

بسم الله الرحمن الرحيم





شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم



جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار





بعض الوثائق الأصلية تالفة





بالرسالة صفحات لم ترد بالأصل





Ain Shams University
Faculty of Engineering



Digital Relay Performance During Power Quality Disturbances

By

Mai Mohamed El Nady

B.Sc., In Electrical Power Engineering

A thesis Submitted for the Requirement of the
Degree of Master of Science in Electrical Power
Engineering

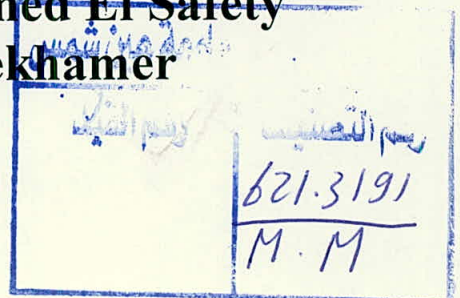
Supervised by

Prof. Dr. Hossam El Din Talaat

Prof. Dr. Samah Mohamed El Safety

Dr. Said Fouad Mekhamer

Cairo 2010



2

10-1-25

10-1-25

Approval Sheet

For Thesis with Title
**Digital Relay Performance During Power
Quality Disturbances**

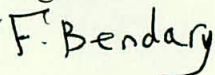


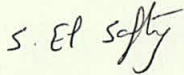
Submitted in partial fulfilment for the requirement of
degree in
Master of Science in Electric Engineering

Presented By
Eng. Mai Mohamed El Nady

Examiners Committee

Name, Title, and Affiliation

Signature

1. **Prof. Dr. Fahmy Metwally Ahmed Bendary**
Electrical Engineering Dept.
Faculty of Engineering
Banha University.

2. **Prof. Dr. Ibrahim El Desouky Helal**
Electrical Power and Machines Dept.
Faculty of Engineering
Ain Shams University.

3. **Prof. Dr. Hossam El Din Abd Allah Talaat**
Electrical Power and Machines Dept.
Faculty of Engineering
Ain Shams University.

4. **Prof. Dr. Samah Mohamed Taha El Safety**
Electrical Power and Machines Dept.
Arab Academy for Science , Technology & Marine
Transport.


1000

Hand

Statement

This dissertation is submitted to Ain Shams University in partial fulfillment of the requirements for the degree of Master of Science in Electrical Engineering.

The work included in this thesis was carried out by the author in the department of Electrical Power and Machines, Ain Shams University.

No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

Name: Mai Mohamed El Nady

Signature:

Date:

Acknowledgement

I would like to thank my supervisor, Professor Dr. **Hossam Talaat**, for his guidance and advice during the research. Also for his creative way to simplify complicated problems. Without his constant inspiration and patience this work could not have been completed

I am deeply indebted to professor Dr. **Mohamed M. Mansour** for suggesting the research topic, helpful advices, encouragement, and the time he offered me during his period of supervision.

Special thanks to Prof. Dr. **Samah El Safety** for her assistance, encouragement and guidance during the research period.

Special thanks to Dr. **Saeed F. Mekhamer** for his guidance and advice during the research period and his support in reviewing the drafts during the preparation of this thesis.

Thanks are also extended to the committee members.

Last but not least, I am grateful to my family and friends for their support, prayers and encouragement during the research period.

Finally, I would like to dedicate this thesis to my loved father, sisters, my fiancé and to my mother (May her soul rest in peace).

ABSTRACT

This thesis investigates the impact of power system disturbances on the performance of digital protective relays. The study relies on simulating the transients generated from the power system disturbances using Power Systems Computer-Aided Design software (PSCAD). The implementation of the digital relay algorithms and the evaluation study has been carried out using MATLAB. Four power system disturbances have been considered for this research: System frequency deviation, transformer energization, power factor capacitor bank switching and transmission line shunt capacitance switching. For each disturbance, the suitable power system configuration is selected. The operating conditions are adjusted in order to operate the protective relay under severe conditions close to its setting value. Four algorithms are used to perform the digital relay function; namely: Fourier full cycle, Fourier half cycle, approximate Walsh method and true root mean square algorithm.

For each considered case study, the power system disturbance is applied to the digital relay which is programmed using the four algorithms, one at a time. The relay response is estimated and then evaluated. A comparative study is accomplished to evaluate the reliability of different algorithms.

The study revealed that some of the disturbances have significant impact on digital relay performance leading to false

trip condition or at least START condition of relay algorithm, while, other disturbances have minor effect on the relay and are classified as non-fault conditions.

The results prove the significance of proper selection of digital relay algorithm to maintain the power system security.

Keywords: Digital protective relay, Power quality disturbance, System simulation, Overcurrent relay algorithm, Distance relay algorithm, PSCAD.