What's New with AERmodels

The development of AERmodels (previously ERCBmodels) for flaring and incineration follows (note, several internal version were developed but not necessarily released):

AERflare-incin.xlsm

AERflare-incin Version 2.03.141010

- Incinerator residence time and stack top temperature are displayed on the oSUMMARY page.
- Changed the source characterization numbers on the oMODELLING. The numbers were displayed with rounded to 3 significant digits causing potential inconsistencies between numbers used for modelling.
- Added the ability to name the flare/incinerator source the non-Default selections. This allows the user to create multiple source files for modelling several sources at the same time. The hourly source files can be combined using external processing such as AWK or PERL.
- Bug fixes

AERflare-incin Version 2.02.140903

- Flare Assist selection contained bug related greyed-out for selection of yes instead of no.
- Batch page operation of the source type Incinerator contained a bug(s) that prevented batch page operation. This has been corrected.
- On the iTERRAIN page, the 'Get DEM Data' is used to extract get DEM and determine worse case terrain heights automatically, as opposed to the older manual method. AER now recommends the automatic method as the default methodology, and therefore the location (X,Y) of the worse-case contour levels, heights and distances are now saved to the batch page. The listed results have been moved into the main-stream listing (left side of worksheet).
- Changed the extraction of DEM and LCC zip files. On user computers, if the Windows Explorer option to 'hide file extensions of known file types' is selected (the default Windows configuration), then extraction of files will not return the expected listing if ".shp" files are not associated on the user computer. The logic has been changed to avoid the bug.
- Added flag and entry of user defined fenceline to the creation of a receptor grid on iUSERTER. A comma separated file (no header) can be used to enter X,Y utm coordinates of the fenceline. The fenceline is charted on the iUSERTER page for reference along with the flare stack location. All receptor points within the fenceline are erased, see also below fill resolution.
- Added flag and entry of a sources.csv file. The file is a comma separated file containing X,Y,name of sources or points of interest. The receptor grid is created by adding a 50m resolution receptors grid within 500m of each point. This grid better represents the ESRD modelling guidelines when fenceline(s) is large and/or the number of sources within the fenceline are distributed. This feature can also be used to assist in capturing the worst case ground level predictions.
- Added a flag and entry for a receptor grid fill resolution within a fenceline. Predictions within a fenceline may be of interest for occupational health.

AERflare-incin Version 2.02.140711

- Added two more contour intervals 100 and 500 to capture VERY rough terrain and poor initial guesses on elevation. This corrects a potential bug if a user inputs a poor initial guess of the site terrain (say 0m) in very rough terrain (peak terrain elevations >2500m), then the number of contours at the maximum interval setting may exceed the maximum space allowed (25 contour levels). Added 200m and 1000m contour levels to prevent and capture possible issues.
- Changed the minimum flare stack height on iSOURCE from 12.2m to 12m to match D060.
- Added an option on oFIGURE1 page to display concentration output using/not using the duration correction for sub-hourly events.
- Added distances, ws and PG output for 100% concentration predictions from oMODELLING to oBATCH and oBATCHVIEW.

AERflare-incin Version 2.02.140711

- Updated the Temperature ranges used for the creation of the SCREENING and SCREENING+ meteorological data sets based upon a broader number of meteorological stations and including Alberta, British Columbia and Saskatchewan. Added the temperature ranges to iSTART page to facilitate other application areas.
- Adjusted the assigned roughness, albedo and bowen ratio for the creation of the screening meteorological datasets from the default AERMOD to the default AERSCREEN settings. This change makes the screening met datasets consistent with SCREENING+ and refined data sets created in AERflare-incin.
- Corrected assignment of ‘mixed forest’ and ‘shrub’ land classification from ‘crop land’ to ‘deciduous forest’, being the most representative.
- Added calculation of compliance with ambient objective calculation. This calculation estimates the likelihood of the (yearly) maximum concentration being less than the objective.
- Added batch mode dump of output data on bottom of oAERSCREEN page using MEXPORTOUT technical setting. MEXPORTOUT forces the MKEEP and MKEEPOUT settings. On the iBATCH page, the MKEEP output path/filename setting is used to define the basename for the MEXPORTOUT. If MKEEP output path/filename is blank, then the current folder is used and the scenario name is used as the basename. If MKEEP output path/filename is a folder, then the basename is application default name of ‘AERflare-incin’ and all folders will have similar filenames for simplicity in automation(s). MKEEP and MKEEPOUT are adjusted during run-time, and reset back to their initial settings upon completion of the batch run; errors during batch runs may leave these settings in an altered state.
- Change the flag name from ‘re-calculation required’ to ‘*** REMODEL*** INPUTS DON'T MATCH OUTPUTS’. This message is also displayed on the ABOUT page
- Changed the ‘recalculate’ button to ‘remodel’
- When the ‘Save to iBATCH’ button is pressed, the save processes checks if the RECALC_REQD flag is set. If so, then the inputs are copied to the iBATCH page and the user is prompted yes/no/cancel before copying the outputs. This allows the results to be kept following an inadvertent change in inputs. The oBATCH preserves the RECALC_REQD flag setting.
- Added footnote comment to bottom of oMODELLING page that the concentration results presented on this page DO NOT INCLUDE rounding. Added footnote comment to bottom of oSUMMARY page that the concentration results INCLUDE rounding for comparison to regulatory limits.

- Corrected reference to external library for use with 64-bit operating system in module utils2
- Corrected reference of LIMIT1 to LIMIT2, on oPOSTPROCESS and oAERSCREEN dump data column descriptions.
- Corrected oPOSTPROCESS page with incorrect dump of the xyz data to LIMIT2 area
- Added comment on oPOSTPROCESS page for n'th highest and percentile summary table, when N<mnDATA. Changed the summary to display the statistic instead of zero, but provide the comment feedback
- Added calls to the clearstatusbar before operation of getdem and getlcc. Changed the clearstatusbar routine to include clearing clearstusbarti.

AERflare-incin Version 2.02.140702

- Added Incineration as an alternative source type. Name change from AERflare to AERflare-incin. The iSTART page now begins with the selection of flaring or incineration. Source information is entered on the iSOURCE page (previously called iFLARE page). Detailed calculations for flaring are performed on the oCALCULATIONS page and for incineration on the oCalcIncin page.
- Flaring (and incineration) emissions have been added as per USA EPA and are listed on the oCALCULATIONS and oCALCINCIN pages.
- The AERSCREEN page includes export of plottable data suitable for SURFER mapping for RBC and LIMIT1 data. The AERSCREEN page contains the data for the maximum of years included in the meteorological period. Either the raw data can be exported or the adjusted data can be exported. The raw data does not include flare duration adjustment for sub-hourly time average nor transient blow down effective hourly time average. The adjusted export data account for sub-hourly time averaging and transient blow down. The effective transient blow down derived from the AERSCREEN page is a worst case screening calculation since it uses the worst case concentration for each of the Qmax, Qmid and Qlow emission rates as opposed to the concentration prediction for the same hour for each Qmax, Qmid and Qlow emission rates. The oPOSTPROCESSING calculations can be used for that purpose.
- The oPOSTPROCESSING results can be exported for either the RBC or the LIMIT1 data. These data include sub-hourly time duration or transient blow down sequencing on an hourly basis.
- The iUSERMET page has been re-arranged into logical order for recommended assessment. Users can create a SCREENING+ data set or a REFINED data set.
- Batch processing has been added for SCREENING+ data sets. The SCREENING+ data set only requires the source location. On the iBATCH page a column group for iUSERMET has been added. The batch processing for iUSERMET only requires the source location from iFACILITY and the output file name as specified on the iBATCH page. The regular iBATCH processing is independent of the results for iUSERMET batch outputs. Therefore, the batch processing can be performed in sequence without disturbing the results of the other. Also, batch processing for iUSERMET SCREENING+ can be recalled so that the determination of LCC statistics doesn't have to be repeated if a REFINED meteorological data set is later created.
- Bug fixes/spelling

AERflare Version 2.02.140302

- Added int() to the receptor iUSERTER page calculations for the display of the number of receptors for each grid spacing

- Corrected shift in the index numbering of screening meteorology. This affected the selection of grasslands being assessed as deciduous tree areas.

