MINUTES OF MEETING

FLACS User Group (FLUG) meeting

Venue: Gexcon, Bergen, Norway
Meeting: 3-4 May 2017
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List of participants

Name	Company
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Anaïs Dubois	Technip FMC
Andrea Brambilla	Gexcon
Anna-Lena Braatz	Gexcon
Bjørn J. Arntzen	Gexcon & University of Bergen
Bjørn Lilleberg	Gexcon
Camille Azzi	Gexcon
Cheng Kang	CCS
Chris Savvides	BP
Deiveegan Muthusamy	Gexcon
Dimitrios Kostopoulos	Total E&P Norge AS
Djurre Siccama	Gexcon
Franz Zdravistch	Gexcon
Gordon Atanga	Gexcon
Hanne Gøril Thomassen	Statoil ASA
Hans-Christen Salvesen	Gexcon
Heidi Skålevik	Gexcon
Idar Storvik	Gexcon

Name	**Company**
Jan Terje Birkeland	Lilleaker Consulting AS
Joe Hobbs	MMI Engineering
Knut-Arne Vik	Safetec / Independent
Lars Pesch	Gexcon
Laurence Bernard	Gexcon
Lorenzo Mauri	Gexcon
Maryam Ghaffari	Gexcon
Michal Folusiak	Gexcon
Olav Roald Hansen	Lloyd's Register
Olav Sæter	Statoil ASA
Paris Laurent	TechnipFMC
Prankul Middha	Abercus
Ranveig Niemi	Safetec
Ronan Abiven	Gexcon
Sturle Pedersen	Gexcon
Sunil Lakshmipathy	Gexcon
Sverre Aleksandersen	Gexcon
Tommy Stokmo Jørstad	Gexcon
Torstein Boge	Gexcon
Trygve Skjold	Gexcon
Ørjan Knudsen	Gexcon

FLUG meeting 3-4 May 2017

FLUG chairman: Olav Sæter (Statoil)

Day 1: Wednesday 3 May 2017

Welcome

Djurre Siccama (Gexcon Software) welcomed the participants to the FLUG meeting.

Agenda

Olav Sæter (chair) presented the agenda for the meeting.

'Technical Q&A from the FLUG Meeting in Paris', and 'Gexcon Application Development: Activities and prospects'

Djurre Siccama (Gexcon Software) informed about the plans to release a prototype of the CFD solver Flacs that include results from JIP MEASURE in the autumn of 2017. More than 25 'two-pagers' from FLACS validation cases will be included in the new FLACS v10.6 user manual, and Gexcon will continue adding and updating new 'two-pagers' in the future.

A question was raised whether zip-files including FLACS simulation files, can be made available by Gexcon for some of the validation cases. Djurre responded that Gexcon will evaluate what can be done here (a possibility might be to make some files available at the FLACS User Portal).

It was commented by Olav R. Hansen (Lloyd's Register) that the jet utility program in FLACS sometimes gives too low momentum. Djurre responded that a more advanced inhouse version (using the Ewan-Moodie pseudo source model) of the jet utility exists, and Gexcon can consider the possibility for making this version more widely available.

A question was raised by Prankul Middha (Abercus) about how the JIP Measure version of Flacs will be made available. Idar Storvik (Gexcon) responded that the JIP Measure version has similar input as of today for FLACS simulations, but it includes additional output variables.

Gexcon R&D: Activities and prospects

Trygve Skjold (Gexcon Software) presented on-going R&D activities at Gexcon and prospects for new functionality in the Flacs solver. He summarized results from the Joint Industry Project MEASURE and the first experimental campaignfrom the HySEA project. The HySEA project receives funding from the Fuel Cells and Hydrogen Joint Undertaking under grant agreement No. 671461. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme and United Kingdom, Italy, Belgium and Norway.

Olav Sæter (chair) asked how Gexcon develops the vision for new (or improved) products and services. Trygve responded that decisions related to product development rely on input from users, technological development, results from validation work, etc.

Olav R. Hansen asked about the technical solutions chosen for the JIP MEASURE version of Flacs. Trygve commented that the JIP version includes a new two-equation turbulence model (the kskL model), a model that estimates an integral length scale that can be used by the combustion model from a geometric length scale derived from the local congestion, a transport equation for flame folding, and a burning velocity correlation that incorporates the stretch rate Markstein number.

