KNOWLEDGE PROPOSAL

Proposer Name and Organisation: Mohammad Royapoor – CIBSE Data Centre Special Interest Group

Topic/ Title: Data Centre Computational Fluid Dynamics (CFD) simulation & analysis guidance

Date received:

1. Justification: Why is this guidance needed?

CFD is critical to a successful and resilient DC design as it is the most robust tool in visualising the behaviour of air (or a liquid) through the space prior to building the facility. It can successfully predict and resolve several problems, with the most notable being the removal of hot spots in data halls and entrainment with external heat rejection assets. Additionally, space planning and building form optimisation can also be supported by a CFD analysis by conducting comparative analysis and ‘what-if’ scenarios. In the absence of a robust CFD analysis, the design is often overengineered which leads to CapEx and embodied Carbon penalties. The densification of DCs resulting from next generation AI and high density compute together with the rising climatic temperatures particularly in suburban areas (where edge DCs are predicted to expand) make CFD a more instrumental solution for the CIBSE to consider a best practice guide. This research theme seeks to bring together leading industry expertise to compile a technical memo.

1. Format: What format will the guidance take?

|  |  |
| --- | --- |
| [x]  | a traditional publication with words and diagrams to be produced for CIBSE’s Knowledge Delivery Platform, and in PDF |
| [ ]  | a data set |
| [ ]  | a digital tool or software application |
| [ ]  | something else (please elaborate) |

1. Content: If guidance, please list proposed chapter and section headings. If a data set, digital tool, software application, or something else, please detail your proposed plan.

Technical Memo style of publication with the following as indicative outlines of chapter contents:

* Light treatment of the fundamentals of CFD.
* How CFD can act as a decision-making guide for the design team to systematically optimise and refine their solution at rack, row, data hall and ultimately at campus level.
* Guidance to identify all required parameter inputs and assumptions, build and run high fidelity models at the right stage of design and systematically use the model to validate the design airflows, cooling efficiencies and DC thermal management.
* Clarification on how CFD can assist compliance with ASHRAE TC 9.9 efficiency targets
* Outline of limitations of CFD so that analysts are able to set expectations of the wider design team on the limitation of the results, the need for quality input and clear assumptions but also the engineering judgement needed to use CFD predictions to achieve the most cost and Carbon efficient engineering outcome.
1. Readership: Who is likely to read this guidance?

Data centre professionals, but also the wider CIBSE readership particularly built environment MEP designers interested in high fidelity modelling work (for instance to conduct natural ventilation CFD work).

1. Authoring: Are authors in place? If so, please list them below.

No, authors are not in place, however a collection of practitioners exist in RED who can make significant contribution and the wider CIBSE community will also be consulted to identify the best possible talent for the work.

1. Timescale: When would you expect to complete the project? Please provide a rough timeline.

12 months

Fees: Will authors require funding? If so, how much?

Potentially yes, budget fee £2000.00

1. Landscape: Does any similar or complementary guidance exist, published by CIBSE or elsewhere?

There are guides that aim to guide verification and validation of CFD in mechanical engineering or aeronautical applications, not on the theme of data centres. The top 2 are:

* ASME Standard for Verification and Validation in Computational Fluid Dynamics and Heat Transfer.
* AIAA Guide for the Verification and Validation of Computational Fluid Dynamics Simulations.
1. **Collaboration**: Are there any organisations that may wish to be involved in the production of this guidance? (For example: membership organisations, trade associations, contractors, consultants, government departments).

Potentially IMechE, CFD software vendors & Leading academics in top tier universities in an advisory role.

1. Are there any organisations that may wish to sponsor the production financially?

Potentially (CFD software vendors in non-monetary staff equivalent economic cost contribution)

1. Categorisation: CIBSE has created a taxonomy of building services, the Knowledge Matrix. On the following pages, please tick the topics and sub-topics that will be covered in this project.

