BEST MANAGEMENT PRACTICES
FOR THE CONTROL OF BENZENE
EMISSIONS FROM GLYCOL DEHYDRATORS

Working Group on Benzene Emissions
From Glycol Dehydrators

November 1997

BENZENE EMISSIONS CRITERIA

The Canadian upstream oil & gas industry is committed to minimizing health risks related to benzene emissions from glycol dehydrator operations through a continued reduction of benzene emissions, and a target of 90% reduction from the 1995 national emissions baseline (estimated 9000 tonnes/year) by January 1, 2005. The following are presented as emission control criteria set forth by the Working Group on Benzene Emissions from Glycol Dehydrators.

- ***By January 1, 1999: Reduction of Emissions at "High Emission" Facilities***

Benzene emissions from existing glycol dehydrators will be controlled to 9.0 tonnes per year or less by January 1, 1999. The most urgent requirement is to reduce emissions from glycol dehydrators that currently emit more than 9 tonnes per year. It has been estimated that the 7% of glycol dehydrators with benzene emissions greater than 9 tonnes/year account for 41% of total Canadian glycol dehydrator benzene emissions. This criteria will only affect operators of existing facilities that emit more than 9 tonnes of benzene/year.

- ***By January 1, 2001: 3.0 Tonnes/Year at "Close Proximity" Facilities***

Benzene emissions from existing glycol dehydrators located within 0.75 kilometres of permanent residences or public facilities will be controlled to 3.0 tonnes per year by January 1, 2001.

- ***By January 1, 2001: 5.0 Tonnes/Year at Other Existing Facilities***

Benzene emissions from existing glycol dehydrators located more than 0.75 kilometres from permanent residences or public facilities will be controlled to 5.0 tonnes per year by January 1, 2001.

- ***Effective January 1, 1999: 3 Tonnes/Year for New Glycol Dehydrators***

New glycol dehydrators will be designed and operated to control benzene emissions to 3.0 tonnes per year or less. Any glycol dehydrator that is commissioned or relocated after January 1, 1999 is a "new glycol dehydrator". All other glycol dehydrators are "existing glycol dehydrators". Glycol dehydrators commissioned or relocated between January 1, 1999 and January 1, 2001 will be grandfathered should the criteria change after January 1, 2001. That is, these units will not be subject to new control requirements that would require new capital investments.

- ***Effective January 1, 2001: Lowest Level Practical for New Glycol Dehydrators***

New glycol dehydrators commissioned after January 1, 2001 will be expected to have benzene emissions controlled to the lowest level that can be practically achieved. This level may be determined based upon what is learned during the first three years of the program.

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1. INTRODUCTION

This document was prepared by the Working Group on Benzene Emissions from Glycol Dehydrators, with the following objectives:

- to promote effective management of emissions from glycol dehydrators in Canada, particularly benzene emissions;
- to promote awareness of human health risks and risk controls associated with exposures to benzene, in both workplace and domestic environments; and
- to promote adoption of emission control and reporting criteria by the natural gas industry in Canada.

1.1 BACKGROUND

The natural gas industry uses glycol dehydrators to remove water from natural gas. The main reason for this application is to enhance the properties of the raw natural gas as a saleable commodity. The dehydration process also helps to prevent corrosion and hydrate formation in pipelines.

Recent estimates indicate that there are about 3500 glycol dehydrators currently in service in Canada. Table 1 (below) provides an indication of the distribution of these glycol dehydrators based on a survey made in 1996.[i] The majority of the units are installed in rural environments. The units are typically unmanned / unattended, and emissions are not regularly monitored.

The document is intended for use by management, engineering, and field operations personnel in the industry. It provides guidance on how to consider potential benzene emissions during:

- decision-making (where and when to install dehydration);
- project planning;
- engineering and safety design;
- operation conditions; and
- maintenance procedures.

Table 1
Distribution of Glycol Dehydrators (1996)

	BC	Alberta	Sask.	Other	Total
# of Companies reporting	25	86	19	6	93
# of Dehydrators operated					
Well site	213	1485	58	1	1757
Compressor	86	421	60	0	567
Battery	22	127	2	0	151
Gas Plant (TEG)	17	163	11	7	198
Gas Plant (EG)	5	156	1	0	162
Gas Storage	2	58	36	8	104
Totals	*345*	*2410*	*168*	*16*	*2939*

The issue of air emissions from glycol dehydrators has only been identified in the past few years. Many operators in the Canadian natural gas industry have recently begun to assess their dehydrator(s) from this perspective. As a result, emission controls have been installed on a number of glycol dehydrators in Canada. Work for, and by, the Canadian Association of Petroleum Producers (CAPP), the Canadian Gas Association (CGA), and the Small Explorers & Producers Association of Canada (SEPAC), has brought increased attention to glycol dehydrators.

Emission controls such as condensers, flare stacks, and incinerators for still column vent vapours have been installed by industry at some locations. Member companies from the Canadian Association of Petroleum Producers (CAPP) have also reported the use of other approaches such as piping the still column vent emissions to tankage (for condensation) and installing flash tanks for collecting non-condensable vapours. In general, emissions from glycol dehydrators can be reduced by:

- optimization of operations;
- equipment modifications or replacement; and/or,
- addition of emission control equipment.

Emission reduction opportunities are site-specific. Operational and equipment options may be applied singularly or in combination. Factors considered include weather, location (i.e. remoteness), operation (i.e. automation), hydrate control (for efficiency / market value), throughput, gathering system, and economics.

1.2 WORKING GROUP ON BENZENE EMISSIONS FROM GLYCOL DEHYDRATORS

Under the Canadian Environmental Protection Act (CEPA), a Priority Substances List Assessment Report classified benzene as carcinogenic to humans, and designated benzene as “toxic” as defined under CEPA.[ii] Environment Canada formed the Working Group on Benzene Emissions from Glycol Dehydrators in early 1995. The Working Group was composed of representatives from government, industry, and environmental organizations (see Appendix C for membership listing).

On July 24, 1995, the Minister of the Environment announced that federal action on regulations limiting benzene releases would be accelerated. Part of this announcement was a directive to produce regulations that would control emissions of benzene from natural gas dehydrators. Other specific initiatives included:

- national fuel standards for the production of gasoline;
- codes of practice for the distribution of gasoline;
- Responsible Care7 programs (Canadian Chemical Producers Association) for various processes in the chemical industry;
- ongoing consultations with the steel industry; and,
- Canadian Standards Association (CSA) standards for wood stove construction and installation.

Initially, the Working Group sought to compile information on the number, distribution, and emissions associated with glycol dehydrators in Canada. Accordingly, the Working Group evolved toward developing a strategy for controlling benzene emissions and reducing associated health risks to nearby people. It was decided that a non-regulatory program would be administered as the most effective way to address this particular issue. In essence, the program would be maintained by industry and monitored by the government. This voluntary approach would be given the opportunity to succeed or fail, and would be subject to replacement by regulations should it not succeed after a pre-determined time period.

