MINUTES OF THE PROJECT BOARD MEETING
BRUSSELS, BELGIUM, 29 JANUARY 2014

Present:

Naser Sayma	City University London
John Oakey	Cranfield University
Peter Breuhaus	International Research Institute Stavanger
PeterJansohn	Paul Scherrer Institute
Christer Björkqvist	ETN
Ugo Simeoni	ETN

Apologies:

Sauro Pasini	Enel

Agenda:

1. Welcome and approval of minutes of the Oslo meeting and review of the action list
2. Short report from December Board meeting (R&D report, GT courses)
3. Horizon 2020 calls and proposed projects:
    a. Small CHP topics
    b. High efficiency MG for CHP for biofuels (LCE2gii)
    c. HYCOSOL Project Proposal (LCE3)
    d. Flexible Integration (LCE17)
    e. CAES (LCE10)
4. Air Filtration Workshop
5. Restructuring of ETN Technology Committees
6. ETN Activities

1. Welcome and approval of minutes of the Oslo meeting and review of the action list

C. Björkqvist opened the meeting and welcomed the Project Board members. He relayed the apologies of Sauro Pasini, who unfortunately could not attend due to business reasons. C. Björkqvist notified that Heikki Oltedal from Statoil has left his position as Project Board member and he recommended to the Project Board members to propose new candidates. C.Björkqvist promised to send the details of the new contact person from Statoil as soon as he had been appointed.

The Project Board approved the minutes of the Oslo meeting and discussed the action list.

Action: Project Board members and Members of the ETN Board to propose a new candidate from the oil & gas sector.

2. Short report from the December Board meeting

C. Björkqvist stated that positive comments had been given by the Board regarding the R&D recommendation report even though C. Lappe, Vattenfall had stated that he believed the part related to the "Carbon Mitigation and CCS" seemed to be prevail a too high importance compared to the reality. The board still believed this was an important R&D topic in the longer-term but It was agreed by the project board that one or two sentences could be inserted to provide a more correct picture. .

C. Björkqvist also reported that the Board had decided to propose to allow users outside of Europe to join ETN as Affiliated Members with the aim to strengthen the users' group and increase the input of development needs from the global market. If approved by the General Assembly this is expected to enter into force by late spring 2014.

He also informed them that the Board is currently working on developing a questionnaire to be circulated to the user community in order to learn more about their gas turbine fleet and the most critical issues that they would like to have solved.

The Project Board members was in favour of the proposal but proposed that it would also be useful to have an overview of all the users' group meetings taking place in Europe in order to have an update on the evolution of gas turbines and learn more about generic developing needs..

Action: The text in the section of the Carbon Mitigation and CCS to be reviewed by the Project Board.

Action: U. Simeoni to make an overview of users' group meetings in Europe.

3. Horizon 2020 calls and proposed projects

C. Björkqvist explained that the calls under Horizon 2020 have a fixed budget but we may request costs up to 20% above the recommendation budget without any additional justification. Higher request above the 20% of the fixed budget could also be made but then a detailed explanation would be needed. The proposed projects were discussed by the Project Board members:

a) Small CHP topics

Peter Breuhaus said that the small CHP topic may be integrated with the “High efficiency MG for CHP with biofuels” in the call LCE2gii.

b) High efficiency MG for CHP with biofuels

N Sayma reported that the high efficiency MG for CHP with biofuels proposal could be submitted under the call LCE2gii, which is a two-stage call where a 3-6M€ contribution from the EC could be requested. The first stage proposal would need to be submitted already by the end of March but preparations are already well on their way. C. Björkqvist stated that he believed it would be beneficial to include Ansaldo, due to their recent acquisition of the designs from Turbec, and test may be done on the T100 available in Stavanger.

N. Sayma proposed to try to get more utilities involvement in the project.

P. Breuhaus proposed that it could be worthwhile to investigate any possibilities to connect our proposal to the ERAfrica project.

Action: C. Björkqvist to contact Ansaldo to review their interest to have an involvement in the project.
Action: N. Sayma to update the proposal.
Action: ETN to circulate the proposal of the project to the utilities.
Action: P. Breuhaus to circulate to Project Board members the ERAfrica project details.

c) Former “HYCOSOL” Project Proposal (LCE3)

C. Björkqvist explained the schedule of the call and the status of the consortium discussions. It is a one-stage project proposal to be submitted on 10 September 2014.

The proposal would be based on the former HYCOSOL project, with updates on the current state-of-art based on on-going projects like Solugas and the “SunShot” project developed by the U.S. Department of Energy. As Siemens have decided to withdraw their participation ETN is currently looking for an OEM with a suitable engine. C. Björkqvist reported that Solar has expressed interest in the project with their Mercury 50 turbine but alternative OEM’s are being explored.

Action: C. Björkqvist to follow up with OEM’s.

d) Flexible Integration (LCE17)

P. Breuhaus explained that a project outline has been drafted for this proposal. The main objective of this project is to deliver a methodology and software framework for a cost efficient operation of energy supply systems exposed to highly fluctuating demand and
supply patterns dominated by renewable energy sources. C. Björkqvist stated that projects under this call would be 100% funded by the European Commission with a possible EC contribution between 3 to 6M€. The proposal submission is a two-stage process with the first stage to be submitted prior to the 3 September 2014. . Currently the proposal has been circulated to EON, Vattenfall, Enel, and GDF Suez for feedback on their interest.

The project would be suitable for a double shaft engine but an OEM has still to be identified. N. Sayma stated that the involvement of an OEM would be beneficial for the project but a user would

bring even bigger value to it. However he mentioned that the benefits for the utility companies have to be clearly shown.

The Project Board suggested to follow up with the utilities as well as some smaller operators and then as a second step contacting OEM's based on the user's fleets. The project would focus on two simulation fields (the 1st simulation would be tailored to the materials; the 2nd one would be tailored to the plants' efficiency).

Action: ETN to follow-up with the utilities and then approach the OEMs.

e) CAES (LCE10)

It was highlighted by P. Brehaus that there would be an call on Compressed Air Energy Storage in 2015. No outline has so far been proposed but it was agreed that ETN should highlight this opportunity to its members.

Action: ETN to inform its members about this opportunity to see if there is any interest for such a project.

4. Air Filtration Workshop

C. Bjorkqvist informed the Project Board on the preparation for the Air Filtration Workshop that will take place on 20 February in Brussels.

A questionnaire prepared in cooperation with the filtration companies (Camfil, Donaldson, AAF), would be sent to the Workshop participants in order to better understand their expectations and to better organise the round tables discussions planned in the afternoon.

5. Restructuring of ETN Technology Committees

The Project Board agreed to change the name of the TC1 from "Low Carbon GT operation" to "GT systems with a reduced carbon footprint". The research areas of TC1 should include the following subjects:

- Renewables
- Advanced cycle
- Exhaust gas recirculation
- External heat exchange

It was highlighted that there is a need to find a Chairman and Vice-Chairman for each TC, preferable with a one from industry and one from the R&D community. P. Jansohn stated that Alstom had expressed an interest to provide a chairman for the TC's.
The updated vision of the TC's are listed in the Annex II.

Action: ETN to approach M. Ladwig, Alstom to see if they could propose a candidate for one of the TC's

Action: Project Board members to send any suggestion of potential candidates to ETN.

6. ETN activities

The Project Board discussed the current on-going projects by going through the draft minutes of both the Project Board meeting held in June 2013 in Oslo and the Annual General Meeting held in October 2013 in London. It was proposed by C. Björkqvist to make an overview table available on the ETN website with the ongoing projects and the project proposals on hold. By clicking on any proposal or project you would find an outline of the initiative or a link to the details of the project. The project Board agreed that this would be a good idea.

For each of the listed proposals/projects, a follow-up should be done to verify the current status. It was also decided that the Project Board should assign each initiative to one Project Board member who would be responsible together with ETN to follow up on the status.

a) **Virtual Testing**
b) **Dispatchable power generation with minimum carbon footprint**
c) **Dynamic combustion**
d) **Supercritical CO_2 GT cycles**
e) **Innovative sensors for combustion instabilities**
f) **TBC Literature Study**
g) **Hot Borescope Project**
h) **Condition Based Maintenance**

Please see the Annex I for the actions.

Annex I: ACTION LIST Project Board Meeting, 29 January 2013, Brussels, Belgium

No	Responsible	Action	Deadline
1.	PB members and ETN members	To propose a new candidate from the oil & gas sector for the PB.	30 March 2014
2.	PB members	To review the text in the section of the Carbon Mitigation and CCS.	15 March 2014
3.	U. Simeoni	To make an overview of the users' group meetings in Europe.	30 March 2014
4.	C. Björkqvist	To contact Ansaldo to review their interest to have an involvement in the project MG for CHP.	28 February 2014
5.	N. Sayma	To update the proposal for high efficiency MG for CHP with biofuels	30 March 2014
6.	ETN	To circulate the proposal of the project MG for CHP to the utilities.	28 February 2014
7.	P. Breuhaus	To circulate to Project Board members the ERAfrica project details.	14 February 2014
8.	C. Björkqvist	To follow up with OEM's about former Hycosol Project Proposal	28 February 2014
9.	ETN	To follow-up with the utilities and then approach the OEMs for the Flexible Integration project.	30 March 2014
10.	ETN	To inform its members about this opportunity to see if there is any interest for CAES.	30 March 2014
11.	ETN	To approach M. Ladwig, Alstom to see if they could propose a candidate for one of the TC's	30 March 2014
12.	PB members	To send any suggestion of potential TC's candidates to ETN.	30 March 2014

Annex II: ETN Technical Committees as proposed by the ETN Project Board January 2014

TC1: GT systems with a reduced carbon footprint
Chair: TBD

Vision: The decarbonisation of gas-fired power generation will be required in the coming years to meet the significant CO_2 reduction targets of those countries where gas is a major contributor to the energy mix, while retaining the operational flexibility needed to balance the increased levels of generation from intermittent renewables. This extends from new build plants with integrated CO_2 capture technologies, enhancements to improve efficiency/increase exhaust CO_2 levels (exhaust gas recycle), firing of low CO_2/high H_2 fuels, the retrofit of CO_2 capture with existing installed plants and advanced cycles, including oxy-firing.

Research areas include:

- Minimisation of CO2 emissions across the full operational range required for flexible operation through i) the development of flexible, high-efficiency cycles and ii) technological improvements to existing machines aimed at improved efficiency (with TC2)
- Process integration to minimise the energy/cost penalties of implementing post combustion capture technologies of various types
- Performance and reliability impacts of exhaust gas recycle, with or without selective recycle, on combustion and hot gas paths materials
- Oxy-fired and other advanced gas turbine power cycles for improved efficiency combined with CO_2 capture, including improved turbomachinery aerodynamic design/blade cooling for the changed hot gas path environments
- Materials and coatings technologies for high CO_2/high steam hot gas path environments
- Impact of the integration of CO_2 capture technologies on operational and fuel flexibility
- Retrofit of CO_2 capture technologies with existing gas turbine power installations
- Control and monitoring strategies for gas turbines with integrated CO_2 capture
- Development of CO_2 capture technologies suitable for gas turbine combined cycles
- Impact of increased operational flexibility on plant operating costs.

TC2: Operational and Fuel Flexibility
Chair: TBD

Vision: Improved performance of gas turbine components and intelligent system integration will enhance fuel efficiency and environmental performance of future power generation units.

To have gas turbines capable of operating in an efficient, safe and reliable manner utilising a wide range of fuels for a broad operational range whilst minimising polluting emission such as NOx and aiming at zero CO2 emissions.

Research areas include:

- Increased plant operational flexibility and efficiency, using retrofit solutions as well as new technologies;
- Optimisation of the gas turbine efficiency over a wide operating range;
- Development of hybrid gas turbine cycles (solar gas turbines, fuel cells, etc.).
- Faster start-up, power ramping times;
- Increased operational range, turn-down ratio with emissions below current levels
- Development of new combustion concepts (e.g. catalytic combustion, flameless oxidation, wet combustion, etc.)
- Increased fuel flexibility for the use of broader range fuels, such as Shale Gas, LNG Syngas, Hydrogen and other renewable fuels, which requires further research in combustion kinetics.
- Development of combustion processes in the “zero (CO2) emissions” environment, i.e. carbon capture and storage technologies.

- Development of advanced numerical models, including CFD tools and virtual testing, for the prediction of the system and system component performance and stability.

TC3: Material Degradation, Repair Technologies and Manufacturing
Chairman: Ron van Gestel, Chromalloy

Vision: Achieve full insight in the mechanisms that have a negative effect on the performance of the engine, the individual components specifically, and understand how these mechanisms can be positively influenced by an alternative operation/maintenance strategy. The interaction of the different mechanisms will also be considered.

With the knowledge collected, develop – in line with the requirements – alternative, improved alloy – coating combinations that can be used in the current and future turbine designs and that perform in accordance with the demands stated for that design

Research areas include:

- Identification of the life limiting degradation models of the key gas turbine engine components;
- Extension of the predictability and modeling of the key degradation mechanisms (e.g. bondcoat oxidation or spallation of TBCs during cyclic operation); monitoring of such damage is covered by TC4
- Extension of the limits of reparability by improved insight into the occurrence and behavior of the failure mechanisms;
- Consequences of repair processes on future component lifetimes.
- The role that materials and coating systems selection play on the life of the key gas turbine components
- Development of alternative, improved alloy-coating combinations and manufacturing procedures that fulfill the defined requirements (e.g. improved resistance to TBC sintering with increased firing temperatures)

TC4: Condition Monitoring and Instrumentation
Chairman: Chris Dagnall, GL Noble Denton

Vision: Optimisation of the overall gas turbine power plant equipment effectiveness (reliability, availability, maintainability and performance), by a systematic coordination of all activities and an optimum use of the knowledge embedded in the organisation, in order to properly define the time to next service for flexible operating gas turbines and to go beyond 25000 hours of continuous operation.

Research areas include:

- Replacement of boroscope inspection (such as pyrometer);
- Control and predictive measurement of emissions;
- Increased machine monitoring with advanced instrumentation for damage detection and monitoring of components;
- Risk Based Decision Making;
- Instruments applicable for high pressure (50 bar) and high temperature;
- Control logics for predictive (performance) analysis;
- Technology to extend intervals between off-line water wash.

TC5: Asset Management
Chairman: Pascal Decoussemaeker

Vision: Use knowledge on the condition of the assets in a gas turbine based plant to optimise competitiveness over the complete lifecycle of the plant in a sustainable manner. This is needed to adapt in a flexible, sustainable and competitive manner to the uncertainty in the grid caused by changing operation profiles to support renewables and will ensure competitive power generation in a changing environment.
The focus of TC5 is complementary to TC3 and TC4, since the knowledge on the condition of the assets is based on insight in the degradation mechanisms (TC3) and the results of the condition monitoring (TC4).

Research areas include:

- Development of a concept and method to efficiently and effectively apply risk based maintenance (RBM) / risk based inspection (RBI) for all the main systems of gas turbine based plants, such as the gas turbine, HRSG, generator, steam turbine, steam cycle, mechanical BOP and electrical systems. Output of this research will include a collection catalogue of best practices for the different systems of the plant.
- Develop effective methods and tools to monitor the asset condition of the main equipment (GT, HRSG, ST, generator, compressor, …), in an aligned manner, through a combination of on-line monitoring systems and off line inspections. This will lead to a methodology to develop over-all optimized planned maintenance recommendations, based on the recommendations for the individual systems.
- Development of smart systems that are able to handle the large amount of data that is generated continuously on a power plant in order to provide value (clustering, pattern recognition, fusion, optimisation, ….), such as detection of anomalies, improvement of data quality, insight in current and achievable performance and make recommendations for corrective actions to restore the performance, improve the reliability or improve the operation. Examples are early warning systems, performance monitoring systems, …
- Develop methods to optimise competitiveness over the complete plant lifecycle, from design to decommissioning. Optimisation can also be extended to fleet level for owners of large fleets of power plants. A possible output here is a method to justify measures to improve maintainability during the design phase, even though they will only be needed at a later stage in the lifetime of the plant.