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Head of Expert-Centre Head of QCD

/*Signature*/ A.M. Prosvirin /*Signature*/ S.A. Yerokhov

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Scientific Research\*MOSCOW MONTAZHNO-STROITELNOYE UPRAVLENIYE No. 90

/illegible/\* Certification Centre NIKIMT SOSNOVIY BOR

WELDING QUALITY CONTROL LABORATORY No.1

Process Flow Chart for Radiographic Inspection

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| **1 Inspected item** | |
| 1.1 Inspected item | Reference specimen |
| 1.2 Inspected element | Pipeline specimen weld joint |
| 1.3 Category | II as per PNAE G-7-010-89 |
| 1.4 Inspected element dimensions | Ø32x3 |
| 1.5 Weld joint type | Butt weld |
| 1.6 Beveling | 1-22-1 (S-22-1) as per PNAE 7-009-89 |
| 1.7 Welding method | manual argon non-consumable electrode arc welding (RAD) |
| 1.8 Material | 12Х18Н10Т |
| 1.9 Scope of inspection | 100% |

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| **2 Regulatory and Guidance Documentation** | |
| 2.1 Regulatory documentation | PNAE G-7-010-89, PNAE 7-009-89 |
| 2.2 Guidance documentation | PNAE G-7-017-89, GOST 7512-82 |

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| **3 Weld Joint Sketch** |
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| Figure 1. Weld Joint Sketch |

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| **4 Inspection Tools** | |
| 4.1 Radiation source | Selenium-75 or Iridium-192 |
| 4.2 Focus spot size, mm | 3.0 |
| 4.3 Type and number of image quality indicator | wire-type No. 12 or hole type Fe No. 1 |
| 4.4 Specimen designed to simulate the weld root concavity and convexity | Concavity 0.8 mm (No. 2)  Convexity 2.0 mm (No. 2) |
| 4.5 Type of radiographic film | FUJIFILM1X80 or equivalent |
| 4.6 Intensifying lead screen thickness, mm | 0.027 (screens and film are shipped in the same package) |
| 4.7 Cassette loading | Intensifying lead screen+radiographic film+intensifying lead screen |
| 4.8 Protective lead screen, minimum, mm | 1.0 |
| 4.9 Designatory marks | 1 No. 2, No. 6 |
| 4.10 Tape measure | with the measurement limit at least 3 m |
| 4.11 Measuring ruler | with the measurement limit at least 125 m |
| 4.12 X-ray view box | АЗ Lumen or equivalent |
| 4.13 Densitometer | XRS-4400 or equivalent |
| 4.14 Measuring magnifier | LI-3-10х |
| 4.15 Image interpretation accessories | Template for film interpretation |
| 4.16 Photoprocessing method | AGFA NDT М Есо autoprocessor or equivalent |
| 4.17 Photographic chemical set | Set of chemical agents for automatic photoprocessing of FUJI radiographic film or equivalent |
| 4.18 Marker | Metal |

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| **5 Preparation for Inspection** | |
| 5.1 Visual check of the inspected element | - radiographic inspection works shall be started upon receipt of satisfactory conclusion on visual and measuring inspection of the inspected weld joint; |

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|  | - the metal of the weld and the portion of the near-weld region to be inspected shall be cleaned from scale, slag and weld splatter and shall have all external defects detected during the visual and dimensional inspection eliminated. |
| 5.2 Preparation of the flaw detector and its accessories | - check the operability of flaw detector;  - prepare aids and appliances to fix the flaw detector and the cassette with its radiographic film;  - prepare the required number of:   * image quality indicators; * designatory and limiting marks; * cassettes with radiographic film; * protective lead screens. |

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| **6 Inspection Conditions** | |
| 6.1. Carrying out of inspection | It is required to provide the inspection personnel with convenient access to X-ray-graphical works area, ensure conditions for safe performance of the works, including, when necessary, to install falsework, fencing, scaffolding, cradles, mobile aerial work platforms or other auxiliary equipment ensuring optimal access (convenient operation) of personnel to the surface to be inspected and to ensure workplace connectivity for 12V local lighting facilities. |
| 6.2 Ensuring compliance with radiation safety rules | Before the inspection, the area to be restricted shall be marked off using signal tape and an appropriate number of radiation hazard signs (the size of the restricted area is determined by a dosimetrician in accordance with the radiation field map); |
| 6.3 Operating personnel | The operating personnel shall consist of two certified radiographers one of whom shall have the right to issue a conclusion. |
| 6.4 Operating temperature range, °С | -45 - +45 |

