Session 2

Class 1 on New Generation Relays

A lab session on New Generation Relays aims to provide hands-on experience with the latest and advanced protective relays used in modern power systems. Here's a step-by-step guide for conducting a lab session on new generation relays:

Introduction: Begin the lab session with an overview of the importance of protective relays in power systems and the evolution of relay technology. Discuss the need for advanced relays to handle complex power system scenarios, including renewable energy integration, smart grid applications, and grid stability challenges.

Relay Selection and Features: Introduce the participants to different types of new generation relays, such as digital multifunctional relays, numerical relays, and microprocessor-based relays. Explain the various features and capabilities of these relays, such as communication interfaces, adaptive protection algorithms, disturbance recording, and cybersecurity measures.

Lab Setup: Set up a simulated power system model using advanced power system simulation software. Include generators, transformers, transmission lines, and distribution feeders. Integrate new generation relays into the model and connect them to appropriate current and voltage sources.

Relay Configuration: Guide the participants in configuring the new generation relays for different protection schemes, such as overcurrent protection, distance protection, differential protection, and other advanced protection schemes specific to the relay models used.

Communication Interface: Demonstrate the communication capabilities of the new generation relays. Set up communication protocols such as IEC 61850 or DNP3, and establish communication between relays and the supervisory control and data acquisition (SCADA) system or remote terminals.

Adaptive Protection Algorithms: Explore the adaptive protection algorithms and features available in the new generation relays. Show how these relays can dynamically adjust their settings and operate based on real-time system conditions and changes.

Fault Simulation: Introduce various fault scenarios in the simulated power system model. Simulate faults like short circuits, line-to-ground faults, phase-to-phase faults, and transient faults, and observe the response of the new generation relays.

Disturbance Recording and Event Analysis: Utilize the disturbance recording capabilities of the new generation relays to capture fault events and system disturbances. Analyze the recorded data to understand the system behavior during faults and disturbances.

Cybersecurity Measures: Discuss the cybersecurity features implemented in new generation relays to protect them from cyber threats and attacks. Emphasize the importance of securing critical infrastructure in the context of the modern power grid.

Fault Analysis and Coordination: Analyze the performance of new generation relays during fault conditions. Evaluate the coordination between various protection schemes and discuss any adjustments or improvements needed for better protection coordination.

Documentation and Analysis: Document the observed results, fault responses, communication setups, adaptive protection algorithms, and cybersecurity measures. Discuss the findings and the advantages of using new generation relays in modern power systems.

Q&A and Discussion: Conclude the lab session with a question-and-answer session and open discussion to address any queries or concerns raised by the participants. Encourage participants to share their experiences and insights related to new generation relays.

Throughout the lab session, prioritize safety by following appropriate protocols and guidelines for working with electrical systems and equipment. Emphasize the importance of understanding and effectively using advanced relays to ensure the reliability and stability of power systems in the era of modern grid technologies.

Class 2 on Different types of indoor and outdoor CB

A lab session on different types of indoor and outdoor circuit breakers (CB) involves practical demonstrations and hands-on exercises to understand their construction, operation, and applications. Here's a step-by-step guide for conducting a lab session on indoor and outdoor CBs:

Introduction: Begin the lab session with an overview of circuit breakers and their role in electrical power systems. Explain the importance of CBs in protecting equipment and personnel from overcurrents, short circuits, and other electrical faults.

Indoor Circuit Breakers:

a. Air Circuit Breaker (ACB): Start with an ACB demonstration. Explain its construction, including the arc interruption mechanism, operating mechanism, and auxiliary components. Highlight the typical applications and advantages of ACBs.

b. Vacuum Circuit Breaker (VCB): Introduce VCBs and their advantages over ACBs, such as higher reliability and lower maintenance requirements. Demonstrate the operation of a VCB and discuss its construction and working principle.

c. SF6 Circuit Breaker: Discuss SF6 circuit breakers and their usage in medium-voltage and high-voltage applications. Describe the SF6 gas insulation and arc quenching properties. If possible, demonstrate the operation of an SF6 CB or use visual aids to explain its construction and functioning.

Outdoor Circuit Breakers:

a. Oil Circuit Breaker (OCB): Introduce OCBs and their historical significance. Discuss their construction, including the oil-filled interrupter unit, operating mechanism, and auxiliary systems. Emphasize the need for regular maintenance and environmental concerns associated with oil-based systems.

b. Gas-insulated Circuit Breaker (GCB): Discuss GCBs and their application in outdoor substations. Explain the gas-insulated design using SF6 gas, which provides excellent insulation and arc quenching properties. Demonstrate the construction and operation of a GCB if available or use visual aids.

