

Benzene Management Code of Practice

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|---------------------------|--|---------------------|--------------------|
| Content Owner | <u>Occupational Health</u> | | |
| Custodian | <u>H&S Programs & Projects</u> | | |
| H&S Discipline | Occupational Health | | |
| Program | Chemical Management | | |
| COMS | <u>See COMS Standards</u> | | |
| Document Number | CEN-EHS028 | | |
| Version | 2.0 | Review Cycle | 3 years |
| Revised Date | September 2, 2015 | Issued Date | September 22, 2014 |

| Version | Description | Date | Sign Off | | |
|---------|----------------|-------------|-----------|----------|---------------------|
| | | | Requester | Reviewer | Owner |
| 2.0 | Batch 4 Review | Sept., 2015 | | | Occupational Health |
| | | | | | |
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1.0 Purpose

The purpose of the Benzene Management Code of Practice (COP) is to set a minimum standard and provide operational guidance for controlling worker exposure to benzene.

2.0 Scope

This Benzene Management COP applies to all Cenovus worksites and encompasses all Cenovus work activities. Contractors working at Cenovus sites where benzene may be encountered are expected to have their own management program in place that offers an equivalent level of awareness and safety.

This Benzene Management Code of Practice supersedes any prior revisions and incorporates CEN-EHS006, Benzene Awareness Practice (repealed).

3.0 Benzene Management

3.1 What is Benzene?

Benzene is an aromatic hydrocarbon. It has a sweet smelling odour, and at room temperature it is a colourless liquid. Benzene is extremely volatile, as it easily evaporates in air, and is only slightly soluble in water. It is flammable, with a flammable range between 1.2 – 7.8% by volume.

Benzene originates from both natural sources and industrial processes. Benzene is a natural constituent of crude oil, a by-product of incomplete combustion and a component of cigarette smoke. It is mainly produced from petrochemicals and is used as a precursor to chemicals such as styrene and cyclohexane. It is also used in the manufacturing of products such as rubbers, lubricants, dyes, detergents, drugs and pesticides.

3.2 Health Effects

Benzene can enter the body through the lungs, digestive track and/or the skin. The primary route of exposure to benzene is inhalation. The severity of health effects depends on the dose, or the amount of benzene to which a person is exposed, and the duration of exposure.

Brief exposure to high concentrations of benzene in the hundreds of ppm range can cause drowsiness, dizziness, headaches, tremors, confusion and unconsciousness.

Chronic exposure to low concentrations of benzene can cause blood-related illnesses. These can range from anemia, excessive bleeding, to decreased immune response. Benzene is also a proven human carcinogen, as it can cause blood cancer (acute myeloid leukemia).

3.3 Benzene Management Program

As a result of the health risks associated with benzene exposure, all Cenovus worksites where benzene is present require a benzene management program. The benzene management program must be implemented by the respective asset team and shall consist of the following items:

- recognition of benzene on-site
- pre-job hazard assessment
- air monitoring and evaluation
- benzene hazard controls
- storage, use, handling and disposal procedures
- training
- review of the program every three years

3.3.1 Recognition of Benzene on Site

Although Cenovus does not use or produce pure benzene, we should assume that benzene is present in trace amounts in all hydrocarbon products and process streams unless otherwise determined. Examples of products or process streams containing benzene (either in the material or as emission) include:

- | | | |
|--------------------|------------------------|----------------|
| • condensate | • glycol (gas drying) | • lean oil |
| • crude oil | • amine (gas treating) | • sludge waste |
| • LPG/NGL | • produced water | • diluent |
| • warm lime sludge | • emulsion | • frac fluids |

3.3.2 Pre-Job Hazard Assessment

When working with materials containing benzene, a pre-job hazard assessment is required. All affected workers (i.e. the work crew and other workers in the surrounding area) must be accounted for in the pre-job hazard assessment.

