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Solid recovered fuels — Safe handling and storage of solid recovered fuels

Combustibles solides de récupération — Manutention et stockage en toute sécurité des combustibles solides de récupération

ISO/CEN PARALLEL PROCESSING

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 300, *Solid recovered fuels*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Modern society is based on production and consumption of an enormous variety of products, both for industrial and private use. After its intended use, the product will be disposed as waste by the user and will then enter the chain of waste management which includes a variety of handling, storage and processing/recycling methods.

With production, handling, transportation and storage of SRF (Solid Recovered Fuels) there is always a significant risk of fire and dust explosion. A fire or an explosion provides risks both for human health and the environment and cause large economical losses. It is therefore important that operators throughout the supply chain ensure that there is a developed strategy to prevent fires and to prevent dust explosions, and if a fire should occur, a readiness to handle the fire effectively to reduce the consequences.

Fires will, in addition to economic losses and effects on health and the environment, also have a negative impact on the confidence in the SRF industry and difficulty to obtain insurance coverage might also increase.

In facilities where dry combustible materials are handled such as in SRF facilities, there are several risks present for fires and dust explosions. A typical cause for an ignition of the material is friction heat or impact ignition sources generated within the processing chain. Such ignition sources can be generated due to mechanical wear or break-down, metal pieces and stones, material overfeeding, etc. Most mechanical machines contain moving parts that potentially could generate friction heat high enough to ignite the material. Examples are shredders, conveyors, screening/separation machinery and fans. Other sources causing ignitions are for example hot surfaces, electrical discharges, hot works and self-ignition inside storages.

An ignition source can ignite the material being processed or dust accumulations inside and around the machinery. It is important to take necessary measures for reducing the risk for ignitions. Accumulations of combustible dust are intended to be avoided. However, dust can quickly accumulate to a stage where it can become a significant fire load.

This document provides support, advice and guidance to facility owners, logistics providers, equipment suppliers/manufacturers, consultants, authorities and insurance providers to assess and mitigate different risks when producing, handling and storing SRF.

Solid recovered fuels — Safe handling and storage of solid recovered fuels

1 Scope

This document provides principles and requirements for safe handling, treatment and storage of solid recovered fuels (SRF), prepared from non-hazardous waste, to be used for energy purposes. This document covers process stages from point of acceptance of material to point of delivery of SRF.

This document excludes fuels that are included in the scope of ISO/TC 238 *Solid biofuels* and ISO/TC 28 *Petroleum products and related products of synthetic or biological origin*.

It uses a risk-based approach to determine what safety measures are to be considered.

Although unloading and loading of e.g. vessels, trains or trucks are included, the safety issues following the loading and transport itself are not.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 21637:2020, *Solid recovered fuels — Terminology, definitions and descriptions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21637:2020 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1 Parts of the SRF process

3.1.1
baling
process of producing a compressed material bundle or package secured by wires, hoops, cords or similar

3.1.2
belt conveyor
conveyor with an endless belt acting as a carrying and traction element

Note 1 to entry: There are several belt conveyor types, such as; troughed belt conveyor, deep troughed belt conveyor, pipe belt conveyor, walled belt conveyor, flat belt conveyor and radial conveyor.

3.1.3
belt feeder
shortened form of *belt conveyor* (3.1.2), normally running at slow speed, designed to extract or control the rate of flow of bulk materials from hoppers

[SOURCE: EN 620:2002+A1:2010, 3.2.4]

3.1.4
box
storage with two or three walls

3.1.5
bucket elevator
elevator for loose bulk materials with buckets as the carrying medium attached to a belt or chains as the driving medium

Note 1 to entry: The bucket elevator consists of a strap forming belt, stretched vertically between a driving head pulley and a pulley of foot. Buckets are attached to the strap and the whole is enclosed in a metal frame.

Note 2 to entry: The foot of the elevator is equipped with a chute in which the buckets are filled by shovelling and a head shape suitable for evacuating grain by projection centrifugal.

