**RAM**

**D. Orhon**

Comments from the PB meeting

P. Jansohn suggested that D. Orhon could rewrite the chapter and then the PB will revise it

S. Sigali: The section Reliability would suit better in the chapter Condition monitoring and lifing.

D.ORHON comment: On my side I do not share the idea to eliminate this chapter and to locate in the chapter “condition monitoring and lifing”. Reliability, availability and maintenance are the alpha and omega of gas turbine operators. Condition monitoring and lifing are only one of the ways to improve RAM. Please see my update in page 3.

Gas turbine operators are constantly focused to deliver their production to customers. High rate of reliability allows to deliver ambitious forecasted quantities without disruptions which generate time loss, team and organization efforts and obviously loss of revenue. High availability is a key driver to maintain and potentially increase production (electricity, oil and gas) with a given asset. 10% availability in addition generates straightly 10% production in addition and highly increases profits. The ultimate goal for gas turbine operators would be a maintenance free gas turbine knowing this expectation increases the availability and decreases operation expenditures, directly linked to profit improvements.

RAM values high is paramount of importance to the user communities because it impacts their day-to-day results and finally yearly profits.

In consequence, a constant effort from Universities, Equipment Manufacturers, Services Providers and OEM is necessary to improve gas turbine reliability, availability and maintenance. The following technologies and developments should be considered:

**Reliability**

* Tools (sensors and/or data evaluation algorithm or procedure) for early warning of incipient failures (to detect deviation from expected operational conditions before damage is done or to prevent severe subsequent damage) and those directly usable by Operators or pool of Operators;
* More robust instrumentation (longer service life, reduced requirements for redundancy);
* Instrumentation for severe environments (like in the hot gas path);
* Equipment and sub-equipment developed with higher quality standards at lower price;
* Condition monitoring such as online monitoring of roller bearings, hot components, lubrication oil, etc….

**Availability**

* Increase time between overhaul (TBO);
* Improved capability of engine and its associated systems to sustain harsh environment (i.e. gas and liquid fuels with high sulphur content, offshore and coastal in wet and salty conditions);
* Filtration system addressing industrial conditions like hydrocarbon vapors, soot in order to improve air intake filter performances (longer service time between maintenance with high efficiency);
* Slippery coating on compressor airfoils in order to reduce fouling and the need for operational interruptions (shut- down for a compressor wash);
* Monitoring and prediction of degradation processes to better plan for required shut-downs;
* Auto-run calibration for low emission systems;
* Systems and algorithm eliminating rotor lock-in.

**Maintenance**

* Development of repair standards lowering costs;
* New component design leading to 100% components reparable and re-usable for cost reduction;
* Improved tools for Condition Monitoring, also through the integration of different tools available, enabling the adoption of Condition Based Maintenance;
* Risk-Based maintenance approach, taking into account for the probability and the economic consequences of the potential failure modes;
* Algorithms for predictive analysis (thermal engine performances, sub-system performances, etc.);
* Engine sub-system life extension depending on operating conditions;
* Optimization of spare part management;
* Online transfer of data from remote locations and communication with centralized experts;
* Smarter contract models sharing cost benefits with maintenance service suppliers;
* Technology and methodology transfer from other industries considered to be best in class (nuclear, aviation, etc.).