2. HEALTH EFFECTS OF EXPOSURES TO BENZENE EMISSIONS

2.1 CHEMICAL – PHYSICAL PROPERTIES

Benzene (CAS # 71-43-2) is a simple aromatic or “ring-shaped” hydrocarbon. A short list of physical and chemical properties[iii] for benzene is provided below in Table 2.

Table 2
Physical-Chemical Properties of Benzene

Property	Value	Notes
Freezing Point	5 °C	Higher than water.
Boiling Point	80 °C	Lower than water.
Density	0.8 g/mL @ 20 °C	Liquid benzene will float on water.
Vapour Pressure	10 kPa @ 25 °C	Strong tendency to evaporate to air.
Half-life Degradation (air)	0.1 to 20 days	Degraded by sun and other chemicals.
Flammability	Extreme	Use caution with all ignition sources.

2.2 LONG – TERM (CHRONIC) EXPOSURE

Fatalities from human exposure to high concentrations of benzene have been documented since the early 1900s. Since then there has been an increasing focus on the impacts of benzene at ever lower levels of exposure. Human (epidemiological) studies have shown correlations between workplace exposure to benzene and the onset of certain forms of leukaemia, and at the same time there has been an increased understanding of the mechanisms by which benzene exerts its toxic effects.

The main route of exposure to a person is through inhalation. Once inhaled, benzene is either exhaled or absorbed into the blood. The benzene that is absorbed into the blood is distributed throughout the body and processed into a form that is more easily excreted. Some of the by-products of this can be toxic to bone marrow and produce blood disorders such as anaemia and leukaemia.[iv]

Acute Non-Lymphocytic Leukaemia (ANLL) is the only form of cancer associated with benzene exposure in the workplace. The risk of developing a benzene-related illness increases with the intensity, frequency, and duration of exposure. A study by Rinsky et al.[v] compared cumulative worker exposure to calculated indicators of leukaemia mortality. The results suggest that exposures to 120,000 $\mu g/m^3$ (40,000 ppb) per year over a 40 year period strongly correlates to the incidence of leukaemia.

Table 3 summarizes predicted values[13] for downwind concentrations given various benzene release rates. These values are independent of normal background levels of benzene inherent to the environment.

Table 3
Maximum Annual Benzene Concentrations (in $\mu g/m^3$|ppb)
due to Glycol Dehydrator Emissions

Annual Benzene Emissions Tonnes/year	20 meters from Dehydrator $\mu g/m^3 \mid$ ppb		100 meters from Dehydrator $\mu g/m^3/ \mid$ ppb		500 meters from Dehydrator $\mu g/m^3 \mid$ ppb		1000 meters from Dehydrator $\mu g/m^3 \mid$ ppb	
0.72	16	5.1	3.8	1.2	0.5	0.15	0.15	0.05
3.0	62.3	19.9	14.9	4.8	1.9	0.6	0.6	0.2
4.5	98.6	31.5	23.7	7.6	2.9	0.9	0.9	0.3

Short term (e.g. 8 hour) benzene concentrations may approach or exceed OH&S regulation limits in close proximity (on the facility site) to the glycol dehydrators, depending on wind conditions and dispersion conditions at the facility.[13]

2.3 SHORT – TERM (ACUTE) EXPOSURE

High short-term exposures (greater than 3200 $\mu g/m^3$ (1000 ppb) over an 8-hour period) are unlikely to occur during routine glycol dehydrator operations and worker activities but could conceivably involve inhalation, ingestion, and/or skin contact. Benzene that is absorbed into the blood at extreme concentrations generally affects the brain and, depending on the dose, may lead to symptoms ranging from headaches to irritability to death. Direct skin contact with liquid benzene can cause drying, blistering or an allergic-type reaction (red / itch). If swallowed, benzene can cause irritation of the mucous membranes of the mouth, throat, and stomach. If the liquid is aspirated, severe inflammation of the lungs may result.[vi]

3. CONTROLLING AIR EMISSION FROM GLYCOL DEHYDRATORS

3.1 SELECTING GLYCOL DEHYDRATION

Companies that produce and process natural gas typically employ one of three glycols for dehydration, specifically:

- triethylene glycol (TEG);
- diethylene glycol (DEG); and/or
- ethylene glycol (EG).

Triethylene Glycol (TEG) is the most common type of glycol used. It has the advantage over diethylene glycol (DEG) of a higher boiling point that reduces losses during regeneration. Its low vapour pressure also helps to reduce losses from vapourization into the gas stream. The higher molecular weight of TEG increases its solubility with hydrocarbons and hence it has a higher affinity for benzene. The use of TEG is preferable in processes where the absorber contact temperature is relatively high and the required dewpoint is relatively low.

All types of glycols are regenerated and used as part of a continuous dehydration cycle. TEG units are used throughout the industry at gas wells, gathering stations, and processing facilities. EG is used in low temperature natural gas liquids recovery plants and is conventionally referred to as a hydrate inhibitor. An evaluation of the gas production, gathering, and processing system is required when considering the need for dehydration.

Three factors that determine the need for dehydration are:

- **Process requirements for water content in the gas stream**. Gas sold from a compressor station or gas plant into a transmission or distribution pipeline system must meet the water content and dew point specifications of the pipeline system. Gas produced from a gas well or production facility and taken by a gathering system flow-line to a central production facility prior to sales into a pipeline system, may not need to meet pipeline system specifications. In these cases, installing dehydration at a central production facility may be the best decision.

- **Potential for hydrate formation**. Gas hydrates may form under certain combinations of temperature, pressure, and water content. The need for hydrate protection must be determined on a case by case basis. Hydrate control may be achieved using dehydration, or simply by injecting hydrate inhibitors into the gas stream.

- **Corrosion protection**. Protection of piping, vessels and other equipment must also be evaluated on a case by case basis.

The choice of dehydration, hydrate control and corrosion protection should be evaluated from economic and environmental perspectives. If the need for a glycol dehydrator is established, the design of the unit will depend on factors such as the operating temperature, pressure, water content, gas flow rate (inlet and outlet), and required outlet gas dew point. These variables are all incorporated in equations from GPSA[vii], section 20 (*Dehydration*) that can be used to determine the appropriate type of glycol and flow rate.

One of the main considerations along the entire natural gas transport system is the removal of free water and hence the prevention of hydrate formation. Hydrates can result in ice-like obstructions (plugs) in pipelines affecting the capacity of the lines, cause pressure fluctuations and a build-up of differential pressures across the hydrate plugs. Excessive differential pressures can move hydrate plugs with enough force to cause mechanical damage and pipeline failures. Therefore, formation of hydrates in pipelines may pose a significant risk to people, environment, production, and company assets.[viii]

The following summarizes typical pipeline gas specifications related to the removal of water and prevention of hydrate formation.[ix]

- Gas should be free (at pressure and temperature at the receipt point) of sand, dust, gums or waxes, crude oil, contaminants, impurities or other objectional substances which will render the gas unmerchantable, cause injury, cause damage to, or interfere with downstream facilities.