Procedures must be in place to ensure sources of benzene be identified, flammability be considered, and worker exposure to benzene does not exceed applicable occupational exposure limits (OELs) and is kept as low as reasonably achievable.

3.3.3 Exposure Evaluation and Air Monitoring

Exposure to benzene is regulated in Alberta and Saskatchewan. The OELs are as follows:

Table 1: Occupational Exposure Limits for Benzene

| Jurisdiction | Benzene (ppm) | | |
|--------------|--|--------|---------|
| | 15-minute | 8-hour | 12-hour |
| Alberta | 2.5 | 0.5 | 0.25 |
| Saskatchewan | <i>As low as reasonably achievable (ALARA)</i> | | |

Saskatchewan does not have specific OELs for benzene as it follows the ALARA (as low as reasonably achievable) principle. For the purposes of compliance, evaluation and worker protection, **Cenovus operations in Saskatchewan shall comply with the Alberta standards.**

On a periodic basis or upon request, Cenovus Occupational Health will conduct personal monitoring for select representative Cenovus staff to quantify their individual exposure to benzene and to evaluate Cenovus’s compliance with provincial regulations.

In addition to exposure measurements, a trained and qualified user may use a handheld benzene monitor to measure near real-time atmospheric benzene levels for work activities or events to determine requirement for respiratory protection. These include but are not limited to:

- responding to accidental releases/spills
- line-breaks or entry into process equipment
- working with benzene-containing material
- manual tank gauging

Note: Only RAE Systems UltraRAE series monitors are approved for use at Cenovus. Other handheld monitors may be available but must not be used for benzene detection unless Cenovus Occupational Health or a qualified Cenovus representative who is competent in benzene monitoring and testing has been consulted.

3.3.4 Benzene Hazard Controls

Cenovus will reduce workers’ exposures to benzene at Cenovus worksites by ensuring control strategies are implemented in the following order, and in combination where necessary:

1. Elimination/substitution
2. Engineering controls
3. Administrative controls

4. Personal protective equipment (PPE)

3.3.4.1 Elimination/Substitution

If practical and feasible, a benzene-free product should be chosen over a product containing benzene, provided the substitute material has no greater health, safety and/or environmental impacts.

3.3.4.2 Engineering Controls

Wherever possible, engineering controls will be employed to reduce benzene release and worker exposure. Recommended engineering controls include the following:

- Keeping benzene-containing material contained as much as possible
- Scrubbing benzene and hydrocarbons off of effluent gas prior to venting
- Blanketing or venting storage tanks to vapour recovery systems to minimize airborne release of benzene
- Providing local exhaust ventilation where routine sampling of benzene-containing fluids is required

3.3.4.3 Administrative Controls

Where contact with benzene is anticipated, work practices shall be implemented to reduce potential exposure. These include but are not limited to the following:

- Educate workers of the hazard associated with benzene exposure. Workers must participate in training and monitoring programs.
- Conduct pre-job hazard assessments.
- Erect conspicuous signage to inform workers of the hazard, and limiting access to authorized persons only where benzene may be released.
- Use available engineering controls to minimize benzene release.
- Consider benzene exposure in procedures for sampling fluids, changing process and produced water filters and handling process water and centrate.
- Have an inspection and maintenance schedule for engineering controls used to reduce exposure.

3.3.4.4 Personal Protective Equipment (PPE) Controls

Where engineering and administrative controls are neither feasible nor effective, personal protective equipment shall be used.

Respiratory Protective Equipment (RPE)

The level of respiratory protection required depends on the atmospheric concentration of benzene and duration of exposure.

The use of respiratory protective equipment is allowed as per the minimum recommendations set out by the Cenovus Benzene Respiratory Protection Selection Matrix ([Appendix A](#)), provided the atmospheric concentrations and the exposure duration have been quantified by a competent person.

