CAPP

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Status Report

Upstream Petroleum Industry Benzene Emissions from Glycol Dehydrators 2003

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The Canadian Association of Petroleum Producers (CAPP) represents 150 companies that explore for, develop and produce natural gas, natural gas liquids, crude oil, oil sands, and elemental sulphur throughout Canada. CAPP member companies produce more than 98 per cent of Canada's natural gas and crude oil. CAPP also has 125 associate members that provide a wide range of services that support the upstream crude oil and natural gas industry. Together, these members and associate members are an important part of a $75-billion-a-year national industry that affects the livelihoods of more than half a million Canadians.

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Executive Summary

Benzene is a non-threshold carcinogen and is defined in the Canadian Environmental Protection Act (CEPA) as a toxic substance. This enables Environment Canada to take steps, including the development of regulations, to control benzene emissions. A multi-stakeholder task force agreed to a voluntary approach whereby the oil and gas industry committed to reduce and report benzene emissions. This process is outlined in the Best Management Practices for the Control of Benzene Emissions from Glycol Dehydrators (BMP).

Previous studies (1995, 1999, 2001) have been conducted to gather and analyze benzene emissions reporting from glycol dehydrator operators. This report has been prepared to provide a summary and analysis of the benzene emissions reporting and the Canadian oil and gas industry's progress with the Benzene from Glycol Dehydrators Reduction Performance Project.

Glycol Dehydrator Benzene Emissions

The total benzene emissions rate at January 1, 2003 represents a 77% reduction from 1995 levels. Canadian natural gas production increased 15% during this period.

The total benzene emission rate for the entire dehydrator population is estimated at 1,988 tonnes per year. Total benzene emissions have been previously estimated at 2,224 tonnes per year (2001), 4,006 tonnes per year (1999) and 8,743 tonnes per year (1995).

Glycol Dehydrator Inventory

The estimated 2003 total population of glycol dehydrators is 3720 units. This is a 6% reduction from the estimated 2001 glycol dehydrator population. The majority (>99%) of dehydrators for which locations were reported are operating at locations in the western sedimentary basin in Northeast British Columbia, Alberta, or Saskatchewan.

There is a reported decrease in the relative proportion of dehydrators installed at wellsite locations. In addition, approximately 26% of reported glycol dehydrators are shut-in or by-passed (operating as a separator) and are therefore not benzene emission sources. Approximately 2,737 units are operating.

Survey Participation

Responding companies collectively produced more than 92% of Canada's daily

natural gas production in 2002. The survey response satisfies the target response as identified in the BMP.

Distribution by Company

Thirty-four companies are responsible for operating more than 95% of the reported population of glycol dehydrators. There appears to be an increase in the role of larger companies in the operation of glycol dehydrators. In 2001 and 1999, 55 and 92 companies operated more than 95% of dehydrators, respectively.

Emissions Controls

Most glycol dehydrators continue to vent emissions directly to atmosphere or to storage tanks (aboveground and underground storage tanks). The results suggest a consistent increase in the installation of incinerators and flares to control emissions.

Close Proximity Units

Most glycol dehydrators are located more than 750 metres from private residences or public facilities. In 2003, 1 'close proximity' unit was reportedly emitting greater than 3 tonnes per year.

Compliance with the BMP Requirements

There is a high level of compliance with the emissions criteria and current target dates outlined in the CAPP BMP for Glycol Dehydrators. The details of compliance can be summarized as follows:

Reporting Protocols

In 2003, dehydrator emissions data was received for 3244 of an estimated population of 3,720 dehydrators or 87% of the estimated dehydrator population. There is continuous improvement over 2001 and 1999 reporting years for which dehydrator emissions data was received from 84% and 77% of the estimated dehydrator population, respectively.

Dehydrators with Emissions Greater Than 5 Tonnes Per Year

The BMP requires glycol dehydrators that were installed prior to January 1, 2001 or are located more than 750 metres away from a public facility or residence to emit less than 5 tonnes of benzene per year. In 2003, only 7 of these dehydrators were reported as emitting greater than 5 tonnes of benzene per year resulting in more than 99% compliance with BMP requirements.

New Dehydrators with Emissions Greater than 3 tonnes Per Year

The BMP requires glycol dehydrators that are installed or modified after January 1, 1999 to emit less than 3 tonnes per year. In 2003, there were only 2 dehydrators reported as installed or moved after January 1, 1999 which emitted greater than 3 tonnes of benzene per year. This results in a rate of BMP compliance of greater than 99%.

Close Proximity and Emissions Greater than 3 tonnes Per Year

The BMP requires glycol dehydrators that are located within 750 metres of a public facility or permanent residence to reduce emissions below 3 tonnes per year prior to January 1, 2001. In 2003, 1 'close proximity' unit was reportedly emitting greater than 3 tonnes per year.

