

WINTERISATION

Managing process plant through severe winter weather

CIA has recently published comprehensive guidance on Climate Change Adaptation, which aims to help companies to develop a risk assessment and action plan to manage the projected effects of climate change [Safeguarding chemical businesses in a changing climate - How to prepare a Climate Change Adaptation Plan](#). However, there is additionally the risk of severe weather that we potentially face during any winter in the UK, as part of the normal seasonal fluctuation in temperature and precipitation (including rainfall and snow) and irrespective of climate change.

Chemical businesses should already have well-established procedures to help plan for and manage operations and process plant & equipment through extremes of winter weather – ‘Winterisation’. Depending on the business, these plans are often rolled out well in advance of winter. But it’s never too late to reassess how well prepared a site is to cope with the possible challenges, to review potential impacts on major hazard inventories, and to maintain business continuity including through supply chains that can become compromised by severe weather.

This CIA guide is intended to raise awareness of the need to check winterisation plans and procedures, with a view to implementing any safety and mitigation measures identified as necessary.

Challenges that companies have experienced

The following examples – drawn from more than 10 years’ experience across many chemical businesses - are based on some of the widespread plant and equipment practical issues and resultant disruption that some sites have experienced from severe and prolonged cold weather and its related effects

- The specification for the effective operating range of many items of plant, equipment and instrumentation is typically minus 5 to minus 10 degrees Celsius. But temperatures much lower than this have often been experienced in parts of the UK and for extended periods – leading to the possibility of critical equipment operating outside its design limits or not working at all
- The potential for freezing temperatures to initiate a process safety incident should be considered. Companies have in the past reported incidents including freezing of coolant lines to a chemical reaction vessel resulting in rise in reaction temperature and pressure; and failure of primary containment after freezing and subsequent thaw. Snow and ice loading on tank roofs, warehouses and other buildings are also relevant factors that can result in structural failures. Prolonged freezing temperature has the potential to cause simultaneous failure of multiple layers of protection, and this needs to be factored into risk assessments
- Water and other ‘wet’ lines (even with some hydrocarbon content) can freeze – leading to flanges, valve bonnets and other joints failing. 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 have burst due to expansion and freezing, been cleared and replaced, but froze again because effective lagging was not applied. In some cases, large numbers of failed joints have been 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 can be 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
- Operational and supply chain disruption caused by severe weather is a common problem. This may be due to the temporary unavailability of deliveries of raw materials, transport for finished product from site to customers, and logistics issues caused by roads blocked by snow and ice
- 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 and pedestrian walkways can become dangerously slippery with ice – Slips, Trips and Falls are still some of the most commonly reported industrial accidents. Furthermore, in periods of heavy snowfall there may be a problem about clearing snow from key access areas on plant.

Potential solutions and mitigation measures for sites to consider

- Companies should review their site winterisation procedures in the light of their own and others' experience and use this to plan for each winter. The procedures should cover all the potential examples noted above, from freezing of equipment to unavailability of staff and disruption to movement of materials. It is considered good practice to develop an Action Plan to assist in prioritising and managing actions identified as necessary
- Where techniques such as HAZOP have identified safety critical equipment that may be especially susceptible (for example, the HAZOP guide phrase 'lower temperature' may prompt the provision of lagging or trace heating), arrangements should be made to check that 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 plants, processes or operations for periods during the coldest prolonged spells. 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 temporary shutdown in extreme 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. CIA has produced additional guidance on safe shutdown and start up that may be helpful
- 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 (which may require scaffolding for elevated lines) 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 although 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
- In addition to managing safety issues, the potential for exceeding environmental permit conditions should be considered when operations are maintained during extreme cold weather. CIA advises that companies should contact the environment regulators to discuss the options if you think you will need to operate outside your permit conditions on a temporary basis
- Key site personnel may be unable to get to/from work because of severe weather disruption. Contingency plans should be considered to ensure appropriately trained, qualified and experienced staff are available for critical processes during extended severe weather
- For outdoor work, the provision of adequate warm clothing and PPE for operational 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 may become necessary in severe 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

As indicated at the start of this guide, its purpose is to raise awareness. It cannot identify every scenario but it should stimulate a review of Winterisation procedures, site preparedness for potentially extended periods of sub-zero temperatures, and other seasonal winter weather that can have a significant impact on operational safety and business continuity. The last few winters leading up to 2021/22 have been relatively benign, but companies should not be complacent about this and should prepare to be able to manage processes and plant through more severe conditions.

CIA would be very interested to learn of site experiences in successfully managing winterisation procedures, to add to this information and help share good practice. If you have anything to contribute, or any queries on any aspect of this guide, please contact CIA Safety and Security Director, Phil Scott at ScottP@cia.org.uk.

