December 20, 2007

Rod Seeley, Director, Southwest Region
United States Department of Transportation
Pipeline and Hazardous Materials Safety Administration
8701 South Gessner, Suite 1110
Houston, TX 77074

RE: CPF 4-2007-5042M

Dear Mr. Seeley,

This letter is provided as a response to the Notice of Amendment (NOA) issued to NuStar Energy L.P. ("NuStar") by the Pipeline and Hazardous Materials Safety Administration on November 26, 2007. The NOA concerned the results of the July 16, 2007 inspection of NuStar's procedures for operations and maintenance. NuStar has reviewed the Notice and has no objections to the recommendations outlined in the Notice. The proposed revisions and referenced procedures are included for your review.

Should you have any questions regarding this response, please contact Hector Gonzalez at (361) 696-7562 or by cell phone at (210) 215-5107. Thank you very much for your time and attention to this response.

By: Mark Arguelles, Pipeline Safety Manager

Mark Arguelles

cc: Hector Gonzalez
Rebecca Fink

P.O. Box 23057 • Corpus Christi, Texas 78403
2829 Texaco Road • Corpus Christi, Texas 78402 • (361) 696-7520 • Fax (361) 883-3906

Notice Of Amendment

Listed below is an item-by-item response to each item identified in the November 26, 2007 Notice of Amendment:

1. **195.226 Welding: Arc burns. (c) A ground may not be welded to the pipe or fitting that is being welded. NuStar Energy L.P.'s procedures need to state that a ground may not be welded to the pipe or fitting that is being welded.**

   NuStar Energy L.P.'s procedures need to state that a ground may not be welded to the pipe or fitting that is being welded.

   NuStar Energy L.P.'s Response to NOA #1
   The Welding Manual has been revised to meet the NOA requirements. Spec 100 Section 8.8 Weld Ground Placement states that in accordance with DOT 195.236 (c) a ground may not be welded to the pipe or fitting that is being welded. A copy of the procedure is included for your review.

2. **195.230 Welds: Repair or removal of defects. (c) Repair of a crack, or of any defect in a previously repaired area must be in accordance with written weld repair procedures that have been qualified under 195.214, Repair procedures must provide that the minimum mechanical properties specified for the welding procedure used to make the original weld are met upon completion of the final weld repair.**

   NuStar Energy L.P.'s procedures need to clearly state the requirements for the repairing of a crack, or any defect in a previously repaired area.

   NuStar Energy L.P.'s Response to NOA #2
   The Welding Manual has been revised to meet the NOA requirements. Spec 100 Section 8.22 Weld Repairs states that repair of a crack or defect in a previously repaired area must be in accordance with written weld procedures that have been qualified under 195.214. A copy of the procedure is included for your review.

3. **195.234 Welds: Nondestructive testing. (d) During construction, at least 10 percent of the girth welds made by each welder during each welding day must be nondestructively tested over the entire circumference of the weld. (e) All girth welds installed each day in the following locations must be nondestructively tested over their entire circumference, except that when nondestructive testing is impracticable for a girth weld, it need not be tested if the number of girth welds for which testing is impracticable does not exceed 10 percent of the girth welds installed that day: (1) At any onshore location where a loss of hazardous liquid could reasonably be expected to pollute any stream, river, lake, reservoir, or other body of water, and any offshore area; (2) Within railroad or public road rights-of-way; (3) At overhead road crossings and within tunnels; (4) Within the limits of any incorporated subdivision of a State government; and, (5) Within populated areas, including, but not limited to, residential subdivisions, shopping centers, schools, designated**

commercial areas, industrial facilities, public institutions, and places of public assembly. (f) When installing used pipe, 100 percent of the old girth welds must be nondestructively tested.

NuStar Energy L.P.'s procedures need to clearly state its nondestructively testing (NDT) requirements.

NuStar Energy L.P.'s Response to NOA #3
The Welding Manual has been revised to meet the NOA requirements. Spec 103 Section 5.6 Daily Radiographic Reports includes the radiographic requirements in accordance with 195.234. A copy of the procedure is included for your review.

4. **195.575 Which facilities must I electrically isolate and what inspections, tests, and safeguards are required? Procedures for shorted casings.**

NuStar Energy L.P.'s procedures need to state clearly the requirements for inspecting and testing for shorted casing.

NuStar Energy L.P.'s Response to NOA #4
The Corrosion Manual has been revised to meet the NOA requirements. Section 10.5 Shorted Casings includes procedures for testing, repairing, and recordkeeping requirements for shorted casings. A copy of the procedure is included for your review.

5. **195.577 What must I do to alleviate interference currents? (b) You must design and install each impressed current or galvanic anode system to minimize any adverse effects on existing adjacent metallic structures.**

NuStar Energy L.P.'s procedures need to state that they design and install each impressed current or galvanic anode system to minimize any adverse effects on existing adjacent metallic structures.

NuStar Energy L.P.'s Response to NOA #5
The Corrosion Manual has been revised to meet the NOA requirements. Section 11 addresses the requirement for designing and installing impressed current and galvanic anode systems in accordance with 195.577. A copy of the procedure is included for your review.

Attachment

Welding Manual - Spec 100

Table of Contents

1. .....Scope 3

2. .....Codes and Standards 3

2.1. .....American Petroleum Institute (API) 3
2.2. .....ASME International 3
2.3. .....American Welding Society (AWS) 3
2.4. .....U.S. Department of Transportation (DOT) 3
2.5. .....NuStar Welding Manual 3

3. .....Material Requirements 4

3.1. .....American Petroleum Institute (API) 4
3.2. .....ASME International 4
3.3. .....Manufacturers Standardization Society (MSS) 4

4. .....Welding Procedure Qualification 4

4.1. .....General 4
4.2. .....Temperature 5

5. .....Welder Qualification 5

6. .....Welding Process and Controls 5

7. .....Pre-alignment Inspection 6

7.1. .....General 6
7.2. .....Pipe Wall Discontinuities 6
7.3. .....Pipe Bevel Discontinuities 6

8. .....Welding Requirements 7

8.1. .....Electrodes 7
8.2. .....Line-Up and Fit-Up 7
8.3. .....Longitudinal Seam Offset 8
8.4. .....Weld Joint Bevels 8
8.5. .....Transition Joints 8
8.6. .....Weld Joint Cleaning 8
8.7. .....Welding Equipment 8
8.8. .....Weld Ground Placement 8

8.9. .....Weld Joint Clearance 8
8.10. ...Tack Welds 9
8.11. ...Weld Joint Protection 9
8.12. ...Weld Pass Requirements 9
8.13. ...Preheating of Welds 9
8.14. ...Filler and Finish Beads 9
8.15. ...Interpass Cleaning and Removal of Visual Defects 10
8.16. ...Arc Burns 10
8.17. ...Weld Stripper Passes 10
8.18. ...Back-Welding 10
8.19. ...Pipe Coating Protection 10
8.20. ...Tie-In Welds 11
8.21. ...Identification of Multiple Welders 11
8.22. ...Weld Repairs 11
8.23. ...Welding Magnetized Pipe 11

9. .....Inspection of Welds 12

9.1. .....Recommended Non-Destructive Testing (NDT) Methods 12
9.2. .....Visual Weld Inspection 12
9.3. .....Radiographic Inspection 12
9.4. .....Standard of Acceptability 12
9.5. .....Production Weld Qualification 12
9.6. .....Disqualification of Welders 12

1. Scope

This specification establishes the welding and inspection requirements for the construction and fabrication of all pipelines and piping systems for NuStar.

