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A Basis for determining ASME B31.3 Category M Fluid Services

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(From a paper dated August 16, 2001 in response to a discussion on ASME B31.3 Category M Fluid Services)

ASME defines their Category M Fluid Service in the following manner:

ASME B31.3 Definition

Category M Fluid Service: A fluid service in which the potential for personnel exposure is judged to be significant and in which a single exposure to a very small quantity of a toxic fluid, caused by leakage, can produce serious irreversible harm to persons on breathing or bodily contact, even when prompt restorative measures are taken.

Based on that definition and the Owner's understanding and experience with the chemicals running through their pipelines, it is the Owner's responsibility to determine what liquids and gases constitute Category M Fluids.

While ASME does not extend their definition to a list of possible Category M chemical candidates others do. Not for Category M which pertains only to ASME B31.3, but to other fluid service Categories that various organizations consider hazardous or poisonous to personnel. The Occupational Safety and Health Administration (OSHA) under 29CFR, the Department of Transportation (DOT) under 49CFR, the Environmental Protection Agency (EPA) under 40CFR, and the National Fire Protection Association (NFPA) Guide to Hazard Information each provide their own listing of what they consider hazardous or poisonous chemicals based on their own set of criteria.

By adopting the consensus of one or more of these organizations for determining whether a chemical is hazardous or poisonous, and therefore under consideration as a Category M Fluid, a manufacturer using chemicals can adopt their lists to be used as benchmarks in the process of selecting Category M Fluids.

OSHA

29CFR (OSHA) provides a listing of Highly Hazardous Chemicals, Toxics and Reactives. However, their list is broad in its interpretation and provides a Threshold Quantity (TQ) for each chemical, which requires further consideration on the part of the Owner. Although a good reference, I would eliminate 29CFR as a basis for evaluation.

EPA

40CFR (EPA) provides a listing of Hazardous Substances as defined by the EPA under 33CFR Sect. 1321 para. (a)(2)(A) as follows:

The Administrator shall develop, promulgate, and revise as may be appropriate, regulations designating as hazardous substances, other than oil as defined in this section, such elements and compounds which, when discharged in any quantity into or upon the navigable waters of the United States or adjoining shorelines or the waters of the contiguous zone or in connection with activities under the Outer Continental Shelf Lands Act (43 U.S.C. 1331 et seq.) or the Deepwater Port Act of 1974 (33 U.S.C. 1501 et seq.), or which may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the United States (including resources under the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.)), present an imminent and substantial danger to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, shorelines, and beaches.

This is justifiably a broad interpretation of hazardous chemicals that doesn't define or categorize the various chemicals to the extent that it would assist a Company in making a Category M determination.

DOT

The Hazardous Material Table in 49CFR (DOT) has 23 Class and Division Numbers that categorize chemicals according to their degree of hazard, or non-hazard, for the purpose of transportation. Of those 23

Classes and Divisions, 3 could be considered Category M Fluids: 1. (no Class No.) Forbidden Materials, 2. (2.3) Poisonous Gas, 3. (6.1) Poisonous Materials.

49CFR Definitions:

Forbidden Materials – (*Too lengthy for this paper. Refer to 49CFR 173.21 for clarification*)

Division 2.3 – A gas *poisonous by inhalation*, means a material which is a gas at 68°F in accordance with ASTM E681, Standard Test Method for Concentration Limits of Flammability of Chemicals or other equivalent method approved by the Associate Administrator for Hazardous Materials Safety. The flammability of aerosols is determined by the tests specified in 49CFR 173.306(i) of this part.

Division 6.1 – A material, other than a gas, which is known to be so toxic to humans as to afford a hazard to health during transportation, or which, in the absence of adequate data on human toxicity:

1. Is presumed to be toxic to humans because it falls within any one of the following categories when tested on laboratory animals (whenever possible, animal test data that has been reported in the chemical literature should be used):
 - (i) *Oral Toxicity*. A liquid with an LD₅₀ for acute oral toxicity of not more than 500mg/kg or a solid with an LD₅₀ for acute oral toxicity of not more than 200 mg/kg.
 - (ii) *Dermal Toxicity*. A material with an LD₅₀ for acute dermal toxicity of not more than 1000 mg/kg.
 - (iii) *Inhalation Toxicity*.
 - (A) A dust or mist with an LC₅₀ for acute toxicity on inhalation of not more than 10 mg/L; or
 - (B) A material with a saturated vapor concentration in air at 68°F greater than or equal to one-fifth of the LC₅₀ for acute toxicity on inhalation of vapors and with an LC₅₀ for acute toxicity on inhalation of vapors of not more than 5000 ml/mm³; or
2. Is an irritating material, with properties similar to tear gas, which causes extreme irritation, especially in confined spaces.

Note: To learn more about LD₅₀ and LC₅₀ refer to 49CFR 173.132.

NFPA

The NFPA's Chemical Hazardous Rating System places chemicals into three groups: Health, Flammability and Reactivity. Within those groups are twelve Classes. The only group identifying potential Category M Fluids is the Health group. Within the Health group are four Classifications. The Classification identifying possible Category M Fluids is #4 – Danger: May be fatal on short exposure. Specialized protective equipment required.

DOT and NFPA

Using both the Hazardous Material Table in 49CFR and NFPA's Table of Chemical Ratings a determination of possible Category M Fluids can readily be made. Any chemical flowing through pipe or tubing listed as either a "4" in the Health column of NFPA's Table of Chemical Ratings, or as a "Forbidden", "2.3", or "6.1" in the "Hazard Class or Division" column of the Hazardous Materials Table in 49CFR should be considered a Category M Fluid.

While these two regulatory directives provide essentially the same information, they do so with two different objectives, and therefore do not always agree. As an example NFPA considers Bromine a Class 3 – Warning: Corrosive or toxic. Avoid skin contact or inhalation. While 49CFR considers Bromine a Class 6.1 – Poisonous Materials. NFPA considers Chloroform a Class 2 – Warning: May be harmful if inhaled or absorbed. While 49CFR considers Chloroform a Class 6.1.

Regardless of whether or not they agree on the hazard level of a chemical, if a chemical is indicated as a 4 by NFPA, or Forbidden, 2.3, or 6.1 by 49CFR it should be considered a potential Category M Fluid.

Declaring a fluid service to be classified as Category M places added requirements on the design, fabrication, construction, and examination of the piping. These additional requirements are identified in ASME B31.3 Chapter VIII – Piping For Category M Fluid Service. The added Code requirements themselves are not significant however B31.3 Chapter VIII does not cover the details required for piping layout requirements and other detail design considerations.

The information required of detail design guidelines are much too specific to an overall design approach, and to the Owner's particular needs to be specified by Code. This type of detail should be defined in a Company's own proprietary Specifications and Guidelines.

The B31 series Codes address the requirements necessary to assure system integrity by identifying material limits, stipulating fabrication requirements, providing minimal examination requirements, etc., and they do include basic design guidelines required in order to achieve that assurance. They cannot specify routing requirements, when to use double containment piping systems, determine accessibility or whether this type of piping can or cannot run underground, etc. This type of detail is Owner specific. Even within a Company's specifications and guidelines, these requirements may vary from plant to plant, should the Company have multiple plant sites.

Whenever a chemical, categorized as a Category M Fluid, is made part of a project there should be a well-defined basis of design established in order to convey to the designer a predetermined set of design requirements.

END OF PAPER