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About the Inventory of Sources and Releases (ISR)

Making information about the environment public is central to the work of the Environment Agency. We are committed to providing the public with clear, consistent information on substances produced by industry which

- may be released to air, water or land, and
- have been identified as associated with health and /or environmental effects.

In November 1998 the Agency issued a change to existing IPC authorisations requiring those industrial processes covered by IPC to report under a standard group of conditions. All existing IPC authorisations for processes prescribed under The Prescribed Process and Substances Regulations (SI 472 1991 as varied) were varied, using an Environmental Protection Act 1990 (EPA 90) Section 10 notice, to include a condition requiring the annual reporting (for ISR purposes) of releases of certain substances and categories of substances. All new processes authorised under IPC have the ISR conditions as terms of their authorisation.

Background to the ISR

The Chemical Release Inventory (CRI) was set up in 1990 to compile reports of releases from industrial processes and fulfil part of the UK Government's commitment to make environmental information more widely and readily available. As the CRI developed significant limitations were identified in its use. The Agency held a seminar for industry and NGOs in June 1997. Comments made at that seminar were incorporated in a consultation document which took account of the Agency's commitment to review the lists of substances and to make the inventory as consistent as possible with the likely demands of the EU Integrated Pollution Prevention and Control (IPPC) Directive. In November 1997 the Environment Agency launched an extensive consultation exercise with government, industry and other interested organisations on proposals to improve the consistency of reporting in the CRI.

Following the consultation exercise the Agency reviewed its proposals and implemented the changes to the CRI under the new name of the Inventory of Sources and Releases (ISR). *The Inventory of Sources and Releases – Conclusions of Consultation* includes both the comments received and the Agency's responses to the consultation exercise. It is available upon request from the Environment Agency.

What the ISR reporting process means for Industry

The ISR provides information on

- annual mass releases of specified substances to air, water and land
- the mass of special and/or non special wastes which arise from any part of a process covered by IPC regulations

It will therefore record information about emissions from the entire process such as

- defined release points (point sources)
- non-point sources and fugitive emissions from sources such as processing, transfer, storage, maintenance and cleaning.

You will have to send us annual returns

- using an ISR reporting form
- giving details of substances released into the environment as a result of the operation of the Authorised process during the previous year
- by 31 January each year (for example forms for 1999 will be needed by 31 January 2000)

If more time is required to provide the information you should make a case to the local Environment Agency Office. We may extend the deadline by up to 2 months.

The substances to be considered are listed in the ISR reporting form published by the Agency. This Form also contains standard tables to be used for reporting all these substances. The reporting is to be on paper with the possibility of providing the data in an electronic format at a later date.

On sites which include non-IPC processes, the releases relating to non-IPC operations do not require inclusion on the ISR reporting form at present.

You do not need to perform additional monitoring in order to complete the ISR reporting form, but you must report the most accurate release quantities available to you and the means by which the releases have been determined. As a result, you may have to perform additional calculations and/or estimations. Possible methods for these are explained in "Measurement, calculation and estimation" on page 11. You must record in writing any derivations and/or assumptions made in obtaining the release quantities and keep your records for at least 4 years.

Any existing additional reporting conditions within an authorisation for substances not on the ISR reporting form for that medium, continue in place and the level of release must still be reported to the Agency. Any query with regard to these reporting needs should be raised with the local Environment Agency office.

Guidance on providing this information is given below. Please provide the most accurate figures achievable with the time and resources available. When you have completed the ISR reporting form you should send it to the reporting address in your authorisation.

You must send the original and 2 copies of the form to us and keep a further copy for your own records.

The Pollution Inventory

The information held on the ISR is being turned into a standard record of releases from IPC processes in England and Wales, as the first stage in producing a more comprehensive Pollution Inventory.

The Environment Agency's Pollution Inventory was launched in May 1999 and will eventually cover a wide range of industrial processes and releases. Whilst reporting for the Pollution Inventory is currently only collected under the ISR there are plans under way to extend the range of processes to

- sewage treatment works
- landfill sites
- other industry that will be regulated under the IPPC Directive.

The principal objectives of the Pollution Inventory are to

- provide the public with more information about the releases from industrial processes
 - in their local area and nationally
 - by conventional and electronic means
- enable environmental regulators to be more effective in protecting the environment
- enable the government to meet its commitments and obligations.

The Environment Agency has set up a Pollution Inventory Advisory Committee to consult externally and recommend changes to the Pollution Inventory. It includes representatives from industry as well as non-government organisations (NGOs), environmental regulators and government departments.

Disclosing information you give us in the ISR reporting form

The information you provide us with will be made public

- on www.environment-agency.gov.uk
- at each of the Agency's Regional offices

and will be used in the Agency's State of the Environment reporting.

Information that is 'commercial in confidence'

Part 1 of the ISR reporting form allows you to say if you consider that some or all of the information provided is considered to be commercially confidential.

It allows you to mark the information which you consider confidential, by ticking boxes against release data, or to apply for blanket confidentiality of all the data you supply. If you want to claim commercial confidentiality you must say so on the form **even where the Environment Agency has**

previously accepted any claim for confidentiality in respect of the release information now being supplied.

Any claim will be deemed as a claim under Section 22 of the EPA 90. You must include a justification for listing the substance as commercially confidential. If you fail to provide this justification the claim is likely to be rejected. Where we determine that the information is not commercially confidential we will tell you. We will then wait 21 days before entering the information onto the public register (and releasing it via the ISR). During this time you may appeal against the decision to the Secretary of State.

Further help or queries

If you require any further assistance once you have read the relevant documentation, then please contact the local Environment Agency office referred to in your authorisation.

Completing the ISR reporting form

The ISR reporting form is divided into five parts:

- Part 1 – About the report
- Part 2 – Releases to air
- Part 3 – Releases to sewer
- Part 4 – Releases to controlled water and land, and
- Part 5 – Disposal, recovery or reuse of wastes.

If an authorised process does not have any release to air, sewer, or controlled waters this should be stated on Part 1 (About the report) of the ISR reporting form. It is then unnecessary to complete the part of the form that is relevant to: Releases to air (Part 2); Releases to sewer (Part 3); or Releases to controlled waters and land (Part 4) as appropriate to the statement made in Part 1.

The substances are presented in alphabetical order in respect of Parts 2 to 4 and **an entry is required for each and every substance listed**, in the 'Total release (including notifiable releases)' column. You must put either release data, 'NA', or 'BRT' in each box.

Release – where a release occurs the amount released should be reported as a mass in metric units (see 'Mass units' below).

NA – not applicable where no release of this substance occurs to that medium this should be entered on the ISR reporting form as N/A.

BRT – below reporting threshold level where the release has been determined and is found to be below the indicated annual reporting level thresholds this should be entered on the ISR reporting form as BRT. The threshold reporting levels for a given substance to a particular medium are outlined in the ISR reporting form for each individual substance to the medium concerned.

Mass units

For reporting releases on the ISR you should use one of the following metric units:

kt kilotonnes t tonnes kg kilogrammes
g grammes mg milligrammes

Significant figures

The Agency recommends that two significant figures are used when reporting on the released amounts and off site transfer quantities. All digits other than zero are always considered significant. A zero may be significant depending on its position relative to other digits.

