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Failure analysis of the super heater tubes of S-combined power plant

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ABSTRACT

By analyzing the measured temperature, fatigue life, and damages due to continuous appearance of crack within the interior of the combined cycle power plant's intermediate temperature (IT) and high temperature (HT) super heater header and finned tube weld, the causes of the damages were identified.

1. Introduction

Combined cycle power plant is gas turbine cogeneration power plant that is equipped with heat recovery steam generator (HRSG) which absorbs remaining heat of exhausted gas from the gas turbine. As can be seen in Fig. 1, HRSG is structured in multi level temperature in order to increase the efficiency of heat transfer. It is structured in header and pipe section for the purpose of achieving uniform temperature and pressure of each stage. Water is provided from BFP in high pressure to HRSGs low temperature header which turns into high temperature super heated steam and fed to steam turbine through multi-stages of pipe lines. The pipe between upper intermediate temperature header and upper high temperature header is assembled with attemperator (NA) which maintains constant temperature of super heated steam that is fed to the steam turbine. Fig. 2 shows the structure of connecting part of intermediate temperature upper header and high temperature header. As can be seen in the figure, intermediate temperature header and high temperature header are connected by using 4 units of links and pipes and are assembled with attemperator in order to maintain constant temperature. Attemperator is connected at boiler feed water pump discharge line, and provides high pressure water when divert damper is open during operation. Low part of the header is structured with 35 fin tube in perpendicular at HT-C,D and IT-A,B.

The 'S' combined cycle power plant's HRSG utility is experiencing tube damages at lower part of "A" and "C" as can be seen in Fig. 2. Part "A" experienced 15 counts, and Part "C" counts seven damages. The damage areas are the link area that is near normal attemperator.

2. Analysis

2.1. Investigation of fractured surface

Fig. 3 shows the fractured surface of damaged header and tube weld. In order to analyze the cause of fractured tube's damages, damaged surface was analyzed using SEM. The crack grew penetrating weld metal in 50–70° as can be seen in

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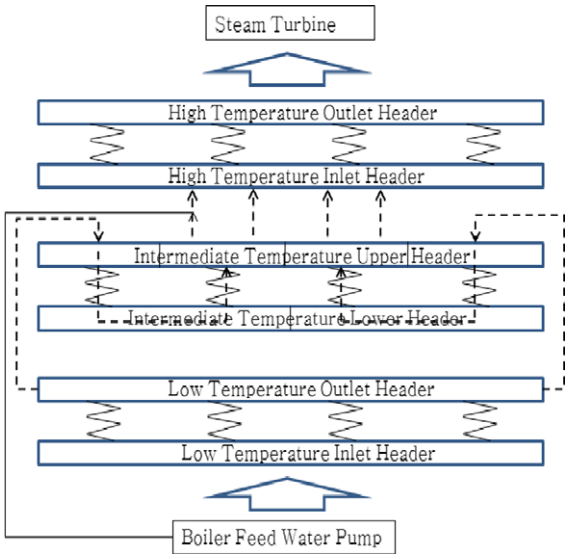

Fig. 1. Multi-stage temperature structure of HRSG.

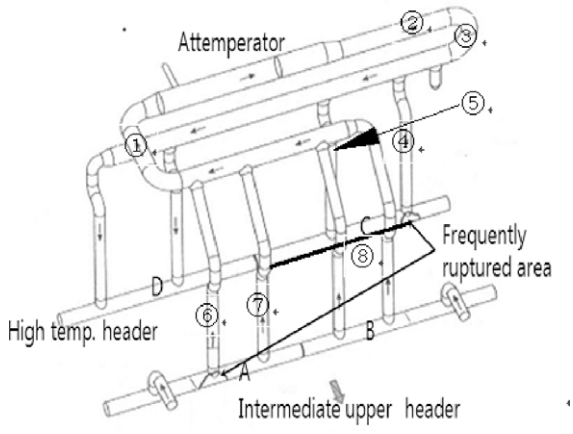

Fig. 2. Structure of connecting part of upper IT header and HT header.

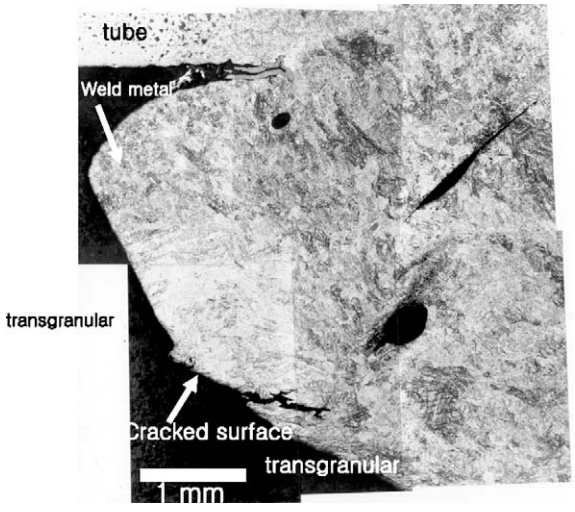

Fig. 3. Fracture surface of damaged header and tube weld.