MODELLING PARTIAL DISCHARGE MONITORING SYSTEM FOR HIGH VOLTAGE POWER CABLE

Ahmad Zaidi Abdullah,
School of Electrical System Engineering
University Malaysia Perlis, 02600 Arau, Perlis Malaysia
Email: zaidiabdullah@unimap.edu.my

Nurul Farhana Binti Rashid,
School of Electrical System Engineering
University Malaysia Perlis, 02600 Arau, Perlis Malaysia

Muzamir Isa, Haziah Abd Hamid,
School of Electrical System Engineering
University Malaysia Perlis, 02600 Arau, Perlis Malaysia

Nurhafiza Azizan
School of Electrical System Engineering
University Malaysia Perlis, 02600 Arau, Perlis Malaysia

ABSTRACT

Partial discharge is a localised electrical discharge, where the insulation between conductors is partially bridges and which may or may not occur adjacent to a conductor. When a partial discharge activity is detected, an associated type of defect and the location must be identified to make an evaluation whether the discharges are harmful or not. The methods of partial discharge detection in the high voltage power equipment are electrical, chemical, and acoustic or optical measurements. Normally, a failure of equipment is due to the partial discharge activity, where the system performance deteriorates and leads to breakdowns, fires or irreparable damage at the cable. This project is to obtain a measurement on partial discharge in the XLPE type of power cable, to develop a model for monitoring system, and is also to analyze partial discharge detection in power cable using rogowski coil as a sensor. The problem need to be solved for this project is to develop a monitoring system of partial discharge by using a software of EMTP-ATP. Each component used to develop the model of monitoring system must have the parameters. A datasheet is used as a reference. This project consists of Partial Discharge (PD) source model and also a model of Rogowski Coil (RC). The result of simulation get from the EMTP-ATP software because it is one of the suitable software for this project simulation. The result of waveform shows that the model of monitoring system was successfully developed and can be used to detect the partial discharge in the power cable.

Keyword : Partial discharge, model of monitoring system, failure of equipment.

INTRODUCTION

One of the factors that can cause the power outages is the damage of power cable due to the partial discharge (greenfield recorder, n.d.). Partial discharge (PD) can be defined as a localised electrical discharge where the insulation between conductors is partially bridges, and there will be no adjacent to the conductor. PD can occur in some points, in the insulation system, for instances, voids in the medium of insulation, at the interface, between the insulation layers or in a gas bubbles in the liquid insulation. Usually, PD is caused by an improper installation, poor design or poor workmanship. Therefore, a model of monitoring system for power cable, need to be developed using the EMTP-ATP software to overcome this problem.

LITERATURE REVIEW

Measurement related to partial discharge is vital in order to monitor the occurrence of partial discharge. Several methods of measuring a partial discharge have been done previous years. One of the thesis, made a measurement setup by using a 22 kV XLPE power cable and made an artificial void, in the insulation layer. Another thesis, used some component such as the high voltage supply which having a low quantity of noise, high voltage filter, a detector circuit which consists of the resistance, inductance, and capacitance, a coupling capacitor which has a low inductance, and an instrument is used to measure the partial discharge. From all of the components, a measurement can be obtained and ultimately a partial discharge can be detected. A measurement is the most important part before a model is drawn or implemented into the software (Illias et al., 2013).

METHODOLOGY

Figure 1 shows the procedure taken from beginning until the end. A find out was conducted in the Universiti Malaysia Perlis, UniMAP's main campus. A collection of data was obtained from the main substation of UniMAP to the substation of School of Microelectronics Engineering. The length of the cable has been identified, where the distance of the cable starting from UniMAP's substation to the substation of School of Microelectronic Engineering is ±2km.

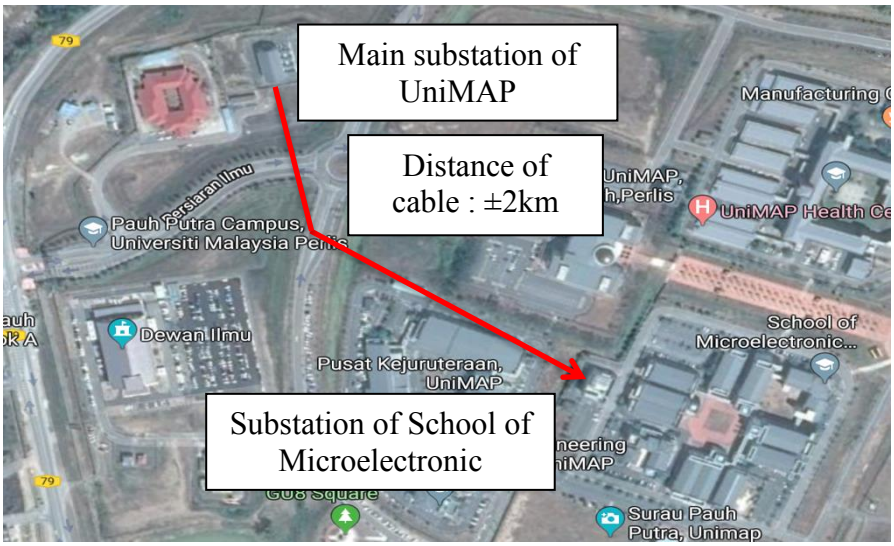


Figure 1 : Cable Routing for PD monitoring

Figure 1 shows a cable routing from of School of Microelectronics Engineering. The schematic diagram is used to get the data of cable used in the substation. The voltage from the main substation is 33/11kV. From the schematic diagram, a size of cable can also be obtained before a model of cable can be design in the EMTP-ATP software.

Figure 2: Model of cable

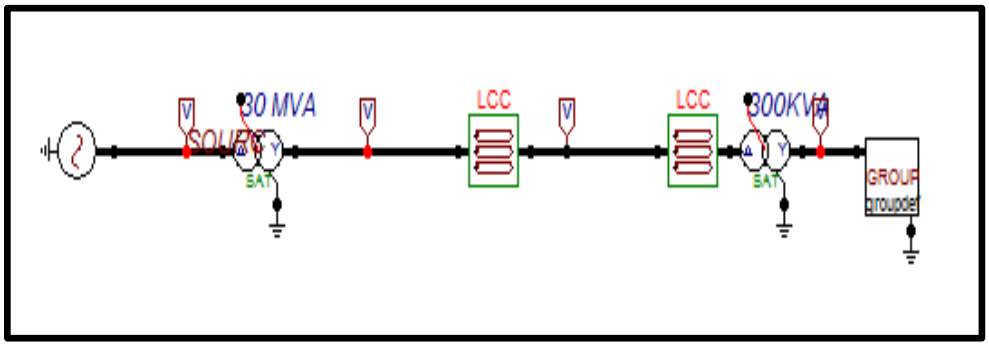


Figure 2 shows a model of cable which consists of component of voltage source, transformer, line covered conductor (LCC), load and voltage probes. The voltage rated used for the voltage source is 132kV. For transformer, the rated power is chosen from the datasheet. The value of rated power chosen is 30MVA and 300kVA for each of the transformer. For line covered conductor (LCC), the nominal area of conductors is chosen from the datasheet. A datasheet of medium voltage XLPE insulated power cable is used. A datasheet is used for reference of three-core 11kV unarmoured cables (copper conductor) for the modeling process. The first voltage probe is situated in between of the voltage source and transformer, second is in between the transformer and line covered conductor (LCC), third voltage drop is placed between the two line covered conductor (LCC), and the last voltage drop is placed between the transformer and load.