Safety Precautions: Emphasize the importance of safety when working with CBs, particularly during lab exercises involving live equipment. Highlight the significance of proper grounding, personal protective equipment (PPE), and adherence to safety guidelines.

Hands-on Exercises:

a. Circuit Breaker Operation: Allow participants to operate selected CBs under controlled conditions. Guide them through the proper procedure for switching the CB on and off.

b. Fault Simulation: Simulate various fault conditions, such as overcurrents and short circuits, using a fault generator or simulator. Observe the behavior of the CBs during fault clearance and discuss the trip characteristics and coordination aspects.

c. Maintenance and Troubleshooting: Demonstrate common maintenance tasks, such as lubrication, contact cleaning, and inspection of auxiliary systems. Explain troubleshooting techniques and common issues associated with CBs, such as contact erosion and mechanical wear.

Comparative Analysis: Facilitate a discussion comparing the different types of indoor and outdoor CBs. Encourage participants to evaluate their advantages, disadvantages, and application areas based on factors like voltage levels, current ratings, environmental considerations, and reliability.

Documentation and Analysis: Document the observed results, operation characteristics, and participants' findings during the hands-on exercises. Encourage participants to write individual or group reports summarizing their understanding of the different types of CBs and their experiences during the lab session.

Q&A and Discussion: Conclude the lab session with a question-and-answer session and open discussion to address any queries or concerns raised by the participants. Encourage participants to share their insights and engage in a dialogue about the practical aspects of indoor and outdoor CBs.

Remember to prioritize safety throughout the lab session and adhere to proper protocols and guidelines for working with electrical systems and equipment.

Class 3 on Breaker Maintenance

A lab session on breaker maintenance focuses on providing practical experience and knowledge of the maintenance procedures associated with circuit breakers. Here's a step-by-step guide for conducting a lab session on breaker maintenance:

Introduction: Begin the lab session by explaining the importance of breaker maintenance in ensuring the reliable operation of circuit breakers. Discuss the objectives of breaker maintenance, such as preventing failures, extending equipment lifespan, and optimizing performance.

Safety Precautions: Emphasize the significance of safety when working with electrical equipment and highlight the necessary precautions. Discuss personal protective equipment (PPE), lockout/tagout procedures, and safe work practices to ensure the well-being of the participants.

Types of Circuit Breakers: Provide an overview of different types of circuit breakers commonly used, such as air circuit breakers (ACB), vacuum circuit breakers (VCB), and SF6 circuit breakers. Explain their construction, operating principles, and typical applications.

Maintenance Tasks:

a. Visual Inspection: Demonstrate the visual inspection process for circuit breakers, including the examination of exterior components, such as contacts, insulation, and auxiliary systems. Highlight the importance of identifying signs of damage, corrosion, or wear.

b. Lubrication: Explain the significance of proper lubrication in ensuring the smooth operation of circuit breakers. Show participants how to identify lubrication points, select suitable lubricants, and apply them correctly.

c. Contact Cleaning: Demonstrate the cleaning procedure for circuit breaker contacts. Discuss the types of contaminants that can accumulate on the contacts and the appropriate cleaning methods, such as using contact cleaners or abrasive materials.

d. Contact Resistance Measurement: Introduce the concept of contact resistance and its impact on breaker performance. Show participants how to measure contact resistance using suitable instruments and discuss the significance of maintaining low contact resistance.

e. Inspection and Testing of Auxiliary Systems: Explain the importance of inspecting and testing auxiliary systems, such as operating mechanisms, control circuits, and trip coils. Demonstrate the testing procedures for these systems to ensure their proper functioning.

f. Insulation Resistance Measurement: Discuss the insulation resistance measurement technique to assess the insulation condition of the circuit breaker. Show participants how to perform insulation resistance tests and interpret the results.

g. Timing Tests: Explain the purpose of timing tests in assessing the breaker's operating characteristics. Demonstrate how to conduct timing tests using specialized timing equipment and interpret the timing curves.

Documentation and Analysis: Emphasize the importance of maintaining comprehensive maintenance records. Instruct participants on the proper documentation of maintenance activities, including findings, measurements, test results, and any corrective actions taken.

Q&A and Discussion: Conclude the lab session with a question-and-answer session and an open discussion. Encourage participants to share their experiences, insights, and any challenges they faced during the maintenance tasks.

Conclusion: Summarize the key takeaways from the lab session, emphasizing the significance of regular breaker maintenance for ensuring reliable operation and extending equipment lifespan. Encourage participants to apply the knowledge gained in their future maintenance practices.

Throughout the lab session, prioritize safety by strictly following safety guidelines and procedures. Remind participants to handle electrical equipment and tools with care and adhere to proper lockout/tagout practices when required.