[SOURCE: EN 618:2002+A1:2010, 3.1.3 – modified: notes to entry were added]

3.1.6
bunker
storage which is closed on four sides and reachable from the top

3.1.7
chain conveyor
conveyor for loose bulk materials with a chain as the driving medium having attached flights or scraper flights moving the material "en masse" in an enclosing trough

3.1.8
chain reclaimer
machine for loose bulk materials with a chain as driving medium having attached flights or scraper flights moving the material in an open drop-in pit of drive over pit

3.1.9
conveyor system
number of linked conveyors with their ancillary equipment and control system

[SOURCE: EN 620:2002+A1:2010, 3.1 – modified: "control system" was added]

3.1.10
crushing
mechanical reduction of *particle size* (3.3.4) by exerting mainly blunt deforming forces to a material

[SOURCE: ISO 21637:2020, 3.15]

3.1.11
density separation
separation of mixed materials by using density differences of the different fractions for classification

Note 1 to entry: With respect to SRF-production, most common application of density separation is wind shifting applying airflow as conveying/transport medium. A process of separation by different densities of particles and fluids.

3.1.12
dust collection system
system that collects free dust from the air in process systems

3.1.13
electromagnetic separation of non-ferrous metals
separation of non-ferrous metals by inducing temporary magnetic forces

Note 1 to entry: This term is also known as eddy current separators.

[SOURCE: ISO 21637:2020, 3.26]

3.1.14
enclosed conveyor
conveyor which is enclosed to avoid contamination between the interior and the exterior environment

3.1.15
enclosed storage
storage that is enclosed to avoid contamination between the interior and the exterior environment

3.1.16
feeder
mechanical device for delivering material at a controlled rate

[SOURCE: ISO 1213-1:1993, 10.1.02]

3.1.17
ferrous metal separation
separation of ferrous metals by use of permanent magnetic forces

3.1.18
fine shredding
shredding (3.1.28) of materials to an average particle size of 20 mm - 50 mm

3.1.19
idler
mechanical element rotating on internal bearing and fitted to support the belt

Note 1 to entry: On *belt conveyors* (3.1.2), several idlers can be used. These are called e.g. troughing idler (which supports the belt and maintains it in a troughed form), carrying idler, return idler.

3.1.20
main shredding
mechanical reduction of particle size of material via *shredding* (3.1.28) it to average *particle size* (3.3.4) of 50 mm - 100 mm

3.1.21
manual separation
separation of material particles individually by hand or mechanical solution

3.1.22
optical recognition
recognition of material particles individually by optical sensors

[SOURCE: ISO 21637:2020, 3.50]

3.1.23
pneumatic conveying
method of transporting bulk materials by means of air through pipes or ducts

3.1.24
pre-shredding
mechanically reducing particle size of material by *shredding* (3.1.28) it to average *particle size* (3.3.4) of 100 mm – 300 mm

3.1.25
screening
separation of larger particles from material flow, typically >150 mm

3.1.26
screw conveyor
conveyor for loose bulk materials with a trough or tube as the carrying medium, the material being moved by the action of a rotating screw

3.1.27
screw reclaimer
mobile equipment located bellow a stockpile for continuously reclaiming bulk materials using a screw as the carrying or conveying medium

[SOURCE: EN 618:2002+A1:2010, 3.3.8]

3.1.28
shredding
mechanical reduction of *particle size* (3.3.4) by tearing, cutting or other means

[SOURCE: ISO 21637:2020, 3.33]

3.1.29
silo
part of a continuous handling system used to contain intended kind(s) of bulk material(s) during a certain period of time

Note 1 to entry: The silo is usually charged from the top and discharged from one or more outlets at the bottom or side.

[SOURCE: EN 617:2001+A1:2010, 3.1 – modified: part of definition was added as a note to entry]

3.1.30
step feeder
feeder which uses friction to transfer material

Note 1 to entry: Walking floor is an example of a step feeder.