2. Codes and Standards

In addition to complying with the requirements of this specification, the following regulations, codes, standards and specifications, latest edition, approved by the U.S. Department of Transportation (DOT) Office of Pipeline Safety (OPS), shall apply:

2.1. American Petroleum Institute (API)

API STD 1104	Welding of Pipelines and Related Facilities
API STD 1104	Welding of Pipelines and Related Facilities, Appendix B: In-Service Welding

2.2. ASME International

ASME Sec IX	Boiler and Pressure Vessel Code, Section IX: Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators
ASME B31.3	Process Piping
ASME B31.4	Pipeline Transportation Systems for Liquid Hydrocarbons

2.3. American Welding Society (AWS)

AWS A5.1	Specification for Covered Carbon Steel Arc Welding Electrodes
AWS A5.5	Specification for Low Alloy Steel Covered Arc Welding Electrodes

2.4. U.S. Department of Transportation (DOT)

49 CFR 195	Code of Federal Regulations, Title 49, Part 195, Transportation of Hazardous Liquids By Pipeline

2.5. NuStar Welding Manual

Spec 102	Welder Performance Qualification
Spec 103	Radiographic Examination of Piping Welds
Spec 109	Arc Burn Removal Procedure

3. Material Requirements

In addition to NuStar material specifications and purchase order requirements, all pipe material, steel pipe flanges, fittings, and valves used in the construction of NuStar pipelines and related piping systems shall meet the requirements of the following:

3.1. American Petroleum Institute (API)

API SPEC 5L	Line Pipe
API SPEC 6D	Pipeline Valves

3.2. ASME International

ASME B16.5	Pipe Flanges and Flanged Fittings

3.3. Manufacturers Standardization Society (MSS)

MSS SP-44	Steel Pipeline Flanges

4. Welding Procedure Qualification

4.1. General

In accordance with DOT regulations, detailed welding procedures must be established prior to production welding and qualified to demonstrate that welds having suitable mechanical properties and soundness can be made with a particular procedure. The quality of the procedure welds shall be determined by destructive testing in accordance with API 1104 or ASME Section IX, latest editions, as applicable.

Qualification of welding procedures shall be in accordance with API 1104 for the construction of new pipelines and API 1104 Appendix B for welding of "In-Service" pipelines. Welding procedures and welders for Plant piping systems designed in accordance with ASME B31.3 shall be qualified in accordance with ASME Section IX.

The maintenance support personnel shall be responsible for conducting all testing, evaluation and approval of test results for each welding procedure. A welding procedure shall NOT be used for pipeline construction or for repair welding prior to its approval by the Integrity Management Team.

Unless otherwise specified and approved, the welding procedures to be used will be those provided in this manual. The approved welding procedures shall be adhered to at all times during welding. In the event that the contractor requests a change of essential variables (as defined by API 1104), a new procedure shall be developed.

As required, additional procedures will be established and incorporated into this manual.

4.2. Temperature

The ambient temperature at which the welding procedure qualification was conducted shall be included in the procedure. The approved procedure may be used for construction at temperatures above or below the test temperature provided preheat temperatures specified in the procedure are followed.

5. Welder Qualification

Prior to performing any work, all welders shall be qualified in accordance with VWM Spec 102. All welder qualification testing shall be performed under the direct supervision of a company approved inspector.

A welder is not allowed to weld on ANY pipelines or pipeline facilities until the welder has been tested and qualified in accordance with VWM Spec 102. Once qualified, the welder is then permitted to weld within the essential variables established by the qualification test. These essential variables are detailed in API 1104 for new construction or API 1104 Appendix B "In-Service" welding.

6. Welding Process and Controls

The approved field welding process to be used for construction and fabrication is the shielded metal arc welding (SMAW) process.

Welding electrode and ground requirements include, but are not limited to the following:

a. Cellulose coated electrodes (E6010, E7010-G, and E8010-G) shall not be stored in ovens, but shall be maintained in a dry area at a temperature above freezing and below 100 deg F.

b. Low hydrogen electrodes (EXX16, EXX18) used for maintenance welding shall be stored in holding ovens at 250 deg F. minimum to 350 deg F. maximum temperature.

c. All electrodes that have been exposed to an atmosphere that may affect their operating characteristics or weld quality shall be discarded.

d. Electrode holders shall be of the fully insulated type when used for welding on the inside of the pipe.

e. The ground connection shall be constructed of steel, of similar chemical composition, with respect to the pipe and be of sufficient size to prevent overheating. The ground shall be located and held, if necessary, in a manner that prevents arc burns on the pipe. It shall be insulated on all points contacting the pipe except for the one point of contact that should be located in the weld joint.

f. Commercially available grounding clamps may be used for fabrication and/or field construction as applicable.

g. Ground clamps shall not be welded to the pipe or fittings.

7. Pre-alignment Inspection

7.1. General

Prior to alignment, all pipe and/or fittings shall be inspected for defects that would impair the service life of the pipeline.

Pipe wall and bevel discontinuities shall be repaired or removed as described herein.

7.2. Pipe Wall Discontinuities

Pipe wall discontinuities shall be handled as specified in the sections below:

7.2.1. Laminations

Laminations found in the pipe wall require that the pipe be inspected by an approved ultrasonic thickness gage and the portion of the pipe, which contains the lamination, be cut-out as a cylinder.

7.2.2. Cracks

Cracks found in the pipe wall shall require that the portion of pipe containing the crack be cut-out as a cylinder.

7.2.3. Dents

All dents exceeding the requirements of API 5L shall be cut-out as a cylinder.

7.2.4. Gouges, Grooves, Scratches, and Notches

All gouges, grooves, scratches, and notches that exceed the requirements of API 5L shall be eliminated by grinding, providing the wall thickness is not reduced to below the minimum requirements. For API 5L wall thickness tolerances refer to Paragraph 8.16 of this specification. In the event grinding reduces the wall thickness below the minimum requirements, the area shall be cut-out as a cylinder of pipe.

7.3. Pipe Bevel Discontinuities

7.3.1. Laminations

Laminations or other visual defects in the pipe bevel that exceed 1/4 inch shall be removed by cutting out this portion of the pipe as a cylinder.

7.3.2. Bevel Damage

Bevel damage such as dents, gouges, or depressions shall be repaired if their depth exceeds one-sixteenth of an inch. Repairs shall be made by grinding or filing to smooth the defect into the existing bevel. Damage that requires grinding to the point where the bevel may be modified, from the tolerances on the welding procedure, shall be rejected and the end shall be re-beveled.

7.3.3. Root Face Damage

The root face (land), if damaged, may be restored to its original dimension by filing or grinding. In the event restoration is not possible, the end shall be completely re-beveled.

7.3.4. Bevel Dents

Denting restricted to the top edge of the bevel shall be ground smooth and shall not be cause for rejection, unless, in the opinion of the welding inspector, the denting extends beyond the area where the cap pass will tie-in to the bevel edge.

8. Welding Requirements

8.1. Electrodes

The specific classification and type of welding electrode used during construction and fabrication shall be as described in the approved welding procedure. Electrodes shall be ordered by their American Welding Society (AWS) classification number (example E6010 and E7010-G) based on their designation in the applicable procedure. Any change in the AWS classification number requires approval by NuStar Maintenance Support.

The NuStar inspector has the right to disallow the use of any electrodes brought to the job site that may be of questionable condition or moisture content. Electrodes, which are of obviously questionable condition, shall not be used for any welding including welder qualification.

Welding electrodes shall be stored and handled in accordance with the manufacturers recommended practice. Electrodes should be stored in sealed original metal containers until ready for use. Those in opened containers should be protected from deterioration and excessive moisture changes. Visual inspection of the electrodes should be done prior to welding. Electrodes that show surface oxidation, fractured coatings, or eccentricity of the coating with respect to the electrode core wire should be discarded.

