



Diploma seminar

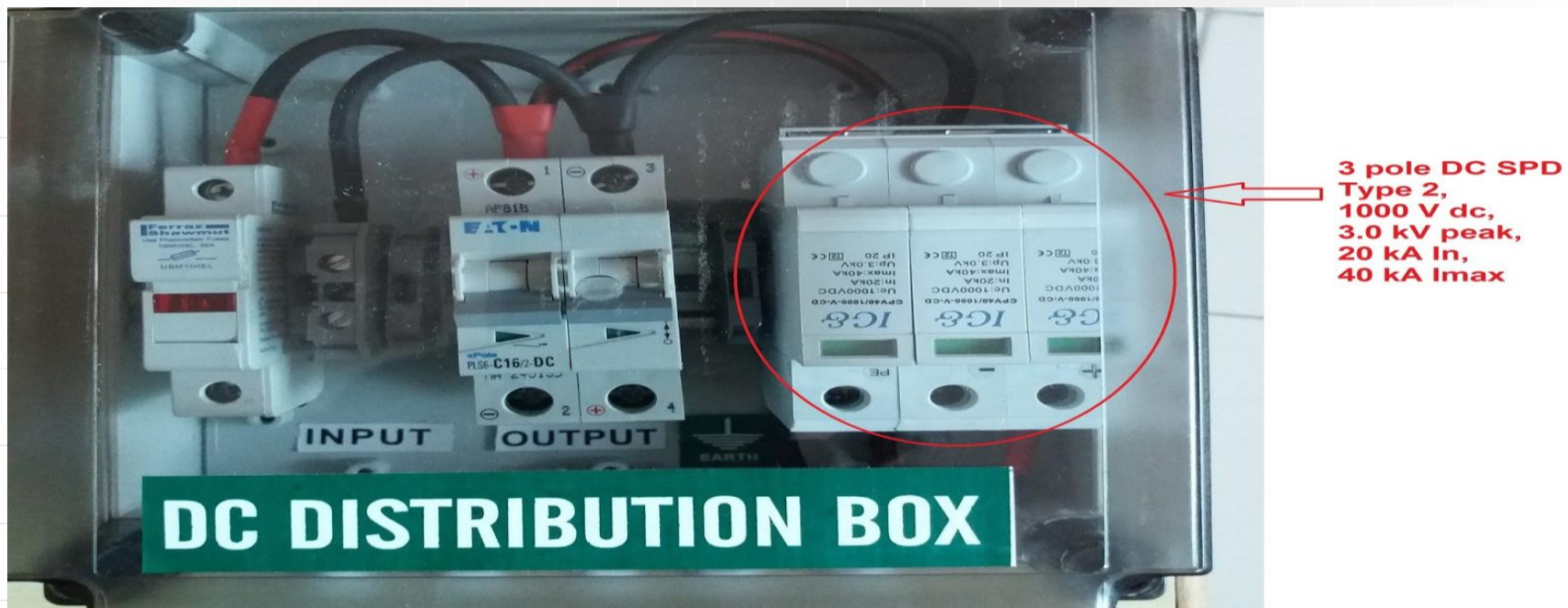
politechnika wrocławska

Q11/13 Renewable energy resources

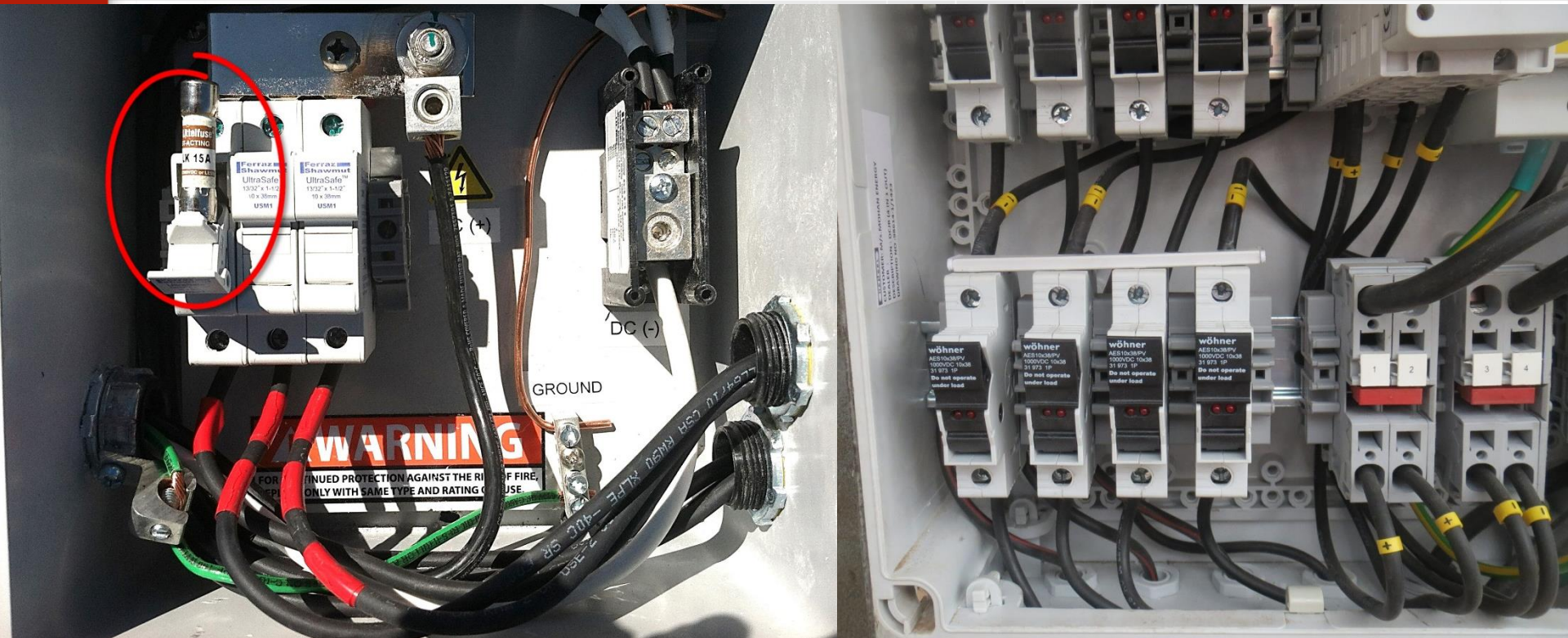
methods of protection of photovoltaic sources

Photovoltaic (PV) sources, which generate electricity from sunlight, require protection to ensure their reliable operation and longevity. Some common methods of protecting PV sources include:

- Surge Protection Devices (SPDs): SPDs are installed in PV systems to protect against surges in voltage caused by lightning strikes or other electrical events. They divert excess voltage to the ground, preventing damage to the PV system.

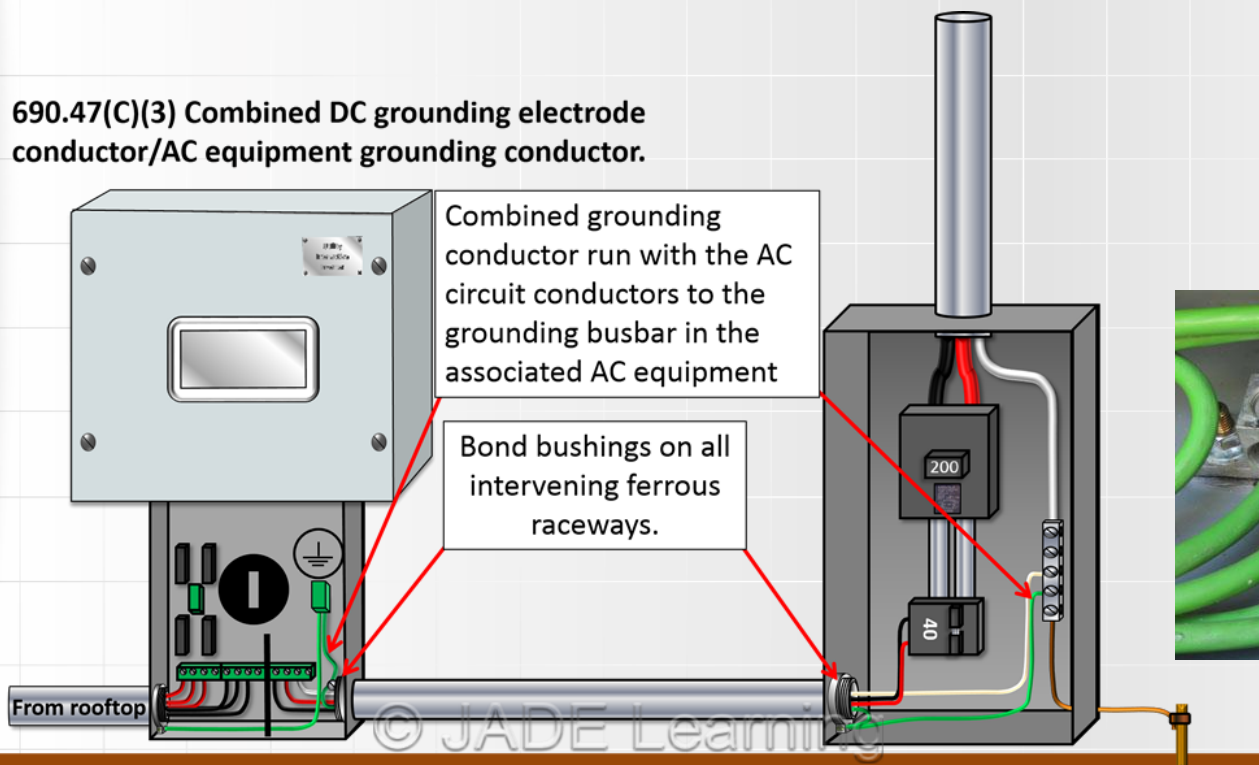


- Overcurrent Protection Devices (OCPDs): OCPDs, such as fuses or circuit breakers, are used to protect PV systems from overcurrent conditions that can occur due to faults or other issues. They prevent excessive current from damaging the PV modules or other system components.



- **Grounding and Bonding:** Proper grounding and bonding of PV systems can help protect against electrical hazards, such as electrocution and fires caused by stray currents. Grounding and bonding ensure that electrical currents are safely directed to the ground, reducing the risk of damage to the PV system and other connected equipment.

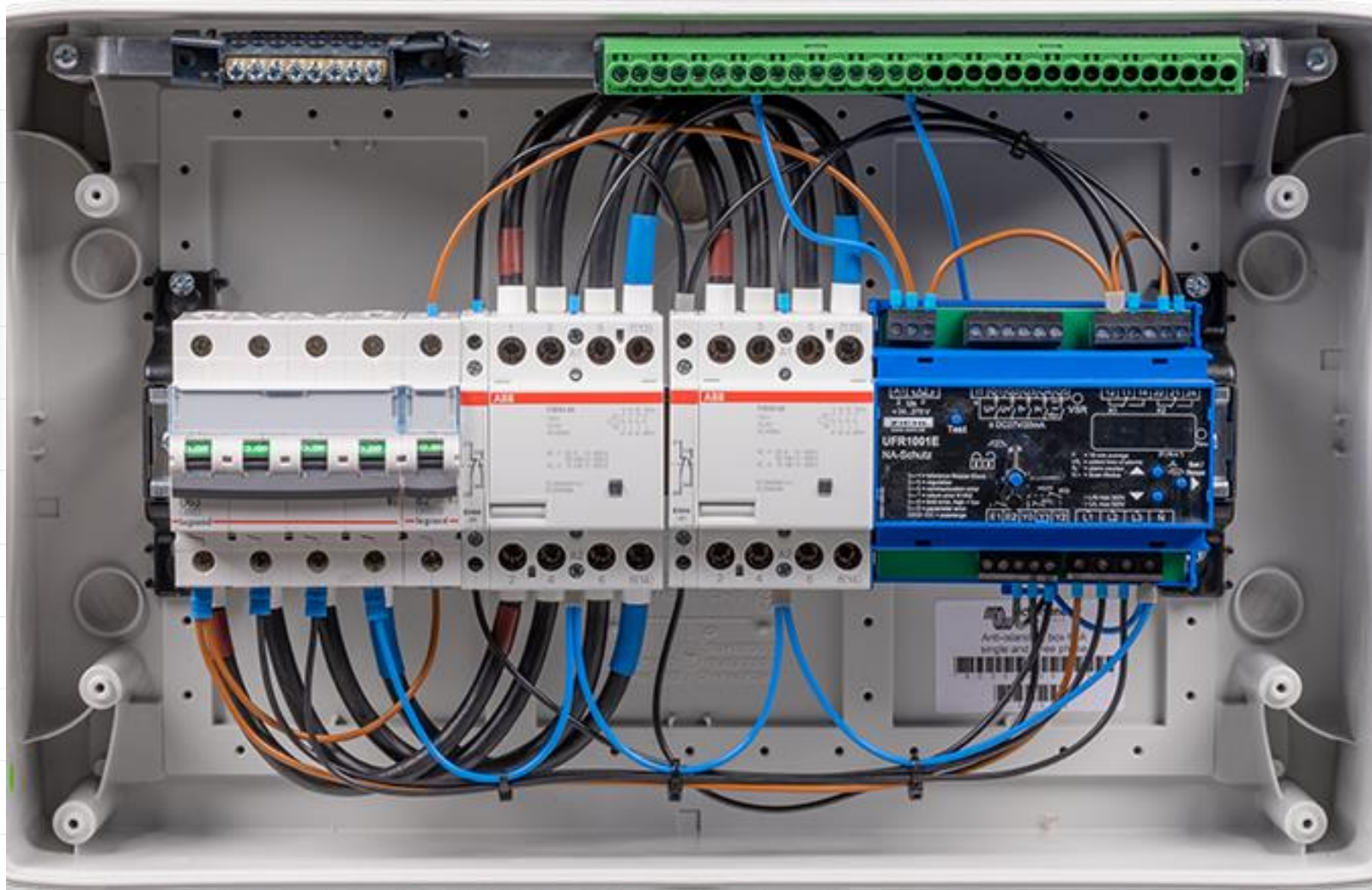
690.47(C)(3) Combined DC grounding electrode conductor/AC equipment grounding conductor.



