TWA 800 R296 Scavenge Pump Relay and Reserve Transfer Valve Circuit Breakers (Failure Analysis)

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Evaluation Report
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TWA 800 R296 Scavenge Pump Relay and Reserve Transfer Valve Circuit Breakers

PURPOSE

Determine the condition of the two submitted circuit breakers following their recovery.

FACTUAL DATA

R296 Scavenge Pump Relay Circuit Breaker (B #15)

The R296 Scavenge Pump Relay (SPR) circuit breaker, as received, is shown in Figures 1 and 2. The circuit breaker was manufactured by the KLIXON division of Texas Instruments (TI). The following information was molded and printed on the sides of the circuit breaker:

KLIXON
METALS & CONTROLS INC.
CORPORATE DIVISION OF
TEXAS INSTRUMENTS
INCORPORATED
MADE IN USA

1273

The following was printed on a fiberglass panel riveted to the body of the circuit breaker.

2TC6-1
MFD-0174A

Appendix 1 gives a breakdown of the mechanical and electrical components comprising a TI circuit breaker of this design.

A visual examination of the circuit breaker revealed the actuator stem and mounting bushing of the circuit breaker were missing. The plastic housing of the breaker was cracked in several locations. The load and line terminal hardware were still intact, however, they were corroded.

The Klixon side of the breaker was thinned by sanding through the wall of the plastic case. A knife was then used to carefully remove the remaining plastic to expose the interior of the breaker (Figure 3). An examination of the inside of the breaker revealed corrosion and a fibrous material. The thermal and compensator elements were observed to be corroded. The

position of the bell crank on the compensator suggests the breaker is still in the set position. The spring between the bell crank and actuator stem assembly was no longer attached to the stem assembly. The moving line/load contacts were lying loosely against the stationary line/load contacts.

The moving contacts were removed for examination (Figure 4). The surface of the contacts has a tarnished appearance. A fibrous material was present on the surface of the line contact. No arc erosion of the mating surfaces of the contacts was noted. No obvious witness marks were observed on the surfaces of the contacts. Some evidence of mechanical wear (smearing of the contact material) was evident on the surfaces of the contacts (Figures 5 and 6).

The stationary line/load contacts were also removed for examination (Figures 7 and 8). The appearance of their surfaces was similar to that of the moving contacts. They have a tarnished appearance. No arc erosion of the mating surfaces of the contacts was noted. No obvious witness marks were observed on the surfaces of the contacts. Some evidence of mechanical wear (smearing) was evident on the surfaces of the contacts (Figures 9 and 10).

Analysis of relatively clean areas on the surface of the contacts in the scanning electron microscope (SEM) with energy dispersive spectroscopy (EDS) suggests the contacts are primarily silver. Analysis of areas on the contacts with the fibrous material suggests it is composed primarily of the elements carbon, oxygen, aluminum and silicon. Minor amounts of sodium, magnesium, chlorine and calcium are also present. The spectrum (Figure 11) of the fibrous material on the moving line contact is offered as an example. Analysis of an area of the contact described as having a tarnished appearance suggests it was composed primarily of the elements carbon, oxygen, sodium, magnesium, aluminum, silicon, chlorine, calcium, manganese, and iron. The spectrum (Figure 12) is offered as an example of a tarnished area on the stationary line contact. The silver in both spectrums is primarily from the contact material.

Reserve Transfer Valves 1 and 4 Circuit Breaker (B #16)

The Reserve Transfer Valve (RTV) circuit breaker, as received, is shown in Figures 13 and 14. This circuit breaker was also manufactured by the KLIXON division of Texas Instruments. The following information was molded and printed on the sides of the circuit breaker:

KLIXON
METALS & CONTROLS INC.
CORPORATE DIVISION OF
TEXAS INSTRUMENTS
INCORPORATED
MADE IN USA

1070

The following was printed on a fiberglass panel riveted to the body of the circuit breaker.

2TC6-7½
BACC18Z7R
MFD-0370A

A visual examination of this breaker revealed damage similar to that seen in the scavenge pump breaker. The actuator stem and mounting bushing of the breaker were missing and the housing of the breaker was cracked. The load and line terminal hardware were still intact, however, they were corroded. Inside the circuit breaker corrosion and a fibrous material were observed. The thermal and compensator elements were also observed to be corroded. The position of the bell crank on the compensator suggests the breaker was still in the set position. The spring between the bell crank and actuator stem assembly was no longer attached to the stem assembly. The moving line/load contacts were lying loosely against the stationary line/load contacts (Figure 15).

The moving and stationary line/load contacts were removed for examination (Figures 16, 17, and 18). These contacts have a similar appearance to the ones examined from the scavenge pump circuit breaker. The surfaces of the contacts have a tarnished appearance. A fibrous material is covering the surface of the line contact. No arc erosion of the mating surfaces of the contacts was noted. No witness marks were observed on the surfaces of the contacts. Some evidence of mechanical wear (smearing) was evident on the surfaces of the contacts.

Analysis of the surfaces of the contacts by EDS produced spectrums similar to those of the scavenge pump circuit breaker. The spectrums of Figures 19 and 20 are from the moving load and stationary line contact surfaces. The silver in both spectrums is primarily from the contact material.

SUMMARY OF FINDINGS

A summary of the significant findings is offered as a result of the examination of the scavenge pump and reserve transfer

valve circuit breakers.

External

The circuit breakers have impact damage as indicated by the missing actuator stems, mounting bushings, and cracked housings. The mounting hardware for the load and line terminals was corroded.

The mounting hardware for the load and line terminals were intact.

Internal

A fibrous material was present on many of the mechanical and electrical components of the circuit breaker.

The thermal and compensator elements of the circuit breakers were corroded.

The position of the beak of the bell crank on the compensators suggests they are still in the set position.

The moving load/line contacts were lying loosely against the stationary line/load contacts.

The mating surfaces of the line/load contacts did not exhibit signs of arc erosion.

The mating surfaces of the line/load contacts had some evidence of mechanical wear.

The mating surfaces of the line/load contacts did not exhibit signs of witness marks.

REVIEWED BY

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PUBLICATION REVIEW: This report has been reviewed and approved.

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