# Manitoba

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## Information on Solution Gas Flaring Emissions in the Tilston Area

There have been a number of concerns expressed by residents of the Tilston area regarding emissions from the oil battery located at 8-8-6-29 (WPM). The Petroleum and Energy Branch, Manitoba Energy and Mines in conjunction with Manitoba Environment have actively investigated complaints regarding emissions from the 8-8 battery for the past two years. In investigating potential impacts of solution gas flaring the considerable data and experience developed in Alberta, where solution gas flaring is much more common, has been drawn upon.

Recent articles and letters appearing in the media contain some inaccurate information. The following series of questions and answers are designed to address concerns raised by the public.

**How much solution gas is flared at the 8-8 battery?**

Gas production at the 8-8 battery varies as a function of oil production. There are approximately 17.5 cubic metres of gas dissolved in a cubic metre of oil. The dissolved gas is liberated from the oil during production and processing. When the gas is liberated from the oil, some of the gas that is in contact with the produced water will dissolve in the water.

Over the past two years daily gas production has varied between 970 and 2300 cubic metres. Tundra Oil and Gas Ltd., the battery operator, estimates that 95% of the produced gas is burned as fuel in the treater, a process vessel where heat is used to separate the oil, water and gas streams. After processing a small volume of gas remains dissolved in the oil and water in the storage tanks. Any gas that is released in the storage tanks is directed to the flare stack. Over the past two years the daily volume of gas flared has varied between 49 and 115 cubic metres.

**Is solution gas flaring permitted in Alberta?**

In Alberta there are over 5200 batteries where solution gas is flared. Based on a study by the Alberta Research Council, 70% to 80% of these batteries flare more gas than the 8-8 battery.

**Are there other alternatives to flaring the solution gas?**

Due to the small volume of gas flared at the 8-8 battery, there are no economic alternatives to flaring. In other provinces extensive gas gathering systems allow small volumes of gas to be economically gathered, processed and sold. Other options such as re-injecting the gas into the producing formation are not economically feasible at the 8-8 battery.

**How efficient is solution gas flaring?**

The Alberta Research Council conducted a study of flaring at two oil batteries. The study found that combustion efficiency of flare stacks at these batteries ranged from 66% to 84%. Tundra has estimated the overall combustion efficiency at the 8-8 battery is 98%. The reason for the high efficiency is that the majority of produced gas is burned at high temperatures under controlled conditions in the treater at an estimated combustion efficiency of 99%. The combustion efficiency of the flare stack has been estimated at 85%, similar to the combustion efficiency of 84% determined for the sour oil battery in the Alberta Research Council study. The flare efficiency is estimated to be at the upper end of the range observed in the study because the flare stack at the 8-8 battery already meets proposed new guidelines outlined in the following paragraph.

**Can solution gas flaring efficiency at the 8-8 battery be improved?**

The Clean Air Strategic Alliance in Alberta recently released a report recommending new guidelines for flare stacks to improve the efficiency of flares. The flare stack at the 8-8 battery already meets or exceeds these proposed guidelines.

a. A minimum heating value for gas directed to a flare. The heating value of gas produced at the 8-8 battery exceeds the minimum.

b. A flame must be present whenever gas is directed to the flare. The 8-8 battery has both a propane pilot and a backup auto-ignition system that ensures a flame is present.

c. Liquid hydrocarbons are not to be directed to a flare. The flare system at the 8-8 battery has a liquid knock-out drum to remove any liquid hydrocarbons from the gas stream before flaring.

d. Visible emissions released from a flare shall not exceed an opacity of 40% averaged over a period of 6 minutes. The flare at the 8-8 battery burns with a lazy yellow flame approximately 0.5 m in length with a small amount of black smoke. The opacity of emissions from the flare at the 8-8 battery has been estimated by Manitoba Environment to be between 10% to 20%.

e. Flares must be designed so that ground level concentrations of emissions meet air quality guidelines. Offsite monitoring by environmental consultants, the Branch and Manitoba Environment indicates, since July 22, 1998, air quality guidelines for sulphur dioxide have been met 99.96% of the time.

**What is the composition of produced gas at the 8-8 battery?**

The gas produced at the 8-8 battery contains methane – 5.5%, ethane – 3.9%, propane – 8.8%, butane – 6.5% and minor amounts of other hydrocarbon compounds – 3.1%. The gas also contains nitrogen - 48.6%, carbon dioxide - 14.0% and hydrogen sulphide - 9.5%. The presence of hydrogen sulphide results in the produced gas being referred to as "sour gas".