AERflare Version 2.02.130919
- Added path name to run.bat shell command so that if the shell default location is redirected from the current folder, the run.bat command is still executed. Within the run.bat file, the drive is reset to the current folder, and the CHDIR command is used to change the folder to the current directory

AERflare Version 2.01.130114
- Major revisions throughout.
- Removed ERCB_SCREEN3 and replaced with AERMOD.
- Added automatic terrain processing using download from Canada website for DEM.
- Added automatic land use classification processing for determination of site specific meteorological data files

AERflare Version 2 to 2.01
- Bug Fixes and look-feel updates
- Added explicit gas composition of air using GPSA 13th Edition, SI. The molar mass for air is based upon: N2 78.12%; O2 20.96% and Ar 0.92%.
- Added argon (AR) to gas composition inputs.
- Added MPOSTBAT setting on iSTART page. The MPOSTBAT allows an advanced user to create a command line batch or script file to be inserted in the run stream during batch processing. The MPOSTBAT file is inserted after each batch run job.
- Added MMETUSTAR, MLOWWIND1 and MLOWWIND2 advanced switch settings. These settings are used to control how the AERMET meteorological processing and AERMOD processing for low wind speeds is conducted. See also the associated user adjustable SVmin and WSmin settings.
- Allow UTM entry for world UTM locations. Land use classification processing, however, remains available only for Canada. DEM processing for world locations available through generic file (XYZ) inputs.
- Added 'Read User Receptor Grid' option to the iUSERTER page. When selected the user is prompted for a generic XY file containing space or comma separated receptor grid points. The terrain processing will determine the elevations from DEM data.
- Removed the 're starting' and 're ending' controls from the user terrain files created by AERflare to be compatible with typical AERMOD insert files.
- Added options for radius for roughness (rrough) and radius for albedo (ralbbow) for AERsurface meteorology. rrough is set to the older AERsurface 3 km methodology rather than the new 1 km methodology as a balanced compromise between near-field and far-field turbulence effects. ralbbow is set at the AERsurface default of 5 km.
- Added the option for flag pole receptor heights.
- Added the option for nsources, the number of virtual sources used to model a time varying flare source in AERMOD. The default is nsources=9 with a maximum of 20.
- Added the option for flagging the minimum number of data points representing a valid dataset to use risk based criteria. In concept, a single year of meteorology is required with 8760 hours. However, regulations allow for a percentage of these data to be missing or calibration. Therefore, AERflare allows risk based criteria use for data sets with a minimum of 7884 points.

ERCBflare Version 1 to 2

- Added annual and monthly air dispersion modelling predictions. The monthly predictions are based upon the month of the proposed flaring plus the month before and after. Using a 5-year data set, this allows for N>8760 and thus the Risk Based Criteria can be applied.
- Added inefficiency by-products stream for air dispersion modelling impacts of products of inefficiency. These products are modelled as raw H2S whereas combustion products are modelled SO2. The H2S source differs from the SO2 source; the H2S has a lower heat component based upon convective stripping of energy from the flame and momentum is calculated from the mass flow not combusted.
- Added lift gas stream effects to combustion calculations.
- Added flare assist streams for air and/or steam flaring assist. The flare assist streams impact the combustion calculations by adding momentum, energy and reducing the combustion efficiency of the flare.
- Added conversion of sub-hourly emissions predicted concentrations to hourly average concentration.
- Added transient blowdown calculations. The spreadsheet prompts for volume, pressure and temperature of vessel to blowdown and calculates the exponential blowdown curve for the inputs. The curve is divided into three steps for modelling. The modelling predictions determine the maximum hourly concentration from the curve based upon the duration of each step and the maximum predicted concentrations for each step.
- Added oFIGURE 1 page to display in a graphical format the predictions as a function of distance from the facility. The graphic shows max concentration, wind speed producing the maximum concentration, PG atmospheric stability leading to maximum concentration as a function of distance.
- Added oFIGURE 2 page to display in a graphical format the statistical summary of emissions and combustion efficiency for hour-by-hour flaring analysis
- Added a DEFINITIONS reference page as per D060
- Added a LAHEE reference page. Linked the Lahee reference page to the flaring inputs for the determination of the maximum flaring volume allowance as per D060.
- Changed the summary page to reflect the numerous changes below. Also added a check-list style table at the top of the page to summarize how the inputs compare to D060 requirements for approvals.
- Changed the ATTACHMENTS page to iNOTES page. iNOTES page has specific prompts for questions that AER approval reviewers may consider in the review of the application.
- Added iBATCH and oBATCH pages for batch operation of spreadsheet. Users can save the input page to the batch page. Inputs and outputs are saved. Added oBATCHVIEW to review modelling results.
- Added NON-DEFAULT flag for all output pages when a non-default setting is selected.
- Added iSTART page for the selection of type of assessment, advanced program operations and non-default settings
- Non-routine flaring uses the hour-by-hour variation in source parameters. This is implemented in AERMOD using a time varying emissions file and a co-located source. Nine sources are defined based upon an estimate of the final rise of the hourly variation.
- Routine flaring uses the average meteorological wind speed and temperature.
- Added the prediction of concentrations based upon the non-routine flaring Risk Based Criteria.