Most companies operating close proximity units did not contact nearby residents as per the BMP requirements.

Baseline Emission Levels (1995) Emission Reduction Targets

The BMP states that the Canadian upstream oil and 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 benzene emissions baseline by January 1, 2005. The total benzene emissions for 2003 are estimated at 1,988 tonnes per year representing a 77% reduction from 1995 levels (8,743 tonnes per year). Based on the rate of reduction since 2001, it is not likely that the target will be achieved.

New Dehydrators – After January 1, 2001

New glycol dehydrators commissioned after January 1, 2001 are expected to have benzene emission controlled to the lowest level that can be practically achieved as described in the revised BMP (CAPP, 2001). This is demonstrated by production of a Decision Tree Process. Only 26% of new dehydrators are reported as having a decision tree to comply with this requirement.

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1 Introduction

Benzene is a non-threshold carcinogen and is defined in the Canadian Environmental Protection Act (CEPA) as a toxic substance. This enables Environment Canada to take steps including the development of regulations to control benzene emissions.

A multi-stakeholder task force comprised of industry, government, and environmental organizations agreed to a voluntary approach whereby the oil and gas industry committed to reductions in benzene emissions from glycol dehydrators. This approach encourages operations to voluntarily report benzene emission reductions in a process outlined in the *Best Management Practices for the Control of Benzene Emissions from Glycol Dehydrators (*BMP*)* (CAPP, 1997; Revised 2000). Regulators in Alberta, Saskatchewan, and British Columbia have issued bulletins and information letters announcing benzene emissions reduction programs for glycol dehydrators and reminding operators of the reporting requirements of the program as detailed in the BMP.

Previous studies (1995, 1999, 2001) have been conducted to gather and analyze benzene emissions reported from glycol dehydrator operators. This report has been prepared to provide the results of the benzene emissions reporting and the progress with the Benzene from Glycol Dehydrators Reduction Performance Project as of January 1, 2003.

1.1 Background

Benzene emissions from the still column vent on glycol dehydrators occur as a result of glycol's strong affinity for aromatic hydrocarbons (including benzene). When glycol is in contact with gas in the contactor, it preferentially absorbs these hydrocarbons. Since the boiling point of benzene is 80^0C, most of the benzene absorbed by the glycol solution is released during the glycol regeneration stage when exposed to the high temperatures of the reboiler, and emitted to the atmosphere through the still column vent. As much as 90% of the benzene absorbed by the glycol in the contactor may be stripped in the reboiler and emitted to the atmosphere, in the vented gas.

The BMP outlines a schedule for emission criteria. These criteria are discussed in the BMP and summarized below.

Table 1.1 Benzene Emissions Criteria

Applicable Units	Benzene Emission Level	Target Date
New Dehydrators Any dehydrator facility that is commissioned or relocated after January 1, 1999 is a "new dehydrator". All other dehydrators are "existing dehydrators."	3 tonnes/yr	January 1, 1999
"Close Proximity" Facilities within 750 m of permanent residences or public facilities.	3 tonnes/yr	January 1, 2001
Other Existing Facilities located more than 750 m from permanent residences or public facilities.	5 tonnes/yr	January 1, 2001
New 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 as described in the revised BMP.	Lowest Level Practical	January 1, 2001

The BMP was revised in December 2000 to incorporate a Decision Tree Process for new glycol dehydrators. The use of this process allows operators to ensure that they are complying with the requirement that new glycol dehydrators are emitting benzene at the lowest practical level. The revised BMP was the subject of Information Letters issued by Alberta Energy and Utilities Board and Saskatchewan Energy and Mines on August 14, 2001 and October 15, 2001 respectively. The Information Letters also refer to the Frequently Asked Questions (FAQ) document produced by CAPP to clarify ambiguities in the original BMP.

1.2 Study Objectives

The objectives of this study were to:

- Update the 2001 equipment and benzene emissions inventory of glycol dehydrators against data provided by operating companies.
- Develop a database in *Microsoft Access* format to gather and maintain inventory and emissions data.
- Compare the 2003 equipment and benzene emissions inventory to the 1995, 1999 and 2001 inventory.
- Prepare a report summarizing the study findings and recommendations.

1.3 Report Limitations

Companies included in this survey included oil and gas companies with gas production that ranked in the upper 125 gas producing companies, glycol dehydrator operating companies that had previously reported (1999, 2001), operating dehydrators, and new operating companies identified in association lists, merger and acquisition lists, and various other information sources. Not all operators contacted replied to the data-gathering request.

