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General rules for designing the production facilities in accordance with safety and health requirements

生产设备安全卫生设计总则

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General rules for designing the production facilities in accordance with safety and health requirements

1 Scope

This document specifies the overall requirements, general requirements and special requirements for the safety and health design of various types of production facilities.

This document applies to all types of production facilities except air and water vehicles, water facilities, electrical equipment and nuclear power equipment.

2 Normative references

The contents of the following documents constitute the essential clauses of this document through normative references in this text. Among them, for referenced documents with dates, only the versions corresponding to the dates are applicable to this document; for referenced documents without dates, the latest versions (including all amendments) are applicable to this document.

GB 2893 Safety colours

GB 2894 Safety signs and guideline for the use

GB 4053.1 Safety requirements for fixed steel ladders and platform - Part 1: Steel vertical ladders

GB 4053.2 Safety requirements for fixed steel ladders and platform - Part 2: Steel inclined ladders

GB 4053.3 Safety requirements for fixed steel ladders and platform - Part 3: Industrial guardrails and steel platform

GB 50034 Standard for lighting design of buildings

GB 50058 Code for design of electrical installations in explosive atmospheres

GBZ 158 Warning Signs for Occupational Hazards in the Workplace

3 Terms and definitions

The following terms and definitions apply to this document.

3.1 production facilities

Various machines, facilities (including environmental protection facilities), devices and appliances used in the production process for the production, processing, manufacturing, inspection, transportation, loading and unloading, installation, storage and maintenance of products.

3.2 safety and health guard devices

Accessory objects or facilities installed in production facilities to ensure the safety and hygiene of personnel, production processes and equipment.

4 Overall requirements

4.1 The designing of production facilities shall identify the safety risks throughout facilities' life cycles, such as various working conditions and environments, especially the safety risks under abnormal working conditions and adverse environments, and take corresponding safety and health protection measures.

4.2 Production facilities (including parts and components) shall have mechanical properties, stability and reliability that meet the safety performance of the product. When manufactured, transported, stored, installed, used and dismantled in accordance with the specified conditions, it shall not cause harm to personnel.

4.3 During normal operation of production facilities, no chemical poisons, dust or other toxic or hazardous substances exceeding the national standard limits shall be discharged into the workplace, atmosphere, water or soil; no noise, vibration, ionizing radiation, non-ionizing radiation or other pollution exceeding the national standard limits shall be discharged or generated.

4.4 The design of production facilities shall comply with ergonomic principles to protect the physiological and mental health of operators.

4.5 The designing of production facilities shall identify the risk of accidental release of hazardous energy, and measures shall be taken to control hazardous energy or energy carriers to ensure that the production facilities meet safety and health requirements.

4.6 The designing of production facilities shall ensure safety and health requirements are met through the following means:

a) The design plan of production facilities shall be scientifically formulated, and safety and health risk assessment (risk assessment methods include equipment failure mode and failure analysis based on risk assessment, fault tree analysis and safety checklist analysis, etc.) or demonstration of the plan shall be conducted;

dangerous, sound, light or a combination of sound and light alarm signal devices shall be installed. The alarm system shall be able to display the location and type of fault. The alarm signal shall have sufficient intensity and be clearly different from other signals, and its intensity shall be significantly higher than the intensity of other sound and light signals in the same area.

5.6.2 Control systems

5.6.2.1 All operations of control and regulating devices shall not create new risks.

5.6.2.2 When an abnormality occurs in the power source, the control device shall ensure that the production facilities will not cause danger. The control device of production facilities with high risk shall be able to automatically switch to the backup power source or backup equipment system. Important control and regulating devices shall be equipped with energy accumulators so that they can return to a safe position when the power source is lost.

5.6.2.3 Artificial intelligence, remote control, automatic or semi-automatic control systems shall be designed with safety and health guard devices that comply with intrinsic safety, or other measures shall be taken to prevent danger caused by disordered control instructions. Production facilities with automatic or semi-automatic control systems shall be supplemented by manual control devices that can be independently operated.

5.6.2.4 Highly dangerous production facilities and their safety systems shall be equipped with monitoring and alarm devices. The early warning and alarm limits of parameters related to the production process and production safety shall meet the standards and operating requirements of production facilities.

5.6.2.5 The control device of highly dangerous production facilities shall be installed in a position where operators can see the movement of the entire equipment. For a production facility that cannot be seen in full view when the equipment is started, a start-up early-warning signal device shall be configured. The alarm time of the early-warning signal device shall meet the requirements.

5.6.2.6 The control system shall ensure that logic errors, electromagnetic interference, or software and hardware failures in the system will not cause danger. The key components and control valves in the system shall meet the reliability index requirements.

5.6.2.7 Control devices AND clutches, braking devices and interlocking devices that work as safety technical measures shall comply with the reliability index requirements specified in their product standards.

