



RP 44-2

WINTERISATION - LOW TEMPERATURE PROTECTION MEASURES

April 1997

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BP GROUP RECOMMENDED PRACTICES AND SPECIFICATIONS FOR ENGINEERING											
Doc. No. RP 44-2		Issue Date April 1997	Latest Amendment Date								
Document Title WINTERISATION - LOW TEMPERATURE PROTECTION MEASURES											
APPLICABILITY Regional Applicability: International											
SCOPE AND PURPOSE This document gives advice on the protection of equipment against damage or in-operability under winter conditions.											
AMENDMENTS <table border="0" style="width: 100%;"> <tr> <td style="width: 15%;">Amd</td> <td style="width: 25%;">Date</td> <td style="width: 25%;">Page(s)</td> <td style="width: 35%;">Description</td> </tr> <tr> <td colspan="4"> </td> </tr> </table>				Amd	Date	Page(s)	Description				
Amd	Date	Page(s)	Description								
CUSTODIAN (See Quarterly Status List for Contact) Operations Support											
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FOREWORD

Introduction to BP Group Recommended Practices and Specifications for Engineering

The Introductory Volume contains a series of documents that provide an introduction to the BP Group Recommended Practices and Specifications for Engineering (RPSEs). In particular, the 'General Foreword' sets out the philosophy of the RPSEs. Other documents in the Introductory Volume provide general guidance on using the RPSEs and background information to Engineering Standards in BP. There are also recommendations for specific definitions and requirements.

Value of this Recommended Practice

This document represents current technical guidance and accumulated experience in the Inspection and Testing of In-Service Civil and Mechanical Plant, for ensuring a high standard of plant integrity based on economical safe practice.

Application

Text in italics is Commentary. Commentary provides background information which supports the requirements of the Recommended Practice, and may discuss alternative options.

This document may refer to certain local, national or international regulations but the responsibility to ensure compliance with legislation and any other statutory requirements lies with the user. The user should adapt or supplement this document to ensure compliance for the specific application.

Principal Changes from Previous Edition

There have been no significant changes to philosophy or general requirements, but format and style have been simplified.

Feedback and Further Information

Users are invited to feed back any comments and to detail experiences in the application of BP RPSE's, to assist in the process of their continuous improvement.

For feedback and further information, please contact Standards Group, BP International or the Custodian. See Quarterly Status List for contacts.



1. INTRODUCTION

1.1 Scope

This recommended practice specifies BP's general requirements for the protection of equipment against damage or inability to operate under winter conditions.

Winterisation protection should also be used to protect against the effects of low temperatures generated by abnormal process conditions. e.g. Letdown of high pressure gas or LPG to a low pressure which can cause heavy frosting or other problems if water is present.

This recommended practice is applicable to both offshore and onshore facilities.

1.2 Application of this Recommended Practice

This Recommended Practice is particularly applicable for installations located in the more severe climatic areas such as the USA and Canada, Northern and Central Europe but may be adopted elsewhere in whole or in part as required.

In temperate or even tropical climates winterisation techniques may be required to avoid operating difficulties arising from process conditions.

The capital and operating cost of winterisation schemes may be high but this can often be offset against the significant production and repair costs arising from failures or ruptures due to frost damage. In all cases, however, the safe operation of the plant should be of utmost importance.

2. GENERAL REQUIREMENTS

2.1 Conditions Requiring Winterisation

The lowest ambient temperature to be used in determining the requirements for winterisation should be the prevailing temperature after rejection of the lowest 1% of the daily minimum temperature readings in the coldest month, or 1% of the daily minimum temperatures for the year. These criteria should only be used if records extend over a number of years. The effect of wind conditions (wind chill factor) should also be taken into account, using the average occurring in the coldest month of the year.

The probable duration of this minimum temperature should also be taken into account when determining the effect on the process, the equipment to be used and the fluids to be handled.



2.1.1 Equipment should be winterised if any of the following conditions apply for the fluid being handled at any point in the defined temperature range, particularly for stagnant areas:

- a) Flow rates are such that material may be below the pour point or freezing point.
- b) Undesirable phase separation, deposition of crystals or hydrate formation.
- c) Condensation, hydrate or ice formation can occur due to cooling caused by expansion of the gas or due to desorption of moisture eg. from driers.
- d) The viscosity is so high that it is not possible, with the pressure available, to establish an adequate flow rate.
- e) Moisture/other chemicals which may be introduced during an operating upset would be below the pour point or freezing point. In this case the positions where this material may collect or cause blockage must be considered e.g. flare lines or small bore instrument air lines.
- f) Rapid cooling of equipment surfaces by snow, ice or hailstorms could cause condensation leading to partial vacuum or undesirable reverse flows.

The effect on the safe operation of the plant or unit shall be examined in detail, particularly for (b) and (c), hydrate or ice formation in gas systems. Methanol injection, may be acceptable in certain circumstances, but this will need detailed examination of the design to ensure its operational safety, reliability and its effect on product specifications.

2.1.2 If regular draining /washing activities are required at elevations on open structures tundishes and drains should be sized and winterised to ensure free flow for the maximum rates to prevent ice build up.

2.2 Design Aspects

Having identified those items /areas which require winterisation a detailed review of the plant design should be carried out to ensure safe operation with particular emphasis on the effect of hydrate or ice formation etc. as described in 2.1.1 b) and c).

Where this review identifies problems or potential loss of production then the use of extreme minimum temperatures for design may be justified. For example, water draw-off equipment on oil and gas production facilities are likely to process only small quantities of water during the initial years of field life, and so stagnant areas and freezing may be unavoidable without heating.

- 2.2.1 Where possible the requirements for winterisation should be designed out by avoiding stagnant areas or slow moving fluids and areas where freezing fluids can collect. If this cannot be done then facilities for flushing /draining shall be provided. The removal of water from LPG systems needs particular attention.

Poor control/failure of the water removal system for LPG can lead to hydrate formation with blockage of downstream lines and consequent operating problems.

- 2.2.2 It shall be possible to completely drain equipment and piping that may contain water or other material which may freeze.

- 2.2.3 It shall be recognised that where winterisation is applied to prevent the formation of ice or hydrate that could interfere with the operation of or the flow of material through a protective device e.g. an overpressure relief valve, then that part of the winterisation protection shall be viewed as part of the protective system and shall be recorded as such.

When giving consideration to winterisation for effluent treatment plant, instrument impulse lines etc., small static lines (which are more prone to freezing) are generally taken to be those lines that are less than 150 mm (6 inches) dia. although this will vary according to site location and the prevailing conditions.

- 2.2.4 Wherever possible insulation alone as specified in BP Group [RP 52-1](#) should be used to provide protection against cold weather.

- 2.2.5 All equipment fitted with protective heating systems should in general be insulated to conserve energy and minimise operating cost.

- 2.2.6 Plant and equipment should be sited to minimise the formation of ice on structures and stairways. Consideration should be given to water vapour carried over from cooling towers and steam vents and steam traps. Where solid/checker plate floors are installed on open structures particular attention is to be given to drainage and the prevention of pools forming in depressions between supports.

- 2.2.7 In severe climates and areas of heavy snowfall, some general protection of plant may be desirable on its windward side to reduce the weather effects and the extent of insulation which may be required on individual items.



- 2.2.8 Plant line lists and flow sheets should include details of the winterisation applied including insulation thicknesses, specification and type and extent of any trace heating used.

Where thermal relief is required as a result of winterisation this must be clearly noted although details of the relief sizing and calculations must be kept with the information required by BP Group [RP 44-1](#) Overpressure Relief.

3. WINTERISATION TECHNIQUES

3.1 Insulation

Insulation applied to carbon steel equipment for winterisation will almost always carry with it the risk of underlagging corrosion. Painting of equipment prior to insulation and strict attention to the correct sealing of cladding material is essential. Plant personnel should identify a strategy for future inspection of this equipment.

3.2 Electrical Heating

When electrical heating is used as the protective medium, eg. process/instrument lines, meters, water lines etc., the installation shall generally be in accordance with BP Group [RP 12-1](#) with the electrical heating equipment rated to withstand the elevated temperature of steam out or hot water flushing. Recognition should be given to the hazardous area classification and all equipment specified accordingly.

When electrical heating, including tapes, is used for critical winterisation duties, consideration should be given to providing low temperature thermostats/switches to identify individual heating element failures within the system. This is particularly important for long transfer lines.

This is to allow rapid repair of the heating tape, in order to maintain the overall operability and safety of the plant.

For any heat traced system which can be blocked in, thermal relief valves should be fitted where necessary (see BP Group [RP 44-1](#), which states that thermal relief is not normally required in short isolatable sections within battery limits or where the trapped volume is less than 0.4m³ except for LNG and LPG).

3.3 Steam Tracing

This should be in accordance with BP Group [RP 42-1](#). If large sections are not required during the summer months, sections inside and outside

the process units should be fed by separate headers where practical, to facilitate shutdowns. This should also allow easier maintenance. Individual supply valves and steam traps on tracing circuits must be clearly marked.

4. DETAILED DESIGN REQUIREMENTS

4.1 General

For areas of plant where heat tracing is required a review must be made covering:

- a) The consequences of the tracing being left on during plant shutdown and or maximum ambient temperature conditions with respect to plant operation and equipment maximum design temperatures.
- b) The requirement for thermal relief.
- c) In areas where large sections of the steam tracing system are not required during the summer months, such sections both inside and outside the process units should be fed by separate headers where practical and economic to do so, in order to facilitate the shutting down of such systems both during the summer period and for maintenance.

4.2 Equipment and Piping

- 4.2.1 For some gas systems it will be necessary to apply winterisation to prevent condensates from freezing. In such cases the extent of winterisation may be limited to those areas where the condensate collects and not necessarily applied to the whole vessel.
- 4.2.2 Steam coils in tanks should consist of a number of sections arranged in parallel flow, thus avoiding the total loss of tank heating in the event of a coil section leaking.
- 4.2.3 Any pressure-vacuum vents should be of the non-freezing type.
- 4.2.4 Tanks containing liquids which may gel or solidify when cold should, in addition to the normal horizontal heating coils, also have a small vertical heating pipe extending above the upper level of the contents.
- 4.2.5 When carbon steel caustic soda or amine lines have to be heat traced for winterisation purposes, welds and bends shall be heat treated in accordance with BP Group [GS 118-5](#).

4.2.6 Breathing air systems and compressors should be winterised, where necessary, by the provision of a simple heated building or structure.

4.2.7 For lubricating oil systems consideration should be given to providing fast heat up systems to allow warm up of oil following shutdown.

Examples include diesel drivers on fire pumps, and fire/foam tenders.

Any exposed sections such as water lines, lubricating and seal oil lines, air and oil filters, suction lines and knockout drums may require protection/heat tracing.

Pumps in intermittent service handling viscous liquids or ones which might freeze under winter conditions can either be kept warm by passing a slip stream through them from another pump, or can be drained when not in use. If either of these is not possible, the pump should be traced or jacketed, or located in a heated enclosure.

Heavy fuel oil is usually pumped as a continuous circulation in a heated ring main system.

4.3 Instrumentation

Winterisation shall be in accordance with Section 8 of Part I of [API RP 550](#).

When electronic instruments are heat traced, the type of heat tracing should be to the instrument manufacturer's recommendation. Consideration should be given to the use of electrical heat tracing and also to thermostatic control to ensure the manufacturer's specified operating temperatures are not exceeded.

For items subject to routine maintenance and calibration consideration should be given to providing a total enclosure with a facility to provide easy access for maintenance.

The collection of water in instrument impulse lines should be minimised by the method of installation.

Due allowance should be made for the difference between winter and summer conditions to ensure that no malfunction or physical damage to the equipment can occur.

4.4 Steam Traps

In severe climates, steam traps on process units should be protected by enclosing them in cabinets of steel or other suitable material. Consideration should be given to achieving an economical grouping of traps for each cabinet and easy access for maintenance must be provided.

4.5 Cooling, Industrial and Domestic/Potable Water Systems

Water lines having intermittent flow, eg. industrial and domestic/potable water lines, should, wherever possible, be located below the frost line. Where it is necessary to run sections above ground, insulation alone or tracing plus insulation may be required. Tracing should be avoided on drinking water lines.

For water lines in continuous flow which are laid above ground, headers should be provided with crossovers so that circulation rates may be increased to overcome the need for heat tracing and to assist during start up and plant shutdown conditions.

Water supplies to individual items of equipment in a unit should be taken from valved connections taken directly from main headers with valves being placed as close as possible to the main header. Access should be provided to all such branch block valves.

Where it is not possible to place block valves adjacent to the main header, and the water user may be subject to shutdown at different times to the header then consideration should be given to provision of cross over lines immediately adjacent to the valves to provide protection for the lines from the header to the valves . Alternatively the branch lines should be protected by heat tracing .

4.6 Traps and Seals in Water Systems

4.6.1 Traps and Seals in water systems should also be considered for winterisation.

In very severe climates, by-pass connections should be provided at cooling towers, and steam injection facilities provided in the sump serving the cooling water pumps, in order to facilitate start up and shut down operations.

4.6.2 In very severe climates, when there is a major concentration of equipment containing water such as a water treatment unit or cooling water pump and fire pump installations etc., the provision of a simple building with a very limited amount of heating for housing the whole or part of the equipment should be considered, to avoid large quantities of heat tracing and insulation and to minimise operating difficulties.

4.7 Fire Water Systems

- 4.7.1 Mains that are to remain full of water shall be buried at a depth of 750mm (2ft 6in) or 150mm (6in) below the frost line, whichever is the greater.
- 4.7.2 Fire hydrants shall have valves below the frost line and should be self draining. However, when the water table is so high that self draining hydrants cannot be used, alternative proposals, such as those involving the use of anti-freeze in the hydrants, shall be subject to approval by BP. In high water table locations, measures may also be required to prevent valve spindles freezing.
- 4.7.3 For more detailed winterisation requirements for Fire Water Systems, see BP Group [RP 24-1](#) and BP Group [RP 24-2](#).
- 4.7.4 Any sprinkler or firemain pressurisation tanks should be protected as necessary.
- 4.7.5 Where necessary, the engines of diesel driven firepumps shall have jacket or enclosure heaters. Anti-waxing diesel fuel or fully winterised fuel systems should be used.

4.8 Emergency Showers and Eyebaths

- 4.8.1 Any water storage tank for emergency showers and eyebaths should be thermostatically controlled to a temperature of 16°C to 21°C and precautions taken to prevent the feed line from freezing. An outlet valve should be provided at the tank and the outlet line should be self draining.
- 4.8.2 Emergency showers fed from a pressurised water supply shall be protected from freezing. Where some form of heating is used this shall be thermostatically controlled between 16 and 21°C.
- 4.8.3 Any total immersion bath should have a float system to prevent freezing.

4.9 Water Tanks

Where necessary, domestic-type tanks located outside buildings should be provided with temperature controlled electrical heating and should be insulated. Any open vents may require to be heat traced.

DEFINITIONS AND ABBREVIATIONS

Definitions

Standardised definitions may be found in the BP Group RPSEs Introductory Volume.

Abbreviations

LPG	Liquefied Petroleum Gas
LNG	Liquefied Natural Gas

LIST OF REFERENCED DOCUMENTS

A reference invokes the latest published issue or amendment unless stated otherwise.

Referenced standards may be replaced by equivalent standards that are internationally or otherwise recognised provided that it can be shown to the satisfaction of the purchaser's professional engineer that they meet or exceed the requirements of the referenced standards.

American Documents

[API RP 550](#) Manual for Installation of Refinery Instruments and Control Systems. Part 1 Process Instrumentation and Control. Section 8 - Seals, Purges and Winterising.

BP Group Documents

BP Group [RP 12-1](#) Electrical Systems & Installations - General
(replaces BP CP 17 Part 1)

BP Group [RP 24-1](#) Fire Protection - Onshore
(replaces BP CP 15 & BP CP 16)

BP Group [RP 24-2](#) Fire Protection - Offshore
(replaces BP CP 16 & BP CP 16)

BP Group [RP 42-1](#) Piping Systems to ANSI B31.3
(replaces BP CP 12)

BP Group [RP 44-1](#) Overpressure Protection Systems
(replaces BP CP 14)

BP Group [RP 52-1](#) Thermal Insulation
(replaces BP CP 13)

BP Group [GS 118-5](#), The Fabrication, Assembly, Erection and Inspection of Carbon, Carbon Manganese and Low Alloy Ferritic Steel Pipework to ANSI/ASME B31.3
(replaces BP Std 167 Parts 1 & 2)

