ERCBflare
Update to the Sour Gas Industry Screening Tool

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Outline
1. Directive 060 update overview
2. ERCBflare update overview
Disclaimer

• Certain statements contained in this presentation constitute forward-looking information. The information released in this presentation is preliminary only and may be subject to change. The following information is provided for guidance and summary purposes only and is not an exhaustive description of ERCB requirements relating to a given topic or subject area. Operators and licensees must at all times comply with and should consult all applicable ERCB requirements before undertaking any activity.

D060 – the need for change

• Negative public perception regarding flaring and the need to reduce volumes
• Current dispersion modelling criteria is intended for continuous flaring
• Inconsistent risk based criteria
• Screening tool is out of date
• Recent updates in science
• Inconsistent dispersion modelling assessments
D60 - *NEW* Non Routine Flaring

- Remove the need to assess cumulative effects on ambient air quality for well tests and non routine flaring
- Applies to all non routine flaring events with $\text{H}_2\text{S} > 1\%$ or $> 1 \text{ t/d sulphur}$ except if $1 \text{ t}$ of sulphur and $< 15 \text{ min}$
- Risk Based Criteria
- Logging requirements
- Post modelling requirements

D60 Updates

- Released in early 2013
- Upon sanctioning this framework operators must assess non routine flaring within:
  - within 1 year for EPEA facilities
  - within 2 years for compressor stations, dehys, batteries
  - within 4 years for well sites
  - effective immediately for temporary flares/well tests
**D60 Updates**

The following documents will be made available in 2013:

- AESRD Non-Routine Flaring Management: Modelling Guidance
- Directive 60 (2013)
  - ERCBFlare User Guide
  - ABFlare User Guide
- CAPP Framework Sour Non-Routine Flaring

**ERCBflare Tool Highlights**

- **Required Updates**
  - Keeping up to pace with ERCB D060
  - Updatable air dispersion model
  - Screening predictions consistent with refined predictions
  - Getting from A to B to C in air dispersion modelling

- **Features Removed**
  - Screen3

- **Features Changed/Modified**

- **New Features**
  - AERMOD/AERSCREEN
  - SO2 and H2S Emissions
Acknowledgements

- Funding for updates and components of the ERCBflare tool:
  - PTAC-Alberta Upstream Petroleum Research Fund (AUPRF)
  - Suncor
- ERCBflare tool
  - Developed by M.Zelensky & Zelt PSI
- ABflare tool
  - Developed by Zelt PSI, M.Zelensky and Exponent
Flaring

- Routine
- Non-Routine
- Planned: Well Test
- Unplanned: Upset & Emergency

All photos plucked from internet via Google search: Flare Stack. Any similarity to your personal flaring situation is by coincidence.

REMOVED

- ERCBscreen3
  - SCREEN3 predictions are not consistent with AERMOD nor CALPUFF
  - SCREEN3 cannot be relied upon to be a conservative prediction
  - SCREEN3 is no longer a regulatory model and is not updated
  - SCREEN3.dll requires distribution in both 32-bit and 64-bit versions

- Minimum fuel gas calculations
  - These were dependent upon the SCREEN3 calculations and AENV screening meteorology data
**REMOVED**

- ERCB low risk prediction (99% on time)
  - This screening calculation was dependent upon the AENV meteorology data set(s) and SCREEN3 predictions
  - Percentiles are highly dependent upon site specific meteorology and terrain

**Modified**

- Renamed all pages
  i – xxx are INPUT pages
  o – xxx are OUTPUT pages
- Entry fields that are not applicable are *grey*’ed out
*Modified*

- **iTerrain**
  - Reduced Basic Terrain; Complex Terrain; and Terrain Graphic to a single page to reduce clutter
  - All assessments require terrain assessment
  - Domain to lesser of maximum elevation distance or 10km

*Modified*

- **iFacility Page**
  - Lahee lookup dropdown
  - Landuse characterization

- **iFlaring Page**
  - Changed layout for fuel gas addition
  - Flare assist for steam; air; both
  - Lift gas stream
  - Calculations for necessary fuel gas
*Modified*

- Defaults entries are required regulatory applications
- Non-Default entries are allowed for recreational use

- iNotes page (previously “Attachments”)
  - AT LEAST answer these questions...
    ...or the application will be returned

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*Modified* iNotes Page

1. For permanent facilities describe the flaring event modelled including the type of facility, pipeline segments or vessels to depressurize (if applicable), PSV size, etc.
2. Estimate the frequency of the flaring event
   a) number of events per year;
   b) duration of each event;
   c) total number of hours per year
3. Describe attempts to reduce or eliminate the flaring event(s) if applicable
4. State any engineering assumptions you’ve made in completing the entries for ERCBflare
**Modified** & **New**

- **Fuel Gas**
  - Shows required amount of fuel gas
- **Lift Gas**
  - User defined stream composition
- **Flare Assist**
  - Steam assist & Air assist

**NEW** iStart Page

- **Specify NON-ROUTEINE FLARE ASSESSMENT**
  - Planned – Risk Based Criteria
  - Upset/Emergency - Risk Based Criteria
  - Required 3-Modelling Rates
- **Specify ROUTINE FLARE ASSESSMENT**
  - Continuous – Std. 99.9th Criteria
  - Required Max-Modelling Rate
- **RBC with % not to exceed**
- **MAXIMUM (or %) cannot exceed**
Lahee Classification page description

Includes D060 Tier level lookup

Relates to volume allowance

LAHEE CLASSIFICATION REFERENCE

The Lahee classification is an assignment given to a well before it is drilled, reflecting the degree of geological control and known hydrocarbon potential. It was designed to characterize a well as having a high or low risk as a result of the discovery of a new pool.

The classification of exploration wells was established by Frederic H. Lahee in 1944, and has been widely used by AAPG-CSD and API. It is used in well licensing procedures in Canada's provinces and territories.

<table>
<thead>
<tr>
<th>Numeric</th>
<th>Lahee Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFW</td>
<td>New Field Wildcat</td>
<td>The Lahee NFW is located at a considerable distance beyond the limits of known pools and is outside the boundaries of existing fields. The well is drilled in an area where hydrocarbons have not yet been discovered. The geological risk of this type of well is very high. If the well is successful, it will be deemed successful. Samples are collected from the base of the formation to the total depth.</td>
</tr>
<tr>
<td>NPW</td>
<td>New Pool Wildcat</td>
<td>The Lahee NPW is located in an area where hydrocarbons have not yet been discovered. The geological risk of this type of well is very high. If the well is successful, it will be deemed successful. Samples are collected from 30 meters above the deepest hydrocarbon-bearing horizon to the total depth.</td>
</tr>
<tr>
<td>NRW</td>
<td>New Remote Wildcat</td>
<td>The Lahee NRW is located in an area where hydrocarbons have not yet been discovered. The geological risk of this type of well is very high. If the well is successful, it will be deemed successful. Samples are collected from the base of the formation to the total depth.</td>
</tr>
</tbody>
</table>
**NEW** D060 References

Temporary Approval Page
- Table of D060 dependencies and limits
- D060 Figure 4 – Approval required check
- Updated the modelling output section
- Explicit D060 conditions on flaring or modelling with pass/see requirements

**NEW** Blowdown Page
- Additional input section for transient blowdown calculations
- Allows override for user entry of max flow & volume
- Transient blowdown model is an exponential curve based upon the Max Flow, Volume and final pressure
- Built-in processing for flaring less than one-hour duration
**NEW** oBlowdown

### Transient Source

<table>
<thead>
<tr>
<th>Description</th>
<th>Units</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blowdown Volume</td>
<td>m³</td>
<td>148.0</td>
</tr>
<tr>
<td>Excess Flow Rate</td>
<td>m³/minute</td>
<td>655.0</td>
</tr>
<tr>
<td>Exponential Time Constant, $\tau$</td>
<td>min</td>
<td>313.1</td>
</tr>
<tr>
<td>% of Mass Released in 1284.3 min</td>
<td>%</td>
<td>97.9</td>
</tr>
<tr>
<td>Flaring Rate</td>
<td>m³/minute</td>
<td>375.6</td>
</tr>
</tbody>
</table>

### Requirements

- **Equal Mass Puffs**: 3 puffs of equal mass
- **Equal Duration Puffs**: 3 puffs of 428 min duration

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**NEW** AERSCREEN Modelling

- AERSCREEN replaces SCREEN3 for ERCBflare modelling
- AERSCREEN is a specific mode of operation of AERMOD
  - All winds blow in direction of every receptor
  - Meteorology is a $\mu$-meteorological matrix with variation in:
    - Heating; Temperature; $u^*$; $w^*$; Monin-Obukov length
    - User selection of Bowen Ratio, surface roughness, temperature range, Albedo
  - AERSCREEN performs lookup of meteorology conditions related to maximums
How AERSCREEN is implemented

- ERCBflare uses 8 default meteorology files
  - Deciduous; Coniferous; Swamp; Grassland; Grassland; Water; Urban; Desert (at present 0% is desert)
  - Landcover is decided by flare location and lookup

Meteorology files are 3-month and 4-season
- Winter (Dec-Jan-Feb)
- Spring (Mar-Apr-May)
- Summer (Jun-Jul-Aug)
- Fall (Sep-Oct-Nov)

Characterization is based upon AEW – AQMG recommended AERMOD

Figure 1 shows as a function of distance and terrain
- concentrations,
- windspeed at max concentration,
- mixing height at maximum concentration, and
- P& stability at maximum concentration
How AERSCREEN is implemented...

