TSG

TECHNICAL SPECIFICATION FOR

SAFETY OF SPECIAL EQUIPMENT

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Periodic inspection regulation for industrial pressure piping

压力管道定期检验规则 - 工业管道

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1 General

1.1 Purpose

In order to regulate the periodic inspection of in-use industrial pressure piping, in accordance with the “Special equipment safety law of the People’s Republic of China”, “Special equipment catalogue”, the provisions of related safety technical specifications, this Regulation is hereby formulated.

1.2 Scope of application

This rule applies to the periodic inspection of in-use industrial pressure piping (hereinafter referred to as piping) (Note 1-1, Note 1-2).

Note 1-1: The periodic inspection of buried pipe sections can be carried out in accordance with the relevant inspection items of the “Periodic inspection regulations for oil and gas pressure piping” (TSG D7003) as well as the relevant technical standards.

Note 1-2: Power piping (except for piping within the scope of boiler in “Boiler safety - Technical supervision administration regulation” (TSG G0001)) are classified according to grading conditions for industrial piping. The periodic inspection refers to this Regulation as well as the standards to be followed during construction; it may also refer to the related test items of the major connection piping of the boilers which are covered by “Boiler periodical inspection regulation” (TSG G7002) as well as the relevant technical standards.

1.3 Periodic inspection of piping

The periodic inspection of piping, that is, the comprehensive inspection, refers to the conformity verification activities by the special equipment inspection organizations (hereinafter referred to as inspection organization) against the safety status of the piping, based on a certain time period, according to the provisions of this Regulation, relevant safety technical specifications, the relevant standards.

Periodic inspections shall be conducted on the basis of annual inspection.

1.4 Work procedures of periodic inspection

The user organization shall fulfill the following obligations:

(1) Formulate a periodic piping inspection plan; apply to periodic inspection to the inspection institute 1 month before the valid period of the periodic inspection of the piping;

(2) Do well in inspection coordination and safety supervision; be responsible for the authenticity of the relevant information provided;

(3) For the defects and problems which are found in the inspection, propose the treatment or rectification measures, be responsible for their implementation, feedback the treatment or rectification conditions, in writing, to the inspection institute.

1.8 Duties of inspection institute and inspectors

(1) The inspection institute shall perform the inspection of the piping in accordance with the approved inspection scope, be responsible for the authenticity, accuracy and validity of the inspection report (Note 1-4);

(2) Personnel engaged in the inspection and testing of piping shall obtain the corresponding certificate of special equipment inspection and testing personnel, make registration in accordance with relevant provisions;

(3) After the inspection institute receives the periodic inspection application from the user organization, it shall conduct the inspection in time;

(4) The inspection institute shall conduct periodically safety training for the inspection work of the testing and inspection personnel, retain the training records.

Note 1-4: Authenticity means that the report is based on objective facts and does not make false evidence. Accuracy means that the accuracy of the test data involved in the report meets the relevant requirements. Effectiveness means that the qualification of the inspection institute and the inspector complies with requirements; the measuring equipment, instrument and tools which are used for inspection and testing are within the valid period of the calibration standard; the basis for the testing is legal; the report's approval procedure complies with requirements.

1.9 Application of new techniques

If new techniques and new assessment methods are adopted in the inspection, which are inconsistent with the requirements of this Regulation and the related safety technical specifications, or if this Regulation and related safety technical specifications do not make any requirements, or it may have major impact onto the safety performance, the relevant organization shall provide the relevant

piping installation supervision and inspection certificates;

(3) Data on reconstruction or major repair, including construction plans and completion data, as well as the supervision and inspection certificate of the reconstruction and major repair which is required by the relevant safety technical specifications;

(4) Data of utilization management, including “Use registration certificate”, “Use registration form”, “Basic information collection of pressure piping - Industrial pressure piping”, as well as the operation records, startup/shutdown records, changes in operation conditions, abnormalities in operation, records on corresponding treatment, etc.