The following rules apply:

1.1 has two significant figures

1.0 has two significant figures

0.11 has two significant figures

0.01 has two significant figures

When rounding figures to achieve two significant figures, round up from the number 5 or above, and down from the figure 4 or below, for example:

1.55 would be rounded up to 1.6

1.54 would be rounded down to 1.5

1.35 would be rounded up to 1.4

Reporting of 'notifiable releases'

Notifiable releases are unplanned and unauthorised releases of a particular substance or substances to the environment. Such a release may be as a result of an emergency, mis-operation, accident or plant failure.

In these cases the authorisation requires the operator to provide the Agency with a specific notification, followed by specific information on the release (in most authorisations this information will be specified in Part A and Part B of a Schedule or Annex). If a notifiable release of a substance was made during the year, for example as a result of an emergency, mis-operation, accident or plant failure, the amount released during that event should be quantified and detailed in the 'Notifiable release' column.

Reported releases should be estimated based on the quantity released to the environment. The operator should report only the quantity released and try to estimate the media the loss is made to.

The reporting threshold does not apply to notifiable releases and so any notifiable release should be listed on the form.

Examples of notifiable release

Spillage

Spillage of 30 tonnes of cleaning solvent – consider the fate of the spilled substance.

- Not reported in the 'Notifiable release' section:
 - 10 tonnes of solvent recovered for reuse.
- Reported in the 'Notifiable release' section (estimates using engineering calculations etc), loss to:
 - air, 2 tonnes
 - land (in releases to controlled waters section), 14 tonnes
 - controlled waters (R), 4 tonnes.

Fire

Accidental fire in skip of combustible waste for landfill.

Combustion of 60 tonnes of waste wood.

- **Loss to air** (reportable release under 'Notifiable release'). Use emission factors to estimate pollutant release to atmosphere during incident (reportable release under 'Notifiable release').

Substances released to air

1 Nitrogen oxides and sulphur dioxide

The EU Large Combustion Plant Directive requires member states to report on sulphur dioxide and nitrogen oxide emissions from combustion installations.

The mass released for LCPD is not necessarily the same as the mass released for the whole process.

We will already have contacted anyone who operates these installations. If you are affected you should report releases in Part 2 of the ISR reporting form in

- 1 the sulphur dioxide and nitrogen oxides rows and also
- 2 the 'LCPD' rows beneath each of these. Note that the LCPD emission figure has no minimum reporting value – you must report your total emission whatever its value.

If you have any questions about LCPD contact your local Environment Agency.

2 Total volatile organic compounds (VOCs)

The term volatile organic compounds (VOCs) covers a wide range of substances. VOCs are a principal component in atmospheric reactions that form ozone and other photochemical oxidants. The term VOC is not a precise one and various definitions exist. VOCs covers a range of substances with greatly differing environmental impacts. They are a principal component in atmospheric reactions that form ozone and other photochemical oxidants.

The United Nations Economic Commission for Europe (UNECE) has adopted the following definition:

'For the purposes of the VOC protocol, volatile organic compounds means all organic compounds of anthropogenic nature other than methane that are capable of producing photochemical oxidants by reactions with nitrogen oxides in the presence of sunlight.'

For the purpose of this guidance, and when completing the ISR reporting form, volatile organic compounds are defined as:

Definition of volatile organic compound

Any organic compound released to the atmosphere from the operator's plant or process, but **excluding** releases of:

- naturally produced volatile organic compounds from within the plant boundary
- methane (which is a non reactive compound and is therefore not classified as a VOC).

Other organic compounds with negligible photochemical reactivity are also excluded from being classified as VOCs.

Reporting of volatile organic compounds on the ISR reporting form

Groups of organic compounds and total VOC

In the section of the ISR reporting form marked 'Groups of organic compounds', releases of the compounds should be reported as total organic carbon, unless otherwise stated. The 'total of all volatile organic compounds' in this section must include **all the VOCs** that have been reported on the ISR reporting form and should also be reported as total organic carbon. The example below shows how to report compounds as total organic carbon.

Example of reporting in terms of total organic carbon

500 g of benzene and 1,3-butadiene were released from a plant during the year.

Organic carbon released during the year from each compound would be:

$$\begin{aligned} \text{For benzene (C}_6\text{H}_6) &= (6 \times 12) / ((6 \times 12) + (6 + 1)) \times 500 \\ &= (72 / 78) \times 500 \\ &= 462 \text{ g of organic carbon} \end{aligned}$$

$$\begin{aligned} \text{For 1,3-butadiene (C}_4\text{H}_6) &= (4 \times 12) / ((4 \times 12) + (6 + 1)) \times 500 \\ &= (48 / 54) \times 500 \\ &= 444 \text{ g of organic carbon} \end{aligned}$$

Total organic carbon released during the year from would be:

- = 462 g of total organic carbon + 444 g of total organic carbon
- = **906 g of total organic carbon**

3 Named organic compounds

On page 3, Part 2 of the ISR reporting form, the section headed 'Named organic compounds', releases of the compound should be reported as the total mass of the compound (unless otherwise stated) as opposed to the total mass of carbon.

VOC speciation

Where no other detailed species data is available for process emissions for a particular industry the National Atmospheric Emission Inventory (NAEI) speciation database can be used. This database contains species profiles for a number of industrial processes likely to release VOC.

To use this dataset the operator needs:

- Estimate of annual total VOC release (t/year)
- Process details of emitting process

The current industrial process species profiles are listed in the NAEI database. You can get a copy from the Environment Agency.

Using the NAEI database:

STEP 1 Data access:

The database will be held by the Environment Agency and specific data will be provided on request by the Local Inspector.

STEP 2 Data format and sources:

Output data from the database will give a specific VOC species as a fraction of total VOC. The profiles have been prepared for the National Atmospheric Emissions Inventory. The dataset includes data collected from UK trade associations, the USEPA and EMEP/CORINAIR.

STEP 3 Calculation:

Species (for example benzene: t/year) = Total VOC release (t/year) * benzene fraction
4 polycyclic aromatic hydrocarbons (PAHs).

4 Polycyclic aromatic hydrocarbons (PAHs)

The ISR reporting form requires operators to report on the total polycyclic aromatic hydrocarbon (PAH) release from the authorised process. The relevant PAHs are listed in Table 1.

Table 1: PAHs to be considered when calculating total PAH releases

PAH	CAS Number	Molecular mass (g)
Anthracene	120-12-7	178.24
Fluorene	86-73-7	166.23
Naphthalene	91-20-3	128.18
Phenanthrene	85-01-8	178.24
Benzo[ghi]perylene	191-24-2	276.34
Acenaphthylene	208-96-8	152.20
Acenaphthene	83-32-9	154.20
Fluoranthene	206-44-0	202.26
Pyrene	129-00-0	202.26
Chrysene	218-01-9	228.30
Benzo[a]anthracene	56-55-3	228.30
Benzo[b]fluoranthene	205-99-2	252.32
Benzo[k]fluoranthene	207-08-9	252.32
Benzo[a]pyrene	50-32-8	252.32
Dibenz[ah]anthracene	53-70-3	278.35
Indeno[1,2,3-cd]pyrene	193-39-5	276.34

For the purpose of reporting on total PAH, operators should include the chemicals listed in Table 1 and provide a total mass expressed as benzo[a]pyrene by using the following approach:

STEP 1: Calculate moles of each relevant PAH in Table 1 released to air

$$\frac{\text{concentration of individual PAH measured (ng/m}^3\text{)}}{\text{molecular mass of the relevant PAH (g)}} = \text{moles of that PAH} \times 10^{-9}/\text{m}^3$$

STEP 2: Calculate total number of moles of PAHs released

Add together the moles/m³ of each PAH measured to obtain the total moles of PAH /m³ emitted.

