency preparedness and response
Handling, storage, packaging, preservation and delivery	4.15	4.4.6	Operational control
Control of quality records	4.16	4.5.3	Records
Internal quality audits	4.17	4.5.4	Environmental management system audit
Training	4.18	4.4.2	Training, awareness and competence
Servicing	4.19	4.4.6	Operational control
Statistical techniques	4.20	—	
	—	4.4.3	Communication
1) Legal requirements addressed in ISO 9001, 4.4.4.			
2) Objectives addressed in ISO 9001, 4.1.1.			
3) Communication with the quality stakeholders (customers).			

Annex C (informative)

Bibliography

- [1] ISO 9000-1:1994, *Quality management and quality assurance standards — Part 1: Guidelines for selection and use.*
- [2] ISO 9000-2:1993, *Quality management and quality assurance standards — Part 2: Generic guidelines for the application of ISO 9001, ISO 9002 and ISO 9003.*
- [3] ISO 9000-3:1991, *Quality management and quality assurance standards — Part 3: Guidelines for the application of ISO 9001 to the development, supply and maintenance of software.*
- [4] ISO 9000-4:1993, *Quality management and quality assurance standards — Part 4: Guide to dependability programme management.*
- [5] ISO 9001:1994, *Quality systems — Model for quality assurance in design, development, production, installation and servicing.*
- [6] ISO 14004:1996, *Environmental management systems — General guidelines on principles, systems and supporting techniques.*
- [7] ISO 14010:1996, *Guidelines for environmental auditing — General principles.*
- [8] ISO 14011:1996, *Guidelines for environmental auditing — Audit procedures — Auditing of environmental management systems.*
- [9] ISO 14012:1996, *Guidelines for environmental auditing — Qualification criteria for environmental auditors.*

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Appendix 2: Consultation list

Electrical engineering Federation ;

Business for Environment ;

All employees of Hadleigh Castings Ltd ;

D. A. J. Clegg, Department of Manufacturing Engineering, University of Loughborough ;

S. T. Newman, Department of Manufacturing Engineering, University of Loughborough ;

B. Temple, Department of Manufacturing Engineering, University of Loughborough ;

Elaine Pickersgill, School of environmental sciences, University of East Anglia ;

Martha Mac Barron, Casting Development Centre ;

Alison Galdem, Casting Development Centre ;

Paula Murir, British Foundry Institute ;

Kevin O'Loughlin, Morganite Crucible Ltd. ;

Colin Thomas, Ramsell-Naber ;

Energy Efficiency Best Practice Programme ;

Environmental Helpline ;

Institute of Environmental Management & Assessment ;

Alan Hull, Environment Agency ;

Suffolk County Council ;

James Buckingham, Babergh District Council ;

Sue Macky, Elmsett School ;

Men Cap ;

Suffolk Record Office ;

United Kingdom Accreditation Service ;

Nick Farrow, British Standard Institute ;

Collins Skip Hire ;

Shank Ewans Ltd. ;
Bolton Bros. Ltd. ;
Anglia Water ;
Eastern Electricity ;
J. Brown, Land Registry ;
GEE Publishing Ltd. ;
Croners Publication ;
Ashland Ltd.

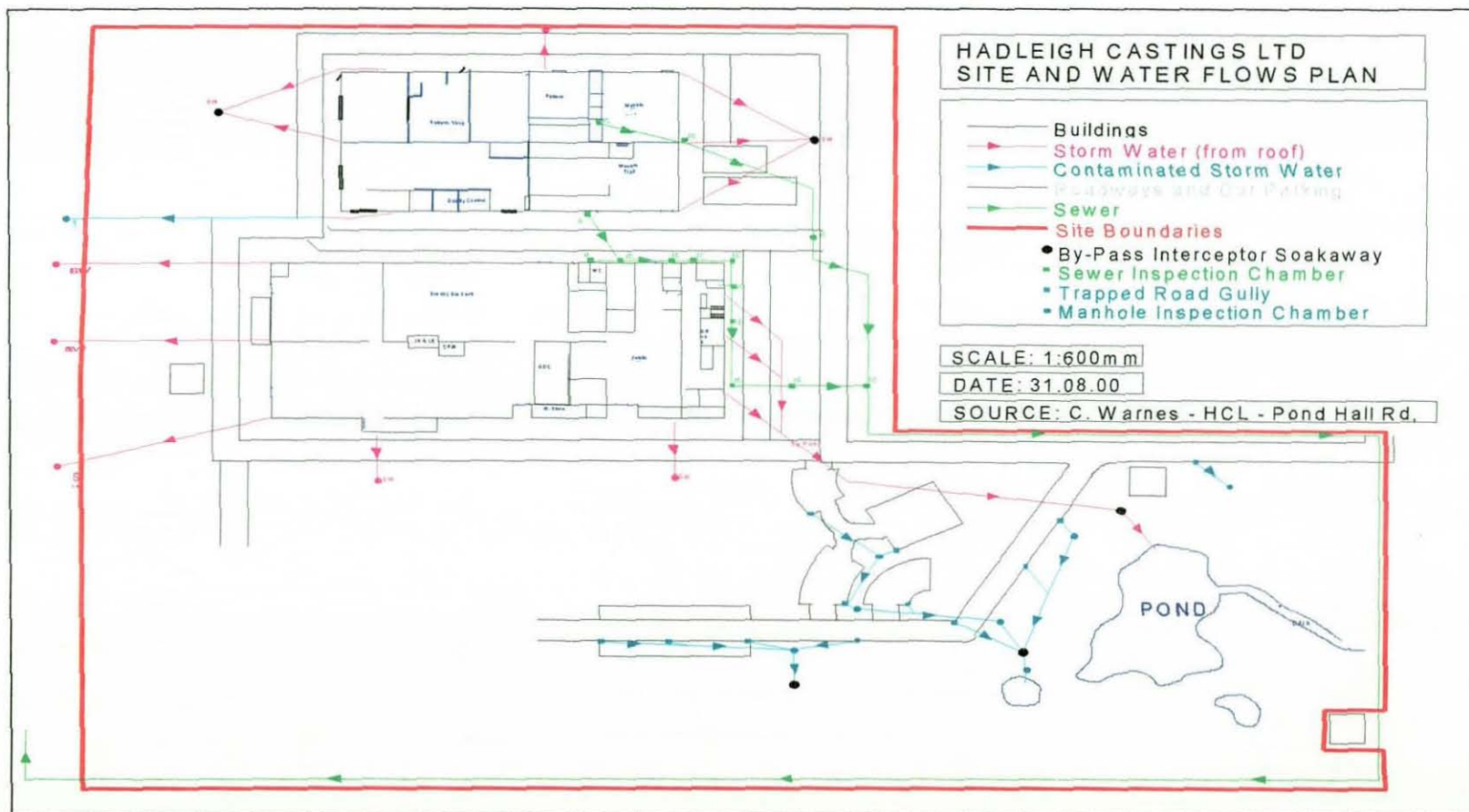
Appendix 3: Sites of Hadleigh Castings Ltd - boundaries, water flows, and equipment layout of building One & Two.

Source: Audits & interviews at Hadleigh Castings Ltd.

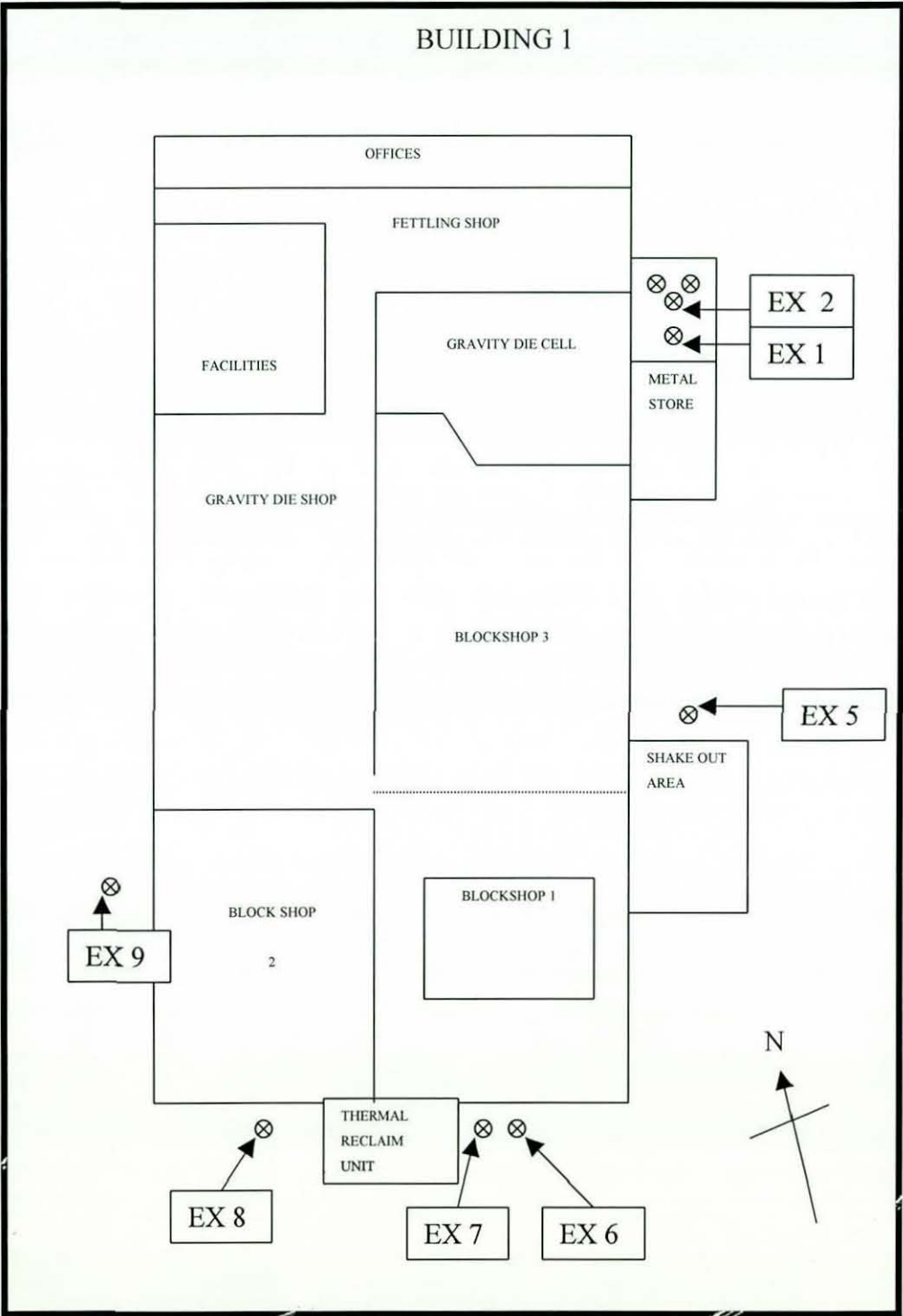
Date: 30.08.00.