(5) Testing and inspection data, including the verification and calibration data on the safety accessories and instrument, the annual inspection report in the periodic inspection cycle, the previous periodic inspection report.

The inspector shall review the piping information which is provided by the user organization. The information in items (1) to (3) of this clause must be reviewed at the time of the first periodic inspection of the piping after it is put into use. The subsequent inspections will be reviewed as required (for example, if alterations or major repairs are performed).

2.3.2 Preparation work for inspection site

The user organization and related supporting organizations (such as repair and maintenance organizations, etc., the same below) shall do well in the technical handling after the shutdown and the safety inspection before the inspection according to the requirements, to confirm that the site conditions meet the requirements of the inspection work, to finish the relevant preparation work. Before the inspection, the inspection site shall meet at least the following conditions:

(1) Auxiliary parts or other objects that affect the inspection shall be cleaned or removed in accordance with the inspection requirements;

(2) Scaffolding, portable ladders and other facilities for inspection purposes shall be safe and secure (for the scaffolding more than 2 m above the ground, set the protective devices such as safety guardrails);

(3) The surface of the piping to be inspected shall be ground and cleaned, especially the corroded location and the parts where crack defects may occur, which shall be thoroughly cleaned to expose the metal body. The surface to be subjected to non-destructive testing shall comply with NB/T 47013 Non-destructive testing of pressure equipment;

(4) During piping inspection, it shall be ensured that it is reliably isolated from

may have seepage of rainwater shall be subjected to non-destructive testing of the outer surface at the corresponding parts;

(3) When the inspector deems it necessary, the fillet welds and so on of the branch piping shall be subjected to the non-destructive testing of the outer surface;

(4) For carbon steel, low-alloy steel low-temperature piping, Cr-Mo steel piping, low-alloy steel piping which has the lower limit of standard tensile strength greater than or equal to 540 MPa, piping which is subjected to long-term obvious alternating load, grade GC1 piping which is subjected to the first periodic inspection, it shall perform the sampling inspection of non-destructive testing at the outer surface of the weld joint and stress-concentrated parts, the sampling inspection ratio shall be not less than 5% of the quantity of the weld joint, meanwhile the number shall be not less than 2;

(5) For piping which has a tendency of environmental cracking, it may use other testing methods at the outer surface to perform sampling inspection of the inner surface. The sampling inspection ratio shall be not less than 10% of the quantity of the butt-welded joints, meanwhile the quantity shall be not less than 2;

(6) When cracks are found in the testing, the inspector shall expand the proportion of surface defect testing, in order to find other defects that may exist.

2.4.2.4 Testing of buried defects

The testing of buried defect generally uses methods such as radiographic or ultrasonic testing as specified in NB/T 47013. When radiographic or ultrasonic testing is not possible at the inspection site, it may use other effective methods of testing. For the piping which is subjected to the first inspection, it shall perform the testing of buried defects according to the sampling inspection ratio as specified in Table 2-2 (note 2-2). For the next inspection, the testing of buried defect is generally not performed again. When it is found that there is an indication of internal damage or if the risk of exceeding the standard is found in the previous inspection, it shall perform the testing of buried defect at the sampling inspection ratio which is not less than those specified in Table 2-2.

The specific sampling inspection ratio for the testing of buried defects as well as the requirements for key positions are as follows:

(1) The sampling inspection ratios of ultrasonic testing or radiographic testing of the grade GC1 and GC2 piping's weld joints are as shown in Table 2-2. If no abnormalities are found in the grade GC3 piping, it is generally not necessary to carry out ultrasonic testing or radiographic

determined by chemical analysis, spectral analysis, etc. according to the specific conditions. It is not necessary to inspect this item during re-inspection;

(2) For piping which has a tendency of high-temperature creep and material deterioration, it shall select a representative position to perform hardness testing; it shall carry out metallographic analysis if necessary;

(3) For piping which has requirements for weld hardness, it shall test the hardness of the weld joint.

2.4.2.6 Verification of pressure strength

When the total thinning amount of the piping components exceeds 20% of the nominal thickness, or when the inspectors have doubts about the strength of the piping, it shall verify the pressure strength. The pressure for verification shall be not less than the allowable (monitoring) use pressure of the piping. The verification of pressure strength is carried out in accordance with the requirements of the corresponding piping design standards.

2.4.2.7 Stress analysis

When the inspector or the user organization deems it necessary, it shall perform stress analysis for the piping in one of the following cases:

(1) No strength calculation sheet, and $t_0 \geq D_o/6$ or $p_0/[\sigma]_t > 0.385$;

Where:

t_0 - Designed wall-thickness of piping, mm;

D_o - Designed outer diameter of piping, mm;

p_0 - Design pressure, MPa;

$[\sigma]_t$ - Allowable stress of the material at the design temperature, MPa.

(2) It has large deformation or deflection;

(3) Leakage or damage of the sealing structure caused by piping stress;

(4) Requiring the setting of compressor but not available, or the failure of compensator;

(5) Abnormal damage of support & hanger;

(6) The structure is unreasonable and serious defects have been found;

(7) There is a serious overall thinning of the wall-thickness.

hardness and metallographic examination, which focuses on the inspection of the graphitization and pearlite spheroidization damage. When the running time reaches to or exceeds 2 x 10^5 h, according to the inspection results of metallographic and hardness, if necessary, cut the piping to perform material assessment according to relevant standards.

(2) When the working temperature is greater than or equal to 400 °C and less than 450 °C, after running for 8 x 10^4 h, according to the running status of the piping, randomly inspect the hardness and metallographic structure. The time and proportion of the next sampling inspection are determined according to the inspection result;

(3) For the piping which has been equipped with the creep measuring point, check whether the creep measuring record meets the relevant standards;

(4) For the power piping which has been operated for more than 2 x 10^5 h, if it is found through inspection that the metallographic spheroidization, creep damage or material aging grade, creep strain, creep rate exceed the requirements of the relevant standards, it shall be treated or replaced in time.

2.7.1.2 9% ~ 12% Cr series steel-made power piping

The periodic inspection of the 9% ~ 12% Cr series steel-made power piping shall include the hardness and metallographic sampling inspection.

2.7.2 Handling of defects

In any of the following cases, the piping segment shall be replaced:

(1) The outer surface of the piping has macroscopic cracks and obvious bulging;

(2) The piping is thinned significantly and has been checked for strength verification, which cannot guarantee safe operation until the next overhaul;

(3) The piping is obviously inflated and cannot guarantee safe operation until the next overhaul;

(4) The depth of the corrosion point of the piping is greater than 30% of the wall-thickness;

(5) The grade of aging or creep damage of the piping material exceeds the requirements of relevant standards;

(6) It has produced creep cracks or fatigue cracks.

safety technical specifications or design and installation standards, if it cannot be adjusted or repaired in time, for the piping which does not bear obvious alternating load and from which no new defect is found through periodic inspection (excluding normal uniform corrosion), it can be rated as grade 2 or grade 3; otherwise it shall perform safety assessment. If the results of safety assessment confirm that it does not affect the safe use, it can be rated as grade 2 or grade 3; otherwise it is rated as grade 4.

3.2.2 Rating of materials of piping components

When the material of the piping components does not conform to the original design, or when the material is unknown, or when the material is deteriorated, it shall rate the grade of safety status according to the following requirements:

(1) When the material does not conform to the original design, if the material is clear, the strength check is qualified, no new defect is detected after inspection (excluding normal uniform corrosion), the inspectors believe that it can be used safely, it does not affect the rating. If defects occur during the process of use and it confirms that such defects are caused by improper use of material, it may be rated as grade 3 or grade 4;

(2) When material is unknown, if the inspection does not reveal new defects (excluding normal uniform corrosion) and the strength check is qualified (calculated according to the lowest strength of similar materials), it may be rated as grade 3; otherwise it is rated as grade 4;

(3) When the material is deteriorated and damaged, meanwhile it is found that there is material deterioration such as surface decarburization, carburization, spheroidization, graphitization, tempering embrittlement, damage such as creep, high-temperature hydrogen corrosion, or abnormal hardness value, if the deterioration or damage is slight and it can be confirmed that it can be safely used under the operating conditions and during the inspection cycle, it may be rated as grade 3; if it produces irreparable defects or damage, according to the degree of damage, it is rated as grade 3 or grade 4;

(4) When the hardness value in the wet H_2S environment exceeds the standard, meanwhile the hardness value of the welded joint of carbon-steel and low-alloy steel piping exceeds HB200 but no stress corrosion occurs, if the inspectors believe that stress corrosion will not occur in the next inspection cycle, it may be rated as grade 2 or grade 3; otherwise it is rated as grade 4.

3.2.3 Rating of overall thinning of wall-thickness of piping and fitting

When the wall-thickness of piping and fitting is completely reduced, it shall

personnel. The approval personnel shall be the technical principal or authorizer of the inspection institute.

Inspection records and inspection reports (single item report) shall be signed by the personnel who participate in the inspection and testing on site. The inspection institute shall keep the inspection records and inspection reports at least until the next inspection cycle.

4.2 Initial conclusions of inspection

Due to the need of piping operation, the inspector may, before issuing the report, issue the “Notice on periodic inspection opinions for special equipment (1)” (see Appendix C), notice the user organization of the initial conclusion of inspection in a written manner. The inspector shall be responsible for the correctness of the inspection opinions.

4.3 Special requirements for handling of problem

When finding the presence of defects which need to be handled during inspection, the inspection institute may issue the “Notice on the periodic inspection opinions for special equipment (2)” (see Appendix C), notice the inspection conditions to the user organization. The user organization is responsible for entrusting the organization with corresponding qualifications to handle the defects. After the defects are handled and they are confirmed by the inspection institute that the handling results comply with the use requirements, it issues the inspection report. If the user organization fails to complete the defect handling work within the agreed time, the inspection institute may issue a periodic inspection report according to the actual inspection situation. The report can be issued after finishing the handling work and it is confirmed by the inspection institute.

When the inspection reveals a serious accident, the inspection institute shall issue the “Notice of periodic inspection opinions for special equipment (2)”, inform the situations to the use registration authority in a timely manner.

4.4 Reconsideration of inspection conclusions

If the user organization disagrees with the inspection conclusion, it shall, within 30 working days after the receipt of the inspection report or the “Notice of periodic inspection opinions for special equipment (2)”, apply for reconsideration to the local or provincial people’s government which is responsible for the supervision and administration of the safety of special equipment.

Appendix A

Requirements for annual inspection of industrial piping

A1 Annual inspection

The annual inspection, that is, periodic self-inspection, refers to the inspection of the presence of abnormal conditions of piping which affect the safe use by the user organization when the piping is in operation. It shall be performed at least once a year.

A2 Basic requirements for annual inspection

The user organization shall establish an annual inspection management system. The annual inspection work may be carried out by the professionally trained personnel organized by the safety management personnel of the user organization, or by an inspection institute which has the periodic inspection qualifications for industrial piping. When performing the annual inspection by itself, it shall be equipped with the necessary inspection tools and equipment.

A3 Contents of annual inspection

The annual inspection shall include at least the inspection of the safety management of the piping, the operation conditions of the piping, the safety accessories, instruments. If necessary, it shall perform the determination of wall-thickness and the measurement of resistance value.

