



NET4GAS, s.r.o

HP PIPELINE DN1400, NODE KATEŘINSKÝ POTOK - NODE PŘIMDA

NDT SPECIFICATION

19.03.2019

DVZ

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TABLE OF CONTENTS

1	GENERAL	5
	1.1 Scope of the Document	5
	1.2 Definitions	5
	1.3 Abbreviations	5
	1.4 References	6
	1.5 Codes and Standards	6
	1.6 Priority of regulations, exceptions	10
2	QUALIFICATION REQUIREMENTS FOR NDT SUPPLIER	10
3	NDT PERSONNEL - QUALIFICATION REQUIREMENTS	11
4	SCOPE AND CONDITIONS OF NDT TESTS FOR INDIVIDUAL TYPES OF WELDS & MATERIALS	12
	4.1 Testing methods	12
	4.2 Scope of non-destructive testing	13
	4.3 Allowed Moment of the NDT test	15
	4.4 Weld identification	16
	4.5 Welding procedure qualification and testing	16
	4.6 Support and coordination of work on site	16
5	METHODS OF NON-DESTRUCTIVE TESTING	17
	5.1 Visual testing (VT)	17
	5.2 Radiographic testing (RT)	18
	5.3 Ultrasonic testing (UT)	21
	5.4 Magnetic particle testing (MT)	28
	5.5 Liquid penetrant testing (PT)	30
6	GOLDEN WELDS	31
7	WELD REPAIRS	32
8	DESTRUCTIVE WELD TESTS	32
9	NDT IN STATIONS	33

NDT SPECIFICATION

19.03.2019

10	CLIMATIC CONDITIONS	33
11	WEEKLY, MONTHLY AND FINAL NON-DESTRUCTIVE TEST REPORT	34
	11.1 Reporting	34
	11.2 Required documentation	34
12	WORK SAFETY REQUIREMENTS DURING NDT	35

1 GENERAL

1.1 Scope of the Document

This document specifies technical requirements, scope and acceptance criteria for nondestructive testing (NDT) during construction of the Project.

This specification stipulates the requirements related to:

- Qualification requirements for NDT supplier
- Qualification requirements for testing NDT personnel
- Scope and conditions for NDT tests
- Requirements for individual testing methods
- Acceptance criteria for individual methods

In general, all works shall be implemented in accordance to applicable standards, regulations and related standards, as amended by later regulations, which are effective at the moment of initiation of works.

1.2 Definitions

Term	Explanation
Project	High Pressure Pipeline DN 1400, Node Kateřinsky Potok- Node Primda
Employer	NET4GAS
Consultant	ILF Consulting Engineers
Supplier	Company having signed the contract with the Employer
Third party	Independent experienced and approved expert/authorized institute
Employer supervision	Performs activities appointed by the Employer or defined in the contract on behalf of the Employer

1.3 Abbreviations

Term	Explanation
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IQI	Image quality indicator
MT	Magnetic particle testing method
MUT	Manual ultrasonic testing method
NDT	Non-destructive testing
PA	Phased array technique of Ultrasonic testing
PT	Liquid penetrant testing method
RT	Radiographic testing method
RT-I	RT (isotope)
TIG	Tungsten inert gas welding
TOFD	Time-of-flight diffraction technique of Ultrasonic testing
UT	Ultrasonic testing method
UT LII	Ultrasonic testing level 2 qualification
VT	Visual testing method
WPS	Welding Procedure Specification
WPR	Welder Performance Qualification
pWPS	Preliminary Welding Procedure Specification

1.4 References

Refer to the Project documents listed in the tender package for the NDT testing.

1.5 Codes and Standards

For this project the mandatory standards are ČSN EN standards.

No.	Number	Title
1	ČSN EN ISO 9712	Non-destructive testing - Qualification and certification of NDT personnel
2	ČSN EN ISO 17635	Non-destructive testing of welds - General rules

No.	Number	Title
		for metallic materials
3	ČSN EN 13480-5	Metallic industrial piping - Part 5: Inspection and testing
4	ČSN EN 13018	Non-destructive testing - Visual testing - General principles
5	ČSN EN 13927	Non-destructive testing - Visual testing - Equipment
6	ČSN EN ISO 17637	Non-destructive testing of welds - Visual testing of fusion-welded joints
7	ČSN EN ISO 5817	Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections
8	ČSN EN ISO 5579	Non-destructive testing - Radiographic testing of metallic materials using radiographic film and X- or gamma rays - Basic rules
9	ČSN EN ISO 17636-1	Non-destructive testing of welds - Radiographic testing - Part 1: X-and gamma-ray techniques with radiographic film
10	ČSN EN 13068-3	Non-destructive testing - Radioscopic testing - Part 3: General principles of radiosopic testing of metallic materials by X- and gamma rays
11	ČSN EN ISO 11699-1	Non-destructive testing - Industrial radiographic film - Part 1: Classification of radiographic film systems for industrial radiography
12	ČSN EN ISO 19232-1	Non-destructive testing - Image quality of radiographs - Part 1: Determination of the image quality value using wire-type image quality indicators
13	ČSN EN ISO 10675-1	Non-destructive testing of welds - Acceptance levels for radiographic testing - Part 1: Steel, nickel, titanium and their alloys
14	ČSN EN 25580	Non-destructive testing. Industrial radiographic

No.	Number	Title
		illuminators. Minimum requirements (ISO 5580)
15	ČSN EN ISO 16810	Non-destructive testing - Ultrasonic testing - General principles
16	ČSN EN ISO 16828	Non-destructive testing - Ultrasonic testing - Time-of-flight diffraction technique as a method for detection and sizing of discontinuities
17	ČSN EN ISO 17640	Non-destructive testing of welds - Ultrasonic testing - Techniques, testing levels and assessment
18	ČSN EN ISO 11666	Non-destructive testing of welds - Ultrasonic testing - Acceptance levels
19	ČSN EN 12668 – 1,2,3	Non-destructive testing - Characterization and verification of ultrasonic examination equipment
20	ČSN EN ISO 18563 – 1,2,3	Non-destructive testing – Characterization and verification of ultrasonic phased array equipment
21	ČSN EN ISO 16811	Non-destructive testing - Ultrasonic testing - Sensitivity and range setting
22	ČSN EN ISO 2400	Non-destructive testing - Ultrasonic testing - Specification for calibration block No. 1
23	ČSN EN ISO 7963	Non-destructive testing - Ultrasonic testing - Specification for calibration block No. 2
24	ČSN EN ISO 23279	Non-destructive testing of welds - Ultrasonic testing - Characterization of indications in welds
25	ČSN EN ISO 10863	Non-destructive testing of welds - Ultrasonic testing - Use of time-of-flight diffraction technique (TOFD)
26	ČSN EN ISO 15626	Non-destructive testing of welds - Time-of-flight diffraction technique (TOFD) -Acceptance levels
27	ČSN EN ISO 13588	Non-destructive testing of welds – Ultrasonic testing – Use of automated phased array technology

No.	Number	Title
28	ČSN EN ISO 19285	Non-destructive testing of welds - Phased array ultrasonic testing (PAUT) - Acceptance levels
29	ČSN EN ISO 9934-1,2,3	Non-destructive testing - Magnetic particle testing
30	ČSN EN ISO 17638	Non-destructive examination of welds - Magnetic particle testing
31	ČSN EN ISO 23278	Non-destructive examination of welds - Magnetic particle testing - Acceptance levels
32	ČSN EN ISO 3059	Non-destructive testing - Penetrant testing and magnetic particle testing - Viewing conditions
33	ČSN EN ISO 3452-1	Non-destructive testing - Penetrant testing - Part 1: General principles
34	ČSN EN ISO 3452-3	Non-destructive testing - Penetrant testing - Part 3: Reference test blocks
35	ČSN EN ISO 3452-2	Non-destructive testing - Penetrant testing - Part 2: Testing of penetrant materials
36	ČSN EN ISO 23277	Non-destructive examination of welds - Penetrant testing - Acceptance levels
37	ČSN EN ISO/IEC 17025	General requirements for the competence of testing and calibration laboratories
38	ČSN EN ISO 6520-1	Welding and allied processes - Classification of geometric imperfections in metallic materials - Part 1: Fusion welding
39	ČSN EN ISO 5817	Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections
40	ČSN EN 12732	Gas infrastructure - Welding steel pipework - Functional requirements
41	TPG 702 04	Gas mains and service pipelines of steel for maximum operating pressure up to 100 bar included

No.	Number	Title
42	TP-T01-01-01-03	Principles for the design, construction, reconstruction and repair of HP pipelines and connections up to 100 bar

All the referenced related standards and technical rules, as amended by later regulations, applicable at the moment of initiation of activities.

1.6 Priority of regulations, exceptions

The Supplier shall notify the Employer supervision/Third party, prior to initiation of activities, of any discrepancies between this specification, related documents, standards, codes and technical rules listed above or any other specifications involved in the selection procedure. In such cases, the Employer supervision/Third party shall provide a written precedence decision and/or comment prior to initiation of construction/activity.

2 QUALIFICATION REQUIREMENTS FOR NDT SUPPLIER

The Supplier providing NDT shall be accredited accordance with ČSN EN ISO / IEC 17025. At least 60 days before the initiation of works, the NDT Supplier shall prepare and submit for Employers/Third party's approval the technical conditions for implementation of individual NDT methods in the following minimum scope:

- Identification data of Supplier
- Technical description of equipment to be used for work
- Calibration certificates of equipment, gauges, blocks, probes and accessories
- Written procedures of testing for each individual NDT method
- Written instruction for individual NDT methods
- Test reports templates
- Qualification of internal personnel with professional CVs

The Supplier shall be certified and authorized by the State Office for Nuclear Safety, which is necessary for permission to handle ionization radiation sources:

- Controlled zone at transition workplaces
- Internal emergency plan
- Quality Assurance for activities important in terms of radiation protection
- Monitoring program

- Permission for handling ionization radiation sources
- and other documents in accordance with Act No. 18/1997 Coll.

The NDT Supplier shall compile detailed written procedures, so-called written procedures for individual NDT methods. These include documents containing detailed descriptions for the execution of individual NDT methods, which shall be approved by a personnel Level III.

The NDT Supplier and Employer (or Employer supervision) are the only personnel authorized to perform all NDT testing for Quality Control of welding works during construction (this does not apply to visual testing).

The NDT Supplier must issue weekly (or monthly) reports on NDT results. Shall be agreed on the regular weekly coordination meeting on site.

The format of the reports shall be approved by the Employer or Employer supervision

Reports on the tests shall be issued by a personnel with minimum Level 2 accordance with ČSN EN ISO 9712.

The Employer and Third party, with the minimum qualification of Level 2 as per ČSN EN ISO 9712, are authorized for supervision including interpretation of results and final approval.

The Employer and Third party are authorized for evaluation and the final decision in terms of interpretation of doubtful indications.

For the quality control of welded joints, the following methods shall be used:

- Visual testing (VT)
- Radiographic testing (RT) - RT-I (isotope)
- Manual ultrasonic testing (MUT)
- Manual TOFD technique of ultrasonic testing (TOFD)
- Automatic ultrasonic testing (AUT) including testing by TOFD and PA technique
- Magnetic particle testing (MT)
- Liquid penetrant testing (PT)

3 NDT PERSONNEL - QUALIFICATION REQUIREMENTS

Non-destructive testing of welds shall be performed by qualified personnel in accordance with ČSN EN ISO 9712.

- Visual testing of all welds shall be performed by a personnel with Level 2 qualification in accordance with ČSN EN ISO 9712.

- Radiographic tests shall be performed by personnel with minimum Level 1 qualification in accordance with ČSN EN ISO 9712. These tests shall be performed under supervision of a personnel with minimum Level 2 qualification in accordance with ČSN EN ISO 9712.
- Interpretation and evaluation of radiographic testing results shall be performed by personnel with Level 2 qualification in accordance with ČSN EN ISO 9712.
- Ultrasonic tests, magnetic particle tests and liquid penetrant tests, including interpretation and evaluation of results, shall be performed by personnel with minimum Level 2 qualification in accordance with ČSN EN ISO 9712 for given method.
- In addition the NDT personnel performing ultrasonic tests (AUT/MUT) using TOFD and/or PA technique and interpretation of data shall have documented training and experience with TOFD and PA technique.

The Supplier's personnel executing interpretation of RT and UT results shall have five-year documented experience with this work as the minimum.

The Supplier shall employ or appoint at least one NDT personnel with Level 3 qualification in accordance with ČSN EN ISO 9712, who shall prepare and ensure the management of the Supplier's NDT procedures, ensuring an employee(s) for interpretation of doubtful indications with Level 3 qualification in accordance with ČSN EN ISO 9712 for given method.

The Employer and Third party are authorized to verify the qualification of the personnel carrying out non-destructive tests and related activities complying with the testing procedures.

4 SCOPE AND CONDITIONS OF NDT TESTS FOR INDIVIDUAL TYPES OF WELDS & MATERIALS

4.1 Testing methods

Depending on the specific Project conditions, NDT equipment and personnel availability, welding method and the technology used, the testing method shall be performed as specified in the Chapter 4.2 of this specification

The testing method selected for girth welds shall be capable of producing permanent records from tests as well as permanent records of test results including appropriate reports. For other tests, the progress and results shall be recorded in test reports. The testing methods shall be selected prior to start of welding by the Employer and Third party.

The Employer and the Third party are authorized to decide on the NDT method for individual welds and to make the final decision in case of interpretation of doubtful indications.

4.2 Scope of non-destructive testing

The minimum scope of non-destructive testing for individual weld types and welding methods shall meet the application design and welding standards and requirements listed in the table below.

Scope of non-destructive testing

Type of weld inspection	Inspected item	Scope of non-destructive testing				
		VT	RT-I	AUT	MUT, TOFD (7)	MT/ PT
I	Girth butt welds in the line executed using mechanical welding method (a)	100%	100% (1)	100% (1)	-	(2)
II	Girth butt welds in the line executed using manual welding method (b)	100%	100%	-	100% (8)	(2)
III	All other girth butt welds in the line executed using manual welding method (c)	100%	100%		100% (8)	(2)
IV	Golden Welds (d)	100%	100%		100%	(2)
V	Repaired parts of any weld	100%	100%		100%	100%(2)
VI	Branch connections and fillet	100%	-		(4)	100%
VII	Welds on weld-on fittings of TDW type girth welds	100% 100%	-	-	100%	100% 100%
VIII	Selection of location for branch offsets, possibly for execution of pipe connection lines	100%	-	-	100%	100%
IX	Weld bevels in the site	100%	-	-	100%	100% (5)
X	Arc strikes and crater cracks	100%	-	-	100%(6)	100% (3)

General notes:

RT-I - isotope radiography using Ir 192 for material thickness ≥ 10 mm.

AUT and MUT - automated and manual ultrasonic method/TOFD can only be used for thickness $t \geq 8$ mm.

For weld repairs, refer to the Chapter 7.

Notes to Inspected items showed in the table:

- a) Welding in protective atmospheres, which allows the root layer to be welded using manually covered electrode or TIG method.

- b) Manual welding using covered (basic) electrode + welds listed in (a) and welds designated by the Employer or a Third party.
- c) Transition welds between pipes of different thickness, connection line welds, T-piece welds, bends, reducers, fittings etc.
- d) Welds not subjected to water pressure test and welds in protective tubing/protective pipes. (Golden/Guarantee Welds)

Notes to Scope of work showed in the table

1. AUT testing shall be performed as a preferred method (weld inspection method). For the start of everyone welding front 100% of the first 3 days production and the first 100 welds (both conditions shall be met), shall be also performed 100% radiographic test (this always applies in case of break of welding works longer than 1 month for all types of welding). If the piece reparability based on RT results is $\leq 10\%$, Employer can - after 3 days of production and after the first 100 welds are executed (both conditions shall be met) - decide on reduction of the RT testing scope to the minimum of 10%. If the piece reparability based on RT result is over 10% (after 3 days of production and after the first 100 welds are executed, both conditions shall be met) the Employer shall specify the RT testing scope, which can be the minimum of 20%. If the piece reparability based on RT results does not drop back to $\leq 10\%$ after 100 subsequent welds, the Employer can increase the RT testing scope to 100%. This 100% AUT and RT testing shall be performed until the piece reparability based on RT results drops back to $\leq 10\%$ for 100 subsequent welds and 3 days (both conditions shall be met). Only Employer can decrease the RT testing scope to 10%. In all cases, it is Employer who decides on the percentage of scope of RT testing.
2. For interpretation of doubtful indications, if required
3. To ensure elimination of the defect (prior to weld repair)
4. If practicable
5. If flame cutting was used
6. for verification of residual wall thickness after grinding
7. Application is specified in the next chapters of this specification
8. Employer decides of the use

4.3 Allowed Moment of the NDT test

Usually, NDT of welds is performed after the final heat treatment and cool down of the weld. The moment of test can be modified based on Employer's written approval. For Golden Welds, the NDT is performed after the minimum delay of 12 hours.

4.4 Weld identification

Each weld shall be assigned a unique identification number. In each weld, a zero point shall be marked, corresponding to the pipe top, and testing direction (marked in the direction of gas flow). This also applies to welds to be cut out. Any faults and defects subject to rejection shall be clearly marked on the pipe weld in a suitable manner, e.g. by a permanent marker pencil (indelible ink), prior to the weld repair shall be done.

4.5 Welding procedure qualification and testing

Prior to start of production each preliminary welding procedure, pWPS, shall be qualified according to ČSN EN ISO 15614-1 including the additional requirements given in this specification.

The qualification test shall be performed on steel with the highest specified minimum yield strength/maximum carbon equivalent, to be covered by the necessary WPS.

Welding of test joints covering all welding, including joints between structural elements and piping components and repair welding, shall be done under conditions similar to site conditions.

All results from the qualification test shall be reported and documented by the WPQR (including attachments) which shall be submitted to Employer / Third party for approval.

The test joints shall be 100% visually, radiographically as well as ultrasonically tested complying with this specification.

Based on the NDT results the Employer / Third party can decided to performed the mechanical testing provided in the scope of welding qualification process. The mechanical testing has to be included but is not limited to the Macro Examination, Hardness Test and Notch Toughness Test /Charpy V-impact test.

4.6 Support and coordination of work on site

NDT Supplier is required to provide necessary support to the station contractor during execution of construction work. The responsible manager / Work coordinator of NDT Supplier shall take part on the regular weekly site- coordination meetings and participant in the preparation of detailed time schedules and work organization between both parties.

5 METHODS OF NON-DESTRUCTIVE TESTING

5.1 Visual testing (VT)

All welds and weld repairs shall be subjected to full-scope visual testing, which shall be performed in accordance with ČSN EN ISO 17637.

The visual testing shall be performed by the Supplier of welding works through a personnel with Level 2 qualification in accordance with ČSN EN ISO 9712, both during welding and after finalization of the weld. This will guarantee the weld quality for further NDT; the visual testing shall be permanently recorded next to the weld, specifying the date and result of the testing.

The visual testing shall include the weld cap, both heat affected zones and - if possible in terms of safety – accessibility, the internal surfaces (roots). The testing shall be performed under acceptable conditions, namely with respect to lighting of the weld surface (minimum 350 lx, recommended 500 lx).

Acceptance or rejection of any weld shall be recorded in the visual testing report. The report format is subject of the Employer approval.

In case of cracks or other damage, the personnel shall report this fact to the Employer supervision/Third party. If the weld execution is not acceptable, a thorough investigation of the reason shall be performed. Further welding/repair work on the existing welds can only start after the reason of any defects is found and necessary corrective actions are taken. If necessary, the Employer representative or Third party shall decide on re-qualification of WPS. The new initial condition shall be reconfirmed by a new visual testing.

5.1.1 Equipment

Product irregularities, deviations, imperfections or defects shall be found either by visual testing without any aids, or using simple aids (magnifying glasses, surface etalons, gauges, templates, weld scales, angle gauges, test plates etc.), or using complex technical devices/equipment (endoscopes, cameras/video-cameras etc.). In both cases, however, the inspected surfaces shall be sufficiently illuminated by daylight or - mostly - artificial light. Testing devices and equipment shall be in accordance with ČSN EN 13927. The testing shall be performed using aids with respected industrial quality level.

5.1.2 Required documentation of NDT(VT)

The test report shall cover the following items as the minimum:

- Name of contractor providing - welding work
- NDT Supplier's name

- Third Party Identification
- Material identification
- Weld type
- Material thickness
- Welding method (WPS)
- Acceptance criteria
- Defects exceeding the acceptance limits incl. their locations
- Scope of testing with references to appropriate documents/ drawings
- Equipment used for testing
- Testing results with references to acceptance criteria
- Testing date/place
- Name, valid qualification and signature of the personnel who performed the testing

5.1.3 Acceptance criteria

Any defects found shall be marked in accordance with ČSN EN ISO 6520-1. The weld itself as well as the adjacent surfaces shall be without of any cracks, craters, pits or other surface defects and shall be executed in accordance with ČSN EN ISO 5817, Quality Level B.

5.2 Radiographic testing (RT)

The radiographic test shall be performed in accordance ČSN EN ISO 17636-1 (Test Class B) and ČSN EN ISO 5579.

The tests shall be performed using gamma rays with iridium-192 or selenium-75 as the gamma source.

Supplier of NDT shall have RT pipeline crawler for centric exposure.

In case of gamma source application, supplier of NDT shall have at least 3 isotope emitters Ir 192 with activity at least 60 Ci. The Employer can require the NDT Supplier of isotope emitters Ir 192 with activity at least 90 to 100 Ci, especially for RT double wall exposure of large diameters and wall thicknesses of the pipes.

The acceptable material thickness range for gamma rays are provided in Table 2 of ČSN EN ISO 17636-1. The Employer permits reducing these values to 10 mm (for Ir 192) or 5 mm (Se 75). For thickness under 10 mm, Se 75 shall be used as the radiation source. If some exception from this article is used, the required radiographic sensitivity shall be reach for particular thickness. All deviations are subject to Employer approval.

Radiographic tests shall be carried under the pipe surface temperatures ranging from - 5°C to +50°C. The surface shall be free of welding spatter, paints, coatings, dirty, rust, oxides or other substances that could mask the defect detection process. Radiographic testing can only be started after confirming of the sensitivity/quality of this method on specific welds (usually, on welds executed as part of qualification of the welding procedure).

If the radiographic test takes place in the area of a steel structure or concrete floor or another concrete surfaces, the radiographic film shall be shielded from the back-scattered radiation using a lead shield of sufficient thickness. The presence of back-scattered radiation shall be confirmed by a lead character „B” in accordance with ČSN EN ISO 17636-1.

Test arrangement of the radiographic test shall be set up so as to achieve the maximum detection rate of unacceptable defects. For all girth welds, the centric radiography test arrangement is preferred, with the radiation source situated inside the pipeline. In case this radiography test arrangement cannot be used for technical reasons (Golden Welds, inaccessible welds, certain welds in stations etc.), it is necessary to use the method of irradiation a double wall exposure single wall viewing. Radiographic test shall also include the repaired parts of welds and adjacent parts of welds over the minimum length of 100 mm. The selected radiography test arrangement shall allow full-scope testing of the weld volume and minimum width of the evaluated area of 10 mm on both sides from the weld edge.

5.2.1 Equipment

For radiographic testing a lead meter shall be placed around the pipe to exact determination of the position of indication.

The test start - so-called zero point - shall be identical to the top point of the pipe; the measurements shall proceed in the direction of gas flow. This direction shall be marked on the pipeline using an indelible paint, starting from the top. A record of the radiographic test shall be permanently marked next to the weld, specifying the date of testing.

The radiographic films used for testing shall be of sufficient quality in accordance with ČSN EN ISO 11699-1. Radiographic films class C4 in accordance with ČSN EN ISO 17636-1 shall be used.

The minimum density of radiogram for Class B is 2.3; the maximum value depends on the limits of the negatoscope used. The maximum permitted fogging is 0.3.

The radiographic quality shall be evaluated using wire image quality indicators manufactured according to ČSN EN ISO 19232-1. Quality of image accordance with Class B ČSN EN ISO 17636-1 shall be reached.

When the pipeline with diameter 200 mm and bigger are tested using centric exposure, minimally 3 image quality indicators shall be placed along the pipe perimeter in regular intervals. The radiographic films where the image quality indicators are displayed are considered as typical images for the entire perimeter.

The radiographic films shall be developed under the conditions recommended by the radiographic film manufacturer, using chemicals needed for the required radiographic film system class.

The radiograms shall be displayed, evaluated and assessed using a negatoscope with infinitely adjustable illumination intensity, which allows reception of information under various (acceptable) values of optical density in accordance with ČSN EN 25580.

Each radiogram shall be clearly marked with designations (the designation shall consist of numbers and letters included in the frame together with given weld). Each weld repair shall be marked at the weld in the radiogram as well as in the report by the character "R".

The radiograms must be identifiable, as the minimum, by the reference number of the pipeline, weld number, date of radiographic test and repair reference number.

The weld position shall be indicated for all welds in the pipe book with references to the numbering system described above. The conformity of the pipe book with weld positions shall be ensured by the Supplier.

After finishing the construction Project, all radiograms and related reports shall be indexed, catalogued, packed in boxes and handed over to the Employer as part of the documentation package.

Acceptance or rejection of any weld shall be recorded in the radiographic test report. The report format shall be approved by the Employer in advance.

5.2.2 Required documentation of NDT(RT)

The test report shall cover the following items as the minimum:

- Name of contractor providing welding work
- NDT Supplier's name
- Third Party Identification
- Material identification
- Heat treatment
- Weld geometry
- Material thickness

- Welding procedure (WPS)
- Test specification incl. acceptance requirements
- Radiography test arrangement and class, required sensitivity of image quality indicators (IQI) in accordance with ČSN EN ISO 17636-1
- Test arrangement in accordance with as per Chapter 6.1 of ČSN EN ISO 17636-1
- Method of designation used
- Scheme of radiographic film test arrangement
- Radiation source, type and size of radiation center and identification of the equipment used
- Radiographic film, foil and filters
- Voltage/current of X-ray tube or source activity
- Exposure period and source/radiographic film distance
- Method of radiographic film development: manual/automatic
- Type and layout of image quality indicators (IQI)
- Test results with final assessment: acceptable/unacceptable
- Radiographic film density, information of image quality indicator (IQI)
- Deviations from regulatory requirements
- Name, certificate and signature of the person in charge
- Date of radiographic testing and test report

5.2.3 Acceptance criteria

Any defects found shall be marked in accordance with ČSN EN ISO 6520-1. Any defects detected during radiographic test shall be evaluated in accordance with ČSN EN ISO 10675-1, Acceptance Level 1 Considering VT results.

5.3 Ultrasonic testing (UT)

Ultrasonic tests are especially used to detect planar defects such as cracks, lack of fusion, incomplete penetration and laminations, to measure wall thickness and to detect larger separated volume defects in the material. The test also allows detection and evaluation of defects in the basic material as well as the welded joints.

Ultrasonic testing can only be performed under the pipe surface temperature ranging from -5 to +50 °C with respect to the coupling, which shall ensure constant possibility of actual defect detection rate (reduced coupling means lower detection rate). The surface shall be free from welding spatter, paints, coatings, dirty, rust, oxides or other substances

that may cause a different absorption from that obtainable from the sample calibration piece. Especially the application of time-of-flight diffraction (TOFD) requires relatively smooth, flat and clean surfaces.

Furthermore, the system shall offer suitable tools for storage, analysis and visual presentation of data. Ultrasonic testing shall be performed by manual ultrasonic testing (MUT manual TOFD technique and automatic ultrasonic testing (AUT) in scope mentioned in chapter 4.2. The probes shall be clearly marked with the manufacturer's name, crystal type and size, frequency and angle.

Acceptance or rejection of any weld shall be recorded in the ultrasonic test report. The report format shall be subject of the Employer approval in advance.

A record of any UT test shall be permanently marked on the location of the weld including the date of testing.

5.3.1 Manual ultrasonic test (MUT)

The manual ultrasonic test shall be performed in accordance with ČSN EN ISO 17640 (Test Class B) and ČSN EN ISO 16810 in case of conventional UT or in accordance with ČSN EN ISO 13588 (Test Class B) and ČSN EN ISO 16810 in case of PA technique of UT.

Apart from using the conventional or PA ultrasonic equipment, the NDT Supplier shall be capable to perform the weld testing using a manual TOFD ultrasonic instrument too. The TOFD method shall be mainly used for testing of Golden Welds and selected welds of the pipeline. TOFD tests shall be performed in accordance with ČSN EN ISO 10863, Test Class C, and ČSN EN 12732, Annex C, with evaluation in accordance with ČSN EN ISO 15626, Acceptance Level 1. Employer has a right to decide about usage of TOFD technique.

The ultrasonic testing system for conventional UT and TOFD technique including the probes used shall meet the minimum requirements specified in ČSN EN 12668-1, -2 and -3.

The ultrasonic testing system for PA technique including the probes used shall meet the minimum requirements specified in ČSN EN 18563-1,-2 and -3.

In case of use of conventional UT the sensitivity (size of defects) shall be determined based on method No. 2 (AVG) in accordance with ČSN EN ISO 17640 and ČSN EN ISO 16811. In case of use of PA technique, the mode of line scan with S-scan at fixed probe position to the weld is required together with evaluation based on signal amplitude and indication length in accordance with ČSN EN ISO 13588 and ČSN EN ISO 19285. At this case the sensitivity (size of defects) shall be determined based on method No. 1 (TCG technique) in accordance with ČSN EN ISO 17640.

MUT shall be used for selection of places for welding any branches, i.e. for fillet welds, to eliminate laminations in the material; the detailed test scope is specified in Chapter 4.2.

If flame cutting is used on pipe ends, the new bevel shall be prepared in accordance with the approved procedures. If the pipe is cut back more than 25 mm from the factory bevel, the pipe end shall be MUT tested, too, to ensure that no laminations are present.

After removal of arc burns by grinding the defective area shall be examined by MUT to guarantee the compliance with the minimum pipe thickness requirement.

5.3.2 Acceptance criteria of MUT

Any defects found by conventional ultrasonic tests shall meet the Acceptance Level 2 in accordance with ČSN EN ISO 11666. Any defects found by PA technique of ultrasonic tests shall meet the Acceptance Level 2 in accordance with ČSN EN ISO 19285 with evaluation based on signal amplitude and indication length.

Sizing defects using TOFD shall be performed in accordance with the requirements of ČSN EN ISO 15626 Acceptance level 1 including total length of indication, mutual distances and grouping indications and the number of point indications.

5.3.3 Automatic ultrasonic test (AUT)

For automatic ultrasonic testing, the SUPPLIER shall provide an ultrasonic testing system with Phased Array (PA) and TOFD technique suitable for testing of the weld from both sides next to weld in a single circumferential scan. This ultrasonic testing system shall be able to continuously make a beam steering, beam focusing and beam movement within the PA probe elements (depending on the weld bevel geometry and weld layers) to ensure complex examination of the entire weld volume. The AUT system shall be able to reliably make a testing on the pipes within manufacturing tolerances in accordance with ČSN EN ISO 3183 and Project specifications.

This AUT system shall allow to use the pulse-echo technique and time-of-flight diffraction technique (TOFD) of ultrasonic method.

The AUT system shall perform the testing the weld including the evaluation in accordance with written testing procedures approved by the EMPLOYER.

The AUT system shall meet the following minimum requirements:

Methodology:

- Combination of PA testing technique with TOFD technique, which should be complementary together regarding of test coverage
- Capability of detection of longitudinal defects in girth welds
- Capability of detection of transverse defects in girth welds

- Capability of full coverage of the weld volume and heat affected zones in the minimum range of 10 mm on both sides next to the weld
- Tests using ultrasonic PA technique shall be in accordance with ČSN EN ISO 13588, Class B, using S-scan at fixed probe position to weld (line scan) for longitudinal and transverse defects
- Tests using ultrasonic TOFD technique shall be in accordance with ČSN EN ISO 10863, Class C + ČSN EN 12732, Annex C
- Evaluation using PA testing technique shall be in accordance with ČSN EN ISO 19285, Acceptance Level 2, based on length of indication and amplitude of signal, including evaluation of mutual distances and grouping indications and cumulative length of indications
- Evaluation using TOFD testing technique shall be in accordance with ČSN EN ISO 15626, Acceptance Level 1, including total length of indication, mutual distances and grouping indications and the number of point- like indications
- Determination of defect length using the method of signal amplitude drop below evaluation level shall be used for PA and conventional UT technique
- AUT system shall continuously verify the quality of acoustic coupling during scanning and on the stored data
- Sensitivity setting and regular checking of setting shall be performed on an approved reference sample/block
- The operators of system shall have sufficient qualification UT Level II in accordance with ČSN EN ISO 9712 / ČSN EN 473, documented special training for TOFD and PA technique of UT methods and documented required experience
- The ultrasonic equipment used in the AUT system shall have valid calibration in acc.to ČSN EN 12668 and ČSN EN ISO 18563 standards (when PA technique is used)
- The system shall have the accuracy of distance read-out by encoder within $\pm 1\%$ of actual distance moved. This accuracy shall be demonstrated by moving the encoder along a minimum distance of 500 mm. A calibration check of encoder accuracy shall be performed at intervals not to exceed one month or prior to first use thereafter.
- Max. scanning speed shall be 150 mm/s for case, when visual monitoring and evaluating of data during scanning is necessary. Otherwise, the scanning speed is limited only by acquisition of quality data fulfills the requirement of missing data lines from standards

Mechanical:

- Suitability of the AUT system for field working in various weather conditions in temperature range -5 °C up to +50°C
- Self-sufficient system in terms of power supply and water couplant feeding in the field
- Possibility of fast and distinct clamping and positioning of guide collar, rim or chain, probe holders and probes in the testing position on the tested material's surface
- Proper guidance and maintenance of probes at correct positions, also with respect to the longitudinal weld axis within a tolerance of +/- 2 mm during the entire process of scanning and data acquisition
- Maintenance of correct probe pressure and homogeneous acoustic coupling during scanning
- Capability of operative adjustment to another tested thickness or weld type

Software:

- Software shall be able to setting of all parameters for testing, scanning and evaluation of indications
- On-line data presentation during scanning
- Capability of displaying and evaluation of the quality of acoustic coupling during scanning
- Automatic evaluation of joint quality using software based on entered parameters, for PA UT technique is preferred and, if possible, also for TOFD technique.
- When automatic evaluation of data from weld joint is not possible, by the software, the system shall be able to immediately unbiased transfer of captured data without any distortion of data, for the operator to perform evaluation. The maximal acceptable time for evaluation of one weld is 2 hour from finishing of weld scanning
- Possibility of analysis of captured data by the operator including the capability of displaying the position of indication and signal amplitude
- System shall be able to automatically data storage, back-up and archiving
- Possibility of off-line displaying and evaluation of captured data on external PC
- When automatic evaluation of data by the software is used, the system shall be able automatically to distinguish and evaluate geometrical indications in the root area of weld from defect indications

- Possibility of displaying a summary of the defects exceeding registration level for each scan/weld, specifying accurate position and acceptability for each defect. In case of unacceptable defect, the reason shall be indicated (as the minimum, single defect/grouped defect/cumulative defect)
- Possibility of generating a test report (sufficiently for one test batch), stating the basic setup parameters (especially the Gain). The test report shall be well-arranged and clear, with a non-editable indication of time and date. It should also contain the defect positions including in the direction of material thickness, defect size (i.e. length and amplitude) and reason of rejection
- The software capability of changing of parameters for evaluation in saved data and backward re-evaluation of data in off-line mode of AUT system will be advantage.

5.3.4 Conditions and verification of detection capability of AUT

For reliable scanning the surface next to the weld shall be properly prepared (cleaned surface, max. gap between probe and material 0.5 mm, all insulation material and coatings removed) up to the distance from the weld edge on both sides specified by the NDT supplier, but max. 120 mm.

The proper execution of the welded joint without unacceptable linear misalignment (Hi-low) and defects detectable by visual testing shall be ensure for AUT testing and correct evaluation of weld joint. Location of crossing of spiral welds of pipes and to girth weld shall be without flattening, with properly ground spiral weld.

The AUT system shall successfully demonstrate the testing written procedure capability of detection and evaluation of defects on a reference sample of girth weld provided by the Employer. The detailed description of demonstration process and reference sample is state in separated Employer document.

The reference sample (mockup) will have the parameters identical with the tested part and weld joint, i.e. the sample will be made of the same material with identical heat treatment. The weld on the sample will be execute using the same welding technology with identical dimensions, geometry, bevel, configuration, surface curvature, roughness and surface condition.

The critical defects (artificial natural) will be placed in the reference sample. These defects simulate all critical defects by their size, character and orientation. The sample will also contain the geometrical deviations (eventual weld backing, pipe misalignment).

5.3.5 Acceptance criteria of AUT

Evaluation of results from AUT testing shall be performed in accordance with requirements of written testing procedures approved by the EMPLOYER. Any defects

found by automatic ultrasonic testing (AUT) system shall meet the requirements of standards.

- Evaluation of PA technique shall be in accordance with ČSN EN ISO 19285. Acceptance Level 2, based on length of indication and amplitude of signal, including value of mutual distances and grouping indications and length of indications.
- Evaluation of TOFD technique shall be performed in accordance with ČSN EN ISO 15626, Acceptance Level 1, including total length of indication, mutual distances and grouping indications and the number of point-like indications.

5.3.6 Required documentation of NDT(UT)

The NDT Supplier shall issue the test report and to hand it with saved rough data from each tested weld to the Employer/Third party in a state of enables to verify the data and sign the report.

The test report shall cover the following items as the minimum:

- Identification of tested object
- Name of contractor providing welding work
- Supplier's name of NDT work
- Third Party (if nominated from Employer)
- Identification of tested subject
 - Product materials and shapes Dimensions
 - Position of weld/tested welded joint
 - Drawing of geometric layout (if applicable)
 - Reference to welding procedure, specification and heat treatment
 - Manufacturing condition
 - Surface condition
 - Ambient temperature
- Contractual requirements, e.g. specifications, standards, directives, special agreements etc.
- Place and date of test
- NDT personnel of supplier and Third Party certification
- Manufacturer and type of ultrasonic equipment with identification/serial number

- Manufacturer, type, nominal frequency, crystal size and actual refraction angle of the conventional or TOFD probes used
- Manufacturer, type, nominal frequency, element size, pitch, number of elements, configuration and actual refraction angle of the PA probes used.
- Identification of reference blocks
- Result of tests of base material
- Written procedure / Written instruction
- Method and values used for sensitivity setting (setting of gain for reference levels and values used for correction of transfer losses)
- Standards for Acceptance Levels and reference to the standard ČSN EN ISO 11666 or ČSN EN ISO 19285 or ČSN EN ISO 15626
- Deviations from international standard ČSN EN ISO 17640, ČSN EN ISO 11666 or ČSN EN ISO 13588, ČSN EN ISO 19285 or ČSN EN ISO 10863 ČSN EN ISO 15626 or from contractual requirements
- Coordinates of indications related to the coordinate system and detailed data of corresponding probe positions during scanning
- Maximum echo amplitude and information on the type and size of indications
- Indication lengths and dB value of exceeding the registration level for conventional UT and PA. Indication lengths and height for TOFD
- Evaluation of results in accordance with the specified Acceptance Levels

5.4 Magnetic particle testing (MT)

Magnetic particle testing shall be performed in accordance with ČSN EN ISO 17638 with respect to the requirements of ČSN EN ISO 3059.

Prior to start of testing, the tested surfaces shall be ground and free of welding spatter, paints, coatings, dirty, rust, oxides, slag, oil or other residual substances and shall not contain any notches or scratches that could have an adverse impact on the test results.

The tests shall be carried under the pipe surface temperatures ranging from +5 to +50°C.

Magnetic particle testing shall ensure complete elimination of defects (namely cracks) after repair prior to welding.

Magnetic particle testing can be used as a supplementary test to radiographic testing as well as for the interpretation of doubtful indications in radiograms.

Magnetic particle testing shall be used for all fillet welds for selection of locations of welded-on pieces, testing of welded-on joints and elimination of cracks on the pipe surface; see the nondestructive testing scope, Chapter 4.2.

Acceptance or rejection of any weld or bevel shall be recorded in the magnetic particle test report. The report format shall be approved by the Employer in advance. If an unsatisfactory indication is found, it shall be photographed and the picture shall be added into the MT report. Prior to start of testing, the sensitivity/quality of this method shall be verified on specific welds. This verification can also be performed on welds executed as part the welding procedure qualification. A record of the magnetic particle test shall be permanently marked next to the weld, specifying the date of testing.

5.4.1 Equipment

The test shall be performed using aids with respected industrial quality level. The dry powder can only be used with written agreement of the Employer. The testing equipment and instruments shall be in accordance with ČSN EN ISO 9934-3 and ČSN EN ISO 9934-2.

5.4.2 Required documentation of NDT(MT)

The test report shall cover the following items as the minimum:

- Identification of tested object
- Name of contractor providing welding work
- NDT Supplier's name of NDT work
- Third Party (if nominated from Employer)
- Basic material and weld material
- Heat treatment after welding (if applicable)
- Joint type
- Material thickness
- Welding procedure
- Temperature of tested object, if different from normal ambient temperature
- Identification of testing procedure and description of used parameters including:
 - Magnetization type
 - Current type
 - Testing aid
 - Displaying conditions

- Details and results of verification of the testing procedure used
- Acceptance Levels
- Description, dimensions and position of all indications found + photographs of all indications found shall be attached to the report
- Names, valid qualification and signatures of the persons who performed the test

5.4.3 Acceptance criteria

Indications found by magnetic particle testing must meet the requirements defined in ČSN EN ISO 23278, Acceptance Level 2X.

5.5 Liquid penetrant testing (PT)

Liquid penetrant testing shall be performed in accordance with ČSN EN ISO 3452-1.

Prior to start of test, the tested surfaces shall be ground and free of welding spatter, paints, coatings, dirty, rust, oxides, slag, oil or other residual substances and must not contain any notches or scratches that could have an adverse impact on the test results.

Liquid penetrant testing shall be used for all fillet welds for selection of locations of welded-on pieces, testing of welded-on joints and elimination of cracks on the pipe surface; see the non-destructive testing scope, Chapter 4.2.

The tests shall be carried under the pipe surface temperatures ranging from +5 to +50°C.

Acceptance or rejection of any weld shall be recorded in the liquid penetrant test report. The report format shall be approved by the Employer in advance. If an unsatisfactory indication is found, it shall be photographed and the picture shall be added into the PT report. Prior to start of testing, the sensitivity/quality of this method shall be verified on specific welds. This verification can also be performed on welds executed as part the welding procedure qualification. A record of the liquid penetrant test shall be permanently marked next to the weld, specifying the date of testing.

5.5.1 Equipment

The test shall be performed using aids with respected industrial quality level. The penetrant test system used shall be neutral in terms of development of any form of corrosion. In case the corrosion characteristics and other properties of the penetrant test system in combination with the pipe material are not known it is necessary to perform corrosion and other tests complying with ČSN EN ISO 3452-2. Control indicators shall be used in accordance with ČSN EN ISO 3452-3.

5.5.2 Required documentation of NDT(PT)

The test report shall cover the following items as the minimum:•

- Identification of tested object
- Name of contractor providing welding work
- NDT Supplier's name of NDT work
- Third Party (if nominated from Employer)
- Execution data
 - Designation
 - Dimensions
 - Material
 - Surface condition
 - Production stage
- Written procedure of the test
- Designation of the penetration system used, name of manufacturer, designation and batch number of agent
- Testing regulations /Code
- Deviations from Code
- Test record (description, position, dimensions and evaluation of the indications found) + photographs of the indications found attached to the report
- Place/date of test
- Name, valid qualification and signature of the personnel who performed the test

5.5.3 Acceptance criteria

Indications found by liquid penetrant testing shall meet the requirements defined in ČSN EN ISO 23277, Acceptance Level 2X.

6 GOLDEN WELDS

Golden Welds, i.e. welds not subjected to water pressure test, shall be subjected to the following NDT testing:

- Visual inspection, which shall be performed in accordance with ČSN EN ISO 17637, with evaluation in accordance with ČSN EN ISO 5817, Quality Level B.

- Radiographic test, which shall be performed in accordance with ČSN EN ISO 17637-1 (Test Class B), with evaluation in accordance with ČSN EN ISO 10675-1, Acceptance Level B.
- Manual ultrasonic test using the TOFD technique, which shall be performed in accordance with ČSN EN ISO 10863, Test Class C, and ČSN EN 12732, Annex C, with evaluation in accordance with ČSN EN ISO 15626, Acceptance Level 1. TOFD method can only be used if the Golden Weld joins walls thickness difference is less than 3,5 mm.
- If the Golden Weld joins walls of thickness higher than 3,5 mm (weld joint by ball valves elbows or other fittings) the golden weld shall be tested by MUT without TOFD from one side only with two or three angles of refraction or by PA technique with S-scan. Manual ultrasonic testing shall comply with ČSN EN ISO 17640 (class B), ČSN EN ISO 16810 with evaluation accordance with ČSN EN ISO 11666 Acc. level 2. Manual PA ultrasonic testing shall comply with ČSN EN ISO 13588 (class B) with evaluation accordance with ČSN EN ISO 19285 Acc. level 2, based on length of indication and amplitude of signal. Manual ultrasonic testing from one side relating to different wall thicknesses is subject to written Instruction approved by Employer / Third party.

7 WELD REPAIRS

Weld repairs shall be performed using the same NDT method as during tests, but if the weld was tested by AUT the repair weld shall be tested by RT and manual TOFD technique. If the weld was tested with both methods RT and TOFD (most often Golden welds) the repair weld shall also be tested with the same methods RT and TOFD.

The requirements for these methods are identical to Chapter 5.

8 DESTRUCTIVE WELD TESTS

For the high pressure gas pipelines designed according to ČSN EN 1594, destructive tests of field welds shall be provided. The minimum scope of destructive tests is stipulated by Table 5 in ČSN EN 12732. The cut weld sample shall be a representative sample for all executed welds. This means that given number of samples shall be selected for each welding method. Prior to cutting, the weld shall be tested by a nondestructive method. The NDT result shall not be used to determine the location of the test sample; it shall only be assessed for the interpretation of doubtful mechanical test results. The weld for destructive test shall be selected by the specialist from Employer / Third Party.

The weld cut-outs for destructive tests, preparation of samples from such welds and subsequent re-welding shall be ensured by the Supplier in the presence of the Employer /Third Party. The subsequent destructive tests shall be ensured by the Third Party through a company, which shall be accredited and approved by the CUSTOMER in advance.

If the destructive tests are not satisfactory, it is necessary to stop the welding works and perform further tests for the weld under test or for other welded joints. Further welding / repair work on the existing welds can only start after the cause of any defects is found and necessary corrective measures are taken. The new initial condition shall be re-confirmed by a new destructive test. If necessary, the Employer and / or Third Party shall decide on re-qualification of WPS.

9 NDT IN STATIONS

All butt girth welds executed in stations shall be subjected to full-scope visual testing and full-scope radiographic test. Golden Welds executed in stations shall be subjected to full-scope visual testing, full-scope radiographic test and full-scope TOFD ultrasonic test. .Prior to welding any fillet weld, the location of weld shall be selected using manual ultrasonic test to eliminate laminations in the material, and magnetic test to eliminate cracks on the pipe surface. All field fillet welds shall be subjected to full-scope visual testing and full-scope magnetic particle test or full-scope liquid penetrant test. The requirements for these methods are identical to Chapter 5.

In respect to selection of locations for branch welding: Prior to welding any branch, i.e. fillet weld, the location shall be tested using the magnetic particle method to eliminate surface cracks, and manual ultrasonic test to eliminate laminations in the material. Magnetic particle testing shall be performed in accordance with ČSN EN ISO 10893-5 evaluation level M1. Manual ultrasonic tests shall be performed and evaluated in accordance with ČSN EN ISO 10893-8, Acceptance Level U0.

10 CLIMATIC CONDITIONS

In case of wind, rainfall, snowing, low temperatures etc., NDT shall be suspended unless appropriate protective measures are taken. These measures can include suitable shelters for the testing personnel and for locations under tests. For this purpose, the NDT Supplier must ensure that these shelters are enclosed on all sides; the shelters can be used at various places of testing. Possible solutions include tents. Under temperatures below freezing point, a heat source shall be used or it is necessary to select a suitable method allowing the tests and evaluation to be performed. Under temperatures below freezing point, it is not acceptable to use testing methods, where there is a risk of

freezing or impaired quality of evaluation. The NDT Supplier shall be equipped with sand and salt for frost protection during winter season. If the NDT inspector finds out that the measures taken are not sufficient, they can suspend the NDT until all faults are eliminated and new corrective measures are taken. If the ambient temperature drops below 5°C, special safety measures shall apply. If it is not possible to ensure that NDT is performed at a sufficient quality level, the pipe welding works shall also be suspended.

11 WEEKLY, MONTHLY AND FINAL NON-DESTRUCTIVE TEST REPORT

11.1 Reporting

The NDT Supplier shall issue regular weekly and monthly reports, containing data on the progress, implementation and results of NDT. On finishing of the construction Project, a final report shall be prepared, informing on the quality level of the NDT works performed during the entire Project.

The final reports shall be provided in four executions, which will be distributed as follows:

- 1 copy for the Employer supervision
- 1 copy for the Project contractor
- 1 copy for the Supplier (NDT Supplier)
- 1 copy for the Third party

Format of the reports – subject of approved by the Employer in advance.

11.2 Required documentation

Documentation available during the entire construction Project:

- Written procedures and instruction for all NDT methods
- Test reports for all NDT methods
- Calibration reports for the NDT equipment used execution of testing
- Software enables viewing and control of measured data from AUT/TOFD tests incl. necessary license
- Digital records (data) from MUT and AUT testing for continuously verification by Employer / Third party
- Radiographic films from RT testing for continuously verification by Employer / Third party

Documentation to be handed over – As built documentation:

- All test report issued after testing - hard copy as well as electronic version of all reports
- Software for viewing and control of measured data from AUT/TOFD tests incl. necessary license
- Radiographic films
- Digital records from the tests executed by using the automatic ultrasonic system
- Digital records from MUT and TOFD manual ultrasonic tests
- Table indicating the numbers of welds tested using appropriate NDT methods
- Overall quality assessment of the construction Project
- Test reports for all NDT methods shall be distributed as follows:
 - 1 hard copy at the construction site office
 - 1 shared electronic digital version (sent by e-mail or stored on a shared server)

12 WORK SAFETY REQUIREMENTS DURING NDT

During the work activities, the Supplier shall ensure that the safety and quality are continually monitored and evaluated every working day by the internal supervisor.

The NDT Supplier shall, in a demonstrable manner, inform the personnel (NDT testing personnel) of the work safety and risk prevention requirements during the work in accordance with the applicable laws and standards.

In terms of monitoring the internal irradiation, it is necessary to focus on the key moments of such activity, which namely include:

- Ensuring sufficient quality of the equipment's and tools using for direct as well as indirect measurements
- Inspections of observance of the prescribed procedures guidelines and method statements for the testing preparation , execution and evaluation
- Definition of responsibilities by the testing personal. Nomination of chief execution manager, team leaders for each working group and independent quality & HSE supervisor.
- Personnel training system verification, certification review and approval
- Quality of registration / result notification system
- Observance and inspection of notification duties towards the State Office for Nuclear Safety

- Internal measurement control system, quality of measurement results archiving system
- Participation in national and international benchmarking

Act No. 18/1997 Coll., on Peaceful Utilization of Nuclear Energy and Ionizing Radiation (the Atomic Act), as amended by later regulations

State Office for Nuclear Safety Decree No. 132/2008 Coll., on Quality Assurance System in Performing and Ensuring Activities Related to the Utilization of Nuclear Energy and Radiation Activities, and on Quality Assurance of Selected Equipment with Regard to their Ranking into Safety Classes.