Author: Chris Warnes.

Map of the site boundaries and water system of Hadleigh Castings Ltd is presented on the following page.



Map of Hadleigh Castings Ltd.'s exhaust points



Appendix 4: Business centres and activities listing.

ENVIRONMENTAL MANAGEMENT SYSTEM MANUAL BS EN ISO 14001 (1996)	Pages number	7
	Date Issue No	16/7/99 1
ENVIRONMENTAL MANAGEMENT RECORDS ENV 1 ACTIVITY REGISTER	Revision No	0
	Issued by	L. Roumégas

Business centres & its associated divisions of Hadleigh Castings Ltd.

A. Buildings/parking/ B. garden	B. Plant equipment/ production/ workshop	C. Sales & administration/ offices
1. Designing buildings, parking	1. Designing	1. Administration/ Business Management & Development
2. Purchasing	2. Purchasing	2. Accountancy
3. Implementing/ Managing & Controlling	3. Implementing /managing/control ling/maintaining On a department basis various processes A. Wood Pattern department * B. Foundry department 1. Metal Melt 2. Sand Distribution 3. Green Sand 4. Core making, 5. Boxless Moulding 6. Gravity Die shop** 7. Gravity Die Cell** C. Fettling/Shot Blasting/ Cut off Department D. Machining Department E. Despatching/Packaging department	3. Human Resources
4. Maintenance of the Buildings	4. Controlling/ Inspection / managing A. Quality Management B. Health & Safety Management	4. Communication / Information Technology
5. Cleaning/ waste management	5. Maintenance/Storage of the plant equipment	5. Sales
	6. Waste management	

*: Wood patterns are stored in the two secondary sites 'Pond Hall ' and Semer Stores.

The secondary site is used solely for the store of wood patterns and gravity die tooling as reported in the initial site audit of HCL.

** : Gravity die tooling is located at the Semer Store.

Activity Register Sheet

<i>Reference number</i>	<i>Activities Register</i>	<i>Normal conditions</i>	<i>Abnormal conditions</i>	<i>Emergency conditions</i>	<i>Past Activities</i>
A	Buildings & Non Production Equipment				
A.1	Designing New Building (isolation, heating system, paints, car park water drainage, storage area...) (N. Warnes)	#	#	#	
...	...				

Appendix 5: Environmental effect identification & register sheet

ENVIRONMENTAL MANAGEMENT SYSTEM MANUAL										Page		
BS EN ISO 14001 (1996)										Date		
ENVIRONMENTAL MANAGEMENT RECORDS ENV 2										Issue		
ENVIRONMENTAL EFFECTS IDENTIFICATION & REGISTER SHEETS										Rev. No		
Department/Business Centre:												
										Issue d By		
ENV'AL EFFECT										Date Ref.		
INPUTS		Raw Material Use /Energy Use								Land/ Water		
										Air		
										Water		
										Visual Impact		
										OUTPUTS		Noise & Vibration
		Quality Aspect										Supplier/Customer Concern
ACTIVITY REFERENCE												
A	#	Energy										
I		Water										
		Sand										
		Metal										
		Wood										
		Chemicals (Codes**)										
	#	Consumables										
	I 4	Solid, Liquid Waste & Dust (Codes*)										
		Atmospheric Emissions										
		Effluent										
		Visual, Landscape Impacts										
		Noise And Vibration										
		Health & Safety Concern: Storage, Remediation Plan										
		Quality Concern										
		Supplier/Customer Concern										
COMMENTS												

Legend:

* The chemicals used by the activities should be coded as follows :

- C1: Wood resins, and chemicals used for wood pattern activities ;
- C2: Metal melt chemicals (degasser, refiner, modifier, flux granules), sleeves...
- C3: Resin and catalyst mixed to the silica sand, waxing agent ;
- C4: Chemicals used in the mixture for sand blasting and machining activities ;
- C5: Engines cleaning chemicals: organic, inorganic paints and solvents & surfactants ;
- C6: Paints solvents for building -related activities and coating agent for gravity die pattern ;
- C7: Cleaning & maintenance purposes chemicals ;
- C8: Diesels & oils ;
- C9: Other chemicals...etc...

** The waste produced from the activities should be coded as follows :

- W1: Chemical containers ;
- W2: Sand blasting waste ;
- W3: Core making green sand ;
- W4: *Dust from sand distribution system thermal and mechanical ;*
- W5: Dross ;
- W6: Swept floor waste (containing metal, sand...) ;
- W7: Scrap Metal ;
- W8: Metallic dust from the shake-out unit ;
- W10: Sawdust from the pattern shop ;
- W11: Swarf or metallic dust ;
- W12: Waste Cutting Liquid from machining ;
- W13: Waste oils from vehicle services ;
- W14: General rubbish ;
- W15: Large metals pieces, building waste...
- W16: Office waste: Cardboard, paper Ink cartridge.
- W17: Other ...

Appendix 6: Methodology for the identification of the environmental impacts
- Environmental effects assessment sheet

ENVIRONMENTAL MANAGEMENT SYSTEM MANUAL - BS EN ISO 14001 (1996)					Page	
ENVIRONMENTAL MANAGEMENT RECORDS ENV 3					Revision No	
ENVIRONMENTAL EFFECTS ASSESSMENT SHEETS						
Date :					Issue No	
Department/Business Centre :					Issued by	
Effect/Process/Activity :					Ref.	
NORMAL OPERATING CONDITIONS						
CRITERIA	SCORE				WEIGHTING FACTOR	
	3	2	1	0		
Legislation	Existing	Impending		None	× 2	=
Environ-mental Damage	Known detriment	Possible detriment	Limited detriment	No detriment	× 3	=
Production efficiency	High	Medium	Negligible	No improvement	× 2	=
Reputation	High	Medium	Low	None	× 1	=
Quantity	High	Medium	Low	Nil	× 3	=
Normal Operating Conditions Total Score =						
OTHER OPERATING CONDITIONS						
CASES	SCORE				WEIGHTING FACTOR	
	12	6	3	0		
Abnormal operations		Increased Environ-mental Impact	No change	Reduced Environ-mental impact	=	
Accident/ Emergency		Increased Environ-mental Impact	No change	Reduced Environ-mental impact	=	
Past Activities	Evident/ requires action	Possible damage/ difficult to evaluate		No damage	=	
Planned Activities		Reduced Environ-mental impact	No change	Reduced Environ-mental impact	=	
Other Operating Conditions Total Score =						

Appendix 7: Significant environmental impacts reports

Source: Significant Environmental Impacts Report, 20th July 1999.
Author: L. Roumégas, Environmental Advisor, Hadleigh Castings Ltd.
Approver 1: N. E. Warnes, Managing Director, Hadleigh Castings Ltd.
Approver 2: D. Mayhew, Production Director, Hadleigh Castings Ltd.

Statistical analysis of environmental impact assessment

Once the environmental impacts of Hadleigh Castings Ltd. were ranked with the use of the environmental effects assessment sheet, the scores are analysed on a statistical basis.

Table presents the statistical results.