8.2. Line-Up and Fit-Up

Either internal or external line-up clamps shall be used for assuring proper alignment for butt welds unless it is impractical due to dimensional differences such as flange or fitting to pipe, etc. The clamps shall remove out-of-roundness and shall provide a uniform joint fit-up. High-low conditions shall not exceed one-sixteenth of an inch.

External line-up clamps may be removed after the root bead is fifty (50) percent complete, provided the completed portion of the root bead is in segments of approximately equal length, and provided the segments are equally spaced around the circumference of the pipe. If conditions are such that it is difficult to prevent movement of the pipe, or if the weld is excessively stressed, the root bead shall be completed to the extent possible before the line-up clamp is released.

When an internal alignment clamp is used for achieving alignment, it shall be held firmly in position until the root pass is one hundred percent complete and the pipe has been properly supported.

Joint alignment shall have a uniform spacing (root opening) throughout the circumference of the joint. The spacing shall be in accordance with the approved welding procedure.

8.3. Longitudinal Seam Offset

Longitudinal seams in adjacent lengths of longitudinal welded pipe shall be offset by a minimum of 2 inches.

8.4. Weld Joint Bevels

Unless otherwise specified, NuStar will supply pipe with beveled ends conforming to API 5L. When re-beveling is necessary it may be accomplished using a mechanized oxy-acetylene beveling machine. When a transition taper is required, it shall be made using a mechanical end preparation machine or by manual preparation and then approved by the NuStar Inspector. A rust preventative such as deoxaluminate may be applied to the pipe bevels to prevent rust and corrosion during long-term storage.

8.5. Transition Joints

The transition between pipe ends of unequal thickness (thickness differences greater than 3/32") shall be by mechanical tapering, by welding in accordance with ASME B31.4, or by means of a prefabricated transition nipple not less than one-half pipe diameter in length.

8.6. Weld Joint Cleaning

The beveled weld joint and the inside and outside surfaces at the end of each pipe to be field welded shall be cleaned for a minimum distance of 1 inch immediately prior to welding.

All traces of foreign material shall be removed by hand or power tools from the weld area. The pipe ends shall be completely dry prior to and during field welding. This may be accomplished by the use of propane or oxy-acetylene torches using a "rosebud" tip regardless of the ambient temperature. There shall be no traces of water at or near the outside or inside pipe surfaces during welding.

8.7. Welding Equipment

Welding equipment used for field welding shall be maintained in good working condition and have the same performance capabilities as that which was used to qualify the welding procedure. Any machine that is not performing satisfactorily shall be removed from service and repaired or replaced.

8.8. Weld Ground Placement

During welding, the placement of welding ground connections shall be on the last finished or unfinished weld. In accordance with DOT 195.226C a ground may not be welded to the pipe or fitting that is being welded. Grounds used for firing line welding shall be placed on the finished or unfinished weld. Arc burns on pipe or on completed welds shall be eliminated in accordance with the NuStar Arc Burn Removal Procedure or cut-out as a cylinder, as directed by the company Inspector.

8.9. Weld Joint Clearance

When the pipe is welded above ground, a minimum clearance of 16 inches is recommended. When the pipe is welded in the ditch, the bell hole shall be of sufficient size to provide the welding personnel with ready access to the joint for all welding operations.

8.10. Tack Welds

Tack welds, which are to be incorporated in the final weld, shall be thoroughly cleaned of scale and suitably prepared at each end by means of grinding to ensure complete stringer bead continuity. Tack welds shall be free of cracks.

8.11. Weld Joint Protection

Welding shall not be performed when weather conditions exist which would be detrimental to the quality of the finished weld. Rain, snow, high winds, and moisture from any source, are known to contribute to unfavorable weld quality conditions. Welding may be allowed to continue during inclement weather only after adequate shelters and precautions are implemented to insure proper weld protection. The company Inspector shall determine if the protective measures are adequate prior to welding.

8.12. Weld Pass Requirements

A minimum of two complete weld passes shall be made prior to leaving the weld in the unfinished condition. The purpose of this requirement is to assure weld cracking will not occur. Depending on the pipe wall thickness and/or weld stress level, the company Inspector may require additional passes be made prior to leaving the weld in a temporarily unfinished condition.

8.13. Preheating of Welds

When preheating is required by the procedure, temperature readings shall be taken using temperature indicating crayons or direct reading pyrometers. Measurements shall be made at four locations ninety degrees apart on each side of the weld joint. The location shall be a minimum of 2 inches from the weld joint centerline. Maximum temperature differential between any two points shall not exceed 50 deg F.

Preheating may be performed by propane, induction, or oxy-acetylene torches with a "rosebud" tip. Preheating shall always be done when the pipe is wet or damp for purposes of drying the pipe prior to welding.

8.14. Filler and Finish Beads

The completed weld shall have a uniform cross-section around the entire circumference.

At no point shall the weld crown (cap pass) surface be below the outside surface of the pipe, nor should it be raised above the parent metal by more than one-sixteenth of an inch, except that the height of a weld crown may exceed one-sixteenth if the weld contour provides a uniform transition into the pipe material on both sides of the weld. Two beads shall not be started at the same location; and the face of the completed weld should be approximately one-eighth of an inch greater than the width of the original groove. The completed weld shall be thoroughly brushed and cleaned.

8.15. Interpass Cleaning and Removal of Visual Defects

Each pass of the weld metal shall be cleaned of slag or remaining flux using hand or power tools with stainless steel buffer wheels before a further pass is applied.

Visible defects such as slag cavities, cold laps, and other deposition faults shall be removed by grinding.

Clusters of surface porosity, starts and stops, and high points, shall be removed by grinding prior to the deposition of the next pass.

8.16. Arc Burns

Arc burns shall be cut-out as a cylinder, or at the discretion of the company Inspector, may be eliminated in accordance with the NuStar Arc Burn Removal Procedure. In the event the remaining wall thickness is less than the minimum specified in API 5L, Table 9, shown herein, the pipe shall be cut-out as a cylinder.

Wall Thickness Tolerances			
Outside Diameter (OD)–in.	Type of Pipe	Tolerance, Percent	
		Grade B or Lower	Grade X42 or Higher
≤ 2-7/8"	All	+20.0, −12.5	+15.0, −12.5
> 2-7/8" and < 20"	All	+15.0, −12.5	+15.0, −12.5
≥ 20"	Welded	+17.5, −12.5	+19.5, −8.0
≥ 20"	Seamless	+15.0, −12.5	+17.5, −10.0

8.17. Weld Stripper Passes

A stripper pass may be used with the approval of a company inspector to eliminate unacceptable external conditions such as external undercut or incomplete fill of a cap pass. Stripper passes, when used, shall be two inches in length minimum, and a minimum of one electrode diameter in width. Prior to the welding of a stripper pass on a weld that has cooled to ambient temperature, the area to be welded shall be preheated to 250 deg F minimum to 350 deg F maximum for a distance of 3 inches on each side of the weld area.

8.18. Back-Welding

When pipe and/or fitting size permits access to the inside surface, back-welding may be used to eliminate unacceptable internal conditions or to complete the weld on transitions or fittings to pipe. Prior to back-welding, the area shall be preheated from the outside to achieve a preheat temperature on the inside surface of 250 deg F minimum to 350 deg F maximum. This preheat requirement applies to all internal back-welding.

8.19. Pipe Coating Protection

Any pipe coating shall be protected from weld spatter and mechanical abrasion during welding.

8.20. Tie-In Welds

Tie-in welds, once started, shall be completed without interruption.

