Alternative Cooling and Mounting Theories for Transition Duct inIndustrial Gas Turbines

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Abstract: Gasoline turbine development is normally pushing forward and forlarger talent extra smoking turbine gulf temperatureis needed. Hence of that, one of the crucial biggestconfiguration problems is to detect amazing procedures tocool the hot constituents in the gasoline turbine. The errand was tocreate and check new option cooling and mounting ideasfor a move channel in turbine, SGT-750. Transfer pipe is ahot part and have the undertaking to direct the sizzling gasolinefrom the burning chamber to the turbine gulf in a gasolineturbine.The transfer pipe of at present is cooled via a relative massivemeasure of compressor air which will have to be diminished ifthere must be an occurrence of a force overhaul. Thepresent mounting association obliges three burningchambers to be uprooted for one move conduit preservation,which is tedious. A writing study and a statisticalsurveying including patent hunts were once made to get aevaluation of preparations utilized today. Thought was thenproduced from potential/approach tree in conjunction withmorphology networks. This was once remoted in two branches,one for cooling and one for mounting and fixing. Thestrategies were assessed with Go-/no make a go at screening,datum strategy and weighted ambitions method. Furtheradvancement and mix of the recommendations brought about exceptionalproposal suggestions which will ease and abbreviate theprotection and diminish the cooling air utilization with keptmaterial temperature.

Keywords-Gas turbine blades, U-bend, rib-roughenedchannel, rotation, heat transfer, cooling, turbulence model,EARSM

I. INTRODUCTION

The SGT-750 is intended to meet the oil and gasindustry's levels of popularity for solid, spotless andeffective force hardware with best in class execution. Itsconfiguration logic was in this way based uponeffortlessness, power and the utilization of demonstratedinnovation, the outline being in light of gauges utilized asa part of the oil and gas industry. Different qualities, forexample, low Life Cycle Cost (LCC), plantconservativeness and short conveyance time, havelikewise been tended to. This overwhelming obligationgas turbine is intended to join focal points of the airsubsidiary gas turbine, for example, quick gas-generatorchange-out while in the meantime keeping up thestrength, adaptability and long-life preferences of theconventional modern gas turbine.

The SGT-750 is a twin-shaft gas turbine (figure 1) whichis suitable for either mechanical commute or force era.The high-productivity, fast, 6100 rpm power turbine isappropriate for mechanical commute. In force era the freepower turbine empowers the SGT-750 to adapt to changesin the framework's recurrence, and licenses bothcontinuous and fast begins, coming to full load in under10 minutes. The complete gas turbine unit is mounted ona solitary base edge into which the lube oil tank iscoordinated. All the assistant frameworks, for example,begin engine and electrically determined move downframeworks are mounted on the base casing.

Figure 1: SGT-750 gas turbine

The innovation in the SGT-750 is in light of the generalSiemens gas turbine armada, both the mechanical and theutility reaches. Advancement concentrated basically onthe center motor keeping in mind the end goal to enhanceexecution and discharges further, while the configurationof assistant frameworks was to an expansive degree inlight of the SGT-600/700 bundle.Since natural execution, for example, restricting NOx,CO, CO2 and commotion outflows, is turning out to beprogressively imperative, the high-effectiveness SGT-750has a low carbon foot shaped impression, the Dry LowEmissions (DLE) combustor being standard for lownitrogen oxide discharges.

This establishment (Figure.2) meets stringent necessitiesfor smallness, short establishment and dispatching timesand simplicity of upkeep. The gas turbine is slip mounted,with the assistants gathered in independent modules set inthe helper room. The format is in view of the samestandard for all applications, whether mechanicalcommute or force era, inland or seaward establishment.

The gas turbine driver slide is constructed from steel bars,supporting the gas turbine, assistant frameworks andstarter engine and, if material, speed-diminishment gear.The helpers are situated before the gas turbine airadmission in the assistant room. The gas turbine driverslip is associated with the determined hardware which canbe on establishment or slide mounted. The entire bundlein this way frames a solitary lift unit, whose advantage isquicker establishment on location with less work at site.The air admission and fumes stack are bolstered byindependent outer pillar structures. A two-stage static airchannel is supplied as standard, yet different choices areadditionally accessible, for example, plane heartbeatthree-stage and so on, contingent upon clientprerequisites. In the standard form, the electrical andcontrol module containing Motor Drive System (MDS),batteries and unit control work spaces remains all alonebolster adjoining the gas turbine/generator slip reportingin real time admission side.

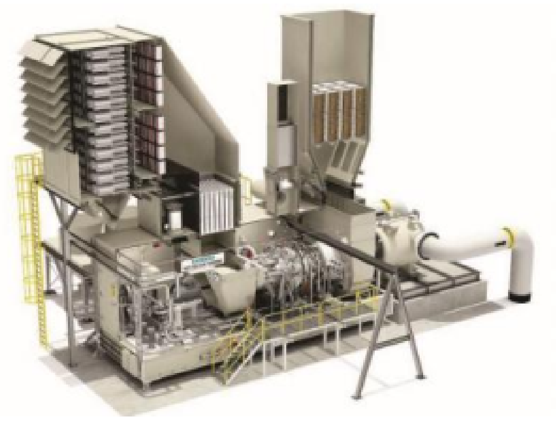

Figure 2: Package layout

Gas turbine technical description

The gas turbine comprises of a pivotal stream gasgenerator with a 13-stage compressor, combustor and atwo stage air-cooled compressor turbine. The two-stageuncooled force turbine is counter-pivoting with respect tothe gas generator for higher effectiveness. The higherproficiency originates from more proficient utilization ofthe outlet twirl from the gas generator.