Table 7: Statistical results of environmental impact assessment (p.206-221)

Reference number	Divisions/Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
A	Buildings & Non Production Equipment					
A.1	Designing New Building (insulation, heating system, paints, car park water drainage, storage area...) (N. Warnes)	18	18	6	6	
A.2	Choosing contractors and suppliers for the building material (N. Warnes)			3	3	0
A.3.1	Construction of building or new projects (e.g. car park)	18	18	6	6	0
A.4.1	Maintenance of the building equipment, pipelines: Repair when breakdown (G. Wyatt)	11		3	3	0
2	General maintenance of the forklifts, the plant, the dampers and diggers (Full Service)	14		6	6	12
3	Subcontracting for maintenance audit of the gas pipelines	12	12	3	6	0
B	Production					
B.1.1	Designing Wood Patterns in the most efficient way (N Morsman)	20				
2	Designing the casting (ad hoc)	26				

Reference number	Divisions/Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
3	Contracting the design of the Gravity Die	15				
4	Plant & office layout design (C.Warnes)	5				
5	Implementation/research of more efficient/effective manufacturing techniques	17	17			
B.2.1	Purchasing small raw materials (chemicals for metal, wood pattern; wood; metal; sand)	19				
2	Purchasing of large & small equipment (machines, new furnace)(filters, safety equipment, ladle...)	19	19			
B.3	Implementing					
B.3.A	Pattern Department		18			
1	Cutting and shaping wood using machinery (sander, saw, planer & hand machines)	21				
2	Filling, laminating patterns with resins and filler	26		6	6	0
3	Coating with chemicals (wax) and painting the wood pattern (Spray or paint with a brush)	21		6	6	0
4	Storage of chemicals such and as solvents and paints	24		6	6	0
5	Collecting wood-dust chipping from drilling, sand saw and planner, in rubbish bin	15				
6	Handling of the wood pattern	12		3	3	

Reference number	Divisions/Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
7	Storage/ logistic management of patterns	0				
8	Repair Wood Pattern	25				
B.3.B	Foundry department (melting process-mould preparation & cut off)					
B.3.B.1	Metal Melting & Pouring in gravity die shop, gravity die cell, blockshops 1,2 and the green sand		20			
1	Storage of aluminium ingots, scrap, chemicals and other materials	20		6	6	6
2	Preheating aluminium furnace	32		6	6	0
3	Degassing with Degasser tablets Ecogas 16 in the Gravity die cell or with the Degassing Mobile Unit in the sand foundry	30		6	3	6
4	Grain Refining with Nucleant 70SS or by plunging the tablets of Nucleant 2000 for LM 25	29		6	6	6
5	Modification of the aluminium alloy with Sodium tablets (Navac 12.5) or Strontium/ Titanium rods (Dycastal) for LM6 or LM9	25		6	6	12
6	Fluxing with coverall GR 2410, GR 2516 and GR 2220	21		3	3	
7	Dross Removal	14		3	3	

Reference number	Divisions/Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
8	Bale out furnaces	17			3	
9	Metal Pouring from furnace to mould travel- ladle manipulation- mould could be a gravity die pattern or a furan sand mould or a green sand mould	24		6	6	0
10	Monitoring of the exhaust points- Requirement of the EPA 90 (V1) authorisation	14		3	6	0
11	Clean extractors			3	6	0
12	Training of employees to manipulate ladle and also to process melting of aluminium alloy	13		0	3	
13	Check the pots	7				
14	Furnace maintenance: change the pots and the insulation of the pots	15		0		
15	Ladle coating with Morganite Thermal coating	16		3	3	
16	Leakage of molten metal			6	6	0
17	Loading, unloading and moving barrels with the forklift	13				
19	Weight of the scrap barrels	23				
B.3.B.2	Thermal and Mechanical Reclamation of the sand		20			

Reference number	Divisions/Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
1	Fill the silo with sand	20			6	
2	Check the alarm system on the silo			0		12
3	Monitoring of atmospheric emission (EX1 to 10, EPA 90 (V1)) Production of dust fumes and noise	9		3		
4	Monitoring of quality of the sand- Calibration of the resin mixing to the sand	29			3	
5	Distribution of the sand- Storage of sand in hoppers- Knocking out Castings –heating - cooling the sand - add resin & catalyst to the sand (blender chute)	26		6	6	
6	Emptying the dust extractor to collect loose and sealed bag sand into the skips	25		6	6	6
7	Cleaning & maintenance of mixers & blender	21			6	
8	Emptying the resin and catalyst in the tank with the forklift	14			6	
9	Leakage spill of catalyst or resin of sand			6	6	0
B.3.B.3	Greensand:		9.1			
1	Green Sand mixing	4			3	
2	Green sand moulding	3			3	

Reference number	Divisions/Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
3	Spraying sand mould with wax	18			3	
4	Knocking out green sand	7			3	
5	Mould preparation using jolt/squeeze – surrounding noise very high + vibration	12			3	
6	Moving moulds to rolling rack	6			3	
7	Storage of old green sand pattern (Appendix 1)	14				
8	Disposal of the old green sand material			6		
B.3.B.4	Core Making		18			
1	Shell Core making with phenolic gas hardened sand on the Imafond 151 machine (Blockshop 2)	20		6	6	
2	Shell Core making with resin coated sand on machine (Green sand area)	20		6	6	
3	Core blowing of CO2 gas by hand on benches (Blockshop 1)	14		6	6	
B.3.B.5	Mould Preparation		16			
	Blockshop 1: Boxless moulding and Carousel processes					
	Blockshop 2: Boxless moulding					

Reference number	Divisions/Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
	Blockshop 3: Carousel Process					
1	Storage of material, raw material & waste (chemicals/ containers of chemicals & waste)	21			6	
2	Spraying wax on sand mould	15			3	
3	Using glue or other chemicals for mould preparation	21		6	6	
4	Mould movement in Rolling rack & carousel and gantry, Irremediable lost of sand	16			6	
5	Addition of the Kalmin sleeves and dypur kalpur (running & feeding agent)	6				
6	Mould filling: Fume from the burning of the wood due to spillage of molten metal from the mould	26		6	6	
7	Cleaning of roof panels			0		
8	Waste management /cleaning, sweeping the blockshops	17				
9	Maintenance of the materials	7			6	
B.3.B.6/7	Gravity Die shop & cell		15.8			
1	Storage of metal/check quantity	15				
2	Handling of the gravity dies using a crane - Lifting gantry for the handling of the gravity dies – manual	12				

Reference number	Divisions/Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
	handling until the band saw -					
3	Sand blasting of the gravity dies	13			3	
4	Heating of the gravity die Pattern- Use of portable gas heating pipes: Use adjustable flow of gas for heating mould	24		6	6	
5	Coating of the gravity dies: spray dies with die coat 34035, dycote ESS34, dycote 39, dycote 11	24			6	
6	Mixing dycote once, twice a week	18			6	
7	Storage of the gravity dies	14				
8	Pouring hot metal (760-800C) into the gravity dies: Use of Steel wool when required	28		6	6	
9	Cleaning dies with wire brush	10				
10	Cleaning of the workstations at the end of the day	14				
11	Noise level assessment-subcontracted			0		
12	Check the fans			0		
13	Top up chemical (e.g. coverall, dycastal)(once a week)	20		6	6	

Reference number	Divisions/Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
	Specific to Gravity Die Cell					
14	Extraction on the finishers	15			6	
15	Finishing	4				
16	Cut-off of casting: Use of band saw, finisher, drill	18			6	
17	Collection of metallic dust around the band saw	11				
18	Maintenance of the extractor	13			6	
B.3.C	Cut Off Department					
1	Handling castings & drums of runners & risers	8	15			
2	Cut Off the casting (use of energy, production of noise & vibration)	21				
3	Maintenance of the band saws	16			6	
	(14 benches with the same risk assessment)					
	Fettling shop is considered as a 'ear protector zone': Production of noise and vibration					
4	Fettling, finishing, cutting operations with hand tools and machines	20	19.8		6	

Reference number	Divisions/Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
5	Sand Blasting: Use of Shot Blaster: compressed air, noise & vibration, electricity & sand	20			3	
6	Disposal of Waste- Emptying waste bins & extractors of linishers and sand blaster	22		6	6	
7	Maintenance: cleaning extractors and pipes done by the employees, sweeping tables and floor, lubrication of machines	19		6	3	
8	Welding	18		6	6	
B.3.D	Machine shop		16			
1	Fettling operations with hand tools including Fettling Hand finishing of castings (non powered & air powered tools), linishing, flat linishing, filing, grinding, straightening	15				
2	Conventional machining including turning with Swift Lathe, Colchester Triumph 2000 Lathe with D.R.O & Harrison Collet lathe, Drilling (6) & banking (4) with 3 - Herbert 6 Spindle Drills, Grinding with tool & cutter grinder (3) with 1 Clarkson Cutter Grinder & 1 Alexander Cutter Grinder, Eroding with Agemaspark spark Eroder (use of paraffin), N C machine for milling, drilling with PRO 3000 XYZ	18		6	6	

Reference number	Divisions/Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
3	CNC machining with six CNC milling centres and single CNC lathe and 1300 S CNC M/C machine, Hwacheon VMC430 CNC M/C Centre, leadwell MCV-T60 CNC M/C Centre, Cincinnati Milacron Sabre 100 CNC machine and CNC lathe LTC 30	18		6	6	
4	Welding	18		6	6	
5	Maintenance & cleaning of the machine shop	18		6		
6	Disposal of Waste- move swarf and collect the used cutting fluid	18		6	6	
7	Handling of castings with forklift	9			6	
8	Packing castings in boxes-use of packaging			6		
B.3.E	Despatching/Packaging department		18			
1	Reuse, recycling of the wasted packaging material	7				
2	Cleaning of the vehicles	16			3	
3	Packaging with cardboard, plastic, staples	23				
4	Transport of the castings to customers	24			6	