- Gas should exhibit a hydrocarbon dew point lower than -10°C at operating pressures.

- Gas should exhibit a heating value of 36 mJ/m^3

- Gas shall NOT contain more than: 23 mg/m^3 (16.5 ppm v/v) hydrogen sulphide; 115 mg/m^3 (88 ppm v/v) total sulphur; 2% (v/v) carbon dioxide; 65 mg/m^3 (88 ppm v/v) water vapour. Maximum water content shall be 4 lb/MMSCF of gas.

- Gas shall not exceed 49°C in temperature.

3.2 ALTERNATIVES TO GLYCOL DEHYDRATION

Alternatives are available for hydrate control and dehydration. Selection of alternative processes should be based on an evaluation of capital and operating costs, and emission reductions. Hydrate control, without dehydration, can be achieved through the use of physical separators, chemical inhibitors, or line heaters.

- **Methanol or Glycol Injection.** These chemical inhibitors mix with the water vapour and condensed water and effectively suppress the hydrate temperature of the gas. The selection of the specific chemical depends primarily on the operating (chemical) cost, because both are equally effective as inhibitors for wellhead dehydration applications. However, glycols injected at a well site could be easily recovered if the gas is further processed in a glycol dehydrator at a downstream central location. There is the potential for chemical inhibitors to create excess liquid hold-up in the gathering system which may require routine pipeline pigging.

- **Separator Package.** A separator provides physical separation and removal of free liquids (including water) in the inlet gas stream. This substantially reduces the volume of chemical hydrate inhibitor injection required in the pipeline gathering system.

- **Line Heater.** The use of a line heater elevates the gas temperatures above the temperature at which hydrates form. This option can be used when chemical injection or separator packages are not viable options. Line heaters require the use of insulated pipelines to minimize heat input requirements.

Dehydration can also be achieved using various “processes”.

- **Solid Desiccant / Molecular Sieve Plants.** Solid desiccants are selectively chosen for treating high pressure gases when it is economical to carry out both the water and hydrocarbon (HC) dewpoint controls in a single step process, or when lower water dewpoints must be achieved. The pressure loss is considerably lower compared to the conventional two step processes involving separate dehydration and HC dewpoint control units.

  Molecular sieve plants are usually restricted to low-temperature processes requiring very low water content gas as feeds to turboexpander or other types of cryogenic/refrigeration plants. In such applications the desiccant systems are commonly positioned as polishing (secondary) units downstream of primary liquids recovery plants.

  A variety of solid desiccants are available in the market for specific applications. Some are good only for dehydrating the gas while others are capable of performing both dehydration and removal of heavy hydrocarbon components. However, in both cases, the desiccant beds must be routinely regenerated with heat to liberate contaminants. The physically adsorbed material is released as a gas and typically disposed of by flaring, incineration, or recovered as liquids if economically feasible. Desiccant systems have substantial capital and operating costs.

- **Membrane Technology**. This technology is used for the selective removal of contaminants, such as water from a natural gas stream. Use of the technology can eliminate certain emissions, relative to glycol dehydration. Membrane technology is not currently in use for production-scale gas dehydration.[x]

- **Other Commercial Processes**. There are many commercially available packages for customized dehydration packages. These types of products are often designed to enhance conventional equipment performance. The suitability of these processes should be evaluated on a case-specific basis.

3.3 SOURCES AND CHARACTERISTIC OF EMISSIONS

Benzene occurs naturally in some gas streams. Benzene and other hydrocarbons are absorbed by the glycol in the absorber and the rate of absorption is proportional to the glycol circulation rate. The still column vent is typically the focus of most emission concerns. During heating of the rich glycol in the still column and reboiler, water and hydrocarbons (including benzene) are emitted as vapours from the still column vent. The still column vent can also be the source of methane emissions due to its association with stripping gas.

Operators in the upstream oil & gas industry often purchase standard sized and equipped glycol dehydrator packages for their operations. In the field, companies typically operate the dehydrators at full capacity to optimize performance. Such practices can increase benzene emissions from glycol dehydrators, due to over-circulation of the glycol and unnecessary use of stripping gas. This is especially common for glycol dehydrators at gas wells where gas production rates decline over time.

Although gas driven glycol pumps may emit a significant amount of fuel gas, they are typically not a significant source of benzene emissions. The flash tank may also vent gas, but is not a significant source of benzene emissions. Flash tank vapours are typically connected to the fuel gas system or a flare system, and do not emit directly to atmosphere.

The key parameters[xi] affecting benzene emissions are:

- **Benzene content in inlet gas**. Benzene is present in some but not all natural gas produced in Canada. Where benzene is not present in the inlet gas processed by a glycol dehydrator, there will be no benzene emissions from the still column vent. Where there is benzene present in the inlet gas, the amount of benzene absorbed by glycol is proportional to the concentration of benzene in the gas.

- **Glycol circulation rate**. The amount of benzene absorbed by the glycol is proportional to the amount of glycol circulation.

- **Absorber temperature**. The temperature in the absorber vessel is determined primarily by the temperature of the inlet gas, and to a lesser amount by the temperature of the lean glycol. Higher gas temperatures are associated with higher water content and increased volatility of benzene. Under these conditions, the efficiency of benzene absorption into the glycol is reduced.

- **Absorber pressure**. The absorber pressure is determined by the pressure of the inlet gas. At higher absorber pressures, the amount of benzene absorbed by glycol increases.

- **Gas flow rate**. The amount of benzene absorbed by glycol is affected by the gas flow rate, but the effect is not as great as the other parameters described above.

4. BENZENE EMISSIONS AND EXPOSURES

There are a number of methods available to determine glycol dehydrator emissions and the subsequent dispersion of pollutants. These types of programs are useful for assessing existing conditions and evaluating (or predicting) emission reductions associated with various changes to dehydrator operations and/or emission control equipment.

4.1 GRI-GlyCalc™ VERSION 3.0

GRI-GlyCalc™ Version 3.0[xii] is a Windows-based computer software package that helps predict benzene and other hydrocarbon emissions from triethylene glycol (TEG) and ethylene glycol (EG) dehydration units. Process data inputs required for the program are listed in Table 4.

Table 4
GRI-GlyCalc™ Calculation Parameters

Input Parameter	Source of Data
Wet gas composition	Sample and analysis - commercial laboratory
Wet gas temp. / press.	Gauge readings
Wet gas water content	Measure or assume saturation
Cold Separator (EG only)	Temperature & pressure measurement device
Dry gas flow rate	Meter readings
Dry gas water content (TEG only)	Measure or calculate based on assumptions
Lean glycol circulation rate	Count pump strokes and use to calculate flow from the pump chart
Lean glycol water content	Sample and analysis - commercial laboratory
Glycol pump type	Program provides defaults for pump type
Flash tank temp. / press.	Gauge readings / assumptions
Stripping gas rate / composition	Gauge readings / assumptions
Condenser temp. / press.	Gauge readings / assumptions
Flare / Incinerator	Assume efficiency level (> 99%)

The GRI-GlyCalc™ program requires the user to obtain a number of input parameters. A detailed description of sampling and analytical procedures for benzene from the site equipment is provided with the program. Like all predictive computer programs, the answer provided is only as reliable as the input used in the calculations.