This project was conducted to gather glycol dehydrator equipment and still column vent benzene emissions information. Other benzene emission sources or environmental implications of current dehydrator operating conditions were not addressed. Conclusions and recommendations are provided based on the gathered data.

2 Methods

2.1 Information Request

A potential list of glycol dehydrator operating companies was developed based on oil and gas companies with gas production that ranked in the upper 125 gas producing companies, glycol dehydrator operating companies that had previously reported (1999, 2001) operating dehydrators and new operating companies identified in association lists, merger and acquisition lists, and various other information sources.

Companies were provided with a blank dehydrator data request to be populated with the company-specific equipment and emissions data. Additional data were requested to help track mergers and acquisitions, and details of dehydrator sales, closures and modifications.

2.2 Database Development

A database was developed using Microsoft Access 2000. Data fields were created corresponding to the information requested from companies.

2.3 Data Validation

The data were evaluated upon receipt from responding companies. Obvious inconsistencies and omissions were resolved during data processing or clarified during follow-up discussions with company personnel.

The majority of companies reported using the Gas Research Institute's GLYCalc process simulation model for estimating benzene emission from glycol dehydrators.

Other methods utilized to estimate benzene emissions included total capture methods, mass balances, and extrapolation from emissions estimates of nearby facilities. In many locations, operators used the absence of benzene (or hexane) in the wet gas to predict that there are no benzene emissions from the glycol dehydrator.

3 Findings

3.1 Company Participation in Survey

A total of 159 oil and gas production and processing companies were contacted and requested to update their individual glycol dehydrator equipment and benzene emissions inventory. Companies contacted included companies that had previously responded to the survey request and new or recently merged companies.

3.1.1 Survey Response

The responding companies collectively produced more than 92% of Canada's 2002 natural gas production as reported by the top 125 producers in Canada (Oilweek, 20032) and estimated total dehydrator population.

3.1.2 Reporting of Dehydrator Data

The dehydrator operating and emissions data supplied varied in completeness and quality. However, some level of dehydrator operating and emissions data was submitted for a total of 3,418 units.

Most of the tables reproduced below have a category labeled "Not Reported" which varies between tables. This indicates that the subject of that table was not reported in the individual dehydrator records. For example, a dehydrator record may be complete except for control type and installation type. In this case the unit would be included in the "Not Reported" totals for control type and installation type but not in the other tables. The estimated 302 unreported units are also included in the "Not Reported" totals.

3.1.3 Unreported Dehydrators

A total of 95 companies failed to respond to the survey at the time of writing. Non-responding companies had reported operating 302 dehydrators in 2001.

Several of these companies indicated that while they were aware of the previous reporting requirement, they were unaware of the 2003 reporting requirements. In addition, many acquisitions and divestitures occurred during 2002 that may have resulted in under reporting of individual dehydrators.

3.2 Dehydrator Inventory

3.2.1 Dehydrator Population

The total population of glycol dehydrators is estimated to be 3,720 units. This estimated total population number includes the 3,418 units reported in the 2003

update and the estimated 302 units associated with non-responding companies.

The 2003 estimated population appears to have decreased since 2001 and 1999. The estimated population of 3,720 units in the most recent survey is a reduction of 6% from the estimated 2001 glycol dehydrator survey population of 3,976 and a reduction of 15% from the estimated 1999 glycol dehydrator survey population of 4,369 units.

In addition the following information was available from the reported data:

- New, modified, or relocated units are contributing approximately 1-2% to the dehydrator population per year over the last 5 years (since Jan 1, 1999).
- The operating status of glycol dehydrators suggest that the active glycol dehydrator population (units that pose a potential benzene emission source) is consistent with previous years findings. Approximately 26% of reported glycol dehydrators are shut-in or by-passed (operating as a separator). Therefore, of the estimated population of 3,720 units in 2003, approximately 74% (2,737 units) are estimated to be potential benzene emission sources.

3.2.2 Geographical Distribution

Geographical location data was reported for a total of 3,407 glycol dehydrators. The majority (>99%) of dehydrators for which locations were reported are operating at locations in the western sedimentary basin in Alberta, Northeast British Columbia, or Saskatchewan. Nine dehydrators were reported in Ontario. No dehydrators were reported in the rest of Canada including Nova Scotia, Newfoundland, Northwest Territories, and Manitoba.

As Table 3.1 illustrates, there is no significant change to the geographical distribution of glycol dehydrators. The following table summarizes the geographical distribution of dehydrators in for 1999, 2001 and 2003.

