FACE
Annual Status Report 2008

Subject	: FACE Status Report
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Compiled by	: Erik J. Holm

Executive Summary

The report covers the period January-December 2008. The FACE centre is a Centre for Research driven Innovation (CRI), a collaboration between the research partners NTNU, SINTEF and IFE.

The funding partners in 2008 have been: CD-Adapco, ConocoPhillips Skandinavia AS, ENI Norge, FMC Technologies, Norwegian Research Council, Shell Technology Norway, SPT Group, StatoilHydro ASA (In 2008 still operating in the centre as the two companies Statoil and Hydro), and Vetco Gray Scandinavia AS.

The scientific work in the centre has had a good start. The work has mainly consisted of investigating the status and gaps in the relevant topics, on establishing a common view on the challenges and the solutions we want to pursue, on further developing the plans, on forming a basic framework on the modelling topics, on developing the first prototypes of fluids mimicking crude oils or suspensions, and on starting with screening experiments showing some of the phenomena we are focusing on. The integration of the work between the three research institutes has been the main focus on the strategic side, in addition to the scientific strategy itself.

In this document, we describe quite briefly the main purpose of the centre, some headlines of the scientific work and some aspects of how the centre is working internally and towards the outside. For a more detailed progress reports, we refer to proceedings of our FACE workshops, and to the bi-annual progress reports. For more details on the scientific plans, we refer to the current documents on the FACE plans.

Less effort was spent in 2008 than planned. This was due to several reasons explained in the report. The delayed work will be performed in 2009, and it is emphasized that the centre gained significant momentum all through 2008.

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1 Introduction

This is the annual report to the Norwegian Research Council for FACE (Flow Assurance Centre). The report covers 2008, i.e. a year of work, following the short startup period in 2007. The FACE centre is a Centre for Research driven Innovation (CRI), a collaboration between the research partners NTNU, SINTEF and IFE.

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In this document, we describe quite briefly the main purpose of the centre and some headlines of the scientific work in 2008. The appendices contain the costs and the FACE staff. For a more detailed progress report, we refer to presentations from of our FACE workshops, and to the bi-annual progress reports. For more details on the scientific plans, we also refer to the current documents on the FACE plans. All these documents are available for FACE partners in the FACE e-room, an internal web site in the centre.

2 FACE main strategy: vision and values, KPIs and targets

The FACE KPIs (Key performance indicators or success factors), vision and values have been developed in 2008 in parallel with the development of the integrated centre work. In addition, we are currently shaping the overall targets inside the innovation areas, and also targets for the current three year period. These building blocks form the base for the FACE centre, and they will be briefly described here. Note that the set of strategic information is not written in stone, and may be slightly modified along with the development of knowledge. The scope will also have to be constantly subject to revision by evaluating realistically the ambitious targets with the boundary conditions of resources and priorities.

The FACE vision:

Combining Surface and Colloid Chemistry with Fluid Mechanics to solve Flow Assurance problems

It expresses the multidisciplinary aspect of the centre, and the challenging balance between academic research and industrial application.

As our most important, we have chosen these three current FACE values: Long term Science, Ambitious, and Industrially relevant.

In a presentation at the NRC in 2007, we received signals on the criteria that will be used for evaluating the CRI centers. From these, the FACE Board and Management have produced a list of KPIs that we believe will give a substantially realistic picture of how the centre is performing as compared to the intentions from all the partners. The list of FACE KPIs:

1. Scientific results
2. PhD, Masters, PostDocs
3. Journal papers
4. Conference papers
5. Number of Partners
6. IPR
7. International cooperation
8. Industrial partners' evaluation
9. Involvement of industrial partners
10. Scientific cooperation across institute lines

Some of these are straightforward to measure. Some of the KPIs are not easy to measure, but still all the more important for evaluating the centre performance. Therefore, we are currently developing a strategy for measuring the KPIs. Following this, we will set goals for each KPI inside the subprojects of FACE.

The targets of the scientific work in FACE is addressed in a dynamic document. There, the current FACE innovation areas are described:

- Model fluids and reference fluids able to reproduce experimentally the behavior of actual crude oils
- Improved tools for design of fluid transport systems with surface active components and emulsions.
- Improved tools for design of flow systems including solids, hydrates and waxes
- Improved tools for design of viscous fluids transport systems

- Improved separator design for water/oil separation

Furthermore, the overall FACE targets are identified:

- Develop macro models that can incorporate micro/meso effects
- Educate PhDs, Post Docs and Masters
- Establish the status and gaps on relevant scientific topics
- Design, synthesize and characterize model fluids to study suspension behaviour
- Characterize crude oil samples from the industrial partners
- Design and characterize Reference fluids, based on the crude oil characterizations, to study emulsion and crude oil behavior
- Establish new understanding of micro/meso phenomena leading to flow assurance problems by performing well designed experiment campaigns
- Develop new models on the meso-scale to describe these phenomena
- Initiate a Forum for Flow Assurance for the FACE partners

Plans have been developed for the first three years (2007-2009) of the FACE centre. They serve as a starting point and direction pointers for the initial work. The plans will be developed further along with the emerging results of the Centre. These plans are collected in an extensive set of documents including CTRs, distributed to and shared by all the FACE partners. These detailed plans will not be published. Early 2009 we started the process for developing the next three year plan 2010-2012.

3 FACE: Organization

The FACE organization is described in the document “Governance structure” following the consortium agreement. The FACE organization is depicted in the figure below.

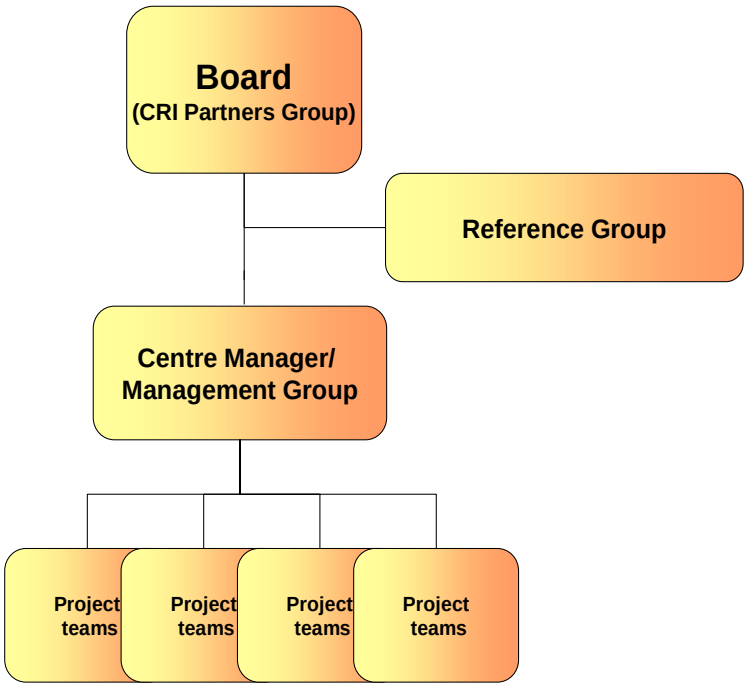

Figure 1: FACE governance structure

To overcome some of the leadership challenges in this virtual centre with three independent organizations, FACE has defined a leader group consisting of personnel that hold executive line management positions in the three research institutions. This CRI Partners Group forms a subgroup of the Board with special responsibility for the supervisory control of leadership and operational management of the Centre. Effectively, this group shall support the centre manager when operation of the centre require decisions in the CRI partner line organizations. At present, this group consists of Dag Thomassen from IFE (Host institution), Kjell Arne Jacobsen from SINTEF and Bjørn Hafskjold from NTNU. However, there has not been significant activity in the group in 2008, as the centre work has progressed in the expected manner, as described in the Governance Structure document.

The following individuals have been filling the roles of the FACE centre in 2008:

FACE Board 2008	
Representative	**Company**
Simon Lo	CD-Adapco
Ole Lindefjeld	ConocoPhillips
Keld Nielsen	ENI
Rune Fantoft	FMC
Dan Friedeman	GE Vetco Gray
Dag Thomassen	IFE
Tor-Petter Johnsen	NRC, Observer
Bjørn Hafskjold	NTNU
Kjell Arne Jacobsen	Sintef
Davoud Tayebi	Shell
Jørn Sikkerbøl	SPT Group
Per Gerhard Grini	StatoilHydro 1, Chair
Pål Hedne	StatoilHydro 2

FACE Reference Group	
Representative	**Company**
Simon Lo	CD-Adapco
Kris Bansal	ConocoPhillips, Chair
Alberto di Lullo	ENI
Lars Grønnæss	FMC
Johan Kristian Sveen	GE Vetco Gray
Jan Nossen	IFE
Tor-Petter Johnsen	NRC, Observer
Sigurd Skogestad	NTNU
Jon Harald Kaspersen	Sintef
Gert van Spronsen	Shell
Lars Hovden	SPT Group
Einar Eng Johnsen	StatoilHydro 1
Bjørn Meland	StatoilHydro 2

FACE Project leaders	
Roar Skartlien, IFE	P1: Modelling
Johan Sjøblom, NTNU	P2: Fluids
Paal Skjetne, SINTEF	P3: Separation
Tor Erling Unander, SINTEF	P4: Experiments
Erik J. Holm, IFE	P5: Make FACE a centre
Jon Harald Kaspersen	P7: Viscous oil (2008 only planning stage, project starting 2009)

FACE Centre Manager
Erik J. Holm, IFE

4 The scientific work

The FACE scientific work is now also organized and coordinated according to the FACE innovation areas described in section 2, in addition to the structure of the projects. There are also strong interrelations between the innovation areas. This must be kept in mind when reading the project progress reporting. Some of the links are clearly stated in the descriptions.

The scientific work and progress in the projects is described in the next chapters.

5 Project 1 – Flow Assurance Modelling

Suspensions:

The theoretical framework for the macroscopic suspension model is now completed. This is a turbulence model for the combination particles/fluid flow in channel or pipe flow. We have developed closure relations for these equations, based on developments at the University of Newcastle. We are now implementing our set of equations for the problem into a numerical solver, and we will compare the results with data from our IFE-lab. The new PhD student in Newcastle, Andrew Bragg, and his advisor D. C. Swailes have been involved in the model development. A report on the model equations and developments is now completed.

A cooperation with Dr. Djamel Lakehal and the Zurich based company ASCOMP has been initiated to study the physical details of particles in turbulence via ASCOMP's numerical simulation tool. This simulation model, and the use of experimental data obtained in the low pressure flow loop at IFE, will help to validate the closure relations in the macroscopic turbulence model.

Preparations for the experimental work on suspensions are nearly completed. An advanced Particle Image Velocimetry (PIV) system that enables measurement of turbulence characteristics and mean velocities in suspension flows is delivered. This instrumentation will give us new possibilities to better understand how particles influence the carrier fluid and vice versa.

Parallel to this, a literature survey on suspension flow emphasizing experimental work and techniques has been finalized. This review covers both dilute suspensions and more concentrated suspensions with formation of beds.

Oil/water mixtures:

The work on oil-water systems is a strong integration of the research in FACE. The experiments use reference liquids made by the Ugelstad laboratory with tailored fluid and interfacial properties. Detailed measurements at SINTEF can directly be compared to numerical simulations performed within the modelling activity.

The general strategy for the modelling of both suspensions and oil/water mixtures is to construct so called constitutive relations (CR) to be used in macro-models for the flow in a pipe. Detailed simulation models are developed and experimental campaigns are set up to improve these CR's.

A main goal in the ongoing fluid-fluid modelling work is to understand the effects of surfactants in oil/water mixtures where hydrodynamic effects are important. Initial focus is put on the stability and break-up of oil/water interfaces in turbulent flow. An important part of the work is linear stability of interfaces, with effects of surfactant included. These are useful tools to validate the numerical models, to gain understanding of the simulation results and to develop CR's.

We have finalized implementation of our prototype simulation code, with surfactant, and started to use it on simple model systems. A report on the model has been completed. A major part of the modelling effort, but so far without surfactant, has been conducted in cooperation with CD-adapco, using a different simulation approach.

Experimental work:

IFE and SINTEF are cooperating closely to test models against settings where oil/water interfaces are hydrodynamically unstable, leading to mixing between fluids. We are for example studying the flow behavior in a tilted channel with oil and water. The project is also cooperating with NTNU (Project 2 - Fluids) on calibrating our models against measured fluid behavior in the lab, in highly controlled settings (e.g., the surface tension of a pendant drop).

Reference fluids have been developed for different purposes. Simple water/hydrocarbon systems with surfactants added to modify the interfacial tension have been developed in cooperation with the modelling group. The target is to test and study the performance of our

prototype simulation code with surfactant. The pendant drop is chosen as a starting case. Low interfacial tension reference fluids have been developed for experimental flow studies in the flow rig at Tiller. These studies should constitute the basis for up-scaled studies in flow rigs in lab sites at NTNU, Sintef and IFE).

We have performed experiments where we look at the break-up of a liquid jet, and lately, the instability and break-up of a plane oil-water interface. In these experiments, the interface becomes unstable and eventually oil and water become mixed and an emulsion is created.

To improve our measuring capabilities, we have successfully built and tested a traversing three-phase gamma densitometer. With this instrument we are able to measure the water/oil/gas fractions in pipes and channels as function of vertical position within the duct.

6 Project 2 – Fluids and Characterization

At the Ugelstad Laboratory the following persons have been employed to work in FACE:

Johan Sjöblom (Project manager, 20%)
Sebastien Simone (Post Doc, part time)
Serkan Kelesoglu (PhD student, 100 %)
Asal Amiri (PhD student, 100%)
Geir Sørland (Anvendt Teknikk, NMR, droplet sizes)

The work within the model fluids (particle suspensions) has been focused on silica systems where the silica particles have a dimension in the 10 – 20 nm range. The characterization has involved flow properties and suspension stability. This has been the main objective of the work of Asal Amiri.

The work within the reference fluid part has been directed towards the characterization of the Heidrun crude oil provided by StatoilHydro. Based on the characterization work synthetic components have been chosen to mimic the properties of Heidrun. This work has been the main focus of Serkan Kelesoglu. The reference fluid work is basically restricted to mimicking water-in-crude oil emulsions both with regard to flow properties as well as stability aspects.

By the end of the year another crude oil sample (Grane) arrived and we started up the experimental characterization work. This is not yet finalized. Asal Amiri started to plan further work in the field of larger particles and also how to co-ordinate her work towards the experimental flow characterization work at IFE. The reference fluid work has proceeded to the level where qualification tests are planned in a newly built flow loop at StatoilHydro's R&D Centre in Trondheim. These experiments were carried out in January/February for different water contents and flow rates of both systems. The result showed an astonishing agreement between the real Heidrun crude oils based emulsions and the reference emulsions based on synthetic components.

The present status is that the work on the aqueous silica suspensions (nm range) is concluded and a manuscript has been prepared. The work by Kelesoglu is in a state where the work on the Heidrun based systems is more or less concluded both with regard to experimental characterization of the crude and with regard to formulating the synthetic emulsion system.

The work by Amiri has resulted in a manuscript: "Influence of pH, High Salinity and Particle Concentration on Stability and Rheological Properties of Aqueous Fumed Silica". This manuscript has been submitted to the Reference Group for reviewing and comments.

The work by Kelesoglu is in preparation for two manuscripts.

Geir Sørland (Anvendt Teknologi) has been in charge of developing NMR as a tool for measuring the droplet sizes and their distributions. Sørland has developed the apparatus, the software and the sampling during the years. A new Maran NMR (20 kHz) has been purchased for the project. Sørland has stabilized the new equipment. The initial problem was that the sampling time of the emulsions was long in relation to the stability of the systems. This problem was eliminated by new experimental techniques and developed software. Per today the instrumentation can sample information of the emulsion systems in 45 – 60 seconds. The droplet sizes from the NMR system have been calibrated towards similar results from microscopy with excellent agreement. The system works well on synthetic and real crude oil systems under stagnant conditions. The existing instrumentation is not applicable for measuring under flowing systems.

The work and results by Sørland have been summarized in a final report approved by the Reference Group.

7 Project 3 – Separation

On December 5th 2008 a workshop was held to clarify the expectations of all the partners in the separation activity. The main expectations were as follows:

- Gain basic understanding of phenomena related to separation
- Understand basic break-up and coalescence. If we can improve this understanding a lot has already been gained, and we will be in a position to move on to more complex systems, e.g. electrostatics, gas bubbles and multiple emulsions.
- Improve physical models that can be used in in-house tools.
- How can modeling be used to scale up pilot tests?
- How is heavy oil different with respect to separation?
- The basic understanding of droplet break-up and coalescence is equally valuable to separation vessels, pipelines and high shear devices in the pipes.

The need for both a phenomenological approach to modeling of separation and a detailed approach was discussed. As a result is was agreed that a second workshop on separation modeling should be held in February 2008. In this second workshop three levels of modeling were discussed; phenomenological modeling (engineering models), multi fluid computational fluid dynamics (CFD) and meso scale modeling techniques, with an emphasis on dissipative particle dynamics (DPD), as a possible tool for modeling droplet coalescence. The meso scale techniques are needed in order to build fundamental insight into coalescence processes, while from an engineering view there is a strong need for engineering models for process modeling and CFD models for detailed separator design. The plan for 2009 with respect to modeling is to investigate the potential for; improving the phenomenological framework suggested, establishing a CFD model for separation, and if and how the effect of surfactants can be captured/represented in these models. We also hope to be successful in securing additional funding for a post doc within DPD together with the modeling project.

The analysis of the separation data from Porsgrunn and the ISEP/GEMS/IWST projects is underway and should be concluded by early autumn 2009.

The short course on ”Interfacial Rheology and High Interfacial Systems” was held on March 23rd and 24th in conjunction with the FACE spring meeting. The course was opened up to participants outside FACE and partners were invited to send non FACE staff. A total of 49 participants attended the course. Professor Gerald G. Fuller (Stanford University, and Bingham

Medalist), Jan Vermat (K. U. Leuven) and Simon Cox (Aberystwyth University) taught the course. They have kindly provided FACE with the full course material, which is available in the eRoom – complete with all animations.

Two new workshops are planned in 2009; one on model development and one on dense emulsions and coalescence. In the latter we plan to invite up to three internationally recognized experts in the field.

During Q1 2009 the project has been exploring phase field techniques with the aim to include the effects of surfactants on droplet coalescence. The technique has been tested against data from literature with respect to droplet dynamics in electrical fields. In addition two small scale test rigs are being assembled. In the PostDoc activity a paper has been submitted for internal review on use of nonionic surfactants as emulsion inhibitors. Two more papers are planned on the interfacial rheology of asphaltene films at oil/water and Langmuir film studies of asphaltene films at the oil/water and air/water interface.

8 Project 4 – Flow assurance Experiments

The work on oil-water systems is a strong integration of the research in FACE. The experiments use liquids made by the Ugelstad laboratory with tailored fluid and interfacial properties. The approach is to do detailed measurements that can directly be compared to numerical simulations performed within the modelling activity. The cases studied include pendant drop experiments, liquid jets and tilted closed channels filled with oil and water. Experiments take place at SINTEF and the Ugelstad laboratory, and modelling and simulation take place at IFE, SINTEF and with FACE partner CD-adapco. The main goal in this fluid-fluid activity is to understand the effects of surfactants and other surface active substances in oil/water mixtures, with initial focus on the stability and break-up of oil/water interfaces in flowing systems. We have finalized implementation of a prototype simulation code. Low interfacial tension reference fluids have been developed for experimental flow studies in the flow rig at Tiller. These studies should constitute the basis for other up-scaled studies in other flow rigs.