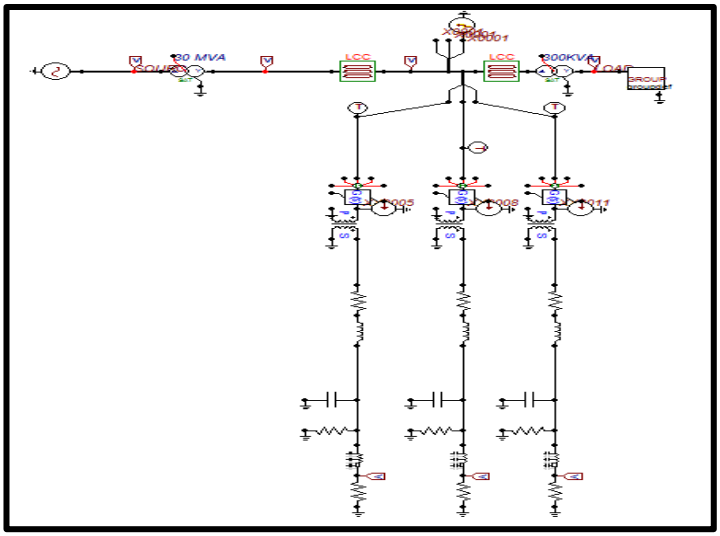
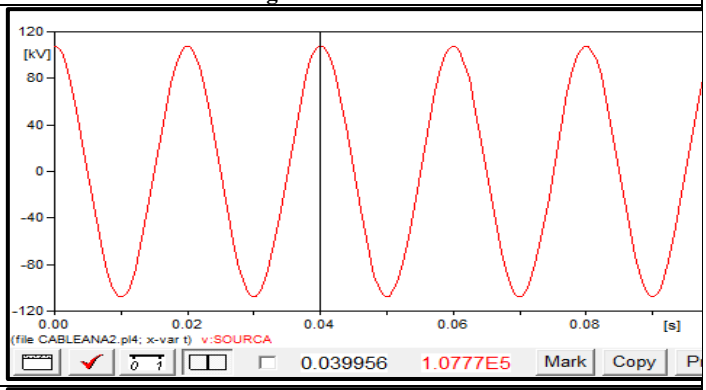
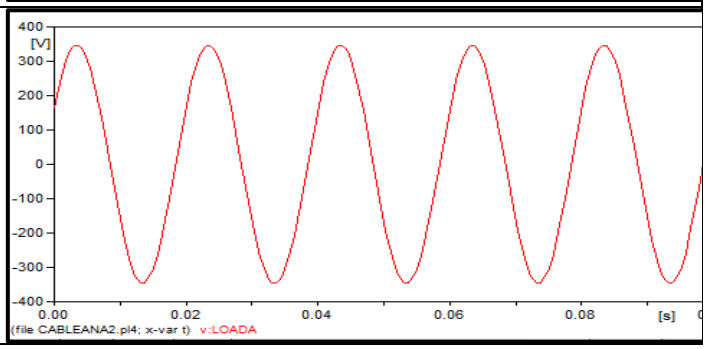


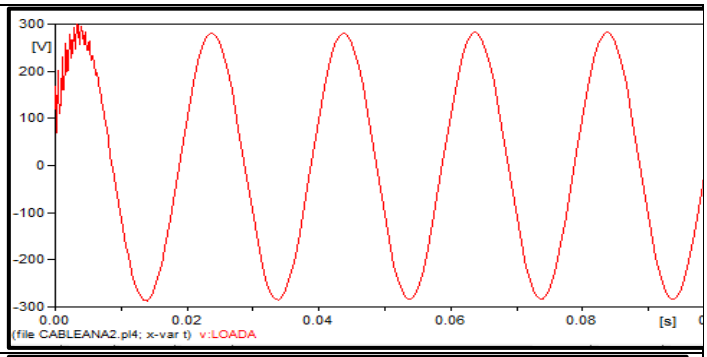
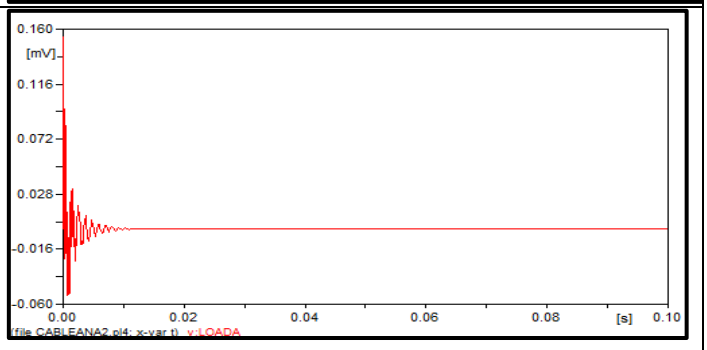
Figure 3: A complete model of cable including sensor and PD source

Figure 3 shows the overall model of cable including the sensor and PD source. In this project, a coreless inductive sensor is used. A rogowski coil, RC is chosen to act as a sensor, because RC has a higher sensitivity and wider bandwidth. Besides, the benefits that can be get by using RC as the sensor are easier to construct and taken care of, lighter in weight, small in size, cheaper, and has a faster response(geometrical shapes impact on the performance of ABS-Based Coreless Inductive Sensors for PD Measurement in HV Power Cables. RC is also used as a sensor, to ensure a partial discharge activity can be detected in an early stage. A fault can also be avoided from affecting the power equipment. From this method, power equipment can last longer instead of functioning well.

RESULTS

Table 1: Table of results

Condition of monitoring	Figure of waveform
Waveform of online monitoring without partial discharge (PD) source	
Waveform of on-line monitoring without partial discharge (PD) source	

Waveform of on-line monitoring with partial discharge (PD) source	
Waveform of off-line monitoring with partial discharge (PD) source	

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