Health and Safety Executive	**Operational Circular**
Field Operations Directorate	**OC** 433/4

To

Factory Inspectors (Bands 0-4)
RSG Specialist Inspectors (Occ Hyg) (Bands 0-3)
RSG Medical Staff

CONTROL OF EXPOSURE TO FUME AT COKE OVENS

ADVICE TO EMPLOYERS

This 2 part OC with its attached information document contains guidance for inspectors and coke oven operators and managers. It describes the process and occupational health issues arising from the generation of fume and dust at coke ovens and the appropriate control measures. The guidance for operators is presented in the form of an Information Document (ID) which may be copied to interested people outside HSE.

Brief process description

1 The coke oven is designed for the destructive distillation of 'coking' coals in order to produce metallurgical coke, usable 'by-products', eg ammonia, coal tar, benzol, naphthalene and ammonium sulphate and coal gas. Coke is produced in the UK primarily for use in blast furnaces at integrated iron and steel works. There are currently 11 coke ovens in the UK of which 7 are located on integrated steelworks sites.

2 Coke is produced in a form of regenerative 'slot' oven. Ovens are typically grouped in 'batteries' to enable efficient gas collection, fuel distribution, coal charging etc. There are several proprietary variants in use, but all fall into this broad description. A typical oven layout is shown in the diagram at the appendix. The fuel required to induce carbonisation is obtained from the recirculation of the coal gas produced in the process or at steel works by use of enriched blast furnace gas.

3 Heat transfer to the coal is achieved through conduction from the walls of the oven; heat is then transmitted through the bulk of the coal mass. The coking coals used undergo a thermal breakdown in these conditions, structurally changing to produce coke and losing, typically, some 20% of their weight as gaseous product. This gas is predominantly hydrogen and methane. Other components include carbon monoxide, nitrogen and water vapour. In addition, a variety of by-products are produced (the largest proportion of which are known as coal tar pitch volatiles (CTPVs)) which include a mixture of hydrocarbons of various molecular weights and structures. The most relevant constituents from the occupational health viewpoint are in the hydrocarbon mixture, especially the polycyclic aromatic hydrocarbons (PAHs), some of which are carcinogenic.

4 The coke battery comprises a large number of ovens, typically 50 to 80 per battery grouped in 'sections' of 15 to 20. The ovens are arranged side by side and charged and discharged on a cyclical basis, in a continual process, with gaseous products being taken off in a controlled manner to a gas handling plant.

5 Despite the controls however, significant dust and fume may leak from the battery fabric and gas emitted during charging and discharging the ovens. During these operations employees may be exposed to dust and fumes and also to the risk of skin absorption of PAHs from contact with spillages of coal or coke.

A typical coke oven battery

6 The base of the battery is normally a cellar containing the gas supply and burner arrangements. Where enriched blast furnace gas (enriched with natural gas or coke oven gas or both) is used there may be a carbon monoxide hazard. There is a regenerator heating system for storing and re-using heat to preheat combustion air. The ovens are heated from underneath and the sides via flues between the oven walls.

7 Above the cellar is a platform and the base of the ovens. The ovens are typically narrow in section but deep and vary in length. They may be referred to as a 4 metre or 6 metre oven to indicate the width of the battery and the capacity. Ovens are arrayed side by side rather like the cells of a conventional car battery (hence the name).

8 The ovens do not take up the full width of the platform. Along either side of the battery the platform extends several metres to form a bench which allows access to the sides of the ovens for 'pushing' the carbonised charge out from the 'ramside' and for receiving the discharging coke on the other side, the 'cokeside' (see diagram at the appendix). Up to 3 electrically-operated rail-mounted 'cars' operate on both sides with specialised equipment to perform their functions; a 'ram' or 'pusher car' for discharging the coke and a 'guide' car on the other (coke) side. The cars provide access to the oven doors and seals for operators both for normal operation and for dealing with leaks.

9 The 'pusher car' has an electric ram to push the coke out from the side after the door has been removed by other equipment mounted on the car. After cleaning the surfaces the door is replaced and the seal made.

10 The 'guide car' removes the oven door on the coke side, and receives and channels the coke into an electrically operated rail mounted 'coke car' run at ground level alongside and below the bench. The guide car then replaces the door and seals.

