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Nota di contenuto	POWER SYSTEM HARMONICS; Contents; Preface; 1 Subject Definition and Objectives; 1.1 Introduction; 1.2 The Mechanism of Harmonic Generation; 1.3 Definitions and Standards; 1.3.1 Factors Influencing the Development of Standards; 1.3.2 Existing Harmonic Standards; 1.3.3 General Harmonic Indices; 1.4 Relevance of the Topic; 1.5 References; 2 Harmonic Analysis; 2.1 Introduction; 2.2 Fourier Series and Coefficients; 2.3 Simplifications Resulting from Waveform Symmetry; 2.4 Complex Form of the Fourier Series; 2.5 Convolution of Harmonic Phasors; 2.6 The Fourier Transform; 2.7 Sampled Time Functions 2.8 Discrete Fourier Transform (DFT)2.9 The Nyquist Frequency and Aliasing; 2.10 Fast Fourier Transform (FFT); 2.11 Window Functions; 2.11.1 The Picket Fence; 2.11.2 Spectral Leakage Reduction; 2.11.3

Choice of Window Function; 2.11.4 Main-Lobe Width Reduction; 2.11.5 Application to Inter-Harmonic Analysis; 2.12 Efficiency of FFT Algorithms; 2.12.1 The Radix-2 FFT; 2.12.2 Mixed-Radix FFT; 2.12.3 Real-Valued FFTs; 2.12.4 Partial FFTs; 2.13 Alternative Transforms; 2.13.1 The Wavelet Transform; 2.13.2 Automation of Disturbance Recognition; 2.14 Discussion; 2.15 References; 3 Harmonic Sources 3.1 Introduction 3.2 Transformer Magnetisation Nonlinearities; 3.2.1 Normal Excitation Characteristics; 3.2.2 Determination of the Current Waveshape; 3.2.3 Symmetrical Overexcitation; 3.2.4 Inrush Current Harmonics; 3.2.5 D.C. Magnetisation; 3.3 Rotating Machine Harmonics; 3.3.1 M.m.f. Distribution of A.C. Windings; 3.3.2 Three-Phase Winding; 3.3.3 Slot Harmonics; 3.3.4 Voltage Harmonics Produced by Synchronous Machines; 3.3.5 Rotor Saliency Effects; 3.3.6 Voltage Harmonics Produced by Induction Motors; 3.4 Distortion Caused by Arcing Devices; 3.4.1 Electric Arc Furnaces 3.4.2 Discharge-Type Lighting 3.5 Single-Phase Rectification; 3.5.1 D. C. Power Supplies; 3.5.2 Line-Commutated Railway Rectifiers; 3.6 Three-Phase Current-Source Conversion; 3.6.1 Basic (Six-Pulse) Configuration; 3.6.2 Effect of Transformer Connection; 3.6.3 Twelve-Pulse Related Harmonics; 3.6.4 Higher-Pulse Configurations; 3.6.5 Effect of Transformer and System Impedance; 3.6.6 Direct Voltage Harmonics; 3.6.7 Imperfect D.C. Voltage Smoothing; 3.6.8 Half-Controlled Rectification; 3.6.9 Uncharacteristic Harmonic and Inter-Harmonic Generation 3.6.10 Frequency Cross-Modulation in Line-Commutated Converter Systems 3.7 Three-Phase Voltage-Source Conversion; 3.7.1 Multi-Level VSC Configurations; 3.8 Inverter-Fed A.C. Drives; 3.9 Thyristor-Controlled Reactors; 3.9.1 The Static VAR Compensator (SVC); 3.9.2 Thyristor-Controlled Series Compensation (TCSC); 3.10 Modulated Phase Control; 3.10.1 The Switching Function Approach; 3.10.2 Derivation of Input Current Harmonics; 3.11 A.C. Regulators; 3.11.1 Single-Phase Full-Wave Controller; 3.11.2 Integral Cycle Control; 3.12 Discussion; 3.13 References; 4 Effects of Harmonic Distortion 4.1 Introduction

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## Sommario/riassunto

Harmonic distortion problems include equipment overheating, motor failures, capacitor failure and inaccurate power metering. The topic of power system harmonics was covered for the first time 20 years ago and the first edition has become a standard reference work in this area. Unprecedented developments in power electronic devices and their integration at all levels in the power system require a new look at the causes and effects of these problems, and the state of hardware and software available for harmonic assessment. Following the successful first edition, this second edition of Power

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