ARCTIC FREEZE

INTRODUCTION

The potential for catastrophic loss due to freezing is similar to other well recognized natural hazards, such as earthquake, earth movement, flood and hurricane. Cold weather and freezing temperatures are part of a normal weather pattern in many areas. Arctic freeze periods lasting several days are not uncommon when there have been one to two week, or longer, periods of hard freeze. A widespread geographic area may be affected by severely adverse climatic conditions. Without adequate preparedness, large loss situations are likely.

Fire protection systems, process equipment systems and other water, air, steam, and gas piping systems are vulnerable to freezing. Any piping, pumping or tank system containing water for domestic, fire protection, heat exchange or process purposes is subject to freezing. Systems containing other fluids (liquids, air or gases) as in instrumentation systems can also freeze. Fire protection systems, both underground and overhead, and domestic water supplies are commonly involved in freeze loss incidents. Process flow streams, if caught in arctic freeze, can be severely damaged and can cause extensive business interruption loss as well.

POSITION

An arctic freeze forecast is a warning of impending, extremely hazardous conditions. Prepare a loss prevention action plan in advance. Formulate a written action plan and prepare for a physical presence for surveillance and maintenance purposes at the facility throughout the freeze period. Prearrange effective freeze protection measures, preassign tasks, and establish special material and equipment requirements, if any.

Arctic Freeze Precautions

Regularly scheduled maintenance is a key ingredient of a good action plan. Provide for regularly scheduled inspection, and repair, as needed, of heating devices, system controls, monitoring devices and low temperature alarms. Schedule a special inspection including testing prior to the onset of the heating season and especially prior to the onset of an abnormal cold period. In addition to heating systems equipment inspection, examine all areas of the facility to be certain adequate heat is provided. Also examine concealed spaces, space above false ceilings, entry ways and other remote areas which contain piping.

At the forecast of unusual cold or a winter storm, inspect the plant to confirm that the pre-emergency action plan has been activated or its activation is underway. A simplified sample action plan is contained on the “Suggested Arctic Freeze Checklist With Cold Weather Precautions” form from the *OVERVIEW* Forms Packet.

Check all building areas for tightness of openings. Close and secure doors, windows, skylights and other authorized openings. Check low temperature alarms and monitoring device operation. Tightly enclose building repair areas or other temporary openings; closely examine for drafts. Provide extra insulation and/or auxiliary heating as necessary.

Adequately heat all areas susceptible to freeze damage; protect them from drafts. Examine pipe chases, stair towers and building passages for drafts. Provide auxiliary heating, added insulation, steam tracing or electric tape with ground fault circuit interruption protection where necessary. Provide water, air, oil, steam and process fluid lines.

Closely examine remote areas that are particularly susceptible to freeze damage for the presence of piping. Constantly survey tunnels, towers, valve houses and pits which are kept warm normally by the presence of transient heated fluids in the piping systems. The heating value of these systems may be lost and the space may be allowed to cool.

Check roofs for access, exposed piping and openings; clear roofs of debris in preparation for snow removal if required.

Heat producing processes, particularly if utilized as by-product building heat, and hot process streams should remain in production through the forecast cold period. Where a process is required to be out of service, perhaps due to maintenance, drain fluid lines purge with nitrogen where possible. Replace plain water in systems with nonfreeze solution in some applications. Check all low points in fluid systems for adequate heating or drain dry.

Auxiliary steam generators may be necessary. Emergency electrical generators may be required to maintain critical heating equipment in service if there is a power failure. Public service fuel supply, such as natural gas, may be cut-back or, in the extreme case, curtailed. Consider privately owned on-site reserve fuel supply where there is dependence upon public allocations. Top off existing fuel supply where on-site tankage or bunkers are used to store fuel. Make arrangements to replenish fuel so a two week supply will be on hand at all times.

