



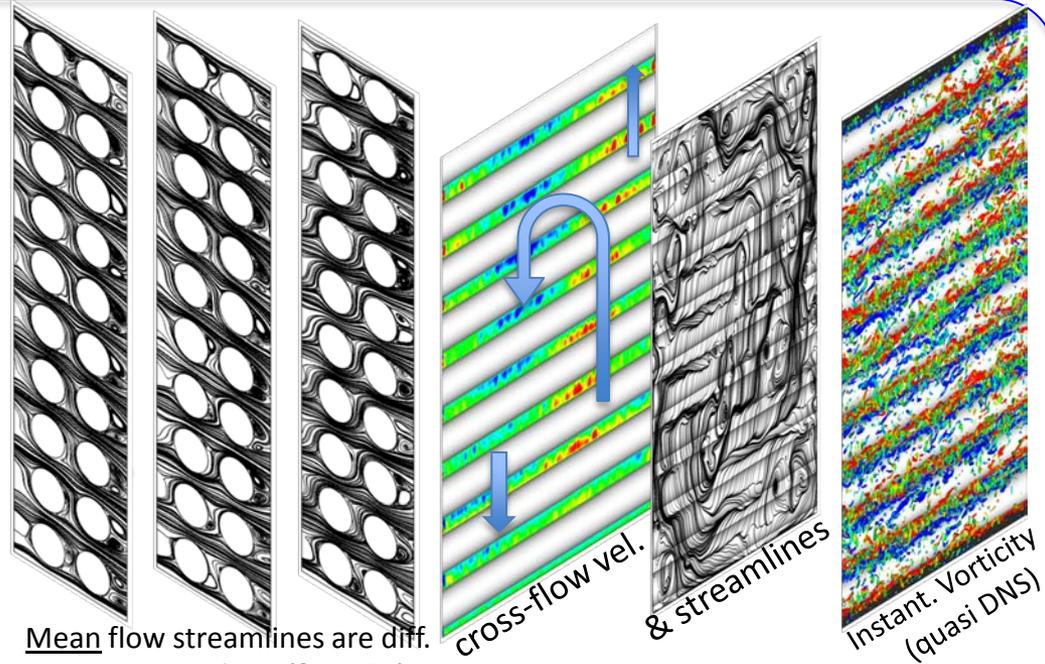
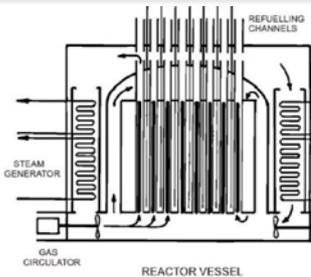
## Flow asymmetries across in-line tube banks & modelling strategies

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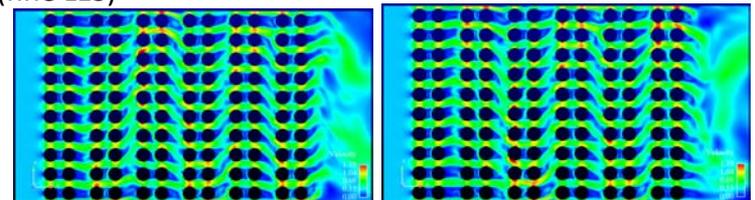
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### RANS, LES & HPC quasi-DNS of AGR heat exchanger

- Pressure drop should force inline flow, but streamlines choose oblique directions!
- Previous (Benhamad., Afgan ...) used too small periodic domains (3x3, 5x5 tubes)
- Here, larger domains => more and more secondary motion paths found!
- Here, end-wall effects included & found large:  
=> *Are periodic CFD and confined exp't rig. relevant to full-size boiler?*
- Mean flow paths also flip irregularly in time
- 3D and time effects also observed in new exp'ts.
- RANS CFD is very sensitive to turbulence, wall models, & inlet parameters.
- *Most unstable design likely chosen for best heat exchange, but will we ever be able to model it?*
- *Are space- and long-time averaged measurements or CFD results relevant? (hot spots, max. fluid force?)*



Mean flow streamlines are diff. in 3 spanwise slices (fine LES)



Mean flow (RANS results) at 2 different times

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