STATE OF VERMONT
PUBLIC UTILITIES COMMISSION

Petition of Vermont Gas Systems, Inc., for a certificate of public good, pursuant to 30 V.S.A. § 248 , authorizing the construction of the "Addison Natural Gas Project" consisting of approximately 43 miles of new natural gas transmission pipeline in Chittenden and Addison Counties, approximately 5 miles of new distribution mainlines in Addison County, together with three new gate stations in Williston, New Haven and Middlebury, Vermont	)	Case No. 17-3550-INV

LEFORCE DEPOSITION EXHIBIT 50

PROJECT MANAGEMENT PLAN / PROCEDURES
12-INCH ANGP INLINE INSPECTION

VERMONT GAS SYSTEMS, INC.

JUNE 15, 2018

LEFORCE DEPOSITION EXHIBIT 50

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INTRODUCTION

Consistent with the information and recommendations presented in the CPG for the installation of the 12-inch ANGP Transmission line, VGS intends to conduct an Internal Line Inspection (ILI). This ILI is scheduled to start the week of July 9th, 2018 and will be conducted on the entire 41-miles from Colchester to Middlebury, Vermont.

PROJECT MANAGEMENT APPROACH

The project sponsor will be John St.Hilaire. The Project Manager, Adam Gero, will have the overall responsibility for managing and executing this project. The project will require support of personnel from the Distribution and Maintenance and Measurement and Control groups. All material project and management plans as well as significant funding decisions will be reviewed and approved by the project sponsor.

The project manager is responsible for communicating with organizational managers/personnel on the progress and performance of each project resource.

This plan is subject to change based on any unforeseen circumstances and/or information from the field.

PROJECT SCOPE

The scope of the ANGP ILI project includes the planning, preparation and inspection of approximately 41-miles of VGS' 12-inch Transmission line.

An initial ILI operation was initiated in February 2018 and was paused after learning about impacts to the local community from a flare used in the operation. VGS has worked with a contractor to come up with a solution to performing the ILI work with current operating flow and pressure parameters and eliminating the need for a flare. The new approach will require the ILI to run at significantly lower speeds and take longer to traverse through the pipeline. The planned ILI work will consist of two initial cleaning runs followed by two runs with smart ILI tools. The cleaning runs will operate at a lower pressure at approximately 175-200 psi, resulting in a velocity of approximately 1 mph. For the smart tool ILI runs it is beneficial to have higher pressure at approximately 450-600 psi, which will make for a slower run (approximately 0.3mph) taking 100+ hours to complete each run.

The project will utilize an external ILI contractor, Rosen. Rosen will be responsible for the placement of the temporary Above Ground Markers (AGMs), pig tracking, cleaning runs, and the final smart tool inspection runs. VGS personnel will be onsite as needed to provide support for Rosen crews.

VGS will be renting the launcher and receiver traps from TPE Midstream. Equipment setup and teardown will be performed by either contractors or VGS personnel. VGS personnel will be in charge of operating the launcher and receiver.

The placement of AGMs, which assist in tracking the pig during the inspection, will require a pre-run survey be completed by an external contractor. This survey will be conducted by Krebs and Lansing prior to the start of the ILI tool runs. Each AGM location requires a GPS location

and grade stake be placed at increments roughly every mile. VGS will review the data to minimize placement of AGMs at locations that could be intrusive to landowners and eliminate or move AGM locations as needed. The AGM data is then sent to Rosen whose personnel will approve the AGM placement locations. For the initial cleaning runs, tracking is less crucial, so field personnel tracking (trackers) the tools can utilize fewer AGM locations. During the smart tool ILI runs, trackers will utilize a greater number of AGM locations.