Olav R.H. commented that the inclusion of additional model parameters complicates the model system. Trygve agreed that this is indeed a challenge, but at the same time it is important to include models that can capture the important physical phenomena. The goal is to strike a reasonable balance between the complexity and the simplicity of the model system.

A question was raised whether Gexcon plan to implement confidence intervals for FLACS results. Trygve responded that Gexcon considers estimating confidence intervals according to the approach proposed by FDS, but this will require further population of the integrated validation framework. This development is most relevant for Flacs-3.

Olav Sæter (chair) pointed out that it is important to understand the reasons for the spread in results for the FLACS simulations of the relatively simple scenarios selected for the first HySEA blind-prediction study. Trygve responded that Gexcon will investigate this, and implement measures for reducing the spread: updated user guidelines (short-term), automated settings and/or warnings for users, etc.

Olav R.H. commented that the results obtained with FLACS depend on the skills of the user. Trygve responded that Gexcon focuses on providing clear guidelines for the users. In a longer perspective, Gexcon aim at implementing automated settings and warnings.

FLACS v10.6 release

Djurre Siccama (Gexcon Software) gave an overview of the new FLACS v10.6 release (released on 31 May 2017). Flowvis 4 will not be included in the package. Olav R. Hansen (Lloyd's Register) pointed out that Flowvis 4 is preferred when preparing certain special animations, since plotting is not automatically synchronized in Flowvis 4 (as it is in Flowvis 5).

FLACS-Fire: Update and new hybrid DTM-Far field model in v.10.6

Deiveegan Muthusamy (Gexcon Software) gave an overview of the new hybrid DTM-Far-field radiation model for FLACS-Fire.

Olav Sæter (chair) asked whether heating up of e.g. a fire wall can be taken into account in the fire simulation. Deiveegan confirmed that a one-dimensional heat conduction model is available in FLACS-Fire. Deiveegan confirmed that a soot model is available.

FLACS-Risk: v1.05, release and future developments

Djurre Siccama (Gexcon Software) gave an overview of the FLACS-Risk tool. Olav Sæter (chair) asked whether there are users of FLACS-Risk today (outside Gexcon). Djurre responded that currently there are no users outside Gexcon, but several customers have communicated that they plan to use FLACS-Risk shortly.

A question was raised about the grid refinement capability of the FLACS-Risk tool. Djurre responded that while the grid refinement in general works fine, the user should be aware of the limitations and guidelines in FLACS (including FLACS-Risk) and verify scenarios during QA.

FLACS-3 Solver: Development and release roadmap

Michal Folusiak (Gexcon Software) gave an overview for the development and release roadmap for the new Flacs-3 solver. Olav R. Hansen (Lloyd's Register) asked how many grid levels the Flacs-3 solver can utilize. Michal responded that there is no fixed maximum number of levels. Chris Savvides (BP) asked whether the Flacs-3 solver have the capability to provide numerical grid aligned to (one or more) walls. Michal responded that Gexcon will look at some algorithm to fit numerical grid lines to the walls.

FLACS-based gas detection layout optimisation and the roll-out of FLACS-Cloud service

Lars Pesch (Gexcon Software) gave a presentation on gas detection layout optimisation based on input from FLACS simulations, and also on FLACS-Cloud service planned to be accessible from the FLACS-Risk tool.

Research on multiphase flow for dispersion and prospects for other application areas, as explosions or deluge

Lorenzo Mauri (Gexcon Software) gave a presentation on research performed by Gexcon on multiphase flow for dispersion and prospects for other application areas, as explosions or deluge.

Hydrogen as a fuel – different properties require different optimization for safety

Olav Hansen (Lloyd's Register) gave a presentation on hydrogen as a fuel, where different properties require different optimization for safety.

Day 2: Thursday 4 May 2017

Evaluation of global loading from FLACS simulations

Paris Laurent (TechnipFMC) presented an evaluation of global loading from FLACS simulations. Olav Hansen (Lloyd's Register) commented that it would be useful whenever Gexcon could make available in FLACS a feature to automatically calculate global force from the gas on geometry inside user-specified box.

Comparing ventilation rates in FLACS vs KFX

Jan Terje Birkeland (Lilleaker) gave a presentation where simulated ventilation rates in FLACS were compared with similar simulation results employing KFX. Some differences were seen, but in general the observed differences for ventilation rates were relatively small (within plus/minus 10%).