Staff for maintenance as well as for plant surveillance. Maintain personnel presence on site throughout the freeze period and 24 hrs beyond. During the thaw period, piping cracked or ruptured by freeze will leak, and immediate repairs will be required. Increase watchman rounds and plant surveillance during the early stages of thaw.

Refer to PRC.4.3.1, PRC.8.2.0.1, PRC.15.5, *OVERVIEW*, NFPA 30 and NFPA 241 for valuable assistance.

DISCUSSION

Changes in upper atmosphere air circulation patterns can cause the frigid air of the higher latitudes to flow toward the middle and lower latitudes. The result is an “arctic freeze” whereby an air mass significantly colder, 15°F to 20°F (8.3°C to 11.1°C), than normal and freezing flows across the region. During these periods of abnormal temperature drop, regions may be subject to unusual freeze conditions. The duration and effect of the ‘arctic outbreak’ depends on the permanence of the causative flow of frigid air. For example, in the three day period from December 22 through December 24, 1988, nearly 300 daily low temperature records were set in the U.S. from the Canadian border to the Gulf of Mexico. Six cities reported all-time record low temperatures. In January and February 1982, a longer and more severe freeze occurred in the United States. Over 200 people died as a result. Most recently as of January 2010 the Arctic Freeze caused death and destruction crippling much of the northern hemisphere. Among the regions hit were China, Russia, Western Europe and the plains of the United States. The cold temperatures killed dozens in India and Poland and threatened the orange crop in Florida. It was reported that more than 60 people in northern and eastern India reportedly died of exposure. In Poland temperatures were pushed down to minus 13°F (-10.5°C) and in South Korea, a part of northeastern Asia experienced the worst winter in six decades, and the capital Seoul was hit with about 10 inches of snow, the heaviest since 1937. In far north China, temperatures plunged to nearly minus 26°F (-3.3°C).

In regions where wintery weather and below freezing temperatures are normally experienced, provide freeze protection for liquid piping, liquid storage, processing equipment, building facilities and occupancy space. There may still be Arctic Freeze losses in these regions. Freeze protection may be provided, but the design may consider only average regional temperatures. During periods of sustained lower temperatures, protection could be inadequate, overtaxed or may fail. Heating system controls set too low, doors left ajar overnight or on weekends, power loss or equipment failure will leave a facility vulnerable.

In more temperate and sub-tropical climatic zones, freeze protection may not receive serious consideration in design and construction. Frequently, less than minimum freeze protection is provided. Buildings, piping systems, process equipment and many process facilities in the warmer climes are constructed as open structures. A drop of ambient air temperature below freezing can initiate freezing. In these circumstances, the vulnerability to a persistent polar air mass is severe.

There is a relationship between management's concern for freeze loss potential and the severity of loss. Effective loss prevention measures can prevent losses. In these cases, the single most common precaution was the physical presence of personnel on site. Cutbacks or curtailment of fuel supplies played a significant role in number of losses simply because preplanning did not include alternate arrangements for powering existing heating devices, or alternate heating devices were not available. A contingency plan developed from "what if" scenarios should envision reduced allocation or curtailment of fuel and/or loss of electrical power. Provide additional fuel storage capacity, or provide a secondary alternate fuel with its own separate storage. An auxiliary or emergency electrical generator to power critical devices may be an alternate solution.

Geographical location has a bearing on potential freeze loss situations. Within the latitudes of approximately 29° north and south, temperatures seldom drop below freezing; it will be colder at higher elevations. Also, deserts or temperate bodies of water, such as the Mediterranean Sea, have a direct effect upon surrounding climatic conditions. In the northern hemisphere this 29° N latitude of North America approximates a line across the U.S. through Orlando, Florida; Galveston, and San Antonio, Texas. See Figure 1. The line then continues across Africa, Eurasia and Asia, approximately through Sidi Ifni, Morocco; Aujila, Libya; Kuwait, Kuwait; Bahawalpur, Pakistan; Delhi, India; and Nanchang, Peoples Republic of China. See Figure 2.

Between 29° and 36° north and south latitude, sustained freezing is infrequent, except as affected by local topographic and geomorphological conditions (the physical features of the earth including ongoing changes). Industrial process equipment and piping frequently are located outside. Building heating systems may be of low or only marginal capacity. Specific freeze protection for process equipment and piping may not be provided. Because of these practices, the frequency of freeze losses within this geographic zone is high when freezing temperatures occur.

In the higher latitudes where freezing temperatures are the norm for the winter season, design and construction features of building, piping, equipment and processes usually include provisions for protection against freezing. Freeze loss incidents are frequently related to heating system failure, controls improperly set, doors or windows left open, or power failure shutting down heating devices. However, organizational planning in these regions normally includes provision for these circumstances, and freeze-up is avoided for the short term. Sustained periods of low temperatures (arctic freeze conditions) are quite another matter. Sustained periods of cold may overtax and overwhelm heating systems or cause fuel shortages. Auxiliary heating devices may be required or special efforts needed for protection of isolated areas or equipment.

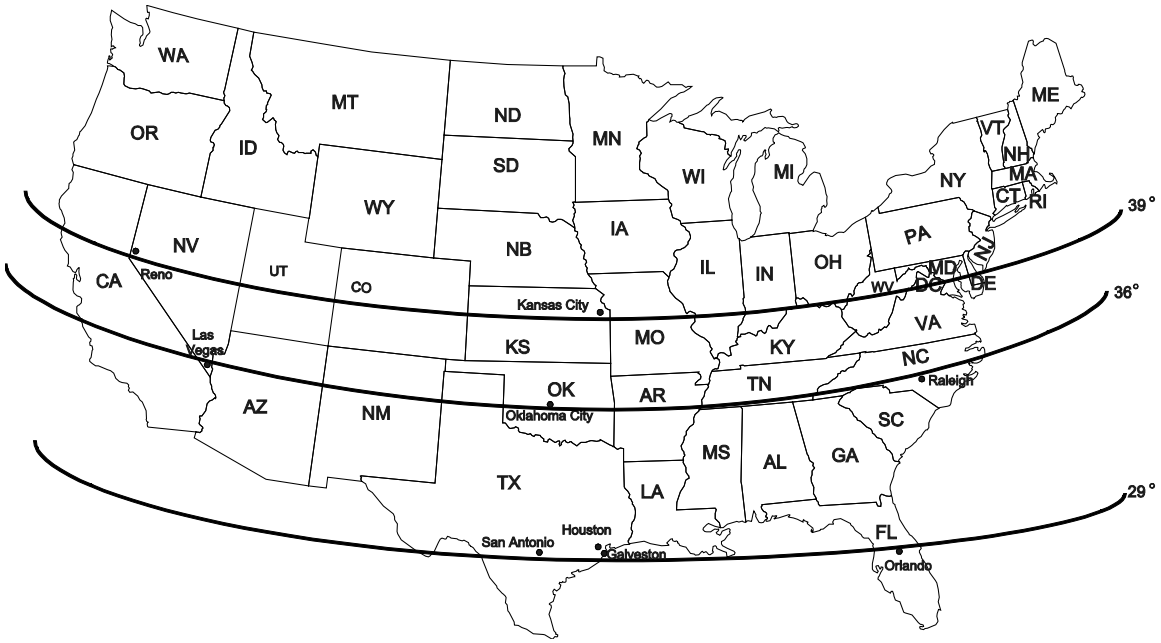

Figure 1. Arctic Freeze Zones.

