# Nigerian Electricity Health and Safety Standards Manual

Nigerian Electricity Regulatory Commission (NERC)
Adamawa Plaza,
Plot 1099 First Avenue,
Central Business District
P.M.B 136 Garki,
Abuja, Nigeria

**Issue Date: Version 1: March 2008**

"This publication has been prepared by Princeton Energy Resources International, Inc. on behalf of the Nigerian Electricity Regulatory Commission under a Grant provided by the United States Trade & Development Agency.



Version 1

Printing No. 1"

## PREFACE

The Health and Safety Standards embodied in this document have been developed as a part of a Technical Assistance (TA) project to the Government of Nigeria. The Technical Assistance for the Nigerian Electricity Regulatory Commission Health and Safety Standards Project is a program to the Government of Nigeria (GON) aimed at developing industry-specific health and safety (H&S) standards. The project was funded as a grant (Grant Number GH061136289) by the United States Trade and Development Agency (USTDA) and implemented by Princeton Energy Resources International (PERI), LLC, a U.S. based corporation.

The Nigerian Electricity Health and Safety standards created under the assistance program represents a technical reference document with both general and industry-specific examples and guidelines of International Industry Best Practice (IIBP). The industry guidelines are designed to be used to address common safety issues specific to the industry sector; however many sections are potentially applicable to other industry sectors.

The power sector in Nigeria is a critical infrastructure needed for the economic, industrial, technological and social development of the Country The World Bank and others have long recognized that electricity consumption is one of the indices for measuring the standard of living of any country. The standards contained herein represent the first major updating of industry-specific safety rules and best practices since the 1980s for the power sector in Nigeria.

At the time of preparation of the standards, the national electricity grid consisted of Fifteen generating stations (4 hydro and 11 thermal) with a total installed generating capacity of 7,994MW. Although the installed capacity of the existing power stations is presently 7,994MW, the maximum load ever recorded was 3,774.4MW in August 2005. Presently, many of the generating units have broken down due to limited available resources to carry out maintenance. The transmission lines are radial and overloaded. The switchgears are obsolete while power transformers have not been maintained. The distribution sub-sector is in need of upgrading as many of its distribution transformers are overloaded. Overall transmission and distribution losses are in the range of 30–40%. The electricity network has been characterized by system collapses as a result of low generating capacity by the few generating stations presently in service.

For a country of more than 150 million people, the generation capacity is inadequate to meet the consumers' electricity demand. The current projected capacity that needs to be into the system is estimated at 10,000 MW. It is expected that these would come in through Independent Power Producers (IPPs) as a liberalized Electricity Supply Industry evolves in Nigeria. As the infrastructure expands to meet the needs of Nigeria as a nation, the standards will need to grow and expand. Therefore, the standards themselves should be considered a living document that will be modified, expanded upon and in some instances contracted to meet technological changes in the workforce.

Limited accident statistics specific to this sector have only recently been gathered by the Nigerian Electricity Regulatory Commission (NERC); however they reflect monthly fatalities from electrocution in both the public sector and among the sector workforce. These incidents are a direct result of the lack of International Industry Best Practices (IIBP) which technologically advanced nations have had in place and continually improve on.

The backbone of the industry is the labor force. The industry sector employs approximately 34,000 people. The country itself has a population of more than 150 million, with about 40% of the population serviced by electricity. The need to protect workers and the general public from the hazards resulting from power generation, transmission, distribution and supply is simply a matter of protecting human life.

Workplaces include all places of work; all non-electrical workers and members of the public in public places. Major causes of fatalities in workplaces include plug in appliances and flexible cords and fixed wiring, and maintenance related activities that are specific to the industry sector. Contact with power lines is a significant causative factor of electrical deaths across several of the electrical safety priorities such as workplaces and public places, but it is not the only one.

Workplaces even within the industry sector represent a very diverse group of locations, with very different levels of electrical risk. Prioritization of high risk areas needs to be determined based on data, but is likely to include:

- the rural sector;
- the construction sector; and
- workplaces where water is significantly involved.

The standards focus on all electrical and non-electrical workers engaged to perform work by electricity entities, involved in the generation, transmission or distribution of power in Nigeria. A review of numerous industry reported studies from the sector support that fatalities occurred which could have been prevented by the use of recognized electricity industry safe systems of work. Many more people have been electrocuted when they contacted electricity industry infrastructure such as power lines.

**NOTICE**

These Standards are designed to save lives. The Nigerian Electric Regulatory Commission has stated its intent to enforce the standards. This means that the practices defined in this publication are legal obligations. Each employer has a legal obligation to ensure that a safe work environment is provided to all employees, both regular and non-regular. Contractors working at substations, transmission stations, power plants or engaging in any work activities involving power generation, transmission, distribution and servicing are also required to follow the best practices and safety standards defined in this publication.

**ACKNOWLEDGEMENTS**

A large number of organizations and individuals have contributed time and information that went into the creation of the standards. The following organizations are expressly thanked for their contribution of materials, reviews, critiques and guidance:

The U.S. Trade and Development Agency
The World Bank Organization
The U.S. Department of Energy
The U.S. Department of Defense
The U.S. Department of Homeland Security
The World Health Organization
The U.S. Occupational Safety and Health Organization
The National Institute of Occupational Safety and Health
The American Conference of Governmental Industrial Hygienists
Gulf Publishing Co.
Marcel Dekker Publishers
SciTech Technical Services
The Nigerian Electricity Regulatory Commission
Tennessee Valley Authority
The U.S. Department of Agriculture, Rural Utilities Service
U. S. Embassy in Nigeria
Power Holding Company of Nigeria (PHCN)
Transmission Company of Nigeria (TCN)

**ABBREVIATIONS**

**AC:** Alternating Current (electricity; physics)
**ACGIH:** American Conference of Governmental Industrial Hygienists
**AED:** Automated Eternal Defibrillator
**AFFF:** Aqueous Film Forming Foam
**AFS:** American Foundry Society
**AIHI:** American Industrial Hygiene Association
**ANSI:** American National Standards Institute
**ASTDR:** Agency for Toxic Substances and Disease Registry
**ASTM:** American Society for Testing and Materials
**ATB:** Anti-Two-Block
**AU:** Absorption Units
**C:** Celsius
**CaF**: Calcium Fluoride
**CDC:** Center for Disease Control
**CERCLA:** Comprehensive Environmental Response Compensation and Liability Act
**CGA:** Compressed Gas Association
**CGI:** Combustible Gas Indicators
**CISD:** Critical Incident Stress Debriefing
**Cm:** Centimeters
**CNC:** Condensation Nucleus Counter
**CO:** Carbon monoxide
**$CO_2$:** Carbon Dioxide
**CPR:** Cardiopulmonary Resuscitation
**CSA:** Construction Safety Association
**CSHO:** Compliance Safety and Health Officer
**dB:** Decibels
**DC:** Direct Current (electricity)
**DUTs**: Devices Under Test
**EAR:** Expired Air Resuscitation
**EHSS:** Environmental Health and Safety Services
**EHV:** Extremely High Voltage
**EMS:** Emergency Medical Services
**EPA:** Environmental Protection Agency
**EPS:** Electric Power Systems
**ESCBA:** Escape Self-Contained Breathing Apparatus
**ESLI:** End of Service Life Indicator
**FID:** Flame Ionization Detector
**FMIS:** Facilities Management Information System
**GFCI:** Ground Fault Circuit Interrupter
**GHz:** Gigahertz (thousands of MHz)
**GM:** Geiger-Muller
**H2S:** Hydrogen Sulfide
**HASPs:** Health and Safety Plans
**HAZWOPEP:** Hazardous Waste Operations and Emergency Response

**HEPA:** High Efficiency Particulate Air
**Hg:** Mercury
**HR:** Human Resource
**HRT:** Health Response Team
**HSC:** Health and Safety Coordinator
**HSO:** Health and Safety Officer
**HV:** High Voltage
**Hz:** Hertz
**IDLH:** Immediately Dangerous to Life and Health
**Kg:** Kilograms
**kHz:** Kilohertz (1000 Hertz)
**kPa:** Kilo Pascal
**LEL:** Lower Explosive Limit
**LFL:** Lower Flammable Limit
**LiF:** Lithium Fluoride
**LMI:** Load moment Indicators
**m:** Meters
**MeV:** Mega Electron Volt
**MHz:** Megahertz (million Hertz)
**mR/hr:** Milliroentgen Per Hour
**MRLS:** Minimal Risk Levels
**MSDS:** Material Safety Data Sheets
**MUC:** Maximum Use Concentration
**MW:** Molecular Weight
**NEPA:** National Fire Protection Agency
**NERC:** North American Electric Liability Corporation
**NHCA:** National Hearing Conservation Association
**NIOSH:** National Institute of Occupational Safety and Health
**NO:** Nitric oxide
**NRR:** Noise Reduction Rating
**NRTL:** Nationally Recognized Testing Laboratories
**NTOF:** National Traumatic Occupational Facilities
**$O_3$:** Ozone
**OH&S:** Occupational Health and Safety
**OSHA:** Office of Safety and Health Administration
**Pa:** Pascal
**PAPR:** Powered Air Purifying Respirator
**PEL:** Permissible Exposure Limits
**PID:** Photo Ionization Detectors
**PM:** Particulate Matter
**PPE:** Personal Protective Equipment
**ppm:** Parts Per Million
**PVC:** polyvinyl chloride
**QLFT:** Qualitative Fit Test
**QNFT:** Quantitative Fit Test
**RCRA:** Resource Conservation and Recovery Acts

**REL:** Recommended Exposure Limits
**RF:** Radiated Frequency
**RFC:** Reference Concentration
**RFD:** Reference Dose
**R/hr:** Roentgens per Hour
**RH:** Relative Humidity
**SA:** Spectrum Analyzer
**SAR:** Supplied Air Respirator
**SARA:** Superfund Amendments and Reauthorization Act
**SCBA:** Self-Contained Breathing Apparatus
**SHELS:** Significant Human Exposure Levels
**SLTC:** Salt Lake Technical Center
**$SO_2$:** Sulfur dioxide
**SPL:** Sound Pressure Level
**STEL:** Short-term Exposure Limits
**SVOCs:** Semi-Volatile Organic Compounds
**TD:** Thermal Desorption
**TICs:** Toxicity Identified Compounds
**TLD:** Thermoluminescent dosimeters
**TLV:** Threshold Limit Value
**TWA:** Time Weighted Average
**UEL:** Upper Explosive Limits
**U.K.:** United Kingdom
**U.S.:** United States
**UV:** Ultraviolet
**VOCs:** Volatile Organic Compound
**VOM:** Colt-Ohm-Milliameter
**VSA:** Vector Signal Analyzer
**WHO:** World Health Organization

## DOCUMENT RETENTION POLICY AND PROCEDURE TO MAINTAINING UP-TO-DATE STANDARDS

As stated in the Preface, the changing landscape of technologies and IPPs planned for Nigeria require the standards to be flexible to meet future safety challenges. As such, the publication should be viewed as a living document that will require periodic review and updates.
NERC will form a committee to review the standards every three years and make a formal recommendation as to whether Parts, Sections, or individual Paragraphs require revisions. They will then form an appropriate task force to make the revisions and to update the publication. If no changes are recommended, NERC will publish a statement to that effect on its web site. If changes are to be made, NERC will submit drafts of the standards for review and comment by the industry with a reasonable response time.

Each page of the publication states the Version and date of Issuance in the Header. In this first printing, the reader will see **Version 1: March 2008**. Subsequent revisions will state **Revision 1: Date; Revision 2: Date**; and so forth. Owners of the publication may replace those pages with subsequent revisions.

NERC will retain one or more copies of the each Version and Revision on permanent file in order to preserve the evolution of the standards.

## FOREWORD AND ORGANIZATION OF THE STANDARDS

The standards represent legal obligations. Not all of the standards are applicable or enforceable at every facility. Each facility must make an assessment as to which of the standards are applicable. This can be made by performing a job classification and hazards assessment and by consulting with NERC.

The standards are organized into five Parts:

Part I. How to Evaluate Safety Programs;
Part II. Safety and Best Industry Practices;
Part III. Worker Safety Rules;
Part IV. Recordkeeping, Training, Inspections, Accident Investigation and Reporting;
Part V. Risk and Vulnerability Assessments

Each Part contains sections and subsections. For related topics, cross-referencing between Parts and individual Sections are provided. Users are likely to refer to Part II most extensively. These contain technical safety work standards.

## TABLE OF CONTENTS

**PART III. WORKER SAFETY RULES**

**PART IV. RECORDKEEPING, TRAINING, INSPECTIONS, ACCIDENT INVESTIGATION AND REPORTING**



**PART V. RISK AND VULNERABILITY ASSESSMENTS**