Review of Incidents at Hazardous Waste Management Facilities

(Version 2.7 October 2013)

Cyfoeth Naturiol Cymru
Natural Resources Wales

Environment Agency

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Contents

Record of changes from previous version		
Version	**Date Change**	**Change**
Version 2.7	October 2013	Changes to the cover following formation of National Resources Wales. Insertion of six new incidents 11, 16, 21, 23, 25 and 27. Reordering of incidents. Additions and changes to ‘Other incidents reported at permitted waste facilities’. Deletions in this section where incident was written up in full. Reference section updated. Minor corrections.

Introduction

The hazardous waste treatment and storage sector has a history of serious accidents and incidents occurring over recent years. The aim of this guidance is to share what happened when an incident occurred so that we can all learn from them and to help prevent them reoccurring.

Operators of installation facilities regulated under the Environmental Permitting (EPR) regime are required to ensure that the necessary measures are taken to prevent accidents and limit their consequences. Accident prevention is also a matter that has to be considered when determining what is the best available technique (BAT) for a regulated facility. In 2005, following consultation with the waste industry, we published the Sector Guidance Note (SGN) for the Recovery and Disposal of Hazardous and Non Hazardous waste (S5.06). This guidance reflects the high priority areas, including accident prevention and limitation of consequences. It sets out, amongst other things, rigorous standards for waste pre-acceptance, acceptance, storage and treatment which operators should have in place. Despite this, further high profile incidents have continued to occur within the sector, many arising for similar reasons to previous incidents.

We review all incidents and near misses at hazardous waste transfer and treatment sites. The findings are disseminated to our staff in order, where possible, to prevent any reoccurrence of these incidents through our permitting and compliance work. We also review the adequacy of our guidance in light of all incidents. We have previously circulated the information that follows in an internal report but now make our findings available to the waste treatment industry. We hope that by doing so, the knowledge gained will enable other operators to prevent similar incidents occurring at their sites.

Some of the information contained here has already been presented to the Industry Sector Group meeting. Operators have shared their experience of these incidents and the lessons their companies have learnt. We are grateful to those companies who have done so, and will continue to encourage this through the Environment Agency / Industry Compliance Group.

We have summarised a number of incidents within this document covering a period of more than 15 years. Operational practices have moved on since many of these incidents occurred, and many pre-date the publication of the S5.06. The operations on each site, at the time of the incident, have been compared to the standards set out in S5.06, in order to assess whether S5.06 addresses the factors that were, at the time, thought to have caused these incidents. We have then assessed whether there are additional measures that should be incorporated into S5.06. We have not yet identified any significant gaps in our guidance. The root cause of many of these incidents was incompatible or poorly characterised wastes being mixed or stored together, which is addressed in detail in S5.06.

In 2011 we made decision to include ‘minor incidents’ and ‘near misses’ where there is useful experience to share. We have also included incidents from hazardous waste facilities which are not installations, as they also contain many common issues and useful lessons which can be applied to the sector. We hope that by doing so, the knowledge gained will enable other operators to prevent similar incidents occurring at their sites.

The information on each accident, incident or near miss has been provided by the local regulatory team for each site and reviewed by the operator. The information has been laid out as follows:

The incident

This section gives a brief description of the incident

Description of causes

This section is divided into sections on:

The process

Background Information

Any other relevant information

Relevant requirements of S5.06

This section sets out the relevant requirements of S5.06 that relate to the incident, including a reference to:

- the relevant section of the S5.06 for example *2.1.2 Acceptance procedures when waste arrives at the installation*
- section heading (where appropriate) for example ***Load Inspection***
- the particular BAT point in that section, for example *2. Hazardous wastes should only be received under the supervision of a suitably qualified person (HNC qualified chemist or higher)*
- any comments about the BAT points specific to the incident

Suggested improvements to S5.06

Identifies suggested improvements to the S5.06.

Actions taken by operator since incident

Outlines particular changes the operator has made to prevent the incident occurring again.

Incident 1 April 1997 - Minworth Treatment Facility, Forge Lane, Minworth	
Date of incident	23 April 1997
Operator Name (at time of incident)	Caird Environmental Ltd
Site Address	Minworth Treatment Facility, Forge Lane, Minworth, Birmingham

The incident

During drum washing operations, a 45 gallon drum exploded due to a build-up of pressure inside the drum. The force of the explosion resulted in the drum flying out of the site onto the roof of a neighbouring building. The drum was one of a load of 80 nominally empty drums delivered to the site. The drums all contained residues of acetyl-chloride (a water reactive substance) and were delivered on-site to be cleaned.

Description of causes

The Process

Cleaning operations for washing water-reactive drums were undertaken outside in the site yard, in a dedicated area for this activity. The cleaning operation involved a site operative running a water lance through the lid of the drum and filling it with water. Any gases produced were then drawn off into a scrubber unit. The drums, when filled with water, were taken to the on-site treatment plant for processing.

Background Information

'Stick tests' were carried out on acceptance of the load of drums to ascertain the level of waste residues. Nominally empty drums (those with around a couple of centimetres of residue) are accepted for treatment at the site. About a quarter of the load was checked to ensure that the drums were nominally empty and suitable for washing. As each drum checked was found to contain a similar and acceptable quantity of waste residue, an assumption was made that the rest of the load was also acceptable. The drum that exploded was not nominally empty. It is likely that it contained more acetyl-chloride than the other drums in the load, but this was not picked up during waste acceptance checks. When being washed, the acetyl-chloride reacted with the washing water and released a large amount of gas, which built up in the drum quickly so that is swelled and then exploded.

Relevant requirements of S5.06

2.1.2 Acceptance procedures when waste arrives at the installation

Load Inspection

4. Check every container to confirm quantities against accompanying paperwork. All containers should be clearly labelled and should be equipped with well-fitting lids, caps and valves secure and in place. Any damaged, corroded or unlabelled drums should be put into a quarantine area and dealt with appropriately. Following inspection, the waste should then be unloaded into a dedicated sampling/reception area.

Sampling Drummed Waste

26. The contents can only be identified with certainty if every container is sampled. Acceptance should involve sampling every container. However, analysis of composite samples is acceptable with such a sampling regime. A representative sample must be

obtained by taking a core sample to the base of the container. Operators should ensure that lids, bungs and valves are replaced immediately after sampling.

Suggested improvements to S5.06

The requirement that container washing and cutting operations must take account of the former contents and any residues that may be present is not included within the “BAT box” in S5.06 but is mentioned in the accompanying text. This requirement could be made an indicative BAT standard.

Actions taken by operator since incident

Improvements have subsequently been made by the operator, including:

- a dedicated water reactive substance drum washing area with a blast cage
- the appropriate procedure was rewritten to ensure all drums are inspected prior to processing
- where excess residues are present these are treated by another process before washing out of the drum the process is now fully automated, and cannot start until the doors are closed and a button pressed
- no site operative is in close proximity of the activity

Incident 2 January 1998 - Liverpool Road, Cadishead	
Date of incident	13 January 1998
Operator Name (at time of incident)	Lanstar Limited
Site Address	Liverpool Road, Cadishead, Manchester

The incident

On 13 January 1998, the fire service was called in response to a fire in a skip. The fire occurred when an oxidising agent was put through a shredder in the 'small pack' facility at the site. The empty shredded containers were placed in a skip on site for disposal, where they reacted with some incompatible waste causing an uncontrolled chemical reaction. The material involved, contained sodium dithionite, which was not approved for treatment at the facility by shredding. The incident resulted in a fire and the emission to atmosphere of noxious and polluting gases.

Description of causes

Background Information

The incident arose because employees did not follow the company's internal procedures. Substances were shredded and mixed at the facility, which were not approved for treatment by the site chemist. However, the employees considered them to be safe for treatment because they were household products.

Relevant requirements of S5.06

2.1.2 Acceptance procedures when waste arrives at the installation

Load arrival

2. Hazardous wastes should only be received under the supervision of a suitably qualified person (HNC qualified chemist or higher).

Sampling – checking – testing of waste - storage

9. The Operator should ensure that waste delivered to the installation is accompanied by a written description of the waste, including:

- the physical and chemical composition
- hazard characteristics and handling precautions
- compatibility issues

Suggested improvements to S5.06

None suggested – incident was as a result of failure to follow procedures.

Incident 3 January 1998 - Liverpool Road, Cadishead	
Date of incident	20 January 1998
Operator Name (at time of incident)	Lanstar Limited
Site Address	Liverpool Road, Cadishead, Manchester

The incident

During a routine inspection on 20 January 1998, it was discovered that fumes from a skip were affecting the premises of the business next door, with several employees complaining that the fumes were making their eyes sting and breathing difficult. Twenty people had to evacuate the area where they were working and one person was admitted to hospital.

Description of causes

The Process

A batch of waste which had been mixed in the solidification and fixation plant was discharged into a skip containing water, where it reacted exothermically producing a cloud of steam and formaldehyde gas. In order to try and control the reaction, the company mixed a further batch of waste, discharged it into the skip and doused it with water. However, the contents of the skip continued to react, and, 30 minutes after the reaction was observed, employees on the site were affected by odour.

Background Information

The incident occurred due to inadequate testing procedures. The waste received at the site was described as lime, but the site operators believed it to be calcium carbonate. The exothermic reaction that occurred when it was treated indicates it must have contained calcium oxide (which can also be described as lime or quicklime), although the tests they had carried out did not reveal anything other than calcium hydroxide in the waste. The bags were marked as being a proprietary lime product and were received sealed and intact; however, no further inquiries were made of the supplier to ascertain if the contents of the 160 bags delivered could be anything other than calcium hydroxide. The wastes that reacted in the skip also included paraformaldehyde - which is solid, but at high temperatures decomposes to produce formaldehyde gas.

Relevant requirements of S5.06

2.1.1 Pre-acceptance procedures to assess waste

1. From the waste disposal enquiry the Operator should obtain information in writing relating to:

- chemical analysis of the waste (individual constituents and as a minimum their percentage compositions)

2. Unless a sample and analysis has already been completed by a third party and the Operator has sufficient written information from them, then the Operator should in every case obtain representative sample(s) of the waste from the production process/current holder and compare it against the written description to ensure that it is consistent.

5. The operator should ensure that the sample is representative of the waste and has been obtained by a person who is technically competent to undertake the sampling process.

14. Following characterisation of the waste, a technical assessment should be made of its suitability for treatment or storage to ensure Permit conditions are met.

2.1.2 Acceptance procedures when waste arrives at the installation

Load arrival

1. On arrival loads should:

- have all documents checked and approved, and any discrepancies resolved before the waste is accepted

Sampling – checking – testing of waste - storage

8. Other than pure product chemicals and laboratory smalls, no wastes should be accepted at the installation without sampling, checking and testing being carried out. Reliance solely on the written information supplied is not acceptable, and physical verification and analytical confirmation are required. All wastes, whether for on-site treatment or simply storage, must be sampled and undergo verification and compliance testing.

10. On-site verification and compliance testing should take place to confirm:

- the identity of the waste
- the description of the waste
- consistency with pre-acceptance information and proposed treatment method
- compliance with permit

This incident occurred due to management failings. Sampling of the waste did take place, and results were compared against the producers' records. However, whilst the discrepancy was acknowledged, the site operator did not check with the producer to find out why.

Suggested improvements to S5.06

None suggested.

Incident 4 May 1998 - Norwood Industrial Estate, Killamarsh	
Date of Incident	30 May 1998
Operator Name (at time of incident)	Sarp UK Ltd
Site Address	Norwood Industrial Estate, Killamarsh, Derbyshire

The incident

The incident took place in one of the acid storage tanks holding wastes prior to neutralisation in the acid treatment plant. The storage tank (containing hydrochloric, nitric, hydrofluoric and sulphuric acid) failed catastrophically. Before the tank failed, orange and brown fumes were seen to be rising from the tank. The failure itself resulted in a wave of acid leaving the tank. It also released a dark orange ball of fumes that rose from the tank to about 30 metres in height. The fumes were kept under control by site operatives spraying the liquid with water until the fire service arrived. Police warned members of the public to stay indoors and keep windows and doors closed. Members of the public reported burning sensations in the throat, sore throats, headaches, severe vomiting, and eyes being uncomfortable to open after the cloud of fumes left the site.

Description of causes

The Process

The Killamarsh site carried out a number of different hazardous waste management processes, such as physico-chemical treatment for inorganic wastes, oil water separation, high temperature incineration, secondary liquid fuel production and solvent recovery.

Background Information

The failure of the tank was due to a rapid build up of pressure inside. This was thought to be a result of sludge in the bottom of the tank reacting exothermically with the acid mixture present, with a subsequent build up of nitrous oxides causing the orange clouds.

Samples of sludge taken after the incident showed some of the compounds within it could be “breakdown or reaction products” formed by the reaction of the acids present in the tank with coal tar based wastes. This coal tar based waste is broadly similar to creosol, which is not compatible with nitric acid.

Although the acid wastes brought onto the site the day of the incident were adequately checked and found to be suitable for storage, the presence and analysis of any sludge at the bottom of the tank was not taken into account. The company did not have any formal external inspection procedures of the acid tanks, although informal inspections were carried out.

Relevant requirements of S5.06

2.1.2 Acceptance procedures when waste arrives at the installation

Preamble: Once a waste has entered bulk storage or a treatment process, the tracking of individual waste will not be feasible. However, records should be maintained to ensure sufficient knowledge is available as to what wastes have entered a particular vessel / tank. For example, it is necessary to keep track of residues that will be building up within a vessel between de-sludging events in order to avoid any incompatibility with incoming wastes.

2.1.3 Waste Storage

General storage requirements

12. Procedures must be in place for the regular inspection and maintenance of storage areas, including drums, vessels, pavements and bunds. Inspections should pay particular attention to signs of damage, deterioration and leakage. Records should be kept detailing action taken. Faults must be repaired as soon as practicable.

Storage of drummed waste and other containerised wastes such as IBCs

20. Containers should be stored in such a manner that leaks and spillages could not escape over bunds/edge of the sealed drainage area.

Aged stock

24. It is important to avoid accumulations of waste, which may in turn lead to deterioration in the container resulting in spillage or, in extreme cases, the deformation of the container.

Compatibility Testing

31. In order to prevent any adverse or unexpected reactions and releases before transfer involving the following activities, testing should take place prior to the transfer:

- tanker discharge to bulk storage
- tank-to-tank transfer
- transfer from container to bilk tank
- bulking into drums / IBCs
- bulking of solid waste into drums or skips

Bulk storage vessels

45. Vessels supporting structures, pipes, hoses and connections should be resistant to the substances (or mix of substances) being stored. There should be a routine programmed inspection of tanks, mixing and reaction vessels including periodic thickness testing. These inspections should preferably be carried out by independent expert staff, and written records should be maintained of the inspection and any remedial action taken.

46. Vessels should not be used beyond the specified design life or used in a manner or for substances that they were not designed. Vessels should be inspected at regular intervals, with written records kept to prove that they remain fit for purpose. See HSE Guidance note PM75.

Suggested improvements to S5.06

HSE guidance note PM75 specifies that methodology and record keeping is required for external and internal inspections of storage. There possibly should be a standard which specifies how often tanks should be de-sludged, or how potential reactions between sludges and other substances in containers should be taken into account.

Consideration should be given to include a requirement to undertake compatibility testing of tank residues with wastes to be accepted before transfer for storage or treatment.

Incident 5 September 1999 - Minworth Treatment Facility, Forge Lane, Minworth	
Date of Incident	September 1999
Operator Name (at time of incident)	Caird Environmental Limited
Site Address	Minworth treatment Facility, Forge Lane, Minworth, Birmingham

The incident

The incident took place during the transfer of waste from the reaction vessel to Intermediate Bulk Containers (IBCs). Monitoring equipment did not detect that the stirrer within a reaction vessel had failed, leading to layering within the vessel. When the content of the reaction vessel was discharged into an IBC, with no lid, a cloud of gas smelling of chlorine was released. The IBC was not in an enclosed area and not connected to a scrubber unit.

The cloud of gas drifted to adjacent industrial units affecting a number of people who complained of sickness and difficulty breathing. The reported effects lasted from 1-2 hours to all day.

Description of causes

The Process

The activity concerned a water reaction process. The reaction vessel contained 1,000 gallons and was vented to a scrubber system. The normal method of operation is to put the water reactive wastes into the reaction vessel and add water at a controlled rate until the reaction is complete. The reaction principally produces heat and acidic water. One member of staff, the site chemist, oversees the reaction. The reaction vessel is then drained off via a flexible pipe to an IBC, which is in an enclosed area and connected to a scrubber unit.

Background Information

The subsequent investigation concluded that the reaction was likely to have come from a brominated water compound, which had not completely reacted, probably due to layering forming within the wastes in the reaction vessel. When this was discharged to the IBC, the reaction started again and gas was released.

The water reaction process has main hazards linked to heat, steam and acidic waste products. Key to controlling these hazards are the condition and maintenance of the reaction vessel, the impermeable pavements and the maintenance of the scrubber system. In this case, none of these led to the incident.

The primary cause of the incident was a failure to ensure the wastes were properly reacted. Although there were monitoring probes in the reaction vessel, on investigation these were found not to be working and there was also some doubt over whether their range of functions would have been sufficient.

A secondary cause was the decision to discharge the wastes to an IBC that was not in the enclosed area connected to the scrubber system. The operating procedure for the site, stated that the IBC should be positioned within the enclosed area which was vented via the scrubber. However it also gives the site chemist discretion to use their judgement and initiative in terms of compliance with the procedure.

Relevant requirements of S5.06

2.1.4 Treatment – general principles

General Principles

5. For each new reaction, proposed mixes of wastes and reagents should be assessed prior to treatment in a scale laboratory test mix of the wastes and reagents to be used. This should lead to all reactions and mixing of wastes being to a predetermined batch “recipe”. It should also take into account the potential scale-up effects, for example, increased heat of reaction with increased reaction mass relative to the reactor volume, increased residence time within the reactor and modified reaction properties.

The site undertook "mimic" tests in the laboratory for other processes carried out on site, but not for the water reactive wastes. The water reaction process is not suitable for this because of the hazardous reactions, which would be dangerous in the laboratory. As a result there needs to be much more emphasis on the chemist’s ability and judgement.

10. Where appropriate, reactor vessels (or mixing vessels where the treatment is carried out) should be charged with pre-mixed wastes and reagents. For example, reactor vessels should be “pre-limed” or charged first with the reacting alkali to control the reaction using, for example, calcium hydroxide solution made up prior to charging the reactor vessel. The decanting of sacks or drums to the vessel should be avoided. Failure to charge the vessel can lead to:

- concentration “hot spots” at the surface of the reaction liquor
- loss of reaction control
- emission of fume from the instantaneous reaction at the interface
- the open hatch venting any fume and by-passing appropriate abatement

There were hot spots and a lack of control of the process, which did not ensure thorough reaction.

11. The reaction should be monitored to ensure that the reaction is under control and proceeding towards the anticipated result. For this purpose, vessels used for treatment should be equipped appropriately for example high-level, pH and temperature monitors. These should be automatic and continuous and linked to a clear display in the control room or laboratory together with an audible alarm. Risk assessment may require process monitors to be linked to cut-off devices.

The monitoring equipment on site was not well maintained and in this case was not functioning. There was no routine maintenance schedule that checked its operation or ensured its routine servicing. The standard of the monitoring equipment fell well short of the required standard because it was very basic.

2.3 Management

Operations and maintenance

1. Effective operational and maintenance systems should be employed on all aspects of the process whose failure could impact on the environment, in particular there should be:

- documented procedures to control operations that may have an adverse impact on the environment
- a defined procedure for identifying, reviewing and prioritising items of plant for which a preventative maintenance regime is appropriate
- documented procedures for monitoring emissions or impacts
- a preventative maintenance programme covering all plant, whose failure could lead to impact on the environment, including regular inspection of major ‘non productive’ items such as tanks, pipework, retaining walls, bunds ducts and filters

There was no procedure for identifying equipment that needed preventative or routine maintenance. There was no routine preventative maintenance programme for equipment, which could have an impact on the environment in the event of their failure.

Competence and training

3. Training systems, covering the following items, should be in place for all relevant staff which cover

- awareness of the regulatory implications of the Permit for the activity and their work activities
- awareness of all potential environmental effects from operation under normal and abnormal circumstances
- awareness of the need to report deviation from the Permit
- prevention of accidental emissions and action to be taken when accidental emissions occur

Training for staff was given but follow up and refresher training was absent.

Organisation

14. The company should have demonstrable procedures (eg. written instructions) which incorporate environmental considerations into the following areas:

- the control of process and engineering change on the installation
- design, construction and review of new facilities and other capital projects (including provision for their decommissioning)
- capital approval
- purchasing policy

There were management procedures for the process that were largely adequate and precautionary. However the procedures were undermined by the inclusion of a statement that the site chemist could use their judgement on whether to comply with the procedure. This was compounded by the problem that the reaction could not be 'mimic' tested which invested even more reliance on the site chemist.

15. The company should conduct audits, at least annually, to check that all activities are being carried out in conformity with the above requirements. Preferably, these should be independent.

17. The company should operate a formal Environmental Management System. Preferably, this should be a registered or certified EMAS/ISO 14001 system (issued and audited by an accredited certification body).

The operator at that time had no formal accreditation scheme and there was no auditing of whether the site operating procedures were being followed or not.

Suggested improvements to S5.06

None suggested

Incident 6 October 2000 - Upper Parting Tar Works, Sandhurst	
Date of incident	30 October 2000
Operator Name (at time of incident)	Cleansing Service Group Ltd
Site Address	Upper Parting Tar Works, Sandhurst Lane, Sandhurst, Gloucester

The incident

A fire started in the lab smalls area of the transfer station, possibly due to incompatible wastes being stored together within the same drum. The lab smalls were stored next to IBCs filled with Isopropyl Alcohol (IPA). These were close enough for a pool of burning liquid to spread under the IBCs. The taps on the IBC's expanded and IPA leaked onto the site surface. These fires under the IBC became self-fuelling due to the leaking IPA. As the fire progressed, these IBCs ruptured, causing a spread of the fire to other flammable liquids stored nearby. When the spreading pool of burning IPA reached these containers, they are believed to have ruptured under the intense heat and exploded, producing large fireballs.

