PREDICTIVE CARD TESTING – AN INNOVATIVE APPROACH

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OVERVIEW

- DGPS Automation System
- Problems
- 6DS 1717-8AA – Overview
- Analysis
- Diagnosis and Testing
- Steps Taken & Observation
- Results & Conclusion
The DGPS Automation System

- The Automation system of Dadri Gas Power Station is TELEPERM ME supplied by M/S Siemens A.G.

- The protection and measurement system of Gas turbine is AS 220EHF

- Different types of input/output cards, communication modules and controller modules are used.
PROBLEMS

- The Teleperm ME system at Dadri Gas Power Station is more than 20 years old.

- The failure of any critical card/module resulted in tripping of gas turbine due to lack of redundancy at input/output card & field level and the inherent safety feature of the system.

- Increasing redundancy is not feasible since Central Processor Unit (CPU) maximum cycle time is of 1 second and presently the system is running at 988-992 msecs (almost close to max. cycle time).
The Intelligent I/O module (Binary Calculation Module 6DS1717-8AA) is used for binary input/output and drive functions.

All input/output functions are configured in these cards, including the critical ones.

Failure of one Critical Module can lead to a possible unit tripping.
Data showed, the major outages (gas turbine trippings) were due to failure of I/O module i.e. Binary Calculation Module (6DS1717-8AA).

All possible steps need to be taken to prevent the failure of any of these modules.

The one way to increase the reliability of the Gas Turbine Automation system at the I/O level is by predicting and changing the cards which are most likely to fail.
The Binary Calculation Module
The Analysis

- Total 35 nos. of I/O module i.e. 6DS 1717 8AA cards had failed and resulted in unit tripping till June ’04

- On examination, three types of failures were found:
  - Failure in power circuit i.e. SMPS (90%).
  - Failure in field interface section (5%).
  - Communication failure (5%).

- These are multilayered multi-card modules with high density of electronic components

- M/s Siemens Germany has not provided any Circuit diagram/functional block diagram for this module.
Diagnosis and Testing

- The SMPS section has different components like high frequency transformer, MOSFETs, capacitors, inductors and high switching transistors, making it difficult to pinpoint the root cause.

- The special testing procedure containing different test point current, voltage and LED status has been developed to capture the signature of each module.

- The data of each Gas Turbine I/O module was recorded during the 4000/8000 EOH inspection shutdown.
• Cut-off parameters for ‘May-Fail’ have been derived based on voltage and current behavior trend with the previous data

• A set up has been built in-house for the above stated testing.

• This setup has passed the test of time and over the years have successfully detected many ’may-fail’ cards.
The Test-Jig
Testing Datasheet

GT# 3 4000 EOH    6DS 1717 card testing    Date – 09 April, 2007

Supply: 25 V DC / System current: 144 mA

<table>
<thead>
<tr>
<th>Card Position</th>
<th>Type of card</th>
<th>Current</th>
<th>No. of LED glowing</th>
<th>Voltage</th>
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Steps Taken & Observation

- ‘May-Fail’ modules were replaced with new ones

- Removed cards were put in non-critical application and same failed within 8 to 12 months.

- The cards are tested during the scheduled major overhaulings thereby maintaining regularity

- The observation and readings are recorded in a proper format.

- The healthiness of the cards is determined by comparing the data from the present testing with that of the previous.
Determination of ‘May-fail’ cards

- A ‘May-Fail’ card is determined based on two criteria:
  - The absolute magnitude of the current and voltage signatures
  - The rate-of-rise of the voltages/current patterns for that particular card
Basis I - Absolute magnitude of the current signatures

- X-axis – EOH at which data was collected
- Y-axis – Current drawn by card with fuse
Basis II – Rate-of Rise of the current parameter for that particular card

- X-axis – EOH at which data was collected
- Y-axis – Current drawn by card with fuse
Results & Conclusion

- This practice of card/module testing during 4000 /8000 EOH inspection started from June ’04

- Resulted in no tripping on account of Binary Calculation Module failure since Feb ’05

- Since June ’04 till Dec ’12, 41 number of ‘May-fail’ cards have been replaced on the basis of the trend analysis

- This procedure has helped in avoiding possible-tripping due to probable-failure of the replaced cards/modules.