Reference number	Divisions/Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
B.4.A	Quality Control:		15			
1	Document control-Updating the documentation of the Quality Manual - Record Management System documentation on Q-Pulse software	12				
2	Booking order & deliveries, drawings	16				
3	Quality control/Quality audits/ Inspection of casting production: Checking Temperature of furnace, Inspection of castings: Milling & turning with 2 Bridgeport Turret Machines with D.R.O and 1 T.O.S Vertical turret mill with D.R.O (XYZ), Production inspection e.g. calibration of the mixers & final inspection of the casting	15				
4	First off Sample check. If the casting is satisfactory it is sent to customer if it is not a corrective action is undertaken with a request procedure	18				
5	Certification paper production	15				
B.4.B	Health and Safety Department:		18			
1	Maintain and update Health & Safety records including Management of Health & Safety at Work Act	17		0	0	

Reference number	Divisions/Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
	1992 (MHSW) assessments, Manual Handling Operations Regulation 1992 (MHOR) assessments, Personal Protective Equipment at Work 1992 (PPEW) assessments, Workplace, Health Safety & Welfare (WHSW) 1992 assessments, Health & Safety Display Screen Equipment 1992 (HSDSE) Assessments, Provision & Use of Work Equipment 1992 (PUWE) Assessment					
2	Updating the documentation of Control Of Substances Hazardous to Health (COSHH) assessment & COSHH hazard data sheet	18		0	0	12
3	Maintain & update emergency action sheets	18		0	0	
4	Implementation of fire Procedures	18		0	0	12
B. 5	Plant Equipment/ Workshop Maintenance		13			
1	Daily maintenance/cleaning in each department	15			6	
2	Breakdown of the equipment for cleaning (e.g. hopper)			6	6	
3	Subcontracting for the maintenance of the two cooling systems linked to the shake out unit	12			3	
4	Repair when breakdown of material e.g. link into sand pipeline...(Neil Scopes)			6	6	

Reference number	Divisions/Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
5	Systematic audit on the compressor	7				
6	Subcontracting to clean coats	9				
7	Storage of oil and chemicals	21		6	6	12
8	Storage of used oil	21		6	6	12
9	Storage, re-use & recycle of the maintenance material	9				
B.6	Waste Management		19			
1	Collection of waste from the production place to the skip (John Leeks)	14			6	
2	Storage & maintenance of the skips (keep it cover)	24				12
C	Offices: Administration/ human resources/ sales/ account/ process development		14			
1	Use of computer, photocopier, fax machine, laser printer, laminating machines	18				
2	Production of Paperwork - letters, contracts etc.	3			6	
3	energy use and water use for heating air and water of the buildings	15				
4	Air conditioning consumption (summer)	12				

Reference number	Divisions/Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
5	Use of kitchen facilities & consumables- water, coffee, soap, drinking water etc	9				
6	Use & maintenance of sanitation & showers	9				
7	Maintenance of IT equipment & of buildings	19				
8	Disposal of filters of the laser printer (filtered ozone) & ink cartridge	18			6	
9	Transport issue of all the employees working at the company & Operation of company car	24			6	

Ranking System Analysis	
Average ranking of the significance of the environmental impacts of all activities under normal condition	17
Number of activities during normal condition with impacts ranked to a level superior to 20	33
Number of activities during normal condition with impacts ranked to a level superior to 21	23
Number of activities during normal condition with impacts ranked to a level superior to 22	23
Number of activities during normal condition with impacts ranked to a level superior to 23	21
Number of activities during normal condition with impacts ranked to a level superior to 24	15
Number of activities during normal condition with impacts ranked to a level superior to 25	13
Number of activities during normal condition with impacts ranked to a level superior to 26	6
Number of activities during normal condition with impacts ranked to a level superior to 27	6

Significant environmental impacts of activities during normal operating condition

The analysis of the ranking system shows that the nine most significant impacts of activities occurring during normal operating conditions are those scoring above 26. Those activities and associated scores are listed in the Table 8.

Table 8: Significant impacts occurring during normal operating conditions.

Reference number	Activities	Score of environmental impacts				
		Normal conditions	Normal condition Average per departments	Abnormal conditions	Emergency conditions	Past Activities
B.1.1.2	Designing the casting (ad hoc)	26				
B.3.A.2	Filling, laminating patterns with resins and filler	26		6	6	0
B.3.B.12	Preheating aluminium furnace	32		6	6	0
B.3.B.13	Degassing with Degasser tablets Ecogas 16 in the gravity die or with the Degassing Mobile Unit in the sand foundry	30		6	3	6
B.3.B.14	Grain Refining with Nucleant 70SS or in plunging the tablets of Nucleant 2000 for LM 25	29		6	6	6
B.3.B.2.4	Monitoring of quality of the sand- Calibration of the resin mixing to the sand	29			3	
B.3.B.2.5	Distribution of the sand- Storage of sand in hoppers- Knocking out Castings - heating - cooling the sand - add resin & catalyst to the sand (blender chute)	26		6	6	
B.3.B.5 6	Mould filling : Fume from the burning of the wood when spillage of melted metal on wood	26		6	6	
B.3.B.6/7/8	Pouring hot metal (760-800C) into the gravity dies: Use of Steel wool when required	28		6	6	

Significant environmental impacts of normal operating activities of HCL are identified as:

- Increase of Global Warming and acid rain with the emission of atmospheric pollutants including greenhouse gases such as CO₂, acid rain gases such as CO₂, and Volatiles Organic Compounds (VOC). Those gases are produced from: furnaces in the entire foundry (VOC, CO₂), sand blasting and finishers (Particulate, VOC), sand distribution system including shake-out unit and all the exhaust points referenced in the Environmental Protection Act 1990 Prescribed Process Authorisation (Particulate, VOC), core blower machine (VOC), painting activities in the pattern shop (VOC), incinerator use (CO₂, VOC) ;
- Use of limited natural resources such as energy, water, chemicals, sand, Brazilian wood and other raw materials ;
- Unsustainable management of waste due to the ineffective segregation of the waste stream into special waste, recoverable waste and controlled waste.

Significant environmental impacts of activities during other conditions

In considering the environmental effects assessment sheet, certain environmental impact of activities occurring during past, abnormal or emergency conditions require corrective actions. Those environmental impacts are considered

significant. They are the ones occurring as a result of past activities and their score equal to 12 in the environmental effects assessment sheet.

Table 9 presents those past activities, the problem occurring from them and the associated corrective action to undertake.

Table 9: Significant environmental impacts requiring a corrective action

Reference number	Activities requiring corrective action	Environmental Impacts	Problem/ Environmental impact cause	Corrective action to bring
A.4.2	General maintenance of the forklifts, the plant, the dampers and diggers (Full Service)	Contamination of the soils	Inappropriate storage of the used oil	Storage of the used oil in bunded areas
B.3.B.25	Modification of the aluminium alloy with Sodium tablets (Navac 12.5) or Strontium/ Titanium rods (Dycastal) for LM6 or LM9	Pollution of Atmosphere- Health & Safety Impacts on workers	The use of metallic sodium is prohibited in the gravity die casting area & in the electric furnaces	Stop the use of metallic sodium in the gravity die area Keep in compliance with the EPA authorisations requirements.
B.3.B.22	Check the alarm system on the silo	Non compliance with EPA 1990 authorisation	No systematic checking procedure in place	Check if condition adequate and if it is put into place a systematic procedure on silo checking Report any event relative to the silo on the Logbook. Keep in compliance with the EPA authorisations requirements.

Reference number	Activities requiring corrective action	Environmental Impacts	Problem/ Environmental impact cause	Corrective action to bring
B.4.B.2	Updating the documentation of Control Of Substances Hazardous to Health (COSHH) assessment & COSHH hazard data sheet	Risk of fire and contamination of soil by spillage of chemicals	No prevention of risk of spillage & contamination of soil or waters. No consideration of chemical disposal as Special waste Chemicals present in the maintenance workshop were not listed in the COSHH list	<i>Comprehensive and updated</i> inventory of all the chemicals used within the company, which should be assessed according to Health and Safety legislation.
B.4.B.4	Implementation of fire Procedures	Risk of pollution of atmosphere and contamination of controlled water	The remedial actions to take, in case of fire, are not communicated to the employees. The adequate fire equipment is not available in the pattern shop.	Update the fire remedial action and <i>communicate them to all the</i> employees. Adequate fire equipment should be <i>installed everywhere within the</i> company especially where inflammable chemicals are stored.

Reference number	Activities requiring corrective action	Environmental Impacts	Problem/ Environmental impact cause	Corrective action to bring
B.5.7	Storage of oil and chemicals	Risk of soil & waters contamination	Chemicals such as resins and catalysts are not appropriately stored.	Installation of bunded area is advised.
B.5.8	Storage of used oil	Risk of soil & waters contamination	Past activities lead to the contamination of the surrounding area where used oil barrels were stored.	According to the regulation on Special Waste control, the special waste should be carefully stored in appropriate bunded areas.
B.6.2	Storage & maintenance of the skips (keep them covered)	Non compliance to EPA 1990 Autorisation ; Legislation breach.	The skip of loose sand should be covered to avoid the spread of sand. The swarf bags should be disposed in a bunded area because of the oil based cutting fluid leakage.	Cover the loose sand skip and check that the sealed bags of sand are closed. House keeping of the skip area Installation of bunds where the swarf bags are stored.
	Incineration of cardboard and other waste	Legislation breach	Use of incinerator Practice prohibited by law	Stop burning the waste. Compliance with the Waste regulation.