Table 3.1 Dehydrator Geographical Distributions

Geographical Location	# of Dehydrators (2003)	% of Dehydrators with reported locations (1999)	% of Dehydrators with reported locations (2001)	% of Dehydrators with reported locations (2003)
Alberta	2,771	80%	83%	81%
NE British Columbia	434	13%	13%	13%
Saskatchewan	193	7%	5%	6%
Rest of Canada	9	<1%	<1%	<1%
Location Not Reported*	313	---	---	---
Total Dehydrators	3,720	100%	100%	100%

* Includes 302 unreported dehydrators and 9 reported dehydrators without a reported location.

3.2.3 Distribution by Company

Thirty-four companies are responsible for operating more than 95% of the reported population of glycol dehydrators. As Table 3.2 illustrates there appears to be an increase in the role of larger companies in the operation of glycol dehydrators. In 2001 and 1999, 55 and 92 companies, respectively, operated more than 95% of the dehydrators.

Table 3.2 Dehydrator Company Distributions

Company Dehydrator Inventory	# of Companies			% of Dehydrators Reported		
	1999	2001	2003	1999	2001	2003
1-5 Dehydrators	77	27	14	4%	2%	1%
6-20 Dehydrators	44	16	8	11%	5%	3%
21-50 Dehydrators	23	17	17	16%	16%	16%
>50 Dehydrators	25	22	17	69%	77%	81%

3.2.4 Installation Type

This population of dehydrators includes units installed at:

- wellsites processing natural gas from the producing reservoir after primary liquid separation;
- compressor stations processing commingled gas from several gas wells;
- gas plants using ethylene glycol for the primary purpose of dew point control during low temperature liquid hydrocarbon separation processes;
- gas plant using triethylene or diethylene glycol to treat the gas after it has been processed to remove other unwanted components;
- central crude oil treating facilities (batteries) which typically process solution gas associated with crude emulsions from a number of wells; and
- reservoir or salt cavern gas storage facilities.

As Table 3.3 illustrates, there is no indication that installation types are undergoing significant changes. The general trends can be summarized as follows:

- There is a decrease in the proportion of dehydrators installed at wellsite locations. As previously noted, changes in the operating status of glycol dehydrators suggest that the active glycol dehydrator population (units that pose a potential benzene emission source) is decreasing. Converting a wellsite dehydrator to operate as a separator is a common practice as production pressure declines or operators move to central dehydration. As glycol is not circulated through the contactor or regenerated in the reboiler no benzene is emitted. Approximately 26% of reported glycol dehydrators are shut-in or by-passed (operating as a separator). It is the experience of the writers that the majority of units that have undergone a change in operating status (changed to shut-in or by-passed) are wellsite installations.
- There appears to be a consistent increase in the number of dehydrators installed at compressor locations. This trend is consistent with the practice of disabling wellsite dehydrator locations and centralizing dehydration at main compressor facilities.

Table 3.3 Dehydrator Installation Type

Installation Type	# of Dehydrators 2003	% of Dehydrator Data Reported				% Change 1995-2003
		1995	1999	2001	2003	
Wellsite	1,465	60%	52%	52%	46%	-14%
Compressor Station	995	19%	22%	26%	31%	12%
Gas Plant	326	7%	10%	8%	10%	3%
Gas Plant (Refrigeration Unit)	223	6%	10%	9%	7%	1%
Battery	182	5%	6%	5%	6%	1%
Other (Gas Storage)	11	3%	<1%	<1%	<1%	-3%
Not Reported*	518	--	--	--	--	
Total Dehydrators	3,720	100%	100%	100%	100%	

* Includes 302 unreported dehydrators and 216 reported units for which no installation type was reported.

3.2.5 Proximity to Residences

Most glycol dehydrators are located more than 750 metres from private residences or public facilities. Based on close proximity data provided for 2,956 units, indicating that approximately 14% of dehydrators are located within 750 metres of private residences or public facilities, the population of close proximity dehydrators for the entire dehydrator population is estimated at 511.