8.21. Identification of Multiple Welders

If requested by the company Inspector, each welder shall mark the weld or section of a weld for which he has been responsible with the identification assigned to him by the Inspector using a weatherproof crayon or a permanent ink marker.

8.22. Weld Repairs

Depending on the extent of defective weld areas found during radiographic examination, the Inspector may require the weld be cut-out as a cylinder of pipe or be repaired in accordance with the following limits:

1) Repair of a crack or of any defect in a previously repaired area must be in accordance with written weld repair procedures that have been qualified under §195.214. Repair procedures must provide that the minimum mechanical properties specified for the welding procedure used to make the original weld are met upon completion of the final weld repair.
2) Defects, except cracks, found by visual examination, magnetic particle, or liquid penetrant that are externally exposed in the cover pass may be repaired.
3) Defects found by radiographic examination, such as slag inclusions, porosity or gas pockets may be repaired in compliance with API 1104 provided the defects can be removed without grinding completely through the weld. Repair of defects that require removal of the root pass require approval of the company Inspector.

Before the above repairs are made, the defective area shall be entirely removed to clean metal by grinding in a manner acceptable to the Inspector. All slag and scale shall be removed by wire brushing.

All repair cavities shall be not less than 2 in. in length unless impractical and approved by the company Inspector. All repairs shall be made with a minimum of two passes. The start and stop of repair passes shall not be superimposed over the start and stop of the preceding pass.

The start and stop of each repair pass shall be ground smooth.

Prior to repair welding, a minimum of 3 in. on each side of the repair area shall be preheated to a temperature of 250 deg F minimum to 350 deg F maximum and maintained during welding. Temperature shall be checked by the use of temperature indicating crayons or pyrometers.

All repairs shall meet the Acceptance Standards for Nondestructive Testing of API 1104.

8.23. Welding Magnetized Pipe

Residual magnetic fields due to pipe handling with electromagnets, inspection of new pipe with electromagnetic fields or smart pigging of existing lines can create significant deflection of the welding arc resulting in welding problems. In the event magnetic fields are suspected or encountered in the field, the company Inspector will measure the individual joint ends and the joint space to determine if degaussing (demagnetizing) of the weld joint is necessary to assure proper weld quality. In general, a gauss level greater than 100, as measured in the joint space, will require degaussing which will be directed by the company Inspector.

9. Inspection of Welds

9.1. Recommended Non-Destructive Testing (NDT) Methods

NuStar recognizes there are several NDT methods available for field inspection of fillet and groove welds for new construction. The chart shown herein represents the present NuStar NDT recommendations for each type of weld. As NDT methods change or improve, the chart will be revised to reflect the latest technology.

Recommended NDT Methods			
Weld Type	NDT Methods		
Joint Design	X-Ray	LPT	MPT
Groove	R		
Fillet		R	A

LPT=Liquid Penetrant Testing; MPT=Magnetic Particle Testing; R=Recommended; A=Alternate Method

9.2. Visual Weld Inspection

Visual inspection of welds will be conducted to insure that the welding is performed in accordance with the approved welding procedure and the welding meets the requirements of this specification including API 1104.

9.3. Radiographic Inspection

When radiographic examination of groove butt welds is conducted, it shall meet the requirements set forth in the 49 CFR 195. At the option of NuStar, the extent of radiographic examination may exceed these requirements to assure quality welding is being achieved throughout the project. Refer to NuStar Welding Manual Specification 103, 5.6 for the number of girth welds to be nondestructively tested each day.

9.4. Standard of Acceptability

Unless specified otherwise, the standard of acceptability for the radiographic film interpretation of all regulated pipeline or piping system welds shall be API 1104.

9.5. Production Weld Qualification

At the discretion of the company Inspector, production welds may be cut-out and tested to confirm the adequacy of the welding procedure under construction conditions.

Welds meeting the requirements of API 1104 will be charged to NuStar. Those welds not meeting the requirements of API 1104 will be charged to the pipeline contractor.

9.6. Disqualification of Welders

A welder who makes a weld that fails to comply with the requirements of this section may be disqualified from further welding at the discretion of the company inspector.

Attachment

Welding Manual - Spec 103

Table of Contents

1. .....Scope 2

2. .....Codes and Standards 2

2.1. .....American Petroleum Institute (API) 2
2.2. .....ASME International 2
2.3. .....American Society of Nondestructive Testing (ASNT) 2
2.4. .....ASTM International 2

3. .....Radiographic Inspection Personnel 2

3.1. .....General 2
3.2. .....Personnel Qualification 2
3.3. .....Training Requirements 3
3.4. .....Certification 3
3.5. .....Performance Review 3

4. .....Radiographic Procedures 4

4.1. .....General 4
4.2. .....Level of Quality 4
4.3. .....Radiographic Procedure Details 4
4.4. .....Qualification Procedures 5
4.5. .....Essential Variables 5

5. .....Production Radiography 6

5.1. .....General 6
5.2. .....Radiographic Inspection Personnel 6
5.3. .....Production Radiographs 6
5.4. .....Equipment for Interpretation 7
5.5. .....Standard of Acceptability 8
5.6. .....Daily Radiographic Reports 8
5.7. .....Welding Contractor Film Review 9
5.8. .....NDT Records 9
5.9. .....Radiographic Contractor Progress Requirements 10

6. .....Radiographic Inspection Equipment 10

6.1. .....General 10
6.2. .....Darkroom Facilities 10

1. Scope

This specification establishes the requirements for performing radiographic inspection of circumferential groove welds on all pipelines and piping systems for NuStar. This specification applies to groove welds made during construction and fabrication. This specification does not apply to groove and fillet welds made during "In-Service" welding of full encirclement sleeves or patches.

2. Codes and Standards

In addition to complying with the requirements of this specification, the following regulations and standards, latest edition, shall apply:

2.1. American Petroleum Institute (API)

API STD 1104	Welding of Pipelines and Related Facilities

2.2. ASME International

ASME B31.4	Pipeline Transportation Systems for Liquid Hydrocarbons

2.3. American Society of Nondestructive Testing (ASNT)

ASNT TC-1A	Recommended Practice, Personnel Qualification and Certification in Nondestructive Testing

2.4. ASTM International

ASTM E 94	Standard Guide for Radiographic Examination

2.5. U.S. Department of Transportation (DOT)

Part 195	Transportation of Hazardous Liquids by Pipeline

3. Radiographic Inspection Personnel

3.1. General

This section prescribes the qualification requirements for individuals who will be engaged in the production and evaluation of radiographs for NuStar.

3.2. Personnel Qualification

All regularly assigned radiographic personnel shall meet the requirements as defined in ASNT TC-1A and Nuclear Regulatory Commission (NRC) and/or state regulations applicable to radiation safety.

At least one member of each crew designated as being in charge shall meet the requirements for Level II. Only Level II or Level III personnel will be allowed to interpret radiographs. Records of certification for radiographers and interpreters shall be furnished to NuStar prior to production radiography and shall include the following:

a. Background and Experience
b. Training Course Record
c. Technical Examination Record
d. Doctor's Report of Radiographer's Jaeger J-1 Acuity Eye Test
e. Date of Qualification and Re-qualification

The NuStar Inspector shall request the above information when the radiographic contractor is contacted for a work assignment. Each radiographer should carry a copy of his qualification with him to the job site.

In addition, film interpreters may be required to pass a NuStar qualification program and demonstrate their knowledge and understanding of this specification prior to production film interpretation.

Radiographers may be required to demonstrate their ability to produce acceptable radiographs with each radiographic procedure they use prior to performing production radiographs.

3.3. Training Requirements

Radiographic trainees, Level I, shall be trained by the contractor, prior to assignment, in the use of radiation monitoring equipment. A radiographic trainee shall not actuate radiation-producing equipment in production radiography.

3.4. Certification

Upon successful completion of the requirements of Section 3.2 of this specification, NuStar may issue, depending on the project duration, a certification card bearing the following:

a. Name
b. Signature of NuStar Examiner/Reviewer
c. Expiration Date
d. Identification of Level
e. Social Security Number

3.5. Performance Review

The Level II or III radiographer and film interpreter's work will be subject to review by the NuStar representative and any pattern of inconsistency will be cause for additional training, testing, or dismissal.

4. Radiographic Procedures

4.1. General

This section prescribes the minimum requirements for establishing and qualifying the radiographic procedures to be used for the examination of welds covered by this specification.

All procedures shall be qualified prior to the performance of any radiographic inspection and approval by NuStar.

4.2. Level of Quality

The procedures shall produce radiographs of sufficient density, clarity, and contrast so that defects in the weld or in the pipe adjacent to the weld, the penetrameter outline, and the 2-T hole in the penetrameter are clearly visible.

All requirements shall apply equally to x-ray and gamma ray.

4.3. Radiographic Procedure Details

4.3.1. Radiation Sources

4.3.1.1. X-Ray

X-ray equipment shall consist of an approved unit capable of control of KVP (Kilo-voltage Potential) and exposure time. The unit shall be rated at 140 KVP to 300 KVP and a minimum current rating of 3MA (Milliamperes). For internal crawlers, a full 360-degree simultaneous exposure is required. For radiographs made using external x-ray equipment, a spot beam type machine rated at a minimum of 200 KVP and a minimum of 3MA shall be used.

4.3.1.2. Gamma Ray

Gamma radiography, when approved, may be performed using an approved Iridium-192 source contained in an exposure device fully approved and in accordance with all applicable federal and state regulations.

4.3.2. Film

Only Class II film or better shall be used for x-ray. Acceptable examples include Kodak AA, T, or M. Class I film shall be used for gamma ray.

4.3.3. Intensifying Screens

Lead foil screens shall be used. The minimum thickness front and back shall be 0.005 inches respectively.

4.3.4. Film Density

Film shall be exposed so that the H & D density shall not be less than 1.8 or more than 3.0 through the thickest portion of the weld. The recommended average film density is 2.5.

4.3.5. Film Quality

Radiographs shall be free of fog, blemishes or artifacts that interfere with their interpretation.

4.3.6. Penetrameters

API penetrameters made of radiographically similar material to the weld being inspected shall be used. The thickness and location of the penetrameters shall be in accordance with API 1104. The penetrameter selection shall be based on the thickness of the weld.

4.3.7. Shims

The shim thickness shall be based on the average reinforcement (build-up) in accordance with API 1104.

4.3.8. Geometric Unsharpness

Radiographic procedures shall be such that geometric unsharpness as calculated from the formulas in ASTM E94 shall not exceed 0.025 inches.

4.4. Qualification Procedures

The radiographic contractor shall qualify each proposed procedure prior to its use for weld examination. A NuStar representative shall be allowed to witness the test and determine the acceptance of the procedure. Advance notice must be given to NuStar to schedule personnel for witnessing the procedure qualification.

A procedure may be requested to be qualified by making two complete and acceptable radiographs of a weld following the radiographic procedure details of this specification. All procedure details, the test results and the approval by the NuStar representative shall be recorded on the Radiographic Procedure Qualification Form provided by the Radiographic Contractor and approved by NuStar. The radiographer performing the test will be simultaneously qualified with the procedure. One of the two test radiographs and one copy of the record shall be given to the NuStar Inspector. The radiographer performing the test shall retain the second radiograph and a copy of the record.

Qualified procedures may be used by other radiographers from the same contractor provided they have a copy of the procedure record and they qualify their ability to produce an acceptable radiograph using the procedure details.

4.5. Essential Variables

A procedure shall be re-qualified as a new procedure when any of the following changes are made:

a. An increase in radiation source size
b. A change in type of radiation source
c. A change in intensifying screens
d. A change in film class, film manufacturer and film type when the "Relative Film Speed" is increased
e. A change in technique
f. A change in film processing methods such as manual to automatic

5. Production Radiography

5.1. General

This section prescribes the minimum requirements for radiographic inspection of welding during construction.

5.2. Radiographic Inspection Personnel

At least one Level II radiographer shall be assigned to each radiographic unit. The duties and responsibilities of the radiographer shall include, but are not limited to:

a. Directing the performance of the radiographic work

b. Radiographic quality

c. Interpretation of the radiographs

d. Determining whether the welds meet the requirements of the "Standard of Acceptability" of this specification

e. Protection against radiation and exposure monitoring of all persons at or near radiation areas

5.3. Production Radiographs

5.3.1. Quality

Radiographs that do not meet the requirements of this specification shall be re-taken and a separate report shall be made as to the reason(s) for the re-take. The radiographic contractor will not be reimbursed for this additional work.

5.3.2. Weld Identification

The weld identification numbering system will be established by the radiographic contractor and approved by NuStar prior to production radiography.

5.3.3. Film Identification Procedure

All film shall be clearly identified using lead numbers and letters and light printers as follows:

Lead numbers and letters (1/4" - 3/8") shall be used for weld identification on each film.

Contractor's name, date, unit number, location, etc., shall be flashed on the overlap end of each film using a light printer.

5.3.4. Film Number Belt

Unless otherwise approved, a film clock belt shall be a part of production radiography and shall be of sufficient length to cover the entire circumference of the weld. The lead inch numbers shall be in "inch" increments approved by NuStar and shall appear on the radiograph adjacent to the weld. The number "0" shall be in line with the "top button" of the weld and an arrow showing the direction of numbering shall be marked on the pipe. The direction of numbering shall be the same throughout the

project and will be specified by the radiographic contractor and approved by NuStar prior to production radiography.

5.3.5. Weld Marking

The radiographic contractor is required to mark the welds for repair or cut-out. The specific marking material and designation system will be given to the radiographic contractor by NuStar's representative prior to production radiography.

The marking medium shall be such that the marking on the pipe will be identifiable until the location of the welds and final disposition has been recorded.

5.3.6. Film Marking

The location(s) of unacceptable defects shall be marked on the film, outside of the weld area, using a black felt tip pen.

5.3.7. Film Processing

Film processing may be done by manual or automatic processes. Finished radiographs shall be free of all artifacts that will interfere with film interpretation.

5.3.8. Film Packaging

All film of accepted welds and/or repairs shall be carefully prepared and filed in numerical order. Radiographs of unacceptable welds shall be stored with the repair radiographs. Cut-out weld film shall be stored separately.

Compartmentalized boxes or envelopes shall be used for filing the film. When boxes are used, each box shall contain a grid sheet identifying the film in each compartment and a copy of the applicable reports. The following information shall be placed on the front edge of the film boxes or on the front of the storage envelope.

NuStar

Film Container Number _____

Date _____

X-ray Numbers _____ to _____

Radiographic Contractor's Name _____

Project Description _____

Work Order No. _____

5.4. Equipment for Interpretation

The following equipment shall be used for film interpretation on NuStar projects:

5.4.1. Film Viewers

All film viewers shall be the high intensity type with a variable intensity control. The viewer shall produce a sufficient illumination to view a maximum film density of 3.5. A dimmer control switch shall be a part of the viewer to provide the proper illumination for the range of densities being viewed. The viewer screen shall be free of scratches that could lead to misinterpretation, and

masking aids shall be used as necessary to prevent light leakage from interfering with film interpretation.

Radiographic film shall only be viewed in a room with subdued background lighting.

5.4.2. Film Densitometers

To assure the specification densities are met, each darkroom shall have a densitometer for checking film density. The densitometer shall be kept in good working condition and a density calibration strip shall be used to calibrate the unit prior to daily use. The densitometer calibration shall be checked periodically when it is being used.

5.4.3. Tools for Defect Measurement

The accuracy of measurements of discontinuities is extremely important. The following tools shall be used as necessary for measuring the size of weld discontinuities:

a. Rulers - A clear, thin plastic ruler graduated in 1/16 inch increments shall be used for measuring weld discontinuities.

b. Optical Comparators - If it is necessary to use a comparator, it is recommended that the maximum of 5X be used, and it should have a positive focusing adjustment.

c. Film Markers - When a discontinuity is outside of the acceptance limits, a felt tip pen that does not smudge, smear, or melt, should be used to mark the defective area of the film, along with stating the type of defect being rejected.

5.5. Standard of Acceptability

5.5.1. Film Interpretation

The acceptability of a weld is determined according to the standards in Section 9 of API 1104. The radiographic contractor's interpreter is responsible for assuring all radiographs are interpreted in accordance with API 1104 and this specification. Discontinuities shall be measured, using the tools discussed herein. In the case of broken or elongated slag lines that appear in the same plane or line, each indication shall be measured and the total length of all indications shall be used to determine the acceptance of this discontinuity.

If a girth weld is unacceptable under these standards for a reason other than a crack, and if Appendix A of API 1104 applies to the weld, the acceptability of the weld may be determined under that appendix.

5.6. Daily Radiographic Reports

The radiographic contractor shall be responsible for furnishing the NuStar representative and construction contractor's representative with a detailed report of each of the previous day's radiography. If no radiographs were made, but were scheduled to be performed, a report shall be made by the radiographic contractor explaining the reason for the absence of radiographic support.

The number of girth welds radiographed per day shall be in accordance with DOT Part 195.234 and NuStar inspection. The following guidance shall apply:

(A) During construction, at least 10 percent of the girth welds made by each welder during each welding day must be nondestructively tested over the entire circumference of the weld.

(B) All girth welds installed each day in the following locations must be nondestructively tested over their entire circumference (excepting that when nondestructive testing is impracticable for a girth weld, it need not be tested if the number of girth welds for which testing is impracticable does not exceed 10 percent of the girth welds installed that day):

1. At any onshore location where a loss of hazardous liquid could reasonably be expected to pollute any stream, river, lake, reservoir, or other body of water, and any offshore area;
2. Within railroad or public road rights-of-way;
3. At overhead road crossings and within tunnels;
4. Within the limits of any incorporated subdivision of a State government; and
5. Within populated areas, including, but not limited to, residential subdivisions, shopping centers, schools, designated commercial areas, industrial facilities, public institutions, and places of public assembly.

(C) When installing used pipe, 100 percent of the old girth welds must be nondestructively tested.

The daily radiographic report supplied to NuStar shall include, but is not limited to, the following:

a. Weld ID Number
b. Status of Weld (in code/out of code)
c. Defect Type
d. Location of Defect on Pipe Circumference
e. Location of Defect in Reference to cross-section (based on judgment)
f. Date of Radiography
g. Pipe Diameter/Wall Thickness
h. Weld Location
i. Number of Welds Radiographed
j. Crew Size and Unit No.
k. Radiographer's Signature
l. Defect Code
m. NuStar Representative's Signature

The radiographic contractor shall keep a copy of all daily reports for the duration of their assignment to the project.

5.7. Welding Contractor Film Review

The welding contractor shall have the right to review radiographs when accompanied by NuStar's representative. Radiographs may be reviewed on the right-of-way provided it does not interfere with radiographic inspection operations.

5.8. NDT Records

Upon completion of the review of the weld radiographs, and at the discretion of the NuStar Representative, the radiographs may be properly discarded. DOT, Part 195, no longer requires the retention of the radiographs.

However, a copy of the daily radiographic report showing the disposition and location of each weld shall be maintained for the life of the pipeline. These radiographic reports shall be delivered to the NuStar representative and will ultimately be maintained in the "Project" file.

5.9. Radiographic Contractor Progress Requirements

The radiographic contractor shall perform all work under this specification in an orderly and expeditious manner while maintaining the required quality at all times. Reasonable time will be provided for the performance of the girth weld radiography and documentation, but at no time shall unnecessary delays due to equipment, supply, or personnel problems be allowed.

6. Radiographic Inspection Equipment

6.1. General

Radiographic inspection units shall be equipped with all equipment and supplies necessary to produce, process, and interpret radiographs at the job site. All equipment shall be maintained in a state of good repair at all times. Sufficient spare equipment shall be readily available to eliminate downtime of radiographic operations. Only equipment approved by NuStar shall be used for production radiography.

6.2. Darkroom Facilities

Darkrooms shall, in general, be equipped for use as film processing and film viewing facilities. The radiographic contractor may elect to use separate facilities for each function providing the requirements of this specification are met.

In addition to having all film processing capabilities, the darkroom shall meet the minimum following conditions:

a. Darkrooms or viewing facilities shall be large enough to comfortably accommodate at least two people viewing radiographs.

b. Each darkroom or viewing facility shall have at least one film viewer meeting the requirements of Section 5.4.1, Film Viewers, of this specification.

c. Each darkroom shall be equipped with a film densitometer (Macbeth Quantalog, X-Rite Model 301 or equal) for checking the film density.

d. Each darkroom shall have electric power plants of sufficient size to operate all equipment. Heating and air conditioning is recommended.

Attachment

Corrosion Control – Section 10

10. ELECTRICAL ISOLATION DEVICES (§CFR 195.575)

TABLE OF CONTENTS

10.1. Purpose **10-3**

10.2. Material **10-3**
10.2.1. Stud Bolts 10-3
10.2.2. Gaskets 10-3
10.2.3. Sleeves and Washers 10-4
10.2.4. Ordering Material 10-4

10.3. Installation **10-4**
10.3.1. Bolting Sequences 10-5
10.3.2. Torque Requirements 10-6
10.3.3. Testing Electrical Isolation Devices 10-6

10.4. AC Mitigation and AC Ground Fault/Lightning **10-6**

10.5. Shorted Casings

TABLE OF FIGURES

Figure 10–1: Bolting Sequences **10-5**

Table of Tables

Table 10–1: Torque Requirements **10-6**

10.1. PURPOSE

[Resource information for this section is taken from Section 4.3: *Electrical Isolation* in NACE Standard RP0169: *Control of External Corrosion on Underground or Submerged Metallic Piping Systems* (shown in Appendix F of this manual).]

OQ qualified corrosion personnel shall install isolation devices such as flange assemblies, prefabricated joint unions, or couplings within piping systems where electrical isolation of portions of the system is required to facilitate the application of external corrosion control. They should properly select these devices for temperature, pressure, chemical resistance, dielectric resistance, and mechanical strength. Each electrical isolation must be inspected and electrically tested to insure the isolation is adequate. OQ qualified corrosion personnel should avoid installation of isolation devices or safeguard these devices in areas in which combustible atmospheres are likely to be present. If installing an insulating device in an area where a combustible atmosphere is reasonable to foresee, precautions must be taken to prevent arcing. Each buried or submerged pipeline must be electrically isolated from other metallic structures, unless the pipelines and other structures can be electrically interconnected and cathodically protected as a single unit.