5.6.2.8 For highly hazardous production facilities, the key regulating devices shall

5.6.4.2 Safety and health guard devices with mandatory functions shall be designed to prevent accidental start-up of production facilities.

5.6.4.3 A stop control device shall be installed to prevent the power source that is accidentally cut off from being automatically connected and to avoid dangerous operation of the production facilities.

5.6.5 Stop

5.6.5.1 Production facilities shall be designed with control devices that can stop it safely. Stopping devices and starting devices shall be distinguished by color or markings. Stop control of production facilities shall take precedence over start control.

5.6.5.2 For production facilities controlled by remote control or artificial intelligence, when the received signal is abnormal or the signal is interrupted, the automatic stop function or automatic operation function shall be designed without causing other risks.

5.6.6 Emergency stop

5.6.6.1 When the following conditions exist, a production facility shall be equipped with an emergency stop device:

-- When an accident or production facility failure occurs, the dangerous operation cannot be terminated quickly through the stopping device;

-- It is not possible to quickly interrupt several units that can cause danger through a stopping device;

-- The cutting off of a certain unit will lead to other dangers;

-- The whole picture of the control cannot be seen at the console.

5.6.6.2 The emergency stop device shall ensure timely and safe operation at key control points and shall be effective in all modes without interference from other functions. The shape of the emergency stop device shall be different from other operating devices and shall be equipped with a Chinese marking. The color of the emergency stop device shall be red or have a distinctive red marking. The emergency stop device shall be manually reset before its control system can be started again.

5.6.6.3 When the residual energy of a production facility may cause danger after it is stopped by an emergency stop device, an energy release or limiting device shall be installed.

5.7 Working position

5.7.1 Operating position

The operating position on the production facilities for personnel to work shall be safe and reliable, and shall meet the requirements of human-computer interaction functions. The working space shall ensure that all parts of the operator's body can move normally during operation. There shall be a safe escape space at dangerous operating points.

5.7.2 Operating posture

The operating position of production facilities shall be designed with priority in the sitting posture.

5.7.3 Seats

The seats set up on the production facilities shall meet the following requirements:

a) The height, angle and level adjustment of the seat shall be suitable for the needs of the human body and the performance of its functions;

b) The structure and size of the seat shall comply with the principles of ergonomics, and the seat structure shall be adapted to the requirements of various operating activities of sitting work to ensure the comfort and stability of the operator;

c) The seat for the driver shall ensure that the vibration to which the driver is subjected is reduced to a reasonable level. The seat shall be fixed securely and be able to withstand the load in the event of overturning.

5.7.4 Control room

5.7.4.1 The control room shall ensure the safety, convenience and comfort of the operators. At the same time, it shall ensure that the operators can directly control all operating parts and operating components in their seats and have a good field of vision.

5.7.4.2 The main structure of the control room shall be made of non-combustible materials, and the light-transmitting parts of the doors and windows of the control room shall be made of transparent, easy-to-clean safe materials, and shall ensure that operators can wipe them in the control room.

5.7.4.3 The control room shall have good protection against external dangerous and harmful factors (such as noise, vibration, dust, poison, heat radiation, shock wave, splash and object impact). When the control room is in the high-temperature operation or low-temperature operation range, corresponding cooling and heating devices shall be installed.

5.7.4.4 The control room shall ensure that the operating personnel can evacuate safely in the event of an accident. In addition to the safety support to protect the control room, the control room of mobile production facilities with the risk of overturning shall also

shape and other factors, measures shall be taken in shape, center of gravity, and rigid-plastic design; lifting holes, rings and other lifting parts or components shall be designed, or the shape and load shall be designed to be appropriate to the transportation through forklifts and flatbed trucks to ensure smooth lifting and transportation and prevent overturning or plastic deformation.

5.10 Inspection and maintenance

5.10.1 The design of production facilities shall meet the safety and convenience of inspection and maintenance, and the cycle of inspection, maintenance and replacement of parts shall be specified.

5.10.2 The parts of production facilities that need to be inspected or repaired shall be in a safe state. Components that need to be replaced regularly shall be assembled and disassembled safely.

5.10.3 When production facilities that lack oxygen or contain flammable, explosive, toxic, or harmful media need to be inspected and repaired internally, the maintenance location shall be equipped with isolation facilities that can reliably cut off the source of the media.

5.10.4 During inspection and maintenance, for a production facility that still has residual energy after the power source is disconnected, the design shall ensure that its energy can be safely released or eliminated.

6 Special requirements

6.1 Movable parts

6.1.1 Movable parts that may be touched and easily cause personal injury during the operation of production facilities shall be equipped with safety and health guard devices.

6.1.2 Production facilities or parts that may exceed the limit position during operation shall be equipped with reliable limit devices.

6.1.3 When the kinetic energy or potential energy of movable parts (including their loads) may cause danger, safety and health guard devices such as anti-detachment, speed limiter, anti-fall, anti-reversal, and anti-collision shall be installed.