11 The charge in the coke car is then taken under the quenching tower to cool it before being tipped onto the 'coke wharf'. This is located below and outside the coke car track and serves as a final cooling area prior to release and conveying to the blast furnace bunkers or hoppers for temporary storage.

12 The next level is the battery top where the charge car operates. This is electrically operated and rail mounted. Blended coal is discharged into several hoppers on the charge cars from the conveyor-fed coal bunkers above the battery top. The charge car then moves down the line of ovens removing the lids (between 4 and 6 per oven typically) on one oven at a time mechanically either by magnets or hooks. On some ovens the lids are removed manually. Coal is charged into the oven charge holes through sleeves suspended from the car hoppers, usually in a planned sequence to minimise interference with the extraction arrangements.

13 The sleeves are adjustable and provide a good seal around the oven charge holes. After charging the lids are then cleaned, replaced and resealed. Silicate compounds are traditionally used for resealing but other compounds, eg gypsum are sometimes used. The ram on the pusher car levels off the charge of coal inside the oven from a special opening in the top of the oven door.

Door seals

14 The cast iron door frames tend to deform over time. The most common seals in use to eliminate the effects of deformation are:

(1) hand applied luting compounds which are clay based and applied by trowel between the door and frame after the door is replaced after every discharge;

(2) parallel blade seals which are mild steel strips clamped to the inside of the door by hammering them up to the door frame after the door has been replaced; and

(3) flexible seals - the Z type seal has a Z section adjusted to the shape of the door and frame by means of sprung bolts.

These mechanical seals, (2) and (3) above, may both need adjustment over time but do not require re-application after each cycle like the manually applied luting compounds.

Oven extraction/arrestment

15 The coke oven gas is extracted from the ovens by a series of ascension pipes which capture the gas and other waste materials, eg dust etc during charging and feed it into a main collector pipe. Normally charging and discharging are done 'on the main', ie with the extraction connected up to the main collector. Some coke batteries may also have cokeside fume and dust arrestment, ie an extracted hood over the guide car.

Traditionally used job titles

16 Traditionally used job titles and their functions are:

(1) *Benchman*: readies oven doors to be taken off, cleans them up for resealing and keeps the bench area clean;

(2) *Valves and lids man or valvesman (may also be known as the assistant charger man or the carbonisation operator)*; works on charge car operations and cleans up on the battery top;

(3) *Charge car operator or driver*: drives the charge car and responsible for charge car operations;

(3) *Heaterman*: looks after the burners etc, recording temperatures at the burners and on the battery top, gas pressures etc and also cleaning;

(4) *Guideman or guide car driver*: responsible for driving the guide car and oven door removal, sealing and cleaning, and monitoring and dealing with door leaks;

(5) *Ram or pusher car operator*: responsible for ram and charge levelling operations, driving the ram car, oven door removal, sealing and cleaning, and leaks.

15 July 1997

(220/FOD/130/1997)

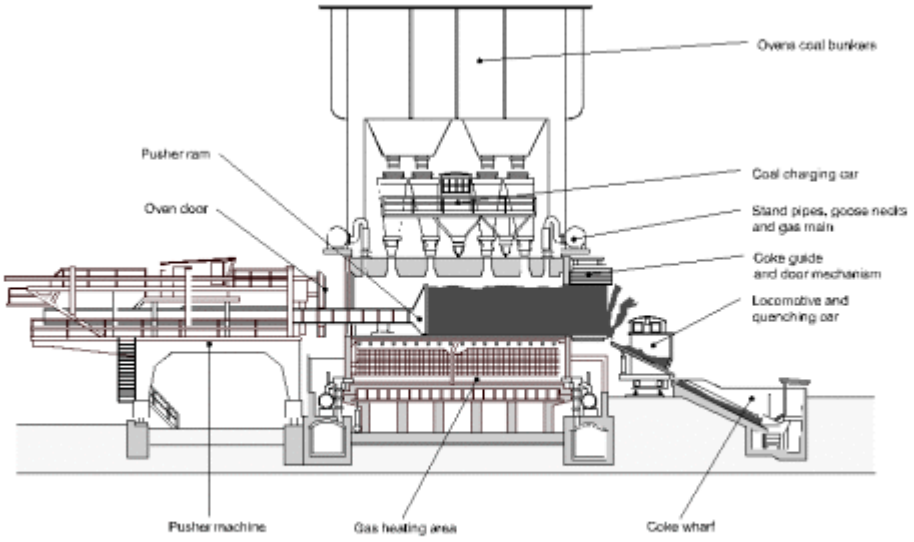
Disc ref: J:\Editors\CA1\ocfiles\433_4.sam

ASI headings

Coking ovens: Control of Substances Hazardous to Health Regulations 1994: dust: fume(s).