3.3 Benzene Emissions

3.3.1 Total Benzene Emissions

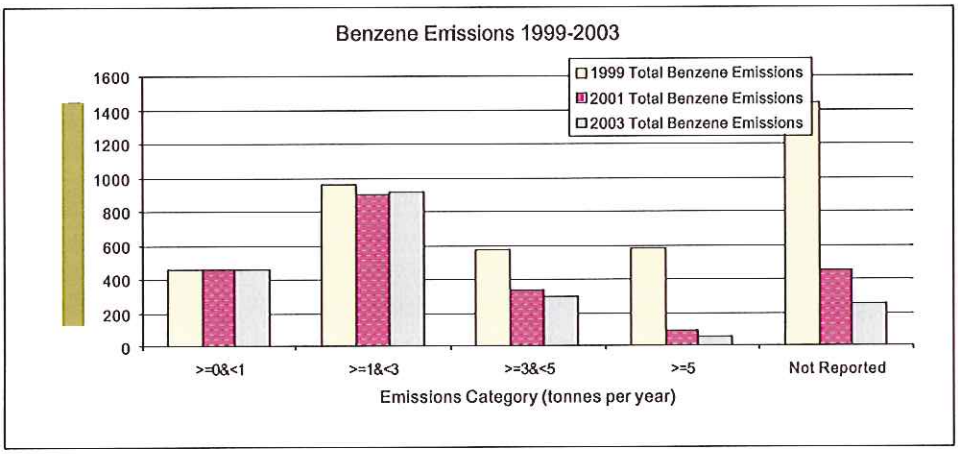
Emissions data were provided for a total of 3244 dehydrators or 87% of the estimated population. The total benzene emissions from these dehydrators totaled 1,733 tonnes per year resulting in an average annual benzene emission rate of 0.53 tonnes per unit. (for all dehydrators for which emissions data were provided). Assuming a similar average for dehydrators for which no emissions value was supplied (476 dehydrators) the estimated benzene emission total for the entire dehydrator population is estimated at 1,988 tonnes per year.

Total benzene emissions have been previously estimated at 2,224 tonnes per year

(2001), 4,006 tonnes per year (1999) and 8,743 tonnes per year (1995). The total benzene emissions for 2003 estimated at 1,988 tonnes per year represents a 77% reduction from 1995 levels.

Figure 3.1 Benzene Emissions by Category 1999 – 2003

As Figure 3.1 illustrates, benzene reductions can largely be attributed to the reduction of units emitting greater than 5 tonnes year.



3.3.2 Future Benzene Emissions

Future benzene emissions reduction options appear to be limited. Based on the data provided in Table 3.4, more than 97% of the glycol dehydrators (for which emission data was provided) are emitting less than 3 tonnes of benzene per year. More specifically, only 3% of the estimated emissions are associated with glycol dehydrators emitting greater than 5 tonnes per year.

3.3.3 Emissions by Installation Type

As found in previous studies, emissions per unit were highest for dehydrators installed at compressor sites and at batteries. Dehydrators installed at batteries typically receive gas associated with oil production and often have higher than average benzene concentrations in the raw gas resulting in relatively higher benzene emissions.

The lowest emissions per unit were estimated for units installed at wellsites and gas plant refrigeration units. The low emission levels are due, in part, to dehydration units at these locations:

- processing less gas;
- receiving gas which has previously been dehydrated by upstream glycol units thereby removing large proportions of benzene originally contained in the gas;
- the use of effective emission control devices more common at central facilities; and,
- the use of ethylene glycol (EG) by refrigeration units, which has a decreased affinity for benzene.

The following table summarizes the emissions from different dehydrator installations:

Table 3.4 Benzene Emissions by Dehydrator Installation Type

	Emissions Category (number of units)							
Installation Type	0 tpy (non-operating)	0 tpy (operating)	>0& <1 tpy	≥1& <3 tpy	≥3& <5 tpy	≥5 tpy	Emissions Not Reported	Totals
Wellsite (TEG or DEG)	627	84	484	218	25	2	25	1465
Compressor Station (TEG or DEG)	119	167	448	147	26	4	84	995
Gas Plant (TEG or DEG)	32	67	158	43	9	1	16	326
Gas Plant (EG refrigeration unit)	17	13	134	35	5	0	19	223
Battery (TEG or DEG)	32	18	86	25	6	0	15	182
Other (Gas Storage)	0	8	3	0	0	0		11
Installation Type not reported	30	19	103	41	8		317****	518
Total Dehydrators (2003)	857	376	1416	509	79	7	476	3720
2003 Total Benzene Emissions (tpy)	0	0	456	917	302	58	255[1]	1988
Total Dehydrators (2001)	n/a	n/a	2,715	506	87	24	649*	3,976
2001 Total Benzene Emissions (tpy)	n/a	n/a	454	903	329	176	363**	2,224
Total Dehydrators (1999)	n/a	n/a	2,500	564	151	114	1,040	4,369
1999 Total Benzene Emissions (tpy)	n/a	n/a	452	958	577	1078	942***	4,006

[1]Assumes 0.53 tonnes per unit average emission per unit for (3,244) dehydrators for which emission data was provided. * Includes 327 previously reported units not reported in the in the 2001 update. **Assumes 0.56 tonnes per unit average emission per unit for (3,327) dehydrators for which emission data was provided. ***Assumes 0.91 tonnes per unit average emission per unit for (3,385) dehydrators for which emission data was provided. **** Includes 302 unreported dehydrators and 15 reported units for which no installation type was reported.

