



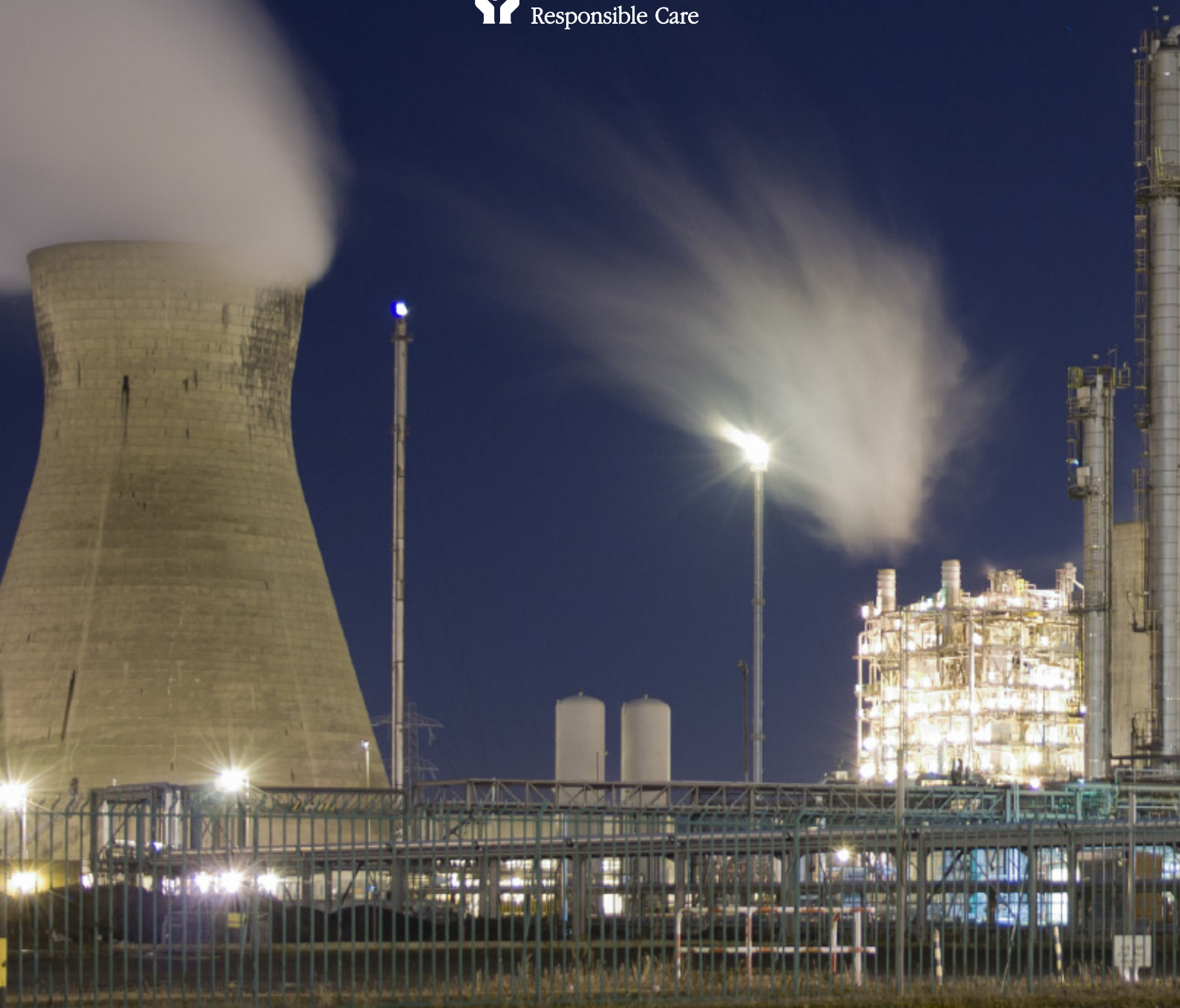
CHEMICAL INDUSTRIES
ASSOCIATION

Winterisation

Managing process plant through
severe and prolonged cold weather



Responsible Care



Managing process plant through severe and prolonged cold weather

The UK has experienced several periods of unprecedented cold weather in recent winters. January 2010 saw very cold weather and snow disruption in many parts of the UK, and the extreme low temperatures experienced in 2010/2011 winter broke all records in some areas. This was made worse by the fact that the cold weather persisted for many days. On occasions, for example, the temperatures in some parts of the UK remained consistently below zero, and there were several consecutive night-time temperatures of -15 Celsius. Localised temperatures even lower than this were recorded in some parts of the country.

Companies will be well aware this can result in extensive business disruption from lost production and inability to move raw materials or finished product by road. However, such extreme weather can also increase the

chances of losses of containment and major accidents as low temperature can have severe effects on plant and pipework, equipment and process fluids.

All companies should already have 'winterisation' procedures prepared, but the experience of recent winter temperatures has highlighted the need for these to be reviewed to ensure they are as robust as possible and appropriate for the sort of low temperatures and snowfall that sites may have to contend with.

CIA has discussed with member companies their experiences in recent severe cold weather, in order that we can spread industry learning and be in the best possible position to help businesses in the future. To help raise awareness of these issues, the key points are highlighted below:

Problems companies have reported

The following are some examples of the widespread plant & equipment problems and resultant disruption that have been reported:

- The design specification for many items of plant and equipment is -5 deg Celsius to -10 deg Celsius but temperatures much lower than this were experienced in 2010 and 2011. Temperatures down to -15 degrees Celsius for several days were commonplace in some parts of the country (lower in some cases).
- The potential for freezing temperatures to be an initiator of major accidents should not be underestimated. Companies have reported incidents including freezing of coolant lines to a chemical reaction vessel resulting in rise in reaction temperature and pressure; and failures of primary containment after freezing and subsequent thaw. Snow and ice loading on tank roofs, warehouses and other buildings are also relevant factors that have resulted in structural failures, and bunds may be cracked by 'heave' from freezing ground. Companies should be aware that freezing weather has the potential to cause simultaneous failure of multiple layers of protection, and this needs to be factored into risk assessments.
- Lots of water and other 'wet' lines freeze – leading to flanges, valve bonnets and other joints failing. In some cases even wet hydrocarbon lines or effluent lines with higher salt concentration have frozen. Some pipelines that were damaged have had particularly disruptive knock-on effects – for example, loss of boiler feed water lines that froze and fractured, leading to consequent process shutdowns due to boilers being out of action. Other wet systems such as cooling towers have also frozen.
- Some joints burst after freezing, were cleared and replaced, but froze again before effective lagging could be applied. In some cases, large numbers of failed joints were experienced simultaneously (and also subsequent leaks on thawing), leading to teams of personnel spending significant time responding to calls and repairing joints.
- Pneumatic control systems have also been affected. If instrument air is not dried adequately, water can condense and freeze leading to line blockages. This can then prevent plant controls (including, potentially, safety critical controls) from working.
- In some regions, gas supplies to industrial consumers have been interrupted at short notice (even when on 'firm' contract) leading to problems with maintaining energy to process plant, or at least resulting in the need to find and use much more expensive alternative energy sources.
- Many sites experienced operational and supply chain problems due to the temporary unavailability of deliveries of raw materials, transport for finished product from site to customers etc.
- The potential effects on the movement of key staff also need to be considered. In some cases, people have been unable to get to work because of impassable roads and other transport disruption.
- Various parts of sites including car parks can become dangerously slippery with ice – some accidents were reported due to people slipping and falling. Furthermore, in periods of heavy snowfall there may be a problem about clearing snow from key access areas, and where to put large quantities of snow that has been cleared.

Potential solutions and mitigation measures for consideration

The following advice and good practice is based on some of the actions companies have implemented to cope with extreme low temperature. Combinations of these measures may help manage business continuity as well as minimise the risk of costly and potentially dangerous plant failures.