STEP 3: Calculate the total mass of PAH released as benzo[a]pyrene

$$\text{total mole/m}^3 \text{ of PAH} \times \text{molecular mass of benzo[a]pyrene} \times \text{m}^3 \text{ released per annum} = \text{total mass of PAH as benzo[a]pyrene released per annum.}$$

Alternative mechanisms for the reporting of total PAH should be discussed the your local Environment Agency Office.

5 Benzo[a]pyrene

The only PAH reported individually on the ISR reporting form is benzo[a]pyrene. It should be noted that benzo(a)pyrene unlike all the other individual chemicals in the named organic compounds section has a threshold reporting level of 100 g rather than 100 kg.

6 Dioxins

Dioxins are a family of compounds known chemically as polychlorinated dibenzo-para-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs).

Each compound is made up of two benzene rings interconnected by oxygen atoms.

Each individual PCDD or PCDF is termed a congener (there are 210 congeners in total). For the ISR you should base the total quantity of dioxins on congeners of only PCDD and PCDF with chlorine atoms in the 2, 3, 7 and 8 positions (which are of particular environmental concern).

The 17 PCDD and PCDF congeners with chlorine in the 2, 3, 7 and 8 positions are listed below.

Congener	I-TEF
2, 3, 7, 8-TCDD	1
1, 2, 3, 7, 8-PeCDD	0.5
1, 2, 3, 4, 7, 8-HxCDD	0.1
1, 2, 3, 7, 8, 9-HxCDD	0.1
1, 2, 3, 6, 7, 8-HxCDD	0.1
1, 2, 3, 4, 6, 7, 8-HpCDD	0.01
OCDD	0.001
2,3,7,8-TCDF	0.1
2, 3, 4, 7, 8-PeCDF	0.05
1, 2, 3, 7, 8-PeCDF	0.05
1, 2, 3, 4, 7, 8-HxCDF	0.1
1, 2, 3, 7, 8, 9-HxCDF	0.1
1, 2, 3, 6, 7, 8-HxCDF	0.1
2, 3, 4, 6, 7, 8-HxCDF	0.1
1, 2, 3, 4, 6, 7, 8-HpCDF	0.01
1, 2, 3, 4, 7, 8, 9-HpCDF	0.01
OCDF	0.001

I-TEF – International toxicity equivalent factor, T – tetrachloro, Pe – pentachloro, Hx – hexachloro, Hp – heptachloro and O – octachloro

While a number of toxicity rating schemes have been developed for dioxins, the scheme that has been internationally adopted, and should be used for the ISR reporting form, is that of NATO/CCMS (1988), under which the toxicity equivalent factors (TEFs) are termed international TEFs, or I-TEFs.

The 2, 3, 7, 8-TCDD isomer is the most toxic, and by convention is assigned a TEF of 1.0. The remaining 2,3,7,8-positional congeners are then assigned lower TEFs, relative to that of 2,3,7,8-TCDD. The toxicity mass of a particular substance relative to 2,3,7,8-TCDD, can then be expressed by multiplying the mass of those 2,3,7,8-positional congeners present in the mixture by their respective TEFs. The resulting products are called toxic equivalents (TEQs), with units identical to that in which the individual congeners are expressed. For ISR purposes this is mass.

See congener list above for PCDDs and PCDFs with chlorine atoms in the 2, 3, 7 and 8 positions and their I-TEFs.

For the ISR reporting form you must provide the total quantity of dioxins and furans in terms of their international toxic equivalents (I-TEQs).

The I-TEFs for the 17 2,3,7,8-positional congeners of PCDDs and PCDFs are presented in the table above.

All other congeners that may be present in a sample are assigned a TEF value of 0.0 and so are not reportable as dioxins on the ISR reporting form.

The I-TEQ of the mixture is obtained by summing the individual I-TEQs using the following approach:

STEP 1: Calculate the I-TEQ for each congener released

Multiply the concentration (per m³) of each released congener by its I-TEF to provide the I-TEQ

STEP 2: Calculate the total I-TEQ released

Add together the I-TEQs of all the congeners released.

7 Polychlorinated biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) are a group of 209 chlorinated organic compound.

The UK Committee on Toxicity has recommended 13 PCB congeners as a priority, which may have a dioxin like effect, and these are listed below.

Table 2: PCBs and their toxic equivalent factors (I-TEFs)

PCB IUPAC Number		TEF
77	33'44'TCB	0.0005
126	33445PeCB	0.1
169	33'44'55'HxCB	0.01
mono-ortho		
105	233'44'PeCB	0.0001
114	2344'5PeCB	0.0005
118	23'44'5PeCB	0.0001
123	2'344'5PeCB	0.0001
156	2'33'44'5HxCB	0.0005
157	233'44'5'HxCB	0.0005
167	23'44'55'HxCB	0.00001
189	233'44'55'HpCB	0.00001
di-ortho		
170	22'33'44'5HpCB	0.0001
180	23'344'55'HpCB	0.00001

The ISR reporting form requires an estimate of the total PCB release to air where it exceeds the threshold level, based on the thirteen substances listed in Table 2. All PCBs other than those listed in Table 2 are assumed to have a TEF of zero and so are not reportable within the total PCBs on the ISR reporting form. The ISR reporting form requires this value for PCBs, like that for dioxins, in terms of its toxic equivalent (TEQ).

The same principle as for dioxins applies and the TEQ for an individual substance is obtained using the following approach:

STEP 1: Calculate the TEQ for each PCB released

Multiply the concentration (per m³) of each PCB released by its TEF to provide the TEQ.

STEP 2: Calculate the total TEQ released

Add together the TEQs of all the PCBs released.

The figure for PCBs released to air will be the sum of the individual TEQs.

8 Halogenated fluorocarbons

There are five groups of halogenated fluorocarbons we need to know about.

Chlorofluorocarbons CFCs

This refers to the general class of halogenated organic compounds based on methane and ethane, in which all of the hydrogen atoms have been fully substituted with either chlorine or fluorine atoms.

Halons

This refers to the general class of halogenated organic compounds based on methane and ethane, in which some of the hydrogen atoms have been substituted with chlorine or fluorine and at least one other halogen species. In practice this means that a halon will contain bromine atoms in addition to hydrogen, chlorine or fluorine atoms. There are other possible definitions for halons that may not agree with the above definition, but operators should calculate the levels for release of halons using this definition.

Hydrochlorofluorocarbons HCFCs

This refers to the general class of halogenated organic compounds based on methane and ethane in which some of the hydrogen atoms have been substituted with either chlorine or fluorine atoms.