The fire spread to other areas of the site, including the designated storage area for cleaned drums and IBCs. The site office was located close to this area, and it too became involved in the fire. The fire also spread to a road tanker, which had been used on site for bulking up and storage of chlorinated solvents. The tanker seals failed in the heat, allowing the contents to escape. The contents are believed to have been incinerated within the fire, causing the formation and release of hydrogen chloride gas, phosgene and possibly some chlorinated hydrocarbon vapours.

Residents from the village close to the site were evacuated. Many complained of breathing difficulties and other symptoms associated with inhalation exposure to a variety of non-particulate toxic combustion products and respirable air particulates.

Description of causes

Background Information

On review of the lab smalls storage area, it was found that drums containing lab smalls had the following problems:

- single drums contained incompatible wastes which had mixed hazards for example water reactive wastes in the same drum as flammable liquids
- some drums contained unknown wastes
- some were poorly packaged and also included packaging which was in itself easily flammable such as cardboard

Fire Spread

Flammable and highly flammable liquids were stored in plastic IBCs. These containers were easily breached in the fire, and released strong flows of burning liquid. There was no provision for controlling the flow of burning liquid in the event of fire – for example designated bunded areas for flammable liquids.

There were no firebreaks between storage areas. Areas that did not contain flammable waste were compromised by the storage of empty plastic drums and IBCs, which provided a pathway for fire to spread.

The IPA was initially thought to be flammable but on review was classed as highly flammable which altered its hazard. However this was not recognised in positioning the waste on site. Additionally the IPA had not been formally designated a storage area or been put in with the other flammable wastes. The storage adjacent to the lab smalls area had been an ad-hoc arrangement that had become accepted practice on the site.

The fire service attended the incident but were hampered in their ability to deal with the fire because:

- the access road passed close to the boundary of the site and was affected by the fire itself, in particular smoke and there was no alternative access
- no site inventory existed. The records of wastes had been stored in the site office, which burnt down, with no additional copies kept available off site. Also there were unknown wastes on site and wastes that would not have appeared on the inventory
- the site was affected by rocketing metal drums and aerosol cans.

Flooding Incident

The River Severn flooded the site three days after the fire incident. Wastes that were subsequently identified as water reactive were inappropriately stored causing further pollution.

Investigation

The subsequent investigation raised concerns regarding the site operations. Some of these had influenced the fire and flooding incidents, while others had played no part but could have led to further environmental consequences. In particular, it was found that although appropriate procedures were in place they weren't necessarily being followed. For example, the operators had a rejection procedure, but this was not being followed as rejected wastes were not being removed from site.

When the site flooded, it became apparent that the contents of 3 drums had reacted and led to a release on site, which was noticeable as a red staining on buildings and equipment. It took 4 months to trace the details of the waste, which turned out to be selenium grinding sludge wastes, which had been kept on site as no onward disposal route had been found. The wastes had been mis-described by the waste producer and sales contact during pre-acceptance and the hazards associated with the waste were not correctly identified. These wastes were found to be water reactive.

In addition to this, 7 drums of waste were found on site, which had originated from early BSE research. The waste originated from the former Veterinary Laboratories Agency, and had been designated for disposal by incineration. This had been agreed with the original waste contractor removing the wastes. The waste contractor stopped using the designated incinerator and obtained a quote from CSG for removing the wastes. The wastes had been on site for four years and had managed to become “lost” in the site and missed off the site’s inventory of wastes.

Another issue picked up by the subsequent investigation was that the site had accumulated radioactive wastes (mostly low level small sources) from the lab smalls collections. The site chemists, when unpacking the wastes, were separating out laboratory chemicals such as uranyl nitrate, and storing them in 45 gallon drums. This practice seemed to have its roots in trying to be helpful to the customer, however the chemists had failed to flag this up to site management. The company had failed to remove the holding they had on site and stop the intake of such wastes. As a result, the accumulations were becoming a hazard.

Relevant requirements of S5.06

2.1.1 Pre-acceptance procedures to assess waste

1. From the waste disposal enquiry the Operator should obtain information in writing relating to:

- the type of process producing the waste
- the specific process from which the waste derives
- hazards associated with the waste

15. There must be a clear distinction between sales and technical staff roles and responsibilities. If non-technical sales staff are involved in waste disposal enquiries, then a final technical assessment prior to approval should be made. It is this final technical checking that should be used to avoid build-up of accumulations of wastes.

It became apparent after the incident that some wastes (for example the selenium waste, BSE-contaminated solvents) were accepted onto site without any onward disposal option being confirmed, leading to accumulations of wastes that posed disposal problems.

17. For laboratory smalls, whether or not the operator of the installation packs them on behalf of the producer, a full list of laboratory smalls should be created and transported with the waste. Operators should have written procedures regarding the segregation, packaging and labelling of laboratory smalls ...

Many of the laboratory smalls stored on site were improperly packed, and not clearly identified.

2.1.2 Acceptance procedures when waste arrives at the installation

Sampling – checking – testing of waste - storage

8. Other than pure product chemicals and laboratory smalls, no wastes should be accepted at the installation without sampling, checking and testing being carried out. Reliance solely on the written information supplied is not acceptable, and physical verification and analytical confirmation are required. All wastes, whether for on-site treatment or simply storage, must be sampled and undergo verification and compliance testing.

10. On-site verification and compliance testing should take place to confirm:

- consistency with pre-acceptance information and proposed treatment method

Acceptance testing did not take place for all containerised wastes, with the result that wastes were subsequently stored inappropriately.

2.1.3 Waste Storage

General Storage Requirements

6. Storage areas are often the most visible aspects of the installation. Storage areas should be located away from watercourses and sensitive perimeters, for example, those which may be adjacent to public rights of way, housing or schools, and within the security-protected area of the installation to prevent vandalism.

10. All containers should be clearly labelled with the date of arrival, relevant hazard code(s), chemical identity and composition of the waste and a unique reference number or code enabling identification through stock control and cross-reference to pre-acceptance and acceptance records. All labelling should be resilient enough to stay attached and legible throughout the whole time of storage at the installation.

11. Storage area drainage infrastructure should ensure that all contaminated run-off is contained, that drainage from incompatible wastes cannot come into contact with each

other and that fire cannot spread between storage/treatment areas via the drainage system.

Turnover

18. Storage within the reception area should be for a maximum of five working days. Following receipt, wastes should be treated or removed off site as soon as possible. The total storage time will depend on the characteristics of a particular site and the waste types being stored. For example, on a site in a sensitive location handling hazardous wastes, it may be appropriate to limit storage times to one month. Other non-hazardous wastes, however, may be held on site for longer periods. However, all waste should be treated or removed off site within a maximum of six months of the date of receipt.

Storage of drummed waste and other containerised wastes such as IBCs

23. Storage areas for containers flammable or highly flammable wastes should meet the requirements of HSG51, HSG71 and HSG176.

Segregation

In addition to the requirements of this document, the segregation of the wastes should meet the requirements of HSG71 and must be justified by risk assessment.

Storage of aerosols

27. Storage of aerosols should take place under cover in closed containers or cages. Aerosols should not be stored in open containers.

Storage of laboratory smalls

29. Incompatible substances should not be stored within the same drum.

30. Sorting and repackaging of laboratory smalls should take place in a dedicated area/store. Once the wastes have been sorted according to their hazard classification, with due consideration for any potential incompatibility problems, and repacked, then these drums should not be stored within the dedicated laboratory smalls area but should be removed to the appropriate storage area.

There were examples of storage arrangements falling short of the above in a number of areas, and the spread of the fire across most of the storage area was believed to have been a direct result of these issues.

2.3 Management

Operations and Maintenance

1. Effective operational and maintenance systems should be employed on all aspects of the process whose failure could impact on the environment, in particular there should be.

a preventative maintenance programme covering all plant, whose failure could lead to impact on the environment.

Competence and Training

3. Training systems covering the following items should be in place for all staff which cover.

- awareness of all potential environmental effects from operation under normal and abnormal circumstances
- prevention of accidental emissions and action to be taken when accidental emissions occur

Accidents/incidents/non-conformance

8. There should be an accident plan as described in Section 2.8 which:

- identifies the likelihood and consequence of accidents
- identifies actions to prevent accidents and mitigate any consequences

2.8 Accidents

1. A formal structured management plan should be in place which covers the following aspects:

2 **A - identification of the hazards** to the environment posed by the installation using a methodology akin to a Hazop study: areas to consider should include, but should not be limited to, the following:

- arrangements for the receipt and checking of incoming wastes, including rejection and quarantine
- arrangements for storage, segregation and separation of differing waste types
- failure to contain firewater
- incompatible substances allowed to come into contact

3 **B - Assessment of risks.** The hazards having been identified, the process of assessing the risks should address six basic questions:

- how likely is the event to occur
- what substances are released and how much of each
- where do the released substances end up
- what are the consequences
- what are the overall risks
- what can be done to reduce the risk

5 **C - Identification of the techniques necessary to reduce the risks.** The following techniques are relevant to most installations:

- there should be an up to date plan showing the precise location of wastes having specific hazard characteristics
- where the installation is in a floodplain, consideration should be given to techniques which will minimise the risk of the flooding causing a pollution incident or making one worse
- appropriate control techniques should be in place to limit the consequences of an accident, such as; fire walls, firebreaks, isolation of drains, provision of oil spillage equipment, alerting of relevant authorities and evacuation procedures

Suggested improvements to S5.06

With regard to indicative BAT requirements for waste storage (2.1.3), points 23 and 25 relating to storage and segregation of non-compatible waste are fundamental to the incident, the current guidance may not be sufficiently robust on this point.

Incident 7 July 2001 - Corporation Road, Newport, Gwent	
Date of incident	16 July 2001
Operator Name (at time of incident)	Park Environmental Ltd
Site Address	Park House, Corporation Road, Newport

The incident

The incident occurred when three times the normal amount of caustic was added to a treatment tank in one go. This produced a vigorous reaction and a cloud of hydrogen sulphide gas was released. The incident was only noticed when an employee (the site chemist) was found unconscious within the building where the treatment was taking place.

The alarm was raised and the site chemist attempted to shut the batching and mixing process down remotely using the automated system. When this failed to respond, the chemist decided to attempt to shut the system down manually close to the tank. He entered the building and was later found by the fire crews. He was pronounced dead on arrival at hospital.

Description of causes

The Process

The site operated almost entirely on one process, an acid/alkali neutralisation process. Most wastes were acids that were treated with caustic/lime sludges. Neutral sludges containing metals were also accepted for treatment. The acids and alkalis were mixed and neutralised, which precipitated out the metals into sludges.

The caustic / alkalis were added at a controlled rate and mixed to produce a controlled reaction. At the end of the addition the mixture was left for 6-7 hours for the reaction to complete. The sludge was then pumped from the bottom of the tank and pressed. The supernatant liquors were sent for disposal to sewer. The sludge was sent for disposal to landfill.

Background Information

Pre-acceptance testing was in place. Any waste streams proposed for the plant were checked for compatibility with the treatment within the terms of the Waste Management Licence and the Trade Effluent Agreement. Virtually all the wastes arrived by tanker. Before offloading, a sample would be taken and analysed for pH, specific gravity, visual appearance and odours. If this proved compliant with the pre-acceptance checks, the waste was offloaded and put into either:

- an empty treatment tank, or
- a treatment tank holding compatible wastes, or
- the site's holding tank.

After pre-acceptance testing the wastes stream was given a unique name/identifier.

There was no consideration of whether reactions may liberate gasses or toxic gasses. The site was not equipped with any gas monitoring / alarms in the building. At the waste acceptance phase, mimic tests were carried out but these did not monitor for gaseous emissions.

While the tanks were structurally sound, certain parts of the maintenance had been neglected. These included:

- The lids of the tanks were in very poor condition although they were not designed to be sealed.
- The pumps used, for emptying the tank of sludges were located inside the tank which made them difficult to maintain and they had not been working for some period. Therefore another system using a pump suspended on a gantry had been installed. Because of this, the tank had a very large accumulation of sludges at the bottom containing various contaminants, which were largely unknown. The mixing system had become compromised by the accumulations of sludge.

The Environment Agency were concerned with the state of the tanks and were considering enforcement action, however, the actual conditions of the sites Waste Management Licence were being complied with.

The incident happened just after responsibilities were handed over to a recently recruited and inexperienced chemist. The hand-over between the chemists was during the shift change. It was very brief and the new chemist was not fully informed of what stage the reaction in the tank was at. The new chemist was under the impression that the process was nearly completed. Level gauges/alarms for the tank were absent and would have helped in this respect.

It was initially considered that the quick reaction and liberation of hydrogen sulphide gas was caused by the addition of too much caustic too quickly. However the investigation could not reproduce the amount of gas from the wastes added alone. The investigation concluded that the sludge in the bottom of the tank contained residues of poly-sulphides from the wastes that had built up over time. The reaction was aided by the fact that thermoclines were probably present in the wastes, initially keeping the acids and caustics layered and subsequently assisting a rapid reaction.

There were failings in the management systems on site, which included:

- poor handover procedures between the chemists
- the lack of auditing/maintenance of equipment
- the lack of health and safety procedures which allowed the chemist to re-enter the building

The subsequent investigation also found that company affairs were almost solely driven by financial considerations. The company was not rejecting new waste streams and the strengths of acids that were accepted for treatment rose steadily until very high strength acids were included in the accepted waste streams.

Relevant requirements of S5.06

2.1.1 Pre-acceptance procedures to assess waste

11. Further analysis may include other parameters relevant to the treatment method or waste stream for example presence of sulphide.

2.1.2 Acceptance procedures when waste arrives at the installation

Preamble: Once a waste has entered bulk storage or a treatment process, the tracking of individual waste will not be feasible. However, records should be maintained to ensure sufficient knowledge is available as to what wastes have entered a particular vessel / tank. For example, it is necessary to keep track of residues that will be building up within a vessel between de-sludging events in order to avoid any incompatibility with incoming wastes.

2.1.3 Waste Storage

Compatibility Testing

31. In order to prevent any adverse or unexpected reactions and releases before transfer involving the following activities, testing should take place prior to the transfer:

- Tanker discharge to bulk storage
- Tank-to-tank transfer
- Transfer from container to bilk tank
- Bulking into drums / IBCs
- Bulking of solid waste into drums or skips

2.1.4 Treatment – general principles

General principles

1. Provide adequate process descriptions of the activities and the abatement and control equipment for all of the activities such that the Regulator can understand the process in sufficient detail to assess the operator's proposals and in particular to be able to assess opportunities for further improvements. This should include:

- details of chemical reactions and their kinetics/energy balance
- description of how protection is provided during abnormal operating conditions such as runaway reactions, unexpected releases, start-up, momentary stoppages and shut-down for as long as is necessary to ensure compliance with release limits in Permits

6. For each new reaction proposed mixes of wastes and reagents should be assessed prior to treatment in a laboratory scale test mix of the wastes and the reagents to be used. This should lead to all reactions and mixing of the wastes being to a predetermined batch "recipe". It should also take into account the potential scale-up effects, for example, increased heat of reaction with increased reaction mass relative to the reactor volume, increased residence time within the reactor and modified reaction properties. See HSG143 for further Guidance.

7. The reactor vessel and plant should be specifically designed, commissioned and operated to be fit for such a purpose. Such designs should include consideration of chemical process hazards and a hazard assessment of the chemical reactions, prevention and protective measures together with consideration of process management that is working instructions, staff training plant maintenance, checks, audits and emergency procedures.

9. All treatment/reaction vessels should be enclosed and should be vented to atmosphere via an appropriate scrubbing system.

11. The reaction should be monitored to ensure that the reaction is under control and proceeding towards the anticipated result. For this purpose, vessels used for treatment should be equipped appropriately for example high-level, pH and temperature monitors. These should be automatic, continuous and linked to a clear display in the control room or laboratory together with an audible alarm. Risk assessment may require process monitors to be linked to cut-off devices.

2.3 Management

Operations and maintenance

1. Effective operational and maintenance systems should be employed on all aspects of the process whose failure could impact on the environment, in particular there should be.

a preventative maintenance programme covering all plant, whose failure could lead to impact on the environment, including regular inspection of major ‘non productive’ items such as tanks, pipework, retaining walls, bunds ducts and filters

Competence and training

3. Training systems covering the following items should be in place for all staff which cover.

- awareness of all potential environmental effects from operation under normal and abnormal circumstances
- prevention of accidental emissions and action to be taken when accidental emissions occur

Accidents/incidents/non-conformance

8. There should be an accident plan as described in Section 2.8 which:

- identifies the likelihood and consequence of accidents.

Suggested improvements to S5.06

Consideration should be given to including a requirement to undertake compatibility testing of tank residues with wastes to be accepted before transfer to storage or treatment.

Incident 8 April 2002 – East Percy Street, North Shields, North Tyneside	
Date of incident	12 April 2002
Operator Name (at time of incident)	Distillex Ltd
Site Address	East Percy Street, North Shields,North Tyneside

The incident

A major fire developed on the site after an IBC containing flammable substances was cut for disposal using an angle grinder. The angle grinder produced a large number of sparks that ignited the contents of the IBC. Despite attempts by site operatives to tackle the fire, it spread quickly through the site.

A contributory factor in the rapid spread of the fire was a number of plastic and steel containers containing flammable and combustible liquids stored outside of bunded areas on site. This reduced the separation distances between stacks of flammable liquids and meant there was an absence of secondary containment.

The fire led to exploding drums of flammable liquid being projected off site. It also spread to some neighbouring premises. The emergency services evacuated people within a half-mile radius of the site. The site buildings and one neighbouring building had to be demolished. The local health authority reported 5 casualties and the police reported 36 injuries on duty resulting from the incident.

The company had not produced any written procedures to provide information, instruction or training to employees on the methods to be used for the disposal of IBCs. Channels for communication of instructions to the site operative cutting the IBC's were not clearly defined.

Description of causes

The Process

IBCs were normally cut in the centre of the yard. However, in this case, cutting occurred between the site skip and the nearby storage area. The container being cut contained Solvent 30 - which contains isoheptanes and cycloheptanes with a flash point of 2 degrees celcius, and 4,4-Difluorobenzophenone, which is a combustible solid. Sparks from the angle grinder ignited the IBCs contents causing the fire.

Relevant requirements of S5.06

2.1.3 Waste Storage

Storage of drummed waste and other containerised wastes such as IBCs

23. Storage areas for containers holding flammable or highly flammable wastes should meet the requirements of HSG 51, HSG 71 and HSG 176. (typo corrected)

Segregation

25. In addition to the requirements of S5.06, the segregation of wastes should meet the requirements of HSG71 and be justified by risk assessment.

2.1.13 Drum washing, crushing, shredding and cutting

4. Processing of containers should only be undertaken in accordance with written instructions. These instructions should include which containers are to be processed and the type of container to hold residues.

2.3 Management

Operations and maintenance

1. Effective operational and maintenance systems should be employed on all aspects of the process whose failure could impact on the environment, in particular there should be:

- documented procedures to control operations that may have an adverse impact on the environment

Competence and training

3. Training systems, covering the following items, should be in place for all relevant staff which cover

- awareness of all potential environmental effects from operation under normal and abnormal circumstances

2.8 Accidents

5 **C** - **identification of the techniques necessary to reduce the risks.** The following techniques are relevant to most installations:

- procedures should be in place to avoid accidents occurring as a result of poor communication between staff at shift changes or during maintenance or other engineering work

Appropriate control techniques should be in place to limit the consequences of an accident, such as, fire walls, firebreaks, isolation of drains, provision of oil spillage equipment, alerting of relevant authorities and evacuation procedures.

Suggested improvements to S5.06

There is no statement in S5.06 that hot cutting/grinding is not an indicative BAT standard. As many alternatives are available, for example handsaw, bolt cutters, and the potential for fire and explosion at hazardous waste management facilities is high, these alternatives should be made BAT standards and hot cutting/grinding deemed inappropriate.

The requirement that container washing and cutting operations must take account of the former contents and any residues that may be present is also not a BAT standard, but is mentioned in the accompanying text. It could be included as a BAT standard.

Incident 9 March 2004 - Tofts Road West, Hartlepool, Cleveland

Date of incident	3 March 2004
Operator Name (at time of incident)	Shanks and McEwan (Shanks Waste Services)
Site Address	Plot 3, Tofts Rd West, Hartlepool, Cleveland

The incident

The incident took place in the site's waste transfer and storage area when 4x160 litre and 4x 205 litre drums containing Lithium / Copper (Li / Cu) strip off-cuts reacted with moisture present either in the packed drum or from water ingress from storage outside.

The initial fire, reported to the fire service at 19.01hrs, happened when a 160 litre drum split open due to pressure build up and a 30cm spool of waste Li/Cu spilt onto the concrete. A witness described a classic metal fire "that appeared to dance like sparklers". The fire service attended the incident and after discussion with the site chemists, used water to cool the area to prevent the fire spreading further as an inventory of chemical waste on the site could not be provided. The site had only dry powder extinguishers which the fire service considered too dangerous to use due to the metal fires random path around the yard and the possibility of endangering fire-fighters.

A water curtain was set up to cool the fire and thermal imaging equipment used to monitor the heat of the fire at its seat, the 160 litre drum. After cooling for an hour the fire service stood the incident down as temperatures where returning to normal. At 21:00 a large explosion occurred in the drum storage area and burning spools of Li/Cu was showered over the entire site causing numerous secondary fires. The local residents at Seaton Carew were warned to close all doors and windows and stay inside as smoke was being blown in the Towns direction. The smoke situation was further exacerbated by the secondary fires in the tank farm and flammable waste storage area. The main "non-haz" tanks were made of glass reinforced resin which was burning rapidly and giving off acrid toxic fumes. Five firemen were treated for smoke inhalation with two being admitted to hospital for monitoring overnight.

Throughout the incident numerous flammable liquids in storage exploded, ranging from 25 litre to 205 litre drums of solvents. Due to fact that an inventory of materials on the site could not be provided the Agency advised the fire service of the waste streams allowed under the licence and the fire was fought with the aim of containing it and preventing it spreading to other areas. At its height 12 fire engines and 60 firemen were fighting the blaze. By 09:00 the following day the situation was under control and all secondary fires were out, with only the water monitor continuing to cool the drummed waste bays.

Description of causes

The Process

The Hartlepool site carries out two specific hazardous waste treatment processes, namely physico-chemical treatment by filter press and oil water separation. A broad spectrum of waste types were also allowed under the site Waste Management Licence in relation to the waste transfer station including pre-cursors, inorganic and organic flammables etc.

Background Information

Waste lithium/copper strips from the manufacture of dry cell batteries were accepted onto the site contrary to the site licence which specifically excludes both alkaline earth metals and water reactives. The Li/Cu strip is used as the anode in dry cell batteries of the type found in modern watches. The material is a two sided strip, about the same width as a 35mm camera film, and is wound onto metal spools similar in appearance to cine films reels and about 30cm in diameter. As virgin product it is hermetically sealed in a dry room within foil packets and further sealed within 160l UN approved containers and shipped from the manufactures as a UN packing group II product. The material that caught fire was no longer sealed. It was wound back around the spool in some cases, and simply scrunched up in others, before being placed in waste 205l and 160l drums. The material had, according to the paperwork, been packed by a Shanks chemist and the waste producer paid for this service.

The failure to correctly store and package the material led to a reaction, most likely with moisture present within the waste drums. This in turn lead to a metal fire and the resulting explosions.

A very serious situation was worsened by the lack of a site inventory. This led to the fire service having to fight the fire defensively rather than being able to attack points selectively to prevent is spread. In effect the fire service had to drench the site and let the fire burn itself out.

Time of the incident

Had this incident occurred in summer not winter and the wind direction not changed, injuries from the fire's smoke could have been more numerous and serious.

Relevant requirements of S5.06

2.1.2 Acceptance procedures when waste arrives at the installation

Waste Rejection Procedures

34. The operator should have clear and unambiguous criteria for the rejection of wastes, together with a written procedure for tracking and reporting such non-conformance. This should include notification to the customer/waste producer and the Environment Agency. Written/computerised records should form part of the waste tracking system information. The operator should also have a clear and unambiguous policy for the subsequent storage and disposal of such rejected wastes. This policy should achieve the following:

- identifies the hazards posed by the rejected wastes
- labels rejected wastes with all information necessary to allow proper storage and segregation arrangements to be put in place
- segregates and stores rejected wastes safely pending removal

The Waste Management Licence specifically excluded both alkaline earth metals and water reactives.

2.1.3 Waste Storage

General storage requirements

12. Procedures must be in place for the regular inspection and maintenance of storage areas, including drums, vessels, pavements and bunds. Inspections should pay particular attention to signs of damage, deterioration and leakage. Records should be kept detailing action taken. Faults must be repaired as soon as practicable...

Aged stock

24. It is important to avoid accumulations of waste, which may in turn lead to deterioration in the container resulting in spillage or, in extreme cases, the deformation of the container.

Suggested improvements to S5.06

HSE booklets HSG 51 and HSG 71 clearly state the correct and safe storage of such materials and their compatibility. Despite this material was not stored properly. A regular audit by a third party within the area of storage would highlight potential problems and help ensure unauthorised wastes are not on such sites.

Incident 10 April 2006 - Lower Bank View, Bootle	
Date of incident	27 April 2006
Operator Name (at time of incident)	Veolia ES Onyx
Site Address	Lower Bank View, Bootle

The incident

The bulking up of incompatible wastes leading to uncontrolled exothermic reaction and the release of toxic gas.

Description of causes

The Process

Acidic wastes are neutralised at the site in reaction vessels. Twenty four tonnes of waste hydrobromic acid (containing organic material including isopropanol and butanol) were accepted at the site were stored in bulk storage tank AST5 pending neutralisation. Four tonnes of hydrobromic acid remained in AST5 when 18 tonnes of aqueous 10% waste nitric acid was accepted at the site (it had been consigned as 4 to 5%) and added to AST5, which also contained a quantity of residual sludge. As AST5 was a 30 tonne glass reinforced plastic storage tank it was not equipped with any reaction monitoring equipment but was connected to abatement scrubbers via PVC pipe work, unfortunately the pipe work was melted by the exothermic reaction.

Background Information

Approximately one and a half hours after the ‘bulking’ of the nitric acid and hydrobromic acid, staff reported the smell of bromine or chlorine gas, an alarm was sounded and the site evacuated. Although there was no confirmation over the nature of the incident, staff subsequently returned to work. When site personnel subsequently investigated, it was found that there was an “orangey brown gas” within the acid tank bund and around the acid storage tanks and it was then concluded that there was a reaction in AST5. White fumes were then observed around the tanks, so the alarm was again sounded and the site was evacuated for the second time. In trying to undertake remedial measures and transfer lime into a bund to react the acid, the site manager and 3 senior staff (wearing cartridge breathing masks) were very badly effected, the site manager collapsed out of the building and all 4 required oxygen at the site and were then taken to hospital.

Conditions with the building were extremely bad with visibility of a few inches due to the fumes. Efforts were made by site personnel equipped with breathing apparatus, supervised by the fire service, to react the contents of AST5. There were a number of problems encountered, with pumps repeatedly failing and the complication that tanks AST5 and AST6 had been transposed on the site plan, so they had been initially attempting to pump from the wrong tank. The lines were then correctly connected to AST5 which held the acid wastes 17 hours after the incident was detected. The transfer then began and the waste neutralised a further 9 hours later.

During this time there had been a number of complaints from public nearby of the effects of the toxic gas off site. These complaints were typically about the effects on their eyes.

The company had compatibility procedures that included the use of a ticket system to record a test had been undertaken and authorising the bulking up, but there was no evidence that it had been used on this occasion. The test undertaken involved the mixing of the sample of waste nitric acid with a sample of waste hydrobromic acid that had been discharged into tank AST5 (not the actual contents of AST5), in a beaker in order to check for reaction. The beaker was held by hand for temperature monitoring, visually checked for colour change or precipitation and sniffed for gases released. The beaker was then left for about 15 minutes and then further checked for reaction.

Other Relevant Information

Emergency Plan

The issues surrounding the emergency plan touched on below, were dealt with by the HSE (in addition to the matters above), as it was a lower tier COMAH site. However, the issues and short-comings identified are no less applicable to other operators and serve as a reminder, so a summary is included for completeness:

- There was no evidence of training or information specifically relating to nitric acid or its reactions risks or mixing of acids
- The emergency plan did not define what they view as a major incident or when the alarm should have sounded, nor was it adequately understood by employees
- There was no procedure or plan for responding to incidents, investigating them safely and criteria for declaring the site safe
- The emergency plan must be reviewed regularly and updated (including changes in infrastructure, personnel, management and staffing structures).
- The Emergency Plan did not anticipate an unplanned reaction in storage vessels and so had not been tested for this type of scenario or incident
- There had been insufficient training on the role and responsibilities of Site Main Controller and Site Incident Controller eg. who would be expected to coordinate incidents
- The Emergency Plan was not followed

Relevant requirements of S5.06

It should be noted that this incident occurred in 2006 when the site was operating under its Waste Management Licence while its PPC permit application was being determined. Site operations would not have been required to meet S5.06 standards until the permit had been issued, however, the applicant (Shanks Waste Solutions) had stated that their procedures met the requirements of S5.06 in the application form.

Significant issues identified were:

- Pre-acceptance procedures should have screened out the hydrobromic acid as an non-permitted waste
- Compatibility testing was not always recorded and the discharge ticket system not always used
- The basic compatibility testing was not sufficiently accurate to detect the exothermic reaction before the waste acids were mixed in the tank
- The compatibility test was undertaken with a sample from the previous incoming load and not the content of the tank itself
- The exothermic reaction was not detected in the bulk storage tank until the abatement failed
- PVC abatement pipework melted due to the reaction heat allowing the uncontrolled release of NOx
- The site plan transposed tanks AST5 and AST6, leading to some confusion

2.1.3 Waste Storage

Compatibility testing

31. In order to prevent any adverse or unexpected reactions and releases before transfer involving the following activities, testing should take place prior to the transfer:

- tanker discharge to bulk storage
- tank-to-tank transfer
- transfer from container to bulk tank
- bulking into drums/IBCs
- bulking of solid waste into drums or skips

32. Any evolved gases and cause of odour should be identified. If any adverse reaction is observed, an alternative discharge or disposal route should be found.

Transfer from tanker, drums and other containers in bulk storage

33. Due consideration should be taken of the implications of scale-up from laboratory compatibility testing to bulk transfer and the Guidance is given in HSG143….

35. Transfer/discharge should only take place after compatibility testing has been completed and then only with the sanction of an appropriate manager. Approval should specify which batch/ load of material is to be transferred, the receiving storage vessel, equipment required, including spillage control and recovery equipment, and any special provisions relevant to that batch/load.

39. A representative sample of the receiving tank/vessel/container should be mixed in a proportional ratio with a sample of incoming waste stream that it is proposed to add to the tank / vessel/container. The two samples should take account of the "worst-case" scenario of likely constituents. The particular test parameters will be driven by the wastes being bulked. As a minimum, records of testing should be kept including any reaction giving rise to:

- increase in temperature
- viscosity change
- separation or precipitation of solids
- evolution of gases
- evolution of odours

Bulk Storage

45. Vessels supporting structures, pipes, hoses and connections should be resistant to the substances (and mix of substances) being stored. There should be a routine programmed inspection of tanks, mixing and reaction vessels including periodic thickness testing. In the event of damage or significant deterioration being detected, the contents should be transferred to appropriate storage. These inspections should preferably be carried out by independent expert staff, and written records should be maintained of the inspection and any remedial action taken.

Suggested improvements to S5.06

Explicit pre-acceptance and acceptance BAT points to check whether waste is permitted at that facility.

Explicit prohibition on mixing or bulking up of nitric acid with any other wastes during storage and to store nitric acid batches separately.

Clarification of minimum requirements for compatibility testing and scale up and requirement for recording test results and keeping test results.

Requirements for all air abatement pipework to be constructed of heat resistant material.

Requirement for temperature monitoring on storage tanks used for bulking reactive wastes.

Incident 11 July 2006 – Technical Service Centre, Hinckley

Date of incident	05 July 2006
Operator Name (at time of incident)	Augean Treatment Ltd
Site Address	Technical Service Centre, Watling Street, Hinckley, Leicester

The incident

A fire started in a drum shredder used at the site. The shredder operator received burns to his face and left arm from a flash fire. The fire did not spread and no environmental damage was reported.

Description of causes

The drum shredder is used to shred empty drums not suitable for direct reuse. The shredded residues are sent for recycling.

The incident occurred during normal shredding operation. The operator's investigation of the cause identified that some undetected aerosols had been contained in the drums being shredded. This released flammable gas which was believed to have been ignited by sparking of metal on metal contact within the equipment.

The drums had not been checked by the operator to ensure their suitability prior to shredding. Although the operator's procedures stated that only empty drums were to be shredded, there were no written inspection procedures in place to check this prior to shredding.

The risk of fire had not been identified in the risk assessment and controls had not been put in place. The shredder did not have a built-in extinguisher system although there were handheld extinguishers located around it. There was no abatement system fitted to the shredder at the time of the incident.

Relevant requirements of S5.06

2.1.13 Drum washing, crushing, shredding and cutting

3. Drums containing (or which have contained):

- flammable and highly flammable wastes.
- volatile substances

that cannot be recovered, should not be subject to crushing, unless the residues have been removed and the drum cleaned.

4. Processing of containers should only be undertaken following written instruction. These instructions should include which containers are to be processed and the type of container to hold residues.

2.3 Management

3. Training systems, covering the following items, should be in place for all relevant staff which cover:

- awareness of the regulatory implications of the Permit for the activity and their work activities.
- awareness of all potential environmental effects from operation under normal and abnormal circumstances.
- awareness of the need to report deviation from the Permit.
- prevention of accidental emissions and action to be taken when accidental emissions occur.

Suggested improvements to S5.06

Under Section 2.1.13 Drum washing, crushing, shredding and cutting, BAT point 3 change ‘crushing’ to ‘processing’ to clarify that this applies also to shredding and cutting, and to emphasise that only empty containers should be processed.

Actions taken by operator since incident

The operator reviewed risk assessments, procedures and training, and ultimately decided to relocate the activity to a larger site where investment could be made in upgraded facilities.

Incident 12 September 2006 – Cannock Treatment Facility	
Date of incident	14 September 2006
Operator Name (at time of incident)	Augean Treatment Limited
Site Address	Cannock Treatment Facility, Walkmill Lane, Cannock, Staffordshire

The incident

A fire was initiated after the lid on a 205 litre drum stored in the waste reception area was removed / loosened by an operative to enable the contents to be sampled and tested by the Site Chemist. It had previously been raining and it is believed that the waste in the drum had water reactive properties, giving rise to ignition, and a fire started.

The fire readily spread to an adjacent container of flammable liquid, propagating the fire. A pool fire then spread to an adjacent storage area.

Photo 1 – fire initiation (photo taken from adjacent office block)

As containers in that area became hot, they pressurised and their lids were ejected from the site. Large volumes of dark smoke were emitted and the industrial estate units adjacent to the southern boundary were evacuated as a precaution. The police and fire service attended, as did a local environmental health officer.

Photo 2- fire escalation (note some reflection from the window)

Description of causes

The Process

At the time of the incident, the site's waste inputs were roughly 50% for on-site treatment through open mixing pits and 50% for onward transfer. The vast majority of inputs were in drums and Intermediate Bulk Containers (IBCs).

The site had a covered storage warehouse allowing particularly dangerous wastes (for example, water and air reactives, oxidants, lab smalls, cyanides) to be stored in individually bunded areas. Other materials destined for treatment or off-site transfer were stored in lanes in the open yard. The open yard was impermeably surfaced with sealed drainage to large sumps. The whole yard drained to these sumps.

Wastes were received in an area of the site used as the reception area, which was between two storage areas, (one of which was also used for quarantined wastes). Stock levels at this time were high so there wasn't adequate separation in between storage areas or between the waste reception and storage areas.

The infrastructure and layout at that time did not meet the standards detailed in S5.06.

Background Information

The morning of 14th September 2006 had been particularly wet, the yard sumps were full and some of the yard had standing water. The afternoon remained damp.

Four Environment Agency officers were on site at the time of the incident conducting a technical meeting with Augean's managers to discuss site development and implementation of the recently issued PPC permit.

It appears it was site practice for a site operative to remove drum lids on received loads, to allow a chemist to then take samples or perform acceptance tests on the wastes. The opening of the 205 litre drum allowed its contents to react with moisture and initiate an exothermic reaction leading to ignition.

When consignment notes for the loads in the reception area, were checked, water reactive or spontaneously combustible waste was not listed. Augean's investigation indicated the offending drum was a 'rogue' waste that had not been expected. Unfortunately the fire resulted in the destruction of the drums and their contents, so they could not determine which of two recently received consignments contained the waste.

During subsequent investigation it was found that some of the drums on the same pallet had markings suggesting that the drums had been routed by the consignor for incineration. It is possible that the pallet was erroneously sent to Cannock.

Other relevant information

The application for the Cannock permit had been initiated by ProActive Waste Solutions Ltd during the hazardous waste treatment sector 'tranche window'. ProActive were acquired by Augean during the determination period, so the application was transferred and the permit was issued to Augean in spring 2006.

ProActive had indicated in their application that they did not have procedures which fully complied with S5.06 but an omission in the issued permit did not include Improvement Conditions requiring S5.06 compliant pre-acceptance, acceptance and storage procedures.

Key findings were:

- all relevant staff had not been fully trained in S5.06 acceptance requirements.
- staff could not provide evidence that they were carrying out sampling and testing as required by S5.06.
- inspection of labelling on drums was not conducted immediately after off-loading, which might have identified the presence of the 'rogue' drum before an incident occurred.
- the failure to leave the container lidded until the visual checking and sampling was actually carried out, allowed the reaction to occur and escalate unnoticed.
- the lack of a self contained drainage system in the reception area allowed the pool fire to spread across the yard and affect other stored wastes.
- inadequate separation between the reception wastes and other stored (including quarantined) wastes allowed the fire and its radiant heat to affect other wastes on site.
- there was no fire wall around the lanes of flammable wastes stored near the affected area.

Relevant requirements of S5.06

2.1.2 Acceptance procedures when waste arrives at the installation

Load arrival

1. On arrival loads should:

have all documents checked and approved, and any discrepancies resolved before the waste is accepted

have any labelling that does not relate to the contents of the drum removed before acceptance on site.

2. Hazardous wastes should only be received under the supervision of a suitably qualified person (HNC qualified chemist or higher).

Load inspection

3. Visual inspection. Where possible, confirmatory checks should be undertaken before offloading where safety is not compromised. Inspection must in any event take place immediately upon offloading at the installation.

4. Check every container against accompanying paperwork. All containers should be clearly labelled and should be equipped with well fitting lids, caps and valves securely in place. Any damaged, corroded or unlabelled drums should be put into a quarantine area and dealt with appropriately. Following inspection, the waste should then be unloaded into a dedicated sampling / reception area.

5. At this stage the waste tracking system unique reference number should be applied to each container. Each container should also be labelled with the date of arrival on site and primary hazard code.

7. The inspection, unloading and sampling areas should be marked on a plan and have suitably sealed drainage systems.

Sampling – checking – testing of waste - storage

9. The Operator should ensure that waste delivered to the installation is accompanied by a written description of the waste describing:

- the physical and chemical composition
- hazard characteristics and handling precautions
- compatibility issues
- information specifying the original waste producer and process

10. On-site verification ... should take place to confirm:

- the identity of the waste
- the description of the waste
- consistency with pre-acceptance information and proposed treatment method
- compliance with permit

14. Wastes must not be deposited within a reception area without adequate space.

15. Wastes in containers should be unloaded into a dedicated reception area pending acceptance sampling... Wastes should be stored within this reception area according to compatibility in line with HSE Guidance Note HSG71. Appropriate storage must be achieved immediately upon offloading.

16. Should the inspection ... indicate that the wastes fail to meet the acceptance criteria (including damaged or unlabelled drums) then such loads should be stored in a dedicated quarantine area and dealt with appropriately...

21. The offloading, sampling point/reception and quarantine areas should have an impervious surface with self contained drainage, to prevent any spillage entering the storage systems or escaping off-site…

Sampling drummed waste

27. For drummed waste, controls should ensure each drum is given a unique label to facilitate a record of:

- the location of each drum
- the duration of storage
- the chemical identity of the drum's contents
- the hazard classification for each drum

General

40. The Operator should ensure that the installation personnel who may be involved in the sampling, checking and analysis procedures are suitably qualified (HNC qualified chemist or higher) and adequately trained, and that the training is updated on a regular basis.

2.1.3 Waste Storage

Offloading/discharge of waste

2. Off-loading and quarantine points should have an impervious surface with self-contained drainage, to prevent any spillage entering the storage systems or escaping off-site.

General storage requirements

8. Storage areas should be clearly marked and signed with regard to the quantity and hazardous characteristics of the wastes stored therein.

10. All containers should be clearly labelled with the date of arrival, relevant hazard code(s), chemical identity and composition of the waste and a unique reference number or code enabling etc.

11. Storage area drainage infrastructure should ensure that all contaminated run-off is contained, that drainage from incompatible wastes cannot come into contact with each other and that fire cannot spread between storage / treatment areas via the drainage system.

Storage of drummed waste and other containerised wastes such as IBCs

19. Storage under cover for drummed waste has the advantage of reducing the amount of potentially contaminated water that may be produced in the event of any spillage and extending the useful life of the container. It is preferable that wastes are stored under cover. This should also apply to any container that is held in storage pending sampling and emptied containers. Covered areas must have adequate provision for ventilation by means of wall or roof vents or construction of the area, for example, open barn. Any such warehousing should meet the requirements of HSG71

21. Containers should be stored with well fitting lids, caps and valves secured and in place.

22. Storage areas for containers holding substances that are known to be sensitive to heat and light or reactive with water or moisture should be under cover and protected from water, heat and direct sunlight.

23. Storage areas for containers holding flammable or highly flammable wastes should meet the requirements of HSG51, HSG71 and HSG76.

Segregation

25. In addition to the requirements of this document, the segregation of wastes should meet the requirements of HSG71 and be justified by risk assessment.

26. HSG 71 provides no guidance on the use of fire walls to achieve separation or segregation of different types of waste in outdoor storage. Fire walls which are impervious to liquid, at least 2m high, and capable of withstanding an intense fire on one side without collapse, can be used to reduce the 3m separation required for some combinations of materials marked as ‘keep apart’. No more than two sides of a storage area should be provided with fire walls, because it would prevent good ventilation.

Suggested improvements to S5.06

2.1.2 Acceptance procedures when waste arrives at the installation

1. The requirement to remove unwanted labelling should be moved to Acceptance BAT point 4 relating to visual inspection.

2. To make it clear that the chemist is in control of the receipt of waste it is proposed that the 'supervision' should be 'direct supervision'.

4, 14 and 15 (and storage point 23). The reception area must be dedicated to the task in accordance with point 4, and according to point 14 it must have adequate space to safely receive waste. Additionally, waste in the reception area must be stored in compliance with HSE Guidance note HSG71 and HSG51 (pre-acceptance point 15 and storage point 23).

Managing the requirements of these three linked areas is made difficult because:

- containerised loads may not be segregated for incompatibility or general safety on the vehicle it arrives in, even on a per pallet basis.
- containers may not be correctly labelled for their waste contents by the producer, which is one of the reasons for sampling and analysing relevant wastes at acceptance.
- HSG51 and HSG71 separation / segregation requirements involve storing wastes large distances apart or with walls between them.

Wherever possible, wastes in reception should be stored immediately in accordance with HSG51 and HSG71 based on the contents expected using the pre-acceptance and consignment/transfer note information.

If this is not possible, each segregated section of the reception area should be used for only one consignment at a time. The waste should be offloaded, checked, sampled, tested and the load put to the correct storage area before the next consignment can be off-loaded into that reception area. Where more than one pallet is received on the same load, each pallet should be separated. Unsegregated wastes stored in the reception area in this way must not remain longer than the end of the working day or 24 hours whichever is the sooner and not the five days normally allowed by point 15.

26. It should be made clear that containers should remain sealed at all times except during sampling/testing.

2.1.3 Waste storage

13. The requirement for daily inspection should be extended to include need to inspect and record daily the "integrity and security of all lids, caps and valves".

