

Life cycle management of MV & HV Switchgear by RLA, Asset management, CBRM and PAS 55 application Course

Course Code: TR-A-2, Duration: 2 days

Day 1-1: Life Cycle Management of MV Switchgear- Overview

- Principles of circuit breaker maintenance – mechanisms and mechanical aspects
- Arc characteristics – closing and opening – short circuit testing -standards
- Switchgear ancillaries, measurement CTs, VTs, relays –complex protection
- Up to 220 kV, 3-phase and single phase 275/400kV SF6 arrangements
- Tests to be undertaken during commissioning
- On line check & Inspection
- Tests to be undertaken during and following maintenance
- Diagnostic testing & Condition assessment
- Principles of time and condition based asset management
- Assessment of aged switchgear
- Definition of failure – according to Cigre
- Cigre CB - Failure survey
- Mechanical aspects
- Maintenance aspects
- Health index scale of medium voltage primary switchgear systems
- Medium voltage primary switchgear designed life expectancy and failure issues

Day 1-2: Maintenance engineering strategy for MV Switchgear

- Maintenance approaches
 - Corrective maintenance
 - Periodic / time interval based maintenance
 - Preventative maintenance
 - Condition based maintenance/ predictive maintenance
 - Reliability centered maintenance
- Maintaining oil circuit breakers
 - Cleaning and inspection of oil-filled
 - Tank cleaning techniques
 - Post-fault maintenance of oil circuit-breakers chambers
- Maintaining vacuum circuit breakers
- Maintaining SF6 circuit breakers & GIS
 - -Frequency of maintenance
 - -SF6 parameters - filling pressures and dew point considerations
 - -Decomposition of arced SF6.
- CT and VT check
- Maintenance schedule: Weekly, Monthly, Yearly schedule of maintenance
- Optimisation of maintenance planning & scheduling

Day 1-3: Condition assessment and Diagnostic Testing

On- line Test

- Switchgear inspection methodologies
- Partial discharge measurement and survey
- Thermovision, Oil testing

Off- line Test

- Mechanism testing and auxiliary relay contact circuits –trip coils open/close test
- Contact trip timing tests and record interpretation
- Testing of MV and HV Switchgear-partial discharge diagnostic tests –off line
- Power Factor tests – Tip-up tests
- Primary injection test
- Static & Dynamic resistance measurement (DRM)
- Vibration testing on circuit breaker
- Vacuum bottle test
- SF6 leakage test
- Motion test & Mounting of motion transducer
- Trouble shooting and Fault localization– use of diagrams and manufacturers manuals

Day 2-1: Switchgear Failure Causes and Root cause Analysis

- Switchgear defects and defect control systems
- Mechanisms of deterioration of insulation
- Assessing degradation in specific suspect components
 - Loose/Hot connection on the cable and busbar contacts
 - Low gas pressure
 - Vacuum loss
 - Insulation breakdown
 - Circuit-breaker speed performance
 - Circuit-breaker contact resistance
 - Mechanical alignment of rackable unit
 - Interlock integrity
 - General conditions-Moisture
 - Contact maintenance and Contact wipe
 - PD activity- Surface PD, Internal PD, Corona, Void

- Failure mode of Individual switchgear Component:
 - Main bus insulation
 - Breaker insulation
 - Current transformers
 - Voltage transformers
 - Cable terminations
 - Support insulators
 - Non-shielded cables in contact
- Identifying non –reliable components
- Improving maintenance programs
- Major failures segmented by failure mode
- Precautions for reducing the risk of switchgear failure and injury
- Case histories of failures – Investigation and Root cause analysis

Day 2-2: Asset Management, PAS 55 and FEMA in Switchgear context

- Development of Asset management systems and maintenance strategies
- Phased manner asset plans and policies
 - Phase 1 – Design Review & Maintenance History
 - Phase 2 – Review of On-line off –line Data & assessment procedures
 - Phase 3 – Asset indexing
 - Phase 4 – Review and decision
- Auditing and benchmarking of maintenance and asset performance
- Asset risk assessments and vulnerability studies
- Optimizing spare parts inventories
- Reliability Centred Maintenance / Risk Based Maintenance studies
- Cost/benefit optimisation of maintenance tasks using decision support tools
- Establishing a detailed planning for maintenance, replacement or refurbishment
- End-of-life criteria and condition rating
- Development of FMEA and Worksheet of FMECA.
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