3.3.4 Emissions by Control Method

Table 3.5 illustrates the prevalence of different emissions control methods. As found in previous studies, the majority of glycol dehydrators direct emissions to atmosphere or to storage tanks (aboveground and underground storage tanks). The results suggest a consistent increase in the installation of incinerators and flares to control emissions.

Operational changes such as optimization (e.g. reduction of glycol circulation rate) are often utilized to minimize emissions but are not specifically reflected in the data reproduced below.

Table 3.5 Benzene Emissions by Emission Control Method

Emissions Control	Emissions Category (number of units)									
	0 tpy (non-operating)	0 tpy (operating)	>0& <1 tpy	≥1& <3 tpy	≥3& <5 tpy	≥5 tpy	Emissions Not Reported	Totals 2003	Totals 2001	Totals 1999
No Control / Emissions to Atmosphere	433	186	576	248	39	4	17	1,503	2,118	2,250
Aboveground Storage Tank	42	43	194	47	9	0	3	338	411	359
Underground Storage Tank	25	15	53	34	6	2	0	135	157	187
Condenser	5	12	47	17	1	1	0	83	116	78
Flare	16	40	165	45	3	0	3	272	194	180
Incinerator	9	14	53	7	1	0	0	84	92	73
Other	12	5	20	7	1	0	1	46	--	--
Control Method Not Reported	315	61	308	104	19	0	452*	1259	886	1,242
2003 Dehydrators	857	376	1416	509	79	7	476	3,720		
2001 Dehydrators	n/a	n/a	2,715	506	87	19	649		3,976	
1999 Dehydrators	n/a	n/a	2,299	562	151	115	1,242			4,369

* Includes 302 unreported dehydrators and 150 reported units for which no control method was reported.

3.3.5 Emissions by Geographic Distribution

The average benzene emission rate per unit is estimated at 0.53 tonnes per year for all dehydrators.

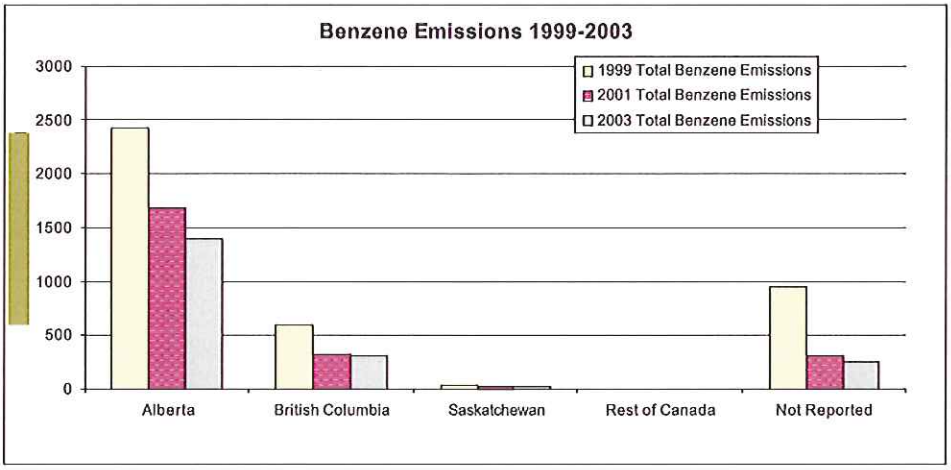
Table 3.6 Benzene Emissions by Geographic Area

Geographic Region	Emissions Level (number of units)						
	0 tpy (non-operating)	0 tpy (operating)	>0& <1 tpy	≥1& <3 tpy	≥3& <5 tpy	≥5 tpy	Not Reported
Alberta	767	283	1,071	433	61	5	151
British Columbia	66	37	226	71	18	2	14
Saskatchewan	22	52	108	4	0	0	7
Rest of Canada	1	0	8	0	0	0	0
Region Not Reported	1	4	3	1	0	0	304*
2003 Dehydrators	857	376	1,416	509	79	7	476
2001 Dehydrators	n/a	n/a	2,715	506	87	19	649
1999 Dehydrators	n/a	n/a	2,499	563	151	114	1,042

* Includes 302 unreported dehydrators and 2 reported units for which region was not reported.

Figure 3.2 Benzene Emissions by Geographic Area 1999 – 2003

As Figure 3.2 illustrates, the total emissions appear to have decreased consistently across all provinces.



3.3.6 Related Emissions Reductions

In addition to the benzene emissions reductions, benefits have also been associated with the reduction of operated glycol dehydrator units (i.e. approximately 26% of the glycol dehydrator population are reportedly used as a separator or are shut-in). Although exact emissions reductions are difficult to quantify the following are associated benefits:

- reductions of greenhouse gas (e.g. CO_2) emissions associated with the consumption of fuel gas;
- reductions of CH_4 and VOC emissions as a result of reductions in stripping gas use;
- reductions of CH_4 and VOC emissions associated with fugitive emissions of operating units; and
- reductions of CH_4 and VOC emissions associated with pneumatic instrumentation and pneumatic circulation pumps.