Finally, the significant environmental impacts during emergency and abnormal conditions are:

- land contamination risk from spillage of raw material and waste into the ground and
- global warming, local acid rain and controlled water contamination risks due to the release of chemicals or atmospheric emissions in case of fire or spillage of catalyst resin or other potential pollutants.

So the risk of fire, spillage of chemicals and waste, which are the sources of potential significant impacts, need to be controlled with fire procedures, updated Health and Safety Data Sheets with Health & Safety management.

Appendix 8: Environmental legislation register of Hadleigh Castings Ltd.

Source: Compliance audits.

Date: June 2000

Author: Lydia Roumégas.

Appendix EP04-A	Register of Legislation
Section Ref.	Reg. of Legislation-1.0- 5.06.00 LR
Version No	1.0
Date	5.06.00
Issued by	L. Roumégas

Legislation/ Code of practice	Applicable to which activities/ product	Copy held on-site? Yes/No	Where?	Responsibility for compliance	Related Procedures
Environmental Protection Act 1990 - Part 1 Local Authority Air Pollution Control Provision - Process Guidance PG2/4 (96)Iron, steel and non-ferrous metal foundry processes - Process Guidance PG 2/6 (96) Aluminium, magnesium and their alloys	Foundry maintenance - covers all the ancillary operations including mould and coremaking, casting, and fettling operations - covers the melting and holding of metal	Yes	Env. Filing System REC 9/C/1	Managing Director	- EP04 Legal and other requirements - Env. Manual - Objective O1/T1

Legislation/ Code of practice	Applicable to which activities/ product	Copy held on-site? Yes/No	Where?	Responsibility for compliance	Related Procedures
Waste Management – the Duty of Care - Code of Practice - Environmental Protection Act 1990 - section 94	All site -To keep records of duty of care annual waste transfer notes	No for legislation text. Yes for waste transfer notes	Accountancy with invoices	- Managing Director	- EP11 Waste Management
Waste Management Licensing Regulations - 1994, 1997 & 1998	All Site - Transport & disposal of waste	No		- Managing Director	- EP11 Waste Management
Special Waste Regulation 1996	Machine shop department Pattern shop department Maintenance/ Site	No for legislation text Yes for consignment notes	Environmental filing system REC 9/B/1	- Managing Director - Depart.Rep. - Env. Advisor	- EP11 Waste Management
Control of Substances Hazardous to Health Regulation 1999 Health and Safety at work Act 1991	Health & Safety department	No		- Managing Director	- Env. Manual
The Producer Responsibility Obligations (Packaging Waste) Regulations 1997	Despatch department The 1999 consumption was well below 50 tonnes a year - So the regulation does not apply to Hadleigh Castings Ltd.	No		- Managing director	- None

Appendix 9: Training protocol of Hadleigh Castings Ltd

Title	<i>Training Protocol for Directors, Managers & Supervisors</i> <i>A Systematic Approach To Training</i>
Document No	
Date of Issue	27.07.00
Revision No	1.0
Prepared by	Lydia Roumégas & Therese Coupe

Training Protocol : A systematic approach to Training

Purpose

Guide for Directors & Managers for the completion of the "Training Description & Approval", "Training evaluation" form and 'training record' forms. These forms are part of the Company Handbook.

Training Policy

The Company recognises its duty in preparing its employees by encouraging them to gain the skills, knowledge and education necessary to undertake their duties.

The Company is committed to providing the resources, equipment and time for its employees to personally develop their skills, knowledge and education to contribute to the Company performance.

In addition, the Company wishes to promote a 'continuous improvement' culture, where every employee is encouraged to personally develop his/her skills.

Accordingly, the Company promotes an atmosphere that recognises training and development as a paramount importance to every business objective.

Training & Development Identification

Training and development needs, will be identified through induction, succession planning, changes in technology and/or procedures, and through annual appraisals.

Internal Training

Personnel performing specific assigned tasks shall be qualified on the basis of appropriate education, training and/or experience.

It is the responsibility of the Manager/Supervisor to ensure training requirements for the assigned tasks are identified. It is the responsibility of the employee to highlight to the Manager/Supervisor if he/she feels that he/she has inadequate knowledge or training for the task assigned.

External Training

New and existing employees who accept training at the Company's expense will be required to enter into a training agreement, HR/TrAgree/ACB/06.99/1. This is to ensure that loyal employees are not penalised if part of the training budget is allocated to an employee who subsequently leaves.

Training Procedure

Identifying the Training Needs

The Company conducts Staff Appraisals on an annual basis and appraisers will be advised to set objectives and targets for appraisees where necessary that will assist both the company in achieving its objectives and will identify training needs.

The Quality manual, Environmental Manual, the Environmental Procedure Manual and the H&S manual contain additive requirements for training.

In order to comply with these documents, directors, managers will identify the training need, objectives, content, responsibilities, evaluation & change forces through the completion of the 'Training Description & Approval' -Company Handbook.

The boiling points are questions or comments to follow in order to fill the 'Training Description & Approval Form.'

'Training Needs'

- List the tasks, procedure or operation that requires a training activity to take place before the operator is able to perform it at the correct level.
- List the skills and knowledge required in order to perform the task.

'Training Objectives/ Requirements & Benefits'

Training requirements should be discussed between the employee and the Manager/Supervisor in the first instance.

The Manager/Supervisor should, wherever possible, identify the benefit to the Company of the employee making this application and communicate such to the Human Resource Manager.

- What do employees or groups of employees require the training ?
- Why does the training need to take place ?
- What will the Trainee be required to do at the completion of the training ?
- What is the level or standard of performance required of the Trainee, i.e., 'the employee will have reached an acceptable level accomplishment when he/she can(list out)' ?

'Training Content'

- Choose the method of training, i.e., formal/informal, 'on the job', training room, by practice, computer based training, ...etc...
- List equipment and/or tools required to make training possible

'Responsibilities'

- State who is responsible for ensuring that training is carried out and who acts as the Trainer (they may not be the same person).
- Other persons, i.e., the trainees work colleague, who may assist in the training.

Attendance

- State the name of the attendants and make them signed the attendance table.

Hadleigh Castings Limited

Training Description & Approval Sheet

Your feedback on this form will enable the Company to focus on the most effective method of providing training for its' employees. Any observations will be received in good faith and you are invited to give your valued opinion on any training undertaken.

Initiator for Training Demand:	Department:
Reasons for Training:	
Training Objectives:	
Training Content:	
Responsible for ensuring that training is carried out:	
Name of Trainer/Training Company:	
Name of Trainees:	Cost of Training:
Expected Training date:	
Approval	
Name of the Approver:	
Signature of the Approver:	
Date:	

Evaluation

- Determine how the trainee will be measured to ensure that the learning is transferred to the workplace.
- State how the training activity will be evaluated to determine whether it has successfully met its objectives.
- Ask the trainees to fill in the 'Hadleigh Castings Limited Training Evaluation' form and then to pass it on to the HR manager.

Hadleigh Castings Limited

Training Evaluation Sheet

Your feedback on this form will enable the Company to focus on the most effective method of providing training for its' employees. Any observations will be received in good faith and you are invited to give your valued opinion on any training undertaken.

Name of Trainee:					Name of Trainer/Training Company:				
					Cost of Training:				
Training Objectives:									
Training Received:					Date:				
In your own opinion, how do you rate the service the trainer provided i.e. consider facilities, aids, professionalism, (please tick relevant box below)									
Low		Poor		Average		Good		High	
1	2	3	4	5	6	7	8	9	10
In your own opinion, did the training meet the objectives (please tick relevant box below)									
Not at all		Partly		Mostly		Fully		Above	
1	2	3	4	5	6	7	8	9	10
Is further training required as a result of this training ?									
What new knowledge and skills have you obtained from this training ?									
How will you use this knowledge and skill to benefit yourself and the company ?									
In your opinion what improvements could be made to the training and would you recommend this training for other employees ?									

Thank you for your time, please return to the HSO as soon as possible.

For Office Use Only		
Action Plan Arising from Training Evaluation Form		
Action Required	Action By	Deadline

Record

- Fill in the training record form once the training had took place.
- Completion of Part One Requisition of the 'Training Record Form' detailing the procedure description and the reference number of the Procedure or other document.
- A copy of the form is passed to the Health & Safety and Training Officer (HSTO) to hold in abeyance in order to monitor that training will take place.
- After the training has been completed, Part Two Action of the form is completed and the original form is forwarded to the HSTO.
- The HSTO identifies that the training has occurred.
- The details of the training are entered onto the relevant training record(s) on QPulse.
- Copies of the form are taken and passed to the relevant persons with a notation of the date.
- The HSTO holds copies of the Training Record Forms and should he identify from the copy of the form in Part One Requisition that the 'Date Training to be Completed has passed, Part Three Reminder will be completed and a copy forwarded to the Supervisor for immediate action.
- The person who initiated the training should attach Part Three Reminder form to the original copy of the Training Record Form then follow points 3-4 above.
- Should the training not take place after the second due date has passed, then the HSTO will raise a corrective action.

TRAINING RECORD FORM	Document Ref. No
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Procedure/ Document Ref. No:	Description:
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PART ONE REQUISITION	Name of Trainee:	Department:	Date Requisition Raised:
	Reason: (new employee/new job/new procedure, etc)		Date Training to be Completed:
	Description of Training		
	Name of identified Trainer	AUTHORISED BY: Signature: Print name:	

PART TWO ACTION	The above named has been trained in accordance with the training requirements of the above procedure and is considered competent to work with a minimum amount of supervision		Date Training Completed:
	SIGNED BY TRAINER:		Date:
	SIGNED BY SUPERVISOR:		Date:
	SIGNED BY TRAINEE:		Date:

PART THREE REMINDER	To : Named Supervisor	
	According to the records, training has not taken place by the required date for the above named trainee. If training is not completed by a Non-conformance will be issued	
	SIGNED BY HSTO:	Date:

PART FOUR RECORD OF TRAINING COMPLETION	Entered onto Qpulse	Date:
	Copy passed to HR Department for personnel records	Date:
	Copy passed to Environmental Audit Manager	Date:
	Copy passed to Supervisor	Date:
	Copy passed Trainee	Date:

Table of Amendments of the Training Protocol & Procedure		
Revision	Description of Change	Date of Issue

Appendix 10: Environmental training plan matrix

See next page.

Environmental Training Matrix																						
Environmental Procedures		MD	EC Members						Env Rep						DIRECTORS	MANAGERS	SUPERVISORS.	STAFF	QUALITY	H&S	MAINTENANCE	Details/ Comments
			CW	GW	LE	DB	GW	CW	GW	SC	SU	AS	LS	DB								
EP01.	Document control and record		•		•	•												•				P. Carlin: QPulse Administrator
EP02.	Environmental Aspects			•														•				
EP03.	Approval and amendment after modification or addition of activities or personnel or equipment																					
EP04.	Legal and other requirements		•	•														•	•			
EP05.	Policy, objectives, targets and programme		•	•	•	•	•	•	•	•	•	•	•	•	•							
EP06.	Training & Awareness	•	•		•																	

[illegible]

Environmental Training Matrix																									
Environmental Procedures		MD	EC Members										Env Rep					DIRECTORS	MANAGERS	SUPERVISORS.	STAFF	QUALITY	H&S	MAINTENANCE	Details/ Comments
		NW	LR	DM	TC	MD	CW	GW	CW	DB	LE	AS	LS	SC	SU										
																									Accountant
EP14.	Raw Material management																								
Part 1	Sand																								
Part 2	Hazardous Substances					•																			Special Waste Identification
Part 3	Metallic Sodium																								
EP15.	Transport																								
EP16.	Supplier Environmental Assessment			•																					
EP17.	Control of activities of contractors																								
Part 1	On site contractors																								
Part 2	Off site contractors																								

Environmental Training Matrix																									
Environmental Procedures		MD	EC Members							Env Rep							DIRECTORS	MANAGERS	SUPERVISORS.	STAFF	QUALITY	H&S	MAINTENANCE	Details/ Comments	
			CW	GW	CW	MD	TC	DM	LR	CW	GW	DB	LE	AS	LS	SC									SU
EP18.	Operational control																								
EP19.	Environmental Emergency and Preparedness Responses																								
EP20.	Verification, measurement and testing																								
EP21.	Compliance evaluation with relevant legislation																								
EP22.	Environmental non- conformance control																								
EP23.	Corrective and preventive action																								
EP24.	Internal environmental		•			•					•	•	•	•	•	•									Technical

Environmental Training Matrix																										
Environmental Procedures		MD	EC Members							Env Rep							DIRECTORS	MANAGERS	SUPERVISORS.	STAFF	QUALITY	H&S	MAINTENANCE	Details/ Comments		
		NW	LR	DM	TC	MD	CW	GW	CW	GW	DB	LE	AS	LS	SC	SU										
	auditing																									Assistant- R. Mill
EP25.	Environmental management review	•	•	•	•	•	•	•										•	•							
EP26.	Preventive maintenance																									
Part 1	Sand Distribution & venting																									
Part 2	House Keeping																									
Part 3	Energy																									
Part 4	Compressed Air																									

Appendix 11: Environmental auditing programme

Internal Environmental Auditing	
Section Title	Environmental audit Programme
Section Ref	Audit programme 29.08.00 LR
Version No	1.1
Date	29.08.00
Issued by	L. Roumégas
Approved by	Env Com
6 Pages.	

Audited Items

Environmental Procedure Listing

No	Procedure Name	Objectives Reference	BS EN ISO 14001: 1996 Paragraph
EP01.	Document Control and Records		4.4.5, 4.5.3
EP02.	Environmental Impacts		4.3.1
EP03.	Approval and amendment of EMS documentation	O6/T4	4.4.5
EP04.	Legal and other requirements	O1 & O2	4.3.2
EP05.	Environmental Policy, Objectives, Targets and Programme	O3/T2	4.3.2, 4.3.3, 4.3.4
EP06.	Training & Awareness	O6/T4	4.4.2
EP07.	Communication	O1/T9, O3/T2, O6/T4	4.4.3

No	Procedure Name	Objectives Reference	BS EN ISO 14001: 1996 Paragraph
EP08.	Complaints		4.4.3
EP09.	Atmospheric Emissions Management Part 1 Non-continuous Atmospheric Emission Monitoring Part 2 Continuous Particulate Emission Monitoring	O1/T2, T6, T7 O1/T3	4.5.1
EP10.	Water Management	O4/T3	4.5.1
EP11.	Waste Management	O5/T1	4.5.1
EP12.	Noise and Visual Impacts	Not Required	
EP13.	Energy Management	O4/T1	4.5.1
EP14.	Raw Material Management Part 1: Sand Part 2: Hazardous Substances Part 3: Metallic Sodium	O6/T5 O1/T8, O2,O1/T1	4.5.1
EP15.	Transport	Not Required	
EP16.	Supplier Environmental Assessment	O3/T3	4.4.6
EP17.	Control of Activities of Contractors Part 1: On site contractors Part 2: Off site contractors	O3/T3	4.4.6
EP18.	Operational Control	All proc.	4.4.6
EP19.	Environmental Emergency and Preparedness Responses	O2/T2, T3	4.47
EP20.	Verification, Measurement and Testing		Not required
EP21.	Compliance Evaluation with Relevant Legislation		4.5.1
EP22.	Environmental Non -Conformance Control		4.5.2
EP23.	Corrective and Preventive Action		4.5.2
EP24.	Internal Environmental Auditing		4.5.4

No	Procedure Name	Objectives Reference	BS EN ISO 14001: 1996 Paragraph
EP25.	Environmental Management Review		4.6
EP26.	Preventive Maintenance Part 1: Sand Distribution & Venting Part 2: House Keeping Part 3: Energy Part 4: Compressed Air	O1/T5 O6/T1 O4/T1,T2 O6/T3 O4/T3	4.4.6 4.4.7

Department Listing

Ref.	Departments	Environmental representatives	Manager
D01	Design Production	C. Warnes	C. Warnes
D02	Site/Maintenance/Building/Offices	G. Wyatt	G. Wyatt
D03	Pattern shop	D. Barrett	N. Morsman
D04	Sand foundry	L. Evans	C. Warnes
D05	Gravity die foundry	A. Snowling	B. Mann
D06	Fettling/cut off department	L. Silito	D. Mayhew
D07	Machining department	S. Cridland	M. Lynch
D08	Despatch/Packaging department	S. Upson	D. Mayhew
D09	Quality, health & safety, environmental departments	R. Mills	Quality T. Orton Environment: T. Coupe H&S: N. Warnes

Auditor Listing

The Health, Safety & Environmental Officer will take the lead for the environmental auditing and the whole EMS implementation at Hadleigh Castings Ltd.

