



INTERNATIONAL OPERATIONS & MAINTENANCE CONFERENCE
IN THE ARAB COUNTRIES

UNDER THE THEME
"MANAGING MAINTENANCE WITHIN INDUSTRY 4.0"
CONICIDE WITH THE 16TH ARAB MAINTENANCE EXHIBITION

7FH Generator Slip Ring Incident & Effective Maintenance

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4.0



Qurrayah Combined Cycle Power Plant



- QCCPP, 18-7FA GT and 6 – D11 ST
 - One block consist of 3-GT , 3-HRSG and-ST
- Total Plant capability up to 4.4 GWatt
- Plant Commissioning start 2008
- ST - Generator Rating: 335,500 KVA.
- GT – Generator Rating: 198,000 KVA.

INCIDENT BACKGROUND



- ❑ A failure occurred in GTG-15.
- ❑ Unit was in normal operation after outage season.
- ❑ Pre Trip Alarms
 - Collector End Vibration Danger Alarm
 - High Field Temperature Alarm.
 - Other alarms
- ❑ Manual Trip was initiated, referring to site inspection as huge smoke was noticed from collector cabinet.

INCIDENT BACKGROUND



- ❑ After Unit Trip, site investigation conducted.
- ❑ Considerable damages observed in the following parts
 - Carbon Brushes
 - Brush holders
 - Brush holders assembly
 - Slip ring surface
 - Rotor Shaft
- ❑ Turning Gear fail to engage and n after shutdown.



REPAIR ACTION PLAN

- ❑ Immediate assessment done and decided for generator rotor replacement and action plan was developed.

QURAYAH COMBINED CYCLE POWER PLANT
Generator PM and Rotor Replacement



ITEM NO	GENERATOR PM AND ROTOR REPLACEMENT (GTG-53)	WORK GROUP
3.	Uncouple and remove the turning gear and the flex coupling.	MECH
4.	Remove the collector chimney silencer, collector cover, and collector fan.	
5.	Withdraw the collector inlet silencer and lower the field exciter cables into the duct below the cab deck.	MECH
6.	Remove the brush rigging and exciter (see Brush Rigging/Collector Rings Description and Maintenance).	
7.	Remove the shaft grounding brushes and vibration sensors (see Shaft Grounding Brushes).	ELEC
8.	Remove the upper half of the load compartment and load compartment silencer (turbine end).	MECH
9.	Remove the bearing caps and outer oil defectors (both ends).	
10.	Remove the upper half bearings, upper half hydrogen seals and upper half inner oil defectors (both ends).	
11.	Disconnect and remove all piping and wiring from both outer end shields.	
12.	Remove the upper and lower half outer end shields (See Disassembly of End Shield) using a trolley hoist or chain block on the overhead support beam (both ends).	
13.	Remove the lower half hydrogen seals and the lower half inner oil defectors (both ends).	
14.	Remove the fan blades from the rotor.	
15.	Uncouple the generator rotor from the turbine load coupling. Use the jacking holes in the coupling flange to disengage the rabbit fit.	
16.	Disassemble and remove the walkway from the rear of the cab.	

WO # 2201403733

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March 2018



ROOT CAUSE ANALYSIS



- ❑ Root Cause Analysis Team established and following interrogation set.
 - Quality of Maintenance?
 - Alarm And Protection criteria?
 - Quality of Materials?

ROOT CAUSE ANALYSIS



❑ Analysis on Pre-Incident PM Program

- **Monthly PM of Brush Assembly** – Visual Inspection.
- **Yearly PM of Excitation System**

Cleaning of Control Panel EX2100

Cleaning of Aux Panel.

Cleaning of Excitation Transformer

Cleaning of Brush Gear Assembly

Replacing wearied brushes (if required) without proper forming.

ROOT CAUSE ANALYSIS



❑ **Corrective Action on PM Program**

• **Updated Monthly PM of Brush Gear Assembly**

Visual Inspection.

1. **Amp Reading of each brush.**
2. **Checking the freeness of the brushes.**
3. **Checking and cleaning of holder.**
4. **Checking the spring tension.**
5. **Cleaning of collector cabinet filter.**
6. **ONLINE Replacement of the brush holders and brushes with proper forming (if required)**

ROOT CAUSE ANALYSIS



❑ **Corrective Action On PM Program**

• **Updated Yearly PM of Excitation System**

Cleaning of Control Panel EX2100

Cleaning of Aux Panel.

Cleaning and PM of Excitation Transformer

Comprehensive PM of Brush Gear Assembly.