3.1.31
under-screen fraction
material fraction that goes through a screen

[SOURCE: ISO 21637:2020, 3.87]

3.2 Risk management

3.2.1
residual risk
risk (3.2.2) remaining after risk reduction measures have been implemented

[SOURCE: ISO/IEC Guide 51:2014, 3.8]

3.2.2
risk
combination of the probability of occurrence of harm and the severity of that harm

Note 1 to entry: The probability of occurrence includes the exposure to a hazardous situation, the occurrence of a hazardous event and the possibility to avoid or limit the harm.

[SOURCE: ISO/IEC Guide 51:2014, 3.9]

3.2.3
risk analysis
systematic use of available information to identify hazards and to estimate the *risk* (3.2.2)

[SOURCE: ISO/IEC Guide 51:2014, 3.10]

3.2.4
risk assessment
overall process comprising a *risk analysis* (3.2.3) and a *risk evaluation* (3.2.8)

[SOURCE: ISO/IEC Guide 51:2014, 3.11]

3.2.5
risk control
process of decision-making for managing and/or reducing *risk* (3.2.2); its implementation, enforcement and re-evaluation from time to time, using the results of risk assessment as one input

3.2.6
risk criteria
terms of reference against which the significance of a *risk* (3.2.2) is evaluated

Note 1 to entry: Risk criteria are based on organizational objectives, and external and internal context.

Note 2 to entry: Risk criteria can be derived from standards, laws, policies and other requirements.

[SOURCE: ISO/IEC Guide 73:2009, 3.3.1.3]

3.2.7
risk estimation
process of assigning values to the probability of occurrence of events and their consequences

[SOURCE: ISO 13824:2020, 3.15]

3.2.8
risk evaluation
procedure based on the *risk analysis* (3.2.3) to determine whether *tolerable risk* (3.2.11) has been exceeded

[SOURCE: ISO/IEC Guide 51:2014, 3.12]

3.2.9
risk management
coordinated activities to direct and control an organization with regard to *risk* (3.2.2)

[SOURCE: ISO/IEC Guide 73:2009, 2.1]

3.2.10
risk reduction measure
protective measure
action or means to eliminate hazards or reduce risks

[SOURCE: ISO/IEC Guide 51:2014, 3.13 – modified: example has been removed]

3.2.11
tolerable risk
level of *risk* (3.2.2) that is accepted in a given context based on the current values of society

Note 1 to entry: For the purposes of this document, the terms "acceptable risk" and "tolerable risk" are considered to be synonymous.

[SOURCE: ISO/IEC Guide 51:2014, 3.15]

3.3 Operation and safety

3.3.1
hot particles
solid particles whose temperature that can be above minimum ignition temperature of flammable gases or vapours and combustible dusts.

3.3.2
intended use
use of a machine in accordance with information for use provided in the instructions

[SOURCE: ISO 12100 :2010, 3.23]

3.3.3
oversize particle
particle exceeding a specific particle size

Note 1 to entry: The definition of oversize particle is dependent on the application and determined between the producer and user.

[SOURCE: ISO 21637:2020: 3.51]

3.3.4
particle size
size of the fuel particles as determined in a solid fuel

Note 1 to entry: Different methods of determination can give different results.

Note 2 to entry: See also *particle size distribution* (3.3.5) and *over size particles* (3.3.3).

3.3.5
particle size distribution
proportions of various *particle sizes* (3.3.4) in a solid fuel

[SOURCE: ISO 21637:2020, 3.53]

3.3.6
personal protective equipment
PPE
equipment that can include, but is not limited to, clothing, gloves, helmets, footwear and face protection

[SOURCE: ISO/TR 21808:2009, 2.1]

3.3.7
reasonably foreseeable misuse
use of a machine in a way not intended by the designer, but which can result from readily predictable human behaviour

[SOURCE: ISO 12100:2010, 3.24]

3.3.8
reduced explosion pressure
resulting overpressure generated by an explosion in an enclosure after effective explosion venting or explosion suppression