We have now successfully made model hydrate particles that will be studied in flow experiments. Real gas hydrates only exist at low temperatures and elevated pressure and this makes flow experiments with such particles complex. Model particles can be used at room conditions, and they mimic real particles with respect to hydrophilicity, aggregation, density and size. The particles have been synthesized at SINTEF Materials and Chemistry, and will be used in experiments at NTNU.

Experiments on the behavior of dilute suspensions, emphasizing the two-way coupling between the carrier fluid and the solid particles, are due to start. A flow rig at IFE has been upgraded to accommodate these experiments, and an advanced PIV system has been acquired for velocity and turbulence measurements of both phases, simultaneously. The dual cavity laser, combined with a high-speed camera, allows for time resolved PIV.

The work will start with studying the effects of negatively buoyant, non-colloidal, spherical particles in a rectangular channel, for particle concentrations below ~2% by volume. The plan is to systematically vary the particle size, density and concentration, together with the flow rate (Reynolds number). In this way the FACE work will contribute with empirical data in an area of research where existing experimental data is sparse and relatively fragmented, and thus limits the development of good generic models.

9 Project 7 – Viscous oil

According to the original plans from the CRI application, FACE will also address the topic of heavy oil (in FACE modified to the term Viscous oil). At startup in 2007 it was also decided to postpone this work till the second three year period (2010-2012). However, the industry has insisted in prioritizing this work in an earlier stage as this is a major topic for the whole

petroleum industry currently. Hence, FACE has responded by reallocating resources and plans in agreement with all partners, putting some effort in 2008 into developing plans for viscous oil in FACE, starting the work in 2009. It is emphasized that much of the scientific work in the generic experimental, fluids and modelling work in 2007/2008 is actually already preparing the grounds for the more specialized viscous oil work in the FACE centre.

Currently, these objectives have been identified for the FACE viscous oil work:

- Close the gaps in generic understanding of multiphase transport processes of viscous oil.
- Reveal the underlying micro/meso phenomena that influence the macro flow assurance problems.
- Develop new simulation models

The targets developed for the first year (2009) in the viscous oil work in FACE covers these elements:

- Map, describe and categorize available field- and flow loop data. Establish a "database" for these.
- Perform a sensitivity study based on the "database". Report the dominating physical phenomena.
- Develop a plan for closing the gaps, inside the current FACE outline of Fluids, Modeling and Experiments.
- Define viscous oil experimental campaign. Map infrastructure needs (loops and measurement techniques)
- If go-ahead: perform the commissioning of experimental facilities for viscous oil purposes.

10 Project 5 – Make FACE a centre

A significant effort in the FACE centre has been put into the coordination and integration inside and between the different innovation areas in the FACE centre. Below, we describe some of the aspects of this.

Management

In addition to the other topics described inside this section, the strategic part of the management work has had the scope of developing the vision, values, innovation areas, targets and KPIs for the FACE centre. This is summarized in the section "FACE main strategy: vision and values, KPIs and targets". In addition

Industrial partners' involvement

The partners of the FACE have up to this date all been active participants of the centre, being constructive in their in-kind contributions. CTRs for the In-kind for 2008 and 2009 has been defined, and the In-kind for 2008 was delivered mostly according to the plans. Some of the partners chose to deliver their in-kind 2008 as cash, as there was not sufficient time for developing good plans, and as the FACE centre work in 2008/2009 would benefit from some extra cash contributions. We are emphasizing the importance of involving scientific personnel within our industry partners, having them share their experience and knowledge of industrial challenges through e.g. presentations at the workshops, literature reviews and contribution to state-of-the-art. In particular, the further development of plans inside the innovation areas of fluid/fluid separation and viscous oil has called for a strong industrial input and engagement.