Prior to conducting the smart tool inspection runs, the line will be cleaned and confirmed passable utilizing cleaning pigs including DCDC, brush, magnetic and gauge pigs. The final two inspection runs will be performed utilizing Rosen's 12-inch tools which consist of Magnetic Flux Leakage (MFL), Deformation (DEF) and Mapping (XYZ). The MFL, DEF, XYZ tools allow for gas to bypass the tools and reduce the likelihood of supply disruptions to downstream customers during the test. The tools will be launched from the Severance Road Station in Colchester, and received at the Middlebury Station in Middlebury. The cleaning and inspection pigs are propelled through the pipeline by gas flow.

Upon completion of a successful inspection process (involving the 4 ILI runs described above), a preliminary report is expected to be submitted by Rosen within 30 days, with a final report delivered within 60 days.

SCHEDULE

The ANGP ILI Project schedule was derived from the Project Scope as well as the contractor provided schedule. The current schedule plan is as follows:

- July 2-6, Setup launcher and receiver traps and all associated piping and fittings.
- July 9-10, Run first cleaning pigs at reduced pressure (increased velocity) of 175-200 psi.
- July 11-12, Run second cleaning pigs at same reduced pressure.
- July 13-16 Run first inspection pig at higher pressure of 450-500 psi.
- July 17-20 Run second inspection pig at same higher pressure.
- July 21-27 Buffer week in case tools run slower than predicted.
- July 30-Aug 3, Tear down launcher and receiver traps and clean up.

The schedule will be maintained by the Project Manager. If scope or change orders are required, the Project Manager and team will determine the impact of the change on the schedule, cost, resources, scope, and risks.

Schedule is based off speed calculations which take into consideration the flows at all three of the downstream gate stations. The Williston gate station will feed the Burlington distribution network to increase the speed of the ILI between the launcher and the Williston gate station.

COMMUNICATIONS MANAGEMENT PLAN

Along with this section of the plan, there is a stand-alone communications plan saved in the project folder titled "2018 ILI Communications Plan" which outlines public outreach and communications for this project.

This section sets the communications framework for this project. It will serve as a guide for communications throughout the life of the project and will be updated as communication

requirements change. This section identifies and defines the roles of the ANGP ILI Project team members as they pertain to communications.

The Customer Lead and Landowner Lead will take the lead role in ensuring effective communications on this project. The communications requirements are documented in the Communications Matrix below.

Communication Type	Description	Frequency	Format	Participants/ Distribution	Deliverable	Owner
Communications Meeting	Meeting for review of communication	Weekly	In Person	Senior Management Representatives, Project Team	Updated tracker	Customer/Landowner Leads
Daily Status Report	Email summary of project status	Daily – during project	Email	Project Sponsor, Team and Stakeholders	Status Report	Project Manager
Project Team Meeting	Meeting to review action register and status	As Needed	In Person	Project Team	Updated tracker	Project Manager

Project team directory for all communications is:

Name	Title/Role	E mail
John St.Hilaire	Project Sponsor	jsthilaire@vermontgas.com
Adam Gero	Project Manager	AGero@vermontgas.com
Lee Brown	Field Lead	LBrown@vermontgas.com
Steve Miner	Operations Lead	Sminer@vermontgas.com
Chris LeForce	Project Support	CLeForce@vermontgas.com
Karen Kotecki	Landowner Lead	KKotecki@vermontgas.com
Tom Murray	Customer & Communications Lead	TMurray@vermontgas.com
Dave Attig	Safety Lead	DAttig@vermontgas.com
Beth Parent	PR Lead	BParent@vermontgas.com

RISK MANAGEMENT PLAN

The approach for managing risks for the ANGP ILI Project includes a methodical process by which the project team identifies the various risks. Every effort will be made to proactively identify risks ahead of time in order to implement a mitigation strategy from the project's onset.

RISK REGISTER

Below are the potential risks for the ANGP ILI Project and how they would be managed:

Run Cannot be Completed – in the event that the ILI runs can't be completed or are cancelled, the project team would work with Rosen to determine an alternate plan. If an alternate cannot be

established or is not feasible VGS would have to work with its regulators to address the timing of the ILI and alternatives.

ILI Tool gets Stuck – the pipeline was designed in accordance with 192.150 Passage of Internal Inspection Devices. A caliper tool was run through each segment of the line post installation and provided no data to suggest that a tool would become stuck or held-up within the line. In addition, three cleaning pigs were run through the line during the initial ILI project. While it is highly unlikely, in the event that any of the pigs get stuck, VGS would have to evaluate options such as increasing flows and/or putting a second pig in to push the tool out or excavate and cut the line to extract the pig. The following are the first options for each tool run:

Cleaning pigs – increase head pressure to increase pressure differential
MFL/DEF/XYZ – reduce downstream pressure, add second pig to bump tool

Inspection Data is No Good – the quality of the inspection data is evaluated prior to Rosen de-mobilizing from the project. In this case, the inspection could be re-run or cancelled by VGS. If poor data is due to an issue with the inspection technology a re-run would be completed at no cost to VGS.

Permits – VGS has reviewed the need for permits and determined that none are required for the scope of this project. After each pig run, the launcher and receiver will need to be depressurized by purging the natural gas in the launcher and receiver. The volume of gas for all 4 pig runs is estimated to be approximately 3 Mcf with a contingency of another 3 Mcf should a complete rerun of the operation is required to acquire good ILI data. An air quality permit is not required for this volume of gas, however VGS will communicate with the Agency of Natural Resources to make them aware of the work.

Purging noise – The depressurization of the launcher and receiver will cause a whistling noise for a few minutes while the natural gas is vented. This work is expected to be conducted during daylight hours and will require verbal authorization from the Project Manager.

Pig noise or vibration during tool run – With the slow speeds (1 MPH or less) any potential noise or vibration created by the pigs traveling down the line will be nonexistent or so low, it will not be noticeable by the public.

Protester interference – A protester response team will be in place with similar protocols utilized during ANGP. Law enforcement, emergency responders, and town officials will be notified as prescribed in the communications plan.

Landowner issues – landowners will be notified as part of the communications plan and will encompass landowners beyond the ROW in the vicinity of the AGMs. The Landowner lead will be available to address issues should they arise.

Field communication breakdown – During the pig runs, a field communications lead will be appointed to report from the field to the Project Manager to disseminate information from the field. AGM trackers will report progress to Gas Control and Gas Control will document progress.

Contractor performance – Contractors will be onboarded with a review of the project, the project plan, and expectations and professionalism in the field. Items to review include no littering, no speeding, reduce idling when available, appropriate PPE and signage, utility signs posted during AGM monitoring, headlights off at night while parked on side of road, and no loud music.

In the event that one of these risk situations occurs the project team will evaluate the consequences, both operationally and financially prior to any final decisions.

STAFFING MANAGEMENT

Staffing requirements for the ANPG ILI Project include the following:

Project Manager – responsible for all management for the project. The Project Manager is responsible for planning, creating, and/or managing all work activities, variances, tracking, reporting, communication, performance evaluations, staffing, and internal coordination.

Field Lead – responsible for oversight of all field activities.

Distribution and Maintenance and/or third-party contractor – provide support to Rosen, specifically during set-up and break-down of equipment. Qualified operator to unload, load and assist in moving equipment for launcher, receiver and flare installations.

Measurement and Control – provide support through the duration of the project, including but not limited to operation of VGS valves, gate station modifications or control, and communications with Gas Control.

TRAINING

All contract employees will be required to attend VGS On-Boarding training to familiarize them with VGS policies including project specific expectations. Attention will need to be given to the sensitivity of landowners, especially for overnight work.

PROJECT PLAN/PROCEDURES

The ANGP ILI will be conducted in accordance with the VGS IMP Plan Section 09: Conducting Assessments, applicable VGS O&M procedures, applicable CFR 192 sections, this document, and Rosen procedures. Should any discrepancies arise, Rosen personnel are considered the SMEs and their procedures, plans and/or decisions shall dictate.

www.rosen-group.com

Tool Data Sheet
29/August/2016
Revision Status: Draft

12" MFL-A Tool
CDP12"1.5V44.10
For RoCorr Inspection Services

Technical Data

On board Service	Technology	Sensor details
Metal loss detection and sizing	MFL-A	176 MFL Channels

Operational Specifications		
Max. Inspection Range without Gyro	18.6	mi
Max. Inspection Time without Gyro	17.5	h
Max. Inspection Range with Gyro		n/a
Max. Inspection Time with Gyro		n/a
Velocity Range	0.67 - 3.36	mph
Min. Operating Pressure	2	MPa
Max. Operating Pressure	12.5	MPa
Product Temperature without Gyro	32 - 149	°F
Product Temperature with Gyro		n/a
Max Product Speed for Speed Control Pigs		n/a

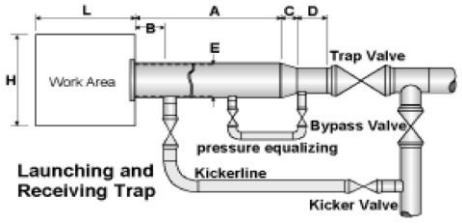
Mechanical Specifications		
Tool Length	57	in
Launch Length	54	in
Rear Sealing Length	39	in
Max. Operational Weight	309	lbm
Max. Transport Weight	441	lbm

Measurement Specifications	
Wall Thickness Range	n/a
Magnetization Level	n/a

Pipeline Requirements		
Min. Bend Radius	1.5	D
Min. Bore in Straight Pipe	10.63	in
Min. Bore in 1.5D Bend	11.42	in
Min. Bore in 3D Bend	10.83	in
Straight Pipe in-between Back to Back Bends	19.69	in
Max. ID step Changes	0.63	in

Launcher and Receiver Requirements

Trap Dimensions	Launcher (minimum)	Receiver (minimum)	
A	57	57	in
B	16	19	in
C	13	13	in
D	11	57	in
E	16	16	NPS
H	96	96	in
L	96	96	in



Performance Specification
February 2014

ROCORR MFL-A

IN-LINE HIGH RESOLUTION METAL LOSS DETECTION AND SIZING WITH DXD SENSORS

ROSEN
empowered by technology

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1 INTRODUCTION

This document defines the ROSEN accuracy specifications for axial Magnetic Flux Leakage (MFL) in-line inspection equipped with the ROSEN DxD sensors. The DxD sensor is a state-of-the-art sensor, equipped with modern hall probes with a spacing of 5.9 mm (0.23") and MFL tri-axial signals output.

It follows well established definitions applicable specifically to pipeline inspection, mainly found in “Specifications and Requirements for Intelligent Pig Inspection of Pipelines” formulated by the Pipeline Operators Forum (POF), version 2.1 (November 1998), version 3.2 (January 2005) and version 2009 (January 2009).

Further information about a particular in-line inspection tool can be provided as part of a particular inspection project. This information will be compliant with POF 2009 and will be derived from the specific pull-test certificate and the individual tool data sheet.

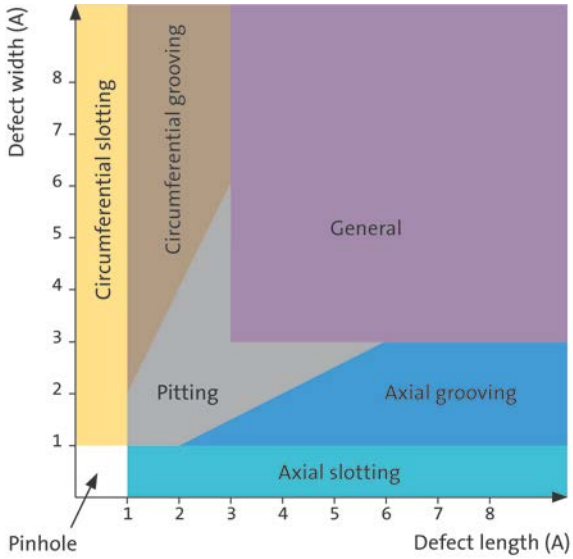
2 DETECTION OF FEATURES

Pipe wall anomalies	Pitting and general corrosion Gouges Cracks Hard spots
Weld anomalies	Anomalies in the heat affected zone of seam welds (longitudinal and spiral) and girth welds may be of reduced accuracy
Mill features	Laminations Inclusions
ID anomalies	Dent Buckle Wrinkle
Wall thickness changes	Specified below (4.4)
Installations	Girth welds Tees Taps Bends Anodes Valves
Repairs	Patches Sleeves
Pipe casings	Location Eccentricity
Ferrous metal	Inside the pipe Outside the pipe if in contact

3 DIMENSION OF CLASSIFICATION

Magnetic Flux Leakage (MFL) is an indirect method. It uses and is being affected by more than one physical property. The influence of the defect shape on the sizing accuracy is parameterized by dimension classes, which depend on the length and width of the feature.

All reported metal loss features are being classified according to these dimensions as per the following POF specification graphic.



Note **A = wall thickness or 10 mm (0.39"), whichever value is greater**

4 DETECTION AND SIZING CAPABILITIES

4.1 Detection and Sizing Accuracy for Anomalies in Body of Pipe

	General metal loss	Pitting	Axial grooving	Circumf. grooving	Circumf. slotting*
Depth at POD = 90%	0.10t	0.10t	0.10t	0.10t	0.15t
Depth sizing accuracy at 80% certainty	±0.10t	±0.10t	±0.15t	±0.10t	±0.10t
Width sizing accuracy at 80% certainty	±15 mm (±0.59")	±12 mm (±0.47")	±12 mm (±0.47")	±12 mm (±0.47")	±15 mm (±0.59")
Length sizing accuracy at 80% certainty	±15 mm (±0.59")	±10 mm (±0.39")	±10 mm (±0.39")	±10 mm (±0.39")	±10 mm (±0.39")
Depth sizing accuracy at 90% certainty	±0.13t	±0.13t	±0.20t	±0.13t	±0.13t
Width sizing accuracy at 90% certainty	±19 mm (±0.75")	±15 mm (±0.59")	±15 mm (±0.59")	±15 mm (±0.59")	±19 mm (±0.75")
Length sizing accuracy at 90% certainty	±19 mm (±0.75")	±13 mm (±0.51")	±13 mm (±0.51")	±13 mm (±0.51")	±13 mm (±0.51")

* Min(L,W) ≥ ½A

4.2 Detection and Sizing Accuracy for Anomalies in Girth Weld or Heat Affected Zone

Within ± 3A of the weld (A = Max (wt,10 mm / 0.39")) detection and sizing are affected by the weld. The extent of this effect depends on weld quality and the weld impact on the tool dynamics. During passage of the magnetic yoke over a weld sizing accuracy might be affected slightly.

	General metal loss	Pitting	Axial grooving	Circumf. grooving	Circumf. slotting*
Depth at POD = 90%	0.10t	0.15t	0.15t	0.15t	0.15t
Depth sizing accuracy at 80% certainty	±0.15t	±0.15t	±0.15t	±0.15t	±0.15t
Width sizing accuracy at 80% certainty	±25 mm (±0.98")	±22 mm (±0.87")	±22 mm (±0.87")	±22 mm (±0.87")	±25 mm (±0.98")
Length sizing accuracy at 80% certainty	±25 mm (±0.98")	±20 mm (±0.79")	±20 mm (±0.79")	±20 mm (±0.079")	±20 mm (±0.079")

