Fluid-dynamic calibration of an atmospheric wind tunnel

The SEADOG DENERG Lab at PoliTO developed a new approach for evaluating consequences of accidental high-pressure releases of dangerous gases in congested industrial environments, e.g. offshore O&G platforms. The approach, based on two modelling steps, is named SBAM (*Source Box Accident Model*).

The two steps consist in the fluid-dynamic modelling of the supersonic release phase of the gas through a certain rupture diameter and of the following pure dispersion phase. Both phases are studied via CFD, and this splitting of the phenomena permits to have a heavily reduced simulation time while maintaining an acceptable accuracy of results with respect to a classical CFD approach. Running the two simulations in a row produces maps of concentration and velocity that are extremely useful for risk assessment and for designing early warning systems.

As any theoretical modelling, however, also this needed a validation.

We designed a mockup of an offshore platform fully equipped with sensors to detect the concentration and velocity of gas released onto it. Although scaled 1/10, the platform still represents a large artefact, being 3mx2m in plan view and 2m high. To host the mockup and be able to reproduce the wind conditions, we designed a new comfortably large wind tunnel.

The SEASTAR-WT is a subsonic, open flow wind tunnel with a test room 5m wide, 6m long and 2,5m high; it is equipped with 10 fans with an installed capacity of about 100kW.

After its completion, the calibration was performed making use of a rack of 10 Pitot tubes disposed in a vertical row, equally spaced. We identified three vertical ideal plans in the test room (near the fans, in the middle of the room, near the air inlet) and for each we retrieved velocities moving the rake at 11 equally spaced positions. Spanning each plan, we captured the velocities in a total of (10x11x3) 330 point.

Data were collected operating the fans at different frequencies in order to obtain a characteristic diagram (frequency-airflow velocity). The range of velocities measured was 0-8 m/s and the velocity maps showed a good uniformity of the velocity field on each plan, considering the atmospheric nature of this wind tunnel. Further uniformity can be reached by tuning each fan separately, a feature that could also be useful for testing several other technologies in the field of structural analysis (e.g. bridges), of ICT (e.g. drones) and of green energy (e.g. wind towers, wave converters).

**application
(as appropriate)**

wind tunnel suitable for any testing of new technologies which have to work in atmospheric wind or modelling of contaminant and pollution dispersion

**technical contribution**

**(as appropriate)**

wind tunnel equipped with control room for remote management of testing

**economic contribution**

**(prospects if any)**

wind tunnel where it is appropriate to perform prior testing of scaled or full scale technologies for cutting prototyping costs. Suitable for renewable technologies makers, oil&gas companies, pollution dispersion researchers.

**innovation
(as appropriate)**

suitable for testing of innovative technologies thanks to the large size of the testing room.