A “Rich - Lean” calculation option is also available on GRI-GlyCalc™ Version 3.0. To run these calculations, benzene concentrations must be measured from actual samples taken from the rich and lean glycol.

The GRI-GlyCalc™ program is available through Radian International at a cost of less than $50.00 ($US). The software comes with a user manual that outlines the steps involved with collecting input data, running the model, and interpreting results. To obtain the GRI-GlyCalc™ Version 3.0 program and technical manual, contact:

Radian International LLC
P.O. Box 201088
Austin, Texas 78720-1088 Tel. # (512) 419-5719

4.2 EVALUATIONS OF DOWNWIND BENZENE EXPOSURES

Benzene emitted from a glycol dehydrator mixes with the surrounding air. The benzene is carried by the wind and dispersed, effectively decreasing in concentration. Benzene also degrades in the atmosphere through various mechanisms including photo-oxidation.

Benzene emissions should be investigated if elevated concentrations of benzene could conceivably reach workers on-site, or off-site public receptors. The assessment of exposures may involve consultations with public health, engineering, and risk assessment specialists. The basic approach to assessing human exposures from a point source emission would include:

- **Characterization of dehydrator emissions**. The first step is to characterize the emissions from the glycol dehydrator. This can be done using GRI-GLYCalc program. In general, emissions from glycol dehydrator still column vents are water saturated, exhibit low temperatures (less than 100 °C), flow-rates and velocities, and are near ground level. A general understanding should be established for frequency, duration, and intensity of emissions, and how emissions relate to operating conditions.

- **Exposure Assessment**. Plume dispersion models have been used to determine how benzene is dispersed around glycol dehydrators.[xiii,21] In general, the highest ambient concentrations of benzene from glycol dehydrator still column vents occur in close proximity to the dehydrator. The first phase of a site-specific assessment of downwind exposure would often be based on such predictive dispersion models.[xiv] Models that could be used are the SCREEN and ISC3 models. If modeling confirms that there is indeed a potential problem, a more accurate assessment of exposure should be completed. A second phase assessment would supplement the dispersion model with actual field measures and/or monitoring of actual individual exposure. It should be realized that estimates of human exposure are based on assumptions regarding a number of factors such as the pattern of daily human activities, meteorological conditions, and emission rates from the dehydrator. Each assumption carries an inherent level of uncertainty.

- **Assessment of the potential risks associated with exposure to dehydrator emissions**. General guidelines for assessing human health risks associated with exposures to toxic substances may be obtained from Health Canada.[xv] The Priority Substances Reports, under CEPA, provide more specific information for compounds like benzene, toluene[xvi] and xylenes[xvii]. Estimates of risk should not be interpreted as fine lines between acceptable and unacceptable, but can serve as indications of relative risk from one exposure scenario to another.

- **Comparison with Standards and Guidelines**. Emission rates may be interpreted by comparing predicted or measured emissions against existing standards or guidelines. (See Section 5) No Canadian exposure standards or guidelines for ambient air levels of benzene exist as of November, 1997. Health Canada has published documentation that provides guideline values for understanding the health risk associated with exposure to toxic substances.[xviii]

- **Making a final decision**. Before making a final risk management decision as to how and whether to control dehydrator emissions, consideration should be given to a broad range of relevant factors. Some issues include normal exposure to benzene during the course of everyday life, the uncertainties in the assessment of exposure (and risk), as well as concerns from nearby residents.

5. BENZENE EMISSION CRITERIA

5.1 GOAL

The Canadian upstream oil & gas industry is committed to minimizing health risks related to benzene emissions from glycol dehydrator operations through continued reduction of benzene emissions, and with a target of 90% reduction from the 1995 national emissions baseline (estimated 9000 tonnes/year) by January 1, 2005.

5.2 PRINCIPLES

In recognition of the potential health risks associated with benzene emissions, operators of glycol dehydrator facilities should commit to:

- determining and reporting benzene emissions from all glycol dehydrators;

- protecting employee health through educating employees about the risks associated with benzene exposure and about good practices that will reduce exposures and risks;

- communicating and maintaining good relations with potentially impacted neighbours;

- using operational practices that reduce benzene exposure potentials; and,

- share innovations and successful benzene emission control methods with industry.

5.3 EMISSION CONTROL CRITERIA

- ***By January 1, 1999: Reduction of Emissions at "High Emission" Facilities***

Benzene emissions from existing glycol dehydrators will be controlled to 9.0 tonnes/year or less by January 1, 1999.

The most urgent requirement is to reduce emissions from glycol dehydrators that currently emit more than 9 tonnes per year. It has been estimated that the 7% of dehydrators with benzene emissions greater than 9 tonnes/year account for 41% of total Canadian glycol dehydrator benzene emissions.[xix] This criteria will only affect operators of existing facilities that emit more than 9 tonnes benzene/year.

- ***By January 1, 2001: 3.0 Tonnes/Year at "Close Proximity" Facilities***

Benzene emissions from existing glycol dehydrators located within 0.75 kilometres of permanent residences or public facilities will be controlled to 3.0 tonnes or less per year by January 1, 2001.

- ***By January 1, 2001: 5.0 Tonnes/Year at Other Existing Facilities***

Benzene emissions from existing glycol dehydrators located more than 0.75 kilometres from permanent residences or public facilities will be controlled to 5.0 tonnes per year or less by January 1, 2001.

- ***Effective January 1, 1999: 3 Tonnes/Year for New Glycol Dehydrators***

New glycol dehydrators will be designed and operated to control benzene emissions to 3.0 tonnes/year or less.

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- ***Effective January 1, 2001: Lowest Level Practical for New Glycol Dehydrators***

New glycol dehydrators commissioned after January 1, 2001 will be expected to have benzene emissions controlled to the lowest level that can be practically achieved. This level may be determined based upon what is learned during the first three years of the program.

5.4 PUBLIC CONSULTATION

5.4.1 Purpose

Public consultations are required to ensure that any residents living in close proximity to a dehydrator that emits more than 3 tonnes per year of benzene are informed about the necessary efforts to minimize any health risks.

5.4.2 Communication Guidelines

Personal contact is preferred wherever possible. Do not indiscriminately pass out information that creates a perception of uncontrolled risk, because it could unnecessarily alarm residents.

Emphasize the efforts to control benzene and the need to control benzene. State specifically that control of benzene is a priority in Canada.

Keep the message simple and direct.

It is important to ensure that people in the proximity area are informed, but remember that any information circulated to residents could have unintended effects. Personal contact, and an informal approach are most important.

