Partial Discharges

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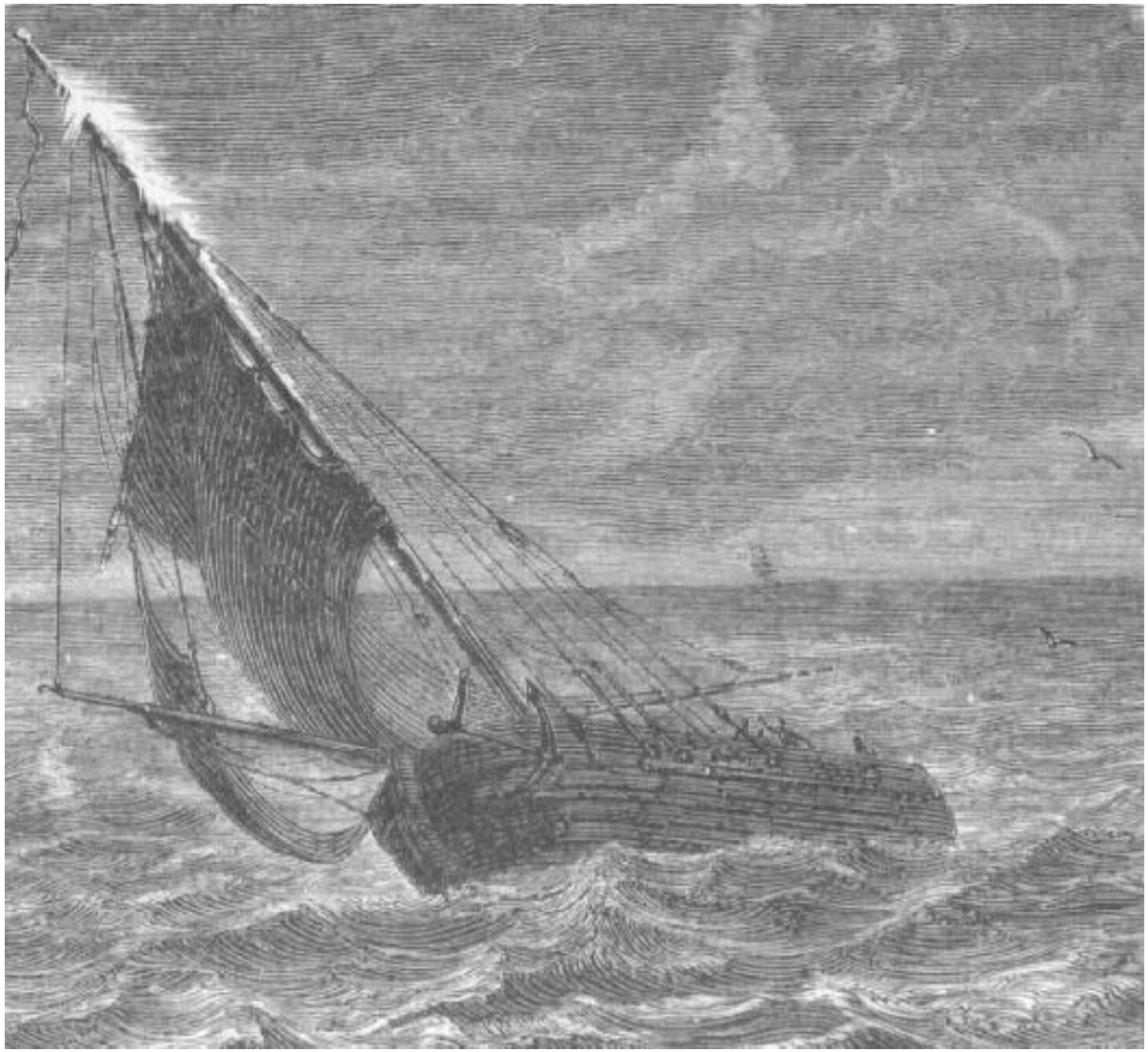
Where we come from



From St-Elm to today

- Early 1900: introduction of high voltage lines:
  - Some glowed at night in certain conditions
  - The glow looked like a corona around the HV wire
  - With spreading of radio broadcasting came radio noise.
- First measurement of this radio noise (RIV) and standards were introduce to reduce this nuisance
- With higher voltage and knowledge increase came the PARTIAL DISCHARGE

PD definition

Localized electrical discharge that only partially bridges the insulation between conductors and which can or can not occur adjacent to a conductor

PD definition - notes

- NOTE 1 Partial discharges are in general a consequence of local electrical stress concentrations in the insulation or on the surface of the insulation.
- NOTE 2 **Corona** is a form of partial discharge that occurs in gaseous media around conductors which are remote from solid or liquid insulation.
- NOTE 3 Partial discharges are often accompanied by emission of sound, light, heat, and chemical reactions.

