# MINUTES OF MEETING

## FLACS USER GROUP (FLUG)

**Venue:** Scandic Byparken
Christies gate 5-7, NO-5008 Bergen
Norway

**Meeting:** 5-6 May 2015

**Minutes issued:** 6 July 2015

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**Distribution:** FLUG mailing list

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**FLUG chairman:** Olav Sæter (Statoil)

## FLUG Meeting – Mai 5th (Day 1)

**Welcome**
Erik Aadland (Gexcon) welcomed the participants to Gexcon and the city of Bergen.

**Adoption of agenda**
Olav Sæter (Statoil), the new chairman for FLUG, welcomed the attendees and opened the two-day meeting. The provisional agenda was adopted.

**Technical QA from last FLUG meeting**
Lars Pesch (Gexcon) gave an overview of some bug-fixes and improvements in FLACS that Gexcon R&D has worked on since the previous meeting. Vincent Tam (DNV GL) asked how bug-fixes and improvements will be documented for the FLACS users. Lars Pesch replied that this will be documented in the release notes for the upcoming version FLACS v10.4. It was commented that the initiative and the present structure of the agenda item "Technical QA from last FLUG meeting" is very useful for the members.

**Gexcon R&D - Activities & Prospects**
Trygve Skjold (Gexcon) presented ongoing research activities and prospects for future activities.

**FLACS v10.4 release**
Djurre Siccama (Gexcon) announced the upcoming FLACS v10.4 release and gave a glimpse of the new developments to be expected. Olav Sæter (Statoil) raised the question where the limit is when adding more and more detail in the geometrical model employed by FLACS, i.e. which level of detail is required and/or still beneficial when simulating the physics with FLACS. Helene Hisken (Gexcon) commented that some testing regarding this question has been carried out for a very congested geometry model. Olav Sæter (Statoil) also enquired how well detailed geometry information is used by the FLACS simulator. Trygve Skjold (Gexcon) commented that an error in the counting of sub-grid geometrical primitives has been discovered earlier (a model improvement is now implemented).

**Improved Entrainment modelling in FLACS**
Lorenzo Mauri (Gexcon) revealed a new functionality for improved entrainment modelling in FLACS when simulating high momentum jet leakages. Olav Sæter (Statoil) asked whether the entrainment model takes into account that the entrained gas may not necessarily be pure air. Lorenzo confirmed that this is taken into account so that for example a jet release of pure methane inside a confined room with initially pure air will eventually fill up towards only methane inside the confined room.

**Validation framework**
Djurre Siccama (Gexcon) showed the framework employed when validating FLACS and presented a proposal for a compressed validation scheme for FLACS. Henri Tonda (Total) asked about the possibility to filter out relevant information from the validation data. Djurre answered that Gexcon would like to create a FLACS validation database including a search tool. Chris Savvides (BP) commented that it would be useful to be able to easily find documentation of changes in FLACS performance relative earlier FLACS versions. Olav R. Hansen (Lloyd's Register) asked how the grid dependency will be presented in the validation documentation. Djurre replied that Gexcon would have to look in more detail on how to best show grid dependency. A good starting point could be to show the reference grid, easily available in the documentation. The presented overall structure for the compressed validation scheme was acknowledged as a suitable format by the FLUG-members.

**New test team in Gexcon India**
Sunil Lakshmipathy (Gexcon) gave a presentation on extended FLACS testing performed by colleagues in the new Gexcon India office. Personnel at the Gexcon India office can also contribute by adding cases to the new validation framework, and contribute to FLACS training in India.

**Dedicated support team**
Lene Sælen (Gexcon) gave a presentation on how the new dedicated support team will serve the FLACS users. She also introduced plans for a certification program for FLACS users. This is meant to document competence of the FLACS users involved in e.g. consultancy work employing FLACS as a tool. Olav Sæter (Statoil) commented that it is important to consider what the industrial stakeholders and risk owners (e.g. owners of oil&gas installations, process plants, etc.) think about a certification concept. Vincent Tam (DNV GL) commented that the competence of the persons assessing the FLACS results is also important (in addition to the persons running FLACS to produce results).

**Vortex shedding and flame propagation**
Helene Hisken (Gexcon) presented experimental work that she and colleagues have performed on vortex shedding and flame propagation.

**Parameter optimisation**
Anne-Lena Braatz (Gexcon) gave a preview of parameter optimisation for FLACS, which is ongoing work as part of her industry Ph.D. Vincent Tam (DNV GL) commented that it would be interesting to see how sensitive the different parameters are to change.

**Update FLACS-Fire**
Deiveegan Muthusamy (Gexcon) presented work to improve the FLACS-Fire model. Vincent Tam (DNV GL) commented that an object might block radiation more in the beginning of a fire compared to later, when the temperature of this object increases.

**Pool fire modelling with FLACS-Fire**
Franz Zdravistch (Gexcon) reported on a study where results from simulations of pool fires are compared to corresponding experimental results.

**Stormfjord 3D visualisation**
Magnus Reigstad (Gexcon) demonstrated the 3D visualisation tool Stormfjord, which has recently been acquired by Gexcon. So far, this tool has a its own brand, but besides its main application for design reviews etc. it can already be used to explore FLACS data.