Hydrofluorocarbons HFCs

This refers to the general class of halogenated organic compounds based on methane and ethane in which some of the hydrogen atoms have been substituted with fluorine atoms.

Perfluorocarbons PFCs

This refers to the general class of halogenated organic carbons based on methane and ethane in which all of the hydrogen atoms have been substituted with fluorine atoms

Table 3: Types of halogenated fluorocarbons

Acronym	Name	Composition
CFC	chlorofluorocarbons	chlorine + fluorine + carbon only
	halons	fluorine +/-or chlorine + carbon + one other halogen
HCFC	hydrochlorofluorocarbons	hydrogen + chlorine + fluorine + carbon only
HFC	hydrofluorocarbons	hydrogen + fluorine + carbon only
PFC	perfluorocarbons	fluorine + carbon only

9 Other substances

For this section of the form we need details of any individual substances described within the following groups that are released in quantities above the stated threshold levels.

Organic compounds

An organic compound is a substance containing carbon.

On the ISR form, give details of any release which

- exceeds 5 tonnes a year
- is not already listed on Part 2.

Halogens

This group consists of the four elements fluorine, chlorine, bromine, and iodine.

On the ISR form, give details of a release of any or all of the above elements which exceeds 1 tonne a year. We need details of each halogen released that is above the reporting threshold.

Acid forming gases

This group includes any substance that may form an acid when added to water.

For example, hydrogen fluoride or hydrogen bromide.

On the ISR form, give details of any release which

- exceeds 1 tonne a year
- is not already listed in Part 2.

Reporting special waste

The Environment Agency has developed an assessment system for the classification of special waste using the principles described within the Special Waste Regulations 1996.

This assessment system is described in the Classification of Special Waste – Information Sheet 1 published by the Environment Agency. You can get copies free of charge from your local Environment Agency office.

Definition of media

Releases to air

For the purposes of quantifying the total amount of substance released to air on the ISR reporting form, 'air' is taken to mean both the inside and outside of a building. However, when quantifying the amounts discharged from a given release point as part of the overall mass contribution, care must be taken not to double count.

Releases to sewer

All discharges to sewer are controlled under Section 118 of the Water Industry Act 1991. This section states that effluent from trade premises may only be discharged to a public sewer with the consent of the sewerage undertaker. Such consent is made in the form of a 'trade effluent discharge consent' issued by the undertaker upon application by the occupier of the trade premises.

Controlled waters and land

Controlled waters are as defined in Section 104 of the Water Resources Act 1991. Definitions for coastal waters, estuaries and rivers/inland waters are outlined below.

In completing Part 4 of the ISR reporting form you are required to state the medium to which the substance is released.

Sea (S)

Sea or coastal waters, for the ISR reporting form, are those waters up to three miles from the coast. The detailed definition is:

'A coastal water means all the water on the landward side of a line every point of which is at a distance of three nautical miles on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate in the case of watercourses, up to the outer limit of the estuary.'

The baseline referred to here is an outline round the coast of the United Kingdom which coincides with the outer edge of all estuaries and which 'rounds off' the details of the coast. Maps of the baseline are held by the Environment Agency.

Estuaries (E)

Estuary is defined in line with the Urban Waste Water Treatment Directive (91/271/EEC):

'estuary means the transitional area at the mouth of a river between fresh water and coastal waters. Member states shall establish the outer (seaward) limits of estuaries for the purpose of this Directive...'

Estuary boundaries have been established by the United Kingdom in pursuance of this definition, and maps of these boundaries are held by the Environment Agency.

Rivers inland waters (R)

This includes surface fresh waters which are defined, by default, as those inland surface waters which are not part of an estuary.

Releases of substances to land

The Part 4 Releases to controlled waters section of the ISR reporting form includes additional information requirements in the form of amounts of substance released to land. 'Releases to land' means a release to land which is not specifically permitted by the conditions of an authorisation. These are uncontained releases due to plant or process failure, accident or malicious action. Uncontrolled releases to land have the potential to reach controlled waters through run-off or via groundwater. These releases therefore constitute a potential uncontrolled release to water via a direct release or spillage on site to land.

These releases are classified as notifiable releases and should be reported annually in the 'notifiable release' column of the ISR reporting form as a 'release to land'.

The following releases should be considered as releases to land

- unexpected leaching from stockpiles
- accidental spillage
- accidental and or unauthorised dumping of liquid or liquefying substances on site
- storage tank or pipework rupture.

Actual losses to land, rather than the quantity spilled, should be reported to the 'Pollution Inventory'. The total of all notifiable releases for that year should be reported for similar release episodes. The operator should exclude any substance recovered or diverted to sewer.

The following releases to land should not be considered

- stockpile under normal authorised operating conditions
- consignment for landfill
- special waste disposal via proper means.

Releases to air, water and land

Purpose of the ISR

The ISR has been developed to provide information on annual mass releases of specified substances to air and water and on the mass of special and/or non special wastes which arise from any given IPC authorised process. The reporting requirements for the ISR encompass emissions from the whole of the IPC authorised process. This therefore includes, along with the defined release points (point sources), non-point sources and fugitive emissions such as processing, transfer, storage, maintenance and cleaning.

Step 1: identify the process boundary

A process diagram will help you identify all possible points from which releases are likely to occur. Take care to ensure that all relevant areas including materials receipt, loading, storage, on-site transportation and waste handling are included.

Step 2: identify sources of release

Once the process boundary and all associated elements have been defined, it should then be possible to identify potential sources of release. The primary sources of release are likely to be from the process activities, but all sources including storage, handling and discharge/disposal must be taken into account.

Step 3: link sources to media

Link each of the identified sources of release to a specific medium – air, water or land. These media form the basis of the ISR reporting form. The quantified release of a substance will have to be documented in relation to the receiving media.

The reporting process

In order to fill in the ISR reporting form accurately you should assess the releases and activities on your site in a logical manner. To do this you will probably need to establish

- the boundary of the process which requires reporting
- the sources of release
- the medium to which a release occurs, and
- the substances released.

The steps below provide a suitable methodology to help you.

Step 4: substances released

All substances which are included on the ISR reporting form (for air and water) which come into or leave the authorised process boundary or envelope, need to be identified. Only substances involved in the process operations and maintenance activities should be included.

Step 5: determine release quantities

If a substance is or has the potential to be released from the process boundary, the amount released has to be established. The total quantity of a given substance released per annum is required by the ISR reporting form. The section below provides details on measuring, calculating or estimating the releases of substances into the different media.

Information on the rate of release and timing of release will be important when calculating the annual release amounts. Therefore, for each of the planned release points, such information should be obtained wherever possible. On sites where IPC and non-IPC authorised processes are in operation, only the releases from the IPC authorised process have to be reported.

Step 6: report

Complete the ISR reporting form and return it to the Environment Agency with 2 further copies.

Measurement, calculation and estimation

The ISR reporting form requires that the operator state how each release has been primarily determined. There are three ways of determining the release, which are by:

- Measurement (M)
- Calculation (C)
- Estimation (E)

This section provides help and information on:

- how to decide whether to enter M, C, or E on the ISR reporting form
- advice on which approach is best to use

A worked example in “Worked example: estimating site releases for the ISR” on page 16 demonstrates how to use these approaches to derive the total emission from a process.

Definitions of M, C and E

The definitions of M, C and E for assessing emissions are:

Measuring (M)

Emissions derived from direct monitoring results for the process in question, based on actual monitoring of a substance, at the operators plant, via a given discharge route. The types of monitoring would include:

- Continuous measurement (by the plant operator)
- Short term or spot measurements (by the plant operator)
- Short term or spot measurements (by contractors or the Environment Agency).

Calculation (C)

Emissions based on calculations using the operator’s plant specific data. The approaches are based on:

- A mass balance approach
- Using emission factors derived from similar plant with similar processes on the operator’s site.

Estimation (E)

Emissions based on more generic data, derived from similar plant or processes.

The approach is based on using emission factors based on those in the references in Table 6, “Type of emission and monitoring regime,” on page 16.

Avoiding double counting

It is important to avoid double counting when several approaches have been used to quantify the total amount released. Double counting might arise when, for example

- Water arising from washing down of the floor in a process area will pass to an on site drain and then may be discharged off site. If the estimated amount of substance released via that wash down water to the on-site drain (fugitive) is added to the known (monitored) amount released via the off site discharge point, the substance would be double counted.
- Volatile compounds may be released through vents as well as by fugitive releases. It is important to ensure that losses through the vented discharges are considered in the mass balance equations.

Comparing measurement, calculation and estimation

Table 4 lists some caveats that should be noted for each of the approaches.

What is entered in the ‘Total release’ column on the ISR reporting form?

The cumulative total annual release, from all discharge routes, should be entered.

To do this you are likely to have to use a mixture of the three methods in order to calculate the total emissions from the plant or process and the worked case for a release below provides an good example of this.

What approach should be used to calculate emissions?

Clearly, the first step is to identify all off-site release points, including drains and roof vents and sources of fugitive emissions. It is important to consider the routes of fugitive emissions carefully, so that none are omitted and double counting does not occur.

Then, in general, the operator should assess releases by applying the approaches in the following order:

- from measurements
- by calculation
- by estimation.

Which option (M, C or E) should be entered in the ‘Method used’ column the ISR reporting form?

Either M, C or E should be entered (but **only one letter** must be entered). The letter entered must correspond to the method used to determine the largest proportion of the annual release. Here are examples of which letter should be entered:

How to decide when to enter M, C or E on the ISR form

- The annual discharge of a compound to air from a plant was determined purely from monitoring data of stack releases, and there were **no other** sources of this compound to air from the plant.
M would be entered on the ISR reporting form.
- The annual discharge of a compound to air was determined from three processes by different approaches
 - 30% of the total from measurements (releases from a stack)
 - 15% of the total by estimation (fugitive releases), and
 - 55% of the total by calculation (releases from vents).**C** would be entered on the ISR reporting form, since the greatest proportion of the total annual release to air was determined by calculation.

Table 4: issues for measurement, calculation and estimation

Measurement	Calculation	Estimation
<ul style="list-style-type: none"> • Continuous emission monitoring will yield the most accurate quantification of releases via that route. • Some monitoring is only performed on an intermittent basis. In these instances, the duration of the emission must be noted to enable accurate quantification of the annual emissions to be made. • The frequency of the direct measurements should also be taken into account when determining if monitoring data alone are sufficient for making a reasonable annual estimate. Spot measurements of any release parameter may not be fully representative of the annual release value of that substance. This may be due to variations in the release profile due to production and process changes, variability in sampling and analysis techniques • Although direct measurement should yield the most accurate results, only rarely will sufficient data be available for all emission points to enable the annual total release of a substance to be quantified without resorting to other techniques (for example calculations and estimations). 	<ul style="list-style-type: none"> • When undertaking a mass balance calculation, the period over which the calculation is performed needs to be defined to take into account non continuous processing or variation in processes. The mass balance calculation may be performed over a year, or over a defined period from which the results are adjusted to provide the annual quantities emitted. • Simple mass balance calculations can be used for a specific substance on an individual process. • Mass balance must estimate annual emissions, and so it is best to estimate based on total annual data. If data collected over a period of less than one year are used to calculate mass balances, the operator must ensure that the interpolated annual figures reflect the operation of the plant over that period. • Use the most appropriate emission factors from monitoring of similar sites, plant or releases. 	<ul style="list-style-type: none"> • The quality of emission factor data can vary widely. In some instances, emission factors have been calculated from measurements under test conditions on a large variety of equipment whilst others have been derived from detailed monitoring data. Some have simply been based on average releases from similar types of processes. • Some emission factors will be plant or process specific, while others maybe national averages. The quality of emission factors varies depending on the applicability and the reliability of the calculations and original measurements to derive them. • The highest quality data available should be used in any calculations. • Once the appropriate emission factors for the process have been identified, they will need to be tailored to the specific site process.

Using measurement (M)

The reporting requirements for 1998 do not require any new or additional monitoring to be carried out. However, improvements in the quality of data submitted to the Agency through the ISR reporting forms will be required over time. It may be beneficial, therefore, to consider where additional monitoring may be implemented in the future to support the annual ISR reporting requirements.

Direct monitoring results are based on actual monitoring of the concentration of a substance released via a given discharge route. Continuous emission monitoring will yield the most accurate quantification of releases via that route. Some monitoring is only performed on an intermittent basis. In these instances, the duration of the emission must be noted to enable accurate quantification of the annual emissions to be made.

The frequency of the direct measurements should also be taken into account when determining if monitoring data alone are sufficient for making a reasonable annual estimate. Spot measurements of any release parameter may not be fully representative of the annual release value of that substance. This may be due to variations in the release profile due to production and process changes, variability in sampling and analysis techniques.

Although direct measurement should yield the most accurate results, it is recognised that only rarely will sufficient data be available for all emission points to enable the annual total release of a substance to be quantified without resorting to other techniques (for example calculations and estimations).

Using calculation (C)

Calculating mass balances

Mass balances provide a reliable estimate of release based on records of the quantity of a substance entering and leaving a process. An imaginary boundary can be placed around the process, and all streams entering or leaving the boundary are identified. The operator will need to account for any accumulation or depletion of the substance within the mass balance boundary.

The general equation for mass balance is:

General expression for mass balance

$$\begin{aligned} &\text{Total substance available} + \text{Substance generated} \\ &= \\ &\text{Substance released} + \text{Amount of substance converted} + \\ &\quad \text{Amount of available substance left} \end{aligned}$$

Where:

Total substance available is total amount of substance available in stores at the beginning of the period plus the amount purchased over that period

Substance generated is amount of substance actually manufactured at the facility

Substance released is the total amount of substance that has left the facility including as product, as waste, as emission (divided into the individual elements, to allow for identification of waste or releases)

Amount of substance converted is the amount converted into another substance

Amount of available substance left is the amount left in stores at the end of that period.

Estimation (E)

Emission factors

These are average values which describe the quantity of a chemical released as a function of a specific process or the method of use of equipment. They can be expressed as a ratio of chemical released to amount of chemical through put.