PD measurement

- RIV is a short band measurement that will measure CORONA in free air type PD, i.e. Corona on HV line conductors or hardware, air switches, busses and bus hardware. **UNIT: μV**
- PD is a wide band measurement that measure all types of partial discharges in air, gas, liquid, solid or complex dielectric material. **UNIT: pC**

Why measure PD

- PD usually do not generate nuisance but may lead to insulation deterioration and possibly failure of the insulation.
- Main concern:

Detect defects

in non-regenerative insulation

Measuring circuit

- Basic measuring circuits can be found in figure 1 of IEC 60270 and PC37.301
- Make sure that the pulse train response is better than 1/30 s in order to detect discharges that occurs only once per cycle (corona or corona like in vacuum or gas)
- Preferable to use the wide band and use different circuit configuration if needed to reduce noise (see fig 1 of IEC 60270)

Inception and extinction

- Generally apparatus show no or very low level of PD at normal or maximum operating voltage.
- In operation the apparatus will be exposed to different sorts of over voltages:
  - Switching surges
  - Overvoltage originating from a fault on an adjacent phase

Inception and extinction

- Over voltages may ignite the PDs
- When the over voltages disappear
  - PD may almost disappear, extinct
  - May stay at high level down to operating voltage or even lower voltage

Basic test sequence first part

- Apply an AC voltage, up to a predetermined pre-stress voltage and maintain for the specified period
  - If this pre-stress voltage is higher than the inception voltage we may then measure quite high PD level