Atmosphere-supplying respirator (ASR) must be used if any of the following is true:

- the atmosphere is oxygen deficient
- the atmosphere contains unknown concentrations of a toxic gas or vapour
- the atmosphere contains other hazards that prohibit the use of an air-purifying respirator (APR)

Goggles and Gloves

Since benzene can be absorbed through intact skin, hazard assessments will consider the potential for skin and eye contact. Splash goggles and impervious gloves will be worn whenever risk of eye or skin contact exists, including during the following tasks:

- entering a vessel or cleaning a tank
- dismantling or opening process equipment
- manual gauging of tanks or tank opening, filling and/or unloading
- conducting maintenance on equipment that contains or carries benzene streams
- collecting process samples, especially those containing condensate and/or diluent
- changing glycol or amine filter
- responding to accidental spills and/or releases
- cleaning large screens/filters

3.3.5 Storage, Use, Handling and Disposal

Where practicable, materials containing benzene shall be enclosed to limit the potential release of benzene vapour to atmosphere, and to prevent worker exposure. Open containers of benzene-containing material are not acceptable.

Procedures shall be developed to ensure benzene releases and worker exposures are kept to a minimum using control methods deemed appropriate by the business unit.

The toxic and flammable nature of benzene must be taken into consideration when labelling or transporting materials and/or waste containing benzene as per WHMIS or TDG requirements, where applicable.

4.0 Roles and Responsibilities

The following responsibilities apply to this practice:

Table 2: Roles and Responsibilities

| Role | Description |
|--------------------------------|--|
| Cenovus Leadership | <ul style="list-style-type: none"> • Commission, develop, review and approve a COP for benzene storage, use, handling and disposal. • Ensure all practices will be reviewed and updated on a three-year cycle or more frequently as required. |
| Asset Team and Site Leadership | <ul style="list-style-type: none"> • Ensure all facilities under their control comply with the requirements of this COP and associated procedures. • Ensure training is provided to Cenovus employees potentially exposed to benzene. • Keep records of employee training in the Learning Management System (LMS). |
| Cenovus Supervisors | <ul style="list-style-type: none"> • Communicate benzene control procedures to affected workers. • Ensure the appropriate PPE is available. • Ensure employees use PPE when required. • Respond to worker questions directly or by seeking additional feedback from H&S personnel. • Provide feedback to the asset team and corporate management concerning the value and effectiveness of this COP and all associated procedures. • Ensure workers have been oriented to the hazards of benzene and the controls that are in place. The LMS or other suitable means to track competency may be used for this purpose. • Ensure contractors engaged to do work on Cenovus's behalf have practices to manage benzene hazards that the contractor's employees may encounter while working on Cenovus worksites. |

| Role | Description |
|---------------------|--|
| | <ul style="list-style-type: none"> • Apply this COP to worksites under their control and establish the necessary competencies for those who may be engaged to support the development and implementation of the COP requirements. |
| Cenovus Workers | <ul style="list-style-type: none"> • Familiarize themselves with this COP and all associated procedures. • Be aware of the hazards of benzene exposure and adhere to the controls that are in place to protect their health and safety. • Apply recommended practices and procedures, including PPE. • Seek clarification concerning any practice or procedure through their immediate Supervisor. • Report to their Supervisor any spills, incidents and/or unusual conditions that may occur during the work, and stop the work if necessary. |
| Contractors | <ul style="list-style-type: none"> • Review any practices and procedures provided to them by Cenovus. • Apply information from practices and procedures as minimum work standards as appropriate to their work situation. • Seek clarification concerning any Cenovus practice or procedure through their immediate Supervisor. • Implement their own benzene exposure control program. |
| Health & Safety | <ul style="list-style-type: none"> • Assist the asset team in complying with this COP and all associated procedures. • Respond to questions or concerns relating to the interpretation of this COP and all associated procedures. • Provide assistance to the asset team regarding appropriate benzene measurements. |
| Occupational Health | <ul style="list-style-type: none"> • Provide expertise on benzene monitoring and detection. • Review and provide continuous improvement on the COP. |

5.0 Training

Benzene Management Code of Practice training is to maintain a baseline competency that includes an understanding of benzene hazards and controls that Cenovus has in place.