Communication and meetings: The communication within the centre between IFE, NTNU and SINTEF is a main focus for the entire FACE centre. As the cost of large plenum meetings is quite high, and also that the coordination of diaries is a challenging task in busy times, we have decided to bundle plenum FACE meetings into two one-week sessions a year. Hence, two such meeting periods have been arranged in 2008; see a list below. At these FACE workshops, all FACE partners were represented. The number of attendees has been around 50 people. The FACE Centre Management Group has met in two seminars. The separation project have had a series of meetins with the industry during winter 2008/2009 in order to upgrade the plans. In addition, the researchers in Trondheim and at Kjeller have met in >15 meetings/Telcons/video conferences in order to coordinate and discuss plans and exchange results.

A FACE leader group, consisting of the Centre Manager, the Project Leaders and four central researchers has assembled in two seminars (2days + one day) in addition to video conferences in order to coordinate plans and workshops. The Centre Manager meets frequently with the members of the Leader Group in order to assert coordination and information flow.

FACE workshops, meetings

- 13. Feb 2008: Board telephone meeting
- 27.-28.March 2008, Jevnaker: Leader group strategy meeting
- 21.-22.April 2008, Asker: Status meeting
- 23.April 2008, Asker: Reference Group meeting
- 30. May 2008, Trondheim: Board meeting
- 12. Sep 2008: Board telephone meeting
- 21.-22.October 2008, Trondheim: Status meeting
- 23.October 2008, Trondheim: Reference Group meeting
- October-December 2008: close communication with the Industry on Separation. Several smaller or larger meetings.
- 10. Dec 2008, Kjeller: Board meeting

Literature review work: Common literature reviews have been performed, some currently still being performed, inside topics like viscous oil modelling, suspension modeling, suspension experiments, instrumentation, separation technology, numerical modelling techniques including Lattice Boltzmann, Dissipative Particle Dynamics (DPD), Phase Field and various variants of CFD.

The review documents (and the literature data base) are uploaded to a searchable wiki-server (the "FACEbook") with access for all FACE partners. The wiki server work in the same way as Wikipedia, namely that anyone in FACE can easily contribute to articles, reviews, gap analysis etc.

Partner status: ENI, Shell and CD-Adapco have joined the FACE consortium agreement in 2008. Discussions have been held and information exchanged with 7 other potential partners, including 3 oil companies, without resulting in any concrete partnership. The FACE management will continue to work for including new partners, though the times are not easy for establishing new economic commitments inside the petroleum industry.

External cooperation.

Significant effort has been put into developing contacts around the world. The main results are reported in the section “National and international cooperation”.

Internal evaluation

Two Senior Researchers (Stein Tore Johansen and Jan Nossen) from Sintef and IFE respectively, and a former industrial expert from StatoilHydro (Per Fuchs) formed an evaluation group by request from the Centre Manager. They worked for a couple of weeks during autumn 2008 by reviewing the plans and interviewing project leaders with focus on the KPI list. This resulted in an internal evaluation report and actions from the FACE Centre Management.

Other: All partners in FACE have access to, and are active in contributing to the FACE eRoom. This is a web-based project tool with high security level, well suited for projects in which the participants are geographically separated. The eRoom enables participants to discuss ideas and share information and documents. In this way, all participants have access to all information at all times, regardless of their whereabouts. In addition we also soon share the FACEbook wiki server for collecting review material from the partners. Finally, web pages for external use have been initiated, and a FACE logo has been developed and can be seen on the top of this document.

The Separation project suffered from staffing challenges and changes in the involvement by central industry players in 2008. This has resulted in an increased focus from the FACE management and Project Leaders in order to rethink the scope and plans, and to communicate closely with the industry. It is a shared view among the partners that the current plans are well considered and that when the plans are converted to work and results, the project is well back on track.

An application was submitted on a possible Marie Curie Fellowship for a PostDoc on the DPD technique. If granted, the Fellow will work in cooperation with other related activities in the centre, and also supporting a future FACE PhD on the subject.