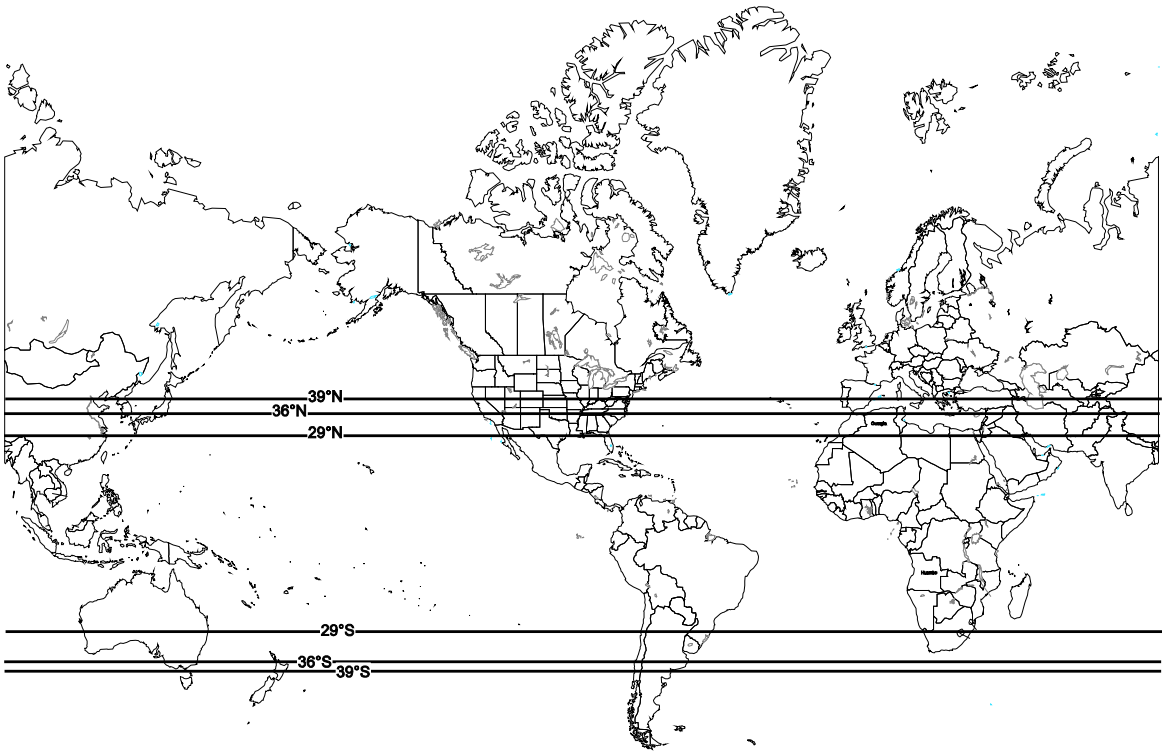

Figure 2. Arctic Freeze Zones.

SAMPLE FORM

OVERVIEW FORMS PACKET
(See PRC.1.7.0.1 in the OVERVIEW Manual)
Published as part of AXA XL Risk Consulting

SUGGESTED ARCTIC FREEZE CHECKLIST WITH COLD WEATHER PRECAUTIONS

When preparing for an Arctic Freeze, a detailed checklist should be developed indicating the order in which processes are to be shut down and the facility secured. The length of time needed - expressed in hours or days - to accomplish these tasks should be determined in advance so that appropriate actions can be initiated at the proper time. Then, as each task is completed during either a winter watch or storm warning, check it off and move on to the next one.

ACTION	TIME NEEDED	DONE
1. Restore any cutback of heat to buildings or processes.	_____	☐
2. Provide additional heat for normally cold areas.	_____	☐
3. Make certain there is an adequate supply of fuel for the heating systems.	_____	☐
4. Expedite the completion of any postponed repairs to the heating system.	_____	☐
5. Forgo any planned heating plant or boiler inspections until the danger of the severe cold has passed.	_____	☐
6. Keep someone on the premises who will continually monitor all areas of the premises for signs of impending trouble, and provide that person with an up-to-date list of emergency numbers to call should trouble be detected.	_____	☐
7. Add heat tracing to process and protective system piping that might freeze.	_____	☐
8. Check insulation on piping and structures to be certain it will protect them against the extreme cold temperatures.	_____	☐
9. Where processes are shut down, drain piping and tanks to prevent freezing damage.	_____	☐
10. Recheck the *Cold Weather* Precautions listed on this form.	_____	☐

Add other items unique to your facility.

