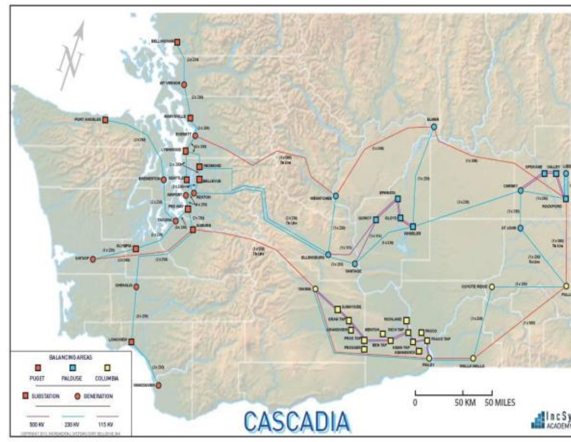
IncSys ACADEMY

Standing Phase Angles

This is a computer-based training module which consists of a video lecture and a simulation exercise. Students watch a video lecture and learn about Standing Phase Angles (SPA). The Instructor reviews findings of the 2011 Southwest Blackout, the definition of Standing Phase Angle, the conditions that lead to SPAs, and the relationship between SPA and impedance. Shock torque will be defined in the lecture and they will calculate an example using per unit values and descript the damage that can be caused to generator suffering shock torque. Synchro-check relays will be defined, along with how they function and provide solutions for lowering SPA by shifting generation, dropping load, and closing in a transmission line at an intermediate point. Students will explain the technique of using double bus arrangement to drop load from the lagging angle end then restore it using the bus with the leading angle. They will learn how to calculate the angle difference based on the estimated line lengths, typical reactance's of transmission lines, and the amount of MW flow on the line in per unit values. Students will perform a simulated exercise where they will play the role of Reliability Coordinator and Transmission Operator while responding to a tripped 500 kV transmission line that causes a large standing phase angle. Students will review the applicable NERC standards IRO-001 and IRO-009 to establish the responsibilities of the RC, TOP, and BA in regards to reliability and having processes to operate within IROLs. Students review applicable NERC standard TOP-001 to establish the TOPs responsibility in monitoring and controlling SOL and IROL violations. They will also review the actions that could be taken to reduce a SPA and the role the RC has in directing the TOPs and BAs to take operating action. Students will place a fault a on a 500-kV transmission line and attempt to reclose it and use a synchroscope display to observe a large SPA then choose the action to take to reduce it. Upon reducing the angle to a manageable level, they return the line to service.



Cascadia 4070 Course Objectives

Standing Phase Angles

COURSE CE HOURS		
OT	STD	SIM
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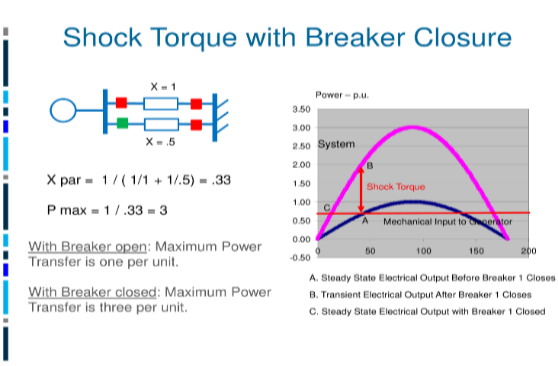
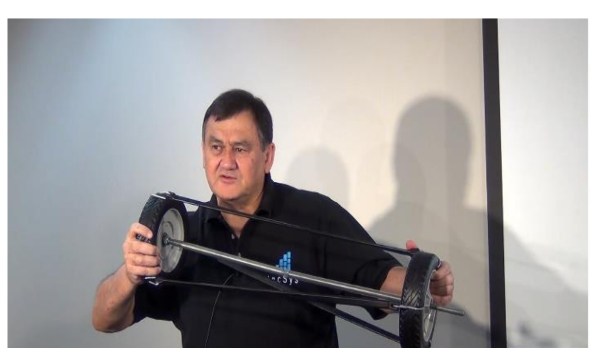
- Choose the correct definition of Standing Phase Angle.
- Identify the function of a Synchro-check relay.
- Identify the correct units for angle measurements.
- State the guideline for limiting generator shock torque.
- State the relationship of series capacitance and line reactance to Standing Phase Angle.
- Identify techniques to reduce SPA.
- Identify the definition of shock torque and how impedance on the parallel path is related to the amount of shock torque when closing a breaker across a large SPA.
- State the reasons why SPAs are a concern during restoration.
- Identify the measurements used to calculate SPA.
- Respond to the trip of a major 500 kV line that creates a large standing phase angle.
- Evaluate options for reducing the large standing phase angle.
- Select the option that will allow the line to be restored to service in the minimum amount of time.
- Return the 500 kV line back into service by using a two bus substation configuration and moving load from the lagging angle end to the leading angle end.





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NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

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