22 and 63. Whilst it is implied that "containers holding substances that are known to be sensitive to heat and light or reactive with water or moisture should be under cover and protected from water, heat and direct sunlight" and "Waste or raw materials in non-waterproof packaging should be kept under cover" includes the reception storage it should be made absolutely clear that this is the case. This means that such materials must only be received in a reception that is under cover.

Incident 13 November 2006 – Wednesbury Treatment Plant	
Date of incident	23 November 2006
Operator Name (at time of incident)	Biffa Waste Services Limited
Site Address	Potters Lane, Wednesbury, West Midlands

The incident

A 400 cubic metre tank (tank 7), which was being decommissioned for removal from site, partially collapsed whilst scaffolding contractors were working on top of it. The tank was connected to neighbouring tanks, which were holding hundreds of thousands of tonnes of hazardous waste, by interconnecting pipework and gantry walkways.

Description of causes

The Process

The decommissioning of tank 7 was subject to health & safety legislative requirements (Construction (Design and Management) Regulations, 2007) in addition to the PPC permit. A detailed decommissioning plan had been prepared by Biffa and their principal contractor; and the operator had established systems, involving ‘permit to work’, for such tasks.

The decommissioning plan had involved the initial removal of liquid waste from tank 7 (although a significant volume of sludge still remained which was to be dug out from the top of the tank subsequently). This was to be followed by the erection of scaffolding prior to any further work to remove tank contents.

The decommissioning contractor had previously loosened bolts on the side hatch of tank to allow excess liquid trapped between the tank sides and the sludge content to drain away to the bund. Biffa operatives were aware of this work and helped in pumping away the liquid.

On 23rd November the decommissioning contractor used a compressed air cutter (similar to those used by the fire service at road traffic accidents) to cut a number of vertical slits in the side of tank 7 to drain any remaining liquid. This caused the tank to buckle and partially collapse, as it had not been fully emptied and the supporting scaffolding had not been completed.

Background Information

The principal contractor, tank removal contractor and scaffolding contractor all received site induction by Biffa.

The scaffolding contractor was working under a permit to work in erecting the scaffolding but the tank removal contractor had not been issued with a permit to work.

Other Relevant Information

Our investigation found that the Operator’s onsite supervision was inadequate for all of the contractors. After initial induction the contractors were able to sign in and out at the office reception each day and then go onto the plant without designated Biffa staff supervising their movements. Even these arrangements failed when contractors came and went outside office hours, consequently the visitor/contractor records had omissions.

Condition 1.1.1 of the PPC permit (the ‘management’ condition) required adequate management and supervision of third party contractors working on their installation.

The tank removal contractor should have been issued with a general permit to work, authorising them to work alone within the installation but setting the limits of their activity.

Relevant requirements of S5.06

2.3 Management

Competence and training

6. The potential environmental risks posed by the work of contractors should be assessed and instructions provided to contractors about protecting the environment while working on site.

Organisation

17. The company should operate a formal Environmental Management System. Preferably, this should be a registered or certified EMAS/ISO14001 system (issued and audited by an accredited certification body).

Suggested improvements to S5.06

None suggested.

Actions taken by operator since incident

The Operator met the requirements of an Enforcement Notice served by the Environment Agency to improve their management procedures for the supervision of contractors.

Incident 14 March 2007 - Heysham Works, Morecambe	
Date of incident	13 March 2007
Operator Name (at time of incident)	Solvent Resource Management Limited
Site Address	Heysham Works, Middleton Road, Heysham

The incident

Bulking up of incompatible wastes leading to uncontrolled exothermic reaction, tank pressurisation, operation of pressure release valve and emissions to atmosphere.

Description of causes

The Process

Hazardous wastes are mixed to produce a fuel to a specification that can be burned in cement kilns. Flammable wastes are off-loaded into a holding tank before being transferred into a larger cemfuel blending tank.

Background Information

Materials received by SRM for the Cemfuel process are subject to a pre-acceptance process to ensure that the material can be received at the site. This process included a sample being received by the SRM laboratory and analysed against the customer declaration. The wastes involved in the incident were a load of approximately 21 tonnes of “hydrocarbon lights distillate” (HLD) and the 125 tonnes that formed the contents of the cemfuel blend tank (C8).

The specific nature of the waste in C8 before addition of the HLD waste is not known. The incoming waste was screen against a generic Cemfuel sample in line with company procedures. A representative sample of the material in C8 was not taken for compatibility purposes before the HLD waste was introduced. The HLD waste was only tested for compatibility against a generic cemfuel sample.

The HLD waste was described by the customer as an approximate composition of:

2-Methyl 2-Butene (m-Amylene) approx 30%

Propylene oxide approx 20%

Penta Methyl Indane 10-15%

Water up to 25%

Low boiling hydrocarbons balance

Acceptance analysis over previous 16 loads had shown that it was quite variable in its water content (and by inference its organic nature) but these had blended without any incident. The variable nature of the waste should have indicated that it required more thorough acceptance (or possibly more frequent pre-acceptance). At that time wastes were only analysed against a generic Cemfuel specification (for example a chlorine limit) and not against individual components so the exact composition of each load is not known.

Less than an hour after the HLD waste was added to C8, a pressure rise in the tank was detected. Within a minute the pressure release valve vented material to the atmosphere.

A minute later the valve vented again. The valve then remained partially open until it finally blew completely; all this occurred within 17 minutes. This was despite the on-site emergency team spraying cooling water onto the C8 tank. In total about 4.3 tonnes of waste were released to the atmosphere.

Whilst continuing to spray cooling water on the C8, the site personnel decided to evacuate the waste from C8 to another tank. The purpose of this transfer was to prevent further escape and to cool the reacting waste. This took over 3 hours. By this time the fire service were in attendance and they continued to spray the tank to cool it. Whilst the waste was being transferred the temperature of the transfer line was monitored (measured approximately 50^{o}C).

It is not clear why the HLD waste reacted with the tank contents but the most credible explanation is that the C8 contained a compound that initiated either the exothermic polymerisation or hydrolysis of the HLD. As previously noted, the waste had been received many times before without incident and was “unreactive” during the compatibility test with the cemfuel standard. However the C8 tank contained 125 tonnes of mixed inputs from other customers so the HLD waste may have reacted with any one of these materials. Whatever caused the reaction (for example an exothermic polymerisation or hydrolysis), the contents of C8 heated up to about 55^{o}C causing pressure build up in the tank and release of waste to atmosphere. As it was a moderately windy day so the emission was quickly dispersed so no external odour complaints were received, indicating that the gas remained local to the site before dispersing.

Other Relevant Information

It should be noted that this facility is not required to meet the requirements of S5.06 as it was permitted as part of the solvent distillation sector rather than the hazardous waste treatment sector.

Significant issues identified were:

- The exact composition of the HLD waste load was not known to a reasonable degree. The waste that reacted contained a significantly small amount of water (0.1%). The waste was too variable over a number of loads to be covered by one pre-acceptance analysis. It is a requirement of the SGN [and the also the Hazardous Waste Regulations 2005] that the constituents of the waste are known.
- Analysing variable wastes using a generic screening process (for example CV, chlorine content, metals etc) is not sufficient to enable an operator to understand the nature of the waste nor its possible reaction chemistry.
- The sales order form used by the site to highlight pre-acceptance information missed off the important safety information when printed out.
- The difference between the pre-acceptance and acceptance information should have been cause to analyse the waste more thoroughly for its composition to indicate the chemistry of the waste and risk assess any potential incompatibilities.
- Compatibility testing should be performed against the wastes that are actually being mixed (that is the received waste and the contents of C8) and not against a generic standard make-up sample.
- The bulk storage tank has a capacity of well over 150 tonnes. A tank of this size cannot even be accurately modelled using an open top beaker. A 1 litre stainless steel dewar flask (which can safely model only up to 10 tonnes) will not provide certainty.

Relevant requirements of S5.06

2.1.1 Pre-acceptance procedures to assess waste

1. From the waste disposal enquiry the Operator should obtain information in writing relating to:

- the type of process producing the waste
- the specific process from which the waste derives
- the quantity of waste
- chemical analysis of the waste (individual constituents and as a minimum their percentage compositions)
- the form the waste takes (solid, liquid, sludge and so on)
- hazards associated with the waste sample storage and preservation techniques

10. Analysis required will vary depending upon the nature of the waste, the process to be used and what is known about the waste already. Results of analysis should be kept within the tracking system. These details should include:

- check on constituents declared by waste producer/holder to ensure Permit compliance,
- treatment plant specification and final disposal
- all hazardous characteristics
- physical appearance
- colour
- pH
- presence, strength and description of odour assessment (note COSHH implications)

16. All records relating to pre-acceptance should be maintained at the installation for cross-reference and verification at the waste acceptance stage. These records should be kept for a minimum of 3 years.

2.1.2 Acceptance procedures when waste arrives at the installation

Sampling – checking – testing of waste - storage

10. On-site verification and compliance testing should take place to confirm:

- the identity of the waste
- the description of the waste
- consistency with pre-acceptance information and proposed treatment method compliance with permit

Records

36. All records relating to pre-acceptance should be maintained and kept readily available at the installation for cross-reference and verification at the waste acceptance stage. Records should be held for a minimum of two years after the waste has been treated or removed off-site. Records should be held in an area well removed from hazardous activities to ensure their accessibility during any emergency.

2.1.3 Waste storage

Compatibility testing

31. In order to prevent any adverse or unexpected reactions and releases before transfer involving the following activities, testing should take place prior to the transfer:

- tanker discharge to bulk storage
- tank-to-tank transfer
- transfer from container to bulk tank
- bulking into drums/IBCs
- bulking of solid waste into drums or skips

32. Any evolved gases and cause of odour should be identified. If any adverse reaction is observed, an alternative discharge or disposal route should be found.

33. Due consideration should be taken of the implications of scale-up from laboratory compatibility testing to bulk transfer and the Guidance is given in HSG143.

39. A representative sample of the receiving tank/vessel/container should be mixed in a proportional ratio with a sample of incoming waste stream that it is proposed to add to the tank / vessel/container. The two samples should take account of the “worst-case” scenario of likely constituents. The particular test parameters will be driven by the wastes being bulked. As a minimum, records of testing should be kept including any reaction giving rise to:

- increase in temperature
- viscosity change
- separation or precipitation of solids
- evolution of gases
- evolution of odours

Suggested improvements to S5.06

Clarification of minimum requirements for compatibility and scale up testing and modelling and requirement for record keeping of approvals.

Require temperature and pressure monitoring of bulk storage tanks.

Incident 15 March 2007 – Kingsnorth Oil Treatment Plant, Kent	
Date of incident	30 March 2007
Operator Name (at time of incident)	Eco-Oil Limited
Site Address	Jetty Road, Kingsnorth Industrial Estate, Kingsnorth, Kent

The incident

This site has had a Waste Management Licence since 30/06/1995 and is used predominantly for the reception, processing, blending and dispatch of waste oils. A PPC permit was issued for the site in October 2007 for activities carried out under Section 5.3 Part A(1)(b) (the disposal of waste oils (other than by incineration or landfill) in a facility with a capacity of more than 10 tonnes per day).

Figure 1 - Tank 4 on fire

During the morning of Monday 30th March an explosion caused one of the tanks on site (Tank 14) holding approximately 250,000 litres of oil to catch fire. The tank was located within a bund along with two further tanks. The bund walls were of breeze block construction with a concrete floor and had no drainage systems penetrating the wall or floor.

During the incident the bund became full with burning oil, firewater and foam, but shortly after the fire was extinguished (at 13:40) it collapsed outwards against an outer crash barrier.

Figure 2 - Collapsed bund wall

Figure 3 - Contaminated water held on site

The oil, firewater and foam mixture that had been contained by the bund, spilt out but was largely contained within the boundary of the site by tertiary containment systems (for example kerbing). This prevented a more serious environmental incident from occurring. A small volume of contaminated water did escape from the site.

Description of causes

Fire initiation

At the time of the incident, a firm of contractors were working on the site's tank farm. Improvements were being made to the tank farm so that it could treat contaminated marine fuel (marpol). The work included installing level gauges on the tanks and installing/repairing walkways and guardrails.

When the incident happened, one contractor was on top of tank 14 installing a walkway, welding parts of the walkway into place using a welding torch. The contents of the tank ignited and blew off the tank's roof. The welder was rescued from the top of the burning tank by a colleague using a mobile elevated platform. The contractors vacated the area as the fire service arrived and fought the fire.

Following the investigation, the HSE inspector concluded that the incident occurred because the site operator had "lost control of what it's contractor was doing".

Figure 4 - Tank 4 after explosion

Bund wall collapse

The bund walls managed to withstand the hydraulic pressure and heat for approximately three hours before one side of the bund collapsed. The structural surveyor that investigated the collapsed bund reported that the most likely cause for its failure was that the bund walls had not been keyed-in to the concrete slab base and therefore could not resist the forces exerted by the volume of liquid contained in the bund and the high temperatures caused by the fire.

Relevant requirements of S5.06

2.1.3 Waste storage

General storage requirements

12. Procedures must be in place for the regular inspection and maintenance of storage areas, including drums, vessels, pavements and bunds. Inspections should pay particular attention to signs of damage, deterioration and leakage. Records should be kept detailing action taken. Faults must be repaired as soon as practicable. If containment capacity or capability of bund, sump or pavement is compromised, (unless effecting a repair is more expedient and working with wastes in close proximity does not compromise safety), then waste must be immediately removed until the repair is completed.

2.2.5 Fugitive emissions to surface water, sewer and groundwater

4. All **above-ground tanks** containing liquids whose spillage could be harmful to the environment should be bunded. For further information on bund sizing and design, see "Releases to water references[1]" on page 131. Bunds should:

- be impermeable and resistant to the stored materials.
- have no outlet (that is, no drains or taps) and drain to a blind collection point.
- have pipework routed within bunded areas with no penetration of contained surfaces.
- be designed to catch leaks from tanks or fittings.
- have a capacity greater than 110 percent of the largest tank or 25 percent of the total tankage, whichever is the larger.
- be subject to regular visual inspection and any contents pumped out or otherwise removed under manual control after checking for contamination.
- where not frequently inspected, be fitted with a high-level probe and an alarm, as appropriate.
- where possible, locate tanker connection points within the bund, otherwise provide adequate containment.
- be subject to programmed engineering inspection (normally visual, but extending to water testing where structural integrity is in doubt).

2.3 Management

Operations and maintenance

1. Effective operational and maintenance systems should be employed on all aspects of the process whose failure could impact on the environment, in particular there should be:

- documented procedures to control operations that may have an adverse impact on the environment.
- a defined procedure for identifying, reviewing and prioritising items of plant for which a preventative maintenance regime is appropriate.
- documented procedures for monitoring emissions or impacts.
- a preventative maintenance programme covering all plant, whose failure could lead to impact on the environment, including regular inspection of major 'non productive' items such as tanks, pipework, retaining walls, bunds, ducts and filters.

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[1] Releases to water references refer to PPG 2 Pollution Prevention Guidance Note – Above-ground oil storage tanks and CIRIA Report 163 – Construction of bunds for oil storage tanks.

Competence and training

3. Training systems, covering the following items, should be in place for all relevant staff which cover:

- awareness of the regulatory implications of the Permit for the activity and their work activities.
- awareness of all potential environmental effects from operation under normal and abnormal circumstances.
- awareness of the need to report deviation from the Permit.
- prevention of accidental emissions and action to be taken when accidental emissions occur.

4. The skills and competencies necessary for key posts should be documented and records of training needs and training received for these post maintained.

5. The key posts should include contractors and those purchasing equipment and materials.

6. The potential environmental risks posed by the work of contractors should be assessed and instructions provided to contractors about protecting the environment while working on site.

2.8 Accidents

5 C - identification of the techniques necessary to reduce the risks.

The following techniques are relevant to most installations:

- physical protection should be in place where appropriate (eg. barriers to prevent damage to equipment from the movement of vehicles).
- there should be appropriate secondary containment (eg. bunds, catchpots, building containment).
- process waters, potentially contaminated site drainage waters, emergency firewater, chemically- contaminated waters and spillages of chemicals should be contained and, where necessary, routed to the effluent system and treated before emission to controlled waters or sewer. Sufficient storage should be provided to ensure that this can be achieved. Any emergency firewater collection system should take account of the additional firewater flows and fire-fighting foams, and emergency storage lagoons may be needed to prevent contaminated firewater reaching controlled waters.

Suggested improvements to S5.06

Section 2.2.5 of S5.06 refers to Pollution Prevention Guidance Note PPG 2 and CIRIA Report 163 Construction of bunds for oil storage tanks for further information on bund sizing and design.

CIRIA 163 provides guidance for oil tanks with a capacity up to 25m^3. It is recognised that storage tanks at a regulated facility may have a capacity greater than 25m^3 (the tank involved in this incident contained approximately 250,000 litres of oil).

S5.06 could be amended to include reference to CIRIA Report 164 Design of containment systems for the prevention of water pollution from industrial incidents, for those sites with storage tanks greater than 25m^3. Section 10.3.11 of CIRIA 164 specifically requires that: "a bund must be able to withstand the effects of a fire of the anticipated maximum duration and intensity, without collapsing and leaking".

Reference could also be made to the joint CIRIA and Environment Agency guidelines on Concrete bunds for oil storage tanks and Masonry bunds for oil storage tanks.

Actions taken by operator since incident

Since the incident, the Operator has employed a full time environmental/safety manager and implemented an environmental management system, although this is not accredited to ISO 14001.

The collapsed bund has been rebuilt with bund walls keyed into concrete base and sections of other bunds affected by the fire have been repaired or replaced. This work was assessed by a structural engineer and recommendations completed.

The Operator has also initiated a Non Destructive Testing regime for all of the site’s storage tanks and an inspection and maintenance regime for both tanks and bunds.

Incident 16 June 2007 – Greenway Environmental Treatment Facility, Crewe

Date of incident	04 June 2007
Operator Name (at time of incident)	Greenway Environmental Limited
Site Address	Greenway Environmental Treatment Facility, Gateway, Crewe Gates Farm Industrial Estate, Crewe, Cheshire

Figure 1 - Damage and aerosol debris on roof of nearby building

The incident

An explosion inside a bespoke aerosol canister shredder operated by Greenway Environmental Ltd caused a fire which spread to the production and storage areas of Aztec Chemicals Ltd (part of the same holding company) destroying the entire site, damaging neighbouring property and causing major disruption in Crewe as surrounding roads were closed all day.

Description of causes

Greenway Environmental Limited was granted a waste management licence in 2003 to store and treat waste aerosol canisters. The main purpose of the treatment was to facilitate the recovery of shredded metal and liquid contents using a custom built shredding machine. The operator occupied an area within the site of Aztec's aerosol manufacturing/filling plant.

Over the next few years the volume of waste processed at the site increased and the operator installed a new shredding machine in January 2007 to increase the throughput of waste. This new shredder was designed and built by a manufacturer who had not previously made a shredder of this type. The machine shredded waste aerosol canisters within a ventilated chamber. Underneath were two stillages, the first of which collected the shredded canisters, whilst allowing the liquid contents to drain through a mesh base, to be caught in a second stillage.

As the shredding operation expanded, the storage arrangements also changed. Aerosol canisters were now routinely stored in cut-off IBCs (IBCs with the tops cut off to make an open top container).

An explosion took place in the shredder shortly after midday on 4 June 2007, whilst shredding was being carried out. The precise ignition source of the explosion has not been determined, but a spark from metal on metal contact is the likely cause, igniting an explosive atmosphere created by aerosol propellant gases within the shredder. The operative using the shredder at the time was fortunately not injured.

The explosion started a fire which spread to the flammable residues collected in the shredder stillages. At the time of the fire, some cut off IBCs containing waste aerosol canisters had been brought out of storage and placed close to the shredder ready for processing. The proximity of these materials enabled the fire to spread rapidly to stored solvents and products across the manufacturing plant. Exploding canisters became projectiles, spreading the fire around the site.

More than 100 fire fighters and 25 fire engines were in attendance at the peak of the incident. A 200 metre exclusion zone was set up around the site whilst the fire was tackled. The Fire Service managed to prevent six bulk tanks containing 25 tonnes of LPG aerosol propellant used by the manufacturing plant from exploding. The operator’s site, the aerosol manufacturing plant and all site buildings were completely destroyed in the fire, as were a number of cars. Significant damage was also sustained by neighbouring properties, but fortunately no one was injured.

Investigations identified that the design and operation of the new shredding equipment was unsafe. The process relied on air dilution by a ventilation fan to keep flammable gas concentrations below their Lower Explosive Limit (LEL). The operator had realised that the shredder lacked adequate ventilation to do this. They had installed an additional ventilation fan prior to the incident, from parts taken from the original shredder, however, this was still not adequate to prevent the formation of an explosive atmosphere within the shredder.

There was no monitoring by the operator of any parameters which may have detected this, such as measurement of the concentration of flammable gases to ensure they stayed below their LEL.

