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Short communication

Failure analysis of a repaired gas turbine nozzle

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1. Background

The component under evaluation was the first stage nozzle of an 85 MW power plant gas turbine (MW 701 B), with the gas inlet temperature of 1020 °C. The turbine consists of four stages of nozzles and buckets. The first stage nozzle in the gas turbine must perform the function of turning and directing the flow of hot gas into the rotating stage of the turbine at the most favorable angle of incidence. Cobalt-base superalloys are the best choice to utilize in the gas turbine as a first stage nozzle due to intrinsic properties such as good stress-rupture parameters, excellent hot corrosion and oxidation resistance. The investigated nozzle is made of cobalt-base X45 superalloy by means of investment casting and with thermal barrier coating (TBC). The nominal composition of this alloy is given in Table 1. The full nozzle consists of 18 nozzle segments and each nozzle segment consists of three vanes. The nozzle is cooled by air extracted from compressor discharge. Internal surface of the nozzle vanes have impingement cooling system. The consuming fuel of the unit has been gasoline for 4 months of the year and then for the left 8 months, natural gas has been consumed. The evaluation was carried out after 23,872 h of nozzle under operation in mode of base load with about 183 cycles of start-ups and shut-downs during this period. It should be considered that the first stage nozzle had been repaired before setting in service [1–3].

2. Visual observation

The general view of the nozzle segment is given in Fig. 1. General inspection showed that more than 80% of the first stage nozzle segments have been noticeably damaged. Damages are seen in the trailing edge and close to the external shroud. There are some cracks in the inner surface of internal shroud, inner surface of external shroud, and also a longitudinal crack

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