EFFECTS fact sheet Andreas Mack, 24/02/2022

Name and version model:

* EFFECTS, V11.4 (an integral model)

Deviations from model input conditions:

* All simulations are performed at 1 bar atmospheric pressure since the heavy gas dispersion model in EFFECTS are performed at 1 bar reference pressure.
* The internal spray model of EFFECTS was used to calculate the rainout (which was 0 or very close to 0 using different models (Yellow Book model or Statistical Spray release model). Reference calculation therefore have 0% rainout. Manual variation to 5% rainout has no major effect on the concentration profiles, therefore it was decided to use the internal spray-release/rainout model in EFFECTS as is.
* Parameter variation of the rainout fractions were performed by an adaptation of the output values of the spray release/rainout model. The flash fraction and droplet evaporation was kept constant; the liquid mass flow rate of airborne droplets was reduced.

Description of the output variables

* **IMPORTANT:** EFFECTS recalculates local mass and molar fractions to ambient conditions (at reference temperature of the ambient air). This leads at low local temperatures (like in the spray region) for concentrations larger than 100%. Since a standard EFFECTS release version (11.4) was used this also applies to the concentrations given here. Comparing with the internally used local mass fractions, for Fladis there is only very little effect close to the release point. The concentration results of Desert Tortoise are higher than the local concentrations (at low temperature). At the release this is a difference of up to 300000ppmv, at the first measurement location (100m) up to 20.000ppmv. Plotting ‘real’ and ‘ambient’ concentration data for Desert Tortoise cases, for x>200m the difference is negligible.
* JR-II concentration fractions are given at 1m height for Desert Tortoise and ground level for Fladis.

Additional comments

* For FLADIS trial 9 and 24 also the liquid fraction was varied (0.999 and 0.997), some minor effect can be seen close to the release but the concentration profiles at the measurement locations are in principle unchanged (results NOT given in the excel sheet)
* We also looked into the temperature distribution along the x-axis for Desert Tortoise 2 (results NOT given in the excel sheet). The length of the ‘cold’ region where droplet evaporation takes place (1st measurement location x=100m: 275K) is over predicted (EFFECTS: 275K reached at 170m). The only sensitivity resulting in relevant differences is the exit vapor mass fraction at the release location. At 5% vapor fraction (which might be quite high) the 275K region extends only to approximately 80m. At the same time, the concentration distributions get ‘flatter’ with much lower concentrations at x=100m and only a minor decrease at the measurement location x=800m. Since there were earlier discussions about the elbow 2 L/D upstream the release (Spicer, with the Metastable and HE model) flashing might take not at the exit plane but already earlier inside the pipe (or an extended cavitation region from bend to exit) which might change the flow field