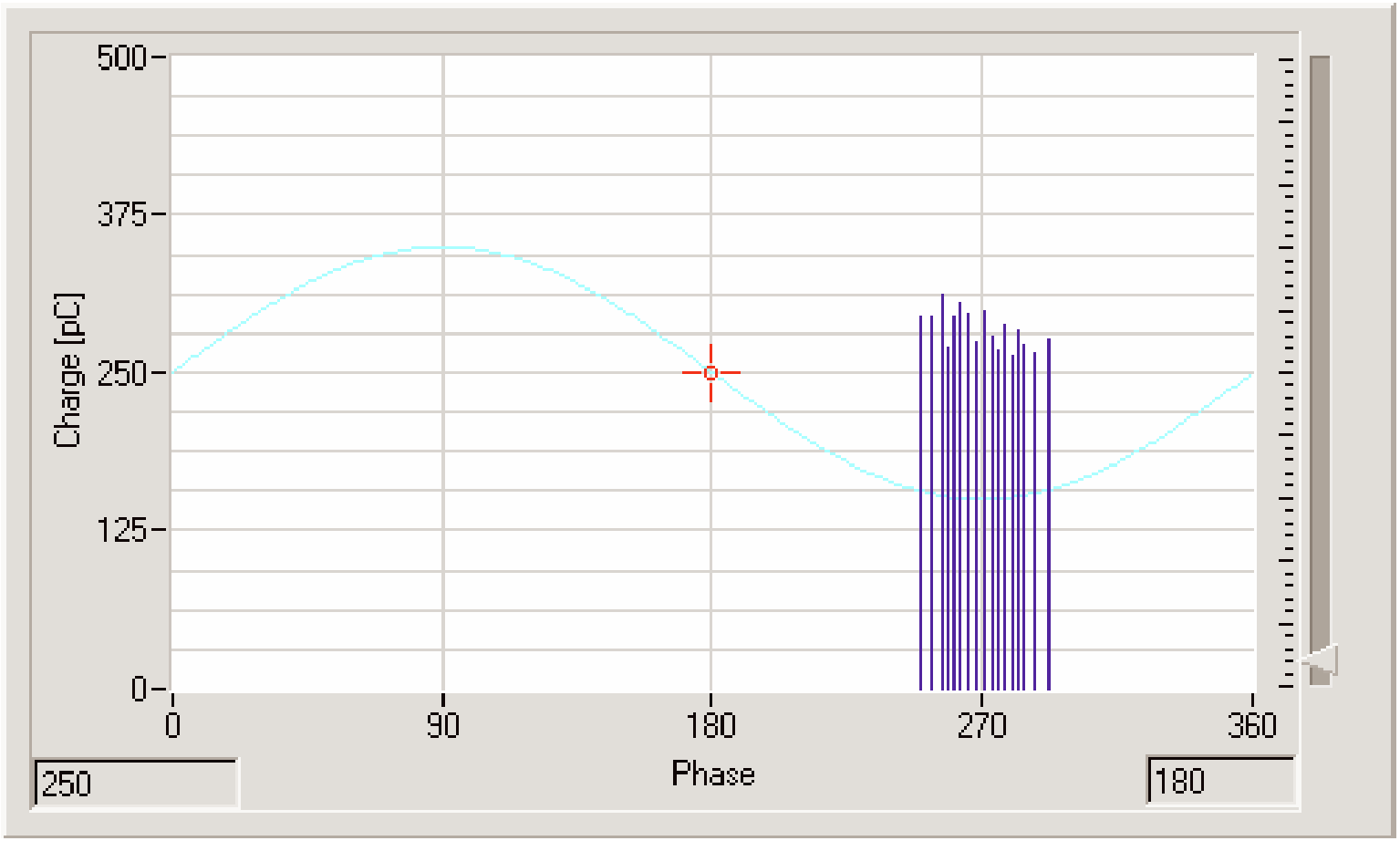
Basic test sequence – second part

- Lower the applied voltage to the specified test voltage and maintain for the specified time
  - While lowering we will generally note that the PD level drops to a low value, the extinction voltage
  - Measure the PD at the specified test voltage

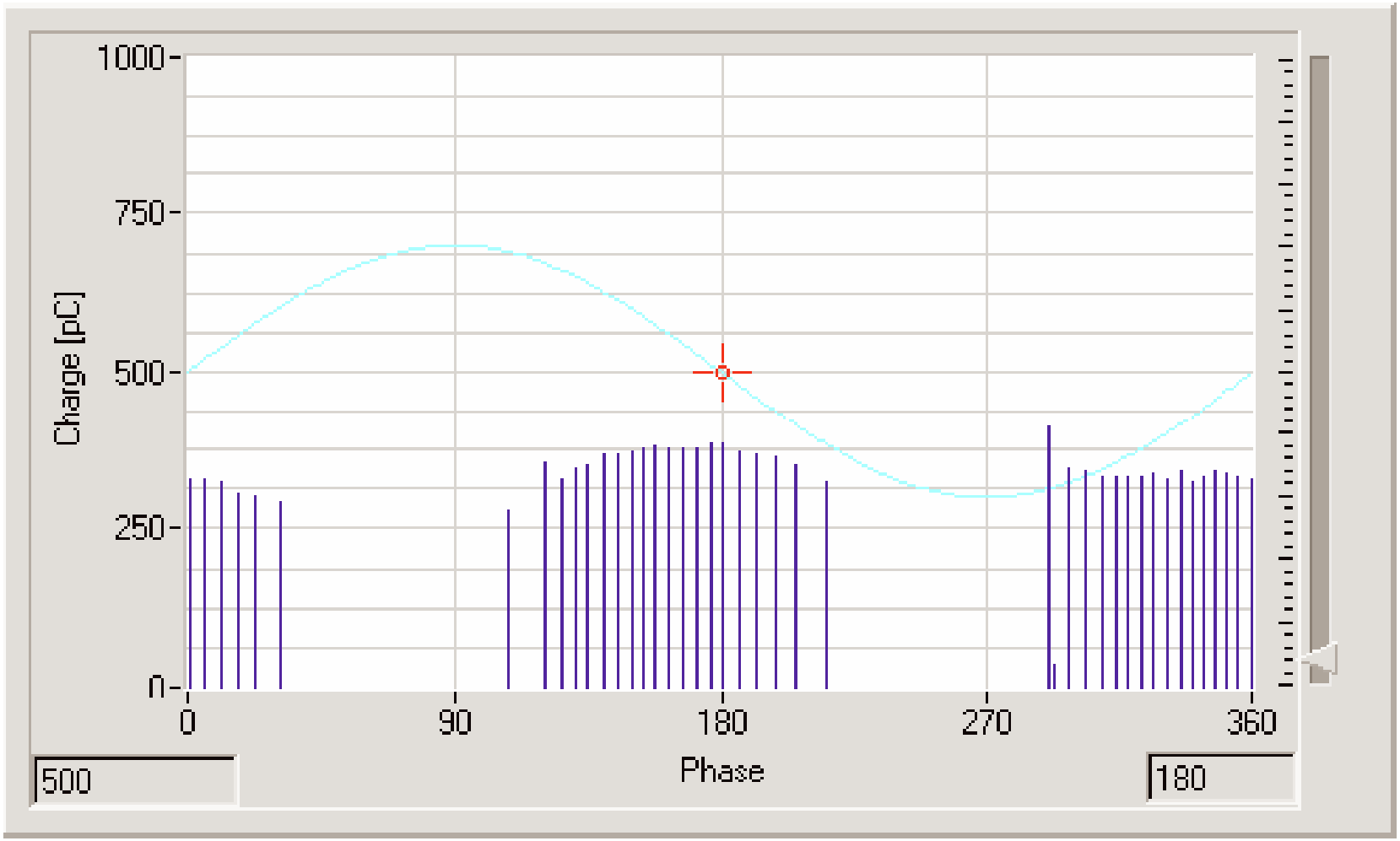
Major steps

- Check for ambient noise and clean up the circuit if required or change for balanced circuit (figure 1 of IEC60270)
- Connect the apparatus to be tested
- Calibrate the test circuit, preferably 3 levels
- Apply the voltage, raise to pre-stress level then lower to the test voltage, may be useful to note the inception and extinction voltages

