Guidelines on earthing/grounding/bonding in the oil and gas industry



GUIDELINES ON EARTHING/GROUNDING/BONDING IN THE OIL AND GAS INDUSTRY

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Project coordination was undertaken by Toni Needham (EI).

FOREWORD

Earthing/grounding and bonding are of major importance for the safety of personnel and the protection of material assets in the energy industry, wherever electrical energy is present. This applies not only where electricity is generated, distributed, stored or used, but also includes the natural phenomena of lightning and static electricity. It is a subject that is often misunderstood and considered to have 'grey areas'.

As a 'safety critical' feature of installations in the energy industry, onshore and offshore, the effectiveness of earthing/grounding and bonding is a prime factor in the protection of personnel against electric shock, fire and burns due to the presence of electricity and the prevention of ignitive sparks in hazardous areas associated with potentially explosive atmospheres. This ranges from protection against static electricity to minimising the possible effects of lightning strikes.

Within the industry there are many discrete activities or locations having specific earthing/grounding and/or bonding requirements relating to them. It can happen that earthing/grounding or bonding provided to satisfy one set of requirements may be incompatible with requirements satisfying other purposes, creating an unforeseen potential hazard. The provision of a connection allowing undesirable current to pass to earth/ground from an installation also provides a route for undesirable current from elsewhere to pass into the installation, with possibly serious consequences.

The EI has an extensive portfolio of codes of practice and other guidance publications for a range of topics, many of which include provisions for earthing/grounding and bonding relevant to the topics concerned. This guidance publication brings together, from that portfolio, the essential requirements relating to earthing/grounding and bonding for installations in hazardous areas in the oil and gas industry. Whilst providing an overview to show a 'bigger picture', this publication does not replicate all the detailed requirements contained in individual publications in the portfolio, which should, in any event, otherwise be referred to. Within this guidance publication the terms 'earth' and 'ground' mean the same thing, as do 'earthing' and 'grounding'.

This publication embodies relevant recommendations in the EN 60079 series; BS 7671 Requirements for electrical installations – IEE Wiring Regulations; relevant aspects of the UK statutory Electricity at Work Regulations and the Electrical Safety, Quality and Continuity Regulations; and gives cognizance to the relevant aspects of the recommendations from IEEE 80 Guide for Safety in AC Substation Grounding.

The contents of this publication are provided for information only and while every reasonable care has been taken to ensure the accuracy of its contents, the El cannot accept any responsibility for any action taken, or not taken, on the basis of this information. The El shall not be liable to any person for any loss or damage which may arise from use of the information contained in any of its publications.

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Suggested revisions are invited and should be submitted to the Technical Department, Energy Institute, 61 New Cavendish Street, London W1G 7AR.

1 INTRODUCTION, SCOPE AND APPLICATION

1.1 INTRODUCTION

This code is aimed at providing an overview of electrical 'earthing', 'grounding' and 'bonding' to address the following phenomena:

- electrical power system earth/ground faults;
- touch and step voltage hazards;
- lightning electrical and ignition hazards;
- ignition hazards associated with Ex apparatus;
- ignition hazards associated with the interruption of currents;
- ignition hazards associated with electrostatic discharges, and
- disturbance of signal transmission.

Earthing/grounding/bonding practices consist of interconnecting certain conductive parts of a system by engineered electrically conductive paths, primarily for the following personnel safety and asset protection purposes:

- To provide a path for power system fault currents to flow back to the source of supply, and to mitigate arc flash hazards.
- The elimination of electric shock hazards (touch and step voltages).
- To provide a path to dissipate lightning currents into the general mass of the Earth.
- The elimination of ignition hazards, whether related to Ex certified apparatus or the prevention of the interruption of stray currents.
- The dissipation of electrostatic charges that could cause potentially incendive sparking.
- To ensure the integrity of signal return paths, and to minimise electrical interference with such signals.

Earthing/grounding/bonding systems are important for electrical safety, lightning safety, and the control of sources of potential ignition. They contribute to the operability of process control systems and to the integrity of active safety functions; hence these systems make a vital contribution to continuity of operation and to ongoing asset integrity.

Note: A protective function, and the system that implements that function, may be regarded as 'safety critical' if a purpose of that function/system is to reduce the likelihood, or the consequences, of an accidental event which may result in major injuries to personnel; earthing/grounding/bonding systems will often meet that definition of safety criticality, and indeed may be subject to specific regulatory requirements (further information is given in the El *Guidelines for the management of safety critical elements*). However, earthing/grounding/bonding systems that are designed, maintained, tested and operated in accordance with this document and the underlying standards should normally meet both personnel safety and commercial objectives.

The overall structure of this document includes discussions of

- the underlying processes;
- the functional requirements and performance standards of earthing/grounding/ bonding systems;
- some specific applications, and
- detailed design and construction issues.

1.2 SCOPE

This publication covers earthing, grounding and bonding practices in the upstream and downstream oil and gas industry, most notably in hazardous areas, but including adjacent areas classified as non-hazardous. The petroleum industry is distinctive because of the flammable nature of the product; this requires the control of sources of potential ignition of flammable product, e.g. the prevention of the interruption of stray currents that could result in an incendive spark. This publication does not cover earthing/grounding/bonding practices in other industrial sectors. References to current international, British and El standards and guidance are provided.

1.3 APPLICATION

This publication is intended for global application to oil and gas facilities such as upstream production installations, storage facilities, terminals, refineries, filling stations and product transfer, but not downstream gas facilities. It covers the design, operation, inspection, test and maintenance of both new and existing facilities, portable/temporary equipment, and to operational interactions with bulk fuel tankers and aircraft refuellers (but no other aspect of tankers or aircraft). This publication creates no general requirement to upgrade a legacy installation designed to obsolete standards, providing that it remains safe, operable and in compliance with legal requirements. However, if a significant modification is required, it should meet current standards where possible.

Note: The legal requirements described in this publication are specific to Britain, and any reference to regulations in this publication refers only to British legislation; other jurisdictions may have different requirements. Metric units are used throughout.