- **Encapsulation and Sealing:** PV modules are typically encapsulated in materials, such as glass and specialized polymers, to protect the PV cells from environmental factors, such as moisture, dust, and UV radiation. Sealing of PV system components, such as junction boxes and connectors, also helps to prevent water intrusion and corrosion.
- **Monitoring and Maintenance:** Regular monitoring and maintenance of PV systems can help detect and address any issues before they cause significant damage. This can include inspecting and cleaning PV modules, checking for loose connections, and verifying the performance of system components.
- **Temperature Management:** Proper temperature management is important for PV systems, as excessive heat can reduce their efficiency and lifespan. Methods of temperature management include using shading devices, improving ventilation around the PV modules, and using cooling techniques, such as water or air cooling.
- **Security Measures:** Security measures, such as fencing, alarms, and surveillance, can protect PV systems from theft, vandalism, and unauthorized access, ensuring their safe and uninterrupted operation.



- **Anti-Islanding Protection:** Anti-islanding protection is a feature in grid-connected PV systems that ensures the PV system shuts down during a grid outage. This protects utility workers who may be working on the power lines from potential electric shock caused by back feeding from the PV system.

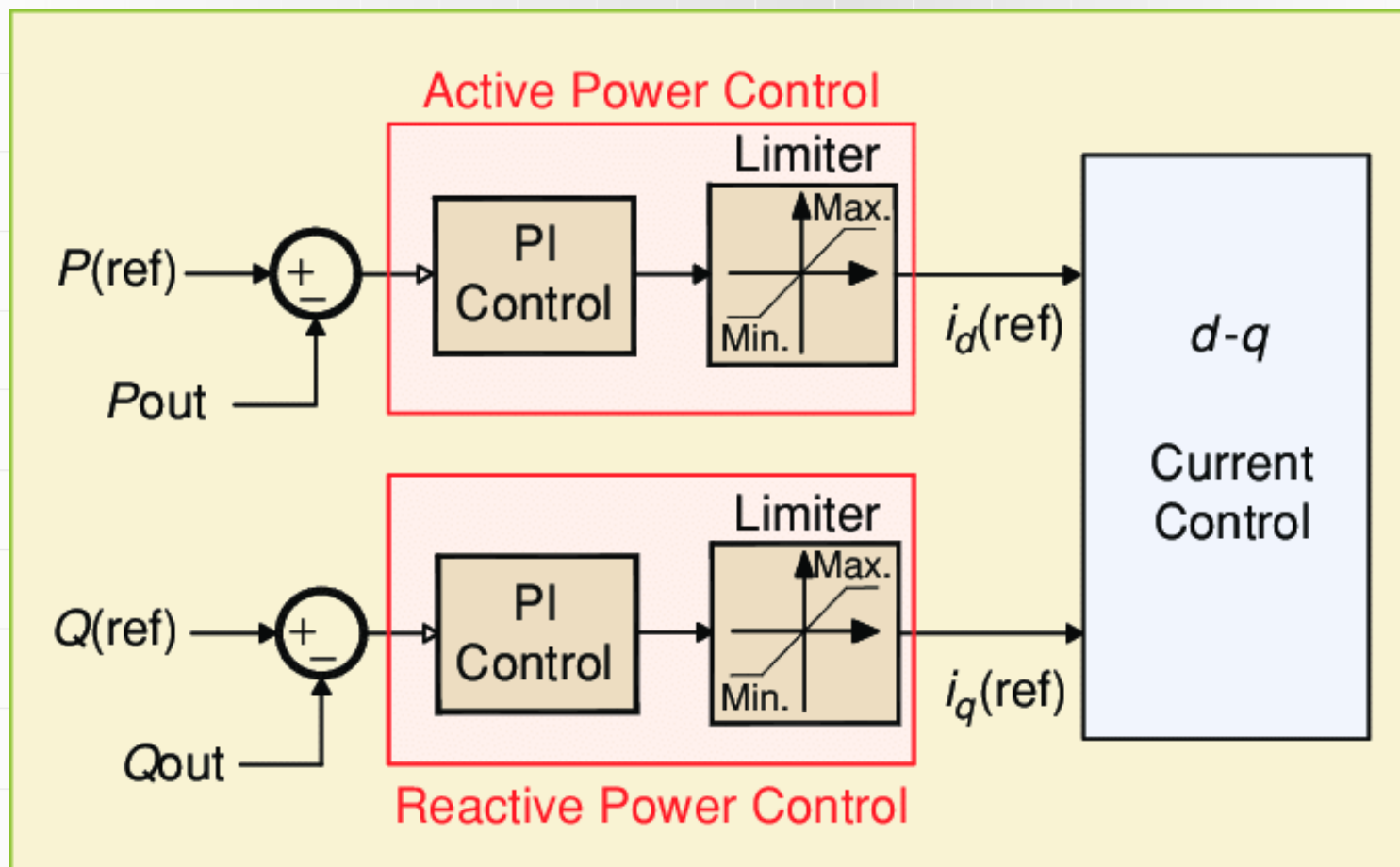


voltage control and stability of distributed generation

- Voltage Regulation: DG systems can include voltage regulation features, such as voltage regulators or tap changers, which adjust the output voltage of the DG system to match the grid voltage. This helps to maintain a stable and acceptable voltage level at the point of common coupling (PCC), where the DG system is connected to the distribution grid.
- Voltage Sensing and Monitoring: Monitoring the voltage at the PCC of the DG system is crucial for voltage control and stability. Voltage sensing and monitoring devices, such as voltage sensors or smart grid technologies, can be used to measure the grid voltage and adjust the output of the DG system accordingly to maintain the desired voltage level.



- Reactive Power Control: Reactive power is the power that alternates between the generation source and the grid, and it is essential for voltage control. DG systems can provide reactive power control capabilities, such as reactive power compensation or power factor correction, to help regulate the voltage at the PCC and maintain stability in the distribution grid.



- **Communication and Control Systems:** Communication and control systems can be employed in DG systems to exchange data and commands with the grid, enabling real-time control and coordination. These systems can facilitate voltage control and stability by allowing the DG system to respond to changes in grid conditions and adjust its output accordingly.
- **Grid-Forming Inverters:** Grid-forming inverters are advanced inverters that are capable of regulating voltage and frequency at the PCC, even during grid disturbances or islanding conditions. They can operate in grid-forming mode, where they actively control the grid voltage and frequency, providing enhanced stability to the distribution grid.
- **Grid Support Functions:** DG systems can provide grid support functions, such as fault ride-through capabilities, which allow the DG system to remain connected to the grid and support grid stability during grid faults or disturbances. Other grid support functions may include voltage ride-through, frequency response, and power quality improvement features.

- **Proper Sizing and Location of DG Systems:** Properly sizing and locating DG systems can also contribute to voltage control and stability. Sizing the DG system appropriately for the load and grid conditions can prevent overloading or underloading of the system, which can affect voltage stability. Locating the DG system strategically in the distribution grid can also help in mitigating voltage fluctuations and maintaining stability.
- **Coordination with Grid Operators:** Coordination and cooperation with the grid operator or utility company is essential for achieving voltage control and stability of DG systems. Close communication and coordination with the grid operator can ensure that the DG system operates in compliance with grid requirements and grid codes, contributing to overall system stability.



Wrocław
University
of Science
and Technology

Thank You



HR EXCELLENCE IN RESEARCH