- Figure 1 shows results for:
  - 3-rates (Qmax, Qave, Qlow)
  - Parallel Terrain & elevated terrain
  - Terrain elevations

- Figure 2: for Non-Routine hour-by-hour source
  - Emissions Probability for SO₂ and H₂S
  - Efficiency Probability

Efficiency

Mass Emission Rates
*NEW* Bridges to Refined

• To allow ‘seemless’ transition from screening modelling to refined modelling:
  – Refined-Screening model within ERCBflare
  – Output of AERMOD ready input files
  – Same Processing As ABflare (refined modelling)
  – Switch to save input files

*NEW* Recalculate Options

Non-Routine Flaring Approval

Routine Flaring Assessment
*NEW* Bridges to Refined Modelling

**NON-ROUTINE**
- Allow hour-by-hour source conditions (with simplification)
- Allow site specific meteorological data file
- Creates a variable source file for use with AERMOD in full mode
  - Full terrain
  - Site specific meteorology

**ROUTINE**
- Allow site specific meteorological data file
- Creates a AERMOD ready file
  - Full terrain
  - Site specific meteorology

*NEW* Screening Modelling

**NON-ROUTINE**
- Screening Met $\rightarrow$ MAX CONCENTRATION
- User Met (5yr) $\rightarrow$ RBC
- Specific Month (uses User Met, 5yr, and 3-month window) $\rightarrow$ RBC

**ROUTINE**
- Screening Met $\rightarrow$ MAX CONCENTRATION
- User Met (5yr) $\rightarrow$ 99.9th
*NEW* SO_2 and H_2S

- ERCBflare uses flare efficiency model
- Efficiency is a function of:
  - Heating value
  - Meteorology
- Source parameters are function of efficiency
- SO_2 emissions are worse case 100% conversion
  - No credit for in-efficiency
- H_2S emissions based upon in-efficiency
  - Assumes worse case fuel gas stays as fuel gas,
    \[ \therefore \text{H}_2\text{S stays as H}_2\text{S} \]

Modified & *NEW*

- SO_2 source parameters based upon heat and momentum energy balance
- H_2S source parameters based upon momentum of stripped gas and stripped heat
Flare Modelling Screening vs Refined

SCREENING
• ERCBflare Tool
• AERSCREEN (AERMOD)
• Gaussian Plume Model
• Simplified Hour-by-hour variable source
• Terrain effects by plume height adjustment

REFINED
• ABflare Tool
• CALPUFF
• Lagrangian Puff Model
• Complete hour-by-hour variable source model
• Terrain effects by terrain avoidance and/or plume height adjustment

Non-Routine Flare Modelling
Modelling Guidance

<table>
<thead>
<tr>
<th>Rate Category</th>
<th>Modelling Refinement Level</th>
<th>Non-Routine Flare Source Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous</td>
<td>1</td>
<td>A steady (constant in time) non-routine flaring rate that:                                                                                                                                  • lasts 1 hour to several days,  • flare durations approaching one day should be modelled as a continuous flare  • use 3 constant rates to represent the maximum, average and low emission rates.</td>
</tr>
<tr>
<td>Short-Term Steady</td>
<td>2</td>
<td>A steady (constant in time) non-routine flaring rate that:                                                                                                                                  • lasts several minutes but less than 24 hours,  • use 3 constant rates to represent the maximum, average and low emission rates</td>
</tr>
<tr>
<td>Exponential Transient</td>
<td>3</td>
<td>A transient (time-varying) non-routine flaring rate that:                                                                                                                                • lasts several minutes to several days,  • represented by an exponentially decreasing emission rate sequence of puffs of specified duration,  • typical of a single stage blow down (vessel or pipeline).</td>
</tr>
<tr>
<td>User-Defined Transient</td>
<td>4</td>
<td>A transient (time-varying) non-routine flaring rate that:                                                                                                                                • lasts several minutes to several days,  • represented by random sequence of emission rates and durations determined by the user,  • typical of a multi-stage blow down (vessels and pipelines).</td>
</tr>
</tbody>
</table>
# Non-Routine Flare Modelling

