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SPECIFICATION FOR REFRIGERATED STORAGE TANKS (PROJECT STANDARDS AND SPECIFICATIONS)

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1.0 SCOPE

1. This standard practice shall be applied to the basic design of a refrigerated storage tank which stores liquefied gas products.
2. This practice provides the guidelines for the preparation of the process requirements to tank vendor.
3. Codes and Regulations defined in BEDD shall take precedence over any other documents. Conflicting items, if any, shall be resolved in advance.
4. Requirements given in the Project Specifications take precedence over the guidelines given in this standard practice.

2.0 WORK PROCEDURE

2.1 Inputs to the Design

2.1.1 Basic Design Conditions

1. The following data should be specified in the basic design basis.
   — Type of Storage Tank
   — Capacity of Storage Tank
   — Main Dimensions
   — Design and Operating Conditions for Pressure and Temperature
   — Boil-off Rate (BOR) due to Natural Heat Leak
   If any of the foregoing items are not available, study and clarification activities must be carried out in accordance with APPENDIX-2, 3, 4 and 5 prior to start of the basic design.

2. The process conditions should be obtained from the following engineering documents.
   — Process Flow Diagram (PFD)
   — Basic Engineering Design Data (BEDD)
   — Plot Plan
   — Preliminary Piping and Instrument Diagram (P&ID)
   Maximum rate of barometric and ambient temperature change shall be clarified.

3. All operation cases must be identified with needed clarifications and taken into consideration in the basic design.

4. The battery limit between tank vendor and COMPANY, or vendor's scope of supply for piping, instrument and accessories must be clarified in advance.

2.1.2 Input Data

A summary of input data is as follows.
1. Design basis as shown in section 2.1.1
2. Following service conditions of inlet/outlet product streams
   - Composition: Usually 3 cases [standard, rich (in heavier components), and lean (in heavier components) cases]
   - Flow rate
   - Temperature
   - Pressure

2.2 Output Data

The deliverable products of the basic design shall include the following.
1. Summary of Design conditions
2. Design conditions for tank accessories
3. List of nozzles with process conditions
4. Developed P&I Diagram around storage tank

This information shall be reported to the relevant discipline for mechanical design and included into the specification for the refrigerated storage tank (Refer to APPENDIX-1).
In addition, review of the vendor's documents shall be included in the basic design activities.

2.3 Work Steps

The basic design of refrigerated storage tank should be carried out in accordance with the following steps.
1. Establish the design basis
2. Establish the scope of work between vendor and COMPANY.
3. Calculation of BOG rate
4. Preparation of basic design information to be included in technical specification
5. Preparation of nozzle list
6. Planning and/or development of monitoring and safeguarding system
7. Development of P&I Diagram around the tank to incorporate the basic design
8. Review of vendor's documents and follow-up/incorporate them into the engineering documents

3.0 DESIGN

3.1 Calculation of BOG Rate

Since BOR (boil-off rate) in the design basis is only due to natural heat leak into tank, the following operating conditions shall be studied and design flow rate of BOG stream shall be established. The purpose of this calculation is to provide the BOG stream conditions around tank.

All operating modes including upset cases shall be considered in the calculation, and the design of BOG outlet stream shall be based on the severest case.
The following steps are for calculating the BOG rate generated in the tank

1. BOG due to individual cause
   — BOG rate being equivalent to Tank BOR

$$W_1 = \frac{B \,.\, Vt_g \,.\, S_l}{(100 \,.\, 24)}$$

   — Feed liquid flashing

$$W_2 = \frac{W_f \frac{d_H}{d_p}(P_{f+}P_t) + Q_l(f) + Q_p(f) + Q_h(f)}{L_{am}}$$

Flash calculation using process simulator may be used in the following product rundown case.

Upstream temperature in the product stream	-	Storage temperature	>	5 ℃

Where d_H/d_P is the rate of change in saturated liquid enthalpy (kcal/kg) with every increase in saturated liquid pressure (mmH_2O).

$Q_l(f)$,$Q_p(f)$, and $Q_h(f)$ should be calculated by the formulas in (2), and "f" means the circulation stream.

   — Vapor displacement

$$W_3 = (W_f - W_2 - W_0)\frac{S_v}{S_l}$$

   — External circulation with pump work