**Asset management**
Alastair Crombie (Gexcon) gave a presentation on asset management related to risk analysis.

**FLACS-Risk tool**
Djurre Siccama (Gexcon) presented ongoing work and plans for the FLACS-Risk tool. In the first stage, risk related to gas explosions will be included in this tool. Later Gexcon will also include risk related to fires and toxic releases. Vincent Tam (DNV GL) commented that it is often difficult to find good (realistic) data for expected frequency of failure for equipment (frequency data needed as part of the risk analysis).

**Risk-based explosion blast loading structural response assessment using one-to-one CFD/FEA approach**
Francesco Chillè (Gexcon Italy) presented a study where a one-to-one mapping is obtained from simulated FLACS data (blast load) to a structural response tool (Impetus Afea solver). Using this procedure, exceedance curves can be made with respect to structural response (maximum perpendicular displacement).

## FLUG Meeting – Mai 6th (Day 2)

**Welcome**
The FLUG chairman, Olav Sæter (Statoil), welcomed to day 2 of the FLUG meeting.

**CFD Based Probabilistic Explosion Studies - Recent Improvements of Methodology**
Olav Roald Hansen (Lloyd's Register Consulting) gave a presentation on CFD Based Probabilistic Explosion Studies - Recent Improvements of Methodology. A question was raised about how results obtained by the multi-energy method compare to similar FLACS results. Olav commented that results using the multi-energy method usually are more conservative, except in the near zone.

**Geometry representation: sensitivity studies using FLACS**
Irufan Ahmed (University of Warwick/DNV GL) presented a sensitivity study regarding geometry representation in FLACS. Vincent Tam (DNV GL) commented that the trends seen in this investigation are based on a limited scope of comparison. Trygve Skjold (Gexcon) invited Irufan to get in touch with Gexcon to coordinate further work in this area in the future.

**Handling of large geometries + development of ACM guidelines**
Djurre Siccama (Gexcon) discussed a number of ways to handle large geometries, and the development of ACM guidelines.

**Modelling of real cloud explosion due to ignited methane jet release**
Vincent Blanchetiere (ENGIE, earlier GDF Suez) gave a presentation on modelling of real cloud explosions due to ignited methane jet releases. The influence of pre-ignition turbulence is not fully known, and it is proposed to do more investigations. Henri Tonda (Total) asked whether comparison has been done also when a jet release is combined with wind (wind will in general give added turbulence everywhere compared to quiescent conditions). Vincent Blanchetiere (ENGIE) answered that such a comparison has not been done yet.

**Location Specific Design Accidental Loads**
Nikolai Rivedal (DNV GL) gave a presentation on location specific design accidental loads. Chris Savvides (BP) asked which gains Nikolai expect when using this approach. Nikolai answered that it is applied to critical elements, using input from the operator.

**FLACS Promotion in Russia**
Anton Sofin (STC) informed about the promotion of FLACS in Russia. The FLUG members appreciated the proclamation that CFD finally is recognized as the best approach for safety studies in Russia.

**Global loads for equipment**
Henning Lohne (DNV GL) showed work regarding estimating global loads for equipment. Henri Tonda (Total) encouraged Gexcon to facilitate improved output that is suitable for structural analysis. Hans-

Christen Salvesen (Gexcon) commented that FLACS output for integrated force from the fluid on an object, has been facilitated in earlier test version of FLACS.

**FLACS simulation of Vapor dispersion from vent mast of LNG fuelled ships**

Wu Shunping (CCS) gave a presentation on the application of FLACS to simulating vapour dispersion from the vent mast of LNG fuelled ships. Henri Tonda (Total) commented that in some scenarios turbulence and vortices can push fuel downwards.

**FLUG wishes**

Lars Pesch (Gexcon) kicked of the FLUG wishes session with a few slides on performed work and further plans regarding earlier FLUG wishes. He encouraged the FLUG members to communicate wishes to Gexcon also between the FLUG meetings (email to flacs@gexcon.com). Some FLUG wishes were communicated immediately during the session:
Irufan Ahmed (University of Warwick, DNV GL) would like more flexibility in Flowvis 5 when displaying velocity vectors in 2D. Henning Lohne (DNV GL) voted for an option in Flowvis 5 to plot velocity vectors not necessarily for each cell of the numerical grid (e.g. option to plot for every other cell). Olav Roald Hansen (Lloyd's Register Consulting) would like a recommendation or template for conveniently specifying color scales in Flowvis 5 when showing, e.g., both flame and pressure on the same page. Another wish is to provide the possibility to have one plot area on a same page, dedicated for a common legend (legend enforced for the other plots in the same page, to avoid possible misinterpretation).

Lene Sælen (Gexcon) asked the audience if there is any specific FLACS tutorial that they would like to have available for the FLACS users. Henri Tonda (Total) commented that a tutorial with a detailed example of typical use of FLACS, including a full data set of simulation files, would be useful.

**Venue and date for next meeting**

Next FLUG meeting (expected to last 3-4 days) is planned to be in Shanghai, China, hosted by CCS, in the week Monday 2nd November – Saturday 7th November 2015. More details will be communicated to the FLUG members when available.

**Closing**

The FLUG chairman Olav Sæter (Statoil) thanked the participants for all the good presentations and contributions during the meeting, summing up the headlines from the presentations. Before closing the meeting he also encouraged the FLUG members who would like to give input regarding the structure of the FLUG meetings, to contact himself (olsate@statoil.com) or Erik Aadland (Gexcon, Erik.Aadland@gexcon.com or flacs@gexcon.com).