4 Introduction to the use of this document

Although risks in connection with the production, handling, transportation and storage of SRF are recognized, factors affecting each risk are different depending on the material type, climate, processing equipment, etc. This document does not intend to focus specifically on the separated risks for individual components, but rather on how the components constitute parts in a system and for example, how hazards can be transferred. Therefore, broad and detailed instructions and recommendations on requirements for design and construction of facility and processes and for operation and maintenance of equipment are given in this document. This document is structured based on different parts in the SRF production and handling process. Stakeholders such as regulators, producers, and consumers of SRF are encouraged to develop regulations or guidelines, considering the local properties and situation as well as this document. Users of this document are responsible for identifying local regulations.

5 Risk management

5.1 General

To improve the safety during production, handling and storage of SRF, both design and operation shall be considered. Safety concerns anyone who is responsible or exposed to the hazards arising from the activities within the premises, here limited to the scope of this document.

For identified hazards the following hierarchy shall be followed as a minimum:

1) Elimination

2) Substitution

3) Engineering controls

4) Administrative controls

5) Personal protective equipment (PPE)

The items above shall be addressed as early as the during design stage, as well as during operation and maintenance.

For the operational management of occupational health and safety, the Plan-Do-Check-Act (PDCA) model according to ISO 45001 should be used.

An important part of these processes, both during design and operation, is management of risk, which includes several steps and sub-steps.

For this document the detailed steps which shall be followed and documented for the general risk management are shown in Figure 1.

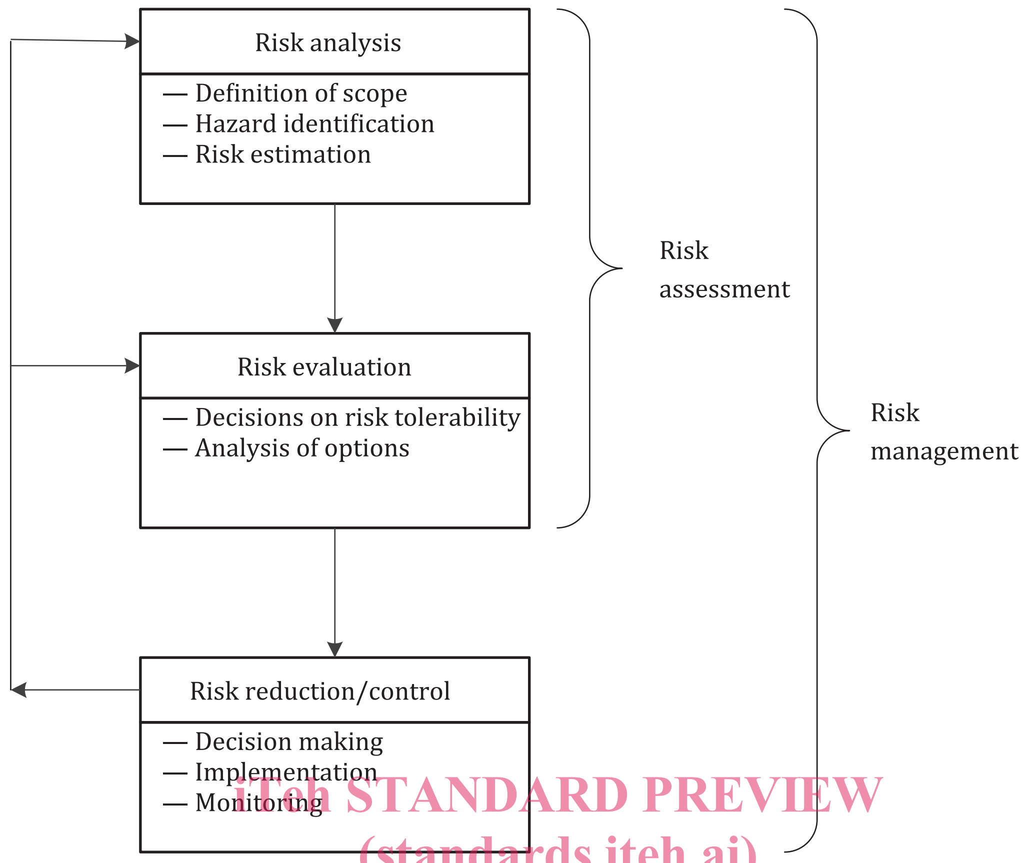

Figure 1 — Risk management

The risk management process includes a risk analysis and a risk evaluation, which form the basis for the risk assessment and what risk reduction/control measures are required for each specific plant.

