Internal Modeling: Summary of Needs

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A. Collaborative Goals

We are interpreting this effort not as a competition between different codes, but rather as an assessment of different levels of modeling sophistication, RANS vs. LES for instance, or compressible vs. incompressible, depending on what capabilities the participants have.

B. Objectives for the session:

1) Define level of confidence of internal flow simulations by validating, where possible, with experimental data.

2) Quantify internal flow dynamics that are likely to affect spray characteristics of primary atomization

C. Description of Targets

1. Spray A is well-characterized, but is likely non-cavitating (and thus, unrealistic). It can be used to test compressibility and turbulence models, but not cavitation modeling. David's group has posted a mesh, but Alan has revised the geometry estimate since.

2. Spray-H would be a better target. The nominal geometry is available and David has made a mesh. Preliminary calculations show that the nozzle cavitates. Single axial hole injectors produce fundamentally different sprays that multi-hole injectors, but the simplicity of this injector is attractive.

3. Spray-B is most realistic, with three holes. Need geometry and mesh. David's post-doc and Caroline's grad student are expected to produce an unstructured mesh by the end of April.

Quantities to be compared for validation:

Cd, Cv, Ca (for each hole, in the case of spray-B).

We need to achieve consensus of what density should be used for these calculations. The most obvious choices are the density at the upstream conditions, the density at the downstream conditions, or an arithmetic mean. There may be a theoretically-based criterion for picking the best. Until we have consensus, report which density you used in the calculations.

D. Quantities to be predicted:

The predicted quantities will necessarily depend on the capabilities of the model and the type of calculations performed. The list below suggests what quantities may be of interest.

1. Pressure drop across the orifice (may be different than nominal pressure difference across the injector)

2. Momentum and fluctuation distribution at the nozzle exit

3. Vapor fraction at the exit plane. These data could also be made available as a function of time

4. Axial slices showing a longitudinal variation of momentum and vapor fraction

5. Spatial position and timing ASI of these quantities (e.g. radial profile at exit, extent of vapor bubbles, swirl) for transient calculations

E. Format of submitted results:

If the data can be reduced to 2D data (from time-averaged axial slices) text files (quantity at node positions) are sufficient.

For and 3D data, we propose VTK. It is readable by Paraview, which is available for free, and many other codes.

G. Deadline for submitted results

End of July. Close enough to give a few more days to the participants, but not too close to the conference.