**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

Reliability, Availability and Maintenance (RAM) is one of the – if not the – most important issue for the economic viability of gas turbine products in the market. High reliability, availability and maintainability of any gas turbine installation are paramount to achieve a profitable economy for the operator and low prices for the market. Keeping RAM values high is of utmost interest to the user communities and a very important topic not only during the introduction of new technologies, but for the entire lifetime of gas turbine systems. RAM issues have very often a strong link with other technical areas such as condition monitoring, sensors and instrumentation, and materials, and have to be seen in conjunction with the introduction of any new feature in a gas turbine product.

To improve the reliability, availability and maintainability of a gas turbine the following technologies and developments should be considered:

**Reliability**

* Tools (sensors and/or data evaluation procedures) for early warning of incipient failures (to detect deviation from expected operational conditions before damage is done or to prevent severe subsequent damage);
* Detailed characterization of operating conditions e.g. improved monitoring of intake filter performance especially in wet and salty harsh environment, improved control systems to avoid deterioration and / or damage of GTs components.
* More robust instrumentation (longer service life, reduced requirements for redundancy);
* Instrumentation for severe environments (like in the hot gas path);
* Condition monitoring such as online monitoring of lubrication oil condition.

**Availability**

* Increase time between overhaul (TBO)
* Improved performance of air intake filters (longer service time between maintenance);
* Improved capability of engine and its associated systems to sustain gas and liquid fuels with high sulphur content;
* Efficient water wash methods (for compressors), with less frequent intervals, on-line capability and applicability to a wide range of operating conditions;
* 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;
* On-line borescope inspection tools for hot section components.

**Maintenance**

* 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 - risk and reward sharing with maintenance service suppliers;
* Technology and methodology transfer from other industries considered to be best in class (nuclear, aviation, etc.).