Title: **TEP-NDT-ADT Procedure for Non-Destructive Examination (NDE) Audits**	Document Type: Procedure
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PURPOSE

This document describes TransCanada's (The Company) procedure for auditing Non Destructive Examination (NDE) results of welds within the Company's pipeline system to ensure that these inspections are carried out complying with the Company specifications, and applicable codes and regulations.

SCOPE

This procedure applies to the auditing of NDE results based on the various methods the Company employs for inspecting welds for Pipeline, Compression, Meter Station, Maintenance and Integrity projects.

The implementation of this procedure will be the responsibility of the project manager.

BRIEF DESCRIPTION OF CHANGE (IF A REVISION)

This is a new procedure.

TABLE OF CONTENTS

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3. DEFINITIONS

ASME -	American Society of Mechanical Engineers.
ASTM -	American Society for Testing and Materials.
CGSB -	Canadian Government Standards Board.
CSA -	Canadian Standards Association.
ECA -	Engineering Critical Assessment.
EUB -	Alberta Energy and Utilities Board.
GMAW -	Gas Metal Arc Welding.
LPI -	Liquid Penetrant Inspection.
MPI -	Magnetic Particle Inspection.
NEB -	National Energy Board (Board).
RT -	Radiographic Testing.
TOFD -	Time of Flight Diffraction.
TOP -	TransCanada Operating Procedure.
UT -	Ultrasonic Testing.

4. REFERENCES

1. ASME – Section V.
2. ASTM E-709 specification.
3. CSA Z662 – Latest Edition, Oil and Gas Pipeline Systems.
4. Pipeline Act and Pipeline Regulations of Alberta.
5. NEB - Onshore Pipeline Regulations, 1999, Part 9, Audits and Inspections.

6. TransCanada documents:
   - Magnetic Particle Test Forms (TOPS# 003672904).
   - TES-NDT-UT1 Mechanized Ultrasonic Examination of Pipeline Girth Welds.
   - TES-NDT-UT2 Manual Ultrasonic Examination of Welds.
   - TEP-NDT-REC Nondestructive Testing Records Management.
   - TES-NDT-RT Radiographic Examination of Welds.
   - TES-NDT-UTG Ultrasonic Inspection Design of Gas Metal Arc Pipeline Girth Welds.
   - TES-NDT-UTS Ultrasonic Inspection Design of Pipeline Girth Welds with a Standard Bevel.
   - TEP-NDT-IMP Implementation of Ultrasonic Inspection of Pipeline Girth Welds.
   - TED-NDT-GPU Guiding Principle for Mechanized Ultrasonic Inspection of Pipeline Girth Welds.
   - TOP - Magnetic Particle Inspection Procedure.

5. GENERAL

The Company uses four non-destructive testing methods to assess pipeline welds:

1) Ultrasonic Testing (UT), which uses short wavelength, high frequency sound waves to detect weld defects.
2) Radiographic Testing (RT), which uses X-ray and Gamma rays to detect weld defects.
3) Magnetic Particle Inspection (MPI), which creates magnetic field on the inspected weld.
4) Liquid Penetration Inspection (LPI), which is done by spraying or swabbing penetrants on the weld to detect defects.

This procedure is divided into these four areas.

5.1 REGULATIONS

NEB, in its Onshore Pipeline Regulations, Part 9, Audits and Inspections - General Compliance, Clause 53, states that:

1) A Company shall conduct an audit and an inspection on a regular basis to ensure its pipeline is designed, constructed, operated and abandoned in compliance with:
   (a) Part III of the Act;
   (b) Part V of the Act , as its relates to the protection of property and the environment and the safety of the public and of the company's employees;

(c) The Regulations; and

(d) The terms and conditions of any certificate or order issued by the Board, as they relate to the protection of property and the environment and the safety of the public and of the company's employees;

2) The audit shall document:

(a) All non-compliance noted; and

(b) Any corrective action taken or planned to be taken.

5.2 ROLES AND RESPONSIBILITIES

The Company will assign the following personnel and their responsibilities for the NDE audit on a given project:

a) Project Manager - The individual responsible for the overall execution of a project and for deciding whether the project will undergo an NDE audit.

b) Auditor - The individual responsible for auditing the NDE results of the pipeline welds.

An auditor could be:

- A third party individual holding a Level II or III CGSB's certificate in the appropriate inspection method, or,
- Company representative with experience in the NDE methods and interpretation of results.

c) Contractor - The party responsible to conduct the NDE inspection of the welds.

d) Construction Manager - The individual responsible for the workmanship of the Contractor and implementation of the specifications, codes and regulations.

6. ULTRASONIC TESTING (UT) - AUDIT PROCEDURE

The UT audit procedure is divided into two phases:

6.1 OFFICE AUDIT

The auditor will, preferably before the start of construction, review the following documents as part of this audit process:

- Prime contract documents for project scope.
- NDE contract documents.
- Weld joint configurations.
- UT contractor's inspection design when mechanized inspection equipment is used; this will include the calibration block and probe configuration.
- NDE Contractor's quality control manual

6.2 FIELD AUDIT

The auditor performing the office audit, in consultation with the Construction Manager, will advise the Project Manager to arrange for a field audit of the NDE results, if warranted.

The Project Manager will arrange to send either the same auditor or a Third Party auditor, for the field audit.

This auditor, once in the field, will:

a) Deal with the Construction Manager for any issues with the Contractors.

b) Be present on site at the start of the NDE to witness the initial set up of the Mechanized NDE systems and calibration of instruments.

c) Review the ultrasonic charts and corresponding calibration data produced by the UT Contractor during NDE to validate the Contractor's assessment of the mainline, compression and metering facilities, assemblies, crossings, tie-in and repair welds, to ensure they meet the acceptance criteria.

d) Review the manual ultrasonic reports and where possible witness a calibration and evaluation on an existing weld.

6.2.1 Audit Timing

The auditor will:

a) Audit the weld NDE results at least twice during the construction phase. At the construction kick-off, which is mandatory, and sometime during construction but before completion of the project.

b) Time the second visit in such a way that he/she can audit both mainline mechanized and manual UT examination results.

c) Forward the audit results to the Construction Manager before the completion of that particular phase of construction in order to resolve any deficiencies.

6.2.2 Mandatory Audit Items

The auditor will review the following items before construction kickoff:

a) Probe configuration (Mechanized).

b) System Evaluation (Mechanized).

c) Axial alignment of data (Mechanized).

d) Completeness of coverage of weld through thickness and length (Mechanized).

e) Complete, accurate reports and interpretations for project records (Mechanized/Manual).

f) Proper calibration reflector signal response for each channel/probe.

g) Signal discrimination between adjacent channels (Mechanized only).

The auditor will review the following items before construction completion:

a) Frequency of calibration (ensure specification requirement is met).

b) Correctness of interpretation sequential data files to ensure that files have not been overwritten.

c) Continuity between calibrations.

d) Complete, accurate reports and interpretations for project records.

e) Proper calibration reflector signal response for each channel/probe.

f) Coupling loss identified and resolved (Mechanized).

6.2.3 Audit Frequency

The auditor will audit the NDE records as follows:

- Mainline Welds - 15% of the Mainline Welds (random selection).
- Major Crossings - 15% of all welds within crossing boundary.
- Tie-in Welds - 15% of tie-in welds (random selection).
- Final Tie-in Welds - 100% of final tie-in welds.
- Repaired Welds - 10% of the repaired weld (random selection).
- Station welds - 15% of the station welds (random selection).
- Assembly welds - 15% of welds on pipeline assemblies.

Note:

1. Repair welds are examined manually with UT method and only paper-audit is required for manual UT.

2. Station welds are welds completed in Compression and metering facilities.

The auditor will review the calibration records (one before and one after) of the welds being audited.

6.2.4 Non-Compliance

The auditor will evaluate the two following types of non-compliances as outlined below;

1) System Performance (Mechanized)

There are two types of system performance non-compliances:

a) Loss of Coupling

Where a weld is exhibiting a lack of coupling in one channel and as well exceeding the maximum allowable defect length, the Contractor will re-inspect it, if the suspect area cannot be evaluated using the other data available for analysis.

b) Sensitivity

Sensitivity below the lower tolerance to ideal, in accordance with the Company specification TES-NDT-UT1 Mechanized Ultrasonic Examination of Pipeline Girth Welds, may be acceptable if the data can be reviewed after compensating for the reduced sensitivity using the raw mapped data channels.

If there is a non-compliance identified, the auditor will:

a) Complete the Progressive Audit, as noted below.

b) Convey the finding to an NDE Specialist for further evaluation.

c) Communicate the assessment of the Specialist to the Construction Manager for appropriate mitigative actions.

2) Interpretation

If there is an interpretation issue with a non-compliant weld, the auditor will:

a) Evaluate the defect for its height (Mechanized UT reports and scan data).

b) Complete the Progressive Audit, as noted below.

c) Convey the finding to a Fracture Mechanics Specialist for further evaluation.

d) Communicate the assessment of the specialist to the Construction Manager for appropriate mitigative actions.

6.2.5 Progressive Audit

In case of a non-compliance, the auditor will conduct progressive audits, which consist of auditing data from 10 welds prior and 10 welds following the non-compliant weld.

If non-compliance is still noted in those 20 welds, the auditor will audit an additional 20 welds, 10 prior and 10 following.

If further indications of non-compliance are noted, the auditor will audit all (100%) the welds in the pipeline for that day's production for that NDE technician.

6.3 DOCUMENTATION AND REPORTING

The auditor will, within two weeks of construction completion, provide a final report of UT audit to the Project Manager.

This report will summarize the inspection and provide an "exception report" detailing specific welds containing any non-compliances and resolutions.

7. RADIOGRAPHIC TESTING (RT) - AUDIT PROCEDURE

The RT audit procedure is divided into two phases:

7.1 OFFICE AUDIT

The auditor will, preferably before the start of construction, review, the following documents as part of this audit process:

a) Prime contract documents for the project scope.

b) NDE contract documents.

c) NDE Contractor's quality control manual

d) Weld joint configurations.

e) A procedure for the production of radiographs, which will include the following variables and their tolerances:

i. Type of material to be radiographed.

ii. Material thickness range for which the procedure is suitable.

iii. Type of radiation to be used with details of effective source size or X-ray machine voltage.

iv. Position of radiation source (external or internal).

v. Type, thickness and position of intensifying screens and filters.

vi. Sketch showing the geometric arrangement for the production of the radiographs, including minimum source to film distance and radiation angle with respect to the weld.

vii. Film type and brand, length and width.

viii. Exposure conditions in milliampere•minutes or curie•minutes; and,

ix. Processing time and temperature for development, stop bath or rinse, fixing, washing and drying.

7.2 FIELD AUDIT

The auditor performing the office audit, in consultation with the Construction Manager, will advise the Project Manager to arrange for a field audit of the NDE results, if warranted.

The Project Manager will arrange to send either the same auditor or a third party auditor, for the field audit.

The auditor, once in the field, will:

a) Deal with the Construction Manager for any issues with the Contractors.

b) Review the radiographs produced by the Contractor to validate the contractor's assessment of the mainline, compression and metering facilities, assemblies, crossings, tie-in and repair welds, to ensure they meet the acceptance criteria.

7.2.1 Audit Timing

The auditor will:

a) Audit the weld NDE results at least twice during the construction phase. Once, at the construction kick-off, which is mandatory, and the other during construction but before completion.

b) Forward the audit results to the Construction Manager before the completion of that particular phase of construction in order to repair any defects in time.

7.2.2 Mandatory Audit Items

The auditor will review the following items before construction kickoff:

a) Radiographic procedures on site.

b) Test Radiographs.

c) Radiographic test films and a piece of unexposed base.

d) Densitometers.

The auditor will review the following items before construction completion:

a) Consistent radiographic quality (density and sensitivity).

b) Correctness of interpretation.

c) Identification on film and reports (Proj.#, Company name, weld #, date, etc.).

7.2.3 Audit Frequency

The auditor will audit the NDE records as follows:

a) Mainline Welds -	15% of the Mainline Welds (random selection).
b) Major Crossings -	15% of all welds within crossing boundary.
c) Tie-in Welds -	15% of tie-in welds (random selection).
d) Final Tie-in Welds -	100% of final tie-in welds.
e) Repaired Welds -	10% of the repaired weld (random selection).
f) Station Welds -	15% of each piping system (random selection).
g) Assembly Welds -	15% of the pipeline assembly welds.

Note:

1. Station welds are welds completed in Compression and metering facilities.

7.2.4 Non-Compliance

1) General

The auditor will evaluate two types of non-compliances, Procedural and Interpretation. If there is a non-compliance, the auditor will:

a) Complete the Progressive Audit, as noted below.

b) Communicate the assessment to the Construction Manager and Project Manager for appropriate mitigative actions.

2) Progressive Audit

In case of a non-compliance, the auditor will conduct progressive audits, which consist of auditing data from 3 welds prior and 3 welds following the non-compliant weld (Care shall be taken to include data from the same RT crew & equipment).

If a non-compliance is still noted in those 6 welds, the auditor will audit additional 6 welds, 3 prior and 3 following.

If a non-compliance is still noted in these new 6 welds, the auditor will audit additional 6 welds, 3 prior and 3 following.

If further indications of significant non-compliance are noted, the auditor will audit all (100%) the welds in the pipeline for that day's production for that NDE technician.

7.3 DOCUMENTATION AND REPORTING

The auditor will, within two weeks on construction completion, provide a final report of RT audit to the Project Manager.

This report will summarize the inspection and provide "exception report" detailing specific welds containing any non-compliances and resolutions.

8. MAGNETIC PARTICLE INSPECTION (MPI) - AUDIT PROCEDURE

The NDE results will be audited during the construction phase. The auditor will review 100% of the inspection reports. The audit will be a paper-audit of the MPI results for the following items:

1. Company Name.
2. Project Number.
3. Equipment List.
4. Identification of the inspected welds.
5. Weld Sketches.
6. Adherence to codes and specifications.
7. Application of proper techniques (include lifting power of yoke).
8. Signatures.
9. MPI report, containing the following items (Refer to ASME Section V, Article 7):
    a. Procedure identification and revision.
    b. Magnetic particle equipment and type of current.
    c. Magnetic particles (visible or fluorescent, wet or dry).

d. Examination personnel identity and qualification level.

e. Map or record of rejectable indications.

f. Material and thickness.

g. Lighting equipment.

h. Date and time examinations were performed.

9 LIQUID PENETRANT INSPCTION (LPI) - AUDIT PROCEDURE

The NDE results will be audited during the construction phase. The auditor will review 100% of the inspection reports. The audit will be a paper-audit of the LPI results for the following items:

1. Company Name.
2. Project Number.
3. Equipment List.
4. Identification of the inspected welds.
5. Weld Sketches.
6. Adherence to codes and specifications.
7. Application of proper techniques.
8. Signatures.
9. LPI report, containing the following items (Refer to ASME Section V, Article 6):
    a. Procedure identification and revision.
    b. Liquid penetrant type (visible or fluorescent).
    c. Type (number or letter designation of each penetrant remover, emulsifier, and developer used).
    d. Examination personnel identity and qualification level.
    e. Map or record of rejectable indications.
    f. Material and thickness.
    g. Lighting equipment.
    h. Date and time examinations were performed.
    i. Dwell times used.

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