Performance

This is designed to meet the very high expectations ofperformance with over 40% efficiency at 37 MW andmarket leading emissions. For different ambienttemperatures there is an opportunity to select differentmatching on the power turbine in order to optimizeperformance for example the hot ambient matching gainstwo MW at 50deg C compared to normal matching.Another important performance aspect is the ability toburn different types of fuels, to be fuel-flexible. In theSGT-750 Siemens has used the experience of fuelflexibility from the rest of the Siemens fleet. The SGT-750 is able to cope with large amounts of inert gases,pentane and varying wobbe index, all with maintainedcombustion stability.

Compressor

The compressor (figure 3) has 13 stages with a pressureratio 24:1. Two variable guide vane rows and threecompressor bleeds located after stages 3, 6 and 9 are usedduring start-up and part-load operation. This is a morerobust design compared to multiple variable guide vanes.The configuration was chosen for maximum reliability,with highest possible compressor performance.The compressor rotor disks and shafts are welded togetherby Electron-Beam (EB) welding, the same technology asused on other Siemens gas turbines. EB-welding has theadvantage of low heat release to maintain the accuracy ofthe disk alignment. Field-balancing possibilities areprovided for, as well as access from the outside to thestandard instrumentation at the bearings, which facilitateseasy exchange of vibration probes if necessary. Allmaterials have been selected to suit hot and cold ambientconditions. Protective anticorrosion coating is alsoavailable if required, for example in offshore applications,where salt from the sea can lead to corrosion issues.

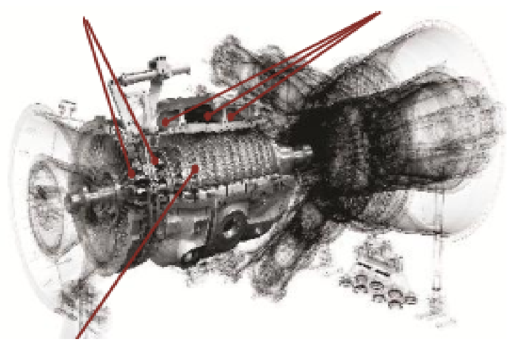

Figure 3: Compressor section

II. METHODOLOGY

The SGT-750 uses high-speed on-line infrared monitoringof the hot blades. Turbine blade 1 and turbine blade 2 areequipped with 2 infrared cameras each covering thepressure side, suction side and the platforms. In figure 4the leading edge of a blade can be seen in three pictureswhile it passes the camera. The information from thecameras can detect anomalies before they go to criticalevents. This system shows high-resolution images ofrotating blades in operation, showing the actual surfacetemperature of the blades.Before and after each inspection an evaluation of thesurface temperature of the turbine blades in thecompressor turbine is performed. The gas turbine isstarted and put on load and the actual materialtemperature of the blading is measured. This methodmitigates risk due to early problem detection bydetecting cracks or blockage of cooling holes.

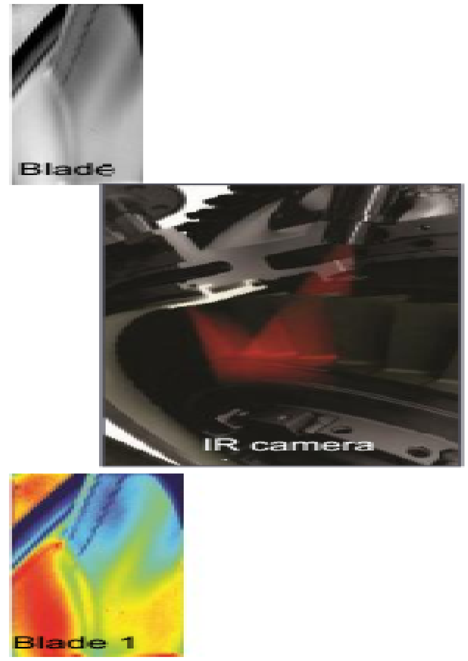

Figure 4: Compressor turbine blade temperature measurement

New and innovative way of working

Significant attention was devoted to serviceability andincreased uptime. Working with 3D tools in avisualization studio made this dramatically simple. In operation with the University in Norrkoping, a 3D stereovisualization approach was developed and used for thecomplete gasturbine package, to evaluate different designalternatives from an access and service perspective. Thecomplete gas turbine and the package werecomprehensively modeled for simulation of access. All interfaces within the gas turbine and also between the coreengine and the base frame with its auxiliaries wereoptimized. All 3D studio sessions involved designers,assembly shop representatives and service engineers toensure that site experience is fed back to the developmentprocess.

Good serviceability must be built in to the designconcepts from the very beginning. During this processdifferent design alternatives, from inlet to outlet, wereevaluated for better access and all foreseen servicesituations were simulated to reduce service time. As aresult the location of many components and the design ofmany features have been improved from an assembly,access and service perspective.

III. RESULTS AND DISCUSSIONS

This part presents the strongest concept combination from the evaluation. Alternative concepts and combination of concepts that can be of interest for SIT AB are also presented. All of the cooling solution contains calculation results of the material temperature and air consumption. In this cooling calculation a new way of calculating the heat transfer coefficient at the hot side have been used to get more reliable results. The duct is divided in five parts, like and the heat transfer coefficient is gained with a factor from SIT AB's earlier CFD calculations.

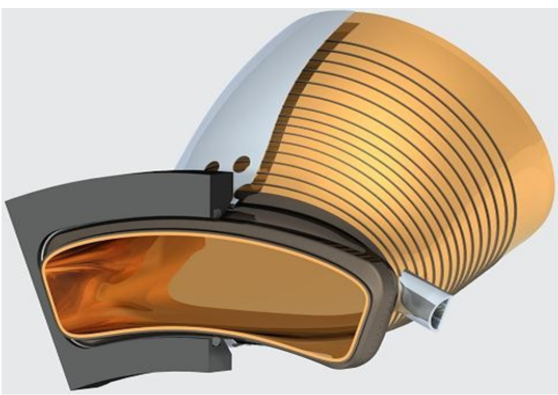

Figure 5. The strongest combination that is on the way to be mounted.

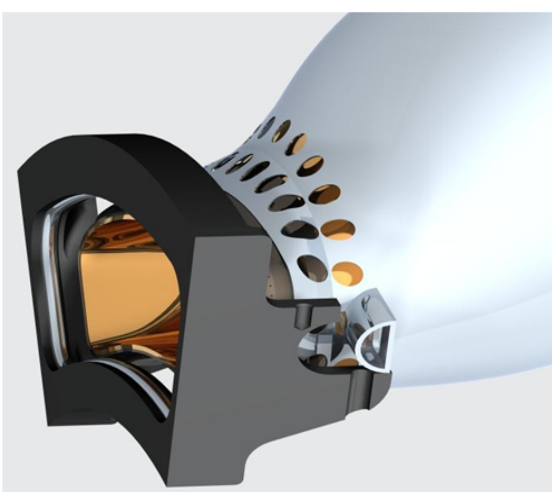

Figure 6. Partly cross sectioned transition duct and its mounting parts.

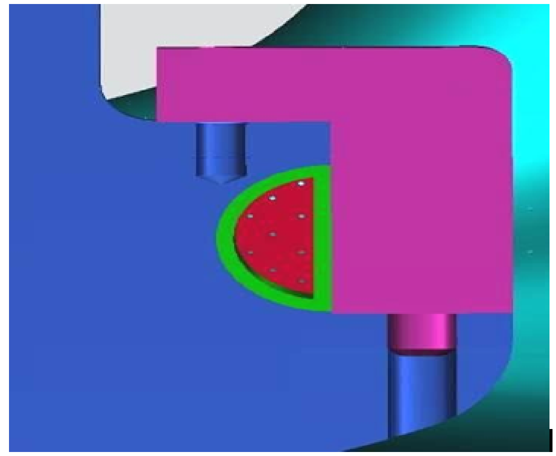

Figure 7. Lock pin in purple.

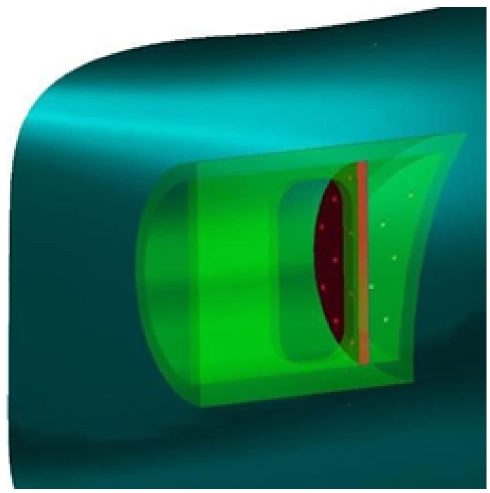

Figure 8. The green D-shaped bar shows the inside impingement cooling plate in red and also the effusion holes in the duct surface.

IV. CONCLUSION

The SGT-750 is competent to fulfill the oil & gas enterprise's needs for effective and clean power based on fuelturbines offering an excessive stage of performance withoutsacrificing reliability. New design tools had been used toincrease reliability and therefore the SGT-750 has theeasiest uptime on the market. The design of the SGT-750has ensured that it has an extraordinarily low lifestyles-cycle cost and thatit is suitable for a huge range of purposes, aspectswhich can be in line with current and future consumerspecifications, for instance both onsite and off-web siteupkeep can be utilized and the gasoline generator may also beexchanged inside 24hours. The first SGT-750 has beenvalidated and each energy and efficiency had beenvalidated.

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