The objects, issues and aspects to be considered and documented in the risk management process are related to general design and construction and general operation and maintenance procedures including preplanning of emergency operations.

For fire prevention and fire protection of machinery, ISO 19353 should be used, when applicable.

Further specific issues to consider are also provided for receiving and feeding (8.1.1); crushing, milling and shredding (8.2); conveying (8.3); storage solutions (8.4); separation and screening (8.5); and other systems (8.6).

The documentation shall describe and justify the measures taken, as well as include aspects not considered applicable or relevant.

The person responsible for the risk management process shall have the necessary levels of competence to undertake a fire and explosion risk assessment; the level of competency required should be commensurate with the complexity of the facility to be assessed, i.e.:

a) A good understanding of SRF and the equipment and processes used for the production and along the supply chain of SRF

b) A good understanding of fire related aspects of building control and function

c) Appropriate knowledge of national fire/explosion and safety legislation and the requirements of other enforcing bodies and stakeholders (i.e. insurers)

d) Appropriately trained and/or experienced in fire/explosion safety and fire protection issues

e) Knowledge of relevant national and local codes and experience of application

5.2 Introduction to the risk management process

Management of risks include several steps and sub-steps as shown in Figure 2. In 5.2.1 to 5.2.5, the different parts of risk management are defined and described.

5.2.1 Definition of scope

When performing a risk analysis, the scope shall be defined, i.e. the system that is to be included in the analysis. This includes definition of the boundary of the system and to identify user, intended use and reasonably foreseeable misuse. Assumptions and limitations for the analysis should also be defined. Technical, environmental, organisational and other aspects relevant for the problem/system should be included.

5.2.2 Hazard identification

Hazard identification involves systematic review of the system under study to identify the type of inherent hazards that are present together with the ways in which they could be realized. Different hazards and sources of risks shall be identified and the type of hazard they pose analysed. Hazard identification methods fall mainly into three categories:

1) Comparative methods (e.g. checklists, hazard indices and reviews of historical data)

2) Fundamental methods that are structured to stimulate a group of people to apply foresight in conjunction with their knowledge to the task of identifying hazards (e.g. HAZOP studies, ISO 12100 and FMEA)

3) Inductive reasoning techniques (e.g. event tree logic diagrams)

The significance of the sources of risks shall be analysed by an initial evaluation, based on a consequence analysis. The aim of this analysis is to decide whether:

a) Actions should be taken to eliminate or reduce the hazard

b) The analysis can be terminated due to the insignificance of hazard

c) The analysis should be continued with a risk estimation

There are many factors influencing the risk management, e.g. the storage capacity, annual SRF turnover and complexity of on-site handling and to consider all the variables that might be valid for a facility.

5.2.3 Risk estimation

Risk estimation should examine the initiating events or circumstances, the sequence of events that are of concern, any mitigating features and the nature and frequency of the possible deleterious consequences of the individual hazards to produce a measure of the level of the risk being analysed. The measures could address human, property or environmental risks and should include an indication of the uncertainty associated with the estimates. The risk estimation process can be described by the following steps:

a) Frequency analysis used to estimate the likelihood of each undesired event identified during the hazard identification stage. To estimate event frequencies three different approaches are commonly used: relevant historical data, analytical or simulation techniques and expert judgement

b) Consequence analysis is used to estimate the likely impacts should the undesired event occur

c) Risk calculations where risk should be expressed in the most suitable term, e.g.: individual risk, predicted frequency of mortality, frequency versus consequence plots (F-N curves), the statistically