The quality of emission factor data can vary widely. In some instances, emission factors have been calculated from measurements under test conditions on a large variety of equipment whilst others have been derived from detailed monitoring data. Some have simply been based on average releases from similar types of processes. The highest quality data available should be used in any calculations. Once the appropriate emission factors for the process have been identified, they will need to be tailored to the specific site process.

Emission factor information

There are a number of primary UK sources for obtaining emission factors.

These sources and their applicability to estimating IPC process emissions are outlined in the tables below.

National and international emission factor sources

Table 5: Details of national and international emission factor sources

	National atmospheric emissions inventory (NAEI)	EMEP/CORINAIR atmospheric emission inventory guidebook	UK emission factors database	US EPA compilation of air pollution emission factors (AP-42)	US EPA wastewater emissions	Australian emission factor information
Brief description of the content	UK estimates of emissions of 19 pollutants or groups of air pollutants. Covers industrial sources and includes estimates from 1970 to 1996.	Provides information to facilitate the development and harmonisation of emission factors and inventory methods throughout Europe.	Dataset derived during the compilation of the Urban Inventories.	Contains US emission factors for use in many different processes across a large number of industry sectors.	Analytical models to estimate the emissions of organic compounds via various pathways from wastewater and waste management treatment units.	Contains Australian emission estimation technique manuals that cover a small range of estimates.
Applicability to industrial reporting	Use where applicable to process. Factors typical of UK average processes. Good for average combustion process emissions but no boiler size breakdown. Includes a VOC speciation database see "VOC speciation" on page 5. Includes historic (time series) emission factor data.	Use where applicable to process in absence of suitable NAEI data. Often based on data from other European countries. Good for combustion emissions from different sized boilers. Includes detailed methodologies often with simplified options. Well validated and reviewed data. Inconsistent pollutant coverage for many of the toxic air pollutants.	Use only in the absence of specific CORINAIR or NAEI factors. Factors have been derived for specific IPC industrial processes. However, the data set does not include all processes under IPC. This database is limited to sites that exist in urban areas which limits the number of processes considered. This also limits the quality of averages provided.	Use only in the absence of specific CORINAIR or NAEI factors. Emission factor data for the United States processes. May differ considerably from UK processes. Wide range of pollutants. Highly detailed process/sub process breakdown. Emission factors available for both primary and fugitive releases to the atmosphere.	Emission factor data for the United States processes. May differ considerably from UK processes. Wide range of pollutants TO BE COMPLETED	TO BE COMPLETED
Pollutants covered	CO, CO ₂ , CH ₄ , HCl, Speciated VOCs, HFC, NH ₃ , N ₂ O, NO _x , PFCs, PM ₁₀ , SO ₂ , heavy metals, speciated PAHs, PCBs, Dioxins	1,3-butadiene, CO, CO ₂ , Pb, NO _x , PAHs, PM, SO ₂	SO _x , NO _x , VOCs, CH ₄ , CO, CO ₂ , N ₂ O, NH ₃ , As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn, HCH, PCP, HCB, TCB, TRI, PER, TCB, TCE, Dioxins, PAH	CO, CO ₂ , CH ₄ , HCl, speciated VOCs, HFC, NH ₃ , N ₂ O, NO _x , PFCs, PM ₁₀ , SO ₂ , heavy metals, PAHs, Dioxins		

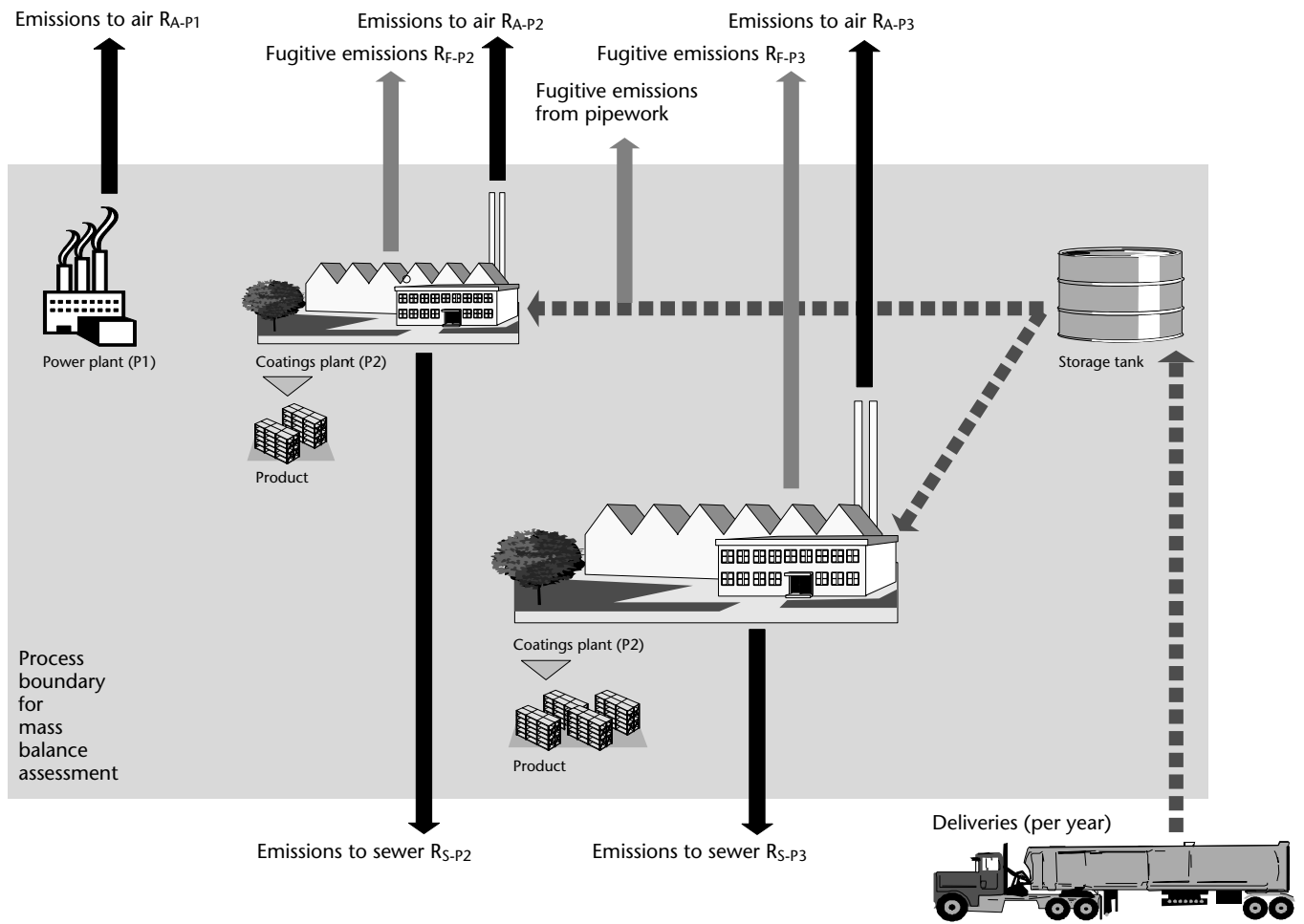
Table 5: Details of national and international emission factor sources (Continued)