5.1 Training

Frontline supervisors and workers should review this document prior to conducting work in environments where there is potential exposure to benzene.

All workers who are required to work in areas where benzene is present must complete the Cenovus Benzene Awareness eLearning module and practice review every three years. This training will at a minimum include the following:

- recognition of benzene hazards
- regulatory requirements relevant to the jurisdiction where the work is being conducted
- communication, assessment and monitoring for the control of benzene hazards
- the selection and use of controls

6.0 Quality Assurance

6.1 Performance Measurement

Compliance with this practice and program effectiveness shall be assessed through program assessments and internal audits, or other measurement criteria as specified in the COMS Assurance Standard. Measurement can also be accomplished through the tracking of appropriate Key Performance Indicators (KPI).

Business functions or departments impacted by this practice must include compliance and program effectiveness verifications in their business assurance program. Performance will be monitored and reported within the responsible departments at least every three years.

Central Health and Safety Services will review Cenovus-wide program KPIs at a minimum every three years in conjunction with program review and update activities.

6.2 Management of Change

Proposed changes to this practice can be directed to H&S Programs and Projects.

6.3 Practice Verification

The document owner will complete and document reviews of this practice, as follows:

- at minimum once every three years
- if there is a significant regulation or industry best practice change that indicates the need for review

- if an incident investigation indicates the causes were related to unclear or inadequate written instructions described within this practice

If frequent and multiple variances are required due to operational needs, the reason(s) will be investigated and the document owner will determine if there is a business need to update the practice.

If submitted MOC requests indicate gaps or significant improvement opportunities, the document owner will determine if there is a business need to update the practice.

7.0 Glossary

Definitions and acronyms for safety documents are described in CEN-EHS243, H&S Definition and Acronym Standard. The following definitions and acronyms are specific to this document:

Table 3: Terms and Definitions

| Term | Definition |
|-----------------|---|
| Flammable range | The range between the LEL and UEL is known as the flammable range for that gas or vapour. The minimum concentration of a gas or vapour that will burn in air is defined as the lower explosive limit (LEL). Below this level, the gas or vapour is too lean to burn. The maximum concentration of a gas or vapour that will burn in air is defined as the upper explosive limit (UEL). Above this level, the mixture is too rich to burn. |

Table 4: Acronyms, Initialisms and Abbreviations

| Term | In Full |
|-------|--|
| COP | Code of practice |
| PPE | Personal protective equipment |
| OELs | Occupational exposure limits |
| PPM | Parts per million |
| ASR | Atmosphere-supplying respirators |
| APR | Air-purifying respirator |
| ALARA | As low as reasonably achievable |
| RPE | Respiratory protective equipment |
| WHIMS | Workplace hazardous materials information system |
| TDG | Transportation of dangerous goods |
| COMS | Cenovus operations management system |
| KPI | Key performance indicators |
| LMS | Learning management system |

8.0 References

8.1 External Documents

The following external documents support this practice:

Table 5: External Document References

| Document Type or Number | Document Title |
|-------------------------|---|
| CAN/CSA | Standard Z94.4-02 Selection, Use and Care of Respirators |
| Work Safe Alberta | Best Practices for the Assessment and Control of Chemical Hazards |
| Work Safe Alberta | Benzene at the Work Site |

8.2 Internal Documents

The following Cenovus documents support this practice:

Table 6: Internal Document References

| Document Type or Number | Document Title |
|-------------------------|---|
| Policy | Corporate Responsibility Policy |
| CEN-EHSReg787 | Regulatory Definitions and Acronyms |
| CEN-EHS2632 | Chemical Management Standard |
| CEN-EHS108 | Personal Protective Equipment (PPE) Standard |
| CEN-EHS010 | Respiratory Protection Equipment Code of Practice |
| CEN-EHS019 | Hazard Assessment and Control Practice |
| Traccess | Benzene Awareness (eLearning) |