Environmental Internal Auditors	Ref.	Nb of Audit
C. Warnes	A01	3
G. Wyatt	A02	3
D. Barrett	A03	2
L. Evans	A04	2
A. Snowling	A05	2
L. Siltoe	A06	2
S. Cridland	A07	3
S. Upson	A08	2
R. Mills	A09	2
M. Dixon	A10	4
T. Coupe	A11	4

Environmental audits listing

Procedure-based audits

Procedure-based audit				
Audit ref.	Time (day)	Audits on :	Ref.	Auditor
EMS System Audits				
EP-MS1	1	Document control and Control of record	EP01	T. Coupe
EP- MS2	1	Environmental aspects/ impacts and ranking of significance	EP02	M. Dixon
EP-MS3	½	Approval and amendment after modification or addition of activities or personnel or equipment	EP03	T. Coupe
EP-MS4	1	Policy, objectives, targets and programme	EP05	G. Wyatt
EP-MS5	½	Operational control	EP18	L. Evans
EP-MS6	1	Environmental non-conformance control	EP22	D. Barret
EP-MS7	1	Corrective and preventive action	EP23	A. Snowling
EP-MS8	1	Internal environmental auditing	EP24	T. Coupe
Communication & awareness audits				
EP-CO1	1	Communication	EP07	M. Dixon
EP-CO2	½	Complaints	EP08	C. Warnes
EP-CO3	½	Supplier Environmental Assessment	EP16	R. Mills
Legislation & compliance audits				
EP-LE1	1-2	Legal and other requirements	EP04	M. Dixon
EP-LE2	1/2	Compliance Evaluation with Relevant Legislation	EP21	M. Dixon

Procedure-based audit				
Audit ref.	Time (day)	Audits on :	Ref.	Auditor
Environmental impacts during normal conditions audits				
EP-IN1	1-2	Atmospheric Emissions Management Part 1 Non-continuous Atmospheric Emission Monitoring Part 2 Continuous Particulate Emission Monitoring	EP09	T. Coupe
EP-IN2	1/2	Water Management	EP10	L. Silitoe
EP-IN3	1	Waste Management	EP11	C. Warnes
EP-IN4	0	Noise and Visual Impacts	EP12	
EP-IN5	1/2	Energy Management	EP13	S. Cridland
EP-IN6	1	Raw Material Management Part 1: Sand Part 2: Hazardous Substances Part 3: Metallic Sodium	EP14	G. Wyatt
EP-IN7	0	Transport	EP15	
EP-IN8	0	Verification, measurement & testing	EP16	
Environmental impacts during emergency audits				
EP-IE1	1	Control of Activities of Contractors Part 1: On site contractors Part 2: Off site contractors	EP17	S. Upson
EP-IN2	1	Environmental Emergency and Preparedness Responses	EP19	R. Mills

Department-based audits

Department-Based Audit				
Audit ref.	Time (day)	Audits on:	Ref.	Auditor
ED01	1/2	Design Production	D01	D. Barret
ED02	1-2	Site/Maintenance/Building/Offices	D02	S. Cridland
ED03	1/2	Pattern shop	D03	G. Wyatt
ED04	1	Sand foundry	D04	L. Evans
ED05	1/2	Gravity die foundry	D05	L. Silito
ED06	1/2	Fettling/cut off department	D06	S. Upson
ED07	1/2	Machining department	D07	A. Snowling
ED08	1/2	Despatch/Packaging department	D08	S. Cridland
ED09	1	Quality, health & safety, environmental departments	D09	C. Warnes

Annual Timetable

Audited Items		Months											
		J	F	M	A	M	J	J	A	S	O	N	D
ED01	Design Production		×										
ED02	Site/Maintenance/ Building/Offices			×									
ED03	Pattern shop				×								
ED04	Sand foundry	×											
ED05	Gravity die foundry		×										
ED06	Fettling/cut off department			×									
ED07	Machining department				×								
ED08	Despatch/Packaging department					×							
ED09	Quality, health & safety, environmental departments						×						
EP1	Document Control and Records										×		
EP2	Environmental Impacts											×	
EP3	Approval and amendment of EMS Documentation												×

Audited Items		Months											
		J	F	M	A	M	J	J	A	S	O	N	D
EP4	Legal and other requirements	×											
EP5	Environmental Policy, Objectives, Targets and Programme		×										
EP6	Training			×									
EP7	Communication				×								
EP8	Complaints					×							
EP9	Atmospheric Emissions Management						×						
EP10	Water Management							×					
EP11	Waste Management								×				
EP12	Noise and Visual Impacts												
EP13	Energy Management									×			
EP14	Raw Material Management										×		
EP15	Transport												
EP16	Supplier Environmental Assessment											×	
EP17	Control of Activities of Contractors												×

Audited Items		Months											
		J	F	M	A	M	J	J	A	S	O	N	D
EP18	Operational Control							×					
EP19	Environmental Emergency and Preparedness Responses								×				
EP20	Verification, Measurement and Testing												
EP21	Compliance Evaluation with Relevant Legislation									×			
EP22	Environmental Non- Conformance Control										×		
EP23	Corrective and Preventive Action											×	
EP24	Internal Environmental Auditing												×
EP25	Environmental Management Review						×						
EP26	Preventive Maintenance	×											

Appendix 12: Listing of environmental procedures of Hadleigh Castings Ltd.

Each Procedure will contain guidance for monitoring and controlling operations, and for taking corrective action in the event of non-compliance to environmental legislation, Hadleigh Castings Ltd's environmental policy, procedures and manual and BS EN ISO14001 requirements.

The Environmental Procedure Manual of Hadleigh Castings Ltd. contains 26 procedures.

The Procedures EP12 Noise and Vibration and EP15 Transport have not been implemented, as their related environmental impacts have not been assessed as significant. However, the transport, noise and visual impacts have been identified as environmental issues and provision has been made to incorporate these Procedures at a time when those impacts are identified as being significant.

The mean of control to conformance and degree of implementation of the procedure is the internal auditing system. Most of the internal auditor's work will be focussed on checking for procedural conformance.

The listing of procedures is presented on the following table, where the procedures are referenced to the environmental objectives of Hadleigh Castings Ltd, the ISO 14001 requirements and the associated responsible who issued it.

Environmental procedures of Hadleigh Castings Ltd.

Abbreviations: BDM: Business Development Manager, BM: Building Manager, EA: Environmental Adviser, EP&FM: Engineering Projects & Foundry Manager, H, S & T O: Health, Safety & Training Officer, N/A: Not Available, PD: Production Director.

Nb	Procedure Name	Objectives Ref.	ISO 14001 Section	Issued by
EP 01	Document control and record		4.4.5, 4.5.3	EA
EP 02	Environmental impacts		4.3.1	EA
EP 03	Approval and amendment of EMS documentation	O6/T4	4.4.5	EA
EP 04	Legal and other requirements	O1 & O2	4.3.2	EA
EP 05	Policy, objectives, targets and programme	O3/T2	4.3.2, 4.3.3, 4.3.4	EA
EP 06	Training & Awareness	O6/T4	4.4.2	BDM
EP07	Communication	O1/T9, O3/T2, O6/T4	4.4.3	BDM
EP08	Complaints		4.4.3	BDM
EP 09	Atmospheric emissions management Part 1 Non-continuous Atmospheric Emission Monitoring Part 2 Continuous Particulate Emission Monitoring	O1/T2, T6, T7 O1/T3	4.5.1	EA HS&TO
EP 10	Water management	O4/T3	4.5.1	BM
EP 11	Waste management	O5/T1	4.5.1	EA
EP 12	Noise and visual impacts	Not Defined as significant impact.		
EP 13	Energy management	O4/T1	4.5.1	LR
EP 14	Raw Material management	O6/T5	4.5.1	

Nb	Procedure Name	Objectives Ref.	ISO 14001 Section	Issued by
	Part 1: Sand Part 2: Hazardous Substances Part 3: Metallic Sodium	O1/T8, O2/T1 O1/T1,		PD HS&TO PD
EP 15	Transport	Not Defined as significant impact		
EP 16	Supplier Environmental Assessment	O3/T3	4.4.6	BDM
EP 17	Control of activities of contractors Part 1: On site contractors Part 2: Off site contractors	O3/T3	4.4.6	HS&TO BDM
EP 18	Operational control	All proc.	4.4.6	EA
EP 19	Environmental Emergency and Preparedness Responses	O2/T2, T3	4.47	HS&TO
EP 20	Verification, measurement and testing	Not required.		
EP 21	Compliance evaluation with relevant legislation		4.5.1	EA
EP 22	Environmental non-conformance control		4.5.2	EA
EP 23	Corrective and preventive action		4.5.2	EA
EP 24	Internal environmental auditing		4.5.4	EA
EP 25	Environmental management review		4.6	EA
EP 26	Preventive maintenance Part 1: Sand Distribution & Venting Part 2: House Keeping Part 3: Energy Part 4: Compressed Air	O1/T5 O6/T1 O4/T1,T2 O6/T3 O4/T3	4.4.6 4.4.7	PD PD EA BM

Appendix 13: Environmental procedure EP10 – Water management

See next page



Environmental Procedure	
Title of Procedure	EP10 Water Management
Section Ref	EP10 Water Management - 1 - 13.04.00 GW
Version No	1
Date	26.05.00
Issued by	G Wyatt

EP 10 Water Management

1 References

- 1.1 Objective 04/T3 Water usage and sewage reduction - a reduction of 2% of the consumption based on the previous years consumption over a two year time-scale.
- 1.2 Water Resources Act 199. Controlled water must be protected from any poisonous, noxious or polluting substances including run-offs from car parks.

2 Scope

- 2.1 The Environmental Management System takes into account the significant environmental impacts in order to mitigate them. The controlled use of water, as a limited natural resource, has been identified as an EMS objective.
- 2.2 Furthermore, by managing water as a limited resource, financial savings will be made by HCL in the management of the utilities.

3 Procedures

- 3.1 **Water Usage Monitoring.** Water is purchased from Anglian Water Authority (AWA) and is measured by means of three water meters, provided by AWA. The meter locations are shown on the Map of the Water System at Appendix A.
- 3.2 **Data Collection Procedure.** On the first Monday on each month the Building Maintenance Supervisor will record the meter readings in a notebook (held by the Management Accountant).
 - 3.2.1 Should, during the collection procedure the Buildings Maintenance Supervisor notice a fluctuation in the amount of water used, he will inform senior management who will notify AWA as appropriate.
- 3.3 **Data entry/ analysis.** The recorded data is used for the following analysis's:



- 3.3.1 Annual Unit cost of m3 of water usage and effluent production
- 3.3.2 Monthly Water Quantity/ cost
- 3.3.3 Quarterly Comparison with quantity & cost from water bills

4 Preventative Maintenance of Plumbing of Water and Associated Equipment

- 4.1 The Water Maintenance Checklist sheet, Appendix B, is a checklist of items which will be checked on a monthly basis by the Building Maintenance Supervisor. Items that require rectification or replacing will be attended to and a notation made on the sheet.

5 Responsibilities

- 5.1 The Building Maintenance Supervisor is responsible for the monthly collection of data and equipment checking.
- 5.2 In the absence of the Building Maintenance Supervisor, the Plant Maintenance Engineer will perform the above duties.
- 5.3 The Management Accountant is responsible for entering and analysing the monthly and quarterly water and effluent quantity and cost.
- 5.4 The Environmental Advisor has the responsibility to provide an annual analysis report on water management for the management review.

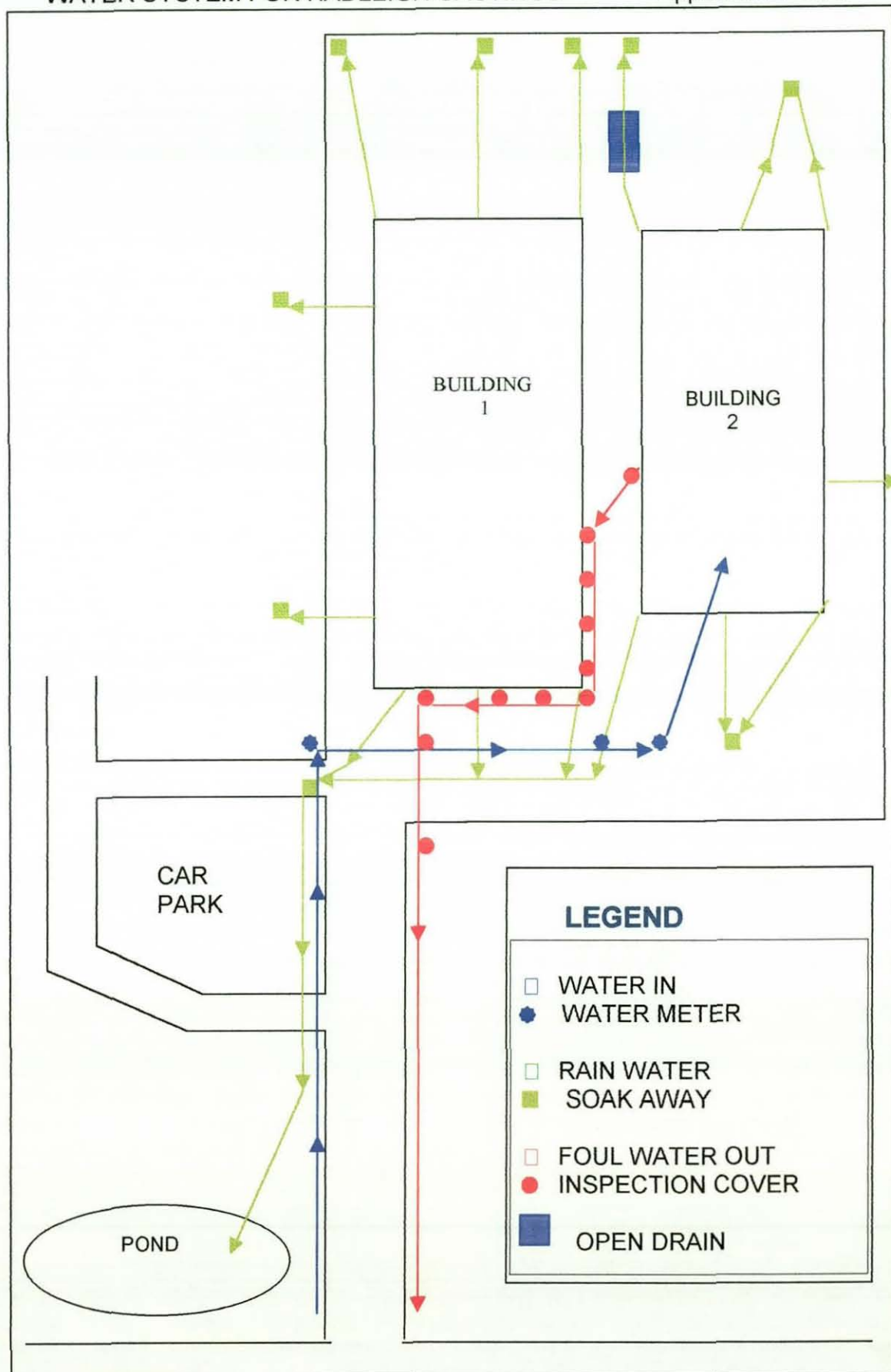
6 Training

- 6.1 The Building Maintenance Supervisor will be responsible for ensuring that training is carried out for the Plant Maintenance Engineer.
- 6.2 The purpose of the training will be to ensure that the Plant Maintenance Engineer is fully conversant with the procedure.
- 6.3 The Environmental Training Authorisation procedure will be followed.



WATER SYSTEM FOR HADLEIGH CASTINGS

Appendix EP10A





PREVENTIVE MAINTENANCE RECORD SHEET	
Documentation Ref	EP26 Preventive Maintenance Record Sheet 1 28.04.00 LR
Area Checked:	WATER MAINTENANCE CHECKLIST
Date:	
Carried out by:	
Signature:	

BUILDING NO.1

No.	Description of Item	Tick if satisfactory	Comments
	<u>Block Shop No 2</u>		No water
	<u>Gravity Die Cell</u>		
1	Water Tank	<input type="checkbox"/>	
2	Showers	<input type="checkbox"/>	
3	4 toilets	<input type="checkbox"/>	
4	6 urinals	<input type="checkbox"/>	
5	3 hand basins	<input type="checkbox"/>	
6	16 water taps	<input type="checkbox"/>	
7	8 sinks	<input type="checkbox"/>	
8	Water fountain	<input type="checkbox"/>	
	<u>Wood Repair Room</u>		
9	2 Water Tanks	<input type="checkbox"/>	
10	Drinks machine	<input type="checkbox"/>	
	<u>Ladies/Mens Toilets</u>		
11	Taps and Boiler	<input type="checkbox"/>	
	<u>Offices</u>		
12	Air Conditioning	<input type="checkbox"/>	
13	Cooling Tower	<input type="checkbox"/>	
14	3 sinks	<input type="checkbox"/>	



PREVENTIVE MAINTENANCE RECORD SHEET	
Documentation Ref	EP26 Preventive Maintenance Record Sheet 1 28.04.00 LR
Area Checked:	WATER MAINTENANCE CHECKLIST
Date:	
Carried out by:	
Signature:	

APPENDIX EP10B.2

BUILDING NO. 2

No.	Description of Item	Tick if satisfactory	Comments
	<u>Machine Shop</u>		
1	Water tap for coolant	<input type="checkbox"/>	
2	Kitchen tap	<input type="checkbox"/>	
3	Drinking Machines	<input type="checkbox"/>	
4	4 toilets	<input type="checkbox"/>	
5	4 urinals	<input type="checkbox"/>	
6	8 taps	<input type="checkbox"/>	
	<u>Quality</u>		
7	Water tank	<input type="checkbox"/>	
8	<u>Workshops</u>		
9	1 tap	<input type="checkbox"/>	
	<u>Security</u>		
10	1 tap	<input type="checkbox"/>	
11	1 toilet	<input type="checkbox"/>	
12	Inspection Cover (map)	<input type="checkbox"/>	

Appendix 14: Abbreviations

BAT	: Best Available Technology ;
BATNEEC	: Best Available Technology Not Entailing Excessive Cost ;
CCL	: Climate Change Levy ;
CH ₄	: Methane ;
CO ₂	: Carbon Dioxide ;
EEBPP	: Energy Efficiency Best Practice Programme ;
EEF	: Engineering Employers' Federation ;
ETF	: Environmental Task Force ;
ETSU	: Environmental Technology Support Unit ;
EMAS	: Eco-Management and Audit Scheme ;
EMS	: Environmental Management System ;
GS	: Greensand moulding ;
HCL	: Hadleigh Castings Limited ;
HFCs	: Hydrofluorocarbons ;
HPDC	: High Pressure Diecasting ;
IPC	: Integrated Pollution Control ;
IPPC	: Integrated Pollution Prevention and Control ;
LAAPC	: Local Authority Air Pollution Control ;
LPDC	: Low Pressure Diecasting ;
NO _x	: Nitrous Oxides ;
NO ₂	: Nitrous Dioxide ;
PFCs	: Perfluorocarbons ;
PPC	: Pollution Prevention Control Act 1999 ;
SO ₂	: Sulphur dioxide ;
SMEs	: Small & Medium Enterprises ;
UNCED	: United Nations Conference on Environment and Development ;

VOCs : Volatile Organic Compounds.