- Added distinction between non-routine flaring and routine flaring. Both are modelled at 9-emission rates. Non-routine flaring results are compared to risk based criteria and routine flaring results are compared to ESRD established modelling objectives.
- Added AERSCREEN/AERMOD air dispersion modelling. Associated with this change are the following additions:
- added 8-screening meteorological data sets corresponding to the 8-land use types in the Alberta Air Quality Model Guideline. The meteorological data sets represent 100% land cover for the respective land cover type.
- added a mapping of Alberta, British Columbia and Saskatchewan for land cover reduced to the 8-land use types. The spreadsheet prompts for a location and the nearest land cover cell value is used to represent the air dispersion modelling.
- allowance for coordinates in geographical coordinates, UTM zones 8,9,10,11,12,13 and 10TM
- air dispersion modelling is performed for the parallel air-flow and elevated terrain from 100m to 10km. The spreadsheet prompts for terrain elevations from the base elevation to the maximum terrain elevation.
- Screening assessment using the AERSCREEN approach with the 8-screening meteorological data sets is intended for rapid assessment.
- Added AERMOD air dispersion modelling for refined analysis. Following a step-wise progression from screening to refined analysis, AERflare can create a refined dispersion modelling input files for AERMOD, run AERMOD, and post-process the results for non-routine, routine and blowdown sources.
- Removed SCREEN3; removed the 99% percentile concentration prediction based upon ISCST3 air dispersion modelling; fuel gas log; and minimum fuel calculation based upon the 99% concentration.
- Added digital terrain processing for inputs to the iTERRAIN page. Digital elevation data (DEM) is downloaded from the internet site automatically or pulled from a user's local library. The terrain processing extracts worst case terrain contour elevations as would be done if performed manually; therefore, manual entry of worst case terrain remains an applicable option.
- Added iUSERMET page to develop a site specific meteorological data set suitable for refined dispersion modelling using AERMOD. The meteorological data set is composed of data from the ESRD MMEU Meteorological Processor extraction of MM5 data for the province of Alberta. The iUSERMET page processing also downloads land use classification code (LCC) files for Canada from the internet or the user's local library. The LCC files are processed using AERSURFACE methodology to determine an average Bowen Ratio, albedo and surface roughness for the user's assessment site. The AERMET processor is subsequently used to create a site specific meteorological file.
- Added iUSERTER page to develop a site specific receptor grid suitable for refined dispersion modelling using AERMOD. Digital elevation data (DEM) is downloaded from the internet site automatically or pulled from a user's local library. The user can create an ESRD standard assessment grid or modify the receptor spacing. Terrain and hill scale factors are determined from the DEM data and output to an AERMOD formatted insert file.
- Added oPOSTPROCESS page to post process external AERMOD output for the determination of AER D060 risk based criteria. Similar to the post-processing provided by the AERflare spreadsheet automated assessment, the oPOSTPROCESS page allows a user to process output created external

to the AERflare interface. The oPOSTPROCESS page allows for advanced statistics for graphical presentation or in-depth analysis.

ERCBflare Version 1.05.004, March 24, 2010

1. Updated programming to reflect EUB to ERCB name change ERCB_Screen3.

ERCBflare Version 1.05.002, March 1, 2010

1. added CO and NH3 as input components of flared gas
2. ambient temperature of 5 C used to reflect average Alberta conditions
3. flared gas (raw gas + fuel gas) temperature set to ambient temperature
4. pseudo temperature estimated at Lower Flammable Limit
5. used estimated temperature to calculate pseudo diameter and pseudo velocity based on buoyancy and momentum flux balance
6. average wind speed of 3.5 m/s is now used for flare efficiency and effective height calculation
7. corrected flame height calculation routine that occasionally failed to solve properly
8. stack tip downwash based on flare tip diameter using actual exit velocity and 99th percentile wind speed at flare tip
9. 99th percentile wind speed in Alberta set at 10 m/s
10. radiation loss set at 25% of converted energy (input*combustion efficiency)
11. user input fuel gas to raw gas ratio for maximum, average and minimum rate
12. provided clarity to small volume approval exemption requirements
13. highlighted required inputs for dispersion modelling

EUBflare Version 1.01.001, December 11, 2006

1. formatting revised
2. temporary flare permit application information revised
3. used U of A Flare Efficiency model for conversion and combustion efficiency
4. revised source parameters to include momentum and energy balance
5. pseudo temperature specified then diameter and velocity calculated to balance buoyancy and momentum flux
6. pseudo temperature specified at calculated stoichiometric value to minimize errors by keeping temperature constant while changing the ambient temperature
7. buoyancy flux still dominated by energy released to plume but includes minor corrections for plume molar mass and specific heat being different then air
8. new dispersion models such as AERMOD and CALPUFF use the initial trajectory of the plume for gradual rise, which is dominated by momentum in the near-field
9. effective stack height based on Brzustowski flare model and is sensitive to exit velocity of flared gas compared to wind speed
10. stack tip downwash based on flare tip diameter using actual exit velocity and average wind speed at flare tip
11. ambient temperature of 15 C assumed
12. flared gas temperature of 15 C assumed
13. average wind speed of 3.42 m/s is used based on Alberta average
14. added ERCBSCREEN3 to predict maximum SO2 concentration for parallel airflow (flat) and complex terrain
15. added H2O as input component of flared gas

EUB-WellTest Version 1, February 6, 2001

1. initial release using energy balance only for source parameters
2. pseudo temperature and velocity specified then diameter calculated to balance buoyancy flux
3. similar to US EPA but with actual exit velocity at flare-tip instead of arbitrary 20 m/s
4. Version 1.01 did not conserve momentum, only energy; but this was acceptable for input to SCREEN3 and ISC3 models which takes the larger of momentum and buoyancy rise (and buoyancy always dominated)
5. buoyancy flux is at site atmospheric pressure based on input stack base elevation
6. assumed 98% conversion and combustion efficiency
7. radiation loss set at 25% of input energy
8. predicts 99th percentile SO2 concentration based on nomographs for parallel airflow terrain
9. user inputs worst case terrain for comparison to complex terrain criteria to determine if complex terrain modelling required

ERCBincin.xls

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AERflare-incin Version 2.02.140626

- ERCBincin is now merged into AERflare

ERCBincin Version 1.05.004, March 24, 2010

1. Updated programming to reflect EUB to ERCB name change ERCB_Screen3.

ERCBincin Version 1.05.002, March 1, 2010

1. corrected minor errors
2. added CO and NH3 as input components of raw gas
3. ambient temperature of 5 C used to reflect average Alberta conditions
4. raw gas and fuel gas temperature set to ambient temperature
5. radiation loss now stack heat loss and remains at 10% of input energy
6. buoyancy flux dominated by energy released to plume but includes minor corrections for plume molar mass and specific heat being different then air
14. used estimated temperature and velocity to calculate momentum flux
15. used estimated velocity to calculate pseudo diameter and pseudo temperature based on buoyancy and momentum flux balance
7. user input fuel gas to raw gas ratio for maximum, average and minimum rates
8. user input excess air for maximum, average and minimum rates
9. provided clarity to small volume approval exemption requirements
10. highlighted required inputs for dispersion modelling

EUBincin Version 1.01.001, December 11, 2006

1. temporary incineration approval request form
2. initial release used material and energy balance for source parameters
3. pseudo temperature based on calculated velocity and specified diameter to balance buoyancy flux
4. radiation loss set at 10% of input energy
5. used Western Research Incineration Kinetics model for H2S conversion efficiency to SO2
6. ambient temperature of 15 C assumed
7. raw gas temperature of 15 C assumed

8. ERCBSCREEN3 used to predict maximum SO2 concentration for parallel airflow (flat) and complex terrain
9. user input single fuel gas to raw gas ratio for all rates
10. user input single excess air for all rates