CGA H-11—2020

SAFE STARTUP AND SHUTDOWN PRACTICES FOR STEAM REFORMERS

SECOND EDITION

CGA
Compressed Gas Association
The Standard For Safety Since 1913

PREFACE

As part of a program of harmonization of industry standards, the Compressed Gas Association (CGA) has published CGA H-11, *Safe Startup and Shutdown Practices for Steam Reformers*, jointly produced by members of the International Harmonization Council.

This publication is intended as an international harmonized standard for the worldwide use and application of all members of the Asia Industrial Gases Association (AIGA), Compressed Gas Association (CGA), European Industrial Gases Association (EIGA), and Japan Industrial and Medical Gases Association (JIMGA). Each association's technical content is identical, except for regional regulatory requirements and minor changes in formatting and spelling.

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NOTE—Technical changes from the previous edition are underlined.

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1 Introduction and purpose

1.1 Introduction

Large scale hydrogen production has been commercially practiced for decades and the demand for such production has grown over that period. In the last several years, developments in crude oil processing, such as the increased use of hydrogen to remove sulfur and the refinement of heavier crude oil stocks, has driven significant growth in the demand for hydrogen supply.

In response to this demand, industrial gas companies operate and maintain large scale hydrogen production facilities worldwide and have done so with an exemplary safety record for many years. However, it should be noted that large scale hydrogen production involves potential personnel and process safety hazards that shall be addressed in design and operation. Such hazard potential is inherent to the processing of toxic and flammable gases via high temperature reforming as practiced in hydrogen production.

The steam reformer represents the core operating unit of most large scale hydrogen production facilities. Therefore, steam reformer furnace combustion safety is fundamental to the overall safe operation of these large scale hydrogen plants. The startup and shutdown of the reformer can create transitional periods of increased risk to the operation of the facility. The operating procedures and practices employed during startup and shutdown shall effectively address the potential hazards of such transitions to ensure plant safety.

The need to specifically consider and address the startup and shutdown of industrial processes is well recognized as a cornerstone to safe operation. Requirements to ensure startup and shutdown safety are addressed in operating procedures and are included in process safety regulations in Title 29 of the U.S. *Code of Federal Regulations* (29 CFR) Part 1910.119, *Process safety management of highly hazardous chemicals*, referred to as OSHA Process Safety Management (PSM), and in Europe, Seveso III Directive 2012/18/EU, *Control of Major Accident Hazards Involving Dangerous Substances,* among other regulatory bodies [1, 2]. [1]

Guidelines for the safe startup and shutdown of industrial production units are technology specific. Industry-wide publications addressing startup and shutdown practices exist for many technologies, including industry publications such as CGA P-8, *Safe Practices Guide for Cryogenic Air Separation Plants,* which addresses startup and shutdown of air separation plants [3].

It should be noted that there are other industries such as ammonia and methanol production, that operate large steam reformers. Therefore, it can be instructive to consider the learning and experiences from those industries through organizations such as the American Institute of Chemical Engineering: Ammonia Plant Safety Symposium and the International Methanol Producers and Consumers Association (IMPCA).

Steam reformer furnace design will continue to develop along with methods to implement combustion safety in these furnaces. A wide variety of steam reformer designs, configurations, and component equipment exists today. Therefore, this publication includes generalized statements and recommendations on matters which there may be diversity of opinion or practice. Users of this publication should recognize that it is presented with the understanding that it can supplement, but not take the place of, sound engineering judgment, training, and experience. It does not constitute, and should not be construed to be, a code or rules or regulations.

1.2 Purpose

The purpose of this publication is to inform and guide interested parties on the procedures and practices fundamental to combustion safety in the operation of steam reformers. This publication presents a baseline for safe reformer operation which, if followed, assures our customers that the hydrogen they receive from member companies has been produced according to accepted industry-wide safety guidelines. This publication provides a technical basis that can be used to present a common viewpoint to government and regulatory authorities, ensuring proper application of rules and regulations.

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

2 Scope

This publication applies to steam reformers that are operated with natural gas, refinery off gas, naphtha, and other light hydrocarbon streams. It specifically applies to large volume hydrogen production plants, defined for this publication as a production capacity of 380 000 scfh (10 000 Nm^3h) (9 MMSCFD or 240 000 Nm^3D) or greater. This publication may be applied to smaller reformers depending on the technology used.

This publication covers operational safety of steam reformer startup and shutdown. Emphasis is placed on operational guidance and features that provide safeguards against the hazards associated with the transition and infrequent nature of startups and shutdowns. The publication is not intended to address the details of design, installation, construction, and initial startup (commissioning) of steam reformers.

3 Definitions

For the purpose of this publication, the following definitions apply.

3.1 Publication terminology

3.1.1 Shall
Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

3.1.2 Should
Indicates that a procedure is recommended.

3.1.3 May
Indicates that the procedure is optional.

3.1.4 Will
Is used only to indicate the future, not a degree of requirement.

3.1.5 Can
Indicates a possibility or ability.

3.2 Technical definitions

3.2.1 Boiler
Closed vessel in which water is heated and steam is generated by heat input from combustible fuels in a self-contained or attached furnace.

3.2.2 Burner
Device for the introduction of fuel and air into a combustion chamber at the velocity, turbulence, and concentration required to maintain ignition and combustion of fuel.

3.2.3 Burner management system (BMS)
Control system dedicated to combustion safety and operator assistance in the starting and stopping of fuel preparation and combustion equipment and for preventing improper operation of and damage to fuel preparation and burning equipment.

3.2.4 Bypass
Means used to temporarily deactivate an alarm, control, or protection system including, but not limited to: jumper wires, control system overrides, forced values, modified setpoints, modification of the normal lock open or closed valve positions, taking the device offline, or running temporary hoses.

NOTE—Based on the type of bypass, it can also be referred to as an override, shunt, or jumper.

3.2.5 Bypass log
Formal document used to track the approval, installation, management, and removal of bypasses.