GexCon
A company in the CMR Group

MINUTES OF MEETING

Meeting : **FLACS USER GROUP**

Venue : **GexCon AS, Bergen, Norway**

Date : **May 8th, 2003**

Prepared by : **Ole Jacob Taraldset**

Participants:

Kari Frederichsen	Aker Kværner
Einhild Eliassen	Det Norske Veritas
Are Bratteteig	GexCon AS
Hans Fredrik Nordhaug	GexCon AS
Hans-Christen Salvesen	GexCon AS
Idar Storvik	GexCon AS
Jerome Renoult	GexCon AS
Ole Jacob Taraldset	GexCon AS
Solveig R. Ryum	GexCon AS
Torgeir Nærø	GexCon AS
Abdelhamid Nazih	IRSN
Catherine Gueguen	Rhodia
Anette Urheim	Safetec
Bernt Natvig	Scandpower
Thomas Magnussen	Statoil
Jens Kristian Holen	Statoil
Henri Tonda	TotalFinaElf

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Karl O. Ingebrigtsen	Scandpower
Bjørn Hekkelstrand	Scandpower
Jo Wiklund	Scandpower
Gunthard Niederbaeumer	SKS
Svein-Tore Sivertsen	TotalFinaElf
Martyn Ramsden	Vectratech
Gary Walker	Vectratech

1. Welcome

Torgeir Nærø wished welcome to the meeting. BP apologized for not being able to attend.

2. Adoption of agenda

The agenda was adopted without any comments.

3. Minutes of previous meetings

Ole Jacob Taraldset went through the previous minutes of meeting. There were no comments.

4. Actions

- Finalize the FLACS guidance document or “best practice”-manual.
- List of FLACS files. Verify the list found in the FLACS manual, update if necessary.
- Next FLUG meeting: October 17th, 2003 at TotalFinaElf's office in Paris, France.

5. Presentation by GexCon

5.1 Idar Storvik

Idar Storvik gave an presentation about the new FLACS, FLACS V8. New functions in FLACS V8 was described and hardware requirements were mentioned. The Hardware requirements are the same as for previous versions of FLACS, except for CASD 5.1 which requires hardware accelerated 3D graphic card. CASD 5.1 is currently available on Linux and sgi. On Linux GexCon recommends using a NVIDIA graphic card and using the latest hardware driver available from nvidia.com. (At time of writing these minutes it is version 4363).

In addition to the standard version of FLACS GexCon is currently making available FLACS products with reduced functionality (called baby FLACS). These includes FLACS-GASEX which is a full-blown explosion simulator, FLACS-DISPERSION which is an efficient and accurate ventilation and dispersion simulator, FLACS-HYDROGEN which have full FLACS capabilities for gas mixtures dominated by hydrogen and FLACS-ENERGY with full FLACS capabilities for gases from cracking of transformer oil.

Torgeir Nærø commented on the reason for developing the baby FLACS products.

As FLACS V8 marks the end of the current Licorefla project GexCon expressed a thanks to the sponsors of this project.

5.2 Hans Fredrik Nordhaug

Hans Fredrik Nordhaug gave a presentation about the forthcoming dust explosion simulator DESC which is based on FLACS. DESC will be made available commercially by the end of 2004.

6. Discussion

Question, Bernt Natvig: Is there a radiation model in the current version of FLACS? For some dispersion simulations radiation will be important close to hot surfaces.
Idar Storvik: A simple radiation model is available in the current version of FLACS by using the cs.RAD file. Only radiative heat loss from the gas is implemented, not radiative heat transfer from hot surfaces. Please see chapter 7 in the FLACS manual for details.

Comment, Henri Tonda: Where to find the electronic version of the FLACS manual. How is the manual organized? A list of files which can/must be edited by hand, i.e. functionality not available through CASD should be made available.

Idar Storvik: The manuals can be found on the help menu in both CASD and Flowvis. The CASD and Flowvis manuals are basically listings of functionality. The FLACS manual is organized by topics.

Question, Catherine Gueguen: Can FLACS handle explosions and dispersion inside vessel fed by a fan?
Idar Storvik: There is no fan implemented in FLACS.

Question, Einhild Eliassen: How to model very large leaks from riser pipeline? The problem is to be able to release a great amount of gas through one normal sized grid cell side.
Answer, Bernt Natvig: Scandpower has done something similar with a very large sub sea leak. The solution is to make many leaks from neighboring control volumes.

7. Presentation by FLACS users

7.1 Solveig Ryum, GexCon

Solveig Ryum gave a presentation about the difference in using the Q5 equivalent gas clouds vs. real gas clouds. The conclusion is that generally the average results correspond very well. For some scenarios the difference in results (overpressure) is larger.

7.2 Bernt Natvig, Scandpower

Bernt Natvig gave a presentation about Far field blast simulations and resulting negative pressure loads. On a structure in the far field negative explosion loads were seen. Is this physical? The pressure-time history on the structure shows a first a positive pressure and then a negative pressure. The pressures have approximately the same absolute value.

