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KLM Technology Group #03-12 Block Aronia, Jalan Sri Perkasa 2 Taman Tampoi Utama 81200 Johor Bahru Malaysia	PROCESS DESIGN OF HEAT TRACING AND WINTERIZING (PROJECT STANDARDS AND SPECIFICATIONS)	

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SCOPE

This Project Standards and Specifications covers the minimum requirements for protection of process and utilities and all associated equipment and flow lines and instruments against the temperature which would cause congealing or freezing of contents, interfere with operation or cause damage to equipment or pipe lines and for heat conservation requirement as would be determined by process conditions. The heat conservation system shall be designed for continuous operations while, winterizing shall be for seasonal operation. The two systems shall be separate from each other.

REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

API (American Petroleum Institute)

API RP-550, Section 8.5, "Winterizing", 4th. Ed., October 1980

SYMBOLS AND ABBREVIATIONS

<u>SYMBOL/ABBREVIATION</u>	<u>DESCRIPTION</u>
CM	Collection Manifold
DM	Distribution Manifold
DN	Diameter Nominal (Pipe Size), in (mm)
ET	Electric Traced and Insulation
ETT	Electric Traced with Heat Transfer Cement
H	Heat Conservation
ID	Inside Diameter
MI	Mineral Insulation
PD Meters	Positive Displacement Meters
P & IDS	Piping and Instrumentation Diagrams
Ref.	Reference
OD	Outside Diameter

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SJ	Steam Jacketing Pipe and Insulation
ST	Steam Traced and Insulation
STS	Steam Traced with Spacers and Insulation
STT	Steam Traced with Heat Transfer Cement and insulation
UOP	Universal Oil Products
W	Winterization
WS	Winter Seal
WISI	Winterize Insulator, Steam Trace, Insulate

UNITS

This Standard is based on International System of Units (SI) except where otherwise specified.

APPLICATION AND METHODS

General Considerations

To avoid operating difficulties in process and utility Units in colder climates and the hazard of freezing which may cause damage to equipment or blockage of lines, different methods to the extent of protection required, will be used. The extent of protection may vary considerably between one location and another. However, the requirements for other ambient temperature conditions is also covered herein.

Methods of Winterization

The following methods of winterization is required to be used for adequate protection as will be determined by combined climatic and process condition for seasonal operation and heat conservation:

1. Insulation

The insulation alone may be used to prevent solidification or increase in viscosity where the liquid in the equipment has sufficient sensible heat for normal operating flow rates and will be of value only for short time exposure; for long term exposure however it is only successful when heat is continuously added by the process. Although heat input at normal flow rates may be adequate, it may fall to an unsatisfactory level at low throughputs, or

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during start up or shut down, or when a line is blocked off in error, and as a result, freezing of the system may take place.

2. Heating

Winterizing with heating should not be used where other methods can be used. Any of the following heating system may be used:

- Internal heat tracing
- External heat tracing
- Jacketing
- Electrical tracing
- Routing along and/or insulating together with a hot line.

Heating medium for non-electric tracing and jacketing can be steam, hot oil and hot water.

3. Vent / Drain on lines and equipment

Winterizing by draining require particular attention which must be given to vents and drains on utility lines and equipment for eliminating low spots or dead ends in which water and other liquids can collect and freeze. During shut-down and non-operating period these lines may completely be drained.

4. Bypasses around equipment to provide continuous flow

Bypass line connection in appropriate points as specified herein, and in accordance to project specification should be provided for use in maintaining flow.

5. Hot air circulation

Hot air circulation may be used in aerial exchangers, instrument and equipment housing, flushing connections to displace viscous-material.

CONDITIONS REQUIRING WINTERIZATION

Process, utilities, equipment and pipe lines and other equipment/pipe lines shall be winterized when any of the following conditions apply to fluids contained:

- a. Pour point or freezing point is above the lowest ambient temperature.
- b. Undesirable phase separation, deposition of crystals or hydrate formation will occur at any ambient temperature.

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- c. Ice or hydrate formation occurs due to pressure reduction of moisture-bearing gases.
- d. Viscosity at any ambient temperature, is so high that an inadequate flow rate is obtained with the pressure available for starting circulation.
- e. Corrosive compounds form if condensation occurs.
- f. Lines which are normally dry, e.g., flare lines which may carry moisture during an operating upset may require some protection.

REQUIREMENTS

General

1. The requirements for protection shall be based on the winterizing temperature specified in project specification, and shall consist of two parts:
 - a. Lines and equipment which appear on P & I Diagrams. The extent and degree of protection shall be specified by the project engineer and shown on the P & I Diagrams.

Note:

Protection described by standard nomenclature on P & I Diagrams may be inadequate for projects involving low winterizing temperatures in combination with unusual process fluid properties. On such projects consideration shall be given to the use of high thermal conduction cement bonding of tracers, steam jacketing, electric heating, shelters and other special design.

- b. Lines and equipment not shown on the P & I Diagrams. Protection shall be provided by the design Contractor/ Consultant to the extent and in the manner provided herein.
2. Layout, design and details which are to be followed by the design Contractor in winterizing all equipment shall be as specified herein.
3. Protective heating of piping and instruments shall be indicated on the process engineering flow schemes and on the piping data sheets.
4. The extreme case of the lowest minimum temperature should not be selected, but in general, equipment should be designed for protection against the minimum temperature prevailing after rejection of the lowest 1% of the hourly temperature readings in the coldest month, or in 1% of the daily minimum temperatures for the year; the readings should as far as possible be based on

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the average of records obtained over a period of years and not those of a single year.

5. The amount of winterizing protection shall be based on minimum atmospheric temperature as shown on site data sheet. For heat conservation during operation, fluids with a pour point of 10°C and higher shall be traced to maintain a temperature at least 22°C above their pour point. Molten sulfur lines shall be maintained between 118°C (245°F) and 158°C (316°F).

Piping

1. A list of all piping requiring tracing should be prepared for each Unit in project specification.
2. Sections of gas systems in which ice or condensate would otherwise be produced, due to atmospheric cooling or auto refrigeration, should be traced. Protection will also be required where there is hydrate formation at temperatures above 0°C.
3. Careful consideration should be given to the design and protection of lines which are dry during normal operations but which may contain sufficient moisture to be troublesome during an operational upset, e.g., flare lines, etc.
4. Process piping
 - a. Compressor suction lines between the knockout drum and the compressor shall be heat traced and insulated if ambient temperature is below the dew point of the gas at compressor suction or if handling hydrocarbon gas components heavier than ethane.
 - b. Intermittently used process piping containing liquids such as tars or chemicals, which will congeal during nonflowing conditions, shall be provided with valves for venting and draining, blowing out with air or flushing with light stock in preference to heat tracing.
 - c. Tank car and tank truck loading lines shall be heat traced and insulated and provided with valved flushing or blow out connections.

Note:

Blowing out piping with air shall be confined to lines containing stocks of low volatility which are well below their flash points. Where piping to be blown discharges into tankage. Venting capacity shall be provided to prevent pressurizing the tankage.

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5. Piping for water services

- a. When daily mean temperature is below -1°C, underground water systems (including sewers) shall be installed at a minimum of 300 mm below the frost line. Above ground portion of water systems shall be winterized by such means as heat tracing or draining component, of the system after each use. All piping in salt water service, if heat traced, shall be cement-lined. A typical pipe line external tracing detail is shown here in Appendix B.
- b. Where branch single service lines rises from below ground, block valves shall be provided in the risers just above the ground. The following arrangement will provide protection against freezing:
 - A by-pass shall be provided just under the block valves, from the supply back to the return for use in maintaining circulation. This by-pass shall be DN 20 (¾") for lines DN 80 (3") and smaller, DN 25 (1") for lines DN 100 (4") to DN 200 (8") and DN 40 (1½") for lines larger than DN 200 (8"). Bypasses shall be covered with 25 mm of insulation.
 - A drain shall be provided in the line at a minimum distance above the block valve, except that for 150 mm and larger size valves a drain shall be provided in the valve body above the seat.
 - 25 mm of insulation shall be provided around the piping, from the ground up to and including the block valves in the water risers.
- c. Where a header for multiple services rises from below ground, protection shall be provided in the same manner as overhead headers.

Instruments

1. Winterization of instrumentation systems should be in accordance with Section 8.5 of API RP 550. However, 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.
2. Proposals for winterization are to be discussed and agreed with the Company.
3. Where practical, instruments shall be installed in heated buildings to simplify protection requirements and facilitate maintenance.

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4. Electronic instruments which may be damaged by freezing shall either be installed in heated housing or located in buildings to maintain the temperature within the manufacturer's recommended temperature rating.
5. When installation of instruments in heated building is impractical, protection is required for instruments on water, steam, hydrocarbons or other liquid services which are subject to freezing or congealing. A safe temperature should be maintained for hydrocarbons with pour points -12°C and above.
 Protection is also required on gas or air service where condensate may render instruments inaccurate operation or make inoperative and on liquid services where moisture is likely to enter lead lines and instruments.
6. Precaution shall be taken to prevent excessive heating of mechanical and electrical instrument components.
7. Enclosed analyzer cabinets shall be heated.
8. Preferred practices are insulation, heat tracing and heated instrument housing to maintain the manufacturer's recommended temperature rating.
9. Instrument piping shall be winterized by sealing with an antifreeze solution where possible. Protective heating of lead lines shall be installed in a manner which will prevent the liquid from overheating and boiling away.
10. Locally mounted pressure gages and instruments, and seals required for corrosion protection, shall be winterized.
11. Unless otherwise specified by the manufacturer the following locally mounted instruments shall not be housed in cabinets. They are winterized by sealing, heat tracing, or by a combination of both:
 - a. Alarm pressure switches
 - b. Control pilots for control valves
 - c. Displacer type level instruments
 - d. Float-type alarm units
 - e. Pressure gages.
12. Protection houses are used for local instruments where the process fluid is in the instrument body. Houses are also used for instruments that require regular access that are outdoors and are otherwise unprotected. Such instruments include controllers and recorders. All housings are of galvanized sheet metal construction with hinged doors and a steam or electric heating coil. Blank metal doors are furnished for blind transmitters. A lucite window is

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furnished in the door on houses for indicating transmitters and meters. The housings for analyzer transmitters are furnished as part of the instrument assembly.

13. Level instruments

- a. Protective provisions for differential type level instruments conform to that, described for differential type flow instruments.
- b. External float instruments are heat-traced for the following services:
 - Steam
 - Water
 - Caustic
 - Viscous hydrocarbon with a pour-point -12°C and above
 - Light hydrocarbon where hydrate formation is possible.

14. Flow instruments

Differential pressure instruments having factory-filled bellows or diaphragm assemblies are specified with a fill material that does not require winterizing. Care should be taken not to overheat diaphragms above their design temperature.

15. Control valves

- a. Control valves are not traced with the associated process piping, except that valves are steam traced on gas or vapor services with high pressure drops, where hydrates may be formed, or where freezing or congealing may occur.
- b. When control valves used as direct connected regulators require winterizing, the pressure control line and valve diaphragm chamber containing the process fluid shall be heat traced and insulated. When the diaphragm chamber is sealed, the pressure control line shall be heat traced and insulated from the point of seal to the process line connection.
- c. In light hydrocarbon-vapor services, where hydrate formation or frosting due to low temperature is likely, only the control valves body shall be heat-traced.
- d. Steam atomizing control valves with diaphragm and in contact with heavy process fluid shall be protected with seal pot filled with glycerin.

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16. Temperature instruments

Bulb type temperature instruments shall be specified with fill material which does not require winterizing for the particular zone in which they are to be installed.

17. Lead lines and instruments

- a. Lead lines and instruments containing fluids subject to winterizing shall be protected by seals, tracing or heated housings.
- b. Seals are a non-freezing solution compatible with the process fluids, and piping and instrument materials. A 60 percent ethylene glycol and water solution is utilized for most hydrocarbon process fluids. (Refer to API RP-550 for other sealing fluids).
- c. Those liquids of seal pots which are in contact with process fluids are protected for the zone in which they are installed.
- d. In areas where steam or electricity is not readily available for heat tracing, consideration shall be given to use of instruments equipped with a mechanical diaphragm type seal at the process connection, in lieu of heat tracing.
- e. Instruments with dry gas or dry air purging do not require protection for the lead line.
- f. Instrument lines and gage glasses which are steam traced and contain liquids that boil at tracing steam temperature shall be separated from the tracer lines by insulation of 25 mm.

18. Rotameters

Rotameters are winterized in accordance with the requirements of the process line in which they are installed. They are housed when they are recording and when they are outdoors.

19. Analyzing instruments

- a. Sample system for analyzers which require a liquid stream shall be protected in the same manner as the pipe line from which the sample is obtained, using caution to insure the sample is not damaged by overheating or vaporizing.
- b. Gas samples to analyzers which contain condensables shall be provided with heat tracing to prevent condensation.
- c. Heated housing shall be provided for analyzer and with temperature control and sample conditioning systems. Each analyzer installation shall be investigated for winterizing requirements.

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Valves

1. Where necessary, relief valves and adjoining piping should be suitably protected.
2. The vent line relief valves discharging to atmosphere should have a suitable drain hole at the lowest point.
3. Flanged shut off valves and check valves in vertical lines shall have bodies trapped and valved above the disk or seat if commodity will freeze or congeal during shutdown.
4. Water seals and traps should be steam traced.
5. Low points of flare lines should drain into vessels which are suitably protected against freezing.

Equipment

1. Drum, vessel, storage tanks
 - a. A drum or vessel containing hydrocarbon and water which operate normally at 52°C or above, shall be protected by insulating the nozzles, block valves and drain piping in contact with water.
 - b. A drum or vessel containing hydrocarbon and water which operates normally below 52°C shall be protected by steam tracing and insulating the nozzles, block valves and drain piping in contact with water.
 - c. All other process vessels containing fluids which may congeal during dormant periods shall be insulated and if necessary shall be heat traced.
 - d. Bottoms of fuel gas drums and low points in above ground gas lines shall be insulated and steam traced.
 - e. Tanks containing liquids difficult to pump or flow when cold, shall be equipped with heaters.
 - f. 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.
 - g. Roofed or open water tanks (except for potable water tanks) shall have steam connections to heat and agitate water at intervals to prevent freezing.
 - h. Storage tanks shall be equipped with freeze proof type water draw valves.

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- i. Consideration may have to be given in some extreme cases to insulating the roofs of some cone roof tanks to prevent internal corrosion due to condensation of sulphurous vapors.

2. Exchangers

- a. Heat exchangers and coolers containing liquids which may congeal or freeze at ambient temperature shall have sufficient valved drain points to insure complete drainage upon shutdown.
- b. Evaporators in chlorine service shall be housed in a heated, forced ventilated building if the ambient temperature can drop below 13°C.

3. Pumps and compressors

- a. Although compressors may be housed in enclosed or partly sheeted buildings, consideration should be given to the protection of any exposed parts such as water lines, lubricating and seal oil lines, air and oil filters, suction lines and knock-out drums. Tracing of the oil sumps of compressors may be required to assist start up.
- b. Pumps shall have plugged drains on all water cooled jackets and pedestals.
- c. Compressors and auxiliaries enclosed in buildings shall have winterizing protection when the system is shut down.
- d. Heating shall be provided for every reciprocating pumps lubricator.
- e. Pumps and associated piping shall be protected as required by the nature of fluids handled and duration of anticipated non-operating periods. Circulating fluid from an active pump through a non-operating pump is a preferred practice for pumps handling viscous fluids. (See Appendix C for typical steam tracing of pumps).
- f. The pumps in intermittent services which cannot conveniently be drained whenever not in use, should be traced or jacketed or located in a heated enclosure if the liquid handled would otherwise freeze or become too viscose to pump.
- g. Seal and flushing oil piping shall be steam traced whenever cooling to the ambient temperature would diminish the quantity or pressure of seal oil at the point of consumption below the equipment manufacturer's recommended minimum.
- h. Suitable provision should be made in the water systems of equipment which is on intermittent duty or immediate standby duty and which cannot therefore be drained to ensure that it will not freeze during idle periods. A particular case to be checked is that of machines which have thermostatic