3.4 Industry Compliance

Overall, there appears to be continued industry compliance with the criteria outlined in the CAPP BMP for Glycol Dehydrators. The first exception appears to be the lack of public consultation associated with close proximity sites that exceed

the prescribed emissions level. The second exception appears to be the lack of a Decision Tree Process for the installation of new dehydrators. The following sections summarize the apparent industry compliance with the BMP requirements. BMP Compliance is tabulated in Table 3.7.

3.4.1 Industry Reporting

In 2003, dehydrator emissions data was received for 3244 of an estimated population of 3,720 dehydrators or 87% of the estimated dehydrator population. In 2001 and 1999 reporting years, dehydrator emissions data was received from 84% and 77%, respectively, of the estimated dehydrator population.

3.4.2 Emitters Greater than 5 tonnes Per Year

The BMP requires glycol dehydrators that were installed prior to January 1, 1999 or are located more than 750 metres away from a public facility or residence to emit less than 5 tonnes of benzene per year. In 2003, 7 of these dehydrators were reported as emitting greater than 5 tonnes of benzene per year resulting in a compliance with BMP requirements of >99%. Non-compliant dehydrators are currently the focus of emission reduction programs.

3.4.3 New Dehydrator and Emissions Greater than 3 tonnes Per Year

The BMP requires glycol dehydrators that are installed or modified after January 1, 1999 to emit less than 3 tonnes per year.

In 2003, there were 2 dehydrators reported as installed or moved after January 1, 1999 and emitting greater than 3 tonnes of benzene per year. This results in a rate of BMP compliance of >99%. Since January 1, 1999, a total of 211 new dehydrators have been installed. Non-compliant dehydrators are currently the focus of emission reduction programs.

New glycol dehydrators commissioned after January 1, 2001 are expected to have benzene emission controlled to the lowest level than can be practically achieved as described in the revised BMP. This is demonstrated by production of a Decision Tree Process. Approximately 26% of new dehydrators are reported as having a decision tree to comply with this requirement.

3.4.4 Close Proximity Greater than 3 tonnes Per Year

The BMP requires glycol dehydrators that are located within 750 metres of a public facility or permanent residence to reduce emissions below 3 tonnes per year prior to January 1, 2001.

In 2003, 1 'close proximity' unit was reportedly emitting greater than 3 tonnes per year. In 2001, 9 'close proximity' units are reportedly emitting greater than 3

tonnes per year. This total has decreased from 58 'close proximity' units reportedly emitting greater than 3 tonnes per year in 1999.

Most companies operating close proximity units did not contact residents. This may be due to the degree of ambiguity in the BMP regarding public consultation. The BMP states that "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." Many operators had plans in place to reduce emissions from close proximity units to less than 3 tonnes per year prior to January 1, 2001 and interpreted the public consultation requirement to apply only to locations that are not emitting less than 3 tonnes per year by January 1, 2001.

3.4.5 Baseline Emission Levels (1995) Emission Reduction Targets

The BMP states that the Canadian upstream oil and 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 benzene emissions baseline by January 1, 2005. The total benzene emissions for 2003 are estimated at 1,988 tonnes per year representing a 77% reduction from 1995 levels (8,743 tonnes per year). Canadian natural gas production increased 15% during this period.

Current benzene emission rates are an 11% reduction from 2001 levels and a 50% reduction from 1999 levels. Significant emission reductions were achieved principally by targeting high emitters (>5 tonnes per year). In 1999, benzene emissions from glycol dehydrators emitting more than 5 tonnes per year accounted for an estimated 1,078 tonnes per year or approximately 27% of the estimated emissions for the dehydrator population. In 2001, 175 tonnes (8% of the estimated total benzene emissions) of benzene per year were reported to be emitted from only 19 units emitting more than 5 tonnes of benzene annually.

In 2003, 7 dehydrators are reported as emitting over 5 tonnes per year. The operators of each of these units have indicated to the authors that they are in the process of being controlled. If they are controlled to the average rate of 0.53 tonnes per year, the emissions would drop from 58 tonnes per year to 3.7 tonnes per year.

It appears that further reductions will require reducing emissions from low emission units to meet the 90% benzene emission reduction target.

More than 97% of the glycol dehydrators are currently emitting less than 3 tonnes per year. Achieving a 90% reduction from 1995 levels would require a further 1,100 tonnes per year reduction in benzene emissions.