Hans-Christen Salvesen: This phenomena has been seen in experiments at GexCon's test facilities at Sotra.

Henri Tonda: If speeds are around sonic then it is physical.

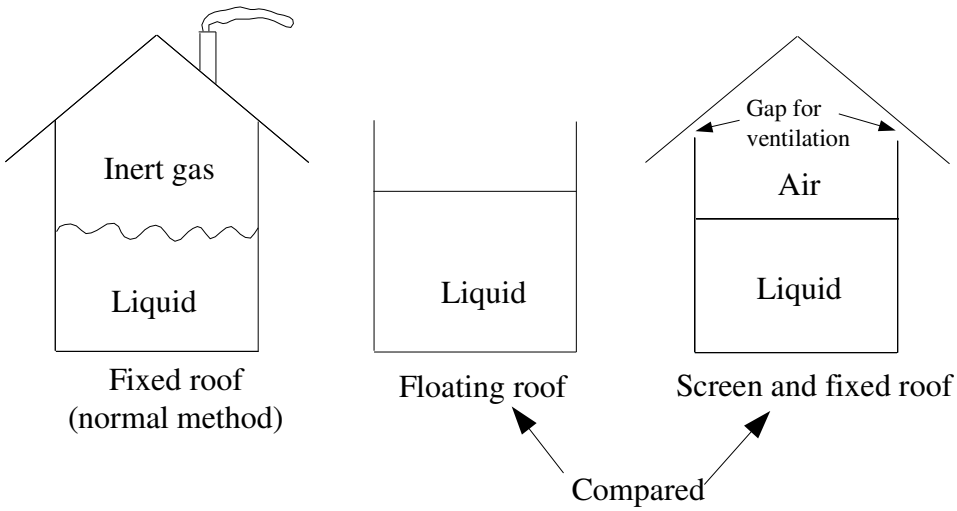
Abdelhamid Nazih: The positive phase push the structure and then the negative phase match the mechanical response which can result in a collapse of the structure towards the explosion.

Comment author of MoM: If the positive and negative pressure has the same absolute value this indicate that something isn't correct. When investigating far field blast it is important to use the PLANE_WAVE boundary condition. The EULER condition can result in a unphysical suction toward the boundary.

7.3 Henri Tonda, TotalFinaElf

A student at TotalFinaElf tried out both FLACS and Kameleon FireEx on a block house around a container with flammable liquid. The block house is 17x8x11 meters.

Dispersion simulations were run in two geometries (see figure below). Will the gap between the roof and the walls in case with Screen and Fixed roof give adequate ventilation? The simulations were run with symmetry plane and the total amount of control volumes was 520 000. The simulations took about 10 days to complete (50 seconds simulation time).



Explosion simulations were performed in the same geometries. A gas cloud was located inside the block house and 1.2 mill. control volumes were used.

Findings and questions:

- The explosion simulations stopped before the blast wave reached the last monitoring point
- Guidance to placement of grid (not size) should be given
- Flowvis should print both sides of a symmetry plane
- Do not place any scenario parameters outside the grid (other side of symmetry plane)
- Manual should be tested by new users
- GexCon should aim to reduce dispersion simulation time

A question about the CFLC number was asked. The CFLC and CFLV numbers are described, and guidance given in the FLACS manual on page 2-35.

7.4 Olav Sæter, Norsk Hydro

Jens Holen gave a presentation on behalf of Olav Sæter about the use of what is referred to as equivalent stoichiometric gas clouds based on ERfac, Q4 and Q5. Q4 and Q5 are not calculated at stoichiometry but at $S_{l,max}$ (maximum burning velocity). This means that what is really used is equivalent gas clouds at $S_{l,max}$. This has very little impact on the results for normaly hydrocarbons, but for e.g. hydrogen $S_{l,max}$ and stoichiometric burning velocity is very different.

Either of the following can be used to remedy this:

1. ERfac, Q4 and Q5 must be processed at $S_{l,max}$ and not at stoichiometry.
2. $V_{Q4} = \sum V_{CV} \cdot \frac{S_{l,CV}}{S_{l,0}}$

By using one of the above methods the resulting volume for hydrogen will be nearly twice compared to using the old method.



8. New application areas

8.1 Ole Jacob Taraldset, GexCon

Ole Jacob Taraldset gave a presentation about a project involving simulating explosions in linked pipes and vessels. The pipe was several hundred meters long and and contained stoichiometric mixture of methane and air. The gas mixture was ignited in one end and ventilated in at both ends.

Results from this project shows that FLACS simulates these kinds of scenarios with reasonable results, but that FLACS is not well adapted running such simulations. The simulations took a very long time to perform (several weeks).

8.2 Jerome Renoult, GexCon

Jerome Renoult gave a presentation about a R&D project which is currently being undertaken at GexCon. The project involves adapting and improving FLACS to better handle hydrogen as a fuel gas. Both experiments and upgrading of FLACS is part of the project.