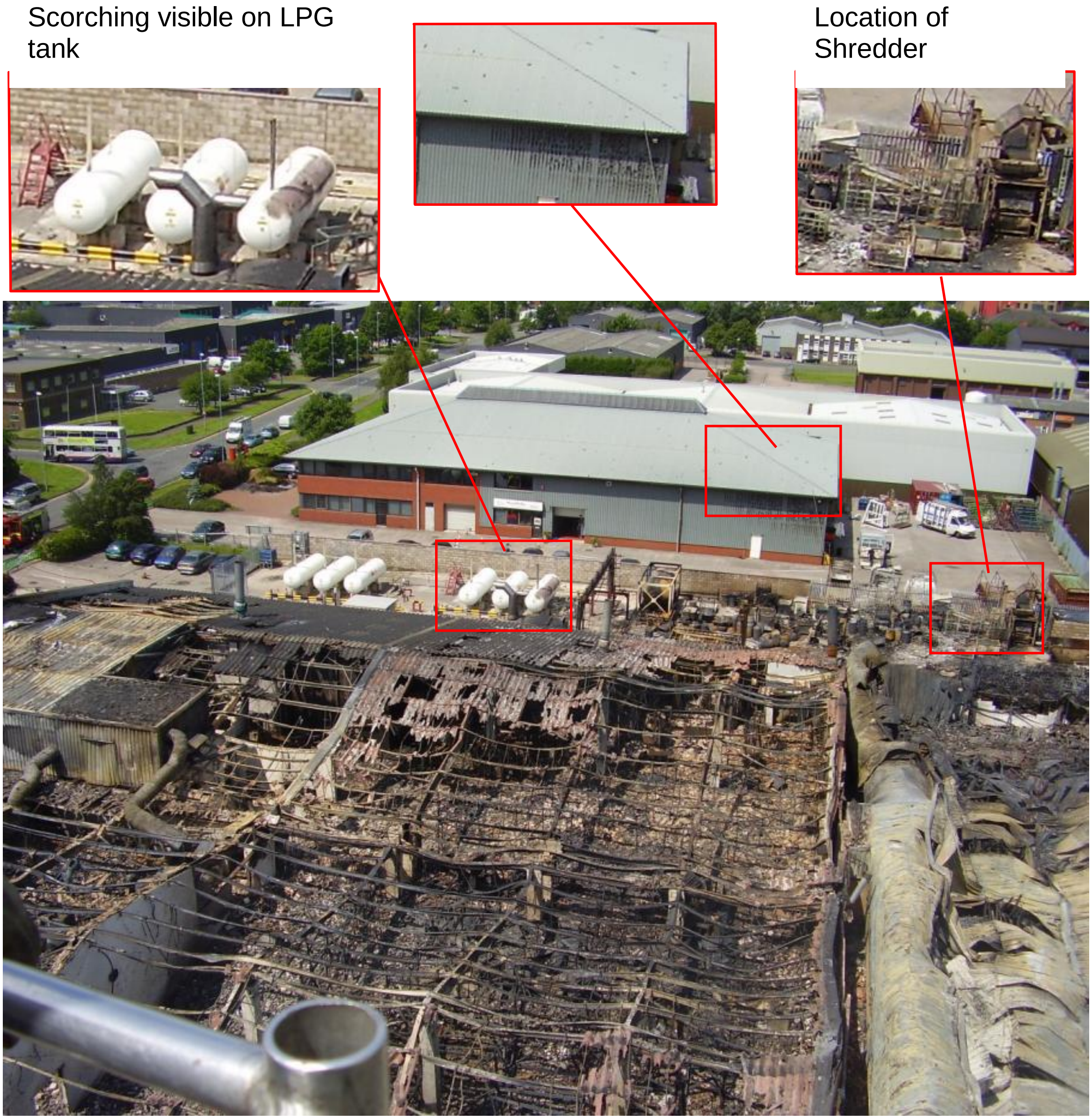


Figure 2: An aerial view of the site after the incident

Relevant requirements of S5.06

2.1.3 Waste storage

General storage requirements

11. Storage area drainage infrastructure should ensure that all contaminated run-off is contained, that drainage from incompatible wastes cannot come into contact with each other and that fire cannot spread between storage/treatment areas via the drainage system.

17. Activities that create a clear fire risk should not be carried out within the storage area, even if it is not formally classified as hazardous. Examples include grinding, welding or brazing of metalwork, smoking, parking of normal road vehicles except while unloading, charging of the batteries of fork lift trucks.

Storage of drummed waste and other containerised wastes such as IBCs

23. Storage areas for containers holding flammable or highly flammable wastes should meet the requirements of HSG51, HSG71 and HSG76.

Storage of aerosols

27. Storage of aerosols should take place under cover in closed containers or cages. Aerosols should not be stored in open containers.

2.1.4 Treatment - general principles

General principles

1. Provide adequate process descriptions of the activities and the abatement and control equipment for all of the activities such that the Regulator can understand the process in sufficient detail to assess the operator's proposals and in particular to be able to assess opportunities for further improvements. This should include:

- a description of how protection is provided during abnormal operating conditions such as, runaway reactions, unexpected releases, start-up, momentary stoppages and shut-down for as long as is necessary to ensure compliance with release limits in Permits.

8. In order to track and control the process of change, there should be a written procedure for proposal, consideration and approval of changes to technical developments, procedural or quality changes.

9. All treatment/reaction vessels should be enclosed and should be vented to atmosphere via an appropriate scrubbing and abatement system (subject to explosion relief).

2.3 Management

Organisation

14. The company should have demonstrable procedures (for example written instructions) which incorporate environmental considerations into the following areas:

- the control of process and engineering change on the installation.
- design, construction and review of new facilities and other capital projects (including provision for their decommissioning).
- capital approval.
- purchasing policy.

2.8 Accidents

2 **A - Identification of the hazards** to the environment posed by the installation using a methodology akin to a Hazop study. Areas to consider should include, but should not be limited to, the following:

- unexpected reactions or runaway reactions.

5 **C - identification of the techniques necessary to reduce the risks.** The following techniques are relevant to most installations:

- storage arrangements for raw materials, products and wastes should be designed and operated to minimise risks to the environment.
- there should be automatic process controls backed-up by manual supervision, both to minimise the frequency of emergency situations and to maintain control during emergency situations. Instrumentation will include, where appropriate, microprocessor control, trips and process interlocks, coupled with independent level, temperature, flow and pressure metering and high or low alarms.

- appropriate control techniques should be in place to limit the consequences of an accident, such as; fire walls, firebreaks isolation of drains, provision of oil spillage equipment, alerting of relevant authorities and evacuation procedures.

Suggested improvements to S5.06

The high level of risk associated with this type of operation and aerosol canister wastes was recognised as requiring greater scrutiny. Specific guidance for the storage and treatment of aerosol canisters and similar packaged wastes has been issued since this incident as an addendum to S5.06 'Guidance for the Storage and Treatment of Aerosol Canisters and Similar Packaged Wastes'.

Actions taken by operator since incident

The original shredder was brought back into service after a number of safety mechanisms were installed as agreed with the HSE and Environment Agency. These included conveyor feeding of the shredder hopper, blast relief doors on the shredder, a nitrogen inerting blanket, monitoring of flammable gas concentrations against LELs and volatile organic compounds (VOCs), safety interlocks, and abatement of VOCs using an activated carbon system.

Following discussion with the HSE and Fire Service, an Environment Agency-initiated variation of the environmental permit was issued requiring a number of improvements including:

- A revised working plan
- A fire risk assessment
- Improved controls on shredder design, installation, operation and maintenance
- Improved controls on waste storage, including fire precautions.

The shredding operation has since been relocated from this site to another permitted Greenway Environmental site.

Incident 17 July 2007 - Preston Waste Management Centre	
Date of incident	2 July 2007
Operator Name (at time of incident)	Veolia ES Cleanaway (UK) Limited
Site Address	Red Scar Industrial Estate, Longridge Road, Preston

The incident

A major fire at the premises of Veolia ES Cleanaway (UK) Limited (“Veolia”) on the Red Scar Industrial Estate, Preston, consuming approximately 130 tonnes of mostly flammable waste. The fire started just after 6am on 2nd July 2007. It resulted in a section of the M6 being closed while fire fighters fought the blaze. A significant amount of damage was caused to the premises, although no-one was hurt.

Description of causes

The fire started just after 6am on Sunday 2nd July in an open storage area (storage Area B) which was used to store drums and intermediate bulk containers (IBCs) of flammable and non-flammable waste chemicals with a flash point above 21°C. It had been raining overnight (there had been 31mm of rainfall over the weekend up to the initiation of the fire) and, whilst it cannot be confirmed, it is believed that the fire may have started when a pallet of lithium batteries reacted with water and spontaneously ignited and then spread to other flammable waste materials that were stored adjacent to the batteries (see Figure 1 and Figure 2).

Figure 1 – Approximately 5 minutes after fire initiation

The site included three large open storage areas (Areas A, B and C) where wastes were stored within the concrete bases of former storage tanks, hence their circular shape. The storage areas were concrete surfaced with a gentle fall that drained towards the centre, somewhat saucer like with a surface area of 1256m^2, where there was a small sump.

Storage area B was at a lower level than Area A.

Figure 2 – Approximately 60 minutes after fire initiation

Storage Area B was used for the storage of both flammable liquids and non-flammable materials, together with flammable solids and toxic substances. A post-fire stock check revealed that within Area B there were not less than 132,000 litres of wastes stored in plastic intermediate bulk containers (IBCs), 26,420 litres of methanol stored in plastic drums and solid wastes destined for incineration or landfill. Included with the solid wastes were lithium batteries.

A large number of lithium batteries with open terminals were stored within the flammable liquid storage area, adjacent to flammable liquids. These batteries were contained in either 120 litre lidded plastic blue kegs or rectangular yellow plastic lidded boxes a little smaller than a milk crate.

CCTV footage of the incident showed the initiation of the incident, with the lithium wastes reacting and burning until the radiant heat from the reaction melted the adjacent plastic containers. This started a pool fire which was self perpetuating and grew rapidly as it spread under adjacent containers, which melted and released their contents in turn, until the whole of the storage area was consumed (see Figure 3).

In addition, some of the waste materials were also seen missiling across the storage area. It was fortunate that these missiles of burning material did not propagate the fire in other areas of the site.

Status of lithium batteries

Industrial batteries can be found in chapter 16 of the European Waste List:

Lithium batteries are coded as 16 06 04 alkaline batteries (except 16 06 03) and are absolute non-hazardous wastes in accordance with classification rules. This is anomalous as it is clear that they do have hazardous water reactive properties and the ability to self combust.

Figure 3 – 60 seconds of CCTV footage approximately 25 minutes after fire initiation

Relevant requirements of S5.06

2.1.1 Pre-acceptance procedures to assess waste

14. Following characterisation of the waste, a technical assessment should be made of its suitability for treatment or storage to ensure Permit conditions are being met.

2.1.2 Acceptance procedures when waste arrives at the installation

Load arrival

2. Hazardous wastes should only be received under supervision of a suitably qualified person (HNC qualified chemist or higher).

Load inspection

3. Visual inspection. Where possible, confirmatory checks should be undertaken before offloading where safety is not compromised. Inspection must in any event be carried out immediately upon offloading at the installation.

4. Check every container to confirm quantities against accompanying paperwork. All containers should be clearly labelled and should be equipped with well-fitting lids, caps and valves secure and in place. Any damaged, corroded or unlabelled drums should be put into a quarantine area and dealt with appropriately. Following inspection, the waste should then be unloaded into a dedicated sampling/reception area.

2.1.3 Waste storage

General storage requirements

8. Storage areas should be clearly marked and signed with regard to the quantity and hazardous characteristics of the wastes stored therein.

13. There should be daily inspection of the condition of containers and pallets and written records should be kept of these inspections. If a container is found to be damaged. Leaking, or in a state of deterioration, it should immediately be over-drummed or the contents transferred to another container or processed.

21. Containers should be stored with well-fitting lids, caps and valves, secured in place.

22. Storage areas for containers holding substances that are known to be sensitive to heat and light or reactive with water or moisture should be under cover and protected from water, heat and direct sunlight.

23. Storage areas for containers holding flammable or highly flammable wastes should meet the requirements of HSG 51, HSG71 and HSG76.

Segregation

25. In addition to the requirements of this document, the segregation of wastes should meet the requirements of HSG71 and be justified by risk assessment.

26. HSG 71 provides no guidance on the use of fire walls to achieve separation or segregation of different types of waste in outdoor storage. Fire walls which are impervious to liquid, at least 2m high, and capable of withstanding an intense fire on one side without collapse, can be used to reduce the 3m separation required for some combinations of materials marked as ‘keep apart’. No more than two sides of a storage area should be provided with fire walls, because it would prevent good ventilation.

Other storage requirements

63. Waste or raw materials in non-waterproof packaging should be kept under cover.

2.3 Management

Competence and training

3. Training systems, covering the following items, should be in place for all relevant staff which cover:

- awareness of the regulatory implications of the Permit for the activity and their work activities.
- awareness of all potential environmental effects from operation under normal and abnormal circumstances.
- awareness of the need to report deviation from the Permit.
- prevention of accidental emissions and action to be taken when accidental emissions occur.

4. The skills and competencies necessary for key posts should be documented and records of training needs and training received for these post maintained.

2.8 Accidents

5 **C - identification of the techniques necessary to reduce the risks.** The following techniques are relevant to most installations:

- there should be an up-to-date site plan showing the precise location of wastes having specific hazard characteristics (for example oxidising, flammable, dangerous when wet etc) with clear identification of the perimeters of the various designated storage areas and their maximum storage capacity.
- procedures should be in place for checking and handling raw materials and wastes to ensure compatibility with other substances with which they may accidentally come into contact.
- storage arrangements for raw materials, products and wastes should be designed and operated to minimise risks to the environment.
- appropriate control techniques should be in place to limit the consequences of an accident, such as; fire walls, firebreaks, isolation of drains, provision of oil spillage equipment, alerting of relevant authorities and evacuation procedures.
- personnel training requirements should be identified and training provided.

Suggested improvements to S5.06

S5.06 or its successor is amended to require:

- the separate storage of all flammable liquids in plastic containers from all other wastes.
- that flammable liquids in plastic containers are stored separately from flammable liquids in metal containers.
- that wastes should be assessed for missiling ability at the acceptance stage then directed to appropriate storage (see Figure 4).
- a separate sub-section for the storage and handling of lithium wastes.

Figure 4 –Smoke trail from missiling waste

- that drainage arrangements are reviewed in flammable waste storage areas to direct spilt liquid directly to sumps so that flowing pool fires do not engulf other waste storage areas.
- guidance on the appropriate sizing of sumps and their use and maintenance.

Actions taken by operator since incident

- Improvements to the emergency arrangements of the site in accordance with recommendations of the Lancashire Fire Service.
- Improvements to the infrastructure for waste storage including restriction of access between areas A and B And construction of full height fire walls within the warehousing.
- Reviewed their operating procedures and put in place measures to minimise the possibility of recurrence.
- There has been a thorough review of training of hazardous waste staff, with training developed for their needs.
- Lithium batteries now stored in containers, within shipping containers.
- Solvent distillation activities at the site have ceased.

Incident 18 December 2007 - Cheshire Waste Management Centre, Ellesmere Port	
Date of incident	6 December 2007
Operator Name (at time of incident)	Tradebe North West Limited
Site Address	Tradebe North West Limited, Cheshire Waste Management Centre, Ellesmere Port.

The incident

The incident occurred when a tanker driver attempted to take a sample of a 15% Caustic Soda solution from the back valve of a tanker. The valve would not close and the solution sprayed over the driver, who required emergency first aid. The tanker was positioned on an access road at the entrance to the installation in an area that drains to surface water. Due to the extent of the spray, the valve could not be accessed to attempt closure and the full contents of the tanker (3-4 tonnes) discharged to the roadway and adjacent hardstanding within 5 minutes. 20-30 tonnes of water were flushed down the drain by the operator in an attempt to dilute the solution and minimize the impact on the receiving watercourse.

Description of causes

The Process

The site carries out acid/alkali neutralization within the treatment plant. Waste alkali solutions are required to be sampled prior to acceptance into storage to ensure that they meet the specification identified at waste pre-acceptance. Sampling of wastes is required to be supervised by suitably qualified site staff and is required to be carried out in an area with an impervious surface and self contained drainage.

Background Information

The incident arose because the waste acceptance and sampling procedures in place were not followed. The tanker driver having previously been inducted did not follow the induction training and so was not supervised during the sampling of the tanker, which was sampled in an unsuitable location and from the back valve.

Other Relevant Information

Although there was a sampling gantry at the installation it was not used as the quantity of waste in the tanker barrel meant the area below the top hatch was dry.

Relevant requirements of S5.06

2.1.2 Acceptance procedures when waste arrives at the installation

Load arrival

2. Hazardous wastes should only be received under the supervision of a suitably qualified person (HNC qualified chemist or higher).

Load inspection

7. The inspection, unloading and sampling areas should be marked on a plan and have suitably sealed drainage systems.

Sampling – checking – testing of wastes - storage

20. The installation should have a designated sampling point or reception area. These should be in close but safe proximity to the laboratory/checking facility and the sampling point should be visible (or covered by CCTV), if sampling is not directly supervised by, for example, laboratory staff.

21. The offloading, sampling point/reception and quarantine areas should have an impervious surface with self-contained drainage, to prevent any spillage entering the storage systems or escaping off-site. Most spills and leaks during sampling are on a small scale, resulting from releases from the back valve of a tanker if the sample is being obtained in this way.

Sampling of bulk liquid wastes

25. A gantry should be used to avoid the need to take samples from the back valve of tankers, which is likely to result in a small spillage.

Suggested improvements to S5.06

None.

Actions taken by operator since incident

Improvements have been made to the site to ensure that such an event cannot be repeated including the installation of an entrance barrier, an alarm bell, additional signage, coverage of exposed drains as well as reviewing the site systems and procedures for accepting waste, sampling, site access and supervision of visitors and contractors.

The Company is now ISO 9001 & 14001 certificated, demonstrating its commitment to continued environmental and health & safety compliance.

Incident 19 March 2008 - Marchwood Treatment Works, Southampton	
Date of incident	12 March 2008
Operator Name (at time of incident)	Veolia ES (UK) Limited
Site Address	Oceanic Way, Marchwood, Southampton, Hampshire

The incident

Whilst not a resulting in a major incident, this accident has been included as there are useful lessons for operators of bulk storage tanks. While waste oils were being discharged into a tank, the tank overflowed from the manlid on top of the tank and due to the strong winds on the day, the waste oil was picked up and blown across the site boundary and on to neighbouring property. As soon as this was reported, the discharge was stopped.

Figure 1 - Bulk oils storage tanks and oil spillage

Description of causes

Eco–oil operated two tankers from the Veolia site, collecting small waste oil consignments on a carrier’s round. The loads were brought back to site and bulked up in two tanks prior to collection via a large road tanker for reprocessing off-site. These inputs were not subject to the same level of control as deliveries to the rest of the site and were not under the direct control of Veolia staff.

Eco-oil personnel were responsible for checking there was sufficient capacity in the tank before commencing discharge and authorising discharge from the tankers was also under their control. There was no level indication on the tank, the tanker driver was able to access the top of the tank for a dip measurement. During the discharge, the driver did not visually check the tank loading and consequently did not notice the tank was overflowing. There was no overflow pipe to direct the overflow into the bunded area.

Relevant requirements of S5.06

2.1.2 Acceptance procedures when waste arrives at the installation

Load arrival

1. On arrival loads should:

- not be accepted into site unless sufficient storage capacity exists and site is adequately manned to receive waste.

2.1.3 Waste storage

Bulk storage vessels

50. Tanks and vessels should be equipped with suitable abatement systems and level meters with both audible and visual high-level alarms. These systems should be sufficiently robust and regularly maintained to prevent foaming and sludge build-up affecting the reliability of the gauges.

52. All connections between vessels must be capable of being closed via suitable valves. Overflow pipes should be directed to a contained drainage system, which may be the relevant bunded area, or to another vessel provided suitable control measures are in place.

2.3 Management

Competence and training

3. Training systems, covering the following items, should be in place for all relevant staff which cover:

- awareness of the regulatory implications of the Permit for the activity and their work activities.
- awareness of all potential environmental effects from operation under normal and abnormal circumstances.

6. The potential environmental risks posed by the work of contractors should be assessed and instructions provided to contractors about protecting the environment while working on site.

2.8 Accidents

5 **C - identification of the techniques necessary to reduce the risks**. The following techniques are relevant to most installations:

- techniques and procedures should be in place to prevent overfilling of tanks - liquid or powder - (eg. level measurement displayed both locally and at the central control point, independent high-level alarms, high-level cut-off, and batch metering).

Suggested improvements to S5.06

None.

Actions taken by operator since incident

The operator has reviewed the procedures for accepting waste oil into storage tanks. All waste oils are sampled and tested prior to acceptance by the on-site chemist. The site chemist also cross checks tank storage space via a digital gauge. All aspects of this procedure are now under the control of site personnel. All tanks in use are now fitted with automatic level control with floor height read outs and audible high level alarms.

Incident 20 December 2008 - Great Yarmouth Waste Management Resource Centre	
Date of incident	10th December 2008
Operator Name (at time of incident)	Biffa Waste Services Limited
Site Address	Unit 2, Bessemer Way, Hafreys Industrial Estate, Great Yarmouth

The incident

A small fire which started in a battery storage crate was put out immediately by site staff using a powder fire extinguisher.

Description of causes

Lead acid batteries are accepted on site for storage prior to transfer to an authorised recovery facility. Batteries are stored in large plastic crates in a warehouse building. The crate involved was a 800 litre plastic storage crate which had been packed by the waste producer and had been on site for two months. Whilst staff were collating an outgoing load of lead acid batteries for delivery to a recycling facility, the crate was moved. That movement appears to have caused some of the batteries to spark across their terminals causing a small fire.

Waste lead acid batteries may not be fully discharged and so are capable of producing sparks and heat if a short circuit is created by a conductive object coming into contact with the battery terminals. Lead acid batteries may split and explode if maltreated. Hydrogen gas can also be produced, which is highly flammable. Lead acid batteries also contain sulphuric acid which reacts exothermically with water.

After the fire was dealt with, the battery box was unloaded in order to make the waste safe and to determine what had caused the problem. It was discovered that the load consisted of two types of lead acid batteries - standard car batteries, and smaller sealed, cylindrical lead acid batteries. The box of batteries was packed by the waste producer. The box consisted of 95% standard car batteries, which were well stacked in line with transport and storage requirements. The cylindrical batteries - less than 5% of the total, were not stacked appropriately, and were underneath the car batteries. They were discovered to be linked together, in series, by way of a flexible cable. This allowed the batteries to move about, and it is assumed that when the pallet box of batteries was moved by forklift, they were able to touch terminals, resulting in spark generation and the fire. After the incident the cylindrical batteries were disconnected from each other, terminals taped up and repacked.

Pre-acceptance sampling is not required for batteries as they are classified as ‘articles’. This type of material had been received from the client on several occasions in the past without incident. Appropriate onsite verification checks against paperwork were undertaken, but only consisted of a visual check of the waste. It was not standard procedure to empty out each container of waste, unless there is known to be a problem or discrepancy associated with the waste. As there had been no incidents of this nature in the past, the container was checked visually by a chemist, and the container put away for storage pending onward travel. The load was received by the transfer station approximately two months before the incident occurred and there were no deficiencies discovered at the time. It is not usual to fully unload a pallet box of lead acid batteries. It is thought the consignment note did not mention that two different types of battery were present.

Relevant requirements of S5.06

2.1.2 Acceptance procedures when waste arrives at the installation

Load inspection

3. Visual inspection. Where possible, confirmatory checks should be undertaken before offloading where safety is not compromised. Inspection must in any event be carried out immediately upon offloading at the installation.

Sampling – checking – testing of wastes - storage

8. Other than pure product chemicals and laboratory smalls, no wastes should be accepted at the installation without sampling, checking and testing being carried out. Reliance solely on the written information supplied is not acceptable, and physical verification and analytical confirmation are required. All wastes, whether for on-site treatment or simply storage, must be sampled and undergo verification and compliance testing.

10. On-site verification and compliance testing should take place to confirm:

- the identity of the waste.
- the description of the waste.
- consistency with pre-acceptance information and proposed treatment method.
- compliance with permit.

Suggested improvements to S5.06

The Waste Storage section (2.1.3) of S5.06 does not specifically mention any storage requirements specifically for batteries. A separate section on battery storage should be considered.

HSE guidance ‘Storing hazardous wastes at household waste recycling centres’ states the following:

When storing vehicle batteries, you should take the following measures:

- Store them in a non-conductive (such as plastic) container that is fitted with a lid and well ventilated – the lid must be kept closed.
- Ensure the containers do not have drainage holes – lids should be kept down to minimise the amount of water that can get in and containers should be inspected regularly.
- Label containers ’for vehicle batteries only’ and have the corrosive warning sign plus a written warning. Containers should be regularly inspected to ensure they are free from conductive objects that may cause shorting.
- Ensure batteries are not located within 6 metres of a flammable gas cage or flammable liquids containers, nor where any spillage may leak into drainage systems.
- Batteries should not be left outside of containers.
- Metal or other conductive wastes should not be placed in vehicle battery containers – this includes small domestic batteries.
- Inventories should be managed to limit quantities on site.
- Any spillage must be cleaned-up immediately using suitable absorbent granules – lead acid batteries contain strong sulphuric acid and full protective clothing including eye protection must be worn.

- Damaged batteries should be double-bagged in polyethylene bags of at least 85 micron thickness.

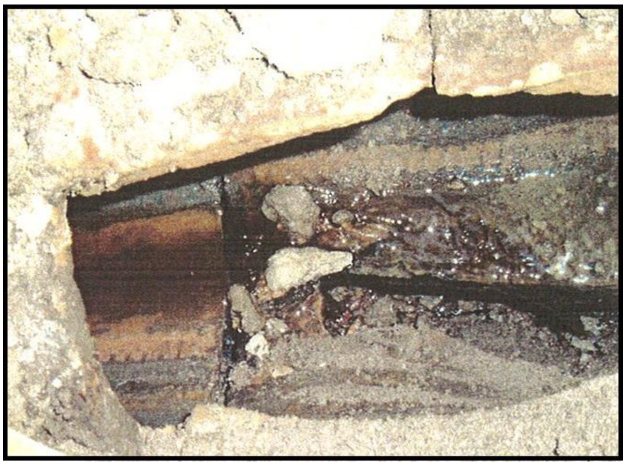
S5.06 should be expanded to incorporate elements of this guidance especially requiring covered storage areas and taping of terminals.

Actions taken by operator since incident

The operator has advised the waste producer to ensure that batteries are packed appropriately and non-standard batteries are packed separately, disconnected with terminals taped.

Incident 21 September 2008 – February 2009 – Image Business Park, Knowsley	
Date of incident	September 2008-February 2009
Operator Name (at time of incident)	Future Industrial Services
Site Address	Image Business Park, Knowsley, Liverpool

The incident



The discharge of effluent from a hazardous waste treatment process and the failure the check the integrity of a private sewer system were identified as the causes of groundwater pollution by substances including dichloromethane (DCM), acetone and tributyl tin (TBT).

Figure 1 – Broken drain

Description of causes

Future Industrial Services operate a permitted hazardous waste treatment and transfer facility at Knowsley. The site is situated on an industrial park with a historic legacy of ground pollution dating back to its use as a munitions factory during the Second World War. Work had been carried out to investigate and remediate sources of pollution on the industrial park to improve water quality.

Routine groundwater monitoring of historic contamination in September 2008 identified new contamination in a remediated area of the industrial park. The groundwater was found to contain unexpected significant levels of DCM, acetone and TBT.

In February 2009, the contamination was traced to a large crack (approximately 5cm by 30cm (as shown above) in the underside of a short section of private sewer outside the waste site boundary. This sewer was the dedicated route by which effluent from the treatment plant was discharged to the public sewerage network.

The landlord was responsible for the maintenance and upkeep of drains in the common areas of site, including this drain. Following the discovery of this new groundwater pollution, the landlord carried out a CCTV survey and repaired the damaged drain.

The treatment plant operator was responsible for the quality of the effluent discharged into the drain. The operator was accepting waste containing DCM for treatment assuming that the granular activated carbon (GAC) would remove any remaining DCM prior to discharge. The GAC technique was not commissioned or proven for this waste and afterwards was found to have been not fit for purpose.

The operator had not obtained detailed waste analyses, but was instead relying on waste declaration forms completed by producers to identify substances likely to be present in the waste. This included waste containing prescribed substances such as DCM and TBT which the operator accepted believing it was able to treat them.

Pre-treatment analysis of the DCM waste was restricted to pH and chemical oxygen demand (COD). No analysis was carried out post-treatment to check the efficacy of the treatment process.

The treated effluent from the GAC was collected with other site effluents for discharge to sewer. DCM was not permitted to be discharged to sewer under the site's trade effluent consent. The operator was not analysing specifically for excluded substances in its final effluent, but was relying on measuring COD.

After the incident, a full site drainage survey was carried out by the operator of the areas for which they were responsible within their boundary. This identified further defects in the drainage infrastructure which could also have allowed pollution of groundwater to occur. Once identified these defects were repaired. In addition, during the follow up investigations one of the boreholes was observed to be showing unexpected results. The likely cause was identified as a faulty seal on the monitoring borehole and the borehole was relocated away from a highly trafficked area.

Relevant requirements of S5.06

2.1.1 Pre-acceptance procedures to assess waste

10. Analysis required will vary depending upon the nature of the waste, the process to be used and what is known about the waste already. Results of analysis should be kept within the tracking system. These details should include:

- check on constituents declared by waste producer/holder to ensure Permit compliance,
- treatment plant specification and final disposal
- all hazardous characteristics
- physical appearance
- colour
- pH
- presence, strength and description of odour assessment (note COSHH implications)

11. Further analysis may include other parameters relevant to the treatment method or waste stream for example:

- presence of oxidants
- acidity and alkalinity
- COD
- ammonia
- flashpoint
- presence of sulphide
- presence of cyanide
- List I and List II substances
- other substances of environmental significance

2.1.2 Acceptance procedures when waste arrives at the installation

Sampling – checking – testing of wastes - storage

8. Other than pure product chemicals and laboratory smalls, no wastes should be accepted at the Installation without sampling, checking and testing being carried out. Reliance solely on the written information supplied is not acceptable, and physical verification and analytical confirmation are required. All wastes, whether for on-site treatment or simply storage, must be sampled and undergo verification and compliance testing.

2.1.4 Treatment – general principles

General principles

1. Provide an assessment of the **efficiency of the treatment process** in relation to Schedule 5 (of the PPC Regulations[2]) pollutants in terms of the removal or partition of substances within the process, for example:

- the precipitation of metals from solution for removal in the filter cake the degree of transfer between the incoming waste and the emissions (to air, solid waste to land and liquid effluent to sewer of, for example, pesticides or solvents)

5. For each treatment process, the objectives and reaction chemistry should be clearly defined. There must be a defined end-point to the process so that the reaction can be monitored and controlled. The suitable inputs to the process must be defined, and the design must take into account the likely variables expected within the waste stream.

2.2.5 Fugitive emissions to surface water, sewer and groundwater

1. For subsurface structures:

- establish and record the routing of all installation drains and subsurface pipework.
- identify all sub-surface sumps and storage vessels.
- engineer systems to minimise leakages from pipes and ensure swift detection if they do occur, particularly where hazardous (that is. Groundwater-listed) substances are involved.
- provide secondary containment and/or leakage detection for sub-surface pipework, sumps and storage vessels.
- establish an inspection and maintenance programme for all subsurface structures, eg. pressure tests, leak tests, material thickness checks or CCTV

Suggested improvements to S5.06

S5.06 does not provide guidance on site laboratory capability.

Actions taken by operator since incident

Remediation of the contamination by treating the contaminated groundwater through the operator's treatment facility was undertaken in the area affected.

A programme of regular management inspections has been put in place (these are documented) including inspection of below ground infrastructure at least every 5 years.

An above-ground drainage system is now in place for effluent.

A large capital investment has been made in an effluent polishing unit.

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[2] now Annex II Industrial Emissions Directive 2010/75/EU

Laboratory testing regimes and analytical capability have been extended and improved so that the internal laboratory is now capable of wide range of analyses.

The trade effluent consent has been varied to allow DCM (up to 3,200 microgrammes per litre). Waste streams at risk of contamination by organotins are no longer accepted at the site.

An ongoing groundwater monitoring regime has been put in place

Incident 22 March 2009 - Rye Process Plant, East Sussex	
Date of incident	11th March 2009
Operator Name (at time of incident)	Solvent Resource Management Limited
Site Address	Lime Kiln Works, Rye Harbour Road, East Sussex

The incident

At around 2.10 am a steel storage tank at the site collapsed, breaching a concrete bund and spilling 340 tonnes of mixed waste onto the site. The mixture contained approximately 91% water, 2% solids and 7% mixed solvents, predominantly toluene. The collapse damaged a valve on a neighbouring tank, causing the release of another 90 tonnes of contaminated water. Some of the material released escaped from the site's tertiary containment, reaching a neighbouring industrial site, but was later pumped back. No significant environmental damage was caused.

Figure 1 - Collapsed tank and spillage.

During the incident, East Sussex Fire Service set up a 300 metre cordon around the site; this was later reduced to just the site boundary. A foam blanket was deployed to reduce vaporisation. Rye Harbour and Rye Harbour Road were closed, and local residents were advised to stay indoors with windows closed.

Description of causes

The site recovers waste organic solvents via a fractional distillation process. The recovered solvents are either, returned to the customer for re-use, sold as new solvent, or used for blending to produce thinners. Residues from the process are sent to another SRM site for conversion into a fuel for cement kilns (Cemfuel).

The tank which collapsed was used to store residues from the recovery process carried out on site, and was due to be taken out of service. The tank had previously been used as a mixing tank to produce a fuel for cement kilns but this process had ceased a few years prior to the incident. Internal corrosion of the tank was the likely cause of the failure. It is believed that much of the corrosion within the tank occurred during its use for this blending process.

The shell thickness testing had not been performed as frequently as required. This was due, in part, to a problem with the way that jobs were set up within the computerised maintenance management system, which incorrectly stated inspections to have been completed.

Relevant requirements of S5.06

Section 2.1.3 Storage

General storage requirements

12. Procedures must be in place for the regular inspection and maintenance of storage areas, including drums, vessels, pavements and bunds. Inspections should pay particular attention to signs of damage, deterioration and leakage. Records should be kept detailing action taken. Faults must be repaired as soon as practicable. If containment capacity or capability of bund, sump or pavement is compromised, (unless effecting a repair is more expedient and working with wastes in close proximity does not compromise safety), then waste must be immediately removed until the repair is completed.

Bulk storage vessels

45. Vessels supporting structures, pipes, hoses and connections should be resistant to the substances (and mix of substances) being stored. There should be a routine programmed inspection of tanks, mixing and reaction vessels including periodic thickness testing. In the event of damage or significant deterioration being detected, the contents should be transferred to appropriate storage. These inspections should preferably be carried out by independent expert staff, and written records should be maintained of the inspection and any remedial action taken.

46. Vessels should not be used beyond the specified design life or used in a manner or for substances that they were not designed. Vessels should be inspected at regular intervals, with written records kept to prove that they remain fit for purpose.

2.3 Management

Operations and maintenance

1. Effective operational and maintenance systems should be employed on all aspects of the process whose failure could impact on the environment, in particular there should be:

- documented procedures to control operations that may have an adverse impact on the environment.
- a defined procedure for identifying, reviewing and prioritising items of plant for which a preventative maintenance regime is appropriate.
- documented procedures for monitoring emissions or impacts.
- a preventative maintenance programme covering all plant, whose failure could lead to impact on the environment, including regular inspection of major 'non productive' items such as tanks, pipework, retaining walls, bunds ducts and filters.

2.8 Accidents

5 **C - identification of the techniques necessary to reduce the risks**. The following techniques are relevant to most installations:

- process waters, potentially contaminated site drainage waters, emergency firewater, chemically- contaminated waters and spillages of chemicals should be contained and, where necessary, routed to the effluent system and treated before emission to controlled waters or sewer. Sufficient storage should be provided to ensure that this can be achieved. Any emergency firewater collection system should take account of the additional firewater flows and fire-fighting foams, and emergency storage lagoons may be needed to prevent contaminated firewater reaching controlled waters.

Suggested improvements to S5.06

None.

Actions taken by operator since incident

Following the incident, all tanks on site were assessed for integrity. An ongoing testing regime has been put in place, and a more detailed tank register developed.

The software package used to manage engineering activities on site has been upgraded, with restricted access to certain editing facilities. This is to reduce the possibility of an action being recorded as complete without work being carried out.

All tanks which were located in the damaged bund have been removed from the site.

Incident 23 May 2010 – Richmond Works, Leeds	
Date of incident	30/05/2010
Operator Name (at time of incident)	Silver Lining Industries Ltd
Site Address	Richmond Works, Selby Road, Leeds

The incident

A serious fire occurred at a hazardous waste transfer station, requiring emergency plans to be activated with multi-agency response. Nearby homes and a hotel were evacuated and some homes remained unsafe for reoccupation for several days. Surrounding roads were closed. Serious pollution of a local watercourse was caused and a major clean-up operation both on site and off site was required afterwards.

Description of causes

Silver Lining Industries operated a permitted waste transfer station in Garforth which handled a range of hazardous and non-hazardous wastes in packages and bulk tanks. Some treatment activities also took place, including bulking of flammable or aqueous liquids and silver recovery.

The fire started at night and the first signs of the fire were puffs of smoke visible on the operator's CCTV recorded at around 23:36. After 30 minutes, flames became visible and the Fire Service was mobilised, arriving at 00:11. On arrival the Fire Service found that the fire had taken hold around a central area of the yard used for the storage of 'general dry waste' which is where the fire was believed to have started. The contents of this area were not recorded, but debris remained of drums of laboratory glassware and bottles, used cans and tins, and aerosol canisters. A series of popping noises and flashes were observed by the Fire Service which are likely to have been caused by aerosol canisters.

At this point the fire was still escalating. Within a few minutes of the arrival of the Fire Service, liquid containers were breached becoming a running pool fire. This forced the Fire Service to withdraw back. An adjacent area was used for the storage of sorted wastes, including flammable liquids and fats, and this is likely to have contributed to the pool fire. A number of flaming projectiles were launched from the burning waste towards the south of the site.

As the fire continued to escalate, it engulfed more combustible materials and breached more containers adding more fuel to the fire. Some of the wastes were known to have been stored in composite IBCs. The permit allowed packaged waste to be stored close to bulk storage tanks. The flames spread to glass reinforced plastic tanks used to store photographic fixer. After the fire, these were observed to have burned down to the water line. Two other tanks containing flammable liquid were observed to start smoking and then burning with flames reaching over 12 metres high. The fire service had difficulty reaching tanks with cooling water through burning waste stockpiles. At 01:54 the fire flared up in a fireball indicating the release of flammable vapour, possibly from failure of a gas cylinder or flammable liquid container.

Due to the explosion risk, residents were evacuated from an adjoining row of terraced houses and from a nearby hotel. Surrounding roads were closed. A press statement was issued advising that members of the public should shelter indoors and close windows as the smoke plume was modelled rising in a northerly direction.

At its peak the fire was attended by 150 firefighters and 30 fire engines, as support was sought from fire crews in the surrounding areas. Three firefighters attended hospital for checks after complaining of shortness of breath and nausea. The fire took several hours to bring under control. By 06:00 fire hydrants were running out of water yet it was expected that the fire would continue to burn. By 09:35 the Fire Service had run out of water and was awaiting foam supplies.

Local emergency plans were activated and a number of agencies were involved in the incident response including all the emergency services, the local authority, the Health Protection Agency, HSE, the Environment Agency, the water company and NHS Leeds. The local authority organised rest centres for evacuees. The operator was also able to assist with information regarding the activities at the site, the general layout and the inventory at the time of the incident.

By 14:00 the fire was finally out and the Fire Service were damping down. Residents were allowed home temporarily to collect belongings.

The majority of the site burnt including waste inventories, the main building, a portacabin and equipment on site including a shredder and an ejector trailer. In the southern corner, the least affected area, a tanker trailer, was relatively undamaged and a few plastic containers remained intact.

The site bunding and containment failed during the incident. Fire water, mixed with material from the site, had formed a sludge that leaked into the grounds and sub-floor space of a nearby mail sorting office and onto residential properties.

The sludge was sampled and found to be heavily contaminated, leading to concerns about the potential for adverse health effects either from direct exposure or from permeation of plastic water pipes. There was also concern that it could give rise to fumes that could accumulate within a confined space leading to a risk of explosion.

Residential properties were monitored for indoor air quality and drinking water quality. Residents of five properties on higher ground were allowed to re-occupy after these checks had been carried out over the weekend. However, other properties were not considered safe, and residents had to wait several days longer for clean-up work to be carried out before they were able to return home. The mail sorting office also required substantial clean up and suffered significant disruption.

During the course of fire fighting, fire water left the site and entered nearby Kippax Beck. The Beck had a very strong green discolouration and appeared as if it contained paint. Black oily material was observed floating on top of the water which looked like burnt rubber or plastics. The fire water washed contaminants such as heavy metals, trichloroethylene, perchloroethylene and toluene into the Beck via local drainage which included a culvert under the site.

The fire service was asked to create a dam to block the culvert and reduce the flow of the contaminated water. The water company provided waste tankers to remove fire water which was building up behind the newly created dam. Further bunds were erected by the Environment Agency and the operator over the following days

The pollution affected Kippax Beck for a distance of almost 3km, although the most serious impacts were contained in the first kilometre. A small number of dead fish were found and the RSPCA attended to rescue 2 ducks. A dead pigeon was witnessed in the watercourse. A large amount of contaminated sediment had to be dug out of the Beck, and disposed of in the aftermath of the fire. The operator instigated a clean-up and an environmental consultant (URS) was employed by the operator to do this work. Testing has shown that there was no lasting environmental impact from the incident.

It was not possible to determine a cause for the fire after the event. The evidence points to a slow smouldering start. There are a number of possible causes of fire in circumstances when a site is non-operational. Arson is a potential cause and an electrical fault also has the potential to start a fire in some circumstances. Other potential causes of fire include an exothermic chemical reaction, or a self heating biological reaction. The weather was known to have been unusually hot prior to the incident which could have accelerated any biological or chemical reaction rates. The site also handled large numbers of batteries. Incompletely discharged batteries may start to heat if they short circuit. If the batteries are wet, this increases the risk of short circuits. Lithium batteries may contain lithium metal which is highly reactive in contact with water presenting an additional hazard. However, there was no evidence as to whether any of these potential causes was involved in this incident.

The site inventory and layout was reviewed after the incident. A large quantity of material was stored on site and the permitted layout was congested providing poor separation between stocks of combustible material, although the operator had been cooperating with the Agency and had improved separation and segregation before the incident. The layout was structured principally around processing requirements into categories such as 'non-sorted dry waste', loads for export, etc. Incoming wastes included both hazardous and combustible wastes. Sorted wastes were segregated by hazard, but only by distance; there was no bunding around segregated wastes, including around flammable liquid. The site was found to have exceeded the permitted quantity of batteries – these were burnt in the fire.

Relevant requirements of S5.06

2.1.3 Waste Storage

General storage requirements

11. Storage area drainage infrastructure should ensure that all contaminated run-off is contained, that drainage from incompatible wastes cannot come into contact with each other and that fire cannot spread between storage / treatment areas via the drainage system.

Storage of drummed waste and other containerised wastes such as IBCs

22. Storage areas for containers holding substances that are known to be sensitive to heat and light or reactive with water or moisture should be under cover and protected from water, heat and direct sunlight.

23. Storage areas for containers holding flammable or highly flammable wastes should meet the requirements of HSG 51, HSG71 and HSG76.

2.8 Accidents

2 **A - Identification of the hazards** to the environment posed by the installation using a methodology akin to a Hazop study. Areas to consider should include, but should not be limited to, the following:

- arrangements for the storage, segregation and separation of differing waste types.
- failure of containment (eg. physical failure or overfilling of bunds or drainage sumps).
- failure to contain firewaters.
- unexpected reactions or runaway reactions.

5 **C - identification of the techniques necessary to reduce the risks**. The following techniques are relevant to most installations:

- there should be an up-to-date inventory of substances, present or likely to be present, which could have environmental consequences if they escape. This should include apparently innocuous substances that can be environmentally damaging if they escape (for example, a tanker of milk spilled into a watercourse can destroy its ecosystem). The Permit will require the Regulator to be notified of any significant changes to the inventory.

- there should be an up-to-date site plan showing the precise location of wastes having specific hazard characteristics (eg oxidising, flammable, dangerous when wet etc) with clear identification of the perimeters of the various designated storage areas and their maximum storage capacity.
- storage arrangements for raw materials, products and wastes should be designed and operated to minimise risks to the environment.
- clear guidance should be available on how each accident scenario might best be managed (eg. containment or dispersion, to extinguish fires or to let them burn).
- communication channels with emergency services and other relevant authorities should be established, and available for use in the event of an incident. Procedures should include the assessment of harm following an incident and the steps needed to redress this appropriate control techniques should be in place to limit the consequences of an accident, such as; fire walls, firebreaks isolation of drains, provision of oil spillage equipment, alerting of relevant authorities and evacuation procedures.
- process waters, potentially contaminated site drainage waters, emergency firewater, chemically-contaminated waters and spillages of chemicals should be contained and, where necessary, routed to the effluent system and treated before emission to controlled waters or sewer. Sufficient storage should be provided to ensure that this can be achieved. Any emergency firewater collection system should take account of the additional firewater flows and fire-fighting foams, and emergency storage lagoons may be needed to prevent contaminated firewater reaching controlled waters.
- consideration should be given to the possibility of containment or abatement of accidental emissions from vents and safety relief valves/bursting discs. Where this may be inadvisable on safety grounds, attention should be focused on reducing the probability of the emission.

Suggested improvements to S5.06

Subsequent to the publication of S5.06 the HSE published research into the fire performance of composite IBCs which highlighted the risks of rapid release of flammable and combustible liquids from these containers in a fire. RR564 - Fire performance of composite IBCs. S5.06 should be updated to provide additional guidance. This should include the recommendation to segregate plastic IBCs and drums from metal IBCs and drums to avoid rapid onset of catastrophic failure of drums and associated fireballs and projectiles.

The sector guidance note refers to CIRIA 163 which relates to oil tanks up to 25m^3 . The wider guidance of CIRIA 164: Design of Containment Systems for the Prevention of Water Pollution form industrial Incidents should be referenced: CIRIA 164: Design of Containment Systems for the Prevention of Water Pollution from Industrial Incidents

The sector guidance does not highlight self-heating properties as a potential hazard.

Specific guidance for the storage (and treatment) of aerosol canisters and similar packaged wastes has been issued since this incident as an addendum to S5.06 'Guidance for the Storage and Treatment of Aerosol Canisters and Similar Packaged Wastes'.

The sector guidance does not highlight the need to consider smoke detection systems, heat detection equipment (fixed or hand held), fire alarms, fire fighting equipment, fire marshal training, and additional precautions such as out of hours security monitoring

Although S5.06 identifies the need for a waste reception area it does not highlight there may be a need for a marshalling area for outgoing loads.

Actions taken by operator since incident

The operator has closed this site and operations have moved to another nearby site. The operator is working towards S5.06 standards at this site.

Incident 24 October 2008, June 2009 and August 2010 - Tockwith Transfer Station	
Dates of incidents	14th October 2008 14th June 2009 11th August 2010
Operator Name (at time of incident)	BCB Environmental Management Limited
Site Address	Unit 87, Marston Moor Business Park, Tockwith, York

The incidents

In 2008 there was a fire in the transfer station building in a single drum. The fire brigade attended and the incident was dealt with rapidly. There was some minor smoke damage to a wall of the building, but no environmental damage was reported.

Figure 1 – incident 2, smoke exiting building

In 2009 a fire started at approximately 7 pm on Sunday 14th June in a skip, located within the transfer building, containing non-hazardous waste, which was destined for landfill. No one was in the building at the time of the incident. Smoke was spotted coming from vents on the side of the building.

The fire service attended and dealt with the fire, which took approximately one and a half hours to put out. The skip was positioned approximately four metres from the site's gas oil tank (fuel for fork lift trucks). This tank was scorched and partially melted, along with some other minor damage to the building. No environmental damage was reported.

Figure 2 – Incident 3 collapsed transfer building

In 2010 a major fire at the site began overnight. The fire service attended and five fire crews worked to contain the fire for most of the next day, one crew stayed at the scene over the next night. Local residents were advised to stay indoors and keep their doors and windows closed while the fire was dealt with.

Figure 3 – Fleet Beck dammed using sandbags and booms.

The whole site was destroyed, but fortunately no-one was injured. Contaminated run-off from the fire escaped from the site and Environment Agency staff temporarily dammed the nearby Fleet Beck, a tributary of the River Nidd, in an attempt to prevent contaminated firewater entering the stream. It was later confirmed that contaminated water had entered the Beck. A small number of fish were found dead.

Description of causes

The site was a transfer station carrying out bulking of waste. It was permitted to handle a wide range of hazardous and non-hazardous waste; wastes were delivered to the site and segregated for storage in concrete sided bays. Solvent wastes were transferred to a sister site on the same estate for onward delivery to recycling facilities. The site was permitted for up to 50,000 tonnes of waste per year. A maximum storage quantity for waste was not set in the permit, but from volumes specified the application for individual areas this was likely to be in the region of 400 tonnes.

2008: The fire was initially believed by the operator to have been caused by an electrical fault in a drum crushing machine, igniting the residue in one of the drums which had contained oil-based paint. The incident was investigated by both the HSE and the Police resulting in a prosecution for arson against one of the site operatives, for deliberately igniting the drum with a cigarette lighter. Management procedures for the control of sources of ignition do not seem to have been effective. The whole of the site was specified as a no smoking zone so the ignition source should not have been present. Procedures should have made sure that all potential sources of ignition such as lighters, key fobs, phones etc were not taken into areas where flammable atmospheres were potentially present. It is not clear why the site was crushing drums containing volatile substances, as this was not in compliance with section 2.1.13 of SGN5.06 or with their permit.

Figure 4 – incident 2, remains of skip fire.

After this incident the operator made changes to their procedures at the site; the equipment was also improved.

2009: The site received a skip containing the contents of eight 205 litre drums of fish oil filters from the food industry along with other non-hazardous material for landfill, such as plastics, cardboard and metal packaging. The filters came from the manufacture of products such as cod liver oil, and consisted of compacted cardboard discs impregnated with oil. It is thought that the filters in the skip spontaneously combusted. While it was not proven that this was the cause of the fire, it had been a very warm weekend and the skip had been loaded and left undisturbed in the building for at least 48 hours before the fire was reported.

Figure 5 – remains of cardboard filter

Unsaturated oils such as vegetable or fish oil can spontaneously ignite at quite low temperatures. When exposed to air they undergo oxidation which generates heat. As bulk liquids the rate of oxidation is low enough to ensure the heat is dissipated. However where oils have been absorbed onto a porous matrix such a cloth (or in this case the cardboard filter), the rate of oxidation increases markedly due to the increased surface area and can lead to auto-ignition temperatures being achieved. Enclosed conditions, as long as there is enough oxygen present, can exacerbate this by slowing heat loss. Saturated oils such as mineral oils are much less prone to auto-ignition, although it has been reported.

The filters were delivered to the site in drums, stored soaked in water to prevent combustion. At the transfer site the filters were removed from the drums and were bulked up into a skip in IBCs for onward disposal. Dry sawdust was also added to suppress odour. There appears to have been a misunderstanding between the producer of the filters and the operator as BCB understood the filters to be stored soaked in water in order to prevent odour. The producer actually stored them in water to prevent possible spontaneous combustion.

Accurate information concerning what was stored on site, and where, was an issue for the fire service during the incident. No one was on site at time of the fire and BCB stored all information electronically. A paper inventory of waste on site was not available until sometime after the fire was put out.

Figures 6 & 7 - interior of transfer building

As a result of the fire, the operator made improvements to the fire alarm system including off-site telemetry and improvements to smoke detectors. BCB clarified storage and packaging requirements with waste producers, and transfer notes were improved. Better information was made available to the fire service regarding what waste was stored and where.

<u>2010</u>: The final incident began during the night when the site was unmanned and it has not been established where or how the fire started. It is not clear how much waste was on site at the time of the incident. Whilst it is hard to be sure what occurred it is likely that flammable and combustible liquid wastes on site spread the fire.

The waste transfer operations were undertaken within a large building, the size and style of an old aircraft hanger, with a concrete base. The site surface had no discernable falls. A 1 m wall formed a bund around the inside perimeter of the building, with roll-over bunds across entrances front and rear. The remaining walls and roof were of corrugated metal sheeting. Individual three-sided storage bays were formed by dividing walls (1 m high) coming off of the perimeter bund, with low roll-over bunds to the entrance of each bay. Each bay was designed to contain a minimum of 25% of the total volume of containers that could be stored in each bay. No fire walls were included in the design. The site had a fire alarm but had no fire suppression system.

As the fire burned, IBCs and drums exploded and the building collapsed, the contents of containers leaked and a concoction of chemicals was formed. Liquid material was largely contained on site as no drainage existed within the building and the bunding contained most of it. Leakage did occur from the front and rear doors of the building where roll-over bunds were overtopped due to the volume of liquid – comprising of firewater and rainwater falling onto the destroyed building after the incident. This was contained using sandbags and then concrete was brought in to create a temporary bund for the liquid.

The contaminated run-off that left the site entered external road drains on the industrial estate and ended up discharging into the beck. The beck is culverted through the estate but opens up about half a mile from the site. It was later confirmed that contaminated water had entered Fleet Beck and a small number of fish were found dead.

The fire service did not carry out an investigation, nor did HSE, because they considered the risk of sending someone on to site with the mix of chemicals present as too much of a health and safety risk.

Figure 3 – collapsed building and emergency sand bagging along bottom of the door.

Relevant requirements of S5.06

2008: Whilst this incident was caused by arson there were a number of failures to adhere to S5.06:

2.1.13 Drum washing, crushing, shredding and cutting

3. Drums containing (or which have contained):

- flammable and highly flammable wastes.
- volatile substances.

that cannot be recovered, should not be subject to crushing, unless the residues have been removed and the drum cleaned.

4. Processing of containers should only be undertaken following written instruction. These instructions should include which containers are to be processed and the type of container to hold residues.

2.3 Management

Operations and maintenance

1. Effective operational and maintenance systems should be employed on all aspects of the process whose failure could impact on the environment, in particular there should be:

- documented procedures to control operations that may have an adverse impact on the environment.
- a defined procedure for identifying, reviewing and prioritising items of plant for which a preventative maintenance regime is appropriate.
- documented procedures for monitoring emissions or impacts.
- a preventative maintenance programme covering all plant, whose failure could lead to impact on the environment, including regular inspection of major ‘non productive’ items such as tanks, pipework, retaining walls, bunds ducts and filters.

Competence and training

3. Training systems, covering the following items, should be in place for all relevant staff which cover.

- awareness of the regulatory implications of the Permit for the activity and their work activities.
- awareness of all potential environmental effects from operation under normal and abnormal circumstances.
- awareness of the need to report deviation from the Permit.
- prevention of accidental emissions and action to be taken when accidental emissions occur.

Accidents/incidents/non-compliance

8. There should be an accident plan … which:

- identifies the likelihood and consequence of accidents.
- identifies actions to prevent accidents and mitigate any consequences.

2.8 Accidents

3 **B - assessment of the risks.** The hazards having been identified, the process of assessing the risks should address six basic questions:

- how likely is the particular event to occur (source frequency)?
- what are the consequences (consequence assessment – what are the effects on the receptors)?
- what are the overall risks (determination of overall risk and its significance to the environment)?
- what can prevent or reduce the risk (risk management – measures to prevent accidents and/ or reduce their environmental consequences)?

2009: This incident occurred because a non-hazardous waste had dangerous properties. It is important to understand the nature of all wastes received so that any associated risks are removed or minimised:

2.1.1 Pre-acceptance procedures to assess waste

1. From the waste disposal enquiry the Operator should obtain information in writing relating to:

- the type of process producing the waste.
- the specific process from which the waste derives.
- hazards associated with the waste.

2.1.3 Waste Storage

Storage of drummed wastes and other containerised wastes such as IBCs

22. Storage areas for containers holding substances that are known to be sensitive to heat and light or reactive with water or moisture should be under cover and protected from water, heat and direct sunlight.

Compatibility testing

31. In order to prevent any adverse or unexpected reactions and releases before transfer involving the following activities, testing should take place prior to the transfer:

- bulking of solid waste into drums or skips.

2.3 Management

Accidents/incidents/non-compliance

8. There should be an accident plan which:

- identifies the likelihood and consequence of accidents.
- identifies actions to prevent accidents and mitigate any consequences.

2.8 Accidents

2 **A - Identification of the hazards** to the environment posed by the installation using a methodology akin to a Hazop study. Areas to consider should include, but should not be limited to, the following:

- arrangements for the storage, segregation and separation of differing waste types.
- failure of containment (eg. physical failure or overfilling of bunds or drainage sumps).
- failure to contain firewaters.
- incompatible substances allowed to come into contact.
- unexpected reactions or runaway reactions.

3 **B - assessment of the risks.** The hazards having been identified, the process of assessing the risks should address six basic questions:

- how likely is the particular event to occur (source frequency)?
- what substances are released and how much of each (risk evaluation of the event)?
- where do the released substances end up (emission prediction - what are the pathways and receptors)?
- what are the consequences (consequence assessment – what are the effects on the receptors)?
- what are the overall risks (determination of overall risk and its significance to the environment)?

- what can prevent or reduce the risk (risk management – measures to prevent accidents and/ or reduce their environmental consequences)?

5 **C - identification of the techniques necessary to reduce the risks**. The following techniques are relevant to most installations:

- procedures should be in place for checking and handling raw materials and wastes to ensure compatibility with other substances with which they may accidentally come into contact.
- storage arrangements for raw materials, products and wastes should be designed and operated to minimise risks to the environment.
- there should be appropriate secondary containment (eg. bunds, catchpots, building containment).
- there should be procedures for responding to and learning from incidents, near-misses, etc.
- appropriate control techniques should be in place to limit the consequences of an accident, such as; fire walls, firebreaks, isolation of drains, provision of oil spillage equipment, alerting of relevant authorities and evacuation procedures.

2010: This cause of this incident was unknown but the following failures contributed to, and exacerbated, it:

2.1.3 Waste Storage

General storage requirements

11. Storage area drainage infrastructure should ensure that all contaminated run-off is contained, that drainage from incompatible wastes cannot come into contact with each other and that fire cannot spread between storage / treatment areas via the drainage system.

23. Storage areas for containers holding flammable or highly flammable wastes should meet the requirements of HSG 51, HSG71 and HSG76.

2.3 Management

Accidents/incidents/non-conformance

8. There should be an accident plan which:

- identifies the likelihood and consequence of accidents.
- identifies actions to prevent accidents and mitigate any consequences.

11. There should be written procedures for investigating incidents, (and near misses) including identifying suitable corrective action and following up.

2.8 Accidents

2 **A - Identification of the hazards** to the environment posed by the installation using a methodology akin to a Hazop study. Areas to consider should include, but should not be limited to, the following:

- arrangements for the receipt, and checking of incoming wastes, including rejection and quarantine.
- arrangements for the storage, segregation and separation of differing waste types.
- procedures for the internal transfer, including "bulking-up", of waste materials.
- transfer of substances (eg. filling or emptying of vessels).
- overfilling of vessels.
- emissions from plant or equipment (eg. leakage from joints, over-pressurisation of vessels, blocked drains).
- failure of containment (eg. physical failure or overfilling of bunds or drainage sumps).

- failure to contain firewaters.
- wrong connections made in drains or other systems.
- incompatible substances allowed to come into contact.
- unexpected reactions or runaway reactions.
- release of an effluent before adequate checking of its composition.
- failure of main services (eg. power, steam, cooling water).
- operator error.
- vandalism.

3 **B - assessment of the risks.** The hazards having been identified, the process of assessing the risks should address six basic questions:

- how likely is the particular event to occur (source frequency)?
- what substances are released and how much of each (risk evaluation of the event)?
- where do the released substances end up (emission prediction - what are the pathways and receptors)?
- what are the consequences (consequence assessment – what are the effects on the receptors)?
- what are the overall risks (determination of overall risk and its significance to the environment)?
- what can prevent or reduce the risk (risk management – measures to prevent accidents and/ or reduce their environmental consequences)?

5 **C - identification of the techniques necessary to reduce the risks**. The following techniques are relevant to most installations:

- procedures should be in place for checking and handling raw materials and wastes to ensure compatibility with other substances with which they may accidentally come into contact.
- storage arrangements for raw materials, products and wastes should be designed and operated to minimise risks to the environment.
- there should be appropriate secondary containment (eg. bunds, catchpots, building containment).
- there should be procedures for responding to and learning from incidents, near-misses, etc.
- appropriate control techniques should be in place to limit the consequences of an accident, such as; fire walls, firebreaks, isolation of drains, provision of oil spillage equipment, alerting of relevant authorities and evacuation procedures.
- spill contingency procedures should be in place to minimise accidental release of raw materials, products and waste materials and then to prevent their entry into water.
- process waters, potentially contaminated site drainage waters, emergency firewater, chemically-contaminated waters and spillages of chemicals should be contained and, where necessary, routed to the effluent system and treated before emission to controlled waters or sewer. Sufficient storage should be provided to ensure that this can be achieved. Any emergency firewater collection system should take account of the additional firewater flows and fire-fighting foams, and emergency storage lagoons may be needed to prevent contaminated firewater reaching controlled waters.

Suggested improvements to S5.06

In 2008 and 2009 the site had two major incidents and the operator should have learned the lessons of those incidents, and consequently ensured that:

- the risk of fire on site was minimised.
- all necessary mitigation steps were taken to deal with fire, for example fire suppression systems.
- proper consideration should have been made for fire water control and the potential for off-site escape of liquids.

S5.06 provides many of the general tools for the safe management of high risk sites. It sometimes does this with reference to other guidance such as HSG51, HSG71 etc. The references in S5.06 should be checked so that the most recent version of these guides is detailed.

Section 2.8 2A of S5.06 should be amended to make reference to “potential for fire” and Section 2.8 3C to refer to “control of ignition sources”.

Section 2.1.3 should be amended to require that filters and wipes contaminated with oil should be considered a potential source of ignition and kept segregated from other flammable/combustible wastes or materials.

Actions taken by operator since incident

After the fire in 2010 the site was not reopened because the operator went into liquidation. The site environmental permit consequently ceased to exist. The site was then cleared of everything including waste, the remains of the building, and the concrete base. The cleanup of the site was dealt with by the site’s insurers.

Incident 25 October 2010 – Liverpool Road, Cadishead	
Date of incident	15/10/2012
Operator Name (at time of incident)	Cleansing Services Group Ltd
Site Address	Liverpool Road, Cadishead, Greater Manchester

The incident

A small explosion occurred inside a shredder (hydraulic rotary shear shredder with ram hopper) resulting in a fire which caused localised damage to the shredder.

Description of causes

The shredder was used for volume reduction of non-hazardous wastes (principally packaging from the printing industry) unsuitable for recovery prior to transport to landfill. At the time of the incident the shredder was being used to process non-hazardous ink waste packaging from the printing industry which was a normal operation. The wastes were stored in cut-off IBCs and fed by the operator from a fork lift truck.

At approximately 14:00 a flash occurred inside the shredder followed by flames which reached the height of the tall canopy roof above. This was followed by a green cloud and empty ink cartridges being ejected from the shredder. A tall green plume was visible from outside the site.

The shredder operator immediately picked up a nearby IBC containing 1% caustic, dropped it into the shredder and closed the hopper lid. As a result the flames died down quickly. With assistance from colleagues the electrical supply to the shredder was switched off and a hose was used to cool the exterior of the shredder and douse the flames. The fire was smothered using bagged soda ash and a powder extinguisher. The Fire Service arrived as the fire was extinguished, approximately ten minutes after the fire started.

The shredder experienced some minor damage and there were some scorch marks on the canopy in the area above the shredder.

Empty toner powder containers were identified in the debris ejected from the hopper, together with a spattering of green powder around the shredder. The green powder was found to contain chromium III oxide.

The cause of the incident is believed to have been a dust explosion within the shredder as toner powder was suspended in air to form an explosive mixture and ignited, probably by sparking from metal on metal contact as wastes were shredded.

The waste had been received from another waste transfer station transported in cut off IBCs (IBCs with the lid cut off to create an open container). Inspection of the waste had been limited to visual inspection off the topmost layer. Waste at the bottom of the IBC was not inspected and cut off IBCs do not facilitate manual emptying for inspection due to the depth and reach required to remove items manually.

The potential for a dust explosion had not been identified on the original risk assessments for the shredder as this was not expected to be an issue for the waste feedstock.

Relevant requirements of S5.06

2.1.2 Acceptance procedures when waste arrives at the installation

Sampling - checking - testing of wastes - storage

8. Other than pure product chemicals and laboratory smalls, no wastes should be accepted at the installation without sampling, checking and testing being carried out. Reliance solely on the written information supplied is not acceptable, and physical verification and analytical confirmation are required. All wastes, whether for on-site treatment or simply storage, must be sampled and undergo verification and compliance testing.

2.1.13 Drum washing, crushing, shredding and cutting

3. Drums containing (or which have contained):

- flammable and highly flammable wastes.
- volatile substances

that cannot be recovered, should not be subject to crushing, unless the residues have been removed and the drum cleaned.

4. Processing of containers should only be undertaken following written instruction. These instructions should include which containers are to be processed and the type of container to hold residues.

2.8 Accidents

2 **A - Identification of the hazards** to the environment posed by the installation using a methodology

akin to a Hazop study. Areas to consider should include, but should not be limited to, the

following:

- arrangements for the receipt, and checking of incoming wastes, including rejection and quarantine
- unexpected reactions or runaway reactions

3 **B - assessment of the risks**. The hazards having been identified, the process of assessing

the risks should address six basic questions:

- how likely is the particular event to occur (source frequency)?
- what substances are released and how much of each (risk evaluation of the event)?
- where do the released substances end up (emission prediction - what are the pathways and
- receptors)?
- what are the consequences (consequence assessment – what are the effects on the receptors)?
- what are the overall risks (determination of overall risk and its significance to the environment)?

- what can prevent or reduce the risk (risk management – measures to prevent accidents and/
- or reduce their environmental consequences)?

5 **C - identification of the techniques necessary to reduce the risks**. The following techniques are relevant to most installations:

- appropriate control techniques should be in place to limit the consequences of an accident,
- such as; fire walls, firebreaks isolation of drains, provision of oil spillage equipment, alerting
- of relevant authorities and evacuation procedures.

Suggested improvements to S5.06

S5.06 does not highlight the hazards of combustible dusts and the risk of explosion if a finely divided powder becomes suspended in air as a dust cloud.

S5.06 does not identify inerting or fire suppression systems for consideration as process controls.

Under Section 2.1.13 Drum washing, crushing, shredding and cutting, BAT point 3 change ‘crushing’ to ‘processing’ to clarify that this applies also to shredding.

Actions taken by operator since incident

Risk assessments have been reviewed to recognise the risk of a dust explosion.

Waste pre acceptance procedures have been reviewed to identify any wastes containing combustible dusts.

Waste inspection procedures have been reviewed.

The operator has decided to send this waste directly to landfill.