Appendix A: Cenovus Benzene Respiratory Protection Selection Matrix

Quantitatively (QNFT) Fit-Tested Workers

| Concentration\Duration | up to 15 min | 15 min - 1 hour | 1 hour - 3 hour | 3 hour - 6 hour | > 6 hour |
|------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| up to 0.25 ppm | none | none | none | Half-face | Half-face |
| 0.25 - 1 ppm | none | none | Half-Face | Half-Face | Half-Face |
| 1 - 2.5 ppm | Half-Face | Half-Face | Half-Face | Half-Face | Full-Face |
| 2.5 - 5 ppm | Half-Face | Half-Face | Half-Face | Full-Face | Full-Face |
| 5 - 10 ppm | Half-Face | Half-Face | Full-Face | SA/Ventilate | SA/Ventilate |
| 10 - 25 ppm | Full-Face | Full-Face | Full-Face | SA/Ventilate | SA/Ventilate |
| 25-50 ppm | Full-Face | Full-Face | SA/Ventilate | SA/Ventilate | SA/Ventilate |
| >50 ppm | SA/Ventilate | SA/Ventilate | SA/Ventilate | SA/Ventilate | SA/Ventilate |

- **This chart applies to workers who have been quantitatively fit-tested and hold a valid certificate of respiratory fit-testing.**
- **To protect against benzene vapour, organic vapour (OV) cartridges are required.**
- **The concentration of benzene must be determined with the use of an UltraRAE with scrubber tubes by a competent person.**

The **duration of exposure indicated is the **sum** over a workday. For example, if a worker is exposed to 0.5 ppm benzene for 45 minutes in the morning and 45 minutes in the afternoon, the total duration of exposure is 90 minutes. Therefore, the worker must don a half-face respirator at 0.5 ppm benzene for the 90 minutes.

Contact occupational.health@cenovus.com for questions or further information.

Qualitatively (QLFT) Fit-Tested Workers

| Concentration\Duration | up to 15 min | 15 min - 1 hour | 1 hour - 3 hour | 3 hour - 6 hour | > 6 hour |
|------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| up to 0.25 ppm | none | none | none | Half-face | Half-face |
| 0.25 - 1 ppm | none | none | Half-Face | Half-Face | Half-Face |
| 1 - 2.5 ppm | Half-Face | Half-Face | Half-Face | Full-Face | SA/Ventilate |
| 2.5 - 5 ppm | Half-Face | Half-Face | Full-Face | SA/Ventilate | SA/Ventilate |
| 5 - 10 ppm | Half-Face | Half-Face | SA/Ventilate | SA/Ventilate | SA/Ventilate |
| 10 - 25 ppm | SA/Ventilate | Full-Face | SA/Ventilate | SA/Ventilate | SA/Ventilate |
| 25-50 ppm | SA/Ventilate | SA/Ventilate | SA/Ventilate | SA/Ventilate | SA/Ventilate |
| >50 ppm | SA/Ventilate | SA/Ventilate | SA/Ventilate | SA/Ventilate | SA/Ventilate |

- **This chart applies to workers who have been qualitatively fit-tested and hold a valid certificate of respiratory fit-testing.**
- **To protect against benzene vapour, organic vapour (OV) cartridges are required.**
- **The concentration of benzene must be determined with the use of an UltraRAE with scrubber tubes by a competent person.**

The **duration of exposure indicated is the **sum** over a workday. For example, if a worker is exposed to 3 ppm benzene for 45 minutes in the morning and 45 minutes in the afternoon, the total duration of exposure is 90 minutes. Therefore, the worker must don a full-face respirator at 3 ppm benzene for the 90 minutes.

Contact occupational.health@cenovus.com for questions or further information.