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- Screening tool is out of date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 H_2S >1% or > 1 t/d sulphur except if 1 t of sulphur and < 15 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 1year 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

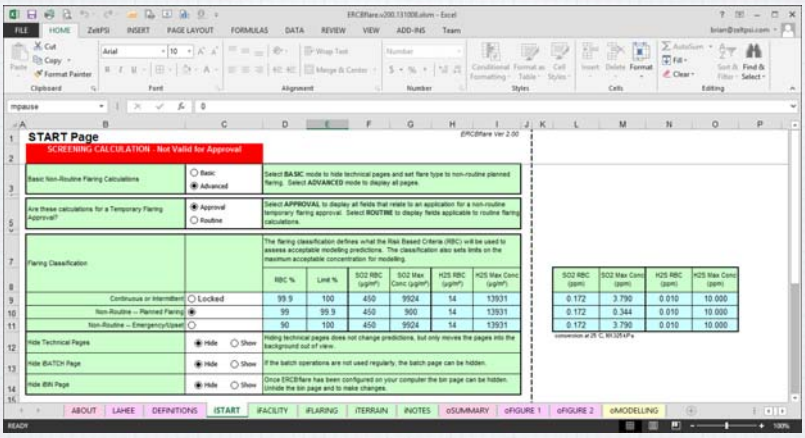
The following documents will be made available in 2013:

- 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

ERCBflare - *NEW* looks



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

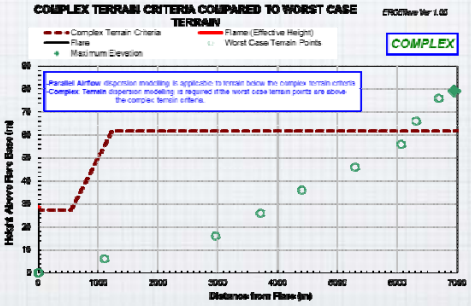
- ERCB low risk prediction (99% on time)
  - This screening calculation was dependent upon the AENV meteorology data set(s) and SCREEN3 predictions
  - Percentiles are highly dependent upon site specific meteorology and terrain

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



Keep the graphic for reference. Complex terrain criterion is displayed for reference

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

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-ROUTINE 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

iStart Page

Basic Non-Routine Flaring Calculations	○ Basic ○ Advanced	Select **BASIC** mode to hide technical pages and set flare type to non-routine planned flaring. Select **ADVANCED** mode to display all pages.
Are these calculations for a Temporary Flaring Approval?	◉ Approval ○ Routine	Select **APPROVAL** to display all fields that relate to an application for a non-routine temporary flaring approval. Select **ROUTINE** to display fields applicable to routine flaring calculations.

Flaring Classification		The flaring classification defines what the Risk Based Criteria (RBC) will be used to assess acceptable modelling predictions. The classification also sets limits on the maximum acceptable concentration for modelling.					
		RBC %	Limit %	SO2 RBC (µg/m³)	SO2 Max Conc (µg/m³)	H2S RBC (µg/m³)	H2S Max Conc (µg/m³)
Continuous or Intermittent	○ Locked	99.9	100	450	9924	14	13931
Non-Routine -- Planned Flaring	◉	99	99.9	450	900	14	13931
Non-Routine -- Emergency/Upset	○	90	100	450	9924	14	13931

Hide Technical Pages	○ Hide ◉ Show	Hiding technical pages does not change predictions, but only moves the pages into the background out of view.
Hide iBATCH Page	○ Hide ◉ Show	If the batch operations are not used regularly, the batch page can be hidden.
Hide iBIN Page	○ Hide ◉ Show	Once ERCBflare has been configured on your computer the bin page can be hidden. Unhide the bin page and to make changes.

NEW Lahee Lookup

- Added Lahee Classification page description
  - Includes D060 Tier level lookup
  - Relates to volume allowance

LAHEE CLASSIFICATION REFERENCE

ERCBflare Ver 2.00

The Lahee classification is an assignment given to each well before it is drilled, and reflects the degree of geological control and known hydrocarbon potential of a drilling location at the time when a well is planned. It was designed to characterize a well by the general degree of risk assumed by the operator

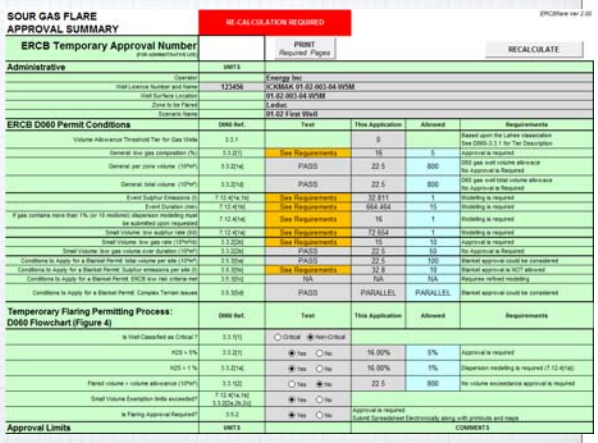
This classification of exploratory wells was established by Frederic H. Lahee in 1944, and has been used since then by AAPG-CSD and API. It was widely adopted throughout North-America and is used with a few additions at well licensing procedure in Canada's provinces and territories

	Mnemonic	Lahee classification	Description	Tier
1	NFW	New Field Wildcat	An NFW well 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: in the absence of the discovery of a new pool, the well would be deemed successful. Samples are collected from base of surface casing to total depth.	1
2	NPW	New Pool Wildcat	The objective of an NPW well is the discovery of a new pool(s) in all zones that the well encounters. The well is located in an already discovered field. The geological risk of this type of well is very high: in the absence of the discovery of a new pool, the well would be deemed unsuccessful. In circumstances where the well is in relatively close proximity to the limits of a known pool(s), the NPW classification must be based on technical data suggesting that a new pool will be encountered. A well drilled within or in close proximity to the limits of a known pool(s) but terminating shallower than the known pool(s) is normally classified as NPW, except in the case where pre-existing wells in close proximity to the well have logs and/or tests that strongly suggest the existence of shallower pools to be penetrated by the well. Samples are collected from 30 m above shallowest potential hydrocarbon bearing horizon to total depth.	1

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



SOUR GAS FLARE APPROVAL SUMMARY — RE-CALCULATION REQUIRED

ERCB Temporary Approval Number — PRINT Required Pages — RECALCULATE

Administrative	UNITS	
Operator		Energy Inc
Well Licence Number and Name	123456	ICXMAX 01.02.003-04 W5M
Well Surface Location		01.02.003-04 W5M
Zone to be Flared		Ledac
Scenario Name		01.02 First Well

ERCB D060 Permit Conditions	D060 Ref.	Test	This Application	Allowed	Requirements
Volume Allowance Threshold Tier for Gas Wells	3.3.1		0		Based upon the Lahee classication See D060-3.3.1 for Tier Description
General: Inv gas composition (%)	3.3.2[1]	See Requirements	16	5	Approval is required
General: per zone volume (10^6m³)	3.3.2[1d]	PASS	22.5	800	D60 gas well volume allowance No Approval is Required
General: total volume (10^6m³)	3.3.2[1d]	PASS	22.5	800	D60 gas well total volume allowance No Approval is Required
Event Sulphur Emissions (t)	7.12.4[1a.1b]	See Requirements	32.911	1	Modelling is required
Event Duration (min)	7.12.4[1b]	See Requirements	664.464	15	Modelling is required
If gas contains more than 1% (or 10 moll/mol) dispersion modelling must be submitted upon requested	7.12.4[1a]	See Requirements	16	1	Modelling is required
Small Volume: Inv sulphur rate (t/d)	7.12.4[1a]	See Requirements	72.654	1	Modelling is required
Small Volume: Inv gas rate (10^6m³/d)	3.3.2[2b]	See Requirements	16	10	Approval is required
Small Volume: Inv gas volume over duration (10^6m³)	3.3.2[2b]	PASS	22.5	10	No Approval is Required
Conditions to Apply for a Blanket Permit: total volume per site (10^6m³)	3.3.3[3a]	PASS	22.5	100	Blanket approval could be considered
Conditions to Apply for a Blanket Permit: Sulphur emissions per site (t)	3.3.3[3b]	See Requirements	32.9	10	Blanket approval is NOT allowed
Conditions to Apply for a Blanket Permit: ERCB Inv risk criteria met	3.3.3[3c]	NA	NA	NA	Requires refined modelling
Conditions to Apply for a Blanket Permit: Complex Terrain issues	3.3.3[3d]	PASS	PARALLEL	PARALLEL	Blanket approval could be considered

Temperorary Flaring Permitting Process: D060 Flowchart (Figure 4)	D060 Ref.	Test	This Application	Allowed	Requirements
Is Well Classified as Critical ?	3.3.1[1]	○ Critical ◉ Non-Critical			
H2S > 5%	3.3.2[1]	◉ Yes ○ No	16.00%	5%	Approval is required
H2S > 1 %	3.3.2[1a]	◉ Yes ○ No	16.00%	1%	Dispersion modelling is required (7.12.4[1a])
Flared volume > volume allowance (10^6m³)	3.3.1[2]	○ Yes ◉ No	22.5	800	No volume exceedance approval is required
Small Volume Exemption limits exceeded?	7.12.4[1a.1b] 3.3.2[2a.2b.2c]	◉ Yes ○ No			
Is Flaring Approval Required?	3.5.2	◉ Yes ○ No	Approval is required Submit Spreadsheet Electronically along with printouts and maps		

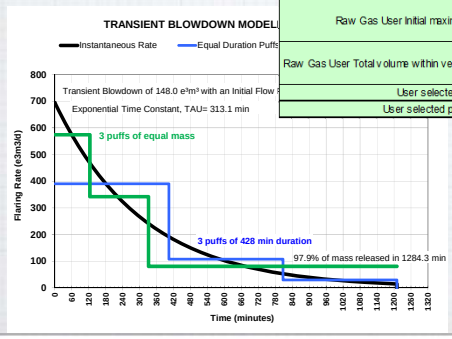
Approval Limits	UNITS		COMMENTS

NEW oBlowdown 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	UNITS	ENTRY
Expected Maximum Initial Pressure, PRESS0	kPa (gauge)	4200
Expected Minimum Initial Gas Temperature, TEMP0	°C	30
Expected Minimum Final Pressure, PRESS1	kPa (gauge)	0
Pipeline/Vessel Inside Diameter, VESSELDIA	m	0.4364
Pipeline/Vessel Length, VESSELLEN	m	25100
Minimum Orifice Diameter, ORIFICE_DIA	mm	43
Discharge Coefficient, DCOEFF	--	0.6
Select the way the blow down curve is converted from a continuous curve to discrete steps MDIST	--	○ 1. Equal Duration ◉ 2. Equal Mass
Raw Gas User Initial maximum flow rate, QMAX	10^3m³/d (15°C and 101.325 kPa)	
Raw Gas User Total volume within vessels/pipes, QTOTAL	10^3m³ (15°C and 101.325 kPa)	
User selected # of puffs, NPUFFS	--	3
User selected puff duration, PUFDUR	min	

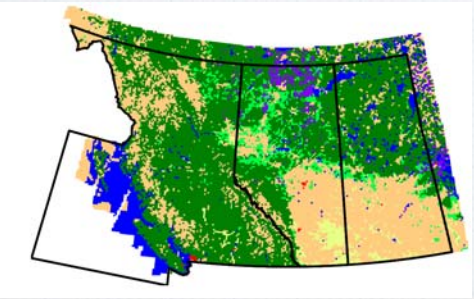


NEW AERSCREEN Modelling

- 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 μ-meteorological matrix with variation in:
    - Heating; Temperature; u*, w*; Monin-Ubikov 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



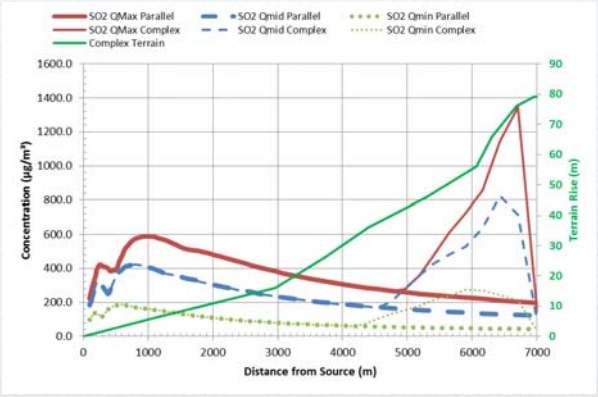
		Description	Alberta Fraction
	10	Coniferous Forest	34.8%
	20	Deciduous Forest	14.7%
	30	Cultivated Land	29.4%
	40	Grassland	9.1%
	50	Urban	0.5%
	60	Swamp	7.9%
	70	Water	3.7%
	80	Desert Shrubland	0.0%

How AERSCREEN is implemented...

- 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
- oFigure1 shows as a function of distance and terrain
  - concentrations,
  - windspeed at max concentration,
  - mixing height at maximum concentration, and
  - PG stability at maximum concentration

How AERSCREEN is implemented...

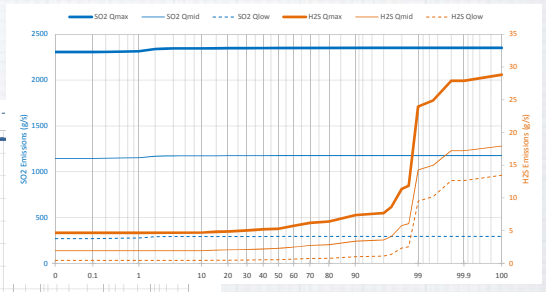
- oFigure1 shows results for
  - 3-rates (Qmax, Qave, Qlow)
  - Parallel Terrain & elevated terrain
  - Terrain elevations



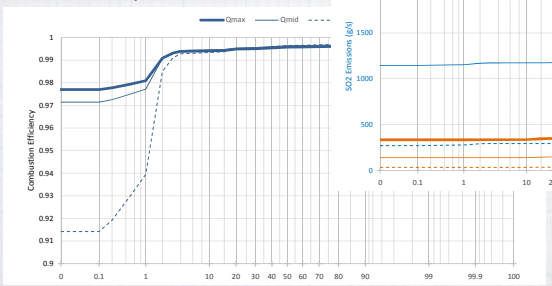
How AERSCREEN is implemented...

- oFigure2 : for Non-Routine hour-by-hour source
- Emissions Probability for SO_2 and H_2S
- Efficiency Probability

Mass Emission Rates



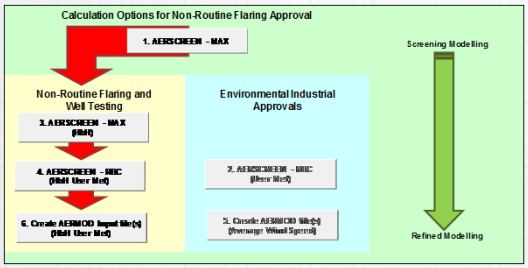
Efficiency



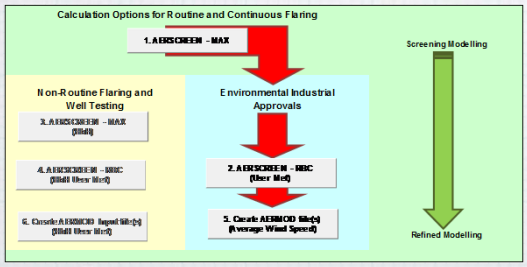
NEW Bridges to Refined

- 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 → MAX CONCENTRATION
- User Met (5yr) → RBC
- Specific Month (uses User Met, 5yr, and 3-month window) → RBC

