

Redesign and Shock Analysis of HALIFAX Class Frigate Gas Turbine Uptake Structure"

Lt(N) Simon Summers, CF

Prof. Thmasz Wierzbicki
Thesis Supervisor

The gas turbine exhaust uptakes of the HALIFAX class frigates of the Canadian Navy have experienced thermally-induced fatigue cracking since soon after the commissioning of these ships. The uptake structure is heavily stiffened in order to meet shock resistance requirements. Unfortunately, the result has been that thermal expansion of the uptake shell is constrained, thus every flash-up and shut-down of a gas turbine results in a fatigue cycle of its uptake with extremely high stresses. Among the methods proposed to address the problem is the structural redesign of the uptakes within the constraints of the original mounting arrangements. Any such redesign would be required to reduce thermal stresses while still meeting the shock resistance requirements. This work presents the redesign of the uptakes such that they continue to meet shock requirements while incorporating design aspects, developed in the literature, which are anticipated to reduce thermal stresses. The original intention was to use the modal-based design response spectrum method to assess shock resistance. However, due to excessive stresses in the original model and in all subsequent modifications using this method, the less-rigorous base acceleration method was primarily used.