	National atmospheric emissions inventory (NAEI)	EMEP/CORINAIR atmospheric emission inventory guidebook	UK emission factors database	US EPA compilation of air pollution emission factors (AP-42)	US EPA wastewater emissions	Australian emission factor information
Availability	From the National Environmental Technology (NETCEN) library. Tel: 01235 46 3068 http://www/aeat.co.uk/netcen/airqual/emissions	Available on the Internet at http://www/eea.dk/aegb.Default.htm Printed copy/CD-ROM available from the European Environment Agency Kongens Nyrtov 6 DK 1050 Copenhagen Denmark Tel: +45 33 36 71 00 Fax: +45 33 36 71 79	From the Department of the Environment, Transport and the Regions	Available on the Internet at http://www.epa.gov/ttn/chief/	Available on the Internet at http://www.epa.gov Some of the analytical models have been assembled into a spreadsheet called CHEMDAT8. Available on the Internet at http://www.epa.gov/ttn/chief/	Manuals available on the Internet at: http://environment.gov.au/epg/npi/eet_manuals.html
Supporting documentation	UK maps of spatially disaggregated emissions at 1 km by 1 km resolution are available on the Internet at http://www/environment.detr.gov.uk/airq/aqinfo.htm		DETR has published a guidance document on the preparation and use of atmospheric emission inventories (LAQM(TGO(98))). Available on the Internet at http://www/environment.detr.gov.uk/airq/aqinfo.htm	The USEPA produces a wide range of documents, which incorporate estimates of emissions. Available on the Internet at http://www.epa.gov	The USEPA produces a wide range of documents, which incorporate estimates of emissions. Available on the Internet at http://www.epa.gov	

Engineering judgement

If no other reasonable option exists, releases should be estimated using best engineering judgement. This can be based on releases from other similar processes where releases are already known, using physical and chemical properties of the materials involved. For example vapour pressure and equipment design information can be used to make appropriate assumptions in order to estimate the amount released.

Worked example: estimating site releases for the ISR



The example is based on a plant that has three processes on-site. Figure 1 shows a simplified version of the plant considered in this example.

- 1 One process (P1) generates power for the plant, and has releases to air (R_{A-P1})
- 2 One process (P2) coats materials, and has releases to air and the sewer (R_{A-P2} & R_{S-P2}) and fugitive releases from flanges, valves etc. (R_{F-P2})
- 3 One process (P3) has a similar but not identical process to 2 above, has a smaller throughput, and has releases to air and the sewer water (R_{A-P3} & R_{S-P3}) and fugitive releases

from flanges, valves etc. (R_{F-P3}).

A liquid effluent stream from P1 and P2 is treated via a water treatment works, and then discharged to a local sewer. Other fugitive releases occur from the pipework leading from the storage tank to the plants.

Not all the possible pollutants that could be emitted from each process have been considered for simplicity.

The type of emissions and the type and frequency of monitoring from all the process on the site are summarised in Table 6 for each process.

Table 6: Type of emission and monitoring regime

Process	Media receiving emissions	Source of emissions	Code for emission source	Example of pollutants emitted	Monitoring regime
P1 (power generation plant)	air	stack	R_{A-P1}	SO_2 , NO_x	continuous for some pollutants, but calibration problems meant data unreliable and has been rejected
	sewer	(none)			
	fugitive	(none)			
P2 (coating process)	air	vent	R_{A-P2}	NM-VOC	continuous
	water	treatment plant	R_{S-P2}		spot reading every month (lasting 1 hr.); reading taken in effluent before it enters local sewer
	fugitive	storage/flanges/pipes etc.	R_{F-P2}		(none)

Table 6: Type of emission and monitoring regime (Continued)

P3 (coating process)	air	vent	R _{A-P3}	VOC	2 spot readings (3 hrs each) over the year
	sewer	treatment plant	R _{S-P3}		spot reading every month (1 hr); reading taken in effluent before it enters local sewer
	fugitive	storage/flanges/pipes etc.	R _{F-P3}		(none)

Table 7 summarises which approach (from measurements, estimation or calculation) could be used in this example to calculate the emissions from each release route, from each process.

It is deliberately not completely prescriptive, as the operator will always have to use some judgement about which is the best approach to calculating emissions.

The most important point is to use the approach that is likely to give the best estimate of the release from the process being considered.

Table 7: One approach to determine emissions

Source of emissions	Pollutants considered	Calculation approach for emissions (M,C or E)	Method to complete the calculations	Notes
R _{A-P1} (to air)	SO ₂	C or E	Emissions of for example SO ₂ could be assessed by calculating (C) the product of the annual fuel burnt by sulphur content of the fuel. Emissions of SO ₂ and other combustion gases could also be assessed by estimation (E) from the products of suitable emission factors and the quantity of fuel burnt.	Ideally, emissions would have been assessed from the monitoring data. It might be necessary to take into account variations in the sulphur content of the fuel if approach (C) is used.
R _{A-P2} (to air)	Total VOC	M	Emissions of total VOC could be assessed from the results of the continuous monitoring (M) and the volume flow rates.	The VOC emissions could be speciated by referring to the guidance in "3 Named organic compounds" on page 5
R _{A-P3} (to air)	Total VOC	M or C	Emissions of total VOC could be assessed from the results of the spot measurement data (M), assuming it is representative of emissions over the whole year. Emissions of total VOC could be assessed from applying the monitoring data from P2 to this process (C).	The operator will have to consider how applicable the continuous monitoring for process P2 is to process P3 before approach (C) is used. The VOC emissions could be speciated by referring to the guidance in "3 Named organic compounds" on page 5
R _{S-P2} (to sewer)	(none)			
R _{S-P3} (to sewer)	(none)			
R _{F-P2} (to air)	Total VOC		Emissions of total VOC for could be assessed by a mass balance approach (C). This would determined from (quantity in the storage tank at the beginning of the year – quantity in the storage tank at the end of the year) + quantity delivered during the year = overall use by P2 and P3 and then fugitive VOC emission from P2 = quantity used by P2 – (sum of emissions to air through vents + converted/contained in the product)	Here, no material is released to the sewer but this may need to be considered
R _{F-P3} (to air)			See method above	

The next step will be to summarise all emissions of the compounds from all the on-site processes according to the discharge route, and then enter the total annual emissions on the ISR reporting form. Here, just the VOC emissions to air are considered:

Table 8: Summary of VOC emissions to air

VOC emissions to ...		Code	% of the total annual emission	Calculation approach
Air	from vents and stacks	R _{A-P1}	(none)	
		R _{A-P2}	42	M
		R _{A-P3}	30	C
	From fugitive releases	R _{F-P2}	17	C
		R _{F-P3}	11	C
Sewer	Via the treatment works	R _{S-P1} & R _{S-P2}	(none released to the sewer)	

Here, the operator would record the total annual emission on the ISR reporting form and enter M as the method used to assess the releases to air.

Sources of information

UK information sources

British Library Science Technology and Industry Environmental Information, *A guide to sources* ISBN 0-7123-0852-3, 1997, which includes details of information database sources such as:

- Enviroline – air emission data (CD-ROM)
- Aqualine – water emission data (CD-ROM)
- Hseline – emission data from various process activities (CD-ROM)
- Wasteinfo – data on non-radioactive waste management (CD-ROM)

Environmental Analysis Co-operative Development Project, *Released substances and their dispersion in the environment: guidance for applicants for process authorisation under Integrated Pollution Control* HMSO, ISBN 0-11-702010-9, 1996.

Environment Agency, *Classification of special waste – Special Waste Regulations 1996 Information Sheet 1*, 1996.

Environment Agency, *Inventory of sources and releases (ISR) – conclusions of consultation*, 1998.

Environment Agency, *Integrated pollution control guidance notes (IPCGN) and technical guidance notes (TGN)*, Stationery Office.

Hester, R. E. and Harrison R. M., 'Volatile organic compounds in the atmosphere', in *Environmental Science and Technology*, The Royal Society of Chemistry, 1997.

Joint Environmental Programme, 'The chemical release inventory in context', PowerGen, Power Technology Centre, Rattcliff on Soar, Nottingham NG11 0EE. PT/98/EA419/R, 1998.

Marlowe, I. T., *The categorisation of volatile organic compounds*, Environment Agency, 1996.

Stationary source emissions – determination of the mass concentration of PCDDs/PCDFs. This is a joint BSI/CEN standard for the determination of stack emissions of dioxins and is issued in three parts

Part 1 Sampling – BS EN 1948-1:1997

Part 2 Extraction and clean-up – BS EN 1948-2:1997

Part 3 Identification and quantification – BS EN 1948-3:1997

US Information Sources

Section 313 Emergency Planning and Community Right-to-know Act, *Guidance for chemical distribution facilities (version 1.0) USEPA TRI form R guidance document*, 1997.

RCRA, Superfund & EPCRA Hotline Training Module, *Introduction to toxic release inventory: estimating releases (EPCRA 313; 40 CFR Part 372), USEPA Solid waste and emergency response (5305W) EPA745-B97-004*, updated June 1997.

Both of these documents can be obtained via the Internet at <http://www.epa.gov>.

US Chemical Manufacturing Association, *Improving air quality: guidance for estimating fugitive emissions from equipment*, CMA Order #018026, 1988.

American Petroleum Institute, various publications including

- *Evaporation loss from external floating roof tanks*, Technical Bulletin 2517, 1989
- *Evaporation loss from fixed roof tanks*, Technical Bulletin 2518, 1991
- *Evaporation loss from internal floating roof tanks*, Technical Bulletin 2519, 1990.

Australian information sources

National pollutant inventory guide, Australian Government, 1998, <http://www.environment.gov.au/net/npi.html>

- *National pollutant inventory manuals*, 1998
- *Emission estimation technique manual for paint and ink manufacturing*, 1998.
- *Emission estimation technique manual for medicinal and pharmaceutical product manufacturing*, 1998.
- *Emission estimation technique manual for glass and glass fibre manufacturing*, 1998.

Canadian information sources

Guide for reporting to the national pollutant release inventory, ISBN 0-662-26612-9, 1997.

The Canadian Government operates a national pollution release inventory similar to the USEPA. It has a website which provides Canadian and International information sources related to release inventories. The site can be accessed via the Internet at:

<http://www.ec.gc/pdb/npri/links.html>

Other information sources

United Nations Environment Programme, *Inventory on information sources on chemicals, Inventory of information sources for chemical management*, 1998.

This information can be accessed through the Internet at:

<http://irptc.unep.ch/irptc/invent/igo.html>

United Nations Environment Programme, *International and national PRTR activities, catalogue of documents*, 1998.

This information can be accessed through the Internet at:

<http://irptc.unep.ch/prtr/docs01.html>

World Health Organisation provides details on a wide range of chemicals.

The information can be accessed via the Internet at:

<http://www.who.int>

Sources of information on emissions

UK emission factors database

This contains information on emissions of benzene, 1-3-butadiene, CO, CO², lead, NO_x, PAHs, PM₁₀, and SO². Some actual release information from UK processes is available as well as default emission factors for industrial processes and transport.

The Department of Environment, Transport and the Regions (DETR) has published a guidance document on the preparation and use of atmospheric emission inventories (LAQM (TGO(98)).

This guidance is available on the Internet at:

<http://www.environment.detr.gov.uk/airq/aqinfo.htm>

National atmospheric emissions inventory (NAEI)

The NAEI contains UK estimates of emissions of 19 pollutants or groups of air pollutants including CO, CO², CH⁴, dioxins, HCl, heavy metals (Pb, Cd, Hg, Cu, Zn, Ni, Cr, As, Se, V), HFCs, NH₃, N₂O, NO_x, VOCs, PAHs, PCBs, PFCs, PM₁₀, and SO². The NAEI covers industrial sources and includes estimates from 1970 to 1996. Methodologies and emission factors used in the NAEI are published most recently in:

Salway, A. G., *UK emissions of air pollutants 1970-1995*, H.S. Eggleston, J. W. L. Goodwin & T. P. Murrells, AEA Technology, report no. AEAT-1746, June 1997.

This report is available from the NETCEN library telephone 01235 463068. There will be a charge for its purchase.

Future versions of this report will be made available free over the Internet. In addition, UK maps of spatially disaggregated emissions at 1 km x 1 km resolution are available over the Internet at:

<http://www.environment.detr.gov.uk/airq/aqinfo.htm>

EMEP/CORINAIR atmospheric emission inventory guidebook

This book provides information on the development and harmonisation of emission factors and inventory methodologies throughout Europe. It is available over the Internet at:

<http://www.eea.dk/aegb.Default.htm>

Alternatively a hard copy/CD-ROM is available from the European Environment Agency:

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DK 1050 Copenhagen
Denmark
Phone +45 33 36 71 00
Fax +45 33 36 71 99

United States emission factor information

The United States Environment Protection Agency (USEPA) has collated a wide range of emission factors to support their industries in the completion of chemical release and toxic release inventories. As the reporting requirements for inventories have been well established in the US for many years, the depth and quality of emission factor information is high.

Compilation of air pollution emission factors (AP-42)

USEPA provide emission factors for use in many different processes across a large number of industry sectors. These provide emission factors for both primary and fugitive

releases to the atmosphere, for specific volatile organic compounds (VOCs), particulates, and some other specific toxic chemicals. This document can be downloaded from the Internet through the technology transfer network (TTN) at the following address:

<http://www.epa.gov/ttn/chief/>

Wastewater emissions USEPA

Analytical models have been developed to estimate the emissions of organic compounds via various pathways from wastewater and waste management treatment units. Some of these models have been assembled into a spreadsheet called CHEMDATA8. The CHEMDATA8 programme and manual can be accessed from the Internet at:

<http://www.epa.gov/ttnchie1/ees.html#water8>

USEPA also produces a wide range of documents which incorporate estimates of emissions.

Further information can be obtained from the USEPA via the Internet at:

<http://www.epa.gov>

Australian emission factor information

The Australian Government operates a national pollutant inventory (NPI), similar to the USEPA's toxic release inventory and many supporting documents for Australian operators have been produced. These include a series of emission estimation technique manuals which cover a small range of industries.

The manuals can be accessed via the Internet at:

<http://www.environment.gov.au/epg/npi/guides/index.html>