ROUTINE

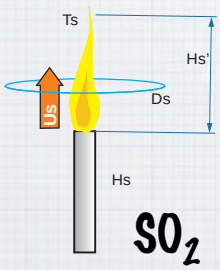
- Screening Met → MAX CONCENTRATION
- User Met (5yr) → 99.9th

NEW SO_2 and H_2S

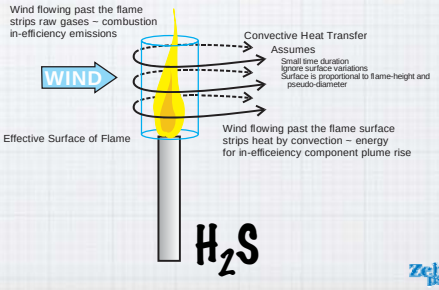
- ERCBflare uses flare efficiency model
- Efficiency is a function of:
  - Heating value
  - Meteorology
- Source parameters are function of efficiency
- SO_2 emissions are worse case 100% conversion
  - No credit for in-efficiency
- H_2S emissions based upon in-efficiency
  - Assumes worse case fuel gas stays as fuel gas, ∴ H_2S stays as H_2S

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



SO_2



H_2S

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

Rate Category	Modelling Refinement Level	Non-Routine Flare Source Description
Continuous	1	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.
Short-Term Steady	2	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
Exponential Transient (blowdown)	3	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).
User-Defined Transient (blowdown)	4	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).

Non-Routine Flare Modelling
Modelling Guidance

Rate Category	Source Model	Dispersion Model	Refinement Level	Source Modelling and Post Processing Requirements
Continuous	Continuous	Plume *	1	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.
		Puff *	1	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.
Short-Term Steady	Continuous	Plume	1	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.
		Puff	1	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.
	Finite Duration Puffs	Puff *	2	Source emission rates are determined based upon the actual duration of the short-term event. The source modelling is conducted according to DETAIL C. Time averages are post processed according to DETAIL D.
Exponential Transient or User-Defined Transient	Continuous	Plume	1	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.
		Puff	1	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.
	Sequence of Finite Duration Puffs	Puff *	3 or 4	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.

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

Description	Variable	Units	Inputs	Default
Re-create run.bat file each time (1-Yes, 0-No)	mrunbat	--	1	0
Add pause to run.bat file (1-Yes, 0-No)	mpause	--	0	0
Keep input files (1-Yes, 0-No)	mkeep	--	0	0
AERMOD input files- uses 0,0 origin (1-Yes, 0-No)	mrelloc	--	0	0
AERMOD input files-export receptors (1-Yes, 0-No)	mexprec	--	0	0

Non-Default Settings

Description	Variable	Units	Inputs	Default	Comment
Ambient Temperature	Ta	°C	5	5	
Average Ambient Wind Speed	Ua	m/s	3.5	3.5	
PG Stability Class	iPG	--	4	4	
SO2 1h Air Quality Objective	OBJ_SO2	µg/m³	450	450	
H2S 1h Air Quality Objective	OBJ_H2S	µg/m³	14	14	
Run Flags	MYRUN	--	0	0	
User Period Selection (Annual or Month)	MFLMON	--	1	1	
Blowdown Distribution of Mass Option	MDIST	--	2	2	
Blowdown User Entry of Qmax	Qmax	--	blank	blank	
Blowdown User Entry of Qtotal	Qtotal	--	blank	blank	
Land Use around the well site	WELL_LU	--	5	1	NON-DEFAULT SELECTION

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...