6.1.4 The design of safety and health guard devices for movable parts shall meet the following requirements:

-- It can keep workers out of reach of movable parts in operation, and the protection

distance shall be determined based on the scope of the dangerous area and the contact mode of human body parts;

-- In an emergency situation where workers are close to movable parts and danger may occur, the production facilities shall be unable to start, or shall be able to stop immediately and automatically;

-- Contact hazards between safety and health guard devices and movable parts shall be prevented;

-- It shall be easy to adjust, inspect and repair, and shall not become a source of danger;

-- It shall comply with the reliability index requirements stipulated in product standards.

6.1.5 Based on the plane where the operator's operating position is located, all exposed hazardous components and dangerous parts such as transmission belts, rotating shafts, transmission chains, couplings, pulleys, gears, flywheels, sprockets, and electric saws, within a height of 2 m shall be equipped with safety and health guard devices.

6.2 High-speed rotating and easy-to-fly-off objects

6.2.1 High-speed rotating parts shall be equipped with protective covers that meet the strength, stiffness, shape and size requirements, and the inspection cycle and replacement standards for such parts shall be specified in the design.

6.2.2 When the power source of production facilities is suddenly interrupted during operation, if there is a risk of fastening parts of moving parts or processed materials becoming loose or flying off, anti-loosening measures shall be taken in the design and safety and health guard devices such as protective covers or protective nets shall be installed.

6.3 Overcooling and overheating

When overcooled or overheated parts of production facilities may cause danger, anti-contact shielding measures shall be taken.

6.4 Fire and explosion prevention

6.4.1 For production facilities that produce, use, process, store or transport flammable and explosive media (including dust, wastewater, waste gas or hazardous waste that may cause fire or explosion), appropriate protective measures shall be taken according to the different properties of the flammable and explosive media, such as ignition

pressure relief facilities such as safety valves, bursting discs, and explosion vents. Bursting discs, explosion vents and other facilities shall be arranged to release energy in low-risk directions.

6.4.5 For production facilities with explosion hazards, the remote-control system shall be set up outside the explosion hazard area, or other measures stipulated in national standards shall be taken.

6.5 Hydraulics and pneumatics

Production facilities using pressure media shall ensure the safety of the filling, application, recovery and removal processes and meet the following requirements:

-- It shall be able to prevent the discharge of pressurized liquid or gas causing danger;

-- The device for isolating energy shall be reliable;

-- The support and fixation of the connected pipelines shall be reliable;

-- It shall be able to withstand the predetermined internal and external loads.

6.6 Noise and vibration

For production facilities that generate noise and vibration, the noise and vibration index limits shall be specified in the product standards, and corresponding prevention and control measures shall be taken in the design. For production facilities that generate high noise and strong vibration, noise reduction, vibration reduction, isolation or remote-control measures shall be taken.

6.7 Dust and toxic substances

6.7.1 For all production facilities that can produce dust or other toxic and harmful substances in the production process (including three waste treatments), mechanized, automated and closed devices shall be preferentially used to complete feeding, unloading and other operations; absorption, purification, and discharge devices, or interfaces that can be connected to purification and emission systems shall be set up to ensure that the concentration of harmful substances in the workplace and in emissions meet the requirements.

6.7.2 For closed systems of toxic and harmful substances, escaping, emitting, dripping or leakage shall be prevented. In workplaces where acute occupational poisoning may occur, automatic alarm or detection devices shall be designed according to the technical development level of automatic alarm devices. For production facilities and their

ancillary environmental protection facilities that are seriously harmed by dust and poisons during the production process, accident handling devices and emergency protection facilities shall be designed and installed.

6.8 Ionizing or non-ionizing radiation

For any production facilities that can generate ionizing radiation or non-ionizing radiation, appropriate shielding measures shall be taken; remote operation or automated operation shall be preferentially adopted; monitoring and alarm devices, etc. and warning signs shall be set up.

6.9 Laser

The design of laser devices in production facilities shall meet the following requirements:

-- It shall be able to prevent unintentional launches;

-- Effective shielding shall be adopted to prevent emission, reflection, scattering and secondary radiation from causing harm to personnel;

-- Optical instruments used to observe and adjust laser devices shall be safe and reliable and shall not become a source of laser radiation hazard;

-- Warning signs shall be set up.

6.10 Lightning protection, anti-static and electric shock protection

6.10.1 Lightning protection

Production facilities that may be struck by lightning shall be protected through lightning protection measures.

6.10.2 Anti-static

For production facilities in explosion-hazardous areas and other production facilities that can generate static electricity hazards, appropriate measures such as grounding, neutralization and bridging shall be taken to eliminate static electricity hazards.

6.10.3 Prevention of electric shock

For electrical production facilities, measures shall be taken to prevent electrical hazards, including isolation protection measures, measures to prevent misoperation and grounding measures.

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