A3.1 Inspection contents of piping's safety management conditions

(1) Whether the safety management system and operating procedures are complete and effective;

(2) Whether the design documents, installation as-built drawings, quality certification documents, supervision and inspection certificates, data of installation, modification, repair materials which are specified in the relevant safety technical specifications are complete;

(3) Whether the safety management personnel work with certificate;

(4) Whether records of routine maintenance and operation, records of periodic safety inspection meet the requirements;

(5) Whether the annual inspection and periodic inspection reports are complete; whether the problems raised in the inspection and testing reports are resolved;

(3) Whether the sealing device of the adjusting screw of the spring-type safety valve is in good condition;

(4) If a shut-off valve is provided between the safety valve and the discharge port, whether the shut-off valve is in the fully-open position and whether the lead seal is intact;

(5) Whether the safety valve leaks;

(6) Whether the venting pipe is unobstructed; whether the rain cap is intact.

During the inspection, if finding the type selection error, beyond verification validity period, or leakage, the user organization shall take effective measures, to ensure the safe operation of the piping; otherwise it shall suspend the operation of this piping.

A3.5.3 Contents of inspection of rupture disc device

(1) Whether the rupture disc exceeds the period of use as specified in the product specification;

(2) Whether the installation direction of the rupture disc is correct; whether the burst pressure and temperature on the product's nameplate meet the operational requirements;

(3) Whether the rupture disc device has a leakage;

(4) Whether the rupture disc has non-overpressure rupture or overpressure non-rupture during use;

(5) Whether the venting pipe which is connected to the rupture disc's holder is unobstructed; whether there is water (or ice) in the venting pipe; whether the waterproof cap and the rainproof piece are intact;

(6) If the shut-off valve is installed between the rupture disc device and the piping, whether the shut-off valve is in the fully-open state and whether the lead seal is intact;

(7) When the rupture disc device and the safety valve are used in series connection, if the rupture disc device is installed at the outlet side of the safety valve, check the pressure gauge and the shut-off valve installed between the safety valve, as well as whether the pressure, drainage and discharge capacity between the two meet the requirements; if the rupture disc device is set on the inlet side of the safety valve, check whether the pressure gauge installed between the safety valves has a pressure indication, whether there is gas leakage after the shut-off valve is opened.

During the inspection, if the rupture disc device is found to have exceeded the

requirements;

(3) Whether the pressure gauge's appearance, accuracy grade, range, dial diameter meets the requirements;

(4) Whether the position of three-way cock or needle valve, opening sign, locking device between the pressure gauge and the piping comply with requirements;

(5) Whether the readings of the pressure gauges on the same system are reasonable.

During the inspection, if it is found that the type selection of pressure gauge is wrong, the sealing glass of the dial breaks, the dial's scale is ambiguous, the seal is damaged, it exceeds the valid period of verification, the spring tube leaks, the pointer is loosening or distorted, the shell is seriously corroded, the opening sign of three-way cock or needle valve is unclear, the locking device is damaged, and so on, the user organization shall take effective measures to ensure the safe operation of piping. Otherwise, it shall temporarily suspend the operation of this piping.

A3.5.7 Content of inspection of temperature meter

(1) The periodic calibration and overhaul of the temperature measuring instrument meets the requirements;

(2) Whether the temperature measuring instrument's range matches the temperature range as tested by it;

(3) Whether the appearance of the temperature measuring instrument and its secondary instrument meets the requirements.

During the inspection, it is found that the temperature measuring instrument exceeds the specified verification and maintenance period, the instrument and its protective device are damaged, or the instrument's measuring range is selected incorrectly, the user organization shall take effective measures to ensure the safe operation of piping. Otherwise, it shall temporarily suspend the operation of this piping.

A4 Annual inspection report and conclusion

In the annual inspection work, the inspectors shall make records. After the inspection is completed, it shall analyze the safety status on the piping use, issue the inspection report (the report format is as shown in Annex a), make the annual inspection conclusions according to the requirements below. The annual inspection conclusion includes complying with requirements, basically complying with requirements, not complying with requirements:

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