If all dehydrators emitting more than 3 tonnes per year (currently grandfathered to

less than 5 tonnes per year by the BMP) reduced benzene emissions to the average of 0.53 tonnes per year, the reduction would be 315 tonnes. If all dehydrators emitting more than 1 tonne per year reduced benzene emissions to the average of 0.53 tonnes per year, the reduction would be 962 tonnes. Dramatic reductions of this nature could require installation of many more "end-of-pipe" solutions such as condensers, flares and incinerators.

Figure 3.3 illustrates the effects of these reductions. "Target" values reflect the 90% benzene reduction target. "Probable" values illustrate the effect of all units that reported emitting more than 5 tonnes of benzene per year being controlled to emit the average of 0.53 tonnes per year. "<3TPY" values illustrate the effect of grandfathered units emitting an average of 0.53 tonnes of benzene per year. Similarly, "<1TPY" values illustrate the effect of all units that reported emitting more than 5 tonnes of benzene per year being controlled to emit the average of 0.53 tonnes per year.

Figure 3.3 Projected Benzene Emissions to 2005

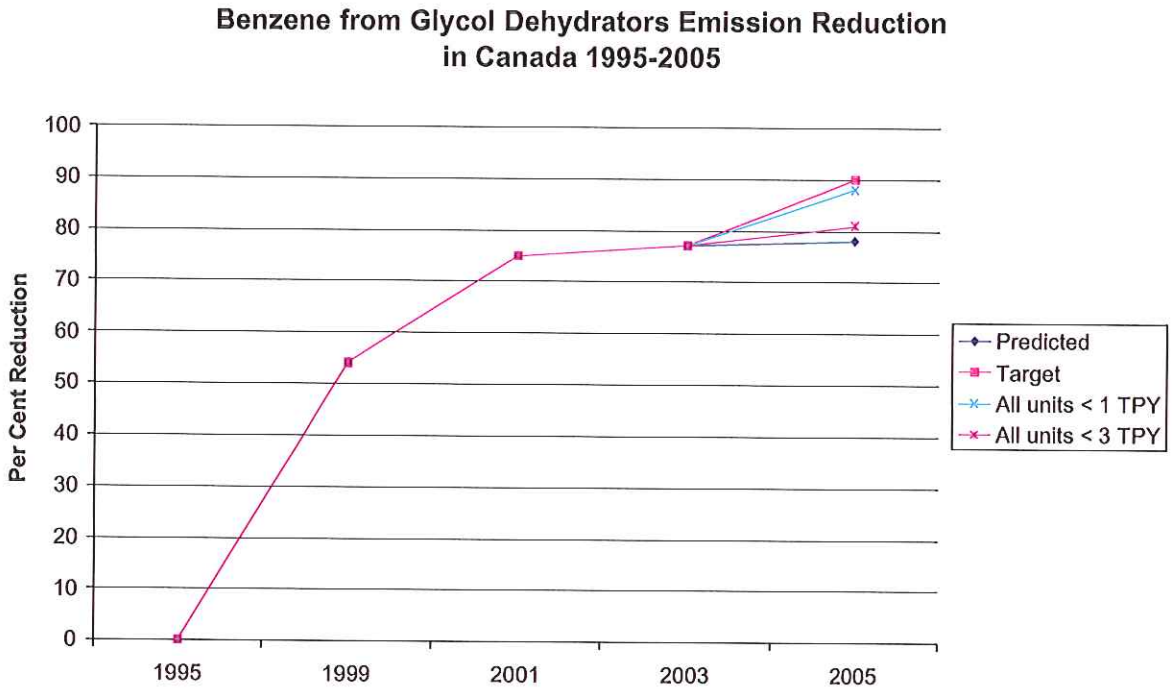


Table 3.7 BMP Requirements Compliance Summary

Requirement	Details	Estimated Compliance (2003)	Estimated Compliance (2001)	Estimated Compliance (1999)
Reporting Protocols	Report dehydrator benzene emissions inventory by June 1, 2003.	87%	84%	77%
Close Proximity Units	Reduction of Close Proximity Units within 750 metres of permanent residences or public facilities below 3 tonnes per year prior to January 1, 2001.	>99%	99%	92%
Greater then 5 tonnes per year	Emissions Levels < 5 Tonnes Per Year prior to January 1, 2001.	>99%	99%	97%
New Dehydrators	Emissions from New Units < 3 After January 1, 1999.	>99%	95%	N/A
	Low achievable emissions documented by Decision Process.	26%	N/A	N/A
Public Consultation	Companies are required to consult residence and / or public within 750 metres of dehydrators emitting greater than 3 tonnes per year.	N/A	N/A	N/A

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4 References

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