Locations at which electrical isolation devices should be considered include, but are not limited to, the following:

- Points at which facilities change ownership
- Connections to main-line piping systems
- Inlet and outlet piping of in-line measuring and/or pressure-regulating stations
- Pumping stations
- Stray current areas
- Junction of dissimilar metals
- Termination of service line connections and entrance piping
- Junction of a coated pipe and a bare pipe
- Locations at which electrical grounding is used

10.2. MATERIAL

10.2.1. STUD BOLTS

Longer stud bolts are required to accommodate the additional thickness of the washers and gasket stud bolts for all installations will be ASTM A193 Grade B-7. These bolts have tensile stress limits of 100,000 psi or more, so Table 10-1: *Torque Requirements* is applicable to these bolts.

10.2.2. GASKETS

10.2.2.1. TYPE "E" GASKETS

Type "E" gaskets have the same outside diameter as the flanges and are made with precision-located bolt holes. They are easy to center and will prevent foreign material from becoming lodged between the flange faces and "shorting out" the flange insulation. Type "E" gaskets are available in a wide variety of materials.

10.2.2.2. TYPE "F" GASKETS

Type "F" gaskets are made to fit within the bolt hole circle of the flange faces. The outside diameter of the gasket is slightly larger than the inside diameter of the bolt hole circle. They are available in a wide variety of materials.

10.2.2.3. TYPE "D" GASKETS

Type "D" gaskets are made specifically to fit into the ring groove of RTJ flanges. They are available in reinforced phenolic and other materials.

10.2.2.4. INSULATING SLEEVES AND WASHERS

Insulating sleeves and washers are available in complete kits, with or without a gasket. Sleeves and washers are available as separate parts or as a one-piece molded unit.

10.2.3. SLEEVES AND WASHERS

10.2.3.1. SLEEVES AND WASHERS

Sleeves and washers are to be one piece in design and molded from acetal resin. One piece sleeves and washers are structurally tough but limited to applications where the flange temperature does not exceed +180°F and compressive loads do not exceed 18,000 psi.

10.2.3.2. STEEL WASHERS

Steel washers are designed to fit over the one-piece isolating sleeve and washer. The outside diameter is sized to fit within the bolt facing on ANSI standard flanges. They are made of $^1/_8$ in. thick plated hot-rolled steel.

10.2.4. ORDERING MATERIAL

NOTE: The above materials are specified, but material of equal or greater quality may be substituted.

The specified gaskets can be ordered from:

MESA PRODUCTS

4445 South 74th East Avenue

Tulsa Oklahoma, 74145

918-627-3188 (voice)

918-835-6808 (fax)

NOTE: PSI Insulation Products are recommended.

10.3. INSTALLATION

NOTE: OQ qualified corrosion personnel complete all of the steps in this procedure unless stated otherwise.

Step 24a	Align the mating flanges on the flange surfaces that will seal without any stress.
Step 24b	Ensure the gasket will be slid between the flanges and held with two temporary bolts with sleeves.
Step 24c	Clean and oil the B-7 stud bolts to allow for proper torque to the applied bolts so that the correct force will be on the gasket.

Step 24c	**1**	Slide the one-piece integral sleeve and washer on one end of the bolt.
	2	Place the bolt and insulator through the flange.
	3	Add the second one-piece sleeve and washer.
	4	Add metal washers and nuts to studs.
Step 24d	Center the bolts across the flange face and keep them centered so that at least one full thread will protrude from each bolt.	
Step 24e	Install the nuts and run them up on the threads finger tight, leaving the bolt centered across the flange faces.	
Step 24f	Ensure that each bolt is secure.	
Step 24g	Use a torque-wrench to apply the tightening force in a pattern as shown in Figure 10-1, applying no more than 30% of the required torque (shown in Table 10-1) at any one stop or application of the torque to a bolt.	
Step 24h	After torque requirements are reached, perform the last required clockwise check of each bolt for torque to ensure that the bolts have been properly and equally stressed.	
Step 24i	Install sleeves and washers on both sides of the flange.	

10.3.1. BOLTING SEQUENCES

FIGURE 10-1: BOLTING SEQUENCES

10.3.2 TORQUE REQUIREMENTS

TABLE 10–1: TORQUE REQUIREMENTS

Nominal Diameter of Bolt (inches)	60,000 psi (or more)	
	Torque (Ft. Lbs.)	Compression (Lbs.)
1/4	8	1,620
5/16	16	2,700
3/8	24	4,080
7/16	40	5,580
1/2	60	7,560
9/16	90	9,720
5/8	120	12,120
3/4	200	18,120
7/8	320	25,140

Nominal Diameter of Bolt (inches)	60,000 psi (or more)	
	Torque (Ft. Lbs.)	Compression (Lbs.)
1	490	33,060
1 1/8	710	43,680
1 1/4	1,000	55,740
1 3/8	1,360	69,300
1 1/2	1,600	84,300
1 5/8	2,200	100,800
1 3/4	3,000	118,800
1 7/8	4,000	138,240
2	4,400	159,120
2 1/4	6,360	205,380
2 1/2	8,800	257,520
2 3/4	11,840	315,540
3	15,440	379,440

10.3.3. TESTING ELECTRICAL ISOLATION DEVICES

OQ qualified corrosion personnel are to test electrical isolation devices once a year during the annual pipe-to-soil survey using an electrical isolation device instrument and measuring pipe-to-soil potential on each side of the isolation device. They are to note information from the test and pipe-to-soil potentials on the *Annual Pipe-to-Soil Survey* (shown in Appendix G).

10.4. AC MITIGATION AND AC GROUND FAULT/LIGHTNING

[Resource information for this section is taken from NACE Standard RP0177: *Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems* (shown in Appendix F).]

Valero adheres to the requirements of NACE Standard RP0177 for the guidelines and procedures during design, construction, operation, and maintenance of metallic structures and corrosion control systems used to mitigate the effects of lightning and overhead alternating current (AC) power transmission systems.

During annual pipe-to-soil surveys, areas of pipelines that run parallel to overhead AC power lines will have the AC voltage read and recorded. OQ qualified corrosion personnel will read the AC voltage using a suitable AC volt meter of proper range. A suitable reference for measurement is a copper/copper sulfate electrode. They will record AC voltages in the Induced AC Voltage column in NuStar's Corrosion Database. OQ qualified corrosion personnel will consider AC voltages that are higher than 15 AC volts as Abnormal Operating Conditions and will treat these conditions with a higher priority.

During operation and construction of pipeline and terminal systems, OQ qualified corrosion personnel will make observations for possible AC Ground Fault/Lightning concerns and notify the Corrosion Control Managers or OQ qualified corrosion personnel assigned to that region. After identifying an area, OQ qualified corrosion personnel will follow the guidelines defined in NACE Standard RP0177 to mitigate any situation that would be deemed unsafe.

10.5 Casings

Casing –to-soil readings shall be collected as part of the annual pipe-to-soil survey in accordance with Part 195.573 (a) in order to monitor for conditions that may adversely affect the safe operation of a pipeline such as a casing that is electrically shorted to the carrier pipe. The section of pipeline inside a

casing is not protected when a casing becomes shorted to the pipeline because of the shielding effect of the casing which prevents cathodic protection current from reaching the pipeline inside the casing.

10.5.1. Conduct Casing to Soil Potential Tests

a. Measure the carrier **pipe-to-soil potential** (P) with respect to a suitable reference electrode (copper-copper sulfate).

b. With the reference electrode placed at the same location as described above measure the **casing-to-soil potential (C)** . Subtract the casing-to soil reading from the carrier pipe-to-soil reading (P –C).

c. If the absolute difference (P –C) is equal to or greater than 100 millivolts (0.100 volt), the casing is considered electrically isolated (non-shorted).

d. If the absolute difference (P-C) is less than 100 millivolts (0.100 volt), the casing may be shorted and further testing is required to confirm the possible short.