* Min(L,W) ≥ ½A

4.3 Detection and Sizing Accuracy for Crack or Crack-like Features

	Circumferential slotting
Depth at POD = 90% of crack with W ≥ 25 mm (0.98") [W = circumferential extension of the crack]*	0.25t
Minimum crack opening	1 mm (0.04")
Depth sizing accuracy at 80% certainty	±0.25t
Width sizing accuracy at 80% certainty	±20 mm (±0.79")

* Provided that the S/N ratio of the MFL amplitude is ≥ 5

4.4 Wall Thickness Measurement

±1 mm (±0.04") or ±0.10t, whichever value is greater at 80% certainty.

5 LOCATION AND ORIENTATION CAPABILITIES

Axial position accuracy from reference marker	1:1000 (1 m on 1000 m marker distance) (1 ft. on 1000 ft. marker distance)
Axial position from closest weld	±0.1 m (±4")
Circumferential position accuracy	±10°

The axial positioning accuracy specified is based on following conditions:

- Distance between u/s and d/s marker/reference point < 2000 m (6500 ft.).
- Actual above ground distance to both u/s and d/s marker/reference points to be measured and correlated.
- Negligible difference between pipeline and soil contour.

6 DEFINITIONS, REQUIREMENTS AND NOTES

6.1 Feature Detection and Sizing Capabilities

The given accuracy values were derived from statistical analysis of sizing results originated by straightforward standard procedures. The sizing results were compared with a large number of known feature events.

Definitions

- Specifications are only valid for longitudinally welded pipes.
- Parameter t is defined as follows:
  - Wall thickness ≥ 5 mm (0.2"): t = wall thickness
  - Wall thickness < 5 mm (0.2"): t = 5 mm (0.2")
- The depth sizing and the wall thickness evaluation are independent, i.e. the percentage depth is based on the actual wall and not on the calculated.
- The accuracy relevant dimension classification is derived from the shape of the most significant contributing part of a defect, e.g. a deep pit embedded in shallow general corrosion.

Requirements

- Data is recorded within the parameter as specified in the respective Tool Data Sheet.
- The required minimum magnetization for tabled specifications is 10 kA/m.
- The according valid pipe wall material is grade API 5L grade B up to API 5L grade X65 or equivalent grades.
- These specifications are valid generally where no more data were missing than:
  - Primary survey channel ≤ 5%
  - Primary adjacent survey channel gap < 60 mm (2.4")
  - In case of more data loss the data quality must be approved by procedure.
- The proper inspection tool velocity is normally between 0.3 m/s (0.98 ft./s) and 3 m/s (9.8 ft./s) but might be restricted by well known MFL methodological conditions[1+2]. In some cases specifications for non standard inspection tools vary.

Notes

- Specifications given above are valid where:
  - both yokes and sensors were located in the same straight pipe body and the magnetic field not affected by installations neither internal nor external
  - pipes have smooth surface
  - pipes are sufficiently clean, i.e. MFL sensors have contact with pipe wall, the odometer wheels were not blocked and the spring-supported magnet yokes are not hindered in their movement
- Above 3 m/s (9.8 ft./s) mechanical influences caused by e.g. weld roots, pipe roughness and dirt might affect the accuracy.
- Features shallower than the specified detection threshold or smaller than the specified dimension classes will be reported as analyzed.
- The accuracy will not be kept in areas where tool acceleration exceeds 3 m/s^2 (9.8 ft./s^2).

1 R.J. Davis J.B. Nestleroth. The effects of velocity on magnetic flux leakage inspection of gas pipelines. GRI Topical Report GRI-95/0008, Gas Research Institute, June 1996
2 Dieter Meinert. Motivation for a speed limitation on an MFL tool. Internal report, RTRC Germany, October 2002.

6.2 Features in longitudinal welded pipe

In general the detection and sizing accuracy for anomalies in the long seam area or the heat affected zone is the same as in the pