TransCanada
In business to deliver

May 17, 2007

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Chris Hoidal
Pipeline and Hazardous Materials Safety Administration
12300 W Dakota Ave., Suite 110
Lakewood, CO 80228

Dear Mr. Hoidal,

On April 23, 2007, Gas Transmission Northwest Corporation (GTN) received a letter from your office dated April 20, 2007 (CPF No. 5-2007-0016M) titled "Notice of Amendment." The letter included procedures for responding which direct GTN to notify you of our plans to address the inadequacies identified in the Notice within 30 days, and page 3 of the letter proposes that we submit our amended procedures to your office.

We have amended our procedure for Repair of Pipeline Defects and Imperfections (OMI FF-11) to address the concerns identified in the Notice. A copy of the procedure is attached with the amended portions highlighted in yellow for your convenience. We hope that you will find this an adequate resolution and the enforcement action can be closed.

We are also in the process of developing an engineering standard that will eventually replace OMI FF-11 and will ensure that it addresses the concerns identified in the Notice.

An electronic copy of this letter and OMI FF-11 will be emailed to your office.

If you have any other questions, please call or write me.

Sincerely,

Ross Parker
Regional Director

Enclosure: OMI FF-11 Repair of Pipeline Defects and Imperfections
KAS:jkf

OPERATION AND MAINTENANCE INSTRUCTION SHEET

SUBJECT: Repair of Pipeline Defects and Imperfections

PURPOSE:
(1) To provide instruction for evaluating in-service pipeline conditions
(2) To list acceptable repair/remediation methods for defects
(3) To provide time requirements for defect repair/remediation
(4) To provide instruction for completing repairs

DEFINITIONS:

Anomaly:
An indication (generated by nondestructive examination) of an irregularity, deviation from sound welds or base pipe material, or area of damage, which may or may not be an actual condition.

Condition:
An irregularity, deviation from sound weld or base pipe material, or area of damage, confirmed by visual examination or other positive means of identification, that may or may not impair the serviceability of a length of steel pipe from the standpoint of its pressure carrying capacity or its ability to resist other stresses imposed upon it.

Defect:
A condition that impairs the serviceability of a length of steel pipe from the standpoint of its pressure carrying capacity or its ability to resist other stresses imposed upon it. A defect must be repaired, removed, or otherwise mitigated.

Imperfection:
A condition that does not impair the serviceability of a length of steel pipe from the standpoint of its pressure carrying capacity or its ability to resist other stresses imposed upon it. An imperfection requires no remedial action.

APPLICABILITY:

Code requirements, industry practice, and assessment and remediation instruction provided for in-service pipeline facilities will sometimes differ from those provided for construction of pipeline facilities. This instruction is intended for in-service pipeline facilities. It is not intended for new construction, although it may be useful as a reference in some situations. Similarly, construction codes, practices, and specifications are not intended for in-service facilities, although they may be useful as a reference in some situations.

REFERENCES:

(1) DOT 49 CFR 192	Minimum Federal Safety Standards
(2) GPTC	Guide for Gas Transmission and Distribution Piping Systems
(3) ASME B31.8	Gas Transmission and Distribution Piping System
(4) RSTRENG	AGA Pipeline Research Committee Project PR 3-805, "A Modified Criterion for Evaluating the Remaining Strength of Corroded Pipe"
(5) ASME/ANSI B31G	Manual to Determine the Remaining Strength of Corroded Pipelines

I) CONDITION ASSESSMENT AND REPAIR

General
Each defect must be removed by cutting out and replacing a cylindrical piece of pipe or repaired by a method that reliable engineering tests and analysis show can permanently restore the serviceability of the pipe. Acceptable repairs include, but are not limited to, the methods provided in the following sections:

Section	Defect Classification
A	Corrosion
B	Dents
C	Wrinkles and Buckles
D	Stress Risers
E	Metallurgical Conditions
F	Cracks and SCC
G	API 1104 Weld Defects

In addition to the instruction presented herein, an appropriate repair also requires consideration of factors such as overburden, dynamic loads, soil conditions, geographic location, accessibility, and the location of the condition relative to high consequence areas.

Damage not addressed by this instruction will require a more thorough investigation and analysis to determine a proper disposition or repair of the affected area. Repairs not addressed by this instruction require approval of the Compliance Manager, the Integrity Manager or the Pipeline Integrity Engineer, Pipe Engineering Group (Calgary).

Repair of Leaks
Additional precautions must be observed if a defect involves a leak. Refer to 192.715 and 192.717.

Operating Pressure During Repair
Operating pressure must be at a safe level during a repair.

Time Requirements
Defects should be remediated within the time limits specified. For defects not remediated within the specified time period, the operating pressure of the pipeline shall be reduced as appropriate to ensure the safety of the line segment or proper justification documented as to why the schedule cannot be met and that delaying the schedule will not jeopardize public safety.

Pressure reductions in excess of 365 days shall be documented regarding the technical justification that demonstrates continued operation at the reduced pressure will not *jeopardize pipeline safety.* [192.933(a)]

Operator Qualification
O.Q. tasks associated with pipeline repairs will be performed by qualified individuals or under the direct supervision of qualified individuals. Refer to O.Q. Program LOB #6 and O.Q. Task List, Exhibit A.

Reporting
Discovery of certain conditions or failure to complete repairs in the specified time may trigger certain reporting requirements. See OMI's FF-30 and FF-31 for reporting incidents and safety related conditions.

Documentation
The date, location, and description of each defect repair must be retained for as long as the pipe remains in service. Documentation should include:

1. FF-11, Form B – "Documentation of Defect Repair"
2. CC-30 Form – "Exposed Pipe Report"
3. Photo of Condition (Digital Preferred)
4. Clock Spring® documentation, when applicable
5. NDT Records, when applicable
6. Hydrotest Records, when applicable
7. Welding Procedure, when applicable
8. Welder Qualification Records, when applicable
9. B31G or RSTRENG Calculations, when applicable
10. Calculations or Other applicable documentation

Original documentation shall be sent to the Pipe Regulatory Specialist for permanent retention. A copy of FF-11 Form B should be sent to Portland drafting for posting to the Alignment Sheet.

For any condition physically evaluated that does not require a repair, inspection records must be retained for at least 5 years or until the next inspection. Use OMI CC-30's Exposed Pipe Report Form, with any other pertinent documentation or records attached.

A ***Corrosion***

Description
Corrosion is metal loss caused by electrochemical activity and characterized by visible pits or large irregular depressions. This is not intended to include selective seam corrosion. (There is no pre-1970 ERW pipe in the system, so this instruction does not cover selective seam corrosion.)

Corrosion at Welds
Corrosion in submerged-arc welds should be treated as corrosion in the body of the pipe. Corrosion in girth welds should be assessed per PRCI's "Serviceability of Corroded Girth Welds".

Inspection Methodology
For external corrosion, carefully clean the corroded area to bare metal by sandblasting or power wire brushing so that the depth and axial length can be measured. Measure the depth using a depth micrometer or pit gauge as appropriate. Measure the maximum length and width or circumferential dimension, using suitable tools. Do not grind; it is not necessary to remove metal where no stress riser exists.

For internal corrosion, clean the external surface of the pipe where internal corrosion is suspected. Establish to the extent possible that the anomaly in question is a metal-loss corrosion condition. Measure the depth, width or circumferential dimension, and axial length of the corrosion using an ultrasonic thickness gauge. Multiply each dimension by a factor of 1.1 as a conservative measure to account for inherent uncertainties in sizing a condition where precise measurements are difficult to obtain.

Analysis
Analyze the corrosion to determine a Predicted Failure Pressure, (PFP), using ASME/ANSI Modified B31G, or AGA RSTRENG. Refer to OMI FF-11, Form A or RSTRENG documentation when evaluating corrosion defects.

Acceptance Criteria

Depth (%w.t.)	Classification
≤ 20% w.t.	Imperfection
20-80% w.t.	Imperfection if PFP ≥ 1.39*MAOP unless external bending stresses on the pipe require a more conservative limit. Defect if PFP < 1.39*MAOP
>80% w.t.	Defect

Acceptable Repairs
Clock Spring® - Not applicable for leaks or defects with a depth > 80% w.t.
Type A Sleeve with Filler - Not applicable for leaks.
Type B Sleeve
Hot Tapping - Not applicable for leaks.
Pipe Replacement

Repair/Remediation Schedule
*PFP ≤ 1.1 * MAOP or Depth >80% w.t.* These defects shall be repaired within one year of discovery. Until the defect is repaired, immediately reduce the pressure in accordance with ASME/ANSI Modified B31G, RSTRENG, or to a level not exceeding 80% of the level at the time the condition was discovered.

*1.1 * MAOP < PFP ≤ 1.39 * MAOP.* These defects shall be repaired or reassessed within (T) years according to the following formula: T (time in years) = (PFP/MAOP – 1.1)/(0.029)

B ***Dents***

Description
A dent is depression (other than a wrinkle or buckle) that produces a gross disturbance in the curvature of the pipe wall without reducing the pipe-wall thickness.

Plain Dents
Plain dents are smooth in contour and contain no mechanical damage, metal loss, stress riser, or compressed or crushed wall thickness in the area of the diameter reduction. Plain dents exist outside any seam or girth weld. Plain dents are generally caused by a rock near or against the pipe and do not adversely affect the burst strength of the pipe. Dents with no coating damage and no coating disbondment are plain dents.

Dents with Metal Loss, Cracking or a Stress Riser
The combination of a dent with metal loss, cracking, or a stress riser is more severe than either condition in isolation and should be treated with extreme caution.

Dents at Welds
Dents are potentially injurious to welds when any part of the damage falls within the immediate area of the weld or heat affected zone. Under certain conditions,

dents on girth welds and ERW long seam welds may be classified as imperfections.

Inspection Methodology

Depth
The depth of a dent is determined by measuring the gap between the lowest point of the dent and a prolongation of the original contour of the pipe. For exposed dents, use a straight edge extending from an undeformed section of the pipe upstream and downstream of the reduction to establish the original pipe contour. Measure the depth of the reduction at the deepest location using a suitable depth measurement device such as a caliper, depth gauge, or ruler.

Inspection for Stress Risers and Cracking
For exposed dents with coating damage or dents that have re-rounded during excavation, check for stress risers or cracking in and around the area of the dent visually and using dye penetrant or a magnetic particle inspection.

Rock Dents - General
Where a dent is restrained by a rock, typically at the bottom 1/3 of the pipe (between 4:00 and 8:00), the rock prevents the dent from re-rounding due to internal pipe pressure. Therefore, for obviously plain dents (smooth rock and no coating damage) the rock should not be removed. For dents that must be removed to enable inspection or repair, the pipeline pressure should be lowered to a level not exceeding 80% of the historical average operating pressure for the dent location.

Rock Dents with Metal Loss, Cracking or a Stress Riser
For rock dents with metal loss, cracking, or a stress riser, the pipeline should be blown down prior to removing the rock. This condition is not expected and would generally require the presence of a very sharp rock.

Rock Dents at Welds
For rock dents at welds, the pipeline should be blown down prior to removing the rock.

Analysis
Establish a percentage of pipe diameter reduction as follows:

$$\% \text{ Reduction} = \frac{\text{Reduction depth (in.)} * 100}{\text{Pipe diameter (in.)}}$$

Acceptance Criteria
Plain Dents

Depth (%w.t.)	Classification
≤ 6% (≤ 0.5" for 12 ¾" diameter or smaller pipe)	Imperfection
> 6% (> 0.5" for 12 ¾" diameter or smaller pipe)	Defect

Dents with Metal Loss, Cracking or a Stress Riser
A dent with any indication of metal loss, cracking or a stress riser is a defect.

Dents at Girth Welds
A dent at a girth weld is a defect unless all of the following requirements are met, in which case the dent is an imperfection.

1) Dent is in sound material with no indications of metal loss or damage in the area of the dent.
2) Dent is in ductile material.
3) Weld was made to API 1104 or comparable standards.
4) Weld has passed an x-ray inspection to API 1104 standards.
5) Analysis per PRCI's "Guidelines for the Assessment of Dents on Welds" indicates the condition meets at least a 100-year service life.

Dents at Long Seam Welds
A dent at a long seam weld is a defect unless all of the following requirements are met, in which case the dent is an imperfection.

1) Dent is in sound material with no indications of metal loss or damage in the area of the dent.
2) Dent is in ductile material.
3) Dent is in ERW pipe. (Coyote Springs and Medford Laterals)
4) Dent is less than 5% deep.

Acceptable Repairs
Plain Dents
Clock Spring® with filler - Not applicable for leaks.
Type A Sleeve with filler - Not applicable for leaks.
Type B Sleeve with filler
Pipe Replacement

Dents with Metal Loss, Cracking or a Stress Riser
Clock Spring® with filler for Corrosion Metal Loss Dents Only - Not applicable for leaks.
Type A Sleeve with filler for Corrosion Metal Loss Dents Only - Not applicable for leaks.
Type B Sleeve with filler
Pipe Replacement

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Dents at Welds
Type A Sleeve with filler - Not applicable for leaks.
Type B Sleeve with filler
Pipe Replacement

Dents at ERW Seams (Coyote Springs and Medford Laterals)
Type B Sleeve, Hot Tapped
Pipe Replacement

Repair/Remediation Schedule

Dents with Metal Loss, Cracking or a Stress Riser
These defects shall be repaired immediately. Until the defect is repaired, immediately reduce the pressure to a level not exceeding 80% of the level at the time the condition was discovered. The pressure reduction shall be maintained until the repair is completed.

Dents at Welds
A dent defect that affects pipe curvature at a girth weld or at a longitudinal seam weld should be repaired within one year of discovery.
Plain Dents

Dent defects located on the upper 2/3 of the pipe (between 8 o'clock and 4 o'clock) shall be repaired within one year. While there are no specific time requirements specified by code regarding dent defects on the bottom 1/3 of the pipe, these defects should generally be repaired within one year of discovery.

C ***Wrinkles or Buckles***

Description
A wrinkle or buckle is local deformation of the pipe wall with outward bulging or inward symmetry and characterized by a dominant circumferential axis.

Inspection Methodology
Measure the wrinkle or buckle using a straight edge that extends from peak to peak and obtain the depth of the deepest trough using a caliper, depth gauge, or other suitable means.

Analysis
Wrinkles or buckles shall be analyzed by measuring the peak-to-trough height.

Acceptance Criteria
A wrinkle or buckle having a peak-to-trough height ≤ 0.094" that does not involve the seam weld of the pipe is an imperfection. A wall thickness manufacturing upset condition associated with the manufacture of a hot bend fitting is an imperfection. All other wrinkles or buckles are defects.

Acceptable Repairs
Pipe Replacement

Repair/Remediation Schedule
Defects shall be repaired in accordance with the severity of the condition. An immediate pressure reduction shall be taken for any defect in the judgment of a qualified assessor that needs immediate action. The pressure reduction shall be to a level not exceeding 80% of the level at the time the condition was discovered.

D **Stress Risers:**

Description
A stress riser is a physical notch that can initiate and/or propagate a crack in the pipe and may take the form of a gouge, scrape, smeared metal, or compressed or crushed wall thickness. Stress risers are often caused by mechanical damage. See "Metallurgical Conditions" for arc burns, hard spots, and laminations.

Inspection Methodology
The area in and around the damage shall be cleaned of pipe coating and the presence or absence of stress risers shall be verified using visual, dye penetrant or a magnetic particle inspection.

Analysis
N/A

Acceptance Criteria

A stress riser in the body of the pipe or in a weld zone is a defect.

Acceptable Repairs

Grinding: - Not applicable for leaks.

For all non-indented defects within grinding parameters. Removal of the affected area shall be confirmed using an appropriate NDE technique such as magnetic particle, dye penetrant, or ultrasonic shear wave.

Grinding with Clock Spring®: - Not applicable for leaks.

When the defect is completely removed by grinding, but grinding has reduced the wall thickness beyond acceptance criteria.

Grinding with Type A Sleeve: - Not applicable for leaks.

When the defect is completely removed by grinding, but grinding has reduced the wall thickness beyond acceptance criteria.

Grinding with Type B Sleeve: - Not applicable for leaks.

When grinding reduces the wall thickness beyond acceptance criteria and/or when the defect cannot be completely removed by grinding.

Hot Tapping: - Not applicable for leaks.

Type B Sleeve

Pipe Replacement

Repair/Remediation Schedule

These defects shall be repaired in accordance with the severity of the condition. An immediate pressure reduction shall be taken for any defect in the judgment of a qualified assessor that needs immediate action. The pressure reduction shall be to a level not exceeding 80% of the level at the time the condition was discovered.

E **Metallurgical Conditions**

Description

Metallurgical conditions are characterized by a discontinuity or variation in the metallic structure of the pipe. Metallurgical conditions may exist as:

1) Hard Spot – A manufacturing condition created by accidental local quenching during hot rolling of the skelp. Hard Spots are characterized by a localized increase in hardness, and are susceptible to hydrogen cracking if cathodic protection levels are high.
2) Lamination – A manufacturing condition characterized by an internal metal separation creating layers generally parallel to the surface. Laminations are not time dependent and any lamination in the system has met manufacturing tolerances at the time of its installation and has been successfully hydrotested.
3) Arc Burns – A result of poor welding practices and characterized by a metallurgical discontinuity visible on the pipe surface.

Inspection Methodology

Hard Spot – Clean coating from exterior of pipe adjacent to the suspected hard spot and test area for uneven hardness by etching with a 20% solution of ammonium persulphate. The presence of metallurgically altered material will be evident by blackened spots in the area of the swab. Verify the absence of

cracking using dye penetrant or magnetic particle inspection. If necessary, use a portable hardness tester to determine a hardness value.

Lamination – N/A

Arc Burn - Visually inspect for the presence of arc burns. A 20% solution of ammonium persulphate may be used to verify the presence/absence of the arc burn if it has been previously repaired. Verify the absence of cracking using dye penetrant or magnetic particle inspection.

Analysis
Hard Spot - N/A
Lamination - N/A
Arc Burn – N/A

Acceptance Criteria
Hard Spot – Imperfection if either ≤ 35 Rockwell c (or 327 Brinnell) or ≤ 2" in any dimension.

Defect if > 35 Rockwell c (or 327 Brinnell) and minor dimension is > 2".

Lamination – Imperfection

Arc Burns – An arc burn is a defect.

Acceptable Repairs
Grinding: - Not applicable for leaks.
Not allowed for hard spots, because the defect may extend through the pipe wall. Allowed for other non-indented metallurgical defects within grinding parameters. Removal of the affected area shall be confirmed using an appropriate NDE technique such as magnetic particle, dye penetrant, ultrasonic, or ammonium persulphate.

Grinding with Clock Spring®: - Not applicable for leaks.
When the defect is completely removed by grinding but grinding has reduced the wall thickness beyond acceptance criteria.

Grinding with Type A Sleeve and filler: - Not applicable for leaks.
When the defect is completely removed by grinding but grinding has reduced the wall thickness beyond acceptance criteria.

Grinding with Type B Sleeve: - Not applicable for leaks.
When grinding reduces the wall thickness beyond acceptance criteria and/or when the defect cannot be completely removed by grinding.

Hot Tapping: - Not applicable for leaks.

Type A Sleeve with filler: - Not applicable for leaks.
Allowed for hard spot with no cracking. Not allowed for arc burn unless defect has been removed.

Type B Sleeve

Pipe Replacement
Repair/Remediation Schedule

These defects shall be repaired in accordance with the severity of the condition. An immediate pressure reduction shall be taken for any defect that a qualified assessor determines needs immediate action. The pressure reduction shall be to a level not exceeding 80% of the level at the time the condition was discovered.

F **Cracks and SCC**

Description
This section applies to all cracks in the body of the pipe but does not cover cracks in welds. For cracks in welds see "Weld Defects".

Inspection Methodology
Clean the coating from the exterior of the pipe in the area to be inspected. Use visual, dye penetrant, magnetic particle, ultrasonic, or other appropriate inspection technique to verify the absence or presence of cracks or SCC within the pipe section.

Analysis
N/A

Acceptance Criteria
Any crack is a defect.

Acceptable Repairs
Grinding: - Not applicable for leaks.
For all non-indented cracks within grinding parameters. Removal of the affected area shall be confirmed using an appropriate NDE technique such as magnetic particle, dye penetrant, or ultrasonic shear wave.

Grinding with Clock Spring®: - Not applicable for leaks.
When the defect is completely removed by grinding but grinding has reduced the wall thickness beyond acceptance criteria.

Grinding with Type A Sleeve and Filler: - Not applicable for leaks.
When grinding reduces the wall thickness beyond acceptance criteria and/or when the defect cannot be completely removed by grinding.

Grinding with Type B Sleeve: - Not applicable for leaks.
When grinding reduces the wall thickness beyond acceptance criteria and/or when the defect cannot be completely removed by grinding.

Hot Tapping: - Not applicable for leaks.

Type A Sleeve with Filler - Not applicable for leaks.

Type B Sleeve

Pipe Replacement

Repair/Remediation Schedule
Defects shall be repaired in accordance with the severity of the condition. An immediate pressure reduction shall be taken for any defect that a qualified assessor determines needs immediate action. The pressure reduction shall be

to a level not exceeding 80% of the level at the time the condition was discovered.

G **API 1104 Weld Defects**

Description
This section refers to all defects and imperfections as defined in the current edition of API 1104 recognized by 49CFR Part 192.

Inspection Methodology
Weld area may be inspected visually or by other appropriate non-destructive techniques.

Analysis
N/A

Acceptance Criteria
Refer to the "Acceptance Standards for Nondestructive Testing" and "Repair and Removal of Defects" sections of the current edition of API 1104 recognized by 49CFR DOT 192.

Acceptable Repairs
Per GTN's Welding Control Manual, ASME B31.8, and OMI FF-10, as applicable:

If it is feasible to take the segment of transmission line out of service, the weld must be replaced or repaired with in appropriate repair weld procedure in accordance with DOT 192.245. [192.715(a), 192.245]

A weld may be repaired in accordance with DOT 192.245 while in service only if the weld is not leaking and pressure in the segment is reduced so that it does not produce a stress that is more than 20 percent of the SMYS of the pipe and grinding of the defective area can be limited so that at least 1/8 inch thickness in the pipe weld remains.

Type B Sleeve – If it is not feasible to take the pipe segment out of service and it can not be repaired in accordance with the restrictions specified above.

Pipe Replacement

Repair/Remediation Schedule
Defects shall be repaired in accordance with the severity of the condition. An immediate pressure reduction shall be taken for any defect in the judgment of a qualified assessor that needs immediate action. The pressure reduction shall be to a level not exceeding 80% of the level at the time the condition was discovered.

II) **TESTING TECHNIQUES**

A **Visual Examination**

Visual examination is an inspection method used to ascertain the surface condition of the pipeline and should always be the primary method of inspection when applicable regardless of what other inspection techniques are involved. Visual examination may include the use of mechanical devices to measure

dimensions. The inspector should be able to recognize various conditions such as poor coating, corrosion, dents, wrinkles, buckles, gouges, scrapes, metal loss, laminations, cracks and arc burns.

In some cases visual inspection may be hindered by limited access. If so, the use of remote camera or fiber optic devices should be considered to allow for visual inspection.

Pipe surfaces or imperfections on the pipe surface to be inspected shall be free of coatings, dirt, debris and other foreign matter.

Individuals performing visual inspection shall be O.Q. qualified for the specified inspection task they perform.

B **Magnetic Particle Testing (MT)**
This section has been replaced by the Magnetic Particle Inspection Procedure TOP (EDMS 003864114) effective 1/27/06.

C **Liquid Penetrant Testing (PT)**

Liquid penetrant testing is used to detect discontinuities that are open to the surface of the material being examined. This method may be used on both ferrous and non-ferrous materials. Liquid penetrant examination may be used for the detection of surface discontinuities such as cracks, seams, laps, laminations and porosity.

When the company specifies liquid penetrant testing, a detailed written procedure for liquid penetrant testing shall be established that meets the requirements of ASTM E-165. The company and the nondestructive testing contractor shall agree on the liquid penetrant testing procedure or procedures prior to the performance of testing.

The company shall require the contractor to demonstrate that the proposed procedures will produce acceptable results and shall require the contractor to use such procedures for testing.

Surface preparations for liquid penetrant testing shall be completed by power tool cleaning to bare metal while retaining a surface profile. Wire wheels, coated abrasive discs, coated abrasive flap wheels and non-woven abrasive wheels and discs shall be used for this preparation (SSPC Specification No. 11). Surfaces shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter.

If it is desirable to remove slight residues of rust and paint that may be left in the lower portions of pits, the surfaces shall be prepared to near-white blast cleaning (SSPC Specification No. 10).

Only O.Q. qualified Level II or III nondestructive testing personnel shall interpret test results.

D **Ultrasonic Testing (UT)**

Ultrasonic testing is used for volumetric examination of welds and base materials (metallic and non-metallic) for detection of flaws. This method depends on sound waves of very high frequency being transmitted through metal and reflected at

Caution is advised when this method is applied to in-service weld inspection due to potential parent material and surface imperfection that can interfere with the use of the ultrasonic technique.

Surface preparations for ultrasonic testing shall be completed by power tool cleaning to bare metal while retaining a surface profile. Wire wheels, coated abrasive discs, coated abrasive flap wheels and non-woven abrasive wheels and discs shall be used for this preparation (SSPC Specification No. 11). Surfaces shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter.

In-service girth weld caps and pipe seam welds may require grinding to obtain a suitable surface for inspection. Weld caps shall be ground smooth to a minimum height of 0.0625" above the parent metal surface prior to inspection. Grinding below the surface of the pipe OD in the cap area shall not be allowed without prior company approval.

If it is desirable to remove slight residues of rust and paint that may be left in the lower portions of pits, the surfaces shall be prepared to near-white blast cleaning (SSPC Specification No. 10).

Only O.Q. qualified Level II or III nondestructive testing personnel shall interpret test results.

E **Ultrasonic Thickness Testing**

Ultrasonic thickness testing using a resonance or pulse-echo type hand held portable battery operated thickness gauge is used to determine the thickness of the material being examined. The principal application of the tool for pipelines is wall thickness measurement under field conditions. Ultrasonic thickness examination may be used to determine actual remaining wall thickness at corrosion metal loss areas or other areas where metal loss is evident or suspect. This method may be used on both ferrous and non-ferrous materials.

Prior to ultrasonic thickness testing, calibration of the gauge shall be performed using the steel thickness standard supplied with the gauge or accurate standards fabricated from the material to be tested.

Surface preparations for the ultrasonic thickness testing shall be completed by power tool cleaning to bare metal while retaining a surface profile. Wire wheels, coated abrasive discs, coated abrasive flap wheels and non-woven abrasive wheels and discs shall be used for this preparation (SSPC Specification No. 11).

Surfaces shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter.

If it is desirable to remove slight residues of rust and paint that may be left in the lower portions of pits, the surfaces shall be prepared to a near-white blast cleaning (SSPC Specification No. 10).

Testing shall be completed by an O.Q. *qualified individual.*

F **Radiographic Testing (X-Ray)**

Radiography is a volumetric method that can detect discontinuities throughout a material. This method is commonly used to examine for surface and subsurface discontinuities. The use of this method may be restricted due to the configuration of the welded joint or the limitations of the radiographic equipment. Radiography will not give an indication of the depth of discontinuity unless special procedures are used.

A detailed procedure for the production of images shall be established and recorded. Radiographic film produced by the procedure shall meet the requirements of "Radiographic Test Methods" the current edition of API 1104 recognized by 49 CFR Part 192.

The company and the radiographic contractor shall agree on the radiographic procedure or procedures to be used prior to the performance of testing. The company shall require the contractor to demonstrate that the proposed procedures produce acceptable images and shall require the contractor to use such procedures for testing.

Surface preparation of the area to be radiographed shall be free of coatings, weld slag, dirt, debris and other foreign matter.

Only O.Q. qualified Level II or III nondestructive testing personnel shall interpret test results.

G **Ammonium Persulphate Etching**

A 20% ammonium persulphate etching solution is used to identify metallurgically altered material at "arc burns" and adjacent to "hard spots". The ammonium persulphate etching solution is comprised of 20% ammonium persulphate crystals and 80% water. When applied to arc burn removal areas and hard spots, it will produce blackened spots (martensite) if the metallurgically altered material has not been removed.

When ammonium persulphate etching is specified by the company for arc burn removal, GTN Standard 61-E-W-3 shall be followed. For etching of hard spots the inspection methodology and acceptance criteria of this instruction (Metallurgical Conditions) shall apply. The company and the nondestructive testing contractor shall agree on the testing procedure or procedures prior to the performance of testing.

The company shall require the contractor to demonstrate that the proposed procedures will produce acceptable results and shall require the contractor to use such procedures for testing

Surface preparation for ammonium persulphate etching shall be completed using power or hand tools. Files, wire wheels, coated abrasive discs, coated abrasive flap wheels and non-woven abrasive wheels and discs shall be used for this preparation. Surfaces shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter.

Ammonium persulphate etching shall be completed by an O.Q. qualified individual.

H **Hardness Testing**

Portable held testing devices of compact size, high accuracy, wide measuring range and simplicity of operation are used for testing the hardness of specific, or wide ranges of ferrous and non-ferrous metals. Typically, a hand held hardness tester combines the universal impact device and a processor in a single unit that automatically computes measurement into Vickers, Brinell, and Rockwell or Shore hardness values. Impact directions can be set to insure that accurate values are achieved at any angle. Most electronic devices provide for statistical mean values automatically and utilize an integrated printer or can be configured with an optional printer for real time print out.

When handheld hardness testing is specified by the company, a detailed written procedure for use of the individual testing device shall be established and recorded. Proof of device calibration shall be verified and recorded. The procedure shall meet the requirements of the device manufacturer and company. The use of portable hardness testing devices and the scope of its use shall be at the option of the company.

The company and the hardness-testing contractor shall agree on the hardness testing procedure prior to the performance of testing.

Surface preparations for hardness testing shall be completed by power tool cleaning. The test surface should be smooth and polished. Wire wheels, coated abrasive discs, coated abrasive flap wheels and non-woven abrasive wheels and discs shall be used for this preparation. Surfaces shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products and other foreign matter.

Testing shall be completed by an O.Q. qualified individual.

III) REPAIR TECHNIQUES

A **Grinding**

Grinding is applicable for the removal of non-indented, non-leaking cracks, stress risers, and arc burns. Defects shall be removed by smooth contour grinding in a manner to ensure that the heat of grinding does not produce a metallurgical notch. The wall thickness shall not be reduced by less than the manufacturing wall thickness tolerances per the material specification. Common specifications are provided below.

Material Specifications

API-5LX	>2.875and ≤ 20"	12.5%
	>20" Welded	8%

The removal of all cracks and stress risers should be verified by means of PT or MT. In addition, if the defect is an arc burn, or if a metallurgical notch is otherwise suspected, the removal of all metallurgically altered material should be verified by etching with a solution of 20% ammonium persulphate.

B **Clock Spring®**

Clock Spring® composite sleeves are appropriate for repairing corroded pipe having a minimum of 20% remaining wall thickness. They can also be used to reinforce pipe in which the remaining wall thickness, after grinding, has been reduced beyond acceptable levels, and, when used with filler, for repairs of plain dents and dents with corrosion metal loss.

Clock Spring® composite sleeves operate by restricting bulging in the pipe at the defect location. The hoop stress is transferred through high compressive strength filler, to the composite sleeve wrapped around, and bonded to, the pipe. As such, the greater the pressure reduction in the pipeline during installation of the sleeve, the more hoop stress is transferred to the sleeve.

An O.Q. qualified installer that is trained and certified by an authorized Clock Spring® trainer shall complete the installation.

Clock Spring® sleeves installed above grade shall be covered with an opaque coating in order to protect them from ultraviolet damage. Below grade sleeves shall be treated as a standard pipe repair and an external barrier coating applied. All below grade Clock Spring® repairs should be fitted with a metallic band for future location identification. Applicable documentation as supplied by Clock Spring® shall be completed by the installer and included along with other repair information as detailed in the documentation section of this standard.

C **Type A Sleeve**

Type A - full encirclement welded split sleeves installed with a hardenable epoxy filler are appropriate for repairing sections of pipe containing corrosion metal loss, plain dents, hard spots, cracks and SCC. Type A sleeves shall be fabricated and installed as detailed in Technical Standard 60-D-L-10, and shall extend at least 2" beyond the ends of the defect. Type A Sleeves operate by restricting bulging in the pipe at the defect location. As such, the greater the pressure reduction in the pipeline during installation of the sleeve, the more hoop

stress is transferred to the sleeve. All welds shall pass visual examination and appropriate non-destructive testing.

D **Type B Sleeve**
Type B - pressure containing full encirclement welded split sleeves are appropriate for repairing sections of pipe containing corrosion metal loss, stress risers, cracks, SCC, and dents. Type-B sleeves are distinguished from Type A sleeves by the installation of filler welds to the pipe at the sleeve ends and operate by containing or potentially containing the full operating pressure of the pipeline. Sleeves shall be fabricated and installed as detailed in Technical Standard 60-D-L-10. In situations in which the sleeve is used to repair a dent, hardenable epoxy filler shall be installed between the pipe and sleeve. The sleeve shall be designed to carry to maximum allowable operating pressure of the pipeline. It shall extend at least 2" beyond the ends of the defect. All welds shall pass visual examination and appropriate non-destructive testing.

E **Hot Tapping**
An appropriately designed branch connection shall be welded to the pipe and the entire defect removed by hot tapping. All welds shall pass visual examination and appropriate non-destructive testing.

F **Replacement**
Defects may be removed by cutting out and replacing a cylindrical piece of pipe. The replacement section of pipe shall be designed to meet the intended service, shall not have been used previously, and shall be subject to a pressure test. The test pressure shall be that of a new pipeline or main installed in the same location, and the test can be performed prior to installation, provided all welds other than final tie-in welds are tested with the pipe. All welds shall pass visual examination and appropriate non-destructive testing.

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Regional Director

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