If a resident requests information on the human health effects of benzene, he/she should contact the local Medical Health Officer (MHO). A list of MHOs is provided in Appendix D.

5.4.3 Suggested Messages

Benzene is a naturally occurring compound that has been identified as a potential cancer causing agent. The oil and gas industry is one potential source of this substance and is therefore taking steps to ensure that benzene emissions from natural gas facilities are reduced.

Benzene can be emitted during the operation of natural gas production facilities. Effective January 1, 1998, Canada’s oil and gas industry, in co-operation with provincial and federal environmental agencies, has initiated a program to reduce benzene emissions.

The best way to address possible health concerns is to reduce benzene emissions at the source. That is what the oil and gas industry is doing now. The facility located near you either (a) already complies with new guidelines, or (b) will have emissions reduced to the required levels by [DATE INSERTED BY OPERATOR]. Public consultation should work towards achieving a message that reduction has already begun.

The benzene emitted from a natural gas facility is diluted quickly by the air, and the health risk associated with benzene exposure drops off rapidly with distance from the facility. Control of benzene at this site is being undertaken to ensure that your health is protected.

If you have any concerns about benzene releases, or wish to see the industry's code of practice on benzene emissions, please contact [INFO. INSERTED BY OPERATOR].

5.5 REPORTING PROTOCOLS

- ***By March 1, 1999, Operators will report that individual glycol dehydrator facilities emit 9.0 tonnes or less of benzene per year***. Operators should clearly identify facilities where benzene emissions previously exceeded 9.0 tonnes per year, and note the current reduction. A report form is provided in Appendix A. It should be completed and FAXED to the Technical Advisory Team for Benzene Emissions from Glycol Dehydrators, c/o the Canadian Association of Petroleum Producers at (403) 266-3214 or E.mailed to communication@capp.ca.

- ***By March 1, 2000, Operators will report that they have established a benzene emissions monitoring and reporting system.*** A report form is provided in Appendix A. It should be completed and FAXED to the Technical Advisory Team for Benzene Emissions from Glycol Dehydrators, c/o the Canadian Association of Petroleum Producers at (403) 266-3214 OR E.mailed to communication@capp.ca. On behalf of the Advisory Team, a consultant will be contacting as many operators as possible to offer advice towards ensuring that the monitoring and reporting system meets all requirements.

- ***By March 1, 2001, Operators will submit a comprehensive benzene emissions report for all glycol dehydrator facilities.*** A report form is provided in Appendix A. It should be completed and FAXED to the Technical Advisory Team for Benzene Emissions from Glycol Dehydrators, c/o the Canadian Association of Petroleum Producers at (403) 266-3214 OR E.mailed to communication@capp.ca. The report will include the following information:

    - the number of glycol dehydrators operated;

    - the initial date of production for new or relocated glycol dehydrators (if new or relocated after January 1, 1999);

    - the number of glycol dehydrators in close proximity (less than 750 m) to residences and public facilities, and the number of those that have benzene emissions that exceed three tonnes per year. For each dehydrator in close proximity, indicate the distance to the closest residence;

    - the benzene emissions in tonnes per year for each glycol dehydrator as of the end of the year 2001;

    - a corporate commitment to Best Management Practices; and,

    - a company name, contact, and telephone number.

General Notes Regarding Reporting:

1. Benzene emission criteria describe an “annual average” emission rate. Operators will be expected to control emissions to levels below this limit, but will not be required to monitor emissions on a daily basis or to report short term excursions. This approach will require operators to create an administrative record to prove that their annual average is verified (e.g. gas production data).

2. Dehydrators should be grouped together for the purpose of estimating annual emissions if they are located in the same pool or field as defined by the provincial regulatory authority (if the pools can be shown to have uniform benzene content). Group reports must include a typical gas analysis (including benzene) in the pool or field and a typical GRI-GlyCalc^{TM} calculation that can be prorated to the total volumes of gas being dehydrated.

5.6 REVIEW PROCESS

5.6.1 Reporting

All parties are committed to ensuring that there is an excellent record of actual industry experience and results during the first three years after issuance of the Best Management Practices document. This means, at a minimum, that the need for these reports will be reinforced with industry operators, and that government representatives will actively remind industry of the importance of a complete reporting program.

5.6.2 Preparation of a Reference Report

The Technical Advisory Team will ensure that a reference report is created. They will engage and direct an independent consultant who will receive, consolidate, and review the industry data received and prepare a report that will facilitate the review. This report will provide the following:

- a statement of total industry benzene emissions;
- a statement of benzene emission reductions (compared to 1995 baseline), by glycol dehydrator category;
- separate statements of annual benzene emissions from new and existing glycol dehydrators, which will include a statistical analysis (i.e., maximum, mean, mode, minimum, and percent), presenting a direct comparison to the 1995 CAPP study;
- a table which illustrates the reductions achieved through controls during the three year period;

- a description of effective technologies that have been employed to successfully achieve benzene emission reductions (including an assessment of the related purchase, installation, and implementation costs for new and existing glycol dehydrators);

- a description of publicly available research and development undertaken here and elsewhere to improve benzene emissions from new and existing glycol dehydrators;

- a review of the BMP to assess: a) conformance levels in industry, and b) effectiveness in reducing risk of benzene exposure;

- a review of health studies related to benzene emissions that could further clarify the risks and need for further emission control;

- a review of the data for ambient benzene levels in Canada, in particular in oil and gas production areas; and,

- identification of the percentage of non-conforming operators and of any reporting deficiencies that weaken the findings (including a list of companies not in compliance, and operating companies that have not reported).

5.6.3 Schedule

The following provides target dates for key tasks for the Technical Advisory Team:

1998	Initiate group; organize short term and long term requirements.
1999	Review reported reductions from "high emitter" facilities. Review of reporting of "close proximity" dehydrators. Organize terms of reference for the consultant who will prepare the third year report. Initiate the reporting process. Review any changes that affect long term plan.
2000	Review the consultant's work and findings. Make major decisions about the long-term continuation of the program, and the efforts needed to achieve the goal.
2001	Four meetings. To review the consultant's reference report and identify any deficiencies. To make decisions based upon the consultant's findings. To establish direction for the benzene emission program in order to achieve the long-term goal of the program.

5.6.4 The Need for Formal Regulation

The Technical Advisory Team will make a recommendation about the success of the voluntary benzene control program once their review is completed. As a guideline, if companies reporting account for less than 90% of Canadian annual natural gas production, or if the control criteria have been met by companies with less than 90% of natural gas production reported, then regulation under the Canadian Environmental Protection Act or under provincial mechanism may be recommended. If a few companies fail to comply, then these companies would be dealt with directly by regulatory authorities rather than adopting industry-wide regulation.

