*Review of the article Evolution of Turbine Cooling*

Ronald S. Bunker, June 2017

We will in this summary make the review of an article treating of the cooling aspects in Turbomachinery, and more specifically in the turbine cooling’s field.

The document is based on a study that puts in comparison the ways of improving cooling technologies and that compares different ways of cooling a turbine in order to confront evolution (material improvement and innovation) and effectiveness. Thus, throughout the document, the author makes the link between manufacturing and cooling effectiveness.

First, turbine cooling is at the cross of several fields. It is argued that it is important to consider the cooling field as being a part of a component gathering multiple fields, as well as restrictions and needs coming with it. By doing so, we ensure the study, modelisation, calculations, etc ; to be more relevant. Indeed, those fields that are being considered have all their own aspects they have influence on. Besides, those fields are for the most part on contradiction with each other in the fact that to improve one of them, we will have to decrease the influence or the effectiveness of an other one.

Because we can’t neglect none of those, we have to define them in order to then define the one to work on to ensure a good turbine cooling effectiveness.

As field we can cite chemistry (oxidations limits), engineering science (stresses, strains), manufacturing and design.

Generally speaking, when we take some hindsight on the elements discussed on the document, we see that the points of *manufacturing* and *design* are the one the author is dedicating most of his developpements to.

We thus have constantly in opposition the ideas of durability and effectiveness. The balance between both of them beside the idea of manufacturing is also put in contrast with calculations and modellings. Thereby, in the SOA (State Of the Art), this opposition between manufacturing and design results in an opposition between development and experience that are the main ideas of the document : to have an efficient system of turbine cooling, we have to base the researches on modelisation and to support it with experimentation and statistical analysis.

To make those comparisons more understandable for the reader, the accent is also put on showing the evolution of each methods, materials, etc, with diagrams exhibiting the advances made by cooling with regard to the time and more importantly, with regard to the effectiveness.

Thanks to the differents graphics, drawings and diagrams present in the document, the author is able to support visually his analysis.

For example, he thus define that the application through commercial and military fields are making the turbine cooling being more and more developed. In the same time, as the author does often in the document, he precises is thought, here by defining that in his analysis he doesn’t consider the military field as a reliable source because of the classified researches resulting of it. To sum-up, this field isn’t relevant in our study by considering it doesn’t represent the same area/degree of study.

To finish with those fields boundered with air cooling, they also imply negative aspects as described below :

* an air cooling system can’t be optimized enough in terms of distribution and quantity of cooling ;
* an interdependence unenabling to make a modification on a component without altering the efficiency of an other one.

Those bad aspects imply for example, in order to modify in good conditions the turbine cooler, changing such as re-design, new hardwares, recertification, and so forth.

Nevertheless, it doesn’t mean that we should stop improving the manufacturing or design aspects of cooling, but simply that ideas such as those must be well thought and that a technology like this has to last over time (by being reliable in term of efficiency, by not showing any dramatic fatigue, etc).

This is where we see the manufacturing aspect taking its importance. As detailed in the article, “testing and experience have contributed the most over time”.

In fact, while with species it is their link with nature and humankind that is defining which will survive, with turbine cooling it is the manufacturing field that takes most importance.

Then, along with the design aspect which is developing methods such as *internal cooling,* the manufacturing field is made to be the hub of cooling researches as it implies *film effectiveness* or even *heat exchanger,* which are among the biggest aspects worked on today as sources of improvement for turbine cooling.

To conclude, the author has presented an article consisting in a sum-up of the last 50 years of research in the field of turbine cooling, by detailing the methods used before, today and that are likely to be used later, and their different aspects.

So we saw the downstream work that consists in optimizing the turbine’s design, as well as the upstream work that consists in applying the methods to various objects, by using various manufacturing processes.