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Ministry Of Energy

سازمان مدیریت تولید و انتقال نیروی برق ایران (توانیر)
Iran Power Generation & Transmission Management Organization - Head Office (Tavanir)

۱۳

چاپ اول
اردیبهشت ۱۳۸۱

گزارش فنی

مشخصات و خصوصیات انرژی الکتریکی

" کیفیت برق "

قسمت دوم -منابع و مراجع استانداردهای کیفیت برق

Iran Power Industry Standards - Power Quality
Part Two : Sources and Reperences

**کمیسیون استاندارد « مشخصات و خصوصیات انرژی الکتریکی (کیفیت برق)-
گزارش فنی
قسمت دوم – منابع و مراجع استاندارد کیفیت برق»**

رئیس	**سمت یا نمایندگی**
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دبیر

اعرابیان - آقای مهندس یزدان لیسانس مهندس برق	شرکت مهندسین مشاور نیرو

یادآوری : با توجه به تعداد ۱۱ جلسه برگزار شده برای استاندارد کیفیت برق افراد فوق الذکر در تمامی و یا در تعداد بیش از ۳ جلسه حضور داشته اند.

فهرست مندرجات ....صفحه

مقدمه :

استاندارد مشخصات و خصوصیات انرژی الکتریکی (کیفیت برق) از قسمت های مختلفی به شرح زیر تشکیل شده است که می بایستی همراه مراجع الزامی آنها مورد استفاده قرار گیرند.

قسمت اول - کلیات

قسمت دوم - حدود مجاز هارمونیک ها

قسمت سوم - فلش و قطعی ولتاژ

قسمت چهارم - تغییرات ولتاژ و فرکانس

قسمت پنجم - پایداری و پدیده های گذرا

قسمت ششم - زمین کردن

قسمت هفتم - کیفیت برق تحویلی به انواع مشترکین

قسمت هشتم - مشخصات فنی وسایل اندازه گیری و معیار انتخاب آن ها

قسمت نهم - دستورالعمل اندازه گیری کیفیت برق ، بازرسی و اطمینان از کیفیت آن

برای آشنایی بیشتر کاربران این استاندارد علاوه بر قسمتهای فوق گزارش های فنی مشخصات و خصوصیات انرژی الکتریکی (کیفیت برق) در قسمتهای دیگری که جنبه اطلاعاتی وآموزشی دارد با عناوین زیر تهیه شده است.

قسمت اول - مفاهیم و تعاریف کیفیت برق

قسمت دوم - منابع و مراجع استانداردهای کیفیت برق

قسمت سوم - تجزیه و تحلیل نتایج وضعیت موجود کیفیت برق

استاندارد مشخصات و خصوصیات انرژی الکتریکی (کیفیت برق)

گزارش فنی

قسمت دوم - منابع و مراجع استانداردهای کیفیت برق

۱ هدف

هدف از این نشریه ارائه منابع و مراجع بین المللی مربوط به کیفیت برق می باشد.

۲ دامنه کاربرد

این نشریه برای کلیه سطوح ولتاژ کاربرد دارد.

۳ استاندارد IEC

60038 : (1993) IEC standard voltages

Ed 6.0 (Bilingual). 19 pp. (K). SR : 2002-10.TC 8.

ISBN 2-8318-0876-6

Applies to : a.c. transmission , distribution and utilization systems and equipment with standard Lfrequencies 50 Hz and 60 Hz and a nominal voltage above 100 V; a.c. and d.c traction systems : a.c. and d.c. equipment with nominal voltages below 120 a.c. or below 750 V d.c.

Amendment No .1 (1994)

Ed 6.0 (Bilingual) . 9 pp. (E) . SR: 1999-08 TC 8.

ISBN 2-8318-3128-8

Amendment No .2 (1996)

Ed 6.0 (Bilingual) . 3 pp. (B) . TC8.

ISBN 2-8318-4061-9

60868 (1993) : Flickermeter – Functional and design specificaations .

Ed. 1.0 (Billingual) 31 pp. (p). SC 77A.EN 60868.

ISBN 2-8318-1202-X

This report gives a functional and design specification for ficker measuring apparaturs intended to indicate the correct ficker perception level for all practical voltage fluctuation waveforms.

Sufficient information is presented to enable such an instrument to be constructed . It does not specify the method of calculating a flicker severity value, or give tolerable limit vallues.

Amendment No . 1(1995)

Ed. 1.0 (Bilingual) . 9pp. (E) . SC 77A. ISBN 2-8318-1796-X

60868-0 (1996) : Filickermeter – Part 0:Evaluation of flicker servertiy

Ed.1.0 (Bilingual) . 42pp. (S). SC 77A. EN 60868-0

ISBN 2-8318-2030-2

61000-1-1 (1992-05) : Electromagnetic compatibility (EMC) – Part 1 : General – Section

1: Application and interpretation of fundamental definitions and terms.

Ed. 1.0 (Bilingual). 59 pp. (U). TC 77. ISBN 2-8318-2315-3

This report describes and interprets terms of basic importance to concepts and practical applications in the design and evaluation of electromagnetically compatible systems.

61000-2-1 (1990-05) : Electromagnetic compatibility (EMC) – Part 2: Environment – Section 1 : Description of the environment – Electromagnetic environment for low-frequency conducted disturbances and signalling in public power supply systems .

Ed. 1.0 (Bilingual) . 48 pp.(T). TC 77. ISBN 2-8318-1788-9

Has the status of a technical report , and gives information on the various types of disturbances that can be expected on public power supply systems. The following disturbance phenomena are considered : harmonics – inter harmonics – voltage fluctuations – voltage dips and short supply interruptions – voltage unbalance – mains signalling – power frequency variation – d.c. components.

61000-2-2 (1990-05) : Electromagnetic compatibility (EMC) – Part 2: Environment – Section 2: Compatibility levels for low –frequency conducted disturbances and signalling in public low – voltage power supply systems.

Ed . 1.0 (Bilingual) .22 pp. (L) SC 77A .En 61000-2-2, modified. ISBN 2-8318-1787-0

Gives compatibility levels to be considered in public low- voltage supply systems with regard to the above – mentioned phenomena. Compatibility levels are intended to serve as reference values for trouble – free operation for equipment installed in public power supply systems.

61000-2-3 (1992-10) : Electromagnetic compatibility (EMC) – Part 2: Environment – Section 3: Description of the environment – Radiated and non-network – frequency – related conducted phenomena.

Ed. 1.0.(Bilingual) . 135 pp. (XB) . TC 77. ISBN 2-8318-2460-5

Describes the electromagnetic environment . Intended as a basis to achieve electromagnetic compatibility in system and equipment design , using test standards and mitigation methods which satisfactorily take account of undesirable effects.The report is primarily concerned with characteristics and levels of electro magnetic fields and of non-network – frequency-related conducted emissions from unintentional sources of interference.

61000-2-4 (1992-02) : Electromagnetic compatibility (EMC) – Part 2: Environment – Section 4: Description levels in industrial plants for low- frequency conducted disturbances.

Ed. 1.0.(Bilingual) . 31 pp. (P) . SR : 1999-02. SC 77A

EN 61000-2-4. ISBN 2-8318-2933- X

Section 4 of IEC 1000-2 gives the requirements for the compatibility levels for industrial and non-public networks. These levels are relevant to disturbances that may occur in the electrical power supply in normal operating conditions. This standard applies to low voltage and medium voltage a.c.power supply at 50 Hz/60 Hz. Networks for ships k aircraft, off-shore platforms and railways are out of its scope.

61000-2-5 (1995-09) : Electromagnetic compatibility (EMC) – Part 2: Environment – Section 5: Classification of electromagnetic environments. Basic EMC publication.

Ed. 1.0.(Bilingual) . 101 pp. (XA) . SR: 1998-09. SC 77B.

This publication has the status of a Technical Report – type 2.

61000-2-6 (1995-09) : Electromagnetic compatibility (EMC) – Part 2: Environment – Section 6: Assessment of the emission levels in the power supply of industrial plants as regards low – frequency conducted disturbances.

Ed. 1.0.(Bilingual) . 117 pp. (XA) . SR:2000-09. SC 77A.

ISBN 2-8318-3534-8

This publication has the status of a Technical Report – type 3.

61000-2-9 (1996-02) : Electromagnetic compatibility (EMC) – Part 2: Environment – Section 9: Description of HEMP environment – Radiated disturbance .

Basic EMC publication.

Ed. 1.0.(Bilingual) . 49 pp. (T) . SR : 2001-02. SC 77C

This section of IEC 1000-2 defines the high – altitude electromagnetic pulse (HEMP) environment that is one of the consequences of a high – altitude nuclear explosion.

Those dealing with this subject consider two cases:

- high – altitude nuclear explosions;
- low – altitude nuclear explosions.

For civil systems , the most important case in the high – altitude nuclear explosion. In this case , the other efectr of the nuclear explosion : blast , ground shock , thermal and nuclear ionizing radiation are not prosent at the ground leve. However the electromagnetic pulse associated with the explosion may cause disruption of , and damage to , communication , electronic and electric power systems thereby upsetting the stability of modern sociery.

The object of this standard is to establish a common reference for the HEMP environment in order to select realistic stresses to apply to victim equipment for evaluating their performance .

61000-3-2 (1995-03) : Electromagnetic compatibility (EMC)–Part 3:Limits-t–Section 2: Limits for harmonic current emissions (equipment input current 16 perphase).

Ed. 1.0.(Bilingual) . 47 pp. (T) . SR : 2002-09. SC 77A

ISBN 2-8318-3293-4

This section of IEC 61000-3 is applicable to electrical and electronic equipment having an input current up to and including 16 A per phase , and intended to be connected to public low-voltage distribution systems. The tests according to this standard are type tests. Test conditions for particular equipment are given in annex C. For systems with nominal voltage less than 220 V (line to neutral).the limits have not yet been considered.

61000-3-2 (1997-12) : Electromagnetic compatibility (EMC)–Part 3:Limits–Section 2: Limits for harmonic current emissions (equipment input current 6 perphase).
Ed. 1.1.(Bilingual) . 49 pp. (T) . SC 77 A : ISBN 2-8318-4103-8

This section of IEC 61000-3 is applicable to electrical and electronic equipment having an input current up to and including 16 A per phase , and intended to be connected to public low – voltage distribution systems. The tests according to this standard are type tests. Test conditions for particular equipment are given in annex C. For systems with nominal voltages less than 220 V (line to neutral) , the limits have not yet been considerd.

Amendment No.1 (1997-09)
Ed.1.0 (Bilingual) – 5 pp. (C) . SC 77A – ISBN 2-8318-4013-9

61000-3-3 (1994-12) : Electromagnetic compatibility (EMC)–Part 3:Limits-t–Section 3: Limition of voltage fluctuations and filcker in low- voltage supply Limitation of voltage fluctuations and flicker in low – voltage supply systems for equipment with rated current 16 A.

Ed. 1.0.(Bilingual) . 41 pp. (S) . SR : 1999-12. SC 77A

EN 61000-3-3

This section of IEC concerned with the limitation of voltage fluctuations and filcker on the public low-voltage system. It specifies limits of voltage changes which may be produced by on equipment tested under specified conditions and gives guidance of methods of assessment . This section is applicable to electrical and electronic equipment having an input current up to and including 16 A per phase and intended to be connected to public low – voltage distribution systems of between 220 V and 250 V at Hz line to neutral .

This publication supersedes IEC 555-3.

61000-3-5 (1994-12) : Electromagnetic compatibility (EMC)–Part 3:Limits Section 5: Limitation of voltage fluctuations and flicker in low – voltage power supply systems for equipment with rated current greater than 16 A

Ed.1.0 (Bilingual) . 33 pp. (Q) , SC 77A . ISBN 2-8318-3222-5

The recommendations in this Technical Report are applicable to electrical and electronic equipment intended to be connected to a public low-voltage a.c. distribution system , where or has a lower rated current , but requires the special consent of the supply authority.

This publication has status of a technical report – type 2

61000-3-6 (1996-10) : Electromagnetic compatibility (EMC)–Part 3:Limits–Section 6: Assessment of emission limits for distorting loads in MV and HV power systems – Basic EMC publication.

Ed. 1.0.(Bilingual) . 113 pp. (XA) . SR : 2001-10. SC 77A.

This technical report outlines principles which are intended to be used as the basis for determining the requirements for connecting large distorting loads (producing harmonics and/or interharmonics) to public power systems . The primary objective is to provide guidance for engineering practices which will ensure adequate service quality for all connected consumers.

Since the guidelines outlined in this report are necessarity based on certain simplifying assumptions, there is no guarantee that this approach will always provide the optimum solution for all harmonic problems . The recommended approach should be used with flexibility and judgment as far as engineering is concerned , when applying the given assessment procedures in full or in part.

61000-3-7 (1996-11) : Electromagnetic compatibility (EMC)–Part 3:Limits–Section 7: Assessment of emission limits for fluctuating loads in MV and HV power systems – Basic EMC publication.

Ed. 1.0.(Bilingual) . 81 pp. (X) . SR : 2001-11. SC 77A

61000-3-8 (1997-09) : Electromagnetic compatibility (EMC)–Part 3:Limits-Section 8: Signalling on low – voltage electrical installations – Emission levels , frequency bands and electromagnetic disturbance levels .

Ed. 1.0.(Bilingual) . 39 pp. (R) . SR : 2002-09. SC 77B

ISBN 2-8318-3944-0

Applies to electrical equipment using signals the frequency rang from 3 kHz up to 525 kHz to transmit information on low – voltage electrical installations, either on the public supply system or within customers premises.

Specifies frequency bands allocated to different applications (where appropriate) , limits for the terminal output voltage in the operating band and limits for conducted and radiated disturbance . It also gives the methods of measurement . Specifies distribution limits in the frequency range from 3 kHz up to 400 GHz.

61000-4-1 (1992-12) : Electromagnetic compatibility (EMC)–Part 4: Testing and measurement techniques – Section 1: Overview of immunity tests. Basic EMC Publication.

Ed. 1.0.(Bilingual) . 141 pp. (XB) . SC 77B . EN 61000-4-1.

ISBN 2-8318-2515-6

Considers immunity tests for electric and/or electronic equipment (apparatus and systems) in its electromagneic environment. Both conducted and radiated phenomena are considered including immunity tests for equipment connected to power , control and communication networks.

61000-4-2 (1995-01) : Electromagnetic compatibility (EMC)–Part 4 : Testing and measurement techniques – Section 2: Electrostatic discharge immunity test. Basic EMC Publication .

Ed. 1.0.(Bilingual) . 58 pp. (U) . SR 2000 –01SC 77B.

ISBN 2-8318-3238-1

This publication is based on IEC 801-2 (second edition : 1991) . It relates to the immunity requirements and test methods for electrical and electronic equipment subjected to static electricity discharges , from operators directly , and to adiacent objects. It additionally defines ranges of test levels with relate to different environmental and installation conditions and establishes test procedures. The object of this standards to establish a common and reproducible basis for evaluating the performance of electrical and electronic equipment when subjected to electrostatic discharges . In addition , it includes electrostatic discharges which may occur from personnel to objects near vital equipment.

61000-4-3 (1995-03) : Electromagnetic compatibility (EMC)–Part 4 : Testing and measurement techniques – Section 3: Radiated , radio –frequency , electromagnetic field immunity test.

Ed. 1.0.(Bilingual) . 55 pp. (U) . SR 2000 –03. SC 77B.
ISBN 2-8318-3284-5

Applies to the immunity of electrical and electronic equipment to radiated electromagnetic energy . Establlishes test levels and the required test procedures. Establishes test levels and the required test procedures . Establishes a comman reference for evaluating the performance of electrical and electronic equipment when subjected to radio – frequency electromagnetic fields.

61000-4-4 (1995-01) : Electromagnetic compatibility (EMC)–Part 4 : Testing and measurement techniques – Section 4: Electrical fast transient/burst immunity test. Basic EMC Publication.

Ed. 1.0.(Bilingual) . 59 pp. (U) . SR 2000 –01 SC 77B.
ISBN 2-8318-3237-3

Relates to the immunity requirements and test methods for electrical and electronic equipment to repetitive electrical fast transients. Additionally defines ranges of test levels and establishes test procedures. The object of this standard is to establish a common and reproducible basis for evaluating the performance of electrical and electronic equipment when wubjected to repetitive fast transients (bursts) , on supply , signal and control ports. The test is intended to demonstrate the immunity of electrical and electronic equipment when subjected to types of transient disturbances such as those originating from switching transients (interruption of inductive loads, relay contact bounce , etc.). The standard defines:

- test voltage waveform;
- range of test levels;
- test equipment;
- test set –up;
- test procedure.

61000-4-5 (1995-03) : Electromagnetic compatibility (EMC)–Part 4 : Testing and measurement techniques – Section 45: Surge immunity test.

Ed. 1.0.(Bilingual) . 77 pp. (W) . SR 2000 –03 SC 77B.

ISBN 2-8318-3282-9

Relates to the immunity requirements, test methods , and range of recommended test levels for equipment to unidirectional surges causd by overvoltage from switching and lightning transients. Several test levels are defined which relate to different environment and installation conditions. These requirements are developed for and are applicable to electrical and electronic equipment. Establishes a common reference for evaluating the performance of equipment when subjected to high – energy disturbances on the power and inter – connection lines.

61000-4-6 (1996-04) : Electromagnetic compatibility (EMC)–Part 4 : Testing and measurement techniques – Section 6: Immunity to conducted disturbances, induced by radio- frequency fields.

Ed. 1.0.(Bilingual) . 85 pp. (X) . SR 2000 –04 SC 77B.

Relates to the conducted immunity requirements of electrical and electronic equipment to electromagnetic disturbances coming from intended radio-frequency (RF) transmitters in the frequency range 9 kHz up to 80 MHz. Equipment not having at least one conducting cable (such as mains supply, signal line or earth connection), which can couple the equipment to the disturbing RF fields is excluded. This standard does not intend to specify the tests to be applied to particular apparatus or systems. Its main aim is to give a general basic reference to all concerned product committes of the IEC. The product committes (or users and manufactures of equipment) severity level to be applied to their equipment.

61000-4-7 (1991-08) : Electromagnetic compatibility (EMC)–Part 4 : Testing and measurement techniques – Section 7: General guide on harmonics and interharmonics measurements and instrumentaation , for power supply systems and equipment connected there to

Ed. 1.0.(Bilingual) . 67 pp. (V) .SC 77A. 61000-4-7.

ISBN 2-8318-2093-6

This guide is applicable to instrumentation intended for measuring voltage or current components with frequencies in the range of d.c. to 2500 Hz which are superimposed on the voltage or current at the power supply frequency . This guide is also applicable to measurement equipment in accordance with emission limits given in standards as well as for the measurement of harmonic voltages and current in actual suply systems. The survey of harmonics in power supply systems is of particular concern.

61000-4-8 (1993-06) : Electromagnetic compatibility (EMC)–Part 4 : Testing and measurement techniques – Section 8: Power frequency magnetic field immunity test . Basic EMC Publication.

Ed. 1.0.(Bilingual) . 59 pp. (U) . SR 1998 –06 SC 77B.

EN 61000-4-8. ISBN 2-8318-2705-1

Relates to the immunity requirements of equipment, only under operational conditions , to magnetic disturbances at power frequency related to :

- residential and commercial locations.
- Industrial installations and power plants.
- Medium voltage and high voltage sub-stations…

61000-4-9 (1993-06) : Electromagnetic compatibility (EMC)–Part 4 : Testing and measurement techniques – Section 9: Pulse magnetic field immuntiy test. Basic EMC Publication.

Ed. 1.0.(Bilingual) . 57 pp. (U) . SR 1998-06. SC 77B.

EN 61000-4-9. ISBN 2-8318-2736-1

Relates to the immuntiy requirements of equipment , only under operational condirions . to pulse magnetic disturbances mainly related to :

- industrial installations and power plants.
- medium voltage and high voltage sub-stations.

61000-4-10 (1993-06) : Electromagnetic compatibility (EMC)–Part 4 : Testing and measurement techniques – Section 10: Power frequency magnetic field immunity test . Basic EMC Publication.

Ed. 1.0.(Bilingual) . 59 pp. (U) . SR 1998-06. SC 77B.

EN 61000-4-10. ISBN 2-8318-2747-7

Relates to the immunity requirements of equipment , only under operational conditions , to damped oscillatory magnetic disturbances related to medium voltage and high sub-stations.

61000-4-11 (1993-06) : Electromagnetic compatibility (EMC)–Part 4 : Testing and measurement techniques – Section 11: Voltage dips , short interruptions and voltage variations immunity tests.

Ed. 1.0.(Bilingual) . 41 pp. (U) . SR 1999-06. SC 77B.

EN 61000-4-11. ISBN 2-8318-3028-1

This standard defines the immunity test methods and range of preferred test levels for electrical and electronic equipment having a rated current not exceeding 16 A per phase. It does not apply to electrical and electronic equipment for connection to d.c. networks or 400 Hz. a.c. networks.

61000-4-12 (1995-05) : Electromagnetic compatibility (EMC)–Part 4 : Testing and measurement techniques – Section 12: Oscillatory waves immunity test. Basic EMC Publication.

Ed. 1.0.(Bilingual) . 85 pp. (X) . SR 2000-05. SC 77B.

ISBN 2-8318-3389-2

This basic standard establishes the immunity requirements and a common reference for evaluating in a laboratory the performance of electrical and electronic equipment intended for residential, commercial and industrial application, as well as of equipment intended for elctrical stations, as applicable. The purpose of this standard is to define.

- test voltage and current waveforms:
- ranges of test levels;
- test equipment ;
- test set-up;
- test procedure.

61000-4-15 (1997-11) : Electromagnetic compatibility (EMC)–Part 4 : Testing and measurement techniques – Section 15: Flickermeter – Flickermeter – Functional and design specifications.

Ed. 1.0.(Bilingual) . 43 pp. (S) . SR 2002-11. SC 77A.

ISBN 2-8318-4086-4

Given a functional and design specification for flicker measuring apparatus intended to indicate the correct flicker perception level for all practical voltage fluctuation waveforms. Information is presented to enable such an instrument to be constructed. A method is given for the evaluation of filcker severity on the basis of the output of filckermeters complying with this standard.

61000-4-24 (1997-02) : Electromagnetic compatibility (EMC)–Part 4 : Testing and measurement techniques – Section 24: Test methods for protective devices for HEMP conducted disturbance – Basic EMC Publication.

Ed. 1.0.(Bilingual) . 21 pp. (L) . SR 2002-02. SC 77C.

ISBN 2-8318-3738-3

Deals with methods for testing protective devices for HEMP conducted disturbance . It primuarily covers testing of voltage breakdown and voltage – limiting characteristics but also methods to measure the residual voltage under HEMP conditions for the case of very fast changes of voltage (u) and current (I) as a function of time.

61000-5-1 (1996-12) : Electromagnetic compatibility (EMC)–Part 5 : Installation and mitigation guidelines - Section 1: General considerations – Basic EMC publication.
Ed. 1.0.(Bilingual) . 61 pp. (V) . SR 2001-12. SC 77B.

This technical report covers general considerations and guidelines on mitigation methods aimed at ensuring electromagnetic compatibility (EMC) among electrical and electronic apparatus or systems used in industrial , commercial, and residential installations. This technical report is intended for use by installers and users, and to some extent manufacturers , of sensitive electrical or electronic installations and systems , and equipment with high emission levels that could degrade the overall electromagnetic (EM) environment. It applies primarily to new installations , but where economically feasible , it may be applied to extensions or modifications to existing facilities.

61000-5-2 (1997-11) : Electromagnetic compatibility (EMC)–Part 5 : Installation and mitigation guidelines - Section 2: Earthing and cabling.
Ed. 1.0.(Bilingual) . 137 pp. (XB) . SR 2001-11. SC 77B.
ISBN 2-8318-4125-9

This technical report (type3) covers guidelines for the earthing and cableing of electrical and electrical systems and installations aimed at ensuring electromagnetic compatibility among electrical and electronic apparatus or systems. More particularly , it is concerned with earthing practices and with cables used in industrial , commercial and residential installations. This technical report is intended for use by installers and users, and to some extent, manufactures of senstive electrical or electroni installations and systems , and equipment with high emission levels that could degrade the overall electromagnetic environment.

61000-5-4 (1996-08) : Electromagnetic compatibility (EMC)–Part 5 : Installation and mitigation guidelines – Section 4: Immunity to HEMP – Specifications for protective devices against HEMP radiated disturbance . Basic EMC Publication.
Ed. 1.0.(English) . 54 pp. (u) . SR 1999-08. SC 77C.

This technical report defines how protective devices for High Altitude Nuclear Electromagnetic Pulse (HEMP) protection of civilian systems are specified. Performance requirements will be given in future IEC standards. This technical report is intended to be used for the harmonization of existing or future specifications issued by protective devices manufacturers electronic equipment manufacturers , administrative bodies and other buyers.

This technical report covers protective devices currently used for protection against HEMP radiated.

EM fields. In general , parameters relevant to HEMP , that is parameters related to very fast changes of EM fields, as a furiction of time , are dealt with.

61000-5-5 (1996-02) : Electromagnetic compatibility (EMC)–Part 5 : Installation and mitigation guidelines - Section 5: Specification of protective devices for HEMP conducted disturbance . Basic EMC Publication.

Ed. 1.0.(Bilingual) . 71 pp. (W) . SR 2001-02. SC 77C.

This part of 100-5 defines how protective devices for conducted disturbance proposed for HEMP protection shall be specified. It is intended to be used for the harmonization of existing or future specifications issued by protective device manufactures , electronic equipment manufacturers , administrations and other ultimate buyers. Performance requirements shall be given in future IEC documents.

This section covers protective devices currently being used for protection against induced HEMP transients on signal and low voltage power lines (nominal voltage up to 1kV a.c.)

General information can be applied also to high voltage lines. However , in these cases , the additonal require ments for the protection levels of existing lightning arresters (especially gapless MO-arresters) are under consideration.

61000-6-1 (1997-07) : Electromagnetic compatibility (EMC)–Part 6 : Generic standards - Section 1: Immunity for residential , commercial and light – industrial environments.

Ed. 1.0.(Bilingual) . 27 pp. (N) . SR 2002-07. TC 77.

ISBN 2-8318-3930-0

Defines the immunity test requirements in relation to continuous and transient , conducted and radiated disturbances , including electrostatic discharges , for electrical and electronic apparatus intended for use in residential , commercial and light – industrial environment, and for which no dedicated product or product – family standard exists. Immunity requirements in the frequency range 0 kHz 400 GHz are coverd and are speccified for each port considered. This standard applies to apparatus intended to be directly connected to a low – voltage public mains netwrok or connected to a dedicated d.c. source which is intended to interface between the apparatus and the low-voltage public mains network.

61000-6-4 (1997-01) : Electromagnetic compatibility (EMC)–Part 6 : Generic standards - Section 4: Emission standard for industrial environments.

Ed. 1.0.(Bilingual) . 17 pp. (J) . SR 2002-01. TC CISPR.

ISBN 2-8318-3686-7

This standard for emission requierments applies to electrical and electronic apparatus intended for use in the industrial locations (both indoor, or in proximity to industrial power installations) for which no dedicated product or product –family emission standard exists. Disturbances in the frequency range 0 Hz to 400 GHz are coverd.

٤ استاندارد ANSI/IEEE

1. ANSI C84.1-1989, Electric Power System and Equipment –Voltage Ratings (60 Hz) (Voltage rating for power system and equipment)

2. IEEE Std 141-1991 , IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (IEEE Red Book) (ANSI).

[Industrial electrical power systems]

3. IEEE Std 142-1991, IEEE Recommended Paractice for Grounding of Industrial and Commercial Power Systems (IEEE Green Book) (ANSI)

[Industrial and commercial power system grounding]

4. IEEE Std 241-1991, IEEE Recommended Practice for Electric Power Systems in Commercial Buildings (IEEE Gray Book) (ANSI).

[Commercial electric power systems]

5. IEEE Std 242-1986, IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book) (ANSI).

[Industrial and commercial power system protection]

6. IEEE Std 399-1990, IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis (IEEE Brown Book) (ANSI).

[Industrial and commercial power system analysis]

7. IEEE Std 446-1987 , IEEE Recommended Practic for Emergency and Standby Power System for Industrial and Commercial Applications (IEEE Organe Book) (ANSI)

[Industrial and commercial power system system emergency power]

8. IEEE Std 487-1992, IEEE Recommended Practice for the protection of Wire Line Communications Facilities serving Electric Power Stations.

9. IEEE Std 493-1990 , IEEE Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems (IEEE Gold Book) (ANSI).

[Industrial and commercial power system reliability]

10. IEEE Std 518-1982 , IEEE Guide for the Installation of Electrical Equipment to Minimize Noise Inputs to Controllers from External Sources (Reaff 1990) (ANSI).

    [Guide on noise control]

11. IEEE Std 519-1992 , IEEE Recommended Practices and Requirements for Harmonics Control in Electric Power Systems (ANSI)

    [Recommended practice on harmonics in power systems.]

12. IEEE Std 739-1986 , Ieee Recommended Practice for Electric Systems in Health Care (ANSI).

    [Industrial and commercial power system in health facilities]

13. IEEE Std 929-1988 (Reaff 1991), IEEE Recommended Practice for Utility Interface of Residential and Intermediate Photovoltaic (PV) Systems (ANSI).

    [Energy conservation in industrial power systems]

14. IEEE Std 929-1988 (Reaff 1991) , IEEE Recommended Practice for Utility Interface of Residential and Intermediate Photovoltaic (PV) Systems (ANSI).

    [Industrial practices for photovoltaic power systems]

15. IEEE Std 1001-1988 , IEEE Guide for Interfacing Dispersed Storage and Generation Facilities with Electric Utility Systems (ANSI).

    [Industrial dispersed generation and storage]

16. IEEE Std. 1035-1989 , IEEE Recommended Practice : Test Procedure for Utility – Interconnected Static Power Converters (ANSI).

    [Test proceduers for interconnecting static power converters.]

17. IEEE Std. 1050-1989, IEEE Guide for Instrumentation and Control Equipment Grounding in Generating Stations (ANSI).

[Grounding of power station instrumentation and control.]

18. IEEE Std. 1100-1992 , IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment (Emerald Book) (ANSI).

[Power and grounding sensitive equipment.]

19. IEEE Std. 1159 , IEEE Recommend Practice for monitoring Electric Power Quality

[monitoring of power quality]

20. IEEE Std. 1250-1995 , IEEE Guide for Service to Equipment Sensitive Momentary Voltage Disturbances (ANSI).

21. IEEE P1346 (D2.0 9.95) , Recommended Practice or Evaluating Electric Power System Compatibility With Electronic Process Equipment.

22. IEEE Std. C57-110-1986 (Reaff 1992) , IEEE Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents (ANSI).

23. IEEE Std C62-41-1991, IEEE Recommended Practice on Surge Voltage in Low – Voltage AC Power Circuits (ANSI).

24. IEEE Distribution , Power , and Regulating Transformers Standards Collection , 1995 Edition (C57) (ANSI)

۵ لیست مراجع به تفکیک موضوع

۵-۱ موضوعات کلی :

۱- سید حمید حسینی ، شهرام کریمی ، حسین سبزی اوغانی ، " نظارت وارزیابی کیفیت برق " ، دوازدهمین کنفرانس بین المللی برق ، ۱۳۷٦ .

در این مقاله انواع اغتشاشاتی که به کیفیت برق آسیب می رسانند توضیح داده شده است و عوامل ایجاد کننده این اغتشاشات و اثرات سوء آنها در شبکه به اختصار آورده شده است . همچنین نمونه هایی از اغتشاشات که با استفاده از نرم افزار EMTP شبیه سازی شده است ، در این مقاله آمده است . سپس قسمتهای مختلف سیستمی که برای نظارت و ارزیابی کیفیت برق طراحی و ساخته شده است توصیف شده و نمونه هایی از خروجی های سیستم به نمایش گذاشته می شود.

۲- سعید شعاری نژاد ، " مبانی کیفیت برق و اثرات آن " سیزدهمین کنفرانس بین المللی برق ، ۱۳۷۷.

در این مقاله سعی شده است ضمن ارائه تاریخچه و مقدمه کوتاهی از موضوع کیفیت برق ، ابتدا عوامل موثر در کیفیت برق به اختصار مورد بحث و تجزیه و تحلیل قرار گرفته و سپس روی یکی از موثرترین عوامل یعنی اعوجاجات هارمونیکی و منشاء آن تا حدودی به جزئیات پرداخته شود . آنچه که بیش از همه بر روی آن تاکید شده است راه حلهای عملی و اقتصادی جهت بهبود کیفیت برق و بالطبع افزایش راندمان شبکه می باشد.

۳- سید حمید حسینی ، عبدالحسین نصیری ، فریدون بهنیا ، " طراحی و شبیه سازی سیستم بهبود دهنده کیفیت انرژی الکتریکی " ، سیزدهمین کنفرانس بین المللی برق ، ۱۳۷۷.

در این مقاله طراحی یک سیستم برای حذف قطعی ولتاژ ، کاهش ولتاژ ، اضافه ولتاژ و هارمونیک های فرکانس بالا و پایین در ولتاژ شبکه قدرت شرح داده شده است . این سیستم بهبود دهنده برای تثبیت ولتاژ بار از یک مدبل ولتاژ PWM استفاده می کند.

4- G.H Heydt and W.T. Jewell , " Pitfalls of electric power indices " , IEEE Trans . on power delivery , Vol. 13 , No. 2, 1988.

Several indices are in common use for the quanification of electric power quality. These are convenient for condensing complex time and frequency domai waveform phenomena into a number. However, a variety of commonly encounterd circumstances are not readily acoommodated (for example : quasiperiodic and aperiodic signal components, noniteger multiples of the power frequency) . Also , the power acceptability curves have been used as convenient measures of power quality and these curves do not capture three phase detail of power quality problems. In this paper , the general subject of pitfalls of power quality indices is discussed and suggestings for alleviating problems are made.

5- " SVC light – a Powerful tool for power quality improvement " ABB review 6/1998.

ABB has developed and introduced a new technology called SVC Light which brings together the VSC (Voltage Source Converter) and IGBT (Insulated Gate Bipolar Transistor) to create a tool offering unique possibilities for power quality

6- D.O . Kaval and J. Leonard , " Power quality of small rural industries " , IEEE Trans. On Industry Applications , Vol . 29 , No.4 , 1993.

This paper will present the results of a detailed power quality survey of 23 small rural industries sponsored by the Canadian Electrical Association and provides a knowledge base on rural power quality and the possible origins of power supply anomalies . This paper will summarize the major power quality problems experienced at the various industrial sites. The results of the survey will provide a basis for mitigating actions by the utilities and their rural industrial customers to design and operate their electrical systems to minimize the effects of power supply anomalies.

7- A. Domijan , G.T. Heydt, " Directions of research on electric power quality " , IEEE Trans . on power Delivery , Vol.8, No. 1,1993.

In this paper , several important research areas in electric power quality are described. Aspects of electric power quality have been categorized as : fundamental concepts ; modelling and analysis;Measurement and instrumentation ; sources ; solutions ; effects ; and educational issues . The goal of the paper is to identify the high priority research areas in electric power quality , and to stimulate interest in this topic.

8- Burke , James ; Griffith David ; and Ward , Dan , " Power Quality –Two Different Perspectives , " IEEE Transactions Trasactions on Power Delivery , Vol. 5, No. 3, pp. 1501-1513 , July 1990.

9- Douglas , John , " Quality of Power in the Electronics Age , " Electric Power Research Institute EPRI Journal , Nov . 1995.

10- Thomas S, " Diagnosing Power – Quality – Related Computer Problems , " IEEE Transactions on Industry Applications , IA –I5 , No. 4, July/Aug. 1979.

11- Robert J. , Ed. , Electrical systems for Computer Installations . New York : McGraw – Hill, 1988.

12- Mehta, H. and Smith, J.C,. " Important Power Quality Concerns on the Supply Network , " PQA 91 , Paris , France , 1991.

13- Martzloff, Francois D. and Gruzs , Thomas M., " Power Quality Site Surveys : Facts , Fiction , and Fallacies , " IEEE Transactions on Industry Applications , Vol.24,No. 6. Nov ./Dec. 1988.

۵-۲ اندازه گیری

1. C.Dewinkel , P. Vinett, " Description of a MICRO – EMES system for protection of critical customer facilities " , IEEE Trans. On Power Delivery , Vol. 2, 1994.

The system configuration , theory of operation , computer simulations , and important application experiences of a small (750 kVA) superconducting magnetic energy storage device (Micro –SMES) for application on power distribution circuits to enhance customer power quality are presented. The functions of the major components of the Micro-EMES are separately discussed and the operation of each component is illustrated with an Electro-Magnetic Transients Program (EMTP) simulation example . Application performance characteristics obtained form the first practical installation of a Micro-SMES are summarized and its protection effectiveness is evaluated.

2. A. Miller , M.B. Dewe , " Multichannel continuous harmonic analysis in real – time " , IEEE Trans. On Power Delivery , Vol . 7 , No. 4, 1992.

A flexible , modular multichannel continuous real – time harmonic analyzer with the capability of precision time stamping (via GPS satellite signals) of the acquired data is described . The key design features which provide this performance are fully discussed . These include remote distributed adta conversion moduled coupled via digital fiber optic links to parallel individual digital signal processor Multibus II based modules which are all controlled by a highly integrated 486 based module. The resultant Multibus II parallel processor system is run under the iRM XIII real –time operating system and is interfaced via enherent to control and display workstations using a custom designed Windows 3 environment. The ready extension of the harmonic monitoring system to transient measurement is also described.

3. J.Ruiz , J. ortuondo , " Real time Power supply quality measurement and monitoring multichannel system " , IEEE Trans. on Power Delivery , Vol. 10 No. 3 , 1995.

This paper describes a multi-channel system for measuring electric power supply quality in real time . The hardware is simple but powerful, because it is based on a PC with an acquisition card m and a development card with a single dedicated DSP (Digital signal processor).

Three software modules which all run on the same hardware have been developed for measuring all low frequency disturbances . There is a description of how these instrument modules were constructed , and the results of the field tests qre given. We would like to stress that we have not found a single system working in real time which is capable of fully characterizing power supply quality.

4. R.H. Simpson, " Instrumentation , measurement techniques and analytical tools in power quality studies" , IEEE Trans. On Insustry applications , Vol. 34, No.3, 1998.

The proper choice of instrumention , measurement techniques , and analytical tools is vital to the successful implementation of any power quality study. Whether the desired result is the determination of harmonic distortion levels, a harmonic filter design, or transient waveform analysis , the proper chioce of instrument, measurement technique, and analytical tools can make the difference between a well-engineered solution to a complex problem and an expensive failure. This paper revies the points of consideration for power quality instrumentation , description of appropriate measurement techniques, and a discussion of analytical methods.

5. R. Sfichi , " Distrorting Power conditions indicators for electric power quality delivered to users", Cigre 36-306,1994.

This report presents the main indicators and their constraints according to Romanian regulations and the already accepted definition of distorting Power conditions . Two categories of indicators are presented : safety and economic indicators.

6. G.T. Heydt and E. Gunther , " Post – Measurement processing of electric power quality data" , IEEE Trans. On Power Delivery , Vol. 11.No.4.,1996.

This paper addresses the issues of post – measurement processing of data collected in a power quality assessment study. Three broad types of post – measurement processing objectives are considered : to enhance accuracy; to estimate data ; and to reduce the volume of the collected data. The methods used to enhance accuracy are bad data identification and rejection . Averaging is discussed as a method to " filter " measurement error . The methods used for data estimation are state estimation techniques in both the time and frequency domain . The methods used to reduce the volume of the collected data are based on the calculation of marginal and conditional probablities and expectations. The integrated use of these techniques in an instrumentation system for power quality assessment is discussed . The main suggested application is for the measurement of harmonics.

7. A . Abur and M. Kezunovic , " A simulation and testing laboratory for addressing power quality issues in Power systems " , IEEE Trans. On Power Systems , Vol . 14, No. 1, 1999.

A simulation and testing laboratory for electric power quality studies is described in this paper . The functions of the laboratory as a medium of instruction and as a research environment are discussed and their utilization the context of power quality related studies are shown.

8. " Basic measuring instruments ", Handbook of Power signatures , Second Edition , 1993.

9. Allen and Segall , " Monitoring of computer installations for Power line disturbances ", IEEE PES , C74 199-6, 1974.

۵-۳ فلش و قطعی ولتاژ

1. P.P. Khera , K.C. Dickey , " Analysis and mitigation of voltage disturbances at an industrial customer corporate campus " , IEEE Trans. On Industry Applications , Vol. 34, No.5, 1998.

This paper presents the analaysis of voltage sag data collected over several years at an industrial customers , corporate campus. Facilities on the capmus include office buildings , pilot plants , R&D labroteries , chiller plants , and boiler plants . The paper examines the " cause and effect " of voltage dips to the processes at the campus . It also details what the utility and the industrial customer did , or is doing , to mitigate additional dips to the campus . The determination of the final configuration of the power distribution system and its effect on the customer's power quality is also discused .

2. M.Bolen , " Fast assessment methods for voltage sags in distribution systems " , IEEE Trans . on Industry Applications , Vol . 32 , No. 6 , 1996.

In this paper , based on a simple voltage divider model , a relation is derived between the load sensitivity to voltage sags (expressed as a critical voltage) and the exposed area (expressed as a critical distance). The critical distance increases about linearly with voltage level. The relation found is remarkably similar to relations found in power quality surveys . An equivalent expression is found for the critical distance as a function of the critical phase angle jump.

Realizing that faults downstream of a transformer do not significantly influence the expected number of sags at a specific load location.

The method is extended to some nonradial systems : simple subtransmission loops, local generation , feeding from two substations , and opereating with a normally open breaker.

3. M. Bollen, G. Yalcinkaya , " A ssessment of the number of voltage sags experienced by a large industrial customer " , IEEE Trans. On Industry Applications . Vol. 33, No. 6, 1997.

In this paper , Circuit theory models are used to estimate the number of voltage sags in the supply mill. For every voltage level , the radius of the exposed area (the critical distance) gives the expected number of sags. As the main sensitive load is formed by large adjustable – speed drives , a classification of sags into four types is used . The conclusion of the paper is that the equipment should first be made resilient against sags due to single – phase faults at 400 kV. These faults cause the majority of sags. Sags due to three- phase faults are more severe (especially due to faults at 11 kV), but are less common.

4. M.F. McGranghan , D.R. Mueller , " Voltage sags in industrial systems " , IEEE Trans . on Industry Applications , Vol . 29, No. 2, 1993.

This paper describes the causes of voltage sags in industrial plants , their impacts on equipment operation , and possible solutions . The definition proposed focuses on system faults as the major cause of voltage sags. The sensitivity of different types of industrial equipment , including adjustable speed drive controls , programmable logic controllers, and motor contactors, is analyzed. Available methods of power conditioning for this sensitive equipment are also described.

5. C.Becker, W. Braun, " Proposed chapter 9 for prediciting voltage sags in revision to IEEE std 493, the Gold Book " , IEEE Trans . on Industry Applications. Vol. 30, No.3, 1994.

This paper shows how to predict voltage sag performance of electric wupply systems by combining a new analysis method with reliability data . The analysis method is proposed for a new chapter in the next revision of IEEE Std 493.

6. L.E. conrad , H.j. Bollen , " Voltage sag Coordination for reliable plant operation " , IEEE Trans. On Industry Applications , Vol . 33, No.6 , 1997.

This paper offers techniques to coordinate sensitive electric equipment with predicted or measured voltage sag characteristics . The techniques for predicting voltage sag characteristics have already been developed and proposed for Chapter 9 of the Gold Book. This paper describes the coordination techniques and another section that are planned for inclusion in dhapter 9 . The techniques provide a display of sag characteristics and equipment sensitivity on a simple graphical display .This greatly simplifies the coordination of sensitive equipment with sag characteristics on the electric supply mains . The paper also covers a discussion of sag reporting options that is planned for Chapter 9 and some suggestions on futrure extensions for this coordination technique.

7. D.O. Koval , M.Brent , " Canadian national Power quality survey " Frequency and duration of voltage sags and surges at industrial sites " , IEEE Trans. On Industry Application . Vol. 34, No.5 , 1998.

This paper will attempt to answer several questions concerning the frequency and duration of voltage sags and surges posed by industrial customers. The answers to these questions will be based on the national survey results of the frequency and duration of voltage sags and surges at industrial sites monitored at their utilization voltage levels and on the utility primary side of their facilities. The survey results provide a knowledge base for monitoring , designing , and utilizing voltage sag and surge mitigating technologies.

8. M.j. Sulivan, M.Johnson, " Power interruption costs to industrial and Commercial Consumers of Electricity " , IEEE Trans . on Industry Applications , Vol. 33, No.6,1997.

This paper summarizes the results of a survey of 210 large commercial and industrial customers to obtain detailed descriptions of the components of interruption costs they would experience under varying outage conditions . In addition , the survey observed plant operating schedi;es; products and services , processes used , machinery used in production , back up generation , and equipment designed to ensure power quality . The paper describes a statistical approach for obtaining inexpensive outage cost estimates for individual customers by combining information from on-site interviews with less costly information obtained from utility representatives. Results form regression modes estimated from the information obtained in the on-site survey are described in detail.

9. C.Methorn, T.D. Davis , " Voltage Sags : Their impact on the utility and industrial customers. " IEEE Trans . on Industry Applications , Vol . 34, No. 3, 1998.

This paper describes the impact of voltage sags on the utility and industrial customers. Several utility measures are presented to minimize the customer's exposure to voltage sags.These measures cannot completely eliminate the impact of voltage sage on sensitive equipment , however. A case study is presented in this paper that includes measurement results that were used to characterize the voltage sags experienced on the utility system and in the industrial facility . Simulation results used to develop " area – of –vulnerability curves " for the industrial facility , mitigation equipment that was employed to improve the sensitive equipment's ridethrough capability , and the lessons learned from the systems approach analysis are presented.

10.S.W. Middlekauff, E.R. Collines, " System and customer impact : considerations for series custom power devices " , IEEE Trans. On Power Delivery , Vol. 13, No.1 , 1998.

The growing interest in power quality has led to a variety of devices designed for mitagating power disturbances , primarily voltage sags. One class of these devices is the series device . The size of a series device (SD) is usually described as having a certain percent rms magnitude voltage injection capability . The required rms magnitude is usually taken form measured data or the results of a circuit model simulation . These results can be graphically illustrated using magnitude versus duration matrices or curves. Due to the one cycle averaging effect of the rms calculation, waveshape , transients , and phase shift are not adequately described , and thus does not accurately predict the necessary injection capability required of the series device . Careful consideration must also be taken when applying a series device onto a system. The series device acts as an additional energy source on the system. The device must coordinate with other protective devices to prevent damage to other loads on the system , particularly upstream loads . The series device requires a continuous current path to insert energy , so protective devices must be arranged accordingly. However , a load upstream of the series device and downstream of the protective device creates a potential for reverse current flow through the upstream load.

11.A. Zyl and A. Faveluke , " Voltage sag ride – through for adjustable – speed drives with active rectifiers" , IEEE Trans . on Industry Applications , Vol.34 , No.6, 1998.

In this paper , a methodology for incorporating voltage sag ride – through in the design od ASD 's with active rectifiers is presented . The magnitude of the voltage sag for which ride – through can be provided is determined by the current rating of the active rectifier and load condition of the ASD , but a sag of any duration can be compensated for .

12.Power quality ensured by dynamic voltage correction , ABB Review 4/1998.

Growing demands made by industry on power quality as well as the quality diversification that deregulation has brought , point to a need for additional devices that , by ensuring high – quality system voltages , prevent critical loads from failing and causing production downtime . Options include the Dynamic Voltage Restorer , which has its own energy storage unit , and the Unified Voltage Controller . Both system concepts allow economically and technically optimized corrective action , designed to counter voltage reductions or rises occurring in power transmission networks.

13.Cooper, Edward , " Power Line Conditioning , " Measurements and Control , June 1985.

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19.Meirich , R.P. " The Evolution of Uninterruptable Power Supplies, " PCIM Power Conversion & Intelligent Motion, Oct . 1989.

20.Sturgeon ,Jeffrey B., " UPS – Providing Power You Can Count On When Things Go Wrong, " Electrical Systems Desgin , May 1989.

21.R.Qader , J. Bollen , " Stochastic Prediction of Voltage Sags in a Large Transmssion System " , IEEE Trans. On Industry Applications , Vol . 35 , No.1 , 1999.

This paper discusses two stochastic prediction methods for voltage sags and applies them to a 97-bus model of the 400 –kV National Grid of England and Wales. The method of fault positions is most suitable for implementation in a software too. It has been used to get exposed areas and sag frequencies for each bus . The results are presented in different ways, including a so-called voltage sag map showing the variation of the sog frequency through the network. The method of critical distances is more suitable for hand calculations , as both the amount of data and the complexity of the calculations are very li,ited . It has been used to obtain sag frequencies for a number of buses. A comparison with the results obtained by using the method of fault positions shows that the method of critical distances is an acceptable alternative where software or system data are not available for a more accurate analysis.

٤-٥ فلیکر

۱- وحید گواهری صدر ، اسماعیل محسنی کبیر ، " پیش بینی فلیکر ناشی از کوره های قوس الکتریک در شینه کوپلاژ مشترک " ، دهمین کنفرانس بین المللی برق ، ۱۳۷٤.

در این مقاله با ذکر روشها و استانداردهای موجود ، روشی مناسب برای پیش بینی شدت فلیکر ارایه گردیده است . ضمنا" آثار بسیار مطلوب و قابل توجه استفاده از کندانسور سنکرون برای کارخانه فولاد آلیاژی یزد که در حال احداث است ، آورده شده وهمچنین مقایسه ای بین استفاده از نیروگاه و یا کندانسور برای جبران فلیکر مجتمع مذکور انجام گرفته و ارجح بودن کندانسور از نقطه نظر کاهش میزان فلیکر مورد بررسی قرار گرفته است.

۲- فرید مسلط ، " فلیکر ولتاژ و روش های اندازه گیری آن " نشریه برق ، سال ششم ، شماره ۲ ، پاییز ۱۳۷۷.

در این مقاله پدیده چشمک زن فلیکر و روشهای اندازه گیری آن بر طبق استاندارد IEC به طور مفصل توضیح داده شده است.

۳- مهرداد عابدی ، عماد شریفی ، داود جلالی ، " نوسانات ولتاژ در شبکه های توزیع و شبیه سازی دینامیکی از راه اندازی موتورهای القایی در شبکه ، پنجمین کنفرانس شبکه های توزیع نیروی برق .

هدف اصلی این مقاله بررسی نوسانات ولتاژ ناشی از راه اندازی بارهای اعوجاجی به کمک یک برنامه کامپیوتری در شبکه های توزیع شعاعی می باشد.

٤- سید حمید حسینی ، فرید مسلط ، شهرام کریمی ، بررسی کیفیت ولتاژ در حالت ماندگار دهمین کنفرانس بین المللی برق دراین مقاله قسمتهای مختلف سیستمی که برای اندازه گیری و ارزیابی کیفیت ولتاژ در حالت ماندگار طراحی و ساخته شده است توصیف شده و نمونه هایی از خروجی های سیسم به نمایش گذاشته شده است. همچنین در این مقاله غیر قابل استفاده بودن فلیکرمتر دیجیتالی برای اندازه گیری میزان چشمک زن ولتاژ به علت ثابت نبودن فرکانس شبکه و حساسیت این نوع فلیکر متر به تغییرات فرکانس ذکر شده است.

5- A.A.C . Arruda & F.L.A.P. Cavalcanti , " Power system harmonic and flicker survey " , Cigre , 36-202,1992.

This paper describe the work that has been carried out on harmonic and flicker measurements, the evaluations and solutions at the transmission and distribution systems and the current efforts to allow an overall analysis methodology in this area. Two real cases analysis are presented , one on harmonic and another on flicker. In each one are showed the measurements and simulations done and the possible solutions to minimize the detected problems. Some conclusions are made concerning instruments , simulation tools , regulations for limiting interferences and about the danger that these interferences get out of control.

6- K.srinivasan , " Conforming and non-conforming current for attributing steady state power quality problems " , IEEE Trans . on Power delivery , Vol. 13 , No.1 , 1998.

7- T.Gomez and J.Roman , " Power quality regulation in Argentina : Fliker and harmonics " , IEEE Trans . on Power Delivery , Vol . 13, No.3, 1998.

This paper describes the Argentinean regulatory scheme for power quality , particulary regarding harmonics and flicker , considering as main points: Reference Levels, Emission Limits, Measurement and Control Procedures and Economic Penalties.

8- A. Robert and J. Marquet , " Assessing voltage quality with relation to harmonics , flicker and unbalance " , Cigre , 36-203 , 1992.

Due to the stochastic noture of harmonics , filcker and unbalance , long-duration measurements are generally needed providing huge amounts of data . As a result of an international study , simple statistical criteria are proposed for comparison with the compatibility levels , in order to enable an unambiguous iudgement of the voltage quality.

9- A. Robert and Mo.Couvereur , " Recent experience of connection of big arc furnaces with reference to flicker level " Cigre , 36-305, 19994.

This paper gives additional information on the reduction to be expected from a series reactor , the benefit from DC vs AC furnaces , general evaluation criteria , the assessment of the emission level from one furnace in presence of other ones and summation effects.

۵-۵ عدم تعادل ولتاژ

۱- علی اکبر محسنی شوشتری ، " بررسی اثرات عدم تعادل بار و ارایه روشهای عملی به منظور متعادل نگهداشتن بار شبکه " پنجمین کنفرانس شبکه های توزیع نیروی برق .

این مقاله به بررسی پدیده عدم تعادل بار و تاثیر آن روی تلفات سیستم می پردازد.

۲- رحیم سلیمان آذر ، " اثرات نامتعادلی بار در شبکه های توزیع " بنجمین کنفرانس شبکه های توزیع نیرو برق .

دراین مقاله به مشکلات ناشی از نامتعادلی بارها و تاثیر این عوامـــل برکـارکرد موتورهـا ، ترانســهای توزیع ، کنتورهای اکتیو و ایمنی مصرف کننده ها پرداخته شده و در انتهای مقاله جهت کاهش اثـرات نا متعادلی بارها راه حلهای عملی ارایه شده است.

3- M.V. Agunov and A.V. Agunov , " Energy balance in electric circuits with non-sinusiodal voltage and current " IEEE Trans . on Power systems , Vol.12 , No.4,1997.

An approach to apparent power components determination in non-sinusoidal voltage and current circuits has been presented. It is based on the use of mathematics of trigonometric rows , Parseval equation in particular . The proposed method gives a possibility to avoid mistakes of a formal approach and to evaluate apparent power components more precisely as compared to the well –known methods.

4- A. Robert and J.Marquet , " Assesing voltage quality with relation to harmonics , flicker and unbalance " , Cigre , 36-203,1992.

Due to the stochastic nature of hamonics , filcker and unblance , long – duration measurements are generally needed providing huge amounts of data . As a result of an international stuey , simple statistical criteria are proposed for comparison with the compatibility levels , in order to enable an unambiguous judgement of the voltage quality.

٥-٦ هارمونیک

1. K. Srinivason , " Attributing harmonic in private Power Production " , IEEE Trans . on Industry Applications , Vol. 34 , No.5 , 1998.

This paper presents a concept for sharing the responsibility for harmonics . The sharing is based soely on measurements during the operation and at the point of connection . The concept is also applicable to other types of steady – state power quality deterioration , namely , repetitive rms fluctuations , waveform distortion , and three – phase unbalance.

2. R.D. Henderson and p.J. Rose , " Harmonics : The effect on power quality and transformers" , IEEE Trans. On Industry Applications , Vol. 30, No.3 , 1994.

This paper is based upon actual harmonic studies on 480 V, three –phase , variable speed drives and the effects of harmonics on transformers in those systems , It also includes the recommendations for correction of the problems resulting from harmonic distortion.

3. A.E. Emanuel and D. Cyganski, " A survey of harmonic voltage and currents at the customer's bus " , IEEE Trans . on Power Delivery , Vol . 8 , No.1 , 1993.

This paper reports seven day-measurements of harmonic current voltage made at the main buses of industrial , commercial and residential customers. These results are representative low voltage buses in the Northeast US. The data collected provides initial core of documentation for future reference and follow-up the trends in harmonic levels at the end users.

4. Harmonics , Characteristic Parameters, method of study , estimates of existing values in the network , By Working Group 36-05 , Electra , No.77.1989.

This paper describes the Possible source of harmonic distortion , the disturbing effects on different type loads and the technique of measuring harmonics that may be found in the vicinity of disturbing loads at different voltage levels.

5. Arrillaga , Bardley and Bodger , " Power system harmonics " , John wiley and sons , 1985 (Book) .

6. H.T. Volkommer , T.L. kirk Patrick, " Survey of harmonic levels on the American electric Power distribution system , " IEEE Trans . on Power systems , 1989.

7. Fuchs, E.F., " Investigations on the Impact of voltage and Current Harmonics on End – Use Devices and Their Protection , " The U.S Department of Energy , contract no. DE-Aco2-80RA 50150 , Jan . 1987.

8. Lowenstein , Michael Z., Holley , Jim, and Zucker , Myron , " Controlling Harmonics While Improving Power Factor , " Electrical Systems Design , March 1988.

9. A.A.C. Arruda & F.L.A.P. Cavalcanti , " Power system harmonic and flicker survey " , Cigre , 36-202,1992.

10. T. Gomez and J. Roman , " Power quality regulation in Argentina : Fliker and harmonics " , IEEE Trans . on Power Delivery , Vol. 13, No. 3 , 1998.

11. A . Robert and J. Marquet , " Assessing voltage quality with relation to harmonics , flicker and unbalance " , Cigre , 36-203,1992.

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۵-۷ گذرا و زمین کردن

1. Martzloff , Fancois D., " Matching Surge Protective Devices to their Environment , " IEEE Transactions on Industrial Applications , Vol. IA –21 , no.1 , Jan/Feb. 1985.
2. Shakarjian , D.R. and Standler , " AC Power Disturbance Detector Circuit, " IEEE Transactions on Power Delivery , Vol. 6:pp. 536-540 , April 1991.
3. Smith , S.B. and Standler , " The Effects of Surges on Electronic Appliances , " IEEE Transactions on Power Delivery , Vol. 7,pp. 1275-1282 , July 1992.
4. Standler , Protection of Electronic Circuits from Overvoltages . New York : Wiley – Interscience , May 1989.
5. Freund , Arthur , " Double the Neutral and Derate the Transformer – Or Else , " EC & M , Dec. 1988.
6. Lazar , Irwin A ., " Designing Reliable Power Systems for Processing Plants , " Electrical Systems Design , July 1989.
7. Lewis , Warren , " Application of the national Electrical Code to the Installation of Sensitive Electronic Equipment , " IEEE Transactions on Industrial Applications , Vol IA –22 , May / June 1986.
8. McLoughlin , Robert C., " Power Line Impedance and Its Effect on Power Quality , " EMC Technology & Interference Control News , Vol.7, No.6, Sept . 1988.
9. Standler , Ronald B., " Transients on the Mains in a Residential Environment , " IEEE Transaction on Electromagnetic Compaatibility , Vol. 31 , No. 2 , May 1989.
10. " Secondary surges in distribution transforms " IEEE Trans . on Power Delivery , Vol. 7, No.2 1992.

The Task Force was formed in response to a proposal that a secondary , or low-side , current surge withstand design test be included in the IEEE test standards . It was charged with reviewing all information on low-side surges and determining if revisions of dielectric tests of distribution transformers are indedd warranted . Although agreement on a standard test has not been reached, substantial work has been done and is summarized in this report.

The report describes the problem of failures of distribution transformers due to low-side surge phenomena and how it is being addressed by the industry . The problem is describe in historical perspective along with the varied viewpoints of the Task Force members. The stystem and transformer parameters that influence the problem are discussed. Proposed solutions and their tradeoffs are presented. A reference list of published literature is provided.

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