APPENDIX

(paras 2 and 8)



General layout of a typical coke oven

Health and Safety Executive Information Document

HSE 433/4

GUIDANCE ON SAFE OPERATION OF COKE OVENS

1 This document contains internal guidance which has been made available to the public. The guidance is considered good practice but is not compulsory. You may find it useful in deciding what you need to do to comply with the law. However, the guidance may not be directly applicable in all circumstances and any queries should be directed to the appropriate enforcing authority.

INTRODUCTION

2 This guidance deals with the occupational health issues for operators arising from the generation of fume and dust at coke oven batteries. This guidance*:*

(1) identifies the main sources of exposure to fume at coke ovens;

(2) identifies the hazards and risks presented by such fume;

(3) identifies the control and monitoring methods available to reduce these to a level which is reasonably practicable to achieve;

(4) presents an overview of the problems associated with coke oven fume, and assesses current practice; and

(5) gives practical advice to those responsible for managing coke ovens to enable them

to minimise health risks to employees and to comply with current legislation.

3 This guidance is particularly aimed at employers, managers and engineers responsible for coke oven management. Other groups, such as employees and health and safety professionals will also find this guidance useful. It does not deal with environmental pollution from coke ovens or with the corresponding legal requirements under the Environmental Protection Act 1990.

4 The situations described and the control strategies suggested will vary from site to site, but the overall approach and objective (to reduce operator exposure to harmful fumes) should be similar.

EFFECTS ON HEALTH

5 The major occupational health risk is that of lung cancer thought to be due to inhalation of the dust and fumes which contain polycyclic aromatic hydrocarbons (PAHs), some of which are known carcinogens. There is also some evidence for increased risk of death from kidney cancer (see para 52 (1)). Coal soots, coal tar, pitch and coal tar fumes are defined as carcinogens in the Control of Substances Hazardous to Health Regulations 1994 (COSHH) Schedule 8.

6 A recent study and review of uptake of PAHs through the skin shows that skin absorption may contribute significantly to the internal PAH dose measured in coke oven workers (see para 52(3)). Skin absorption effects are not peculiar to the coke battery and workers exposed to coal tars elsewhere, eg at the by-product and gas plants, may also be at risk.

7 Contact with these substances can also adversely affect the skin itself. For example 'pitch warts' are perhaps the best known effect and are attributed to direct skin contact with coal tars and pitch.

Exposure limits

8 Coal tar pitch volatiles (CTPVs) is the term used to describe the aerosol resulting from the volatilisation of coal tar and pitch materials which constitutes much of the dust and fume to which coke oven operators are exposed. The current position is that CTPV is included in HSE Guidance Note EH 40/97 Table 4 'Substances to be reviewed' and is not currently assigned a numerical occupational exposure limit (para 52(4)).

9 In practice, exposure to CTPVs may be controlled in accordance with a guidance value of 0.14 mg/m^3 8-hour Time Weighted Average (TWA), measured as cyclohexane soluble material (CSM). This guidance value is based on the previous occupational exposure standard for CTPV.

10 The COSHH Carcinogens ACoP (para 52(5)) requires that exposure should be as low as is reasonably practicable for any carcinogen. Taking this requirement in conjunction with the stringent requirements of COSHH Regulation 7 on the control of exposure to carcinogens, the guidance value should not be exceeded, and employers should aim to reduce exposure to as low a level below it as is reasonably practicable.

THE LEGAL FRAMEWORK

11 The COSHH Regulations require employers to ensure that the exposure of their employees to substances hazardous to health is either prevented or, where this is not reasonably practicable, adequately controlled. A key requirement of COSHH is for employers to carry out a risk assessment of the substances to which their employees may be exposed, and to then adopt appropriate control measures such that exposure to those risks identified is prevented or reduced so far as is reasonably practicable.