6. PREVENTING AND MINIMIZING EMISSIONS FROM GLYCOL DEHYDRATOR

6.1 DESIGN CONSIDERATIONS

The most effective, and often the most cost-effective, method of controlling emissions from an engineered system is to incorporate proactive thinking in the design stages of the project. The key areas for controlling contaminant emissions from glycol dehydrators include:

- glycol circulation rate, concentration and purity;
- absorber temperature (where applicable);
- the number of trays or contact stages in the absorber;
- any mitigating equipment (e.g., inlet scrubbers, flash drums, properly sized still columns, vent gas cooling/condensing systems with a liquid collection tanks); and,
- supplemental emission controls.

Most well-site glycol dehydrators use gas-operated equipment due to the lack of electricity. They are usually “skid” mounted, prefabricated, economical packages with gas treating capacities in the range of 14,000 to 140,000 m^3/d (.5 to 5 MMSCFD) or higher.

Operating companies typically purchase these short-delivery, off-the-shelf packages and install them in the field as quickly as possible. It is quite probable that the majority of these units are over designed and over-sized for the application for which they were intended. Inlet gas flow can decrease over time and create a further exaggerated condition with respect to overdesign. Some of the optional equipment (e.g. flash drums) may not be available. Field personnel can reduce benzene emissions by optimizing the operation of the dehydrator on a regular basis. The following are guidelines to achieve a high level of performance.

6.2 PERFORMANCE EVALUATION

Field operating data can be fed into any of the technical evaluation programs being used to assess the performance of the dehydrator. These technical programs include the previously discussed GRI-GlyCalc^{TM} and Rich-Lean methods, or other programs such as Prosim, Hysim[xx], or “in-house” / commercial simulators. Results of these evaluations can be used in a sensitivity analysis whereby specific components of the system can be identified as the most appropriate place for implementing emission control strategies.

6.2.1 Glycol Circulation Rate

The amount of benzene absorbed by glycol is proportional to the circulation rate. Of all operating variables affecting benzene emissions, the circulation rate has the greatest impact. This is especially important when considering that operators may have to maintain higher than necessary circulation rates for dehydrating the gas, to overcome some of the inherent physical limitations of the equipment (e.g., the glycol flow distribution across the trays, pump minimum flow requirements etc.). Operators can double-check the needed circulation rates, on a case by case basis, by referring to standard charts available or provided for the dehydrator by the supplier. Alternatively, operators may use simplified computer programs (e.g., GRI-GlyCalc™) intended for this purpose or consult with their company’s engineering personnel.

6.2.2 Absorber Operating Conditions

Generally speaking, benzene absorption by glycol increases with higher absorber pressure and lower absorber temperature. [xxi] Additional points are listed below.

- Adjusting absorber pressure for curtailing benzene emissions is generally not an option. However, absorber pressures may decline over time, at gas well and some facility installations.

- Absorber temperatures can be controlled in some cases by optimizing the lean glycol temperature (e.g. with heat exchangers) or by adjusting the inlet gas temperature (e.g. adjusting compressor discharge temperatures or installing a line heater upstream of the absorber).

- TEG absorption of benzene increases with the number of trays or packing height of the absorber. Therefore, absorbers with an excessive number of trays can add to benzene emissions. Stock dehydrator absorbers are especially prone to over-staging. If the absorbers are built with multiple entry nozzles for the lean glycol, it would provide an opportunity for the operator to determine if some of the top trays could be bypassed during normal operation.

6.2.3 Reboiler Temperature

The reboiler reconcentrates the glycol to regain its absorption quality. Optimized reboiler temperatures are essential to reconcentrate glycol for achieving specification dryness in the product gas. Relevant charts are published in standard references such as GPSA[7] and vendor supplied information for the operator to set the reboiler operating temperature.

Reboiler temperature deviations, either above or below the optimum temperature range, can make the dehydrator operation inefficient. Higher than optimum temperatures may still result in adequate dehydration of the gas stream, but can lead to glycol losses and excess consumption of fuel gas. Lower than optimum temperatures may result in reduced water removal efficiency. In this case, the glycol circulation rate may be set higher than if reboiler temperatures were within the optimum range.

6.2.4 Stripping Gas

Stripping gas is typically dry fuel gas introduced in the stripping section of the reboiler specifically to regenerate high concentration glycol for improved dehydration. The use and rates of stripping gas should be adequately evaluated because that is what finally escapes into the atmosphere. Specialty charts are available in standard references such as the GPSA[7] data book and other vendor publications, and should be consulted for estimating the stripping gas requirements for specified sets of conditions. Reductions in stripping gas consumption can translate directly into savings both in operating cost as well as increased production volumes.

One way of avoiding the use of stripping gas is by choosing suitable alternative technologies . For example, in the Cold Finger Process, cool rich glycol is used for heat exchange purposes, causing water vapour in the accumulator vessel to condense. High glycol purity may thus be achieved without the direct use of stripping gas. The circulation rate and heat requirements for the regeneration of glycol are also reduced which potentially decreases benzene absorption by the glycol from the gas stream.[xxii]

6.2.5 Flash Tank

The main purpose of a flash tank is to remove dissolved gas from the rich glycol stream and improve the glycol reconcentration process. In addition, the liberated gas can be used as fuel gas (i.e. reboiler burner), flared, vented, or conserved. An operational concern is that the flash gases are wet and can cause operating and freezing problems. The use of a flash tank increases the effectiveness of condenser systems in controlling benzene emissions.

6.2.6 Other Optimization Opportunities

The addition of structured packing to existing contactor trays may increase gas handling capacity and improve dew point suppression. Contaminants such as produced water, lubricants, well-treating chemicals, and scale, reduce the ability of glycol to absorb water. The heavier hydrocarbons increase benzene absorption by the glycol. Performance can therefore be optimized by providing some type of filtering device such as a Filter-Separator unit upstream of the dehydration facility.

The glycol dehydrator absorber operating pressure is an important factor because the solubility of benzene in glycol increases with increased pressure. This potential drawback is often offset by the limited capacity for high pressure gas to carry water which allows glycol circulation to be reduced. The gas temperature, which primarily controls the operating temperature of the absorber, also has an effect on benzene absorption because lower absorber temperatures favour dissolution of benzene in glycol. This is an especially important parameter to be considered during the design stage.

Modifications to the glycol pump system can also provide emission abatement benefits. Many well site dehydrators use gas-driven pumps that exhaust gas to the atmosphere. Optimization opportunities include routing the exhaust gas back into the fuel gas header for firing the reboiler or changing the drive mechanism to an electric motor.[xxiii] These opportunities are site-specific, but do provide potential benefits such as reduced fuel gas consumption and reduced emissions.

6.3 MAINTENANCE PROCEDURES

Filter change-out is a frequent maintenance activity undertaken at dehydrators in the field. Company protocol(s) should be in place for everyday access, and there should be ongoing training programs to ensure that benzene exposures are minimized while handling filter elements. Consultation with a qualified occupational hygiene professional may be required if policies are outdated or non-existent. Worker exposure is typically controlled through the use of <u>appropriate</u> personal protective equipment and adequate ventilation in the work area.

