## RUNNING THE BENCHMARK including the RISK MODEL CALCULATIONS

## FILE DESCRIPTIONS

The files related to the risk calculations of BSM1 are placed in the directory *risk_calculation*, except for the main script *perf_risk.m*.

It contains the following additional files:

- *Deficiency.fis, LowDOBulking.fis, FtoMBulking_1.fis, FtoMBulking_2.fis, Foaming1863_1.fis, Foaming1863_2.fis, FoamingNocMic.fis* and *Rising.fis* – *.fis files (generated by the fuzzy toolbox of Matlab) which, for each one of the operational problems, include the definition of the fuzzy membership functions for the input and output variables together with the rule base.
- *FuzzySettlingProblems_Oct2008.m* – file including all the extra-calculations required for the risk assessment in BSM1 (version of October 2008);
- *smoothing_data* – exponential filter to calculate SRT and, if required, to smooth the risks according to the time constant of each problem (3 d. for bulking and foaming and 2 h for rising sludge);
- *Risk_results_on_BSM1.xls* – Excel file containing some of the results of the risk assessment module applied to the dry, rain and storm influents of BSM1 (for comparison purposes). This file is in the directory *Results*.

The main evaluation script perf_plant.m now calls the script perf_risk.m at the end. *perf_risk.m* performs the calculation of risk assessment of all the operational problems considered in BSM1 and the code required to plot these risks

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Running the benchmark with the risk assessment module is very similar to running the BSM1 because only steps from 10 to 14 are new; steps from 1-9 are the same steps that have to be followed to run the BSM1. The methodology that should be used to carry out simulations is as follows:

1. start Matlab (it is a good idea to start it from the benchmark directory);
2. command *benchmarkss* for BSM1 or *bsm1ltss_S51* (or another similar implementation of BSM1_LT) for BSM1_LT (the simulink window with the benchmark implementation with closed loop control but with no noise and delay on the measurement signals will appear);
3. command *benchmarkinit* (initiates all variables and parameters, loads the data files etc. The file *asm1init.m* contains all variables and parameters with regard to the ASM1 model, *settlerinit.m* everything for the settlermodel, *reginit.m* everything for the controllers ) (*init_bsm1lt_V6* or a similar one for BSM1_LT);
4. run *benchmarkss* or *bsm1ltss_S5* with constant input for 150 days and determine a steady state (use the ode15s solver).
5. command *stateset* for BSM1 or *stateset_bsm1lt* for BSM1_LT and *benchmarkss* or *bsm1ltss_S5* can be closed.
6. command *benchmark* for BSM1 or *bsm1lt_S5* (or another similar implementation of BSM1_LT) for BSM1_LT (now the Simulink window with the benchmark implementation will appear);
7. command *load states.mat* for BSM1 or *load states_bsm1lt.mat* for BSM1_LT.

8. select DRYINFLUENT as the input data file in the Simulink window;
9. Start a simulation for the DRYINFLUENT file for 14 days and save the results in workspace (command *stateset* for BSM1). Now we have the results for 150 days of simulation with constant influent followed by 14 days of dynamic influent saved in our workspace;
10. Command *load states.mat* for BSM1 (being *states* the initial conditions after 150 days with CONSTINFLUENT and 14 days with DRYINFLUENT)
11. select the input data file you want to use (DRYINFLUENT, RAININFLUENT or STORMINFLUENT);
12. Start a simulation for a particular influent file and let it finish;
13. Command *perf_plant.m* for BSM1.

After a simulation all data are stored in the Matlab workspace and not to files. Use the *who* command to see what variables you have available.