12 The 1993 amendments to COSHH included important new requirements for the control of carcinogens. Regulation 7 sets out specific control measures and maintenance requirements. The COSHH and Carcinogens ACoP gives practical guidance.

13 The general duties upon employers made under Health and Safety at Work etc Act 1974 Sections 2(1) and 3 also apply. The Management of Health and Safety at Work Regulations 1992 and The Personal Protective Equipment Regulations 1992 augment the primary legal framework designed to achieve the control of risk.

14 These Regulations underpin an occupational hygiene approach which can be summarised in the following hierarchy of measures:

(1) avoid the risk(s) where possible;

(2) substitute more hazardous substances with less hazardous substances where reasonably practicable;

(3) provide suitable engineering controls;

(4) provide safe systems of work;

(5) provide personal protective equipment if all other reasonably practicable precautions have not achieved adequate control; and

(6) provide adequate instruction, information and training to employees.

PATTERNS OF EXPOSURE

15 Monitoring exercises carried out at coke oven batteries (para 52(6)) show that the workers exposed are, in order of degree of exposure

(1) battery top workers (chargemen and charge car drivers);

(2) ram operators and coke guide men; and

(3) heatermen, pollution men and maintenance personnel.

16 Contractors personnel may also have significant personal exposures, especially if carrying out lengthy oven-top jobs, eg ascension pipe changing. They should not be overlooked when considering who may be exposed.

EXPOSURE SOURCES AND CONTROLS

17 The primary source of the PAH exposures at the coke battery is the heated coal charge within the ovens. Employees are exposed to risk when the PAHs escape from the oven into the atmosphere where employees work. The main sources of escape into the atmosphere are:

(1) open or poorly sealed oven lids;

(2) oven lids during charging operations;

(3) oven doors that are poorly sealed;

(4) oven ends during coke discharging;

(5) ascension pipes and associated 'caps';

(6) structural leakage in the battery; brickwork leaks, charge hold frame leaks etc; and

(7) coal spillages on the battery top subjected to heat.

In attempting to control these sources of exposure it is worth considering each in turn in respect of the practical causes for fume leakage and remedies available.

Oven lids

18 The basic differences in lid design are primarily in the methods of operation, ie whether they are manually or mechanically removed and re-fitted. In all cases to achieve a good oven lid seal requires adequate cleaning before re-fitting; there should be a facility to provide this whether the lid be mechanically or manually operated. The application of luting (sealing) compounds such as clay or gypsum to the lid edges may provide a better seal initially, but may also require greater cleaning effort in continuous use; this should be considered when choosing to use sealants. Any sealant used should not itself give rise to PAH generation when subject to heat.

Oven charging operations

19 Oven charging operations present probably the greatest single source of exposure. Charging operations should be 'on the main', ie with the oven connected to the main extraction system, should be 'sequential' where oven design allows, and should be carried out as quickly as practicable. Sleeves from the charge hoppers on the charge car to the charge holes on the oven tops should be used wherever practicable. Sleeves should be adjusted to provide a good seal around the charge holes. Fume emission control equipment associated with the charging operation should be designed and maintained to minimise operator exposure and reduce overall atmospheric pollution. Charging equipment and methods of work should be designed to minimise spillages; coal spilled in the charge hole area during charging should be cleared up as soon as possible.

20 Good design of charging car equipment particularly hoppers, can significantly reduce worker exposures. In fully automated charging cars air-conditioned control cabs which provide filtered air to the operator can make a considerable contribution to reducing overall operator exposure, and can greatly reduce the need for respiratory protective equipment (RPE). This approach is an engineering solution that can be achieved on most batteries.

21 Whatever systems of work and charging equipment are in use, it is essential that workers are properly trained and supervised.

Coke oven doors

22 Poor coke oven door seals are a major source of fume leakage. Various designs of door seal are in use and continue to be developed. The precautions in paras 23-26 below will be common to all of these designs.

23 Door seals should be designed and constructed so as to maintain an effective seal in conditions of arduous use and to cope with the thermal distortion of the cast iron door frames over time.

24 The key objective is adequate maintenance of seals and their corresponding sealing surfaces on the oven. Regular maintenance and cleaning are essential as leaks will accelerate further deterioration of the door seal. This is particularly important at 'luted' type doors where the seals are

manually replaced after each charging or discharging cycle.