COLD WEATHER PRECAUTIONS

Unless proper precautions are taken, cold weather can cause problems. Buildings may be loaded beyond their design by accumulations of snow and ice. Fire protection equipment may freeze, leaving a major portion of the facility without protection.

Prior to and during cold weather, the following precautions should be taken.

A. General
   1. Plans should be made to remove snow from flat roofs or other structures which might collapse.
   2. All doors, windows, skylights, ventilators, and other openings should be weather-tight so they will not admit cold air that could cause sprinkler systems to freeze.

B. Heating Systems
   1. To determine that the entire system is in proper operating condition, it should be examined and deficiencies corrected. Burners, boilers, and flues should be clean. Obstructions should be removed from all pipes, radiators, and unit heaters. Controls of heating equipment should be tested for proper operation.
   2. Where possible, an adequate reserve supply of fuel should be on hand at all times. Safe alternate energy sources should be investigated.
   3. Temperatures about 40°F (5°C) must be maintained at all times in buildings equipped with wet pipe sprinkler systems; in all dry pipe, pre-action, and deluge valve closets; and in all pump houses.
   4. Clearances should be maintained between heating system components and combustible floors, walls, partitions, platforms and stock.

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COLD WEATHER PRECAUTIONS (continued):

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C. Protective Systems

Some of the following maintenance procedures involve valve operation or other impairments to protective systems. Proper procedures should be followed in all such cases (see OVERVIEW Section 1, Impairments To Protective Systems).

1. Plans should be made to promptly clear snow from access ways, control valves, hydrants, hose cabinets, smoke and heat vents, explosion relief vents, and other essential equipment to permit effective operations in the event of an emergency.
2. Wet pipe sprinkler systems in areas which are inadequately heated should be converted to dry pipe or pre-action systems.
3. Dry pipe sprinkler systems and preaction or deluge systems dry pilot lines should be inspected carefully to make sure that the piping is properly pitched for drainage. Any condensation that collects in low points in the piping should be removed. Excessive priming water should also be removed.
4. Sprinkler heads in the immediate vicinity of steam pipes, unit heaters, or other heat-producing appliances should be of the correct temperature rating.
5. Solutions in all anti-freeze sprinkler systems should be tested and anti-freeze added as necessary.
6. Any "shut-in-winter" valves controlling small unheated areas should be closed, tagged with Global Asset Protection Services cold weather shut-off tags, and properly drained. Consideration should be given to converting such systems to either a dry pipe or a pre-action system.
7. All wet standpipe systems with piping located in areas subject to freezing should be shut off, drained and tagged.
8. Connections to water motor gongs and fire department connections should be properly drained.

D. Fire Protection Water Tanks

1. Gravity tanks must not leak, since an accumulation of ice on trestles can cause the tank structure to collapse. The expansion joint and riser boxing should be in good condition.
2. The water temperature in the gravity tank should be checked frequently during cold weather and maintained at no less than 42T.
3. The tank heating system should be flushed and put in good working order.
4. The tank roof-hatch cover should fit tightly and be fastened.

E. Hydrants and Underground Piping

1. Hydrants and fire pump hose headers should be drained. Outlet hose valves must be left half open to prevent damage from freezing.
2. Hose should be properly drained and dried.
3. Packing on post indicator valves should not be leaking.
4. Sections of exposed piping should be drained or otherwise protected against freezing.
5. Valve and meter pits should be dry and frost-proof.

F. Portable and Wheeled Fire Extinguishers located in cold areas should be suitable for such locations or installed in heated cabinets.

G. Automotive Fire Apparatus should be properly serviced for cold weather.