- Companies should review their site winterisation procedures in the light of their own and others' experience, and use this to plan for the remainder of winter and for next winter. In particular, companies should ensure that their procedures cover all of the potential contingencies noted above, from freezing of equipment to unavailability of staff and disruption in movement of materials. It is considered good practice to develop an Action Plan to assist in prioritising and managing actions identified as necessary.
- Where specialist techniques such as HAZOP or SIL assessment have identified safety critical plant that may be especially susceptible (for example, the HAZOP guide phrase 'lower temperature' may prompt the provision of lagging or trace heating), arrangements should also be made to ensure protection measures are maintained in effective working order to ensure the safeguards are adequate.
- Where safety of plant and equipment cannot be assured, it may be necessary to consider shutting down process plants, lines or in some cases even sites for periods during the coldest prolonged spells. Several CIA member companies took this option in the 2010/2011 winter. Although not an attractive option, (and after assessing the value of keeping plant running to prevent freezing) it may in some cases be a better alternative in the long run than expensive plant failures. Where shutdown in cold weather is necessary as a last resort, the procedures should encompass leaving plant in safe condition including blow-through to ensure there is no residual water or other fluids that may freeze.
- There is no guarantee that gas supplies (even if on a 'firm' contract) will not be interrupted in periods of severe prolonged cold weather. Companies should be aware of this possibility, and consider what alternative arrangements they have and how they would cope with this contingency.
- Increased lagging and/or trace heating will help vulnerable parts of plant and equipment to stay operational during cold weather. Reviews of pipework should identify such lines so that the necessary work can be planned and carried out well in advance.
- Extra attention should be paid to plant emergency mitigation systems – fire mains, hydrants, remote monitors, fusible tubes in fire detection systems, water deluge, emergency showers etc. are all especially vulnerable in extreme cold weather, and it may not be safe to maintain normal operations if any of these become unavailable. Furthermore, the viability of emergency showers may be an issue - the potential effects of being drenched in cold water in sub-zero conditions for anyone unfortunate enough to have to use an external shower following a serious contamination should be considered. On some sites 'winterised' showers may be available though these can be expensive.
- Scaffolding and sheeting of pipetracks and some process plants can be effective as a precaution. This is best utilised well in advance to prevent severe cold getting into plants in the first place. Furthermore, such arrangements can help if external warming such as warm air needs to be provided to keep lines running or to unfreeze plant should this become necessary.
- Where key site personnel have been unable to get to/from work because of severe weather disruption, some companies arranged to put up staff in local hotel accommodation temporarily to avoid the disruption.
- For outdoor work, the provision of adequate warm clothing and PPE for staff to cope with extreme weather will be needed. Arrangements may also need to include provision for extra breaks in a warm/ sheltered environment where necessary.
- Extra site gritting and snow clearance will be necessary in bad weather. Experience has shown that additional warnings and awareness raising for staff can have a positive effect in minimising the risk of accidents and personal injury. Some plants have experienced the formation of very large icicles at height from leaking pipes, and temporary thaws. While we have no reports of accidents from falling icicles and other frozen liquid, the potential for injury from these should be taken into account when assessing risks to pedestrians in severe cold weather.
- Over the last two winters CIA is aware of companies who were penalised by the environment regulators when they had to operate outside of their permit conditions. CIA advice is to contact your inspector to discuss the options if you think you will need to operate outside your permit conditions due to, for example, switch to back-up fuel, increasing emissions limits on a temporary basis etc.

CIA will review the advice in this note periodically, and update it to reflect any new information or successful mitigation measures we learn about. For more information please contact Phil Scott (scottp@cia.org.uk) or Jackie Coates (coatesj@cia.org.uk).



**Steve Elliott, Chief Executive,
Chemical Industries Association**

Recent winters have highlighted the vulnerability of some of our sites to prolonged spells of unusually cold weather. The effects of continuous sub-zero temperatures have caused both severe business disruption and safety/environment incidents. The impact of frozen process plant and pipelines

as potential causes of major accidents should not be

underestimated. It's important for us to learn from these experiences. There are steps that companies can take to help prepare for the effects of prolonged cold weather and to improve business continuity as well as manage safety. This short guidance aims to raise awareness of the potential problems and suggest some solutions – I urge you to consider it carefully in terms of your site arrangements as we move into winter.



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