**What kinds of emissions result from burning produced gas at the battery?**

The combustion or burning of produced gas at the battery involves the interaction of oxygen in the air and hydrogen, carbon and sulphur in the produced gas. When the produced gas is burned water vapor, carbon dioxide and sulphur dioxide are the primary end products or "products of combustion". Nitrogen and carbon dioxide, which together account for over 60% of the produced gas, are inert and do not burn.

The Alberta Research Council study found that when sour gas is flared at a combustion efficiency of less than 100%, the products of combustion include a variety of sulphur compounds including hydrogen sulphide and a large number of different hydrocarbon compounds in very low concentrations. These different hydrocarbon compounds are collectively referred to as "volatile organic compounds".

**Are there other sources of these kinds of emissions?**

Yes, there are sulphur dioxide emissions from industrial and non-industrial sources in all sectors of the economy. In 1995, sulphur dioxide emissions in Manitoba averaged 1,000 tonnes per day, the majority of which was emitted by the mining industry. The 8-8 battery emits less than 0.5 tonnes of sulphur dioxide per day.

The emission of volatile organic compounds occurs whenever hydrocarbon gases or liquids are burned at less than 100% efficiency. The burning of natural gas, propane and wood for space heating and the burning of gasoline and diesel in cars, trucks and farm equipment are common sources of emissions of both volatile organic compounds and sulphur dioxide. In 1995, over 475 tonnes per day of volatile organic compounds were emitted by industrial and non-industrial sources in Manitoba.

**If all the produced gas at the battery is burned, why are there still hydrogen sulphide gas odours in the area surrounding the 8-8 battery from time to time?**

Oil produced at the 8-8 battery is transported by truck to Cromer for delivery to the Enbridge Pipeline System (formerly IPL). The Branch suspects that most of the recent complaints related to hydrogen sulphide odours from the battery are "fugitive" emissions that occur during the loading and transportation of oil. Other possible sources of occasional hydrogen sulphide emissions are well workovers, routine battery repairs and maintenance, equipment malfunctions and oil spills.

**Do emissions from the 8-8 battery disperse in the atmosphere?**

Two physical processes act on the plume of emissions from the battery to dilute the concentration of emissions. First, the plume has buoyancy, which causes it to rise and mix with

the atmosphere. This buoyancy is due to both the plume's velocity and its higher temperature compared to the surrounding atmosphere.

Secondly, the surrounding atmosphere acts upon the plume to dilute and disperse the emissions. This mixing of the plume in the atmosphere decreases the concentration of emissions within the plume. Any wind present in the atmosphere will affect the plume's direction of travel and the amount of air mixed into the plume.

The degree to which emissions in the plume will be diluted and dispersed depends on the amount of mixing or turbulence in the atmosphere. Under windy or sunny conditions, which increase the turbulence in the atmosphere, the plume readily mixes and disperses. During very stable, calm atmospheric conditions which may occur at night or with very cold atmospheric temperatures, it is possible for the plume to remain relatively stable over longer distances. Even under these very stable conditions, however, dilution of emissions in the plume will still occur due to the initial buoyancy effects and mixing of air into the plume as it travels.

**Does the province have air quality guidelines for emissions from the battery?**

While emissions criteria have not been established specifically for oil batteries, Manitoba does have air quality objectives and guidelines that set out maximum acceptable levels of compounds in the air to provide adequate protection for soils, water, vegetation, materials, animals, visibility, personal comfort and well-being. The 1-hour maximum acceptable level for sulphur dioxide is 0.34 parts per million (ppm) and for hydrogen sulphide is 0.011 ppm. Emission levels of volatile organic compounds are addressed on a case to case basis.

**Have emissions from the battery been monitored to ensure provincial air quality objectives and guidelines are being met?**

Since complaints were first received regarding hydrogen sulphide and sulphur dioxide emissions from the 8-8 battery, the Petroleum and Energy Branch has carried out intermittent monitoring for hydrogen sulphide and sulphur dioxide at the battery and in Mr. Bill Campbell’s yard and house. At no time have we measured any hydrogen sulphide or sulphur dioxide concentrations.

An environmental consulting firm from Alberta has also carried out monitoring for Tundra Oil and Gas Ltd. The consultant monitored for hydrogen sulphide, sulphur dioxide, nitrogen dioxide and total hydrocarbon gas (volatile organic compounds) over a 4-day period in June 1998. The monitoring recorded trace levels of hydrogen sulphide at the battery that were eliminated when a leaking tank seal was repaired. No hydrogen sulphide was detected within a 500-m radius of the battery. No sulphur dioxide was detected at the battery, or within a 500-m radius of the battery. The consultant notes that "this is not surprising, as sulphur dioxide is generally a hard gas to detect due to its buoyancy and ability to easily disperse into the atmosphere after being burned". The consultant also monitored in Mr. Campbell’s yard and no hydrogen sulphide or sulphur dioxide was detected. The consultant did not detect any nitrogen dioxide or volatile organic compounds.

