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Simulation and implementation of emergency cooling operation in a server room of OeNB (Austrian National Bank)

August 2014

Overwiew of simulation and implementation of emergency cooling operation at a server room at OeNB

Task

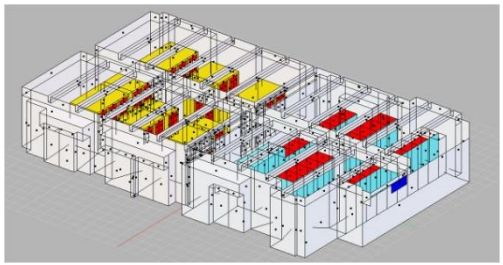
Engineering of emergency operation in a separated server-room. One part is mostly free standing racks cooled by redundant CRAHs. The other part is housed racks using in-row cool loops. The raised floor is shared between the rooms.

By choosing correct ventilation in the separation wall between the two parts of the server room a stable cooling for emergeny operation should be achieved. Ventilation starts automatically if the cool loops fail.

Stable emergency operation in case of partial cooling failure

Simulation

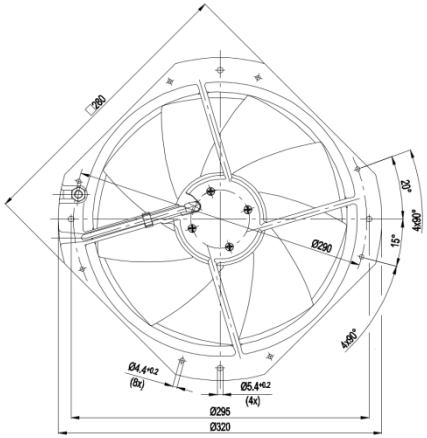
In a virtual geometry the required flow rates for the fans in the separation wall was calculated to achieve a stable maximum end temperature in case the in-row cool loops fail to operate correctly.



Cooling power (flow rate, temperature) for stable cooling operation

Result

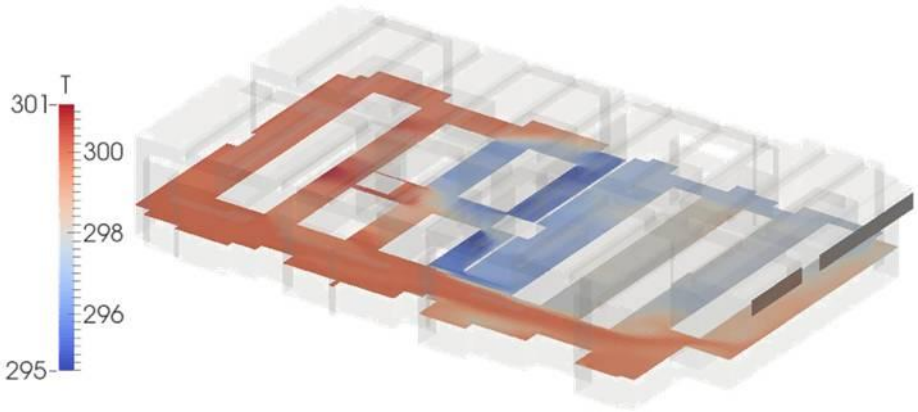
Based on simulation results 8 250mm fans with 140W power each were chosen to install at specific positions in the separation wall.



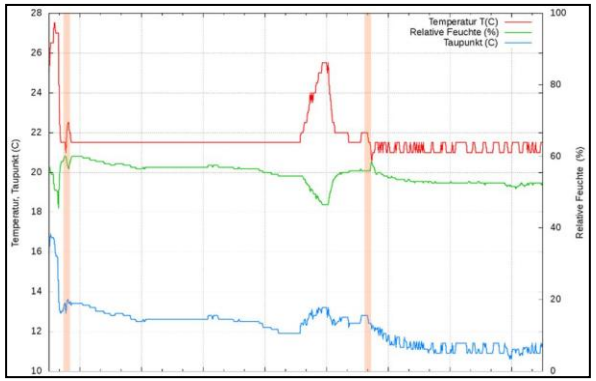
Suggestion of fan type

Simulation results were validated in an experiment after installation of the fans

Simulation results are temperatures and flow rates across the server room in case of emergency cooling operation.



After adaptation of the separating wall with the suggested fans the temperature in the server room was monitored during a two day experiment.

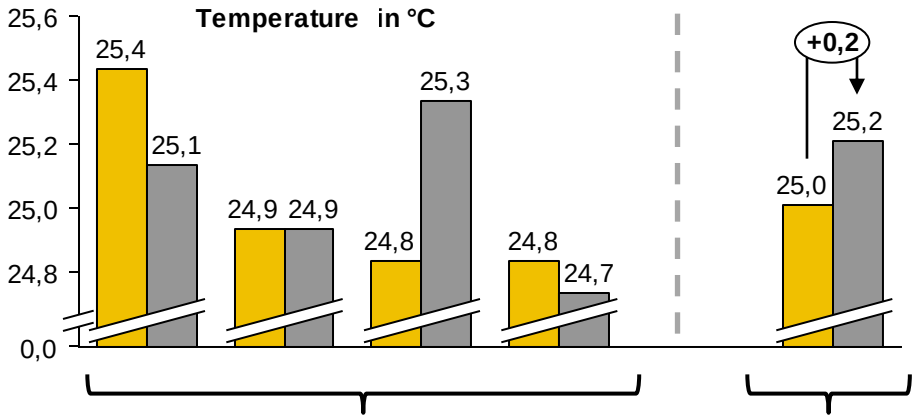


Comparison of simulation and experiment shows excellent accuracy of simulation results

After practical implementation of suggestions derived from simulation results an experiment was conducted to prove stable operations under emergency conditions (failure of in-row cool loops). Cooling was provided only by CRAHs.

Temperature and humidity in a two day experiment were recorded with data loggers and the results show excellent accuracy (within measurement tolerance of used equipment) of the simulation results.

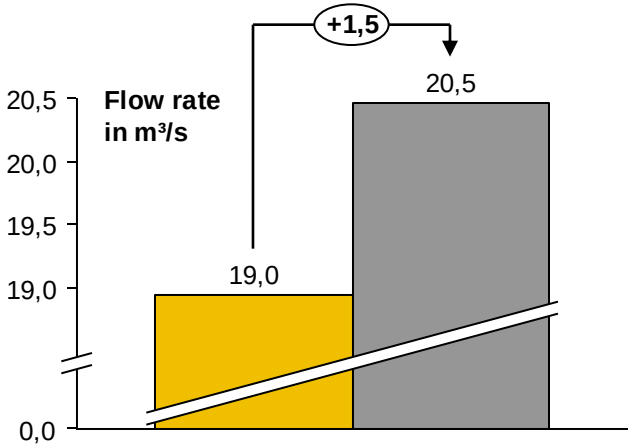
Temperature deviations are within measurement accuracy of the equipment (0,3°C)!



Comparison of simulation and measurement at some positions in the server-room. Deviation ±0,5 °C

Average deviation at CRAH inlet: 0,2°C.

Deviation of volumetric flow rate lower than 10%.



Deviations in flow rate: 1,5m³/s (8%) are negligible.

Planning emergency operations using CFD[1]: *First-time-right* with minimal CAPEX and investment risk

Application of CFD[1]-Simulations for engineering of emergency cooling operations has shown to have many benefits compared to classic approaches:

- Exact forecasts → exact planning of construction work
- Retro-fit → costly constructions are minimized
- Dynamic problems can be solved as well (eg. time to emergency temperature limit)
- Payback of capital expenses is known in advance
  → minimal investment risks

Using CFD simulations the result (and thus payback) of an optimisation of cooling or air condition equipment is planned spot-on and with minimal investment risk.

1 Computational Fluid Dynamics

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Rheologic GmbH
Liniengasse 40/12
1060 Wien
FN 393458 s