Introduction of Preforming all the necessary test (Field winding, Excitation Control & Protection).

ROOT CAUSE ANALYSIS



❑ Analysis On Field Ground Protection

- Field Ground detection Alarm and Trip was not triggered however field was actually grounded.
- No diagnostic Alarm
- Field Ground detection functionality check & test was not included in PM Procedure.

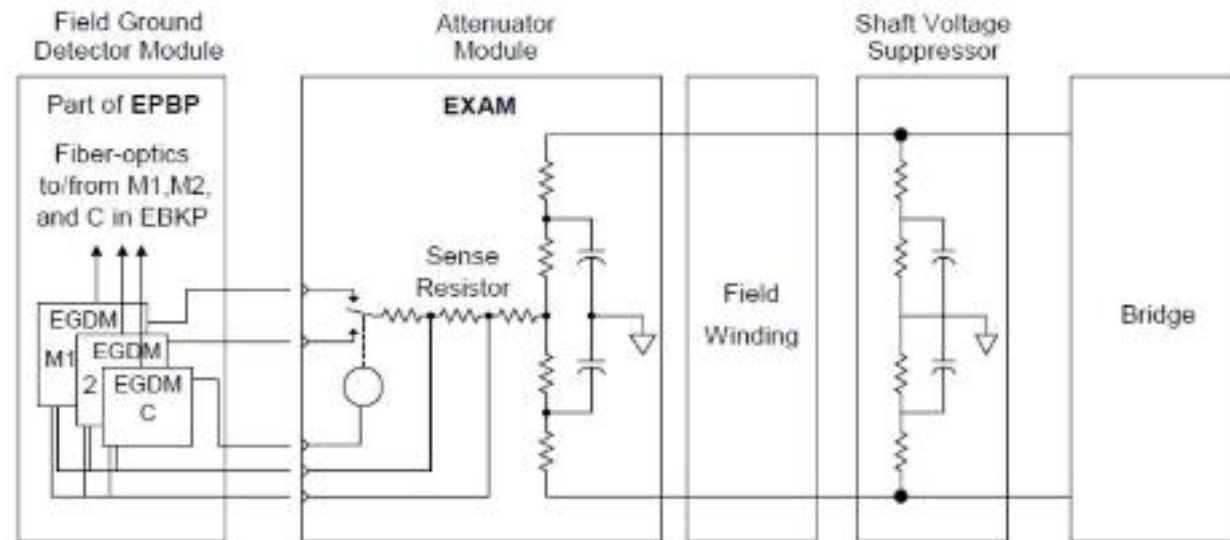
ROOT CAUSE ANALYSIS

❑ Description of Generator Rotor Protection

• Field Ground Detection Protection

EGDM is installed in Excitation control panel and used to detect the insulation resistance between the Generator Field and ground.

Function can be tested using variable resistance and multimeter.



ROOT CAUSE ANALYSIS



❑ Action On Field Ground Protection

- Generator Rotor Field Ground Detection functionality test included in Yearly PM.
- It was found that field ground detection function was not working for this unit due to failure of control card (EXAM Card).
Card replaced and rectified.
- Study of adding the a diagnostic alarm in case of EGDM abnormality.

ROOT CAUSE ANALYSIS



❑ Analysis of Carbon Brushes Materials

- Conducted Thorough inspection of all the units' Carbon Brush.
- Poor contact with slipring and current distribution is not proper.
- Overheated, Frayed and disconnected pigtails in some units.
- Most of the failure of a specific batch with OEM LOGO and Part Number



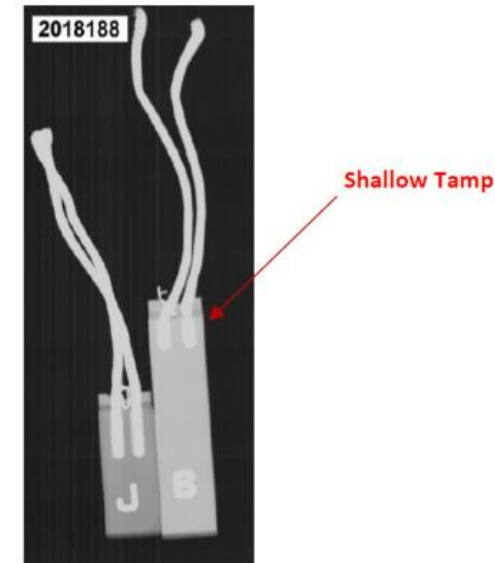
ROOT CAUSE ANALYSIS



❑ Action on the Materials Quality Analysis

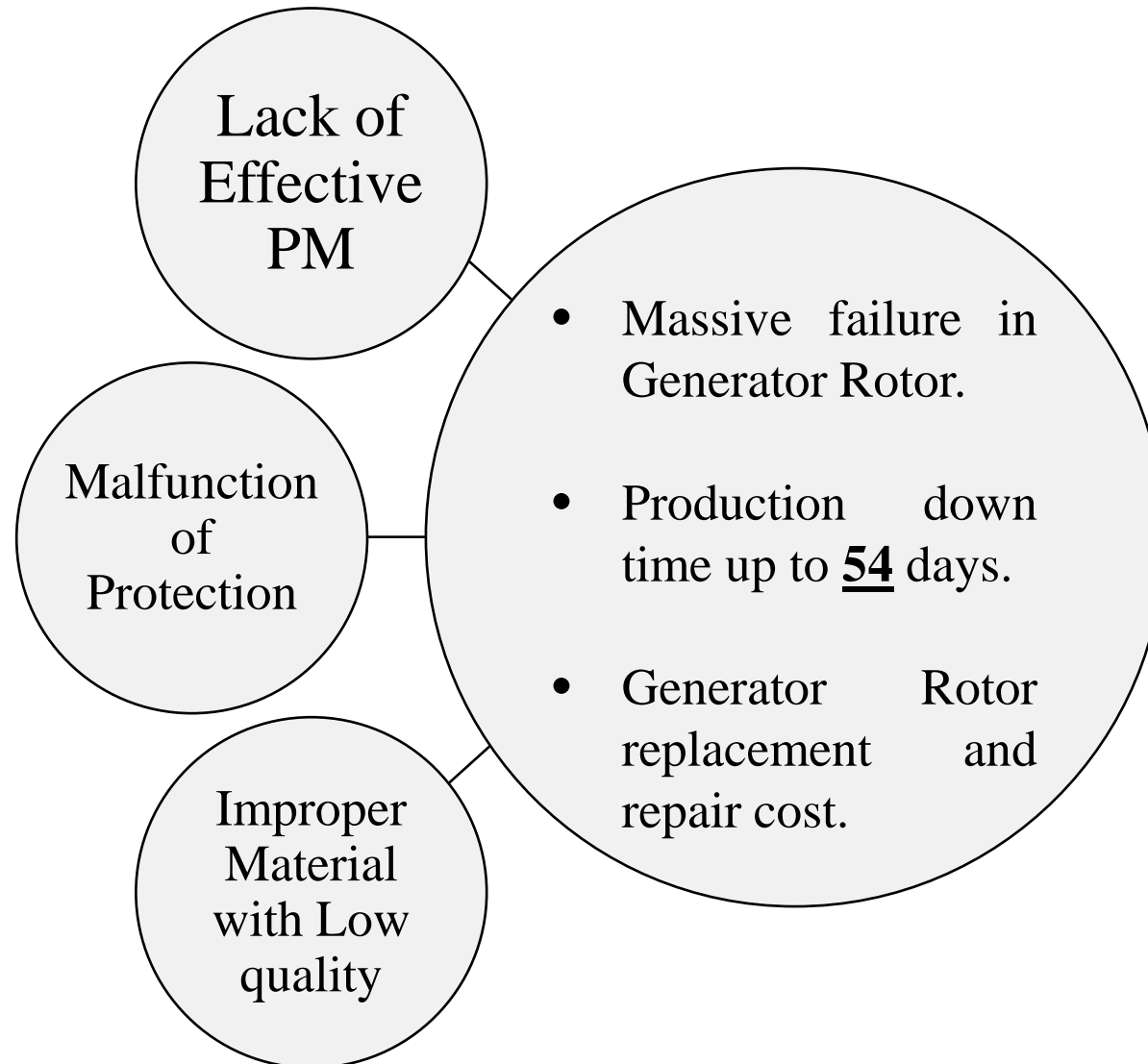
- Material Analysis performed and found suspected batch does not match quality requirement and considered as duped.

Properties	GRADE 634	QCCPP Brushes
Transverse Strength	750 PSI	1401 PSI
Pull Strength	>150 lbs	54 lbs
Specific resistance	0.001 ohm-inch	0.003 ohm-inch
Density	1.28 g/cm ³	1.67 g/cm ³
Contact Drop	1.7 mv/a	6.46 mv/a
Ash Contact	< 3.0 %	7.4 %



- Decided to purchase the carbon brushes directly in co-ordination with the manufacturer.

SUMMARY OF RCA



Reliability/Availability is directly proportional with the **Effective Maintenance Program**