Special care should be taken to ensure that the operating / maintenance personnel do not open the filter housing before the trapped hydrocarbon liquids are drained through a properly installed drain pipe into a dedicated collection tank for safe disposal. Glycol sludge deposits are often found at the bottom of various vessels and heat exchangers when they are opened for inspections and annual turnarounds. These deposits should be flushed out with water and drained to dedicated containers for proper disposal. The affected equipment should all be purged with air for a sufficient amount of time before cleaning scale as a safety precaution to drive off the remaining hydrocarbon vapours.

7. SUPPLEMENTARY EMISSION CONTROLS / FACILITY OPTIMIZATION

Supplementary or “add-on” emission controls are used to remove or destroy pollutants in the still column vent emissions. The most common practices involve the use of condenser and thermal systems, either separately or in series. These emission control options could be considered as an optimization of facility design and are best handled on a site-specific basis.

7.1 CONDENSER SYSTEMS

Condensers reduce the temperature of the still column vent vapours to condense water and hydrocarbons (including benzene). The condensed liquids are then collected for further treatment or disposal. Generic types of condensers are air-cooled, gas-cooled, water-cooled, glycol-cooled, and ground-cooled. Air-cooled condensers typically rely on the ambient air for removing the heat from the condenser; the condenser may use fins or a fan to improve heat exchange. Gas-cooled and glycol-cooled condensers utlilize cool medium (dry gas or rich glycol) from the glycol dehydrator operation as the heat exchange mechanism. Water-cooled condensers follow similar principles, but have not been used in Canada due to freezing concerns. Ground-cooled condensers consist of piping and storage vessels installed below surface grade, where the surrounding soils act as a heat sink.

An approach currently used by some operators is to route the still column vent (off gas) line to either an aboveground or underground storage tank for cooling. This approach can be effective in cold climate locations where ambient temperatures act as a convenient heat sink. It also lends itself to further emissions control through rerouting flows from the tanks to a flare or incinerator system.

There are several patented designs available in the market, developed by various companies based on the cooling concepts discussed above. They include the Texaco-Coastal BTEX System, R-BTEX Process, CONOCO's Aromatic Recovery Unit, and others. Most of these patented designs are used on large gas processing facilities and not at well sites and small dehy applications. None of these systems are known to be in operation in Canada.

Condensing systems benefit from (and may require) a flash tank in the glycol process upstream of the exchange mechanisms to liberate non-condensables (e.g. methane, ethane, etc.). The use of stripping gas (being a non-condensable) reduces the cooling efficiency of condenser units. Condensing system designs can range from a simple vessel and piping-modification to commercial type heat exchangers.

In cold climates, above ground condensing units are susceptible to frequent operating problems due to freezing of the condensates (e.g., as water, benzene).. Proper heating and insulation are required to prevent or minimize problems from freeze-ups, however, the
cost of such measures can be prohibitive. Ground-cooled installations are made relatively resistant to such freeze-ups by carefully laying the pipes and tanks sufficiently below grade.

7.2 THERMAL SYSTEMS

Thermal treatment systems include flare systems and incineration systems. Both can provide effective control of benzene emissions from glycol dehydrators. Both types of systems have been installed at glycol dehydrator locations in Canada. To date, these systems have typically been installed for control of hydrogen sulphide emissions (i.e. where gas containing hydrogen sulphide is being processed) or for odour control (e.g. where gas contains mercaptans).

7.2.1 Flare Systems

A flare system design involves the collection of off-gas vapours (i.e. instrument vents, flash tank, pump exhaust, still column vent) to an underground tank where condensables are collected, and venting the tank to a low pressure flare. A fuel gas purge is recommended to sweep the system (and/or use of a flame arrestor) to prevent flare flashback. This system may be used in conjunction with underground piping and a collection tank ground-cooled condensor. Flaring will help BTEX destruction through combustion and improve emission dispersion by elevating the point source emission which subsequently reduces ground level concentrations. It is possible to attain higher combustion efficiencies by choosing properly designed atomizer and burner systems that promote complete combustion of the BTEX compounds. However, the fuel gas consumption needed to maintain sweeping gas and burner firing increases operating costs as well as emission of carbon dioxide.

7.2.2 Incineration Systems

Off gas can be directly incinerated or an incineration system can be installed after a condenser system. Incineration at temperatures of 730 °C (1500 °F) can provide almost complete (>99%) destruction of BTEX and eliminate hydrocarbon odours. Incinerator stack height and location should be based on safety and ground level concentration requirements. There are also freezing protection and fuel gas related costs associated with the decision to install incineration systems.

8. WASTE MANAGEMENT ALTERNATIVES

There are a number of waste streams generated from the operation of glycol dehydrators in the natural gas industry. The following are recommended management practices for each one of these waste streams:

Waste Glycol Filters. There are two basic types of glycol filters: activated carbon and sock-type filters. Unless specific analyses have been performed on the filters, all glycol filters should be considered Dangerous Oilfield Wastes, Special Wastes or Waste Dangerous Goods, and should be handled, stored, transported, and disposed at an approved hazardous waste treatment facility. The hazardous nature of these filters is primarily related to flammability and combustibility.

Waste Glycol. Glycol can become contaminated (usually by chlorides) and is then not effective in removing water from the gas stream. Waste glycol is generally not considered a Dangerous Oilfield Waste or Special Waste (except if the flashpoint is less than 61°C). Glycol is considered a Waste Dangerous Good in Saskatchewan. Waste glycol is not suitable for disposal into the environment. Whenever possible, waste glycol should be recycled at an approved recycling facility.

Condensate. There are two sources of condensate, inlet separators (predominantly water and hydrocarbon) and glycol dehydrators, that generate a glycol - water - hydrocarbon mixture from condensed still vapours. Both of these fluids are likely to be run through a facility to separate the aqueous phase from the condensate. Condensate should also be sent directly to an approved disposal well. Evaluation of the volume and quality of the condensate will help to determine which option is more economical.

APPENDIX A

REPORTING FORM

Province Reported ____________________

Oil and Gas Industry
Glycol Dehydrator
Benzene Emissions at January 1, 2001

* Unique dehydrator identifier (lsd,etc.)	* Dehydrator Use(well/compressor/battery/gas plant)	Emissions Prior to Control Tonne/year	* Emissions from Units >9.0+/yr. at Jan. 1, 1999	Emissions at Jan. 1, 2001	Improvement tonnes/yr.	Control Method	Date of Operation for Dehy Installed after 01/01/99	* Dehydrator in Close Proximity to Residence Yes or No	Contact Made with Residents	** Compliance with Code Yes or No
Overall Improvement										

* Columns to be completed and reported by March 1, 1999

** Reason For Non-Compliance

Comments: ____________________

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Complete and mail to:
Emissions From Glycol Dehydrators
c/o Canadian Association of Petroleum Producers
2100, 350 - 7th Ave. S.W.
Calgary, Alberta T2P 3N9
e-mail: communications@capp.ca
Fax: (403)261-4622

Company Contact:
Name: ____________________ Signature ____________________
Company: ____________________
Phone: ____________________
Fax: ____________________
e-mail: ____________________

11/19/97

APPENDIX B

LIST OF ABBREVIATIONS

APPENDIX B

Abbreviations

The abbreviations used in this Code of Practice, for units of measure, names of associations, government agencies and other words shall have the meanings assigned to them in this section.

