

DETERMINING THE VOLTAGE SAG
IMMUNITY OF AC CONTACTOR WITH
FIELD TESTING IN PETROCHEMICAL
PLANT

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science.

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Salah satu masalah kualiti elektrik yang paling ketara adalah kelendutan voltan. Ia membawa kepada kegagalan peralatan, gangguan dan kerosakan produk yang mengakibatkan kerugian yang besar kepada industri. Sesentuh arus ulang-alik biasanya dipasang di industri sebagai peralatan pensuisan kerana reka bentuknya yang teguh. Walaubagaimanapun ia mudah dipengaruhi oleh kelandutan voltan yang menyebabkan ia pincang tugas seterusnya menyumbang kepada gangguan bekalan. Sesentuh arus ulang-alik telah diuji di persekitaran makmal yang melibatkan kontaktor kecil, sedangkan saiz kontaktor yang dipasang di industri biasanya lebih besar. Sebilangan pengujian telah berpandukan kepada standard SEMI F47 yang dibangunkan khusus untuk industri semikonduktor. Terdapat campuran kontaktor lama dan baru dalam operasi industri kerana yang kontaktor yang lama diganti secara beransur-ansur. Namun, pengetahuan tentang kebolehan kontaktor-kontaktor ini untuk menahan kelendutan voltan adalah terhad. Dengan kefahaman yang lebih baik mengenai ketahanan ini, risiko kegagalan dapat dinilai dan strategi pengurusan aset yang sesuai dapat dihasilkan. Objektif kajian ini adalah untuk menyelidik tentang kesan magnitud voltan landut, tempoh masa dan titik permulaan gelombang bagi sesentuh arus ulang-alik yang lama dan baru yang digunakan di industri. Pengujian di lapangan dilakukan pada sesentuh yang lama dan baru untuk menghasilkan ciri lengkungan ketahanan voltan. Persediaan ujian telah dibuat berdasarkan syor daripada standard IEC 61000-4-11. Bagi memastikan pengujian lapangan dilaksanakan dengan cekap dan untuk mencegah kesilapan, prosedur pengujian dihasilkan dan matriks ujian telah dicadangkan. Tindakbalas mereka dibandingkan dengan had yang disyorkan dalam standard IEC 61000-4-11 dan SEMI F47-0706. Adalah didapati titik permulaan gelombang mempengaruhi lengkungan ketahanan voltan untuk sesentuh yang lama dengan amat ketara. Sebaliknya, titik permulaan gelombang didapati tidak memberi kesan yang ketara kepada kontaktor baru. Oleh itu, kontaktor baru adalah dibuktikan lebih kebal terhadap kelandutan voltan berbanding dengan kontaktor yang lama

ABSTRACT

One of the most prominent problems in power quality is the voltage sag. It leads to equipment failure, interruptions and product damage which amount to substantial financial losses to industries. AC contactor is commonly installed in industries as a switching device due to its robust design. However, they are susceptible to voltage sag and could malfunction, leading to interruption. AC contactors were tested in the laboratory environment, which involved miniature contactors, whereas those installed in the industry are typically larger. Some of the tests referred to the SEMI F47 standard, developed specifically for the semiconductor industry. There are mixtures of ageing and new contactors in industrial operation as the former are being replaced gradually. Nevertheless, there is limited knowledge of the immunity of these contactors concerning voltage sag. A better understanding of the contactor's immunity can assess the risk of failure, and a suitable asset management strategy can be developed. The objective of this study was to investigate the effect of voltage sag magnitude, duration and point on wave for ageing and new AC contactors installed in the industry. A field test was conducted on new and ageing contactors to produce the characteristic of voltage tolerance curves. The test setup was based on the recommendation in IEC 61000-4-11 standard. The test procedure was developed, and a test matrix was proposed to ensure efficiency and prevent error during the field test. The responses were compared to the limits recommended in IEC 61000-4-11 and SEMI F47-0706 standards. The point on wave has a significant influence on the voltage tolerance curves of the ageing contactors. On the contrary, the point on waves has an insignificant effect on the new contactors. The pattern of voltage tolerance curves does not vary when subjected to a different point on waves. Hence it is established that the new contactors are more immune to voltage sag than the ageing contactor.

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LIST OF ABBREVIATIONS

A	Ampere
AC	Alternating current
EMTP	Electromagnetic Transient Programme
Hz	Hertz
IEC	International Electrotechnical Commission
IEEE	Institution of Electrical and Electronics Engineers
ITIC	Information Technology Industry Council
kV	kilo Volt
kW	kilo Watt
ms	mili seconds
p.u.	Per unit
RM	Ringgit Malaysia
RMS	Root mean square
SEMI	Semiconductor Manufacturing Industries
USD	United States Dollar
V	Volt

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