11 National and international cooperation

The internal FACE work is a research cooperation between the IFE group on Petroleum Process Technology at Kjeller, SINTEF groups at Petroleum Technology situated at Tiller Trondheim, Lerkendal Trondheim and also Bergen, SINTEF Materials Technology Gløshaugen Trondheim, the NTNU Ugelstad laboratory Gløshaugen Trondheim, and the EPT lab at Gløshaugen Trondheim. This assembled research forum is unique in the Norwegian Petroleum research history.

PIV measurements at the Fluid Mechanics laboratory at the University of Oslo will be an important resource for the FACE centre 2009. FACE is going to fund a PostDoc position in this work, starting 2009. Inside this scope, a GE Vetco Gray PIV expert is going to perform in-kind work in a 20% position. This PIV work at UIO is coordinated with the upcoming FACE PIV work at IFE; the two parts will support each other and exchange experiences.

The FACE work has attracted Professor Paul Meakin (Idaho National Laboratory, also Prof. II at UIO) who is working on modelling in FACE through a 20% position at IFE.

Through the PhD student on suspension modelling, the FACE centre is collaborating with the University of Newcastle on turbulence modelling, suspensions and numerical methods.

FACE already has a strong international aspect through the partners ConocoPhillips, Vetco Gray (included in GE), CD-Adapco, ENI and Shell.

FACE has in 2008 been in contact with a very small Swiss company ASCOMP, particularly it's manager Professor Djamel Lakehal, in order to establish a cooperation on the computation of suspension flow. The company has developed a simulator code, Trans-AT, that is very well suited for the validation of the FACE particle-fluid turbulence model. The collaboration will start early 2009.

The FACE centre has initiated an informal cooperation with three Professors from Stanford University, K.U.Leuven and Aberystwyth University, respectively. The three professors will

develop and hold a short course on the Rheology of high Interface Systems in March 2009, see also the Separation project section.

FACE has engaged Prof. Sanjoy Banerjee from the Centre University of New York to be an external international expert working in the FACE Reference Group. Possibilities of cooperation between FACE and Pro. Banerjee's group is also being investigated. A second international expert will be engaged in 2009.

12 Recruiting

Prof. Paul Meakin, INL has been recruited to a 20% position in FACE, working mainly on developing ideas inside modelling, in particular on the DPD technique.

Former StatoilHydro expert Per Fuchs has been recruited on an hourly basis, working mainly on QA and on assisting in the development of targets and the KPI elaboration document.

Three PhD students and one Post Doc have so far been recruited to the FACE centre:

Serkan Kelesoglu: PhD student in the Fluids project.
Asal Amiri: PhD student in the Fluids project.
Yanru Fan: Post Doc in the Fluids project.
The Newcastle PhD student in the Modelling project.

In addition, the plans for two PhD students at the EPT lab have been developed. At the change of year, two candidates have been identified and the hiring process going towards offers for the two.

13 Publications

No publications at conferences or international journal have yet been submitted from the FACE centre. Several journal papers (approximately 6-7) are currently being written, and the attendance at conferences are being planned.

14 Communication and propagation of results

FACE been presented at several occations:

- At an NRC meeting for CRIs 3. April 2008
- At an NRC meeting for possible FME applicants 16. May 2008
- At the Middle East & Asia Flow Assurance Conference Cairo May 2008
- At an Intsok meeting in Houston October 2008
- At a HIPGLS Board meeting June 2008
- At the University of Newcastle in a visit to the FACE PhD Student
- At meetings with Chevron and ExxonMobile autumn 2008

15 Deviations

Most of the FACE work is carried out according to the current plans. Less effort was spent in 2008 than planned. This was due to several reasons. One is the described delays in the Separation project, another the return of Prof. O.J.Nydal from sabbatical – establishing PhD plans and connecting to others in the centre took some time, and yet another the delay in the process of purchasing new PIV equipment at IFE. Finally, the hiring of a PhD candidate at the UIO on PIV has proved to be very challenging. We have therefore decided to hire a PostDoc instead, and hope to start this work very soon. The unused funding is transferred to work in

2009. It is emphasized that the FACE centre has gained increasing momentum all the way through 2008.

Attachment: Excel sheets with costs, staff and publications.