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HEALTH, SAFETY AND ENVIRONMENT

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IGNITION SOURCE CONTROL

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This new PTS 60.2123 – Ignition Source Control has been developed to manage the known ignition sources in the plants and ensure adequate control measures are in place to reduce the risks to a level as low as reasonable practicable.

The custodian of this PTS is: Manager - HSE MS, Standards & Regulations, GHSED.

Please direct any questions regarding this PTS to the above-mentioned.

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PREFACE

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They are based on the experience acquired during the involvement with the design, construction, operation and maintenance of processing units and facilities. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

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1.0 INTRODUCTION

Safety and minimization of risk to life and property demand that ignitable, explosive or hazardous environments be isolated from 'ignition source' or the source of ignition be eliminated.

Whenever it is not possible to reliably and safely eliminate any one of the above conditions, procedures shall be put in place to ensure the above conditions do not occur simultaneously.

A study conducted by a Canadian industry group i.e. IRP18 Committee, working with the University of Calgary's Department of Chemical and Petroleum Engineering and Enform (formerly the Canadian Petroleum Safety Council) on the fire and explosion incidents in the Canadian Upstream Oil & Gas Industry. Figure 1 below shows the results of the study on the ratio of different ignition sources which had caused the fire and explosion incidents.

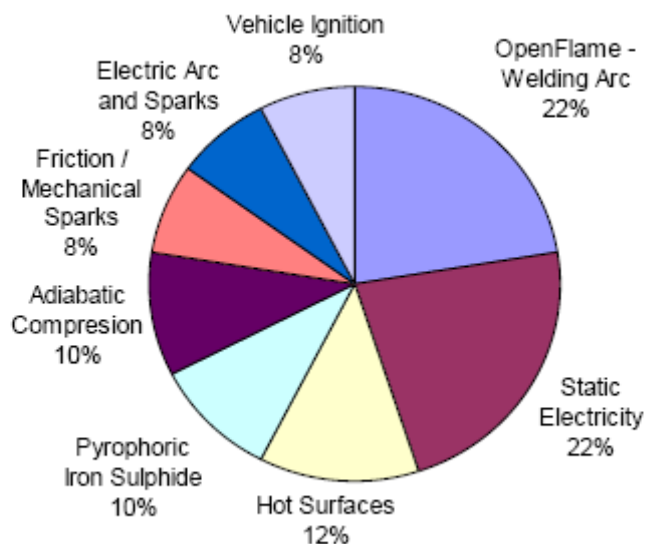


Figure 1: Types of Ignition Sources Identified in Canadian Upstream Oil & Gas Industry Fire & Explosion Incident Analysis

Source: Canadian Upstream Oil & Gas Industry Fire & Explosion Incident Analysis

2.0 SCOPE

This standard provides the overview on the identification and assessment of all the potential ignition sources in the oil and gas facilities and installations and provides guidance on development of procedure to control these ignition sources and implement control measures to reduce the risk to a level as low as reasonable practicable.

3.0 DEFINITIONS

Flammable atmosphere

A flammable atmosphere is defined as a mixture of flammable gases or vapour with air in such proportion that, without any further admixture, it will burn when ignited.

Explosive atmosphere

An explosive atmosphere is a mixture with air, under atmospheric conditions, of flammable substances in the form of gases, vapour, mists or dusts, in which, after ignition has occurred, combustion rapidly spreads to the entire unburned mixture.

The term 'flammable' atmosphere is preferable and should be used because the term 'explosive' is a special case of 'flammable' where either congestion or confinement leads to the generation of over-pressure when the cloud is ignited.

Hazardous Area

A hazardous area is defined as a three-dimensional space in which a flammable atmosphere may be expected to be present at such frequencies as to require special precautions for the design and construction of equipment, and the control of other potential ignition sources. All other areas are non-hazardous in this context.

Incendive spark

An incendive spark is a spark of sufficient intensity to ignite flammable material. The spark can be of mechanical or electrical in nature.

4.0 REFERENCE

- Institute of Petroleum Model Code of Safe Practice Part 15, Area Classification Code for Petroleum Installations
- Process Safety Booklet Twelve, Tank and (Un)Loading Safe Operations, BP 2004
- Guidelines for Fire Protection in Chemical, Petrochemical, and Hydrocarbon Processing Facilities, CCPS, 2003
- Fire Protection Handbook Eighteenth Edition, NFPA 1997
- Guidelines for Engineering Design for Process Safety, CCPS 1993
- Lees' Loss Prevention in Process Industries, Third Edition
- PTS 80.00.10.10 Area Classification (Amendments/Supplements to IP15)

5.0 REGULATORY REQUIREMENTS

5.1 Malaysia

Occupational Safety and Health Act, 1994

PART IV GENERAL DUTIES OF EMPLOYERS AND SELF-EMPLOYED PERSONS

Section 15 General duties of employers and self-employed persons to their employees.

- (2) Without prejudice to the generality of subsection (1), the matters to which the duty extends include in particular-
- (a) the provision and maintenance of plant and systems of work that are, so far as is practicable, safe and without risks to health;
 - (b) the making of arrangements for ensuring, so far as is practicable, safety and absence of risks to health in connection with the use or operation, handling, storage and transport of plant and substances;
 - (c) the provision of such information, instruction, training and supervision as is necessary to ensure, so far as is practicable, the safety and health at work of his employees;
 - (d) so far as is practicable, as regards any place of work under the control of the employer or self-employed person, the maintenance of it in a condition that is safe and without risks to health and the provision and maintenance of the means of access to and egress from it that are safe and without such risks;
 - (e) the provision and maintenance of a working environment for his employees that is, so far as is practicable, safe, without risks to health, and adequate as regards facilities for their welfare at work.

5.2 International operations

These guidelines shall be applicable to all international operations. Where the legal requirements of the host country exceeds or are more stringent than that of these guidelines, then the respective country's legislation shall prevail.

6.0 IGNITION SOURCES

6.1 The different types of ignition sources that should be considered are:

- Mechanical sparks
- Fires
- Hot surfaces
- Auto ignition
- Pyrophoric materials
- Mechanical impact
- Friction
- Electrical equipment
- Electrostatic ignition and lightning
- Combined mechanism

6.1.1 Mechanical Sparks

The sparks generated by grinding action on metal or other spark-inducing materials can have sufficient energy to ignite flammable gases or organic dust clouds.

The practical danger from mechanical sparks is limited by the fact that usually they are very small and have a low total heat content, even though each spark may have a temperature of 1100°C or higher. Mechanical sparks cool quickly and start fires only under favorable conditions, such as when they fall into loose dry cotton, combustible dust, or explosive materials. Larger particles of metal, able to retain their heat longer, usually are not heated to dangerous temperatures.

6.1.2 Fires

Fires are open flame ignition source which can ignite flammable gas or organic dust clouds. e.g. lighted cigarette, open flame from lighter and match.

6.1.3 Hot Surfaces

Hot surface can be a source of ignition if they are large enough and hot enough. The smaller the heated surface, the hotter it must be to ignite a mixture. The larger the heated surface in relation to the mixture, the more rapidly ignition will take place and the lower the temperature necessary for ignition. A flammable liquid, however, must remain in contact with a hot surface for a sufficient length of time to form a vapour-air mixture within its flammable range. For example, a single drop of a low-viscosity, highly volatile flammable liquid that falls on the surface of an electric hotplate at 1093°C may ignite.

The temperature of equipment operating in Class I or II environment must not exceed the ignition temperature of the gas or dust to which it is exposed. NFPA 497M, Manual for Classification of Gases, Vapours, and Dusts for Electrical equipment in Hazardous (Classified) Locations, provides ignition temperature data on dusts, vapours and gases.

6.1.4 Auto-ignition

The temperature at which auto-ignition of dusts, vapours and gases occur. The method of determining packaging classification of self-heating materials used by US Department of Transportation for road transportation is a useful reference.

6.1.5 Pyrophoric material

Pyrophoric material is a substance capable of self ignition on exposure to air under ordinary atmospheric condition.

6.1.6 Mechanical Impact

Some materials can be ignited immediately due to sudden mechanical impact. The ASTM E680 drop hammer test method can be used to characterize materials in this regard.

6.1.7 Friction

Frictional ignition e.g. associated with the impact of light alloy of aluminum and magnesium on rusty steel known as the "thermite" reaction.

6.1.8 Hot Work

Hot work such as welding, gas cutting, grit blasting, grinding are ignition sources.

6.1.9 Electrical Equipment

Electrical equipment can be the source of ignition where flammable materials are handled. Where ever possible, electrical equipment and wiring are best located outside hazardous locations. Where these ignition sources cannot be located outside the hazardous area, then ignition sources are controlled by defining electrically classified areas and designing, procuring and installing equipment accordingly.

6.1.10 Electrostatic Ignition

The principal hazard of static electricity is a spark discharge in a flammable atmosphere.

In order for an electrostatic charge to become a source of ignition, four conditions must exist:

- Electrostatic charge generation
- Accumulation of an electrostatic charge capable of producing an incendive spark
- A mean of discharging the accumulated electrostatic charge in the form of an incendive spark i.e. a spark gap
- An ignitable vapour-air or dust-air mixture in the spark gap.

6.1.11 Lightning strike

During a lightning strike on tall structures such as a tower, building, vessel, tank or stack the soil potential is increased significantly around the grounded structures. This potential rise can reach several hundred of kilo-Volts. The currents built-up in any lightning flash can range from a few kilo-amperes (kA) up to over 100 kA.

In order to protect structures or electronic systems in the vicinity against a direct arc, induced voltage or inrush current originating from the tower or building, it is necessary to install Lightning Protection Systems in accordance with local regulations and PETRONAS Technical Standard i.e.:

- ◆ PTS 33.64.10.10 Electrical Engineering Guideline
- ◆ PTS 33.64.10.33 Electromagnetic Compatibility (EMC) Requirement
- ◆ PTS 20.181 Earthing and Lightning Protection

6.1.12 Combined Mechanisms

In any given ignition scenario it is likely that multiple ignition mechanisms were involved. For example, an un-lubricated bearing (friction, hot surface).

6.2 Minimum ignition energy

Electrical, static and frictional sparks must sufficient energy to ignite flammable vapour-air mixtures. Electrical sparks from most commercial electrical supply installations are above flame temperatures and will usually ignite a flammable mixture. However, friction sparks may fail to ignite a flammable mixture because the spark may be of such short duration as to fail to heat the vapour to its ignition point. Also, not only must an electrical spark have sufficient intensity and length, but some variable conditions must also exist within certain limits before ignition will occur. The nature of the ignition points and surfaces, as well as the composition, temperature, and pressure of vapour-air mixtures, are the principal variables in calculating ignition. Most of these same factors and variables also

apply to static electrical sparks and frictional sparks as a source of ignition because, in either case, the spark must be of sufficient duration, intensity, or both, to create sufficient heat to cause ignition.

Potentials exceeding 350 volts and stored energies exceeding 0.1 mJ are considered hazardous in flammable gas areas. Minimum ignition energies (MIE) of dust clouds vary widely but can be less than 10 mJ. Most dusts of organic composition have MIEs in the range of 10 to 100 mJ.

6.3 Category of ignition sources and their controls

The key elements for preventing fires in process industries is to prevent loss of containment and control ignition sources. The process and equipment should be designed, installed, and operated to prevent or minimize the release or spill of flammable gases, liquids, or combustible dusts, as well as to eliminate or control ignition sources. The categories of ignition sources are:

- Open Flame
- Electrical equipment in classified hazardous area
- Personal Ignition Sources
- Hot Works
- Vehicle and Engine
- Electrostatic and stray electrical currents
- Auto ignition of chemicals and pyrophoric substances
- Hand tools and equipment

6.3.1 Open flame

Open flame is a potential ignition source in the plant. Examples of open flame are Fired Heaters, Furnace, Incinerator, Boiler, Gas Turbine, Flare and burn pit. The flames of burners in fired heaters and furnaces, including boiler houses, may be sources of ignition on process plants. The flame at a flare stack may be another source of ignition. Such flames cannot be eliminated. It is necessary, therefore, to take suitable measures such as care in location and use of trip systems.

When carrying out incompatible activities such as breaking of flange and draining which could release flammable product/vapour around sources of known open flame in the plant, the activities shall be controlled via a work permit system.

For emergency planning, known ignition source in the plant such as open flame should be considered in various accidental flammable product release scenarios.

6.3.2 Electrical equipment in classified hazardous area

Hazardous area classification is a method of analyzing and classifying the environment where explosive gas atmospheres may occur so as to facilitate the proper selection and installation of apparatus to be used safely in that environment, taking into account gas groups and temperature classes. Hazardous area classification is the assessed division of a facility into hazardous areas and non-hazardous areas, and the subdivision of the hazardous areas into zones.

It may not be possible to classify areas into Zone 0, Zone 1 or Zone 2 by a simple examination of a plant or plant design. Hence, a systematic analysis and detailed