Manitoba Environment installed a monitor in Mr. Campbell’s yard on July 22, 1998 to continuously measure sulphur dioxide levels. The monitor has recorded sulphur dioxide readings on 9 occasions. The readings occurred over a two-week period in August. The readings on these occasions were unusually high, 0.45-10 ppm sulphur dioxide, and of a short duration, lasting an

average of 8 minutes. The nature of these reading suggests a more localized source of sulphur dioxide than the 8-8 battery. No other readings have been recorded since August. Based on the results of monitoring in Mr. Campbell's yard over the past 5 months, the measured sulphur dioxide concentrations have exceeded the provincial air quality objective on only four occasions. Manitoba Environment plans to continue to monitor for sulphur dioxide until early in the new year.

In addition, in the vicinity of the 8-8 battery, sulphur dioxide has been detected on occasion by Manitoba Environment, using less sophisticated measurement techniques, at levels below the provincial air quality objective for sulphur dioxide.

**What other efforts have been made to evaluate the potential impacts of emissions from the 8-8 battery?**

The Petroleum and Energy Branch has also done air dispersion modelling to determine the impact of sulphur dioxide emissions from the 8-8 battery on air quality. The computer model predicts the maximum 1-hour average sulphur dioxide concentration at ground level at various distances downwind of the battery. The model predicted a maximum sulphur dioxide concentration of 0.15 parts per million, 287 m downwind of the battery, well below Manitoba's acceptable air quality level of 0.34 ppm. At greater distances from the battery the sulphur dioxide concentration in the model decreases. At a distance of 1.6 km from the battery the model predicted a maximum sulphur dioxide concentration of 0.069 ppm.

Battery gas production was increased by 100 times in the model to evaluate the level of sulphur dioxide emissions. At 100 times the actual battery gas production, the maximum sulphur dioxide concentration was still 20% below Manitoba's acceptable air quality limits.

**Are emissions from the 8-8 battery harmful to humans and animals?**

Alberta Health completed a study in 1998 entitled "Assessment of Respiratory Disorders in Relation to Solution Gas Flaring Activities in Alberta". The study attempted to establish a relationship between areas where flaring occurs and respiratory disorders including asthma, bronchitis, pneumonia and infections. The study found "no obvious correlation between flaring activities and physician claims, or visits to doctors by residents of oilfield regions".

A study was recently released in Alberta on the effects of exposure to emissions from 231 licensed sour gas processing facilities on livestock at nearly 7,000 beef cattle and dairy operations between 1985-94. The study found little evidence of negative effects on cow and calf health or on milk production. The author reported "there was nothing to suggest that sour gas, sulphur dioxide or solution gas flaring emissions were associated with a number of health or productivity outcomes (twinning, adult cow or calf mortality and stillbirths)".

**Can individuals experience health problems from exposure to hydrogen sulphide and sulphur dioxide?**

Occupational exposure limits for workers exposed to hydrogen sulphide and sulphur dioxide have been established by industrial standards. During a conventional 8-hour workday, a worker can be exposed to an average concentration of 10 ppm hydrogen sulphide and 2 ppm sulphur dioxide without adverse health effects.

It is recognized that the concentrations at which these gases affect a person, varies from individual to individual. Hydrogen sulphide can be detected at concentrations as low as 0.009 ppm, eye irritation can occur at concentrations of 10 ppm. Other health effects that appear with increasing hydrogen sulphide levels include headaches (about 15 ppm) and irritation of nose and throat (about 50 ppm).

Sulphur dioxide, which is an irritant, causes the airways from the nose to the lungs to constrict making it more difficult to breathe. Individuals who are asthmatic or exercising are more sensitive than normal individuals. For normal individuals, effects may appear with short exposures above about 1 ppm. For asthmatics, effects may appear after exposures as low as 0.40 ppm for five minutes.

**What does the Petroleum and Energy Branch and Manitoba Environment conclude from their investigation of emissions from the 8-8 battery?**

The Branch and Manitoba Environment have obtained what they believe to be reliable data on the environmental performance and impacts of the battery. The results of air quality monitoring to date would suggest that the 8-8 battery is not likely the source of hydrogen sulphide or sulphur dioxide air quality problems at Mr. Campbell's farm.

**If you any questions** on this informational notice please contact the undersigned or John N. Fox, Chief Petroleum Engineer at (204) 945-6573 and (204) 945-6574, respectively.

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L. R. Dubreuil, Director