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| **7 Inspection Procedure** |
| 7.1 Using a marker, mark the reference point on the item. |
| 7.2 Mark the boundaries of the inspected sections, their numbers and direction of exposure to radiation with an indelible marker (figure 2).  The system for delineation and marking of sections to be inspected (specifying the starting point and direction of numbering) shall make it possible to restore any marks if they are lost. |
| 7.3 Apply designatory and limiting marks onto the base metal of the weld joint to be inspected, at a distance of at least 5 mm from the weld. The wire-type image quality indicator shall be installed directly on the seam with the wires directed across the seam. The hole-type image quality indicator shall be installed at a distance of at least 5 mm from the weld joint with the indicator directed along the seam. It is allowed to avoid putting the limiting marks on the boundaries of sections inspected during one exposure and to install the hole-type image quality indicator along the pipe axis. The marking shall include the following information:   * inspection order number; * radiographer code; * number of weld joint and section exposed to radiation. |
| 7.4 Install the cassette with radiographic film on the weld joint inspected section. |
| 7.5 Install the flaw detector collimator according to the inspection scheme. |
| 7.6 Expose the radiographic film. |
| 7.7 When exposure is done, check whether the source is back in its storage position using a direct-reading dosimeter with a sound alarm. |
| 7.8 Remove the cassette with radiographic film, image quality indicator, designatory and limiting marks from the inspected section. |
| 7.9 Repeat steps described in 7.2 + 7.8for other sections. |
| 7.10 Proceed with photoprocessing of the exposed radiographic film in accordance with the recommendations of the producer. |

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| **8 Inspection Scheme and Parameters** | |
| 8.1 Thickness for determining the inspection sensitivity CC, mm | 6.0 |
| 8.2 Required inspection sensitivity CC, max, mm | 0.2 |
| 8.3 Thickness for quality assessment, mm | 3.0 |
| 8.4 Radiation thickness, mm | 6.5 ÷ 7.5 |
| 8.5 Angle of exposure, degrees | 15 ÷ 45 |
| 8.6 Distance from the radiation source to the surface of the inspected weld joint, min, mm | 1050 |
| 8.7 Distance from the weld joint to radiographic film, mm | 0 |
| 8.8 Number of exposures, ea. | 2 |
| 8.9 Number of sections to be inspected, ea. | 4 |
| 8.10 Length of the section to be inspected, mm | 28 |
| 8.11 Cassette size, mm | 120x90 |
| 8.12 Scheme of exposure to radiation and marking of sections to be inspected | |
| Note: 1 - hole-type image quality indicator installation point (from the source side), 2 - wire-type image quality indicator installation point (from the source side), 3 - designatory marks application point, 4 - reference point and direction of marking, 5 - number of the inspected section | |
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| Note: 1 - radiation source, 2 - item to be inspected, 3 - image quality indicator, 4 - designatory marks, 5 - radiographic film, 6 - protective screen  Figure 2 - Marking scheme for inspected sections and scheme of exposure to radiation 3c as per PNAE G-7-017-89 | |

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| 9 Measurement and Interpretation of Discontinuities Indications |
| 9.1 Viewing and interpretation of images shall be performed when images are completely dry, in a dark room using a X-ray film viewer. |

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| 9.2 Interpretation of images shall be allowed only if they meet the following requirements:   * images shall not contain stains, strips, contaminants and damages of the emulsion layer which make them difficult to be interpreted; * the image quality indicators, designatory marks, limiting marks, and weld root concavity and convexity simulators (if necessary) shall be visible on the images; * optical image density of the inspected section of the weld and its adjacent area as well as of the image quality indicator shall be in the range of 1,5÷3,5 optical-density units; * reduction of optical image density of the weld joint and its adjacent area in any section of the image as compared to the optical image density of the image quality indicator (or the section where the wire-type image quality indicator is installed) shall not exceed 1.0 optical-density units.   - the inspection sensitivity determined based on the image of the image quality indicator shall correspond to the required sensitivity level. |

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| **10 Quality Assessment** | | | | | | | | | |  |
| 10.1 The quality of a weld joint shall be considered satisfactory if the radiographic images do not show any cracks, poor penetrations, as well as any inclusions or their clusters which may exceed applicable standards in terms or their size or quantity. | | | | | | | | | | |
| 10.2 Tolerance standards for single inclusions and clusters are provided in Table 1. | | | | | | | | | |  |
|  |  |  |  |  |  |  |  |  | Table 1 | |
|  | Rated thickness of welded parts, mm | Single inclusions and clusters | | | | | Single large inclusions | | |  |
|  | Maximum allowable size | | Allowable number of inclusions and clusters within any 100 mm-long section of the weld joint, ea. | Allowable total reduced area of inclusions and clusters within any 100 mm-long section of the weld joint, mm2 | | Allowable | |  |  |
|  | Maximum size, mm | Maximum width, mm | Allowable number within any 100 mm-long section of the weld joint, ea. |  |
|  | inclusions, mm | clusters, mm |
|  | PNAE G-7-010-89 II category | | | | | | | | |  |
|  | 3.0 | 0.6 | 1.0 | 11 | 1.7 | | 4.0 | 0.6 | 1 |  |
| 10.3 The revealed inclusions with the size up to 0.2 mm and those with the maximum size less than the Required Inspection Sensitivity value are not taken into account when assessing the quality of weld joints both when calculating the number of inclusions and their total reduced area, and when considering the distances between the inclusions (clusters). | | | | | | | | | | |
| 10.4 Any combination of inclusions (single clusters, groups of inclusions) which can be inscribed in a rectangle with the sizes of sides not exceeding the values of the allowable maximum size and the allowable maximum width of a single large inclusion shall be considered as one solid large inclusion. | | | | | | | | | | |
| 10.5 Any combination of inclusions (single clusters, groups of inclusions) which can be inscribed in a square with the sizes of sides not exceeding the value of the allowable maximum size of a single inclusion may be considered as one solid inclusion. | | | | | | | | | | |
| 10.6 If there are no single large inclusions or if their quantity is less than the quantity permitted by the standards, the corresponding quantity of single inclusions and / or single clusters of allowable sizes can be used instead of them without taking them into account when calculating the total area of single inclusions and single clusters. | | | | | | | | | | |
| 10.7 If necessary, concavity and convexity of the weld root shall be assessed by visual (or using densitometer) comparison of the optical density of their images with the optical density of the image of the groove or protrusion on the simulator specimen. | | | | | | | | | | |
| 10.8 Standards for allowable weld root concavity from the inside | | | | | | | |  |  |  |
|  | Rated thickness S, mm | | | | | Allowable maximum height (depth) of the weld root concavity, max, mm | | | |  |
|  | 3.0 | | | | | 0.8 | | | |  |
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| 10.9 Standards for weld root convexity in case of single welding of pipes | | | |
|  | Rated inner diameter of pipe, mm | Convexity size, max, mm |  |
|  | 26 | 2.0 |  |
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| 10.10 The results of radiographic inspection shall be recorded in the operation logbook and a conclusion shall be prepared  based on the inspection results. | | | |

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| **1 Inspected item** | |
| 1.1 Inspected item | Reference specimen |
| 1.2 Inspected element | Pipeline specimen weld joint |
| 1.3 Category | II as per PNAE G-7-010-89 |
| 1.4 Inspected element dimensions | Ø56x5 |
| 1.5 Weld joint type | Butt weld |
| 1.6 Beveling | 1-24-1 (S-24-1) as per PNAE 7-009-89 |
| 1.7 Welding method | manual argon non-consumable electrode arc welding  (RAD) |
| 1.8 Material | 12Х18Н10Т |
| 1.9 Scope of inspection | 100% |

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| **2 Regulatory and Guidance Documentation** | |
| 2.1 Regulatory documentation | PNAE G-7-010-89, PNAE 7-009-89 |
| 2.2 Guidance documentation | PNAE G-7-017-89, GOST 7512-82 |

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| 3 Weld Joint Sketch |
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| Figure 1. Weld Joint Sketch |

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| **4 Inspection Tools** | |
| 4.1 Radiation source | Selenium-75 or Iridium-192 |
| 4.2 Focus spot size, mm | 3.0 |
| 4.3 Type and number of image quality indicator | wire-type No. 12 or hole type Fe No. 1 |
| 4.4 Specimen designed to simulate the weld root concavity and convexity | Concavity 1.0 mm (No. 3)  Convexity 2.0 mm (No. 3) |
| 4.5 Type of radiographic film | FUJIFILM1X80 or equivalent |
| 4.6 Intensifying lead screen thickness, mm | 0.027 (screens and film are shipped in the same package) |
| 4.7 Cassette loading | Intensifying lead screen+radiographic film+intensifying lead screen |
| 4.8 Protective lead screen, min, mm | 1.0 |
| 4.9 Designatory marks | No. 2, No. 6 |
| 4.10 Tape measure | with the measurement limit at least 1 m |
| 4.11 Measuring ruler | with the measurement limit at least 125 m |
| 4.12 X-ray view box | АЗ Lumen or equivalent |
| 4.13 Densitometer | XRS-4400 or equivalent |
| 4.14 Measuring magnifier | LI-3-10х |
| 4.15 Image interpretation accessories | Template for film interpretation |
| 4.16 Photoprocessing method | AGFA NDT М Есо autoprocessor or equivalent |
| 4.17 Photographic chemical set | Set of chemical agents for automatic photoprocessing of FUJI radiographic film or equivalent |
| 4.18 Marker | Metal |

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| **5 Preparation for Inspection** | |
| 5.1 Visual check of the inspected element | - radiographic inspection works shall be started upon receipt of satisfactory conclusion on visual and measuring inspection of the inspected weld joint; |

|  |  |
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|  | - the metal of the weld and the portion of the near-weld region to be inspected shall be cleaned from scale, slag and weld splatter and shall have all external defects detected during the visual and dimensional inspection eliminated. |
| 5.2 Preparation of the flaw detector and its accessories | - check the operability of flaw detector;  - prepare aids and appliances to fix the flaw detector and the cassette with its radiographic film;  - prepare the required number of:   * image quality indicators; * designatory and limiting marks; * cassettes with radiographic film; * protective lead screens. |

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| **6 Inspection Conditions** | |
| 6.1. Carrying out of inspection | It is required to provide the inspection personnel with convenient access to X-ray-graphical works area, ensure conditions for safe performance of the works, including, when necessary, to install falsework, fencing, scaffolding, cradles, mobile aerial work platforms or other auxiliary equipment ensuring optimal access (convenient operation) of personnel to the surface to be inspected and to ensure workplace connectivity for 12V local lighting facilities. |
| 6.2 Ensuring compliance with radiation safety rules | Before the inspection, the area to be restricted shall be marked off using signal tape and an appropriate number of radiation hazard signs (the size of the restricted area is determined by a dosimetrician in accordance with the radiation field map); |
| 6.3 Operating personnel | The operating personnel shall consist of two certified radiographers one of whom shall have the right to issue a conclusion. |
| 6.4 Operating temperature range, °С | -45 ÷ +45 |

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| **7 Inspection Procedure** |
| 7.1 Using a marker, mark the reference point on the item. |
| 7.2 Mark the boundaries of the inspected sections, their numbers and direction of exposure to radiation with an indelible marker (figure 2). The system for delineation and marking of sections to be inspected (specifying the starting point and direction of numbering) shall make it possible to restore any marks if they are lost. |
| 7.3 Apply designatory and limiting marks onto the base metal of the weld joint to be inspected, at a distance of at least 5 mm from the weld. The wire-type image quality indicator shall be installed directly on the seam with the wires directed across the seam. The hole-type image quality indicator shall be installed at a distance of at least 5 mm from the weld joint with the indicator directed along the seam. It is allowed to avoid putting the limiting marks on the boundaries of sections inspected during one exposure and to install the hole-type image quality indicator along the pipe axis. The marking shall include the following information:   * inspection order number; * radiographer code; * number of weld joint and section exposed to radiation. |
| 7.4 Install the cassette with radiographic film on the weld joint inspected section. |
| 7.5 Install the flaw detector collimator according to the inspection scheme. |
| 7.6 Expose the radiographic film. |
| 7.7 When exposure is done, check whether the source is back in its storage position using a direct-reading dosimeter with a sound alarm. |
| 7.8 Remove the cassette with radiographic film, image quality indicator, designatory and limiting marks from the inspected section. |
| 7.9 Repeat steps described in 7.2 ÷ 7.8 for other sections. |
| 7.10 Proceed with photoprocessing of the exposed radiographic film in accordance with the recommendations of the producer. |

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| 8 Inspection Scheme and Parameters | |
| 8.1 Thickness for determining the inspection sensitivity CC, mm | 10.0 |
| 8.2 Required inspection sensitivity CC, max, mm | 0.2 |
| 8.3 Thickness for quality assessment, mm | 5.0 |
| 8.4 Radiation thickness, mm | 10.5 ÷ 13 |
| 8.5 Angle of exposure, degrees | 15 ÷ 45 |
| 8.6 Distance from the radiation source to the surface of the inspected weld joint, min, mm | 581 |
| 8.7 Distance from the weld joint to radiographic film, mm | 0 |
| 8.8 Number of exposures, ea. | 5 |
| 8.9 Number of sections to be inspected, ea. | 5 |
| 8.10 Length of the section to be inspected, mm | 39 |
| 8.11 Cassette size, mm | 120x90 |
| 8.12 Scheme of exposure to radiation and marking of sections to be inspected | |
|  | |
| Note: 1 - hole-type image quality indicator installation point (from the film side), 2 - wire-type image quality indicator installation point (from the film side), 3 - designatory marks application point, 4 - reference point and direction of marking, 5 - number of the inspected section | |
|  | |
| Note: 1 - radiation source, 2 - item to be inspected, 3 - image quality indicator, 4 - designatory marks, 5 - radiographic film, 6 - protective screen  Figure 2 - Marking scheme for inspected sections and scheme of exposure to radiation 3e as per PNAE G-7-017-89 | |

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| **9 Measurement and Interpretation of Discontinuities Indications** |
| 9.1 Viewing and interpretation of images shall be performed when images are completely dry, in a dark room using a X-ray film viewer. |
| 9.2 Interpretation of images shall be allowed only if they meet the following requirements:   * images shall not contain stains, strips, contaminants and damages of the emulsion layer which make them difficult to be interpreted; * the image quality indicators, designatory marks, limiting marks, and weld root concavity and convexity simulators (if necessary) shall be visible on the images; * optical image density of the inspected section of the weld and its adjacent area as well as of the image quality indicator shall be in the range of 1,5÷3,5 optical-density units; * reduction of optical image density of the weld joint and its adjacent area in any section of the image as compared to the optical image density of the image quality indicator (or the section where the wire-type image quality indicator is installed) shall not exceed 1.0 optical-density units.   - the inspection sensitivity determined based on the image of the image quality indicator shall correspond to the required sensitivity level. |

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|  | **10 Quality Assessment** | | | | | | | |  |
|  | 10.1 The quality of a weld joint shall be considered satisfactory if the radiographic images do not show any cracks, poor penetrations, as well as any inclusions or their clusters which may exceed applicable standards in terms or their size or quantity. | | | | | | | |  |
|  | 10.2 Tolerance standards for single inclusions and clusters are provided in Table 1.  Table 1 | | | | | | | |  |
|  | Rated thickness of welded parts, mm |  | Single inclusions and clusters | | | Single large inclusions | | |  |
|  | Maximum allowable size | | Allowable number of inclusions and clusters within any 100 mm-long section of the weld joint, ea. | Allowable total reduced area of inclusions and clusters within any 100 mm-long section of the weld joint, mm2 | Allowable | |  |  |
|  | Maximum size, mm | Maximum width, mm | Allowable number within any 100 mm-long section of the weld joint, ea. |  |
|  | inclusions, mm | clusters, mm |  |
|  |  |  |  | PNAE G-7-010-89 II category | | |  |  |  |
|  | 5.0 | 0.8 | 1.2 | 11 | 3.0 | 4.0 | 0.8 | 1 |  |
|  |  |  |  |  |  |  |  |  |  |
| 10.3 The revealed inclusions with the size up to 0.2 mm and those with the maximum size less than the Required Inspection Sensitivity value are not taken into account when assessing the quality of weld joints both when calculating the number of inclusions and their total reduced area, and when considering the distances between the inclusions (clusters). | | | | | | | | | |
| 10.4 Any combination of inclusions (single clusters, groups of inclusions) which can be inscribed in a rectangle with the sizes of sides not exceeding the values of the allowable maximum size and the allowable maximum width of a single large inclusion shall be considered as one solid large inclusion. | | | | | | | | | |
| 10.5 Any combination of inclusions (single clusters, groups of inclusions) which can be inscribed in a square with the sizes of sides not exceeding the value of the allowable maximum size of a single inclusion may be considered as one solid inclusion. | | | | | | | | | |
| 10.6 If there are no single large inclusions or if their quantity is less than the quantity permitted by the standards, the corresponding quantity of single inclusions and / or single clusters of allowable sizes can be used instead of them without taking them into account when calculating the total area of single inclusions and single clusters. | | | | | | | | | |
| 10.7 If necessary, concavity and convexity of the weld root shall be assessed by visual (or using densitometer) comparison of the optical density of their images with the optical density of the image of the groove or protrusion on the simulator specimen. | | | | | | | | | |

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|  | 10.8 Standards for allowable weld root concavity from the inside | |  |
|  | Rated thickness S, mm | Allowable maximum height (depth) of the weld root concavity, max, mm |  |
|  | 5.0 | 1.0 |  |
|  |  | |  |
|  | 10.9 Standards for weld root convexity in case of single welding of pipes | |  |
|  | Rated inner diameter of pipe, mm | Convexity size, max, mm |  |
|  | 46 | 2.0 |  |
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|  | 10.10 The results of radiographic inspection shall be recorded in the operation logbook and a conclusion shall be prepared based on the inspection results. | |  |

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| **1 Inspected item** | |
| 1.1 Inspected item | Reference specimen |
| 1.2 Inspected element | Pipeline specimen weld joint |
| 1.3 Category | II as per PNAE G-7-010-89 |
| 1.4 Inspected element dimensions | Ø159x13 |
| 1.5 Weld joint type | Butt weld |
| 1.6 Beveling | 1-24-1 (S-24-1) as per PNAE 7-009-89 |
| 1.7 Welding method | manual argon non-consumable electrode arc welding (RAD) |
| 1.8 Material | 08Х18Н10Т |
| 1.9 Scope of inspection | 100% |

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| **2 Regulatory and Guidance Documentation** | |
| 2.1 Regulatory documentation | PNAE G-7-010-89, PNAE 7-009-89 |
| 2.2 Guidance documentation | PNAE G-7-017-89, GOST 7512-82 |

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| 3 Weld Joint Sketch |
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| Figure 1. Weld Joint Sketch |

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| **4 Inspection Tools** | |
| 4.1 Radiation source | Iridium-192 |
| 4.2 Focus spot size, mm | 3.0 |
| 4.3 Type and number of image quality indicator | wire-type No. 12 or hole type Fe No. 1 |
| 4.4 Specimen designed to simulate the weld root concavity and convexity | Concavity 1.6 mm (No. 5)  Convexity 2.0 mm (No. 4) |
| 4.5 Type of radiographic film | FUJIFILM 1X80 or equi |
| 4.6 Intensifying lead screen thickness, mm | 0.027 (screens and film are shipped in the same package) |
| 4.7 Cassette loading | Intensifying lead screen+radiographic film+intensifying lead screen |
| 4.8 Protective lead screen, min, mm | 1.0 |
| 4.9 Designatory marks | No. 2, No. 6 |
| 4.10 Tape measure | with the measurement limit at least 1 m |
| 4.11 Measuring ruler | with the measurement limit at least 125 m |
| 4.12 X-ray view box | АЗ Lumen or equivalent |
| 4.13 Densitometer | XRS-4400 or equivalent |
| 4.14 Measuring magnifier | LI-3-10х |
| 4.15 Image interpretation accessories | Template for film interpretation |
| 4.16 Photoprocessing method | AGFA NDT М Есо autoprocessor or equivalent |
| 4.17 Photographic chemical set | Set of chemical agents for automatic photoprocessing of FUJI radiographic film or equivalent |
| 4.18 Marker | Metal |

|  |  |
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| **5 Preparation for Inspection** | |
| 5.1 Visual check of the inspected element | - radiographic inspection works shall be started upon receipt of satisfactory conclusion on visual and measuring inspection of the inspected weld joint; |

|  |  |
| --- | --- |
|  | - the metal of the weld and the portion of the near-weld region to be inspected shall be cleaned from scale, slag and weld splatter and shall have all external defects detected during the visual and dimensional inspection eliminated. |
| 5.2 Preparation of the flaw detector and its accessories | - check the operability of flaw detector;  - prepare aids and appliances to fix the flaw detector and the cassette with its radiographic film;  - prepare the required number of:   * image quality indicators; * designatory and limiting marks; * cassettes with radiographic film; * protective lead screens. |

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| **6 Inspection Conditions** | |
| 6.1. Carrying out of inspection | It is required to provide the inspection personnel with convenient access to X-ray-graphical works area, ensure conditions for safe performance of the works, including, when necessary, to install falsework, fencing, scaffolding, cradles, mobile aerial work platforms or other auxiliary equipment ensuring optimal access (convenient operation) of personnel to the surface to be inspected and to ensure workplace connectivity for 12V local lighting facilities. |
| 6.2 Ensuring compliance with radiation safety rules | Before the inspection, the area to be restricted shall be marked off using signal tape and an appropriate number of radiation hazard signs (the size of the restricted area is determined by a dosimetrician in accordance with the radiation field map); |
| 6.3 Operating personnel | The operating personnel shall consist of two certified radiographers one of whom shall have the right to issue a conclusion. |
| 6.4 Operating temperature range, °С | -45 ÷ +45 |

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| **7 Inspection Procedure** |
| 7.1 Using a marker, mark the reference point on the item. |
| 7.2 Mark the boundaries of the inspected sections, their numbers and direction of exposure to radiation with an indelible marker (figure 2). The system for delineation and marking of sections to be inspected (specifying the starting point and direction of numbering) shall make it possible to restore any marks if they are lost. |
| 7.3 Apply designatory and limiting marks onto the base metal of the weld joint to be inspected, at a distance of at least 13 mm from the weld. The wire-type image quality indicator shall be installed directly on the seam with the wires directed across the seam. The hole-type image quality indicator shall be installed at a distance of at least 13 mm from the weld joint with the indicator directed along the seam. It is allowed to avoid putting the limiting marks on the boundaries of sections inspected during one exposure and to install the hole-type image quality indicator along the pipe axis. The marking shall include the following information:   * inspection order number; * radiographer code; * number of weld joint and section exposed to radiation. |
| 7.4 Install the cassette with radiographic film on the weld joint inspected section. |
| 7.5 Install the flaw detector collimator according to the inspection scheme. |
| 7.6 Expose the radiographic film. |
| 7.7 When exposure is done, check whether the source is back in its storage position using a direct-reading dosimeter with a sound alarm. |
| 7.8 Remove the cassette with radiographic film, image quality indicator, designatory and limiting marks from the inspected section. |
| 7.9 Repeat steps described in 7.2 ÷ 7.8 for other sections. |
| 7.10 Proceed with photoprocessing of the exposed radiographic film in accordance with the recommendations of the producer. |

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| **8 Inspection Scheme and Parameters** | |
| 8.1 Thickness for determining the inspection sensitivity CC, mm | 13.5 |
| 8.2 Required inspection sensitivity CC, max, mm | 0.3 |
| 8.3 Thickness for quality assessment, mm | 13.0 |
| 8.4 Radiation thickness, mm | 13.5 ÷17 |
| 8.5 Angle of exposure, degrees | 0 ÷ 15 |
| 8.6 Distance from the radiation source to the surface of the inspected weld joint, min, mm | 476 |
| 8.7 Distance from the weld joint to radiographic film, mm | 0 |
| 8.8 Number of exposures, ea. | 7 |
| 8.9 Number of sections to be inspected, ea. | 7 |
| 8.10 Length of the section to be inspected, mm | 75 |
| 8.11 Cassette size, mm | 120x90 |
| 8.12 Scheme of exposure to radiation and marking of sections to be inspected |  |
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| Note: 1 - hole-type image quality indicator installation point (from the source side), 2 - wire-type image quality indicator installation point (from the source side), 3 - designatory marks application point, 4 - reference point and direction of marking, 5 - number of the inspected section, 6 - boundary of the inspected section | |
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| Note: 1 - radiation source, 2 - item to be inspected, 3 - image quality indicator, 4 - designatory marks, 5 - radiographic film, 6 - protective screen  Figure 2 - Marking scheme for inspected sections and scheme of exposure to radiation 3a as per PNAE G-7-017-89 | |

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| 9 Measurement and Interpretation of Discontinuities Indications |
| 9.1 Viewing and interpretation of images shall be performed when images are completely dry, in a dark room using a X-ray film viewer. |

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| 9.2 Interpretation of images shall be allowed only if they meet the following requirements:   * images shall not contain stains, strips, contaminants and damages of the emulsion layer which make them difficult to be interpreted; * the image quality indicators, designatory marks, limiting marks, and weld root concavity and convexity simulators (if necessary) shall be visible on the images; * optical image density of the inspected section of the weld and its adjacent area as well as of the image quality indicator shall be in the range of 1,5^3,5 optical-density units; * reduction of optical image density of the weld joint and its adjacent area in any section of the image as compared to the optical image density of the image quality indicator (or the section where the wire-type image quality indicator is installed) shall not exceed 1.0 optical-density units.   - the inspection sensitivity determined based on the image of the image quality indicator shall correspond to the required sensitivity level. |

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|  |  |  |  | 10 Quality Assessment | | | |  |  |  |
|  | 10.1 The quality of a weld joint shall be considered satisfactory if the radiographic images do not show any cracks, poor penetrations, as well as any inclusions or their clusters which may exceed applicable standards in terms or their size or quantity. | | | | | | | | | |
|  | 10.2 Tolerance standards for single inclusions and clusters are provided in Table 1.  Table 1 | | | | | | | | | |
|  | Rated thickness of welded parts, mm |  | Single inclusions and clusters | | | | Single large inclusions | | |  |
|  | Maximum allowable size | | Allowable number of inclusions and clusters within any 100 mm-long section of the weld joint, ea. | Allowable total reduced area of inclusions and clusters within any 100 mm-long section of the weld joint, ea. | | Allowable | |  |  |
|  | Maximum size, mm | Maximum width, mm | Allowable number within any 100 mm-long section of the weld joint, ea. |  |
|  | inclusions, mm | clusters, mm |  |
|  |  |  |  | PNAE G-7-010-89 II category | | | |  |  |  |
|  | 13.0 | 2.0 | 3.0 | 14 | 12.0 | | 5.0 | 2.0 | 2 |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  | 10.3 The revealed inclusions with the size up to 0.2 mm and those with the maximum size less than the Required Inspection Sensitivity value are not taken into account when assessing the quality of weld joints both when calculating the number of inclusions and their total reduced area, and when considering the distances between the inclusions (clusters). | | | | | | | | | |
|  | 10.4 Any combination of inclusions (single clusters, groups of inclusions) which can be inscribed in a rectangle with the sizes of sides not exceeding the values of the allowable maximum size and the allowable maximum width of a single large inclusion shall be considered as one solid large inclusion. | | | | | | | | | |
|  | 10.5 Any combination of inclusions (single clusters, groups of inclusions) which can be inscribed in a square with the sizes of sides not exceeding the value of the allowable maximum size of a single inclusion may be considered as one solid inclusion. | | | | | | | | | |
|  | 10.6 If there are no single large inclusions or if their quantity is less than the quantity permitted by the standards, the corresponding quantity of single inclusions and / or single clusters of allowable sizes can be used instead of them without taking them into account when calculating the total area of single inclusions and single clusters. | | | | | | | | | |
|  | 10.7 If necessary, concavity and convexity of the weld root shall be assessed by visual (or using densitometer) comparison of the optical density of their images with the optical density of the image of the groove or protrusion on the simulator specimen. | | | | | | | | | |
|  | 10.8 Standards for allowable weld root concavity from the inside | | | | | | | | | |
|  | Rated thickness S, mm | | | | | Allowable maximum height (depth) of the weld root concavity, max, mm | | | |  |
|  | 13.0 | | | | | 1.6 | | | |  |
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|  | 10.9 Standards for weld root convexity in case of single welding of pipes | |  |
|  | Rated inner diameter of pipe, mm | Convexity size, max, mm |  |
|  | 133 | 2.0 |  |
|  |  |  |  |
|  | 10.10 The results of radiographic inspection shall be recorded in the operation logbook and a conclusion shall be prepared based on the inspection results. | |  |