Benefits of detailed CFD ventilation analysis during early design phases

Josue Quilliou (Gexcon Consulting) gave a presentation on benefits of detailed CFD ventilation analysis during early design phases. Olav Hansen (Lloyd's Register) commented that in practice solar influx and hot surfaces in e.g. a module, can have a significant influence on the gas flow (buoyancy forces), and thereby the ventilation conditions. Olav Sæter (chair) commented that during early design, all details about hot surfaces are not known, and trying to optimize ventilation rates during early design phases can contribute significantly to reduce explosion risk for the facility.

Challenges with 3D modelling in FLACS using detailed PDMS models

Ranveig Niemi (Safetec) gave a presentation on challenges with 3D modelling in FLACS using detailed PDMS models. Received 'as-built' model for the geometry of the facility, may not really be as-built. Jan Terje Birkeland (Lilleaker) commented that it is important with close contact with the client during FLACS study. Terje Birkeland pointed out the need for a safety margin during such studies. He also commented that it has been observed that the relative effect on maximum impulse may be less than for maximum overpressure (when a more detailed geometry model is used). Lars Rogstadkjernet (Gexcon Consulting) commented that a large spread in congestion and confinement levels has been observed in as-built geometry models.

FLACS user dialogue and FLUG wishes

Lars Pesch (Gexcon Software) invited the meeting participants to a FLACS user dialogue and input for FLUG wishes. Olav Sæter (chair) expressed the wish for a kind of parameter characterizing the congestion density of a geometry model in FLACS. Trygve commented that Gexcon will try to improve methodology for how the Flacs solver takes into account an increased level of geometrical details when representing equipment.

Olav R. Hansen (Lloyd's Register) commented that for hydrogen as fuel, jet pseudo source modelling recommendations are different from when typical hydrocarbons are defined as fuel. It was replied from Gexcon that different grid modelling recommendations are taken into account in FLACS-Risk.

A concern was expressed that it can be a challenge to model e.g. round buildings in FLACS. Trygve commented that Gexcon would like to improve the modelling of inclined surfaces, such as sloping terrain, internal ceilings and large round objects. However, this will require significant resources, and will most likely only be considered for Flacs-3. The developers of FDS work on a solution for the so-called 'saw-tooth' problem (i.e. inclined surfaces on a Cartesian grid), and Gexcon will follow this development.

Olav R.H. reported that he has observed crash in CASD when changing hue for one object. Andrea replied that Gexcon will try to reproduce the problem.

Jan Terje Birkeland (Lilleaker) said that it could be interesting to look into other types of fuels when modelling combustion in FLACS. Trygve commented that Gexcon plan to include additional species in future versions, and that Gexcon works on models for fuels containing Fluorine in an ongoing project.

Olav R.H. commented that it would be useful if Gexcon could simplify the visualization of PMAX contours in Flowvis. Trygve commented that Gexcon may consider implementing a gallery of pre-defined plots in Flowvis. The plot templates could include fuel-specific parameters, such as LFL and UFL, from the Flacs solver, and hence simplify the workflow. Several users commented that this functionality would be useful.

Paris Laurent (TechnipFMC) would like the option to apply DTPLOT for output only after a certain time during the simulation. Idar Storvik (Gexcon Software) commented that currently the user can employ a runtime simulation control file (cc-file) to specify in detail FLACS output, and Gexcon can also look into how FLACS output can be easier to specify for the user.

Simulation of explosion consequence

Cheng Kang (China Classification Society) gave a presentation on simulations of explosion consequences for a gas-fuel engine being modelled in FLACS.

On best practice for CFD in the oil and gas sector, technical safety applications

Prankul Middha (Abercus) gave a presentation on best practice for CFD in the oil and gas sector, considering technical safety applications. An example was presented where a plume with two vertices was simulated. These two vertices had opposite rotating direction, and here a projection type of plot might better visualize the fluid flow. Prankul briefly informed about the membership association NAFEMS (www.nafems.org) that seeks to promote the safe and reliable use of finite element, CFD, and related technology.

Venue and date for next meeting

Olav Sæter (chair) expressed the view that he thinks it can be justified to have two FLUG meetings per year, considering the important network effect of these meetings. Various other external participants expressed a similar view. And (one or more) volunteers for hosting the next meeting, are appreciated.

Closing

Olav Sæter (chair) summed up some highlights from the presentations and discussions, and closed the meeting.