**Topic:**

[ ]  Mechanical

[ ]  Heating

[x]  Ventilation

[x]  Refrigeration and air conditioning

[x]  Extract/ exhaust systems

[ ]  Smoke control

[ ]  Pipeline distribution systems (natural gas, liquid fuels, medical gas, compressed air & vacuum)

[ ]  Electrical

[ ]  Extra low voltage

[ ]  Low voltage

[ ]  Medium voltage

[ ]  High voltage

[ ]  Local power generation & standby power

[ ]  Earthing & bonding/ Lightning protection

[ ]  Communications

[ ]  Audio-visual

[ ]  Electric vehicle charging

[ ]  Public Health

[ ]  Water

[ ]  Drainage

[ ]  Gas

[ ]  Lighting

[ ]  Daylight/ sunlight

[ ]  Electric lighting

[ ]  Lighting energy

[ ]  Fire safety

[ ]  Fire life safety

[ ]  Fire protection

[ ]  Fire detection

[ ]  Fire notification

[ ]  Building fabric

[ ]  Façades

[ ]  Access & maintenance

[ ]  Transportation systems in buildings

[ ]  Lifts

[ ]  Escalators

[ ]  Moving walks

[ ]  Stairlifts and lifting platforms

[ ]  Building intelligence

[ ]  Controls

[ ]  Smart buildings

[ ]  Security

[ ]  Physical security

[ ]  Security systems (access control, surveillance, intruder alarm)

[ ]  Cyber security

[ ]  Digital

[ ]  Building information modelling (BIM)

[ ]  Digital engineering

[ ]  Digital construction

[ ]  Sustainability & ESG

[ ]  Climate change mitigation

[ ]  Climate change adaptation

[ ]  Circular economy

[ ]  Biodiversity & natural capital

[ ]  Diversity & inclusion

[ ]  Social value

[ ]  Health, wellbeing and safety

Structure:

[ ]  Introduction of project

[x]  Purpose (strategic/design context)

[x]  Project management (inc info requirements)

[x]  Drivers

[ ]  Commercial

[ ]  Contracts

[ ]  BIM

[ ]  Digital information management

[ ]  Fundamentals

[x]  Physics

[ ]  Design conditions/ data

[x]  Calculations and methods

[x]  Sustainability (key considerations)

[ ]  Health, wellbeing and safety

[ ]  Retrofit and refurbishment

[ ]  Condition surveying

[ ]  Modification/ adaptation

[ ]  System selection

[ ]  Selection (regulations, best practice, finance, operational energy, whole-life carbon)

[ ]  Systems, plant, equipment (terminal equipment)

[ ]  Systems, plant, equipment (network level, central plant, distribution)

[ ]  System design principles

[ ]  System sizing

[ ]  System design conditions/ data

[ ]  System sizing calculations

[ ]  Health, wellbeing and safety

[ ]  Modern methods of construction

[ ]  Access and maintenance

[ ]  Construction

[ ]  Installation

[ ]  Modern methods of construction

[ ]  Health, wellbeing and safety

[ ]  Records (drawings, operation and maintenance)

[ ]  Controls

[x]  Strategy

[ ]  Controls as specified, installed and commissioned

[ ]  Commissioning

[ ]  Plans

[ ]  Procedures

[ ]  Operation

[x]  Facilities management

[ ]  Training

[ ]  Maintenance

[ ]  Health, wellbeing and safety

[ ]  Performance (energy, carbon, water)

[ ]  Performance (IEQ)

[ ]  End of life

[ ]  Reuse

[ ]  Repurpose

[ ]  Recycle

[ ]  Demolition

Building Type:

[ ]  **Residential**

[ ]  Single dwelling

[ ]  Multiple dwelling

[ ]  Non-residential

[ ]  Office

[ ]  Education

[ ]  Higher education

[ ]  Healthcare

[ ]  Retail

[ ]  Leisure

[ ]  Aviation

[ ]  Road and rail

[ ]  Government

[x]  Industrial

[x]  Logistics

[x]  Data centre

[ ]  Heritage

[ ]  Defence

[ ]  Infrastructure

[ ]  Utilities

[ ]  Other

Intended Reader:

[x]  Owner

[x]  Occupier

[x]  Designer

[ ]  Developer

[x]  Constructor

[ ]  Installer

[ ]  Commissioning engineer

[x]  Operator/ Facilities manager

[ ]  Manufacturer

[ ]  Apprentice

[ ]  Student

[x]  Researcher

[ ]  Expert witness

[ ]  Other - please specify: