



**Ministry of  
Energy and  
Resources**

## **Directive S-20 Saskatchewan Upstream Flaring and Incineration Requirements**

**July 1, 2011**

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## **GLOSSARY**

**Appendix 1:** Saskatchewan Upstream Petroleum Industry Storage Standards, S-01  
Version January 1, 2002, Section 2.2.1.

## **Contacts**

## **SECTION 1.0 GENERAL DISCUSSION**

### **1.1 General Discussions**

This document provides comprehensive upstream oil and gas flaring and incineration performance, equipment spacing and set-back distance specifications.

The use of flare pits and earthen pits as storage receptacles in the production operation of wells and facilities are strictly prohibited in Saskatchewan since 2002. All flare pits shall be immediately decommissioned and site remediated.

Where approved, flare pits may be used during drilling of a well.

Directive S-20 has been developed through the *Saskatchewan Upstream Oil and Gas Industry Flaring and Venting Emission Reduction Committee*. The committee consists of subject matter experts in the field of production accounting, air quality protection, oil and gas operations, and gas processing, as well as representatives from the upstream oil and gas industry associations and Government of Saskatchewan organizations.

The participating organizations include:

- Canadian Association of Petroleum Producers (CAPP)
- Small Explorers and Producers Association of Canada (SEPAC)
- Saskatchewan Energy and Resources (ER)
- Saskatchewan Environment (SE)
- TransGas Limited
- SaskPower

### **1.2 Applicable Wells and Facilities**

The standards specified in the Directive S-20 apply to wells and facilities licensed or approved under *The Oil and Gas Conservation Act* and/or *The Oil and Gas Conservation Regulations, 1985*.

Portable incinerator or flare stack used during drilling, servicing, turn-around or tests and located and used on the site for less than one year is exempt from these requirements with exception of applicable equipment spacing. Saskatchewan Ministry of Energy and Resources (ER) may at anytime require the licensee to meet these requirements or shut-down the incineration or flaring operations, if in the opinion of ER, that environmental, public safety or valid public complaints or concerns are present.

An Incinerator or a flare stack permitted by Saskatchewan Ministry of Environment (MOE) is exempt from these requirements. However, any applicable equipment (i.e. flare knock out drums) attached to the incinerator or flare stack must comply with these requirements, S-01 or any other requirements specified by ER.

### 1.3 Phase-In Period

Flare stacks or incinerator installed prior to July 1, 2012 at wells or facilities licensed prior to July 1, 2012 must meet the standards specified in the Saskatchewan Upstream Petroleum Industry Storage Standards, S-01 Version January 1, 2002, Section 2.2.1 (referenced in Appendix 1), unless otherwise approved in writing by ER.

If the aforementioned existing flare stack does not meet the S-01 version 2002, the licensee shall immediately upgrade to the Directive S-20, with exception of equipment spacing requirements, or make a written request for an exemption to ER. Licensee may use the applicable equipment spacing specified in Section 72 of *The Oil and Gas Conservation Regulations, 1985*. All written requests must include the licence number of the well or facility and technical rationale on how these flare stack or incinerator can be operated safe and environmentally responsibly. If an exemption is granted, the exemption will be added as a condition of the existing well or facility licence.

All existing flare stack or incinerator that meets the S-01 version 2002, do not need to upgrade to the Directive S-20 standard unless:

- Flaring or incinerator system is being upgraded as a part of normal upgrade process of the well or facility, after July 1, 2012;
- Facility licence is amended due to facility expansion, for example a battery is upgraded to a gas plant;
- Single Well Battery (a licensed well) is upgraded to a multi-well battery;
- Gas sent to the flare stack or incinerator has [H<sub>2</sub>S] equal to or greater than 10 mol/kilomol; or
- Instructed by ER.

Any flare stack or incinerator installed on or after July 1, 2012 shall comply with standards specified in the Directive S-20.

Exemption may be granted by ER if the licensee provides an acceptable technical rationale to support the requested exemption.

## SECTION 2.0 AIR EMISSION CONTROLS

### 2.1 General Air Emission Control Requirements

No person shall flare, incinerate and/or vent a volume of associated gas greater than 900 m<sup>3</sup> per day from any oil well or facility to the atmosphere unless the activity meets the requirements of S-10.

The licensee shall install a vapour recovery unit to prevent the emission of volatile gases from storage devices and associated processing equipment at a facility or well site when [H<sub>2</sub>S] is equal to or greater than 10 mol/kilomol as measured at the source of emission or 0.01 mol/kilomol as measured at the edge of the lease.

ER may specify a limit for concentration of volatile organic compounds or other air contaminants that can be emitted into the air, where or when in the opinion of ER it is necessary to do so to protect the environment, property or the public safety. The recovered gases shall be flared or collected for fuel.

Other methods to control sour gas emissions at a licensed facility or well site may be approved by the ministry. Upon request by ER, the licensee must be able to demonstrate the effectiveness of the emission control methods employed at these facilities or well sites.

No one shall operate an upstream oil and gas facility or a well in a manner that results in air pollution emission that exceeds the ambient air quality standards prescribed by Saskatchewan Ministry of Environment (MOE), unless the licensee has a permit from MOE approving the activity.

Where persistent or significant odour complaints are received at a licensed facility or a well, and obvious and measurable risk exists, or at the discretion of ER, the licensee may be ordered and required to implement one or more of the following mitigative measure(s):

- conduct an air quality investigation or install air quality monitoring equipment
- attempt to eliminate the air contaminants at their source
- implement good housekeeping to minimize fugitive emissions
- develop and implement a public information and consultation program
- seal and leak proof storage vessels and equipment
- install a vapour recovery unit on storage or process equipment
- direct the recovered vapour to properly operating flares as per section 2.2.1
- recover associated gas (gas associated with crude oil production) that may be vented or flared
- any combination of these requirements as ordered by ER

ER in consultation with the licensee may recommend carrying out air dispersion models at a well or facility:

- when [H<sub>2</sub>S] is equal to or greater than 10 mol/kilomol as measured at the source of emission or 0.01 mol/kilomol as measured at the edge of the lease;
- Air dispersion models must be carried out at a well or facility when ordered by ER.

## 2.2 Flaring and Incineration Performance Requirements

These requirements apply to flares and incinerators used in all upstream oil and gas systems for burning sweet, sour, and acid gas. This includes portable equipment used for temporary operations such as well completion, servicing, and testing. Flare and incinerator systems including associated separation equipment, piping and controls.

Although some design or operating specifications are provided, Directive S-20 **is not a substitute for comprehensive engineering design codes and guidelines**. It identifies minimum ER regulatory requirements but is not intended as a comprehensive design manual.

Licensees must ensure that a professional engineer, certified technician, certified engineering technologist or registered engineering technologist is responsible for the design or review of flare and incinerator systems, including separation, related piping, and controls, and for the specification of safe operating procedures. Equipment and controls design information must be provided to ER upon request if ER determines that there is a concern with the equipment or controls.

Licensees must ensure that operating procedures that define the operational limits of flare or incinerator systems are documented and implemented and that these procedures meet the design requirements. Operating limits and procedures must be provided to ER immediately upon request. Flare and incinerator systems must be operated within operational ranges and type of service specified by the designing or reviewing engineer, technician, or technologist. If this equipment is used for emergency shutdowns, this must be considered in the design.

If an licensee is using a flare or incinerator in a field service that has not previously been field tested, the licensee must be able to provide actual monitoring data to show that performance specifications can be met. Field testing of newly designed equipment is not allowed unless there are acceptable and redundant combustion systems to ensure that any sweet, sour, or acid gas can be properly combusted if the new equipment fails to perform as predicted or the ability exists for the facility to be shut in if problems arise.

*API-RP-521: Guide for Pressure-Relieving and Depressuring Systems*, Section 4: Selection of Disposal Systems, as well as applicable fire safety codes, electrical codes, CSA standards, and mechanical engineering standards, are all necessary references for the design of gas combustion systems.

Licensees must comply with Saskatchewan safety regulations with respect to the design of pressure vessels and piping systems and the design of equipment and operating procedures.

ER recommends that licensees use best engineering practices in the design and operation of flare systems, as well as appropriate engineering codes and standards.

### **2.2.1 General Requirements**

Flares and incinerators, and other gas combustion systems, including those using sour gas as a fuel for production or process equipment, must be designed, maintained, and operated so that emissions do not exceed the Ambient Air Quality Standards prescribed by MOE.

ER may require the licensees to modify or replace existing flares or incinerators if in the opinion of ER that the operation is resulting in off-lease odour, associated complaints or continuous or frequent visible black smoke.

### **2.2.2 Heating Value and Exit Velocity for Flares**

If a flare is also subject to *The Clean Air Act* approval, the more stringent requirement on minimum heating value will apply.

