Minor Gas Turbines : Projects Term 2

2016 / 2017

Project 1 : FP Turbomachinery, Zoetermeer

Supervisor :

Source	FP Turbomachinery BV, Zoetermeer
Project	Study for performance improvement of the air condenser of a combined cycle energy plant in Korinthos, Greece.
Company supervisor	Contact : M. Tsomos FP Turbomachinery BV, Heliumstraat 148, 2718 RS, Zoetermeer, the Netherlands Tel.: +31-(0)79-3434455 E-mail: m.tsomos@fpturbo.com www.fpturbo.com

Project description :

- The air condenser condenses steam from the turbine and returns the water into the steam circuit; it is a closed system
- The heat exchangers use air to condense steam and in high outside air temperature this is not done completely, thus with lower efficiency, leading to a higher back pressure of the steam behind the steam turbine and thus a lower output power
- The performance of the air condenser can be improved through water vaporization in the condenser air stream. Big amounts of air are involved. Calculate the amount of water, depending on outside air temperature and humidity, to be injected in the air stream.
- Droplet size is important for the water vaporization.
- The air condenser is part of the combined cycle energy plant using a GE FR9 gas turbine with a boiler behind it for steam production and a steam turbine. Both gas turbine and steam turbine provide electricity as the end product.
- Research the decrease of the air temperature using water atomization in the process (same application as in the cooling of the GT intake air)
- As a result calculate the amount of water (with a certain pressure) per cooling fan (20 fans in total)
- Recommend suitable equipment (nozzles and pumping installations) for the cooling of the air condenser
- By studying the steam turbine performance, calculate the output improvement in MW depending on the outside air temperature, by lowering the back pressure after the steam turbine.

Project 2 : INNECS, Ter Aar (Toegezegd dd. 21092016)

Supervisor :

Source	INNECS Power Systems BV, Geerweg 44, 2461 EB Ter Aar.
Project	Detailed design of a fuel supply, injection and ignition system for a petrol/kerosene burner.
Company supervisors	Contact : hr. Reidar Koolen +31 85 - 2733160 Koolen@innecs.nl

Project description :
Detailed design of a fuel supply, injection and ignition system for a petrol / kerosene burner.

- Thermal power 0,5 to 1,5 MW
- Exhaust 75 mm i.d.
- Mach < 1
- Turndown 5
- T max = 1200 ˚C
- Base design on a representative engine jet with a fitting burner can (literature search)
- Detail design of fuel supply line, injection and ignition system
- General specification of air supply
- Risk assessment
- Material choice
- Lifetime expectancy

Project 3 : KLu, Woensdrecht

Supervisor :

Source : KLu, Woensdrecht.

Project title : Feasibility study module maintenance RTM 322 NH90

Company supervisors : Leo Voorhout (Head Production Engineering Squadron Component maintenance)
06 – 1279 1536 L.Voorhout@mindef.nl

Project description :

A. Background of project :
To what extent and what is required to implement module level (depot-Level) maintenance of the NH90 RTM322 turboshaft engine at Squadron 981 component maintenance.

B. Expected project items to address :
- Technical requirements
- Law and regulation requirements
- Are the 4Ms (Men, means, methods and materials) in place ?
- Strategic implementation plan with time schedule
- Total implementation costs
- Risk analysis

C. Expected project output / concrete results :
- Project plan
- Project advice report
- Project presentation

Project 4 : Stork, Almere

Supervisor :

Source Stork, Almere,

Project title Astazou inventory optimization

Company supervisors Paul de Boer, Stork Turbo Services B.V., Damsluisweg 32, 1332 ED Almere, The Netherlands
Paul.deBoer@Stork.com

Project description :

Background of project :
Stork Turbo Services operates under a license of the Safran group to perform the maintenance, repair, overhaul and testing of Astazou IV gasturbines. This gasturbine is mainly operated by the Navy on the minehunter fleet. To perform the maintenance on the Astazou fleet, Stork carries a stock inventory of strategic and consumable part. Currently the value of this stock is around EUR 1.6 M. The end customers, navies of various countries, are in the process of changing their maintenance philosophy which results in a change in maintenance intervals and thus annual volume / demand for Stork Turbo Services. This requires a change in our spare parts management process.

Expected project items to address :
- Analyze content of current Astazou inventory in quantity, age, condition and useful purpose
- Define split in obsolete / active / slow moving / consumable parts
- Compare expected volumes of gas turbines for repair with parts on-stock
- Review alternatives / options to sell parts through different channels

Expected project output / concrete results :
- Overview of status of inventory stock, segregated by group
- List of options to reduce inventory (selling, utilize on expected projects, etc.)
- Options to improve inventory to drive turnaround time down for gas turbine overhauls
- Project report

Project 5 : NLR NOP

Supervisor :

Source	NLR Noordoostpolder, Voorsterweg 31, 8316 PR Marknesse
Project title	Continuation of last year project : **Design in Catia a model gas turbine part for 3D printing in metal.**
Company supervisor	Gerrit Kool Gerrit.Kool@nlr.nl +31 88 511 4290

Project description :
Four minor students 2015 have designed a beautiful demonstrator and this design has been printed with our Metal Additive Manufacturing technology. This design can be improved a lot and thus further optimized. Inside the scale model is a planetary gear set, this approximates a gearbox of the Geared Turbo Fan of Pratt & Whitney.

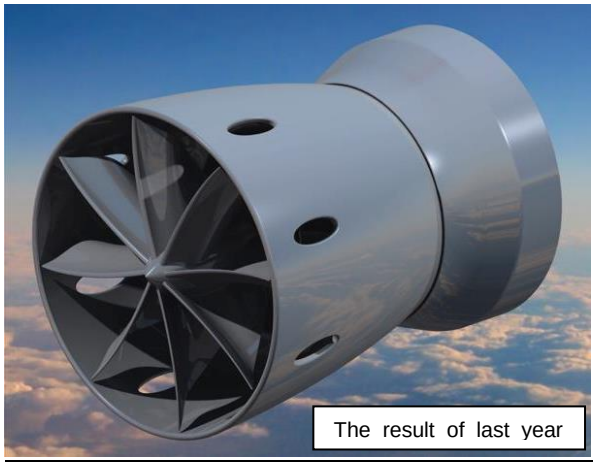
It concerns a small gas turbine with internal rotating parts. The students tasks are :

- To improve the design following their own views and in cooperation with NLR, the design of last year provides a lot of learning lessons.
- To assess this model related to the producibility requirements valid for additive manufacturing. NLR provides the required support.
- To adjust the model according the producibility requirements
- To print the optimized desgin, at the NLR in the Selective Laser Melting machine.
- To finish the final product.

NLR asks the following from the students :

- Knowledge and experience, or anyhow talent to design mechanisms with for example planetary gears
- Preferably experience with Catia.

Perhaps a difficult task, but also very challenging and with innovative technology. And when successful, it results in a physical product with a lot of satisfaction for the students and for NLR. The NLR looks forward to enthusiastic, enterprising students.
In March 2016, the first result has been presented on the RapidPro, the event for the whole additive manufacturing industry.



The result of last year

Project 6 : Chromalloy, Tilburg

Supervisor :

Source	Chromalloy, Siriusstraat 55, 5015 BT Tilburg
Project title	Research what is possible related to protective systems for the future of Chromalloy.
Company supervisor	Ron van Gestel 06 – 5475 3736 rvangestel@chromalloy.com

Project description :
The goal of the project is for Chromally to produce low - maintenance, high - efficiency turbines. To realize this a lot has to be done in the field of protective layers. The available systems are unsufficiently suitable to withstand future operating conditions.
The project task is to determine, given the available protection systems for the compressor, combustion chamber and turbine, what is required to be able to meet the 'new' requirements :

- Compressor : Prone to erosion and corrosion, low degree of pollution, i.e. smooth ?
- Combustion chamber : High temperature, erosion
- Turbine : High temperature, oxidation, corrosion, impact

Think about new materials like nanosystems, new technologies like PVD of for example TiN.
The project concerns obtaining knowledge on existing technologies, determining pros and cons, with this knowledge evaluating new solutions. After the introduction into the existing systems, the project research will primarily be a research on what is possible, and is not limited to the gas turbine world.

G. Doornbos, November 4, 2016.