BRIEF COURSE DESCRIPTION

The course on Power Quality is a review of the power quality problems caused by voltage surges, swells, blackouts, brownouts, sags, transients or spikes, frequency variations, harmonics or electrical noise. The National Electric Code Articles (2020) that are important for the class are Article 250, Grounding and Bonding, Articles 280 and 285 on Surge Arrestors and Protective Devices, Article 300 (especially as it applies to Harmonic frequencies), Article 409 on Industrial Control Panels, Article 410 on the safe operation of test equipment, Article 430 (especially Part X “Adjustable speed drives” and Part XIII “Grounding”), Article 450 on Transformers, Article 460 on Capacitors, Article 645.11 on Uninterruptible Power Supplies and Article 647 on Sensitive Electronic Equipment.

COURSE OUTLINE

The course outline with the time spent on each section and relevant NEC Articles follows.

* Review of Basic Electrical Terms (45 minutes)
	+ Power Factor (Real Power/Apparent Power) Article 430
	+ Grounding Article 250
	+ Bonding Article 250
	+ Induction Article 450
	+ Resistance/ Impedance/ Reluctance Articles 300 & 310
	+ Transients Articles 280, 285 & 409
	+ Harmonics Articles 300 & 430
	+ Frequency Article 645
	+ Dips/Swells/Sags/Surges Articles 450, 645 & 647
	+ Root Mean Square Formula Articles 410 & 450

Each of the above terms has reference to the NEC Articles noted above. The quality of power affects every aspect of an electrical network from the gauge of the wire (heat from harmonic frequencies and voltage drop calculations) to sophisticated load performance (motors, lighting, computers, sensors and other control devices).

* QUIZ (10 minutes)
* Test Equipment for Diagnosis (25 minutes) Article 410 & NFPA 70E
	+ Digital Multimeters (RMS)
	+ Current Probes
	+ Earth/Ground Resistance Testers
	+ Power Analyzers
	+ Thermal Cameras
* QUIZ (10 minutes)

* Sources of Power Quality Problems (1 hour) NEC References as applicable
	+ Variable Frequency Motor Drives
	+ Resistive-Capacitive Circuits
	+ High Frequency Generators (e.g. lamp ballasts)
	+ Unbalanced Loads
	+ Harmonics
	+ IT
	+ Electromagnetic Radiation (EMR)
	+ Radio Frequency Interference (RFI)
* QUIZ (10 minutes)
* Electrical Equipment to remedy Power Quality Issues (1 hour) NEC References as applicable
	+ Supply Transformers, esp. “K” Factor Transformers
	+ Surge Protection (MOV’s and Grounding Methods)
	+ Active Tracking Filters
	+ Constant Voltage Transformers
	+ Uninterruptible Power Supplies
	+ Power Supplies
	+ Industrial Control (Machine Tool) Transformers
* QUIZ (10 minutes)

There will be a 10 minute break approximately half way through the course.

COURSE OBJECTIVES

The course objective is to give journeymen and apprentices the knowledge of line supply problems they may encounter in their daily work, how to diagnose these problems and what remedies are available. The NEC Code references will be cited to show how extensively power quality affects electrical systems.

LEARNING OUTCOMES

The learning outcome should be familiarity with voltage and current problems either coming from the utility or generated within a facility that can cause problems for (or are caused by) sophisticated devices like motor drives, process controllers, computers, sensors, etc., and what can be done about them.

INSTRUCTOR

The course instructor is Ralph Bliquez who has taught at the NECA/IBEW Training Centers in Oregon and California and has been authorized to teach continuing education classes for credit by the states of Oregon, Washington, California, Idaho, Nevada, Montana and Utah.

COURSE PREREQUISITES

The prerequisite for the course is a current journeymen electrical license or a limited maintenance electrician’s license.

PROGRAM MATERIALS

The program materials for the course are the attached outline and a power point presentation that contains references to the NEC Articles noted above, definitions of terms, resources and features for test equipment and power conditioning, and real examples of power quality problems including how they were diagnosed and resolved. There will be four quizzes to reinforce the course material.