- The combined net or lower heating value of gas, including make-up fuel gas, directed to a flare must not be less than 20 mega joules per cubic metre ( $\text{MJ}/\text{m}^3$ ), except as noted below:
  - If existing stacks have an established history of stable operation and compliance with the Ambient Air Quality Standards prescribed by MOE (licensees are expected to support claims that existing stacks have operated satisfactorily over time), licensees are allowed to maintain the current heating value provided that it is not less than  $12 \text{ MJ}/\text{m}^3$ .
  - If flare stacks have a history of flame failure, odour complaints, and/or exceedances of the Ambient Air Quality Standards prescribed by MOE, licensees must operate with a combined flare gas heating value of not less than  $20 \text{ MJ}/\text{m}^3$ .
  - The combined net or lower heating value of acid gas plus make-up fuel gas directed to existing or new flares must not be less than  $12 \text{ MJ}/\text{m}^3$  under any circumstance.
  - Sour gas plant emergency systems must be configured to ensure that the flared gas heating value is not less than  $12 \text{ MJ}/\text{m}^3$  and the Ambient Air Quality Standards prescribed by MOE are met. ER recommends that  $20 \text{ MJ}/\text{m}^3$  heating value be maintained for non-routine flaring but recognizes that short duration emergency flaring with a gas heating value of less than  $20 \text{ MJ}/\text{m}^3$  may occasionally occur.
- If fuel make-up is required, it must be specified for flare stacks by a qualified technical professional:
  - Equipment controls must be installed and operating procedures must be documented to ensure minimum fuel gas make-up during routine and non-routine operating conditions.

- Facilities must be operated in compliance with specified minimum fuel gas make-up requirements.
- The flare tip diameter must be properly sized for the anticipated flaring rates. Equipment and controls design information must be provided to ER upon request if ER determines that there is a concern with the equipment or controls.
- Operating limits and procedures must be provided to ER immediately upon request.

### **2.2.3 Minimum Residence Time and Exit Temperature for Incinerators**

- Incinerators must provide a minimum residence time of 0.5 seconds at maximum flow rate or greater as required for complete combustion of heavier gases.
  - Incinerators must be operated without exposed flame.
  - If the gas contains less than 10 mol/kmol of [H<sub>2</sub>S] and the unsupplemented heating value of the gas is 20 MJ/m<sup>3</sup> or greater, no minimum residence time is required.
- Incinerators must operate with a minimum exit temperature of 600°C.
  - For combustion of gases with less than 10 mol/kilomol of [H<sub>2</sub>S] and an unsupplemented heating value of 20 MJ/m<sup>3</sup> or greater, no minimum exit temperature or temperature monitoring is required.
  - For combustion of gases with greater than 10 mol/kilomol of [H<sub>2</sub>S], the facility must be designed to automatically shut down if the exit temperature of the incinerator drops below either 600°C or the required temperature to meet the Ambient Air Quality Standards prescribed by MOE whichever is higher.
    - For combustion of gases with greater than 50 mol/kilomol of [H<sub>2</sub>S], the incinerator must also be equipped with process temperature control and recording.
    - All violations, together with measures taken to prevent recurrence, must be immediately reported by the licensee to the appropriate ER Field Office.
- Any enclosed combustion technology not meeting the above requirements (minimum exit temperature and minimum residence time) must submit third-party verified conversion efficiency test results to ER for approval.
  - Test programs and submissions must be provided by a qualified person and must include:
    - inlet gas parameters, including flow rates and composition;
    - stack gas exit parameters, including temperature and composition;
    - material and energy balance calculations;
    - a mass-weighted conversion efficiency value representative of the exit conditions;
    - discussion of the variation of measured and calculated results, depending on sampling location across the stack; and
    - discussion of extending test results to other inlet conditions, including discussion of inlet limitations for H<sub>2</sub>S concentration and inlet gas flow rate.

- All testing must meet the Saskatchewan Stack Sampling Code, unless otherwise approved.
- Temperature monitoring and reporting requirements would still apply.
- Equipment and controls design information must be provided to ER upon request if ER determines that there is a concern with the equipment or controls.
- Operating limits and procedures must be provided to ER immediately upon request.
- Licensees using incinerators must be able to provide details about the conversion efficiency of the equipment. Any of the following are considered to be acceptable evidence of compliance with this requirement:
  - The design at the maximum specified capacity meets the residence time, temperature, and conversion efficiency requirements, as calculated using *ERCBincin.xls* spreadsheet, or
  - Conversion efficiency for incinerator is 99% or greater, based on one of the following:
    - the manufacturer's third-party-verified conversion efficiency test results, provided that the tests were conducted under conditions representative of the facility design, or
    - actual field measurements of conversion efficiency from the operating facilities following start-up.
  - If conversion efficiency is less than 99%, the incinerator will be considered to operate as a flare and must meet all requirements for flares, including stack height.

#### **2.2.4 Smoke Emissions**

Routine gas combustion must not result in continuous or repeat black smoke emissions over a consecutive period of six minutes. Any smoke emissions that may result in public concern must immediately be reported to the appropriate ER Field Office.

#### **2.2.5 Ignition**

- Acid gas and sour gas flares and incinerators must have reliable systems to ensure continuous ignition of any gas that may discharge to the device.
  - At all facilities (excluding gas plants) where the gas contains more than 10 mol/kilomol of [H<sub>2</sub>S], a pilot **or** automatic ignition device must be installed on flares and incinerators for continuous (e.g., sour water or condensate tank flash-gas) and intermittent (e.g., emergency depressuring) sources.
  - At gas plants where gas contains more than 0.01 mol/kilomol of [H<sub>2</sub>S], pilots and automatic ignition must be installed on flares and incinerators.

- If repeat failures have occurred or off-lease odours or other impacts have resulted from failure to ensure ignition of sour gas, regardless of H<sub>2</sub>S content, ER may require installation of:
  - both pilots and automatic ignition, and/or
  - flame failure detection and alarms.
- Manual flare and incinerator ignition subject to good fire safety practices will be accepted for nonroutine purposes where:
  - no continuous gas flow exists, and
  - no automatic relieving systems are connected to the stack.

### 2.2.6 Stack Design

Flares and incinerators must meet or exceed all of the applicable stack design requirements listed below.

- Flare and incinerator stacks must be designed so that the maximum radiant heat intensity at ground level will not exceed 4.73 kilowatts per square metre (kW/m<sup>2</sup>).
  - Ground-level radiant heat determinations for flares must be based on calculation procedures outlined in *ERflare.xls* spreadsheet, *API-RP-521* Section 4.4.2.3, or *GPSA Engineering Data Book* (12th edition), Section 5. Incinerators must be operated without exposed flame. Exceptions to this requirement will be considered on request to ER, provided an equivalent level of safety can be ensured.
    - *In such* cases licensees must *restrict access to the area* where the radiant heat intensity guideline could be exceeded and must ensure that this area is free of combustible materials and vegetation. Access restrictions must include appropriate warning signs and the area must be clearly marked.
    - Appropriate procedures (e.g., safe-work permit system) must be in place when it is necessary to work within the area where the radiant heat intensity guideline could be exceeded.
- Flares and incinerators located within a distance of 5 times the height of any neighbouring buildings (on-site and off-site) must have a height of at least 2.5 times the height of the highest building. Where this is not possible, stack height may be based upon calculated radiant heat and proper dispersion, not on distance to buildings, after consultation with ER.
  - The foregoing does not apply to devices for destruction of trace vent gases, such as those emitted from gas dehydrators.
- Flare stacks for acid or sour gas containing more than 10 mol/kmol of [H<sub>2</sub>S] must have a minimum height of 12 m above ground level.
- Flares and incinerators must have sufficient height to provide adequate plume dispersion to comply with the Ambient Air Quality Standards prescribed by MOE for SO<sub>2</sub>.

- Proper stack heights must be used in order to minimize fuel consumption. If the use of supplemental fuel gas is proposed, all other options must be investigated first. Fuel gas usage and amounts must be justified.
- Interconnecting lines to the flare or incinerator must be secured to prevent whipping or flailing.

### 2.2.7 Liquid Separation

Entrained liquids in a flare or incinerator stream may reduce combustion efficiency and contribute to increased emissions of total reduced sulphur compounds, hydrocarbons, and products of incomplete combustion. Proper gas-liquid separation facilities adequate to protect the pipeline system or gas combustion system must be used.

The terms knockout, knockout drum, scrubber, and separator are used interchangeably. These requirements apply to all of these devices.

- Design information on flare and incinerator system liquid separation equipment must be submitted upon request to ER.
- Liquid separation equipment must be provided in both temporary (including well test) and permanent flare and incinerator systems to prevent the carryover of liquid hydrocarbons, water, or other liquids.
- Flare and incinerator separators must be designed in accordance with good engineering practice to remove droplets of 300 to 600 micron diameter and larger (see *API-RP-521*). Designs must be based on the lowest density hydrocarbon liquids that could be released to the flare or incinerator system.
- The flare and incinerator separators or knockout drums must be designed to have sufficient holding capacity for liquid that may accumulate as a result of upstream operations, such as hydrocarbon carryover, liquid slugs, and line condensation.
- Flare and incinerator separators in facilities constructed after the effective date of this directive must be equipped with high-level alarms that can be responded to by the licensee prior to liquid carryover, in addition to liquid level indication.
- High-level alarms and facility shutdowns must be installed on all flare and incinerator separators where liquid streams are directed to the separator for storage or where free liquids are contained in continuously combusted streams.
- Flare and incinerator separator high-level alarms must be connected to facility alarm panels and/or semi-attended facility alarm call-out systems if the facilities are so equipped.
- Well test vessels receiving production from oil wells must be equipped with a high-level shutdown, unless attended 24-hours a day and procedures for monitoring liquid levels are in place.
- Flare and incinerator separators or knockout drums used for liquid storage must be designed, installed and spaced in accordance with S-01.

## **2.2.8 Exceptions to Separator Requirements**

ER does not require independent flare or incinerator separators in situations where the only vessels connected to the flare or incinerator are production separators equipped with an HLSD (or equivalent devices) or with a system that prevents liquids from entering the flare or incinerator.

The following limitations apply to this exception:

- The HLSD must be configured to shut down and block in, but not depressure, the battery. The HLSD trip level must be set so that adequate vapour-liquid separation is not impaired at maximum liquid level and vapour flow rates.
- If liquid carryover involving spills occurs around the flare or incinerator or if black smoke is formed, licensees must install adequately sized flare or incinerator separators.

## **2.2.9 Backflash Control**

Inadequately purged flare or incinerator systems may have sufficient oxygen present to support combustion. Backflash may occur when the linear velocity of the combustible mixture of gas and air in the system is lower than the flame velocity.

- Licensees must take precaution to prevent backflash using appropriate engineering and operating practices, such as
  - installation of flame arresters between the point of combustion and the flare or incinerator separator, or
  - provision of sufficient flare header sweep gas velocities (i.e., purge or blanket gas) to prevent oxygen intrusion into the flare or incinerator system.
- Check valves are not an acceptable form of backflash control.
- Safe work procedures must be in place to ensure complete purging of oxygen from flare or incinerator systems prior to ignition.
- Licensees must provide information on backflash controls to ER upon request if ER determines that there is a concern with the equipment or controls.

## **2.2.10 Flare and Incinerator Spacing Requirements**

Licensees must follow good engineering and safety practices in the layout of facilities. Notwithstanding liquid separation requirements, unexpected liquid carryover to flares and incinerators can happen.

Adequate spacing of these devices from areas frequented by workers and from sources of combustible gas is prudent. Licensees must consult fire protection codes and guidelines as part of facility design.

- Flares and incinerators must be located, as measured from the base of the stack, at least:
  - where applicable, the licensee may use the applicable equipment spacing specified in *The Oil and Gas Conservation Regulations, 1985*;
  - 50 m away from wells, not including water disposal wells or water injection wells where there is no risk of flammable vapours;
  - 50 m away from storage tanks containing flammable liquids or flammable vapours; and
  - 25 m away from any oil and gas processing equipment.
- Flares and incinerators must be located, designed, and operated so that no hazard to public property is created. They must be at least:
  - where applicable, the licensee may use the applicable equipment spacing specified in *The Oil and Gas Conservation Regulations, 1985*;
  - 75 m away from surface improvements;
  - 100 m away from an occupied residence;
  - flare and incinerator spacing must comply with the requirements defined in the current *The Prairie and Forest Fire Act*; and
  - Licensees must maintain areas surrounding flares and incinerators to minimize fire hazards.
- ER recommends that licensees also comply with *The Prairie and Forest Fire Act* in un-forested areas where there is a fire hazard associated with flare and incinerator operations.
- In certain circumstances, ER may consider variances in flare and incinerator spacing requirements:
  - ER discourages variance requests for new facilities.
  - Existing well site equipment spacing waivers in effect prior to the effective date of this Guide are maintained.
  - Licensees requesting a spacing variance must first consult relevant codes and engineering practices and provide related information in support of the variance request.

### **2.2.11 Compliance with Fire Bans**

Information on fire bans can be obtained from Saskatchewan Environment's Web site at <http://www.environment.gov.sk.ca/>

## GLOSSARY

“**0.01 mol/kilomol**” mean 0.1% or 10 parts per million.

“**10 mol/kilomol**” mean 1 % or 10,000 parts per million.

“**[xxx]**” means concentration of a molecule. For example [H<sub>2</sub>S] means concentrations of hydrogen sulphide.

“**acid gas**” means gas that is separated in the treating of solution or non-associated gas that contains hydrogen sulphide (H<sub>2</sub>S), total reduced sulphur compounds, and/or carbon dioxide (CO<sub>2</sub>).

“**and**” means comply with all of the listed items.

“**associated gas**” means gas that is produced from an oil reservoir. This may apply to gas produced from a gas cap or in conjunction with oil.

“**edge of the lease**” means:

- perimeter fence;
- at the lease berm;
- at the edge of the lease; or
- whichever is the lesser of the three.

“**flame type equipment**” means open flame equipment, other heating device or electrical device that has open ignition and/or it could potentially cause a fire or explosion. For the purpose of equipment spacing, flame type equipment includes, but is not limited to, steam boilers, free water knock-outs, dehydrators, generators, heaters, treaters, diesel engines without automatic air shut offs and heated water tanks on a skid.

“**fugitive emissions**” Unintentional releases of gas resulting from production, processing, transmission, storage, and delivery.