## Modelling Guidance

<table>
<thead>
<tr>
<th>Rule Category</th>
<th>Source Model</th>
<th>Dispersion Model</th>
<th>Dispersion Refinement Level</th>
<th>Source Modelling and Post Processing Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous</td>
<td>Continuous</td>
<td>Plume *</td>
<td>1</td>
<td>The emission rate(s) is modelled as if the source emitted continuously. Use continuous source modelling methodology according to DETAIL A. Post processing for time averages is not required.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Puff *</td>
<td>1</td>
<td>The emission rate(s) is modelled as if the source emitted continuously. Use continuous source modelling methodology according to DETAIL A. Post processing for time averages is not required.</td>
</tr>
<tr>
<td>Short-Term Steady</td>
<td>Continuous</td>
<td>Plume</td>
<td>1</td>
<td>Source emission rates are determined based upon the actual duration of the short-term event. Use continuous source modelling methodology according to DETAIL A. Time averages for 1h are post-processed according to DETAIL B.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Puff</td>
<td>1</td>
<td>Source emission rates are determined based upon the actual duration of the short-term event. Use continuous source modelling methodology according to DETAIL A. Time averages for 1h are post-processed according to DETAIL B.</td>
</tr>
<tr>
<td>Finite Duration Puffs</td>
<td>Continuous</td>
<td>Plume</td>
<td>1</td>
<td>Source emission rates are determined based upon the actual duration of the short-term event. Use continuous source modelling methodology according to DETAIL A. Time averages for 1h are post-processed according to DETAIL B.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Puff *</td>
<td>2</td>
<td>Source emission rates are determined based upon the actual duration of the short-term event. Use continuous source modelling methodology according to DETAIL A. Time averages for 1h are post-processed according to DETAIL B.</td>
</tr>
<tr>
<td>Exponential Transient or User-Defined Transient</td>
<td>Continuous</td>
<td>Plume</td>
<td>1</td>
<td>Source emission rates are determined according to the blowdown exponential transient in terms of a sequence of short-term steady emissions. Use continuous source modelling methodology according to DETAIL A. Each emission is assessed independently and the results of all of the assessments are post-processed according to DETAIL E.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Puff</td>
<td>1</td>
<td>Source emission rates are determined according to the blowdown exponential transient in terms of a sequence of short-term steady emissions. Use continuous source modelling methodology according to DETAIL A. Each emission is assessed independently and the results of all of the assessments are post-processed according to DETAIL E.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sequence of Finite Duration Puffs</td>
<td>3 or 4</td>
<td>Source emission rates are determined based upon the actual duration of the short-term event. Source emission rates are determined according to the blowdown exponential transient in terms of a sequence of short-term steady emissions. The source modelling is conducted according to DETAIL F. Time averages are post-processed according to DETAIL D.</td>
</tr>
</tbody>
</table>

---

*NEW* iBatch Page

- For recreational use
- Sensitivity testing
- Field-Flare database in one location

This company is looking for new summer students... again
**NEW* Geek Backdoor

- Several backdoor options are made available for recreational use

### Advanced Technical Switches

<table>
<thead>
<tr>
<th>Description</th>
<th>Variable</th>
<th>Units</th>
<th>Inputs</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Re-create run.bat file each time</td>
<td>mrunbat</td>
<td>--</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Add pause to run.bat file</td>
<td>mpause</td>
<td>--</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Keep input files</td>
<td>mkeep</td>
<td>--</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>AERMOD input files- uses 0,0 origin</td>
<td>mrelloc</td>
<td>--</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>AERMOD input files-export receptors</td>
<td>mexprec</td>
<td>--</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Non-Default Settings

<table>
<thead>
<tr>
<th>Description</th>
<th>Variable</th>
<th>Units</th>
<th>Inputs</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient Temperature</td>
<td>Ta</td>
<td>°C</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Average Ambient Wind Speed</td>
<td>Ua</td>
<td>m/s</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Rainfall</td>
<td>PRA</td>
<td>mm</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>SMOKE TNOX Quality Index</td>
<td>QSM</td>
<td>--</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>SMOKE TNOX Quality Index - NOx</td>
<td>QSNX</td>
<td>--</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Red Flag</td>
<td>RFLG</td>
<td>--</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>User Period Selection (Annual or Monthly)</td>
<td>MFL</td>
<td>--</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Blown Down Distribution of Mass Option</td>
<td>MDI</td>
<td>--</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Blown Down User Entry of Qmax</td>
<td>Qmax</td>
<td>--</td>
<td>blank</td>
<td>blank</td>
</tr>
<tr>
<td>Blown Down User Entry of Qtotal</td>
<td>Qtotal</td>
<td>--</td>
<td>blank</td>
<td>blank</td>
</tr>
<tr>
<td>Land Use around the well site</td>
<td>WELL_LU</td>
<td>--</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

### Release Date

- To coincide with the release of the ERCB D060 Updates
- Install package or ZIP file
- Excel 2007 or greater (to be determined...)
- Draft User Guide
- Refined Model – ABflare
  - Somewhat dependent upon final decisions for ERCBflare for consistency
Questions...