10.5.2 Shorted Casing Test - Testing for Shorted Casing Conditions

When, the absolute difference is less than 100 millivolts between the carrier pipe and the casing one of or a combination of the following test should be performed to determine if a casing short exists:

Potential shift test
Internal resistance test
Casing Depolarization test
Four-wire IR drop test
Underground Insulation test

Tests, test methods and determining results of test can be found in NCCER *Pipeline Corrosion Control Trainee Guide Level Two*, page 4.2, paragraph 2.3.0 through page 4.8 paragraph 2.3.4.

10.5.3. Shorted Casing Corrective Actions

a. Conduct test to determine the approximate location of the short.

b. If the test indicates the short is located at one end of the casing, excavate that end of the casing first exposing the carrier pipe and casing.

c. Check for test lead wire meeting the casing or vent. If a test lead wire is causing the short, repair or replace the test lead as needed. Position the wire so as backfilling does not cause a shorted condition in the future.

d. Once the casing ends and carrier pipe is exposed visually inspect to determine if the condition causing the short can be identified.

e. If the short is caused by the carrier pipe contacting the casing, realign the carrier pipe using within the casing using company approved lifting equipment.

f. Approved electrically insulating supports will be used insulate the carrier pipe from the casing.

g. Verify adequate opening from vent pipe into casing: 1 1/2" diameter minimum to accommodate injection of inhibited fluid or dielectric casing filler if needed.

h. Check for bonding cables or straps connecting the casing to the carrier pipe. If possible remove the bonding device if one exists.

i. Retest the casing to determine if the short has been cleared. If the short has been cleared then casing end seals should be installed and the casing and carriers pipe backfilled insuring that settling will not cause another short in the future. Test leads should be installed or repaired. If the short **has not** been cleared then continue on to step j. so preparation can be done for filling the casing with inhibited fluid or dielectric casing filler.

j. Flush the casing annulus with clean water to remove trapped mud, dirt and to insure an open annulus is obtained. Adapt end of casing vents as needed to facilitate connections for pumping the casing with casing filler. Ensure that the vent hole on the casing is sized adequately enough to allow the casing filler to be pumped in easily. Where practical the vents should be placed on the bottom side of the casing on the casing low end.

k. After the casing has been drained and dried install appropriate non conductive casing seals. Conduct a minimal pressure test (no greater than 15 psi) on the casing to ensure that the end seals will hold the dielectric casing filler within the casing.

l. Casings with an uncleared short between the casing and carrier may be filled with inhibited liquid, dielectric-casing filler.

n. Casing fillers should be pumped through the casing vent on the lowest end of the casing.

10.5.4. Monitoring Shorted Casings

If clearing the short or pumping the annulus with casing filler is impractical, shorted casings may be monitored until the repair or attempt to clear is done. After the annual survey has been completed and a shorted casing has been identified a plan of action will be initiated within six months of completion of the survey. Records of the monitoring are to be maintained and sent to the Corrosion Specialist assigned to the area and the Manager of Corrosion Control.

Techniques for monitoring shorted casings are described in NCCER *Pipeline Corrosion Control Trainee Guide Level Two*, page 4.10, paragraph 3.1.4, step 1 through step 4.

a. Monitor the casing vents with leak-detection equipment.

b. Perform the leak-detection test at least twice each calendar year at an interval not to exceeding 71/2 months until the corrective action is performed.

c. If a leak is detected during the monitoring, corrective action must be taken immediately.

d. If an inline inspection tool survey indicates no corrosion activity on the carrier pipe within the shorted casing, an evaluation for appropriate corrective action should be taken and a time frame for corrective action established.

10.5.5. Recordkeeping

Pipe-to-soil and casing –to-soil potential measurements shall be retained in accordance with Part 195.404(c)(3).

Attachment

Corrosion Control – Section 11

11. INTERFERENCE OR STRAY CURRENTS (§CFR 195.577)

In accordance with Part 195.577 (b) each galvanic or impressed current system must be designed to minimize any adverse effects on existing metallic structures. The presence of stray or interference currents are tested for, identified, and their detrimental effects are mitigated. The following steps are intended to aid in minimizing adverse effects to existing adjacent structures.

NOTE: OQ qualified corrosion personnel complete all of the steps in this procedure unless stated otherwise.

Step 25a	During corrosion control surveys, watch for electrical or physical observations that could indicate interference from a foreign source such as the following:		
	1	Pipe electrolyte potential changes on the affected structure caused by the foreign direct current source.	
	2	Changes in the line current magnitude or direction caused by the foreign direct current source.	
	3	Localized pitting in areas near to or immediately adjacent to a foreign structure.	
	4	Damage to protective coatings in localized area near an anode bed or near any other source of strays current.	
Step 25b	In areas where you suspect interference currents, conduct the appropriate test. Notify all affected parties before you conduct tests. Use any one or combination of the following test methods:		
	1	Measurements of structure-to-soil potentials with recording or indicating instruments. The techniques for measuring structure-to-soil are in *NCCER Pipeline Corrosion Trainee Guide* (Level One, Module 61108-02, Page 8.3, Paragraph 2.20).	
	2	Measurement of current flowing on the structure with recording or indication instruments.	
	3	Development of beta curves to locate the area of maximum current discharge from the affected structure.	
	4	Measurement of the variations in current output of the suspected source of interference current and correlations with measurements obtained in Item 25b (1) and 25b (2).	
	5	Close interval above-ground survey techniques (or other comparable technology).	
Step 25c	Utilize the methods for mitigating interference corrosion problems. Interference problems are individual in nature, and the solution should be mutually satisfactory to the parties involved. These methods may be used individually or in combinations.		
	1	Design and installation of electrical bonds of proper resistance between the affected structures is a technique for interference control. The bond electrically conducts interference current from an affected structure to the interfering and/or current source. All parties concerned must agree to the installation of a bond. In addition to methods described in *NCCER Pipeline Corrosion Trainee Guide* (Level 2, Chapter 3, Page 3.1 through 3.13), you may use the following:	
		A	Uni-directional control devices, such as diodes or reverse current switches, may be required in conjunction with electrical bonds, if fluctuating currents are present.
		B	A resistor may be necessary in the bond circuit to control the flow of electrical current from the affected structure to the interfering structure.

		C	The attachment of electrical bonds can reduce the level of cathodic protection on the interfering structure, Supplementary cathodic protection may then be required on the interfering structure to compensate for this effect.
		D	A bond may not effectively mitigate the interference problem in the case of a cathodically protected bare or poorly coated pipeline that is causing interference on a coated pipeline.
	2		Cathodic protection current can be applied to the affected structure at those locations where the interfering current is being discharged. The source of cathodic protection current may be galvanic or impressed current anodes.
	3		Adjustment of the current output from interfering cathodic protection power sources may resolve interfering problems.
	4		Relocation of the ground beds of cathodic protection power sources can reduce or eliminate the pick up of interference currents on nearby structures.
	5		Rerouting of proposed pipelines may avoid sources of interference current.
	6		Properly located isolating fittings in the affected structure may reduce or resolve interference problems.
	7		Application of compatible coatings to current pick up areas may reduce or resolve interference problems.
	8		Installation of magnesium or zinc anodes as a current discharge point may work as long as there are proper facilities for monitoring current and adequate amounts of magnesium are installed.
Step 25d	Indication of resolved interference problems are as follows:		
	1		Restoration of the structure potential on the affected structure to those values that existed prior to the interference.
	2		Measured line currents on the affected structure that show that the interference current is not being discharged to the electrolyte.
Step 25e	Complete the *Cathodic Protection Interference Report* (shown in Appendix G). **NOTE:** Document all interference investigations with the Cathodic Protection Interference Report.		