25 Leaks which ignite will significantly increase the rate of thermal distortion. A high level of maintenance is required and a routine programme of door maintenance should be initiated. 'Door maintenance stations' should be set up holding an adequate stock of replacement doors and seals to ensure proper maintenance schedules can be achieved and maintained.

26 Tar and debris from the ovens also accumulates at the door and on the seals, and workers may be exposed while working at or on the oven doors. For example the 'benchman' may be exposed while cleaning up after door-opening.

Coke discharging

27 Very heavy short-term exposures are possible during coke discharge or 'pushing'. Control measures available for this rest primarily on ensuring that:

(1) the charge is sufficiently carbonised; and

(2) the environmental pollution arrestment equipment provided is properly maintained.

28 To ensure the charge is sufficiently carbonised good overall management of battery heating and pushing schedules, coupled with proper control of coal blend composition is necessary. Properly designed and adequately maintained pollution arrestment gear will greatly aid controlling fumes that are generated. The degree of exposure is time-based and employers should plan their risk reduction programme accordingly. Anything that lengthens the time taken to push an oven will potentially increase exposure. For example, poor coal blends, or under or over-carbonisation may lead to 'stickers', where the charge adheres to the oven sides and cannot be easily pushed out by the ram.

Ascension pipes and caps

29 The pipes and caps can contribute to the overall exposure levels on the battery top and are a specific source of exposure to maintenance personnel. A maintenance regime which prevents the escape of fume is a key control measure. Water sealed ascension pipe caps should be fitted wherever practicable as these greatly reduce the potential for fume escape from caps. Any valves and valve spindle gear associated with the ascension pipes such as Pullman valves etc, should have fume tight seals.

Structural leakage

30 Battery age and operating conditions will largely determine the amount and type of any structural leakage from areas such as brickwork or door jambs. Whatever the battery history has been or whatever damage has been caused by thermal effects, appropriate maintenance and repair regimes should be applied. Structural leaks, even from sides of batteries, will significantly increase the overall operator exposure on the battery top due to rising fume. This also applies to charge hole frame leaks.

Coal spillages on the battery top

31 Keeping the battery top clean of coal spillage is essential to minimise the 'background' generation of dust and fume. Coal which is left on the hot battery top after charging can be a substantial source of fume as it thermally decomposes. Strict and properly resourced cleaning regimes should be in place, with arrangements for cleaning up both routine minor deposits and more substantial spills that may occur.

32 Cleaning operations should be carried out as speedily as possible after any coal spillage to reduce the time available for thermal decomposition.

FURTHER PRECAUTIONS

Personal protective equipment (PPE)

33 The primary aim should be to minimise operator exposure to dust and fume by engineering controls; this is the expression of good occupational health practice and is a requirement of COSHH. However, existing coke oven battery designs may limit the ability to achieve control to below the present guide figure of 0.14mg/m^3 CSM and some form of RPE for dust and fume, together with suitable protective clothing to prevent skin contact will normally be required to augment the engineering controls.

34 The COSHH Regulations and the Personal Protective Equipment at Work (PPEW) Regulations 1992 set out the criteria for the provision and use of such PPE. These Regulations require that such equipment be 'suitable' for the intended use and provide protection to an appropriate standard. One particular device which fulfils each of these criteria effectively is the powered particulate respirator with a classification of THP2 incorporating head and eye protection. This type of device has been in universal use at coke ovens and remains the most practicable type of RPE that can provide the necessary protection in the prevailing circumstances. It should be noted that this form of RPE normally only protects against dust and fume and is not suitable as protection against vapours unless special filters are fitted (see HSE guidance on RPE referred to in para 52(10): HS(G)53 page 5). Where benzene or other vapours are present at significant levels this additional protection may be necessary.

35 To adequately protect employees from CTPV exposures on coke battery work it will be necessary to provide powered respirators with a classification of THP2 to comply with the strict control of carcinogen requirements in COSHH. New designs of coke ovens should include better engineering control of dust and fume to reduce the dependence on the use of RPE in the future.

36 Suitable protective clothing, eg overalls and gloves, should be provided to protect against skin contamination and the risk of developing skin conditions such as 'pitch warts', and the absorption of PAHs into the body.

37 An essential feature of any control measures which include the protection provided by PPE is the instruction, training and information given to those using the equipment; employees should be properly trained in the correct use of the RPE provided and made aware of its purpose and limitations. Periodic refresher training should be provided. The potential consequences to their health from failure to properly use the PPE provided should form an important part of workers' training and instruction.

38 The RPE and protective clothing provided to employees will need suitable cleaning, maintenance and storage facilities; these are legal requirements. Provision should be made to replace damaged or lost equipment and to provide for any additional 'emergency' PPE and RPE that might be needed, eg for maintenance staff, contractors etc.

39 Short term visitors to the battery, if given appropriate training and supervision, may be adequately protected by suitable, properly fitted, disposable dust mask type RPE (of an approved type with an equivalent classification: FFP2). The duration of exposure should be sufficiently short, less than one hour's continuous use, and suitable head and eye protection should be worn with the mask.

40 The supervisory and management difficulties this 'dual standard' provision may create should be carefully considered before choosing this option. Managers and supervisors should consider

carefully the example that they set for other employees even when making only short visits to the battery. Problems of comfort and maintaining an adequate fit will also arise if disposable masks are worn for more than short periods.

Monitoring

41 To ensure the control measures are being effectively maintained their performance will require monitoring. The visual method proposed by the British Carbonisation Research Association for pollution monitoring (see para 52(9)) is used for this purpose. It was fully endorsed by the UK coking sector and Her Majesty's Inspectorate of Pollution, as it then was known) and it is a criterion of authorisation to operate that all coking works employ it.

42 This method can be used to measure the effectiveness of the controls in place to reduce leakages of dust and fume from fixed sources on the battery. It enables over-all performance trends to be tracked. It should be noted however that this methodology makes no provision for measuring such things as housekeeping standards or the use of RPE; other audit measures will be required to monitor these. In addition COSHH requires employers to set up a suitable personal sampling regime for monitoring workers' exposure to CTPVs.

HEALTH SURVEILLANCE

43 Suitable health surveillance will be required for employees exposed to potentially carcinogenic substances through inhalation of CTPVs, or absorption through the skin of substances such as coal tars (see COSHH Carcinogens ACoP, paras 18-21). The health surveillance requirement for exposure to carcinogenic dust and fume is limited to keeping a suitable health record as specified in the COSHH ACoP Appendix (page 54).

44 To monitor the possible effects of skin exposure 'regular skin inspection by a suitably qualified person, or, alternatively, regular enquiries about any symptoms, following self inspection by the employees concerned.' (COSHH Carcinogens ACoP, para 19) will be required and suitable health records should be kept.

HYGIENE AND WELFARE ARRANGEMENTS

45 Providing suitable hygiene and welfare arrangements is critical to establishing and maintaining good personal hygiene standards amongst employees.

46 Hygiene measures include providing:

(1) clean facilities for eating, drinking[1] and smoking separate from contaminated work areas;

(2) adequate and accessible washing and hygiene facilities including showers;

(3) suitable clothing accommodation facilities to prevent contamination spreading from dirty to clean clothing;

(4) suitable cleaning/laundering arrangements for contaminated clothing;

(5) adequate cleaning and maintenance of RPE

Above all, to secure good personal hygiene practices, it is essential to provide adequate information, instruction and training for employees.

47 Exposing skin to PAHs (from contact with spillages etc) significantly contributes to the internal PAH dose in coke oven workers. This dose can be substantially reduced by, prior to starting work, putting on clean underwear (pants and shirt), a clean pair of socks, a clean pair of gloves, and a clean pair of overalls; and washing before breaks.

48 Personal hygiene and regularly cleaning and changing clothing, and cleaning and maintaining RPE is crucially important. Health surveillance (see para 49(10)) and observing the cleanliness of workers' clothing and RPE will enable employers to judge whether the current cleaning and changing intervals represent adequate control of exposure or not.

PRACTICAL REQUIREMENTS AND STANDARDS: SUMMARY

49 Employers should be looking to provide the following as minimum requirements to reduce risks to employees and achieve compliance with the law:

(1) engineering controls as described in paras 18-32 so far as is reasonably practicable, and adequate maintenance and monitoring of such controls;

(2) systems of work devised to reduce the generation of dust and fume and adequate resource and supervision to minimise spillages of coal and deal with them promptly if they occur;

(3) a suitable respiratory protection regime in the form described in paras 33-40;

(4) suitable protective clothing to minimise skin contamination, combined with training in good personal hygiene practices, and arrangements for the regular cleaning and laundering of clothing (see paras 33-40 and 46-49)

(5) a maintenance, cleaning and monitoring regime to ensure that primary sources of dust and fume such as oven doors, lids, charge car gear, ascension pipe caps and pollution arrestment gear function properly at all times;

(6) training that provides employees with information on hazards and risk, and a management structure that ensures adequate supervision;

(7) periodic personal monitoring, ie using appropriate personal sampling programmes to demonstrate controls are actually effective in achieving their purpose;

(8) monitoring that provides a record of performance that can be used to audit and manage the overall control measures used;

(9) a suitable health surveillance program with associated recording systems; and

(10) suitable welfare facilities that allow eating and drinking away from the work area; a good, clean, well maintained showering provision and storage for clean clothes, work overalls etc.

FUTURE DEVELOPMENTS

50 The design, construction and operation of any new coke oven battery, or significant modifications to existing batteries, should take into account the potential health risks associated with respiratory exposures to CTPVs and skin exposures to coal tar and pitch. The occupational health exposure prevention hierarchy referred to above will need to be considered; in particular there should be greater attention paid to the achievement of control by engineering rather than PPE measures.

Improvements in RPE performance should not be allowed to dilute efforts on the engineering controls. Significant alterations to existing ovens should also address this protocol for control.

51 Environmental Protection Act requirements will of course also need to be considered at the design stage and reference should be made to the relevant Secretary of State's Guidance Notes.

REFERENCES

52 Information on the publications mentioned in this document are listed below:

(1) All studies up to 1992 are reviewed in HSE Toxicity Review 28: *Cancer epidemiology in coal tar pitch volatile-associated industries*.

(2) From BS EN 146:1992 *Respiratory Protective Devices: Specification For Powered Particle Filtering Devices Incorporating helmets or Hoods*. See also the HSE Guidance booklet HS(G)53 *Respiratory Protective Equipment: a practical guide for users* (Reference given below).

(3) *Annals of Occupational Hygiene*, 38(3), pp247-256, 1994. Van Rooij, J G M, Bodelier-Bade, M M, Hopmans, P M J, and Jongeneelan, F J

(4) HSE Guidance Note EH 40/97 *Occupational exposure limits* HSE Books

ISBN 0 7176 1315 1.

(5) L5 *General COSHH ACoP and Carcinogens ACoP* HSE Books

ISBN 0 7176 0819 0.

(6) Results from recent joint HSE/British Steel sampling exercise (unpublished).

(7) The Management of Health and Safety at Work Regulations 1992.

(8) The Personal Protective Equipment at Work Regulations 1992.

(9) *The assessment of smoke leakage from coke-ovens during carbonisation, an agreed uniform technique*: British Carbonisation Research Association (BCRA) Special Publication 19: Chesterfield 1977. Please note: this publication is available from BCRA Scientific and Technical Services Ltd, Mill lane, Wingerworth, Chesterfield, Derbyshire S42 6NG; methods of measuring charging and pushing emissions are also available from BCRA Ltd and are in use on some coke ovens. The Environment Agency is currently in the process of arranging for the reissue (under its own cover) of the published methods for monitoring pushing, charging and smoke leakage.

(10) HS(G)53: *Respiratory protective equipment: a practical guide for users*: HSE Books ISBN 0 11 885522 0.

(11) *Practical suggestions for the reduction of the emission of smoke, dust and grit at coke ovens* BCRA Special publication 5, 3rd Edition, Chesterfield 1974 (available as above: Ref. 9).

July 1997

1 Note: the risk from heat stress to some coke oven employees needs to be balanced against the risk of ingestion of contaminated water from drinking water installations. The risk from heat stress may in some cases be the greater health risk and therefore drinking water can, in some circumstances, be made available in working areas provided that scrupulous attention is paid to the cleanliness and suitability of the installation, eg a covered facility or upward drinking fountain, and that good hygiene practices are adopted for drinking. The relevant risk assessment will need to justify any such decision.