ANLL	Acute non-Lymphocytic Leukemia
BMP	Best Management Practices
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CAPP	Canadian Association of Petroleum Producers
CEPA	Canadian Environment Protection Act
CGA	Canadian Gas Association
CO_2	Carbon Dioxide
CSA	Canadian Standards Association
DEG	Diethylene Glycol
EG	Ethylene Glycol
GPSA	Gas Processors Suppliers Association
GRI	Gas Research Institute
HC	Hydrocarbons
MMSCF	Million Standard Cubic Feet
PSL	Priority Substances List
SEPAC	Small Explorers and Producers Association of Canada
TEG	Triethylene Glycol

APPENDIX C

WORKING GROUP MEMBERSHIP

APPENDIX C

WORKING GROUP MEMBERSHIP

The Working Group on Benzene Emissions from Glycol Dehydrators is Chaired by Environment Canada and includes the following stakeholders:

- Alberta Energy and Utilities Board
- Alberta Environmental Protection
- British Columbia Ministry of Environment, Lands, and Parks
- Canadian Association of Petroleum Producers
- Canadian Gas Association
- Environment Canada
- Health Canada
- Pembina Institute for Appropriate Development
- Saskatchewan Environment and Resource Management
- Small Explorers and Producers Association of Canada

APPENDIX D

MEDICAL OFFICERS OF HEALTH

Medical Officers of Health

British Columbia Health District Service Areas:

British Columbia Ministry of Health
Northern Interior Health Unit #18
1444 Edmonton Street
Prince George, B.C. V2M 6W5
Phone: (250) 565-7334
Fax: (250) 565-1386

Saskatchewan Health District Service Areas:

Swift Current Health District (#1)
350 Cheadle Street West
Swift Current, Saskatchewan S9H 4G3
Phone: (306) 778-5280
Fax: (306) 778-5408

Moose Jaw Health District (#2)
107 – 110 Ominica Street West
Moose Jaw, Saskatchewan S6H 6V2
Phone: (306) 691-6400
Fax: (306) 691-6444

South Central Health District (#3)
Box 2003
Weyburn, Saskatchewan S4H 2Z9
Phone: (306) 842-8618
Fax: (306) 842-8637

Regina Health District (#4)
Community Health Division
2110 Hamilton Street
Regina, Saskatchewan S4P 2E3
Phone: (306) 766-7777
Fax: (306) 766-7607

East Central Health District (#5)
72 Smith Street East
Yorkton, Saskatchewan S3N 2Y4
Phone: (306) 786-0600
Fax: (306) 786-0620

Saskatoon Health District (#6)
101, 310 Idylwyd Drive North
Saskatoon, Saskatchewan S7L OZ2
Phone: (306) 655-4605
Fax: (306) 655-4414

Midwest Health District (#7)
Box 1300
Rosetown, Saskatchewan SOL 2VO
Phone: (306) 882-6413
Fax: (306) 882-6474

Battlefords Health District (#8)
Rm. 204 Prov. Bldg. 1146 – 102nd Street
North Battleford, Saskatchewan S9A 1E9
Phone: (306) 446-6400
Fax: (306) 446-6432

Prince Albert Health District (#9)
Box 3003
Prince Albert, Saskatchewan S6V 6G1
Phone: (306) 953-5600
Fax: (306) 953-5650

Alberta Health District Service Areas:

Chinook Regional Health Authority
Community and Wellness Site – Lethbridge
(Train Station)
801 – 1st Avenue, South
Lethbridge, Alberta T1J 4L5
Phone: (403) 382-6014
Fax: (403) 382-6011

Palliser Health Authority
Community Health Services
2948 Dunmore Road, S.E.
Medicine Hat, AB T1A 8E3
Phone: (403) 526-7950
Fax: (403) 528-2250

Headwaters Health Authority
Box 1266
Banff, AB TOL OCO
Phone: (403) 762-2990
Fax: (403) 762-5570

Headwaters Health Authority
4, 28 – 12th Avenue S.E.
High River, AB T1V 1T2
Phone: (403) 601-8330
Fax: (403) 652-0190

Calgary Regional Health Authority
Box 4016, Station C
320 – 17th Avenue S.W.
Calgary, AB T2T 5T1
Phone: (403) 228-7532
Fax: (403) 541-6621

Crossroads Regional Health Authority
5610 – 40th Avenue
P.O. Box 6627
Wetaskiwin, AB T9A 2G3
Phone: (403) 352-3766
Fax: (403) 361-4336

Health Authority 5
P.O. Box 429
Drumheller, AB TOJ OYO
Phone: (403) 823-5245
Fax: (403) 823-7589

Red Deer Regional Health Unit
2845 Bremner Avenue
Red Deer, AB T4R 1S2
Phone: (403) 341-2166
Fax: (403) 341-2188

East Central Regional Health Authority
4703 – 53rd Street
Camrose, AB T4V 1Y8
Phone: (403) 608-8800
Fax: (403) 672-5023

WestView Regional Health Authority
Provincial Building
4709 – 44th Avenue
Stony Plain, AB T7Z 1N4
Phone: (403) 963-8631
Fax: (403) 963-1698
Lakeland Regional Health Authority
Fort Saskatchewan Health Unit
3rd Floor, 9821 – 108th Street
Fort Saskatchewan, AB T8L 2J2
Phone: (403) 992-2358
Fax: (403) 998-3119

Peace Health Region
Box 6178
10015 – 98th Street
Peace River, AB T8S 1S2
Phone: (403) 624-7260
Fax: (403) 618-3405

Capital Health Authority
Public Health Services
500, 10216 – 124th Street
Edmonton, AB T5N 4A3
Phone: (403) 482-1965
Fax: (403) 413-7950

Aspen Regional Health Authority
Provincial Building
Box 2308
Westlock, AB TOG 2LO
Phone: (403) 349-8705
Fax: (403) 349-4879

Keeweetinok Lakes Regional Health Authority
405 – 6th Avenue S.W.
Slave Lake, AB TOG 2A4
Phone: (403) 849-3947
Fax: (403) 849-3083

Mistahia Regional Health Authority
2101, 10320 – 99th Street
Grande Prairie, AB T8V 6J4
Phone: (403) 538-5387
Fax: (403 538-6230

Northern Lights Regional Health Authority
7 Hospital Street
Fort McMurray, AB T9H 1P2
Phone: (403) 791-6137
Fax: (403) 791-6029

Northwestern Health Services Region
2nd Fl., 9808- 100th Avenue
Postal Bag 2000
High Level, AB TOH 1ZO
Phone: (403) 926-7000
Fax: (403) 926-7001

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