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SPECIFICATION FOR PIPING FLEXIBILITY ANALYSIS

(PROJECT STANDARDS AND SPECIFICATIONS)

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SCOPE

This Project Standard and Specification covers the minimum requirements for piping flexibility analysis of the piping system.

The general scope of these activities is to verify that the piping system shall be designed to have sufficient flexibility to prevent piping displacements from causing failure from overstress of the piping components, overloading of anchors and other supports, leakage at joints, or detrimental distortion of connected equipment. The piping system shall be adequately supported in order to avoid excessive deflection due to pipe self weigh and concentrated loads.

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.

1. American society of Mechanical Engineers (ASME)

ASME B31.1	Power Piping
ASME B31.3	Process Piping

2. American Petroleum Institute (API)

API 560	Fired Heaters for General Refinery Service
API 610	Centrifugal Pumps for General Refinery Service
API 617	Centrifugal Compressors for Petroleum, Chemical and Gas Service Industries
API 618	Reciprocating Compressors for General Refinery Service
API 650	Welded Steel Tanks for Oil Storage
API 660	Shell and Tube Heat Exchanger for General Refinery Service
API 661	Air-Cooled Heat Exchanger for General Refinery Service
API RP-520	Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries

3. National Electrical Manufacturers' Association (NEMA)

NEMA SM23	Steam Turbine for Mechanical Drive Service

4. WRC

   WRC 107 Local Stresses in Spherical and Cylindrical Shells due to External Loading
   WRC 297 Supplement to WRC Bulletin No. 107

5. National Structural Code of The Philippines (NSCP)
6. Expansion Joint Manufacturers Association (EJMA)
7. Fluid Sealing Association (FSA)
8. ASCE

   ASCE-7 Minimum Design Loads for Building and Other Structures

UNITS

This Standard is based on International System of Units (SI) except where otherwise specified. However, nominal sizes of piping components shall be in accordance with inch system.

SCOPE OF STRESS ANALYSIS

The main purpose the stress activities are:

1. To identify those piping systems critical from the thermal behavior point of view, or requiring deep verifications because of particular operating conditions.
2. To identify according to the different grades of line critically, the most suitable verification method.
3. For piping system classified as critical
   a. To verify that the maximum stress levels are below the maximum allowable values stated by governing code for the different load combinations
   b. To verify that reaction forces on machines or equipments nozzle are below the limits the specified on design standards of the equipments
   c. To calculate the load transferred by means of piping restraints to the structures in order to allow the verification by civil engineer
   d. To verify the piping thermal expansion or contraction will not cause the failure
4. For piping system not included in the category described in this Project Standard and Specification, to perform visual check or simplified analysis in

all the cases the stress analysis engineer will consider it necessary on the basis of the piping routing.

DESIGN CONDITIONS

All the piping system shall not have any excessive or abnormal movements, excessive operating loads higher than acceptable limits and higher than code allowable stresses. The design basis load to be considered and the major check points included in this analysis are as follows.

Pressure

Design pressure specified in line list shall be taken for calculations the longitudinal pressure stress.

Weight Effects

The following weight effects combined with loads and forces from other causes shall be taken into account in the design of piping:

- Pipes
- Valves and strainers
- Flanges and blinds
- Fittings
- Insulation material and cover
- Fluid in the pipe
- Test or cleaning fluid load

Unless otherwise specified, weight of fluid in the pipe shall be taken in accordance with the following considerations

For liquid	100% of full water weight
For vapor, gas and steam service	0% of full water weight (up to NPS 14”) 5% of full water weight (NPS 16” and larger)
For liquid gas or liquid vapor mixture	30% of full water weight
For hydrotest	Full water weight
Flare header	Full of liquid (up to NPS 10”) Dead load of pipe (NPS 12” and larger)

For friction load purpose, hydrotested line shall be considered 100% full of water. However, for lines where springs are coming, actual density of the fluid shall be considered.

Thermal Effects

1. Installation temperature

   An ambient temperature (normally 21^{o}C) shall be taken as the installation temperature.

2. Calculation temperature

   a. Maximum operating (or design) temperature as stipulated in the Line index. If the maximum operating temperature does not specified in the line list, calculation temperature shall be considered the variation temperature (± 30^{o}C) plus normal operating temperature.

   b. In addition, the following temperature condition shall be considered in the calculation when lines are specified in the line index:
      - Start-up/shutdown temperature
      - Stream out temperature – Decoking temperature
      - Regeneration temperature
      - Reaction temperature
      - Start-of-run/End-of-run temperature

   c. For electrical traced or steam traced piping, the calculation temperature shall be determined as follows:
      - For normally flow section in the piping, design temperature or 75% of tracer temperature, whichever is higher shall be taken.
      - For normally stagnant section in the piping, 75% of design temperature or 75% of tracer temperature, whichever is higher shall be taken.
      - For section between stand-by equipment and cut-off valve, 75% of tracer temperature shall be taken.
      - For piping which has warming-up by-pass, design temperature or 75% of tracer temperature, whichever is higher shall be taken for all section.

   d. For piping which don't have the follow except electrical traced or steam-traced piping, the calculation temperature shall be determined as follows:
      - For insulated piping, 75% of design temperature shall be taken.
      - For un-insulated piping, 25% of design temperature shall be taken.
      - For section between stand-by equipment and cut-off valve, installation temperature shall be taken.
      - For piping which have warming-up by-pass, design temperature shall be taken for all section.

Occasional Loads

Where two phase flow such as slug, safety/relief valve operating loads, vibrations due to system operating transient are predicted, as well as wind and seismic, the