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RISK MANAGEMENT PLAN GUIDANCE DOCUMENT FOR BULK LIQUID HYDROGEN SYSTEMS

THIRD EDITION

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NOTE—Technical changes from the previous edition are underlined.

NOTE—Appendices A and G (Normative) are a requirement.

NOTE—Appendices B, C, D, E, F, H, and I (Informative) are for information only.

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SECOND EDITION: 2003
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1 Introduction

Section 112(r) of the *Clean Air Act* (CAA), mandates that the U.S. Environmental Protection Agency (EPA) promulgate a regulatory program to prevent accidental releases of regulated toxic and flammable substances and reduce the severity of releases that do occur [1]. Hydrogen is one of the regulated flammable substances under this regulation. The rule was published on June 20, 1996, and formally appears in Title 40 of the U.S. *Code of Federal Regulations* (40 CFR) Part 68 and is officially titled *Accidental Release Prevention Requirements: Risk Management Programs Under Clean Air Act Section 112(r)(7)* [2].[1] The deadline for compliance was June 21, 1999.

The regulation is generally referred to as EPA's risk management program (RMP) rule. The RMP rule requires the implementation of a risk management program for all covered processes at stationary sources containing regulated substances above threshold quantities. A full RMP is comprised of a hazard assessment, a management system, a prevention program, and an emergency response program. However, the RMP rule allows for a tiered approach to regulating stationary sources subject to the rule. There are three tiers or program levels. The placement of a facility into one of the three regulatory tiers is based on the facility's accidental release history, its offsite impact potential, and the types of processes operated at the site. In short, a facility that presents a greater risk to offsite receptors must comply with more stringent requirements than those that present a lower risk to offsite receptors. Appendix A compares the regulatory requirements for each of the tiers, which are known as programs 1, 2, and 3. In addition to the RMP, the RMP rule requires the submission of a risk management plan document. The plan document summarizes the key elements of the RMP at the stationary source.

This guidance document was developed to help owners and operators of liquid hydrogen bulk tanks comply with the RMP rule. This guidance document was developed by a gas industry process safety task force organized by the Compressed Gas Association (CGA).

The details about the application of EPA RMP can be found in CGA P-29, *Application of OSHA PSM and EPA RMP to the Compressed Gas Industry* [3].

2 Purpose

This guidance document is intended to provide information that is required to meet RMP requirements in an easy to understand form. It allows for more efficient completion of RMPs while at the same time promoting consistent responses to the RMP regulatory requirements. A typical system hazard and operability study (HAZOP) as well as the hazard assessment for release scenarios typical of the standard hydrogen customer station tanks used in the gas industry are provided to assist these critical RMP responses.

3 Scope

Hydrogen is an RMP regulated flammable substance at a threshold quantity of 10 000 lb. The RMP rule applies when the total weight of hydrogen in the bulk tank plus the weight of hydrogen in the process meets or exceeds 10 000 lb. More details about calculating the 10 000 lb system threshold quantity can be found in CGA H-5, *Installation Standards for Bulk Hydrogen Supply Systems* [4].

This guidance document provides generic information necessary to support the hazard assessment and the process hazard analysis portion of the prevention program. Specifically, it includes a typical system flow diagram (TSFD), a typical system HAZOP, and offsite consequence analysis (OCA) information for a bulk liquid hydrogen system. Tables and charts for the assessments of the appropriate worst-case and alternative-case release scenarios are also included. In addition, information is provided to assist in the development and submission of a typical risk management plan.

This guidance document does not constitute a total RMP. Facilities covered by the RMP rule must also:

- Compile and report a history of accidental releases for the 5 years prior to the submission of the RMP plan as provided in 40 CFR 68.42 [2];

[1] References are shown by bracketed numbers and are listed in order of appearance in the reference section.

- Develop a management system to oversee the implementation of all elements of the RMP for program 2 or program 3 regulated processes as provided in 40 CFR 68.15 [2];
- Determine one of three program levels to assign the covered process as provided in 40 CFR 68.10 and comply with the applicable program level general requirements as provided in 40 CFR 68.12. Details for program 2 are provided in 40 CFR 68.48 through 68.60, and program 3 details are provided in 40 CFR 68.65 through 68.87 [2];
- Develop and implement an emergency response program for the purpose of protecting public health and the environment as provided in 40 CFR 68.95, except as provided in paragraph (b) of 40 CFR 68.90 [2]; and
- Prepare and submit a single risk management plan as provided in 40 CFR 68.150 that includes the information required by 40 CFR 68.155 through 68.185 for all covered processes [2].

As illustrated above, this guidance document does not represent a total RMP nor does it provide all the information required in a complete risk management plan submission. The very nature of the guidance document is to provide “guidance only” and not to present a complete or model RMP. Each individual company must exercise its own judgment regarding how they use this guidance document and how they achieve RMP compliance.

4 Typical hydrogen system

A typical hydrogen system consists of a storage tank, flow controls, vaporizers, low temperature protection, and other safety systems. More details about hydrogen systems can be found in CGA H-5 [4].

4.1 Flow diagram

A typical hydrogen system flow diagram can be found in Appendix B. The numbers in parentheses in this section refer to parts of the diagram.

4.2 System description

4.2.1 Storage tank

Hydrogen tanks are constructed with a liquid container suspended inside a vacuum casing. Gas- and liquid-phase piping passes through the ends of the casing. All lines are designed with sufficient flexibility to prevent excessive stress due to expansion and contraction of the piping, liquid container, and suspension system as a result of thermal changes. All liquid lines are gas trapped inside the casing to prevent liquid from standing in the lines when the lines are not in use.

The liquid container is insulated by a powder or wrapped insulation material. The annular space between the liquid container and the casing is evacuated and sealed. An adsorbent is factory installed in the vacuum space to help maintain the vacuum. There is an evacuation valve (4) on the tank. The annular space vacuum is measured by a vacuum probe (26A) through the vacuum probe valve (3A).

More details about liquid hydrogen tanks may be found in CGA H-3, *Cryogenic Hydrogen Storage* [5].

4.2.2 Tank piping and controls

The tank is filled through the fill connection (25), the liquid-fill valve (10), and the gas-fill valve (11). The fill piping is vacuum insulated by a system that is separate from the casing vacuum system. The fill-piping vacuum is measured by a vacuum probe (26B) through the vacuum-probe valve (3B). Fill valves (10 and 11) are purged through the purge valve (13).

The tank-fill termination indicator (23) connects to the liquid container through the full trycock valve (1). The tank pressure may be reduced by manually blowing down through the blowdown valve (7).

Container pressure is indicated by the pressure gauge (5). Container content is displayed on the level gauge (6). These gauges (5 and 6) are connected to the liquid container through isolation valves (24A and 24B).