



BSI Standards Publication

**Photovoltaic (PV) modules through the life cycle
– Environmental health and safety (EH&S) risk
assessment – General principles and nomenclature**

National foreword

This Published Document is the UK implementation of IEC TS 62994:2019.

The UK participation in its preparation was entrusted to Technical Committee GEL/82, Photovoltaic Energy Systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2019
Published by BSI Standards Limited 2019

ISBN 978 0 580 97358 1

ICS 27.160

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 28 February 2019.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------



IEC TS 62994

Edition 1.0 2019-01

TECHNICAL SPECIFICATION



Photovoltaic (PV) modules through the life cycle – Environmental health and safety (EH&S) risk assessment – General principles and nomenclature

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 27.160

ISBN 978-2-8322-6419-5

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD..... 3

INTRODUCTION..... 5

1 Scope..... 6

2 Normative references 7

3 Terms and definitions 8

4 Basic principles of EH&S risk assessment for the PV module 9

 4.1 Basic concepts..... 9

 4.2 Life cycle assessment (LCA) of PV 10

 4.2.1 Fundamentals..... 10

 4.2.2 Photovoltaics-specific aspects 11

 4.2.3 Life cycle inventory modelling aspects 12

 4.2.4 Life cycle impact assessment (LCIA) 16

 4.2.5 Interpretation..... 18

 4.2.6 Reporting and communication..... 19

 4.3 Environmental and Health Risk Assessment (EHRA) of PV module 20

 4.3.1 Principle 20

 4.3.2 Process 21

 4.3.3 Risk assessment and risk management 24

 4.3.4 Risk assessment of PV related equipment 24

 4.4 EH&S management system..... 25

 4.4.1 General 25

 4.4.2 EH&S Policy 26

 4.4.3 Planning 26

 4.4.4 Implementation and operation 27

 4.4.5 Checking 27

 4.4.6 Management review..... 27

 4.4.7 End of life management..... 28

Annex A (informative) Sources for LCA and EHRA for PV 29

 A.1 Sources for LCA of PV 29

 A.2 Sources for EHRA for PV 29

Bibliography..... 30

Figure 1 – Product system of electricity produced with photovoltaic modules 7

Figure 2 – Contribution of risk assessment to the risk management process 24

Figure 3 – Environmental management system model..... 25

Table 1 – Impact categories and indicators 16

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PHOTOVOLTAIC (PV) MODULES THROUGH THE LIFE CYCLE – ENVIRONMENTAL HEALTH AND SAFETY (EH&S) RISK ASSESSMENT –

General principles and nomenclature

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, accept IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62994, which is a technical specification, has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
82/1370/DTS	82/1504/RVDTS

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This Technical Specification establishes definitions of terms of environmental health and safety (EH&S) risk assessment and also basic principles and general methods for the EH&S risk assessment for the PV module through its life cycle.

EH&S risk assessment is a method to characterize and evaluate potential adverse impacts to human health or environment in order to develop policies to control and reduce them. Although PV technologies have environmental advantages over conventional energy technologies, PV modules can contain some hazardous materials. Therefore, EH&S risk assessment of PV modules is very important for the safe and sustainable manufacture, use, and end-of-life treatment of PV modules.

Though there are many standards relating to EH&S and risk assessment, there is no published IEC standard for the EH&S risk assessment of the PV module at present.

This technical specification was developed in cooperation with IEA PVPS task 12 (PV Environmental, Health and Safety Activities). The objectives of the task are to 'quantify the environmental profile of PV in comparison to other energy technologies and to define and address EH&S and sustainability issues that are important for PV market growth'. IEA PVPS task 12 and IEC TS 62994 Project team had joint meetings and established a liaison officer to work on this technical specification on the EH&S for the PV.

PHOTOVOLTAIC (PV) MODULES THROUGH THE LIFE CYCLE – ENVIRONMENTAL HEALTH AND SAFETY (EH&S) RISK ASSESSMENT –

General principles and nomenclature

1 Scope

This document specifies definitions of terms and introduces evaluation methods for EH&S risk assessment for the PV module over the product life cycle. Environmental health and safety (EH&S) risk assessment is a method to characterize and evaluate potential adverse impacts to human health or environment and make it possible to take measures to reduce them. EH&S risk assessment of PV modules is very important for the safe and sustainable manufacture, use, and end of life treatment of PV modules. The definition of terms can be applied to the EH&S risk assessment through the life cycle of PV modules. Generally, evaluation methods for the EH&S risk assessment can be divided in two cases:

- ordinary foreseen routine operation, in which life cycle assessment method is applied;
- abnormal non-routine operation, in which risk assessment method is applied.

The scope of the two general cases is described below.

When assessing the environmental impacts of routine operation of PV electricity production with life cycle assessment, the product system includes the manufacturing phase, the use phase and the end of life phase (see Figure 1). Electronic installation, mounting structure and power conversion equipment (such as inverters) are included as part of the PV system to be analysed.

When assessing the risk of non-routine operation of PV modules, the system analysed is limited to the PV module, its supply chain, operation and end of life treatment, and its direct electrical and mechanical interfaces with the balance of system, i.e. the electric installation, mounting structure and inverters.