Incident 26 December 2010 – Lillyhall Waste Treatment Centre, Workington	
Date of incident	16th December 2010
Operator Name (at time of incident)	Waste Recycling Limited
Site Address	Lillyhall Waste Treatment Centre, Dixon House, Joseph Noble Road, Lillyhall, Workington, Cumbria

The incident

A leak from a tanker discharging product sodium hydroxide (caustic). No environmental damage was caused.

Description of causes

On 16th December 2010, 28 tonnes of product caustic was delivered by road tanker to the operator for use at the site. The tanker, which was under the control of haulier, was connected up to the tank discharge point and the valves opened. When, however, the pressure was raised to discharge the caustic nothing came out. There was a blockage within an elbow at the top of the fill stack pipe in to the stock tank. December 2010 was extremely cold and caustic sitting in the fill stack was found to have frozen*. The pipe was defrosted using hot water.

When discharge recommenced a leak was noticed from the cladding at the rear of the tanker. The discharge was stopped again and containers were place under the tanker to catch the leaking waste. The discharge point was suitably contained. The discharge was then recommenced to empty the tanker as soon as possible. Approximately 1,500 litres of caustic leaked. Some of the caustic was collected up and transferred to an IBC for eventual use. Absorbent granules/pads were used to clear the rest and these were collected in drums for disposal.

The tanker was then moved away from the discharge point to another bunded area. On investigation it was found that the caustic had contaminated the insulating cladding of the tanker from a leaking flange hidden underneath the cladding. The tanker was left in the bunded area of the site and engineers were brought on site to strip the contaminated cladding from the tanker. The flange had been in place from the tanker's previous use for moving high temperature product and had gone unnoticed since it's modification to a general purpose tanker. It is thought that the pressurisation of the tanker caused by the blockage caused the flange to fail.

*The freezing point of caustic varies with its solution strength: for example 5% solutions freeze at -4°C, 32% caustic freezes at 2°C and 50% solutions freeze at 12°C.

Relevant requirements of S5.06

None.

Suggested improvements to S5.06

Section 2.8 (Accidents) does not specifically consider severe weather conditions in 'section A Identification of Hazards'. This section needs to be updated accordingly.

Actions taken by operator since incident

None.

Incident 27 April 2011 – Gwent Waste Management Centre, Newport

Date of incident	19 April 2011
Operator Name (at time of incident)	Tradebe Gwent Limited
Site Address	Gwent Waste Management Centre, Park House, Corporation Rd, Newport

The incident

A release of hydrogen sulphide occurred during a treatment process. The release led to two explosions within the plant which damaged a tank and associated extraction fan, and ductwork.

Description of causes

The incident occurred on a normal working day. At the time of the incident reactor vessel T10 was filling with waste and 3 road tankers were at various stages of discharge. Each vehicle was positioned at dedicated off-loading bays that were allocated to the load being discharged.

The event at site became apparent after a single and loud percussive ‘boom’ was heard at around 15:20. Although no emergency alarm was generated by the event, (due to the fact that the only emergency alarm system at the premises related to fire) all persons were quickly instructed by staff to evacuate. A pungent rotten eggs ‘sulphide’ type odour was noticed by evacuated staff, and some staff complained of feeling nauseous.

With all personnel accounted for, a member of staff attended the site’s control room briefly (post first event approx 15:25) in order to:

- gauge the extent of any damage
- check whether any plant had failed in terms of containment.
- double check that the site records were accurate; and
- to find out if all persons had been evacuated from the process building.

Once this had been confirmed, the staff member exited the building wearing respiratory protective equipment and proceeded to liaise with the shift management team.

At approximately 15:30 it was decided to allow staff to re-enter the office building as odours were observed to have declined. Background readings of 7.6ppm H_2S (hydrogen sulphide) were taken at this time.

While staff were re-entering the building, two members of staff positioned outside the process building noticed a rapid increase of the distinctive very pungent ‘sulphide’ odour.

This was coupled with a volume of greyish fumes and associated noise that appeared to occur rapidly within the high level tank / apex roof space around T10. These staff heard a ‘muffled boom’ that was coupled with a brief but large fireball. It was observed that a large fire was generated within the plant. The fire then travelled down the vicinity of tank T9 before extinguishing itself (at approximately 15.35). The event was brief and did not exit the process building confines, but the evacuated people who were still within the car park were moved to its rear vicinities. The small number of employees who had returned to the administration building were moved back to the car park.

The emergency services were called and the emergency services arrived within approximately 10-15 minutes. A roadblock was installed and the road outside the site was closed off.

The Fire Service, in consultation with the operator, assessed there to be a continuing risk of presence of a flammable gas, hydrogen sulphide, together with an unknown ignition source within the process building. The Fire Service decided that no one should be permitted to enter the building which it classified as at potential risk of explosion. This approach was maintained for several hours. It was further decided by the Fire Service not to turn off the power as the operator advised that this would cause the site diesel generator to start automatically which could present a potential ignition source.

At approximately 17:45 the Fire Service and Tradebe detected H_2S levels as being below 1ppm and decided to allow site entry. It was also visually observed that fume levels had significantly subsided. The tank farm’s LEV system was found to have been fractured in numerous places which indicated that the initial explosion was probably experienced either within the treatment tank header space or the associated LEV system.

The site remained occupied throughout the following evening and night by Tradebe management during which an established gas monitoring exercise regime was implemented. No hydrogen sulphide was identified throughout the exercise and the plant did not experience any further adverse events.

The company investigated the cause of the incident and the mixing of two deliveries which arrived at a similar time (that is, within 10 minutes of each other) was identified as the immediate cause of the incident. The first waste was a caustic waste contaminated with sulphide which arrived at 14:15 and the second waste was a battery acid waste arriving at 14:25. Although the loads were positioned at different offloading points both loads were allocated to discharge to T10.

The potential for the two loads to react adversely was identified at shift handover and the new shift planned to ‘allow enough time between the introduction of each load into T10 to allow adequate time for the waste to mix and disperse.’

It is believed that the acid waste reacted with the sulphide in the caustic waste to a degree that resulted in a significant volume of hydrogen sulphide being generated. It is believed that the evolution of gas then filled the headspace of T10 and its associated LEV extraction ductwork. It exceeded its flammability concentration in air and was ignited via a non-atex fan-set.

The pressure generated by the event resulted in the main section of T10’s roof plate being lifted with the retaining bolts throughout the plate sections being removed from their fixings. Additionally, separation at joints of large sections of the associated LEV ducting was also observed. An LEV supply pipe connecting T10 with the main LEV ductwork was also disconnected from its position at the top of the tank which caused it to fall into the bund below. This also caused significant damage to the fan-sets that powered the LEV. The dedicated air lines that serve the treatment tanks were also damaged, ranging from melting of the pipes through to basic dislodging from their intended operational points.

Relevant requirements of S5.06

2.1.2 Acceptance procedures when waste arrives at the installation

Sampling – checking – testing of wastes - storage

10. On-site verification and compliance testing should take place to confirm:

- the identity of the waste
- the description of the waste
- consistency with pre-acceptance information and proposed treatment method
- compliance with permit

2.1.3 Waste storage

Compatibility testing

31. In order to prevent any adverse or unexpected reactions and releases before transfer involving the following activities, testing should take place prior to the transfer:

- tanker discharge to bulk storage
- tank-to-tank transfer
- transfer from container to bulk tank
- bulking into drums/IBCs
- bulking of solid waste into drums or skips

32. Any evolved gases and cause of odour should be identified. If any adverse reaction is observed, an alternative discharge or disposal route should be found.

Transfer from tanker, drums and other containers in bulk storage

33. Due consideration should be taken of the implications of scale-up from laboratory compatibility testing to bulk transfer and the guidance is given in HSG143.

39. A representative sample of the receiving tank/vessel/container should be mixed in a proportional ratio with a sample of incoming waste stream that it is proposed to add to the tank/vessel/container. The two samples should take account of the “worst-case” scenario of likely constituents. The particular test parameters will be driven by the wastes being bulked. As a minimum, records of testing should be kept including any reaction giving rise to:

- increase in temperature
- viscosity change
- separation or precipitation of solids
- evolution of gases
- evolution of odours

2.1.4 Treatment

6. For each new reaction, proposed mixes of wastes and reagents should be assessed prior to treatment in a scale laboratory test mix of the wastes and reagents to be used. This should lead to all reactions and mixing of wastes being to a predetermined batch “recipe”. It should also take into account the potential scale-up effects, for example, increased heat of reaction with increased reaction mass relative to the reactor volume, increased residence time within the reactor and modified reaction properties. See HSG143 for further Guidance.

7. The reactor vessel and plant should be specifically designed, commissioned and operated to be fit for purpose. Such designs should include consideration of chemical process hazards and hazard assessment of the chemical reactions, prevention and

protective measures together with consideration of process management that is working instructions, staff training, plant maintenance, checks, audits and emergency procedures.

10. Where appropriate, reactor vessels (or mixing vessels where the treatment is carried out) should be charged with pre-mixed wastes and reagents. For example, reactor vessels should be "pre-limed" or charged first with the reacting alkali to control the reaction using, for example, calcium hydroxide solution made up prior to charging the reactor vessel. The decanting of sacks or drums to the vessel should be avoided. Failure to charge the vessel can lead to:

- concentration "hot spots" at the surface of the reaction liquor
- loss of reaction control
- emission of fume from the instantaneous reaction at the interface
- the open hatch venting any fume and by-passing appropriate abatement

11. The reaction should be monitored to ensure that the reaction is under control and proceeding towards the anticipated result. For this purpose, vessels used for treatment should be equipped appropriately eg. high-level, pH and temperature monitors. These should be automatic and continuous and linked to a clear display in the control room or laboratory together with an audible alarm. Risk assessment may require process monitors to be linked to cut-off devices.

2.3 Management

Competence and training

3. Training systems, covering the following items, should be in place for all relevant staff which cover:

- awareness of the regulatory implications of the Permit for the activity and their work activities.
- awareness of all potential environmental effects from operation under normal and abnormal circumstances
- awareness of the need to report deviation from the Permit
- prevention of accidental emissions and action to be taken when accidental emissions occur

2.8 Accidents

2 **A - Identification of the hazards** to the environment posed by the installation using a methodology akin to a Hazop study. Areas to consider should include, but should not be limited to, the following:

- arrangements for the storage, segregation and separation of differing waste types
- incompatible substances allowed to come into contact.
- unexpected reactions or runaway reactions.

3 **B - assessment of the risks**. The hazards having been identified, the process of assessing

the risks should address six basic questions:

- how likely is the particular event to occur (source frequency)?
- what substances are released and how much of each (risk evaluation of the event)?
- where do the released substances end up (emission prediction - what are the pathways and receptors)?
- what are the consequences (consequence assessment – what are the effects on the receptors)?

- what are the overall risks (determination of overall risk and its significance to the environment)?
- what can prevent or reduce the risk (risk management – measures to prevent accidents and/ or reduce their environmental consequences)?

5 **C - identification of the techniques necessary to reduce the risks**. The following techniques are relevant to most installations:

- procedures should be in place for checking and handling raw materials and wastes to ensure compatibility with other substances with which they may accidentally come into contact.
- storage arrangements for raw materials, products and wastes should be designed and operated to minimise risks to the environment.
- there should be automatic process controls backed-up by manual supervision, both to minimise the frequency of emergency situations and to maintain control during emergency situations.

Suggested improvements to S5.06

None identified. The draft compatibility guidance current at the time of the incident has since been finalised and issued.

Actions taken by operator since incident

A full review of pre-acceptance, acceptance and acceptance procedures was carried out and improvements made. Retraining was provided for all appropriate staff. The limit on any materials which could give rise to flammable or explosive mixtures on treatment was set at <100mg/L and agreed under the terms of an HSE Improvement Notice.

A new compatibility testing procedure was put in place in line with the draft EA guidance current at the time on gas evaluation & compatibility. Training on this was given to all key staff.

New laboratory equipment was supplied for both pre-acceptance and acceptance labs, including temperature measurement and gas evolution quasi adiabatically.

P&ID drawings for the treatment plant were reviewed by an independent engineering consultant.

A Hazop study, phase 1 was completed by a mixed discipline team, including Ops, Technical (SEQ) & Engineering.

A revised risk Assessment for the plant was carried out post hazop studies.

Other Incidents Reported At Permitted Waste Facilities

Date	Location & region	Company	Summary of incident
01/2002	North Shields, North East	Distillex	Estimated 200 litres of toxic methylene chloride fumes leaked from a distillation unit. Fire crews attended the site and police warned residents to stay indoors and keep windows and doors closed until the gas dispersed out to sea.
04/2002	Manchester , North West	Lanstar	7 tonnes of material leaked from a large tank containing a mixture of creosote, ammonium sulphate and naphthalene. Because the tank was not protected by an impermeable bund, the liquid seeped into the ground, though without reaching groundwater.
09/2007	Ellesmere Port, North West	Tradebe	The reaction of nitric acid in a tanker barrel.
11/2007	Dudley, Midlands	Envirosol	Drums venting fumes. Waste containers which did not have lids or caps secure and in place, and inadequate segregation of incompatible wastes, including laboratory smalls which should have been dealt with on the day of arrival. Envirosol vowed to act quickly to resolve these issues. Site operating over capacity and in a poor state. Incompatible wastes had been received into site before Christmas and stored together without proper assessment and testing being carried out.
03/2008	Sheffied, North East	Viridor	Unexpected reaction resulting in the release of a quantity of hydrogen sulphide gas. Site chemists taken to hospital.
09/2008	Cardiff, Wales	Seaport Environment al	Valve burst, resulting in release of mercaptans and forcing complete shutdown of operations. HSE is taking the lead.
09/2008	Lower Bank View, Liverpool. North West	Veolia ES (UK) Ltd	Bulk consignment of waste received on site and offloaded into a reception pit. Operator detected a change in odour during the offloading process and stopped discharge. Subsequent analysis identified that the waste had a low flash point and the remaining contents of the tanker was rejected. The waste sampling and analysis carried out by the operator during pre-acceptance and upon arrival at the site failed to identify the flammable nature of the material. The tanker was only sampled on arrival at the facility from the back valve.
03/2009	Cannock, Midlands	Augean	Conveyor belt fire. The fire brigade were called after staff could not extinguish fire. Fire brigade put out fire.
03/2009	Falmouth, South West	Falmouth Oil Services	Following a routine transfer of waste oil from one tank to another prior to treatment the receiving tanks floor failed. This allowed the escape of 13,600 litres of waste oil into the ground and gravel within the secondary containment system through the tank floor. The tank actually contained 750,000 litres of waste oil, it was only that someone noticed the leak that it was stopped.

Date	Location & region	Company	Summary of incident
11/2009	Widnes, North West	Wastecare	Ten fire appliances tackled the fire as thick black smoke billowed over houses in Halton View. Part of the building has collapsed and emergency crews are now waiting for Halton Council's building control inspectors to assess the damage.
05/2010	Fawley, Southern	Tradebe Fawley	240 tonne tank of mixed solvents started leaking from the base. FRS used foam to prevent evaporation of the waste solvent. Wastes contained in the bund were transferred to other empty tanks on site.
06/2010	Harworth, Midlands	Solvents with safety	80 fire-fighters on site fighting the blaze. Storage building and storage tanks destroyed. Cause is currently being investigated.
09/2010	Dinnington, North East	Tradebe	Explosion causing damage to building and equipment. No injuries or environmental damage. Currently being investigated by HSE. Believed to have resulted from a reaction & over-pressurisation in the waste conveyor that feeds the solvent cooker.
10/2010	Burscough, North West	PHS	Large fire on site. Believed to have originated from aerosol shredding. >60 fire fighters onsite, 3 members of staff suffered burns, 1 air-lifted to hospital.
11/2010	Cannock, Midlands	Augean	The fire brigade attended the liquid treatment plant in Cannock. A small explosion occurred within part of the abatement system of the liquid treatment plant causing the knock out pot to rupture. Two site operatives received minor injuries.
12/2010	Davyhulme WWTW, North West	United Utilities	The biogas siloxane treatment unit caught fire and exploded, this is located between the biogas holder and the engines. It was the styrene media on the off-line unit which caught fire at the start of it's regeneration cycle, the incident was investigated jointly by the EA and HSE. The incident was localised to the siloxane plant.
03/2011	Aldridge, Midlands	Veolia	Waste material briefly caught fire before being extinguished. Skip lorry arrived on site containing 2340 Kg of waste described as filter cloths/rolls containing less than 0.1% oil contamination. On visual inspection of the skip contents there were initial concerns about the oil content and in particular the metallic (swarf) contamination on the cloths and further information supplied regarding the later. It was decided that the waste should go for thermal destruction rather than non hazardous landfill for final disposal. On the 1st March during a routine site inspection smoke was seen to be emitting from the skip that the filter cloths were being stored in and this was immediately tipped into an empty storage area used for filter cake. During this operation a couple of the filter cloths caught fire which was quickly smothered using filter cake. The filter cloths were cut up and placed into 205 litre drums for disposal by High Temperature Incineration. Further investigation found that the waste was contaminated with an aluminium-based alloy containing magnesium, manganese and chromium, which is pyrophoric in nature when exposed to air.

Date	Location & region	Company	Summary of incident
04/2011	Manchester North West	CSG Lanstar	A fire was discovered by night security at approx. 00:30 on 21st April 2011 in the main non-hazardous storage pit and shredder which required the attendance of the Emergency Services and key site personnel. The batch programme for the previous day had been routine and contained no new waste streams or anything that was suspicious or out of the ordinary. All inputs were non-hazardous. Inputs included contaminated packaging rags, contamination generally being ink residues. The last waste was loaded at approx. 16:00 and the final operation carried out that day was to feed some clean wooden pallets into the shredder to clean and flush it through. The cause of the fire is unknown. It is unclear whether the fire started in the pit or in the shredder chute. There were no injuries sustained however, a fire officer fell into the pit and became submerged under fire water. He attended hospital and was later released. The environmental impact and damage caused was minimal.
06/2011	Kingsnorth, South-East	Eco-Oil Ltd	Major blaze at a waste oil depot on Kingsnorth Industrial Estate, Hoo. The blaze started just after 11pm on Friday 3rd June when a bin containing including oily rags and granules caught fire. The fire quickly spread to the depot yard where other bins containing oily rags/granules, oil filters and aerosols caught alight along with 200 litre drums holding mixed fuels. Two parked HGV lorry cabs (minus trailers) were destroyed along with two small tankers and one tanker trailer. The fire entered the bunded tank storage area, possibly resulting from burning waste projectiles or oil contamination in the bund, causing the failure of a valve on a 300,000 l oil storage tank. The tank bund failed resulting in the release of 212,000 l of waste oil, which set alight and spread on to open land neighbouring the storage site. The pools of burning oil were contained by the fire service and the fire was brought under control just before 8am on Saturday 4th June.
07/2011	Midlands	PHS Ltd	A nearly empty 205 litre drum containing a few 2.5 litre Winchesters of inorganic acids, (nitric, sulphuric, hydrochloric) had evidence of spilled material in the vermiculite and a 2.5 litre bottle of nitric acid was lying on its side. The Winchester was removed and found to have a cracked top so was isolated to overpack. As the Winchester was moved , some poly chip packing material present in the drum must have fallen onto the spill, reacted and burst into flames. The Health and Safety representative saw the situation and extinguished the fire with CO_2 extinguisher. Fire alarm was raised and full evacuation took place. The operative could not guarantee that the fire had been extinguished so the fire brigade was called. They attended site and surveyed the situation. When they were satisfied that there was no sign of fire or continued reaction they allowed the operator to deal with the cleanup operation.

Date	Location & region	Company	Summary of incident
07/2011	Hinckley, Midlands Central	Augean	An IBC of bulked hydrogen peroxide reacted exothermically creating a pressure build up which pushed the lid off the container. This caused water vapour and the liquid H_2O_2 to spill out of the top of the IBC on to the floor in the bund of bay 12. The water vapour set off the fire alarm and the fire brigade were called by the site security. The fire brigade was happy that no fire had occurred and that there was no further risk to the environment. The spill was cleaned up by pumping the sumps in to an IBC and then using sand and spillsorb used to soak up the rest of the residues. The bay was then finally hosed down. 48hours before the incident 2 x Pallets of 25 litre containers of hydrogen peroxide (T ref 1106361 50% H_2O_2 and T1107147 - 4% H_2O_2 5% H_2SO_4) were bulked into an IBC's. A compatibility test was done and recorded on the bulking proforma which showed that no adverse reaction had been observed. The materials were bulked by hand in to a washed out IBC however on inspection of the IBC after the incident a clear PVA glue type material was observed. It is thought that a residue within the IBC catalysed the hydrogen peroxide to produce water and oxygen plus heat which pressurised the container causing the lid to fail.
12/2011	Knottingley, West Yorkshire	Tradebe	A spillage of around 3,800 litres of highly flammable solvent occurred when a road tanker was overfilled. The immediate cause was that the operative did not realize that the tank had already been filled due to a failure of communication at shift handover.
05/2012	West Bromwich	Arrow	A severe fire occurred at a site used for waste oil recycling. Several gas cylinders present were cooled to prevent them from exploding.
07/2012	Widnes	Silver Lining	A violent reaction occurred during the bulking of liquids into an IBC resulting in a brief flash of fire. No injuries were caused.
03/2013	Walkden, Greater Manchester	Adler and Allen	An explosion occurred followed by a fire which damaged a building as a tanker which had previously been used to carry waste petrol was prepared for cleaning. Two employees were injured requiring hospital treatment, one of whom was airlifted to hospital. The incident was attended by the fire service.
08/2013	Taunton	Silver Lining	The fire service was called by the gas board to check reports of a gas-like odour. It was traced to an incident at the site.

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HSG176, Storage of Flammable liquids in tanks. HSE

HSG143, Designing and Operating safe chemical reaction processes. HSE

Sector Guidance Note S5.06 - Guidance for the Recovery and Disposal of Hazardous and Non Hazardous Waste, Environment Agency

Compatibility Testing Guidance for Bulking Operations in the Waste Treatment Industry, HSE / Environment Agency

Guidance for the storage and treatment of aerosol canisters and similar packaged wastes Environment Agency

PPG 2 - Above Ground Oil Storage Tanks, Environment Agency

LIT 6837