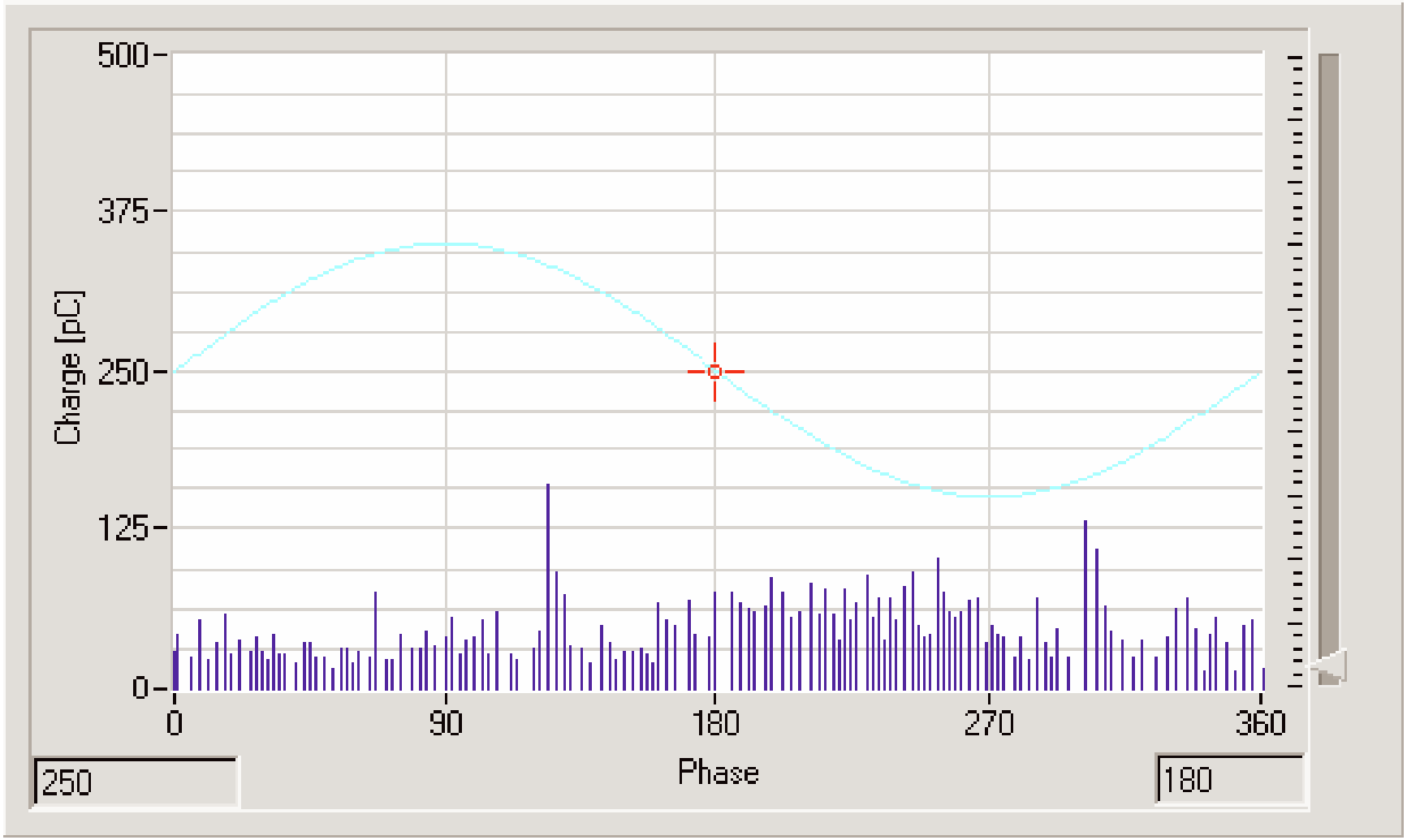
Identify the type of noise
Corona



Identify the type of noise
Bad contact



Identify the type of noise
Noise from mains




Thank you!