“**internal combustion engine exhaust**” means exhaust from gasoline engines, diesel engines with air shut-offs, natural gas engines, propane engines and their respective exhaust gases and free liquids. It does not include diesel engines with no air shut-offs. There are no spacing requirements applicable to internal combustion engines. The exhausts from these engines must be placed away from an oil and gas wellhead, a minimum distance of 6 metres. The exhausts from these engines must be pointed away from the wellhead, either by orientating the exhaust vertically up or pointing it in the opposite direction from the wellhead. Connecting engine exhaust to a wellhead is strictly prohibited.

“**natural gas booster compressors**” means a compressor that is portable with trailer or skid mounts and does not have a permanent concrete footing and does not exceed 250 horsepower. The natural gas booster compressors must be installed a minimum of 23 metres from a wellhead. These compressors must comply with the requirements of the Ministry of Energy and Resources Guideline for Natural Gas Booster Compressors.

**“non-associated gas”** Gas produced from a gas pool (i.e., not associated with oil or bitumen reservoirs or with production).

**“non-routine flaring, venting, incinerating”** Intermittent and infrequent events such as planned maintenance, process upsets, and emergencies that result in flaring, venting, or incinerating.

**"oil and gas site"** means any sites or facilities associated with oil and gas exploration, recovery, production, processing, transmission, transportation, treatment and/or disposal. It includes waste processing facilities but it does not include refineries or upgraders.

**"opacity"** means the degree expressed as a percentage to which an air contaminant obstructs the passage of light and obscures the view of an object in the background.

**“licensee”** means licensee of the well or facility.

**"or"** means comply with one of the items.

**"primary production facility"** means all upstream oil and gas facilities and any other oil and gas sites, including but not limited to gas wells, oil wells, water source wells, disposal wells, Enhanced Oil Recovery projects (steam, water, fire, CO<sub>2</sub>, solvent floods) and waste processing facilities.

**"primary liner"** means the upper most liner that covers all of the area within the dyke and it is keyed into the dyke walls or incorporated into the dyke wall.

**"produced products"** means upstream oil and gas products (unrefined), byproducts, wastes and materials contaminated with produced products. They include, but are not limited to, crude oil, condensate, drilling fluids, drilling waste, frac fluids, frac sands, liquid petroleum gas, oily byproduct, produced water, produced sand and any other material contaminated with produced products.

**"process equipment"** means any non-flame type equipment used in the upstream petroleum recovery or treatment process such as amine tank, pop tank, scrubber, sweetener and separator. Process equipment generally does not have a permanent footing.

**“routine flaring, venting, incinerating”** applies to continuous flaring, venting, and incinerating.

**“S-01”** means *The Saskatchewan Upstream Petroleum Industry Storage Standards*.

**“separator”** means an apparatus for separating liquid and gas at the surface as they are produced from a well.

**"sour gas"** (for purpose of section 2.2) means natural gas containing hydrogen sulphide (H<sub>2</sub>S) concentrations equal to or greater than 0.01 moles per kilomole (10 PPM, 0.001%).

"**storage**" means holding of material produced, generated and used by the upstream petroleum industry for a period of time until the products, byproducts or wastes are transported, treated or disposed.

"**storage area**" means a segregated area of an operating facility that is used to store materials produced, generated and used by the upstream petroleum industry in containers and/or tanks and includes all land and associated structures.

"**storage facility**" means a facility dedicated to the storage of materials produced, generated and used by the upstream petroleum industry in containers and/or tanks and includes all land and associated structures.

"**shallow gas operation**" means any operation in Saskatchewan Area Three conducted specifically for the production of natural gas and producing from no lower than the Medicine Hat formation.

"**specified**" means written or verbal requirements provided by appropriately authorized or delegated person.

"**sulphur emissions**" For the purposes of this Guide, this includes all air emissions of sulphur-containing compounds, including SO<sub>2</sub>, H<sub>2</sub>S, and total reduced sulphur compounds (e.g., mercaptans). Sulphur emissions from flare stacks are expected to be primarily in the form of SO<sub>2</sub>, with minor amounts of other compounds.

"**tank**" means a device designed to contain materials produced, generated and used by the upstream petroleum industry which is constructed of impervious materials that provides structural support.

"**treater**" means an apparatus for separating oil, gas and water at the surface as they are produced from a well.

"**upstream facility**" means all wells and facilities including oil and gas production sites, pipelines, flowlines and associated equipment, satellites, batteries, metering stations, compressor stations, pump stations, truck unloading stations, and gas plants.

"**venting**" The intentional controlled release of un-combusted gas.

### **2.2.1. Flare System Standards**

The licensees shall design, operate and maintain flare systems to safely destroy the collected gas. Wherever possible the licensee shall adopt the most current industry recommended practices such as CAPP Recommended Practices for Flaring of Associated and Solution Gas at Oil Production Facilities and in API Recommended Practice 521, Section 4, "Selection of Disposal Systems."

Industry must comply with the following requirements for flare systems installed at well sites, oil batteries, gas batteries, and gas processing plants unless the licensee has a permit from the relevant provincial and/or federal authority exempting them from these requirements or has provided mitigative measures to minimize the harm to the health and safety of the public, properties and the environment to the satisfaction of ER. All licensees should strive to design and operate flare systems that meet or exceed a combustion efficiency of 98 percent and an opacity of less than 40 per cent average over six consecutive minutes or does not generate black smoke over six consecutive minutes. Where a significant or repeated complaints (verifiable by site visit) are received regarding a specific site, SEM may require the licensee to meet and maintain the above specified CE and opacity.

All new flare systems (installed after April 1, 2002) shall be designed and operated in the following manner:

- A flare system shall be designed and operated with the following ignition features:
  - A flame must be present whenever hydrocarbon vapour, acid gases or sour gas are directed to flares. Intermittent sour gas flares must have a reliable pilot light and/or automatic ignition device to ensure continuous ignition of gas directed to the flare.
  - Manual flare ignition may be accepted for blowdown stacks or flares installed for maintenance purposes where no continuous gas flow exists or where no automatic relieving systems are connected to the stack.
- A flare system shall be designed and operated to provide a stable flame by implementing the following:
  - Sufficient fuel shall be added to the flare system to ensure stable and efficient combustion.
  - Flare stacks shall be designed or evaluated by a qualified professional. Design and evaluation shall take in to account the flare performance based on stack diameter, heating value of the combined flare gas stream, stack exit velocity, local wind velocities, and other stack design features to ensure efficient and stable combustion. These flare systems may be operated at combined heating values of 12 MJ/m<sup>3</sup> or greater. (Heating values refer to the lower or net heating value determined on a water-free basis at 15°C and 101.325 kPa (kiloPascal)).

- In the absence of above evaluations, the flare system shall be operated at minimum combined heating value of 20 MJ/m<sup>3</sup> or greater.
- Flare system must have sufficient exit velocity or be equipped with wind guards to prevent wind from extinguishing the flame. As a guideline, a flare will be relatively stable if stack exit velocities are between 1m/s to 18 m/s. Higher exit velocities, up to 122 m/s, may also be acceptable. The following equations can be used to calculate the maximum flare stack exit velocity.

**Steam and non-assisted flares:  $\text{Log}_{10}(V_{\text{max}}) = (\text{HT} + 28.8) / 31.7$**

**Air assisted flares:  $V_{\text{max}} = 8.706 + 0.7084(\text{HT})$**

**where:  $V_{\text{max}}$  = maximum flare stack exit velocity in m/s**

**$\text{HT}$  = net flared gas or lower heating value in MJ/m<sup>3</sup>**

**Title 40, U.S. Code of Federal Regulations, Part 60.18.**

- A flare stack shall be designed to meet the following height requirements, unless otherwise approved by SEM:
  - Flare stacks must be designed so that the maximum radiant heat intensity at ground level does not exceed 4.73 kW/m<sup>2</sup>. Ground-level radiant heat determinations shall be based on calculation procedures outlined in API Recommended Practice 521, Section 4.4.2.3, or GPSA Engineering Data Book (11th edition), Section 5.
  - Flare stacks located within a distance equivalent to five times the height of the existing third-party building(s) must have a height of at least 2.5 times the height of the highest building.
  - Flare stacks for acid gas or sour gas containing more than 10 moles of H<sub>2</sub>S per kilomole of gas must have a height of at least 12 meters above ground level or greater, as may be required by above calculations.
- A flare system must employ the following liquid separation features:
  - Under no circumstances are flare pits to be constructed after January 1, 2002. For facilities constructed prior to this date, flaring is allowed until January 1, 2004, provided that there is no potential for produced liquids to enter the pit. All flare pits must be decommissioned by January 1, 2004. Specifically, a decommissioning plan (environmental assessment and clean-up schedules), shall be submitted to SEM by January 1, 2004. The contaminated soils in the open pit(s) shall be excavated and the area remediated to SEM's requirements by January 1, 2005, unless otherwise approved in writing by SEM. We encourage all licensees to remediate all known buried pits as soon as practical. Where this is not possible, the licensee shall submit a decommissioning plan for a known buried pit within one year after the identification of the pit. The pit then must be remediated within a year after the submission of the plan, unless otherwise approved in writing by SEM. Where the known buried pit is causing contamination off-lease or impacting the environment in a significant manner (as interpreted by SEM), the licensee may be ordered by SEM to immediately excavate contaminated materials and remediate the pit.
  - Entrained liquids in flare stream reduces combustion efficiency and contribute to increased emissions of total reduced sulphur compounds, hydrocarbons and products of incomplete combustion. To reduce and/or eliminate these effects, SEM requires the following:

- If liquids are present in the flare gas stream, properly designed liquid separation equipment shall be installed in the flare systems.
- The liquids separation equipment must be designed:
  - To provide adequate separation of liquid and large liquid particles entrained in the gas;
  - To have sufficient holding capacity for normal and upset conditions;
  - In a manner that the ability of the vessel to separate liquids from the gas stream is not impaired at the maximum design liquid level;
  - To ensure that no re-entrainment of separated liquids will occur at maximum expected flare gas flow rates; and
  - With visual level indicators, high-level alarms, or operating procedures to ensure that the liquid retention in the vessel will not exceed the maximum holding capacity.
- The flare system piping and other piping related to the liquids control system must be engineered to prevent retention of liquids by ensuring that piping is sloped to drain to separators and to avoid low-point liquid traps.
- The flare system and separator or knockout drum must be designed and operated to ensure that effectiveness will be maintained under all operating scenarios and weather conditions (e.g., freeze protection is required).
- Flare separator or knockout drums used for liquid storage must be designed and operated to meet the requirements, in this document.
- Spacing Requirements
  - Flare stacks must be located at least 100 m away from an occupied residence.
  - Flares must be located, designed, and operated so that no hazard to public property will be created. Flares must be located at least 100 m away from surface improvements, with the exception of surveyed roadways.
  - Flares must meet the equipment spacing in Appendix 2.
  - The following fire prevention steps should be implemented:
    - Areas within 30 m of flare pits must be cleared of all combustible debris.
    - Clear, bare mineral soil surface must be maintained within 8 m of flare pits.
    - In forest areas, flare stacks must be located at least 2.5 times the stack height from combustible debris or otherwise specified by the regulatory agency responsible for the crownland.

Existing flare stacks (installed prior to April 1, 2002) do not required to be immediately upgraded to the above standards if they are properly operated, and there are no significant/repeated complaints (verified by a site visit), unless otherwise ordered by SEM. Existing flare stacks must meet the following minimum operating requirements:

- Existing flare stacks with an established history of stable operation and minimal odour complaints is permitted to operate the flare system with combined flare gas heating values of 12 MJ/m<sup>3</sup>.
- Existing flare stacks with a history of flame failure or odour complaints shall operate the flare system with a combined flare gas heating value of 20 MJ/m<sup>3</sup>. The licensees may be allowed to reduce the combined flare gas heating value to 12 MJ/m<sup>3</sup> if they implement modification to increase flame stability.

- Implement a reliable ignition system.
- Employ equipment spacing and fire prevention steps as specified above.

SEM expects all licensees to develop a reasonable timeline based on risk and other practical factors to upgrade their existing flare stacks to the new standards. This will assist the licensee to develop an upgrade schedule that meets their needs in a dynamic operating environment. Our department will maintain a close watch on the progress of industry's performance on their flare stack upgrades. If there is a perceived abuse of our policy or general lack of compliance, SEM will implement an immediate and definitive upgrade schedule for existing flare stacks.

## **Regulatory Contact List**

### **Ministry of Energy and Resources**

#### **Head Office**

200, 2101 Scarth Street, Regina, S4P 2H9

#### **Petroleum Development Branch**

Technical Inquiries on Directive S-20	(306) 787-9322
Technical Inquiries on the Storage Standards	(306) 798-3083
Fax	(306) 787-2478

#### **Petroleum Development Branch Field Offices**

##### **Flaring and Incineration Emission Inquires, Notification or Complaints**

#### **Estevan**

P.O. Box 5000, 1219 - 5<sup>th</sup> Street, Estevan, S4A OZ1

General Inquiry	(306) 637-4541
Regional Area Manager, Dean Pylypuk	(306) 637-4542
Fax	(306) 637-4547

#### **Kindersley**

P.O. Box 850, 113 2<sup>nd</sup> Avenue E. Kindersley, SOL 1S0

General Inquiry	(306) 463-5400
Regional Area Manager, Kirk Hogarth	(306) 463-5402
Fax	(306) 463-5404

#### **Lloydminster**

4815 - 50<sup>th</sup> Street, Lloydminster, S9V OM8

General Inquiry	(306) 825-6434
Regional Area Manager, Gary Ericson	(306) 825-6436
Fax	(306) 825-6433

#### **Swift Current**

P. O. Box 5000, 350 Cheadle St. W., Swift Current, S9H 4G3

General Inquiry	(306) 778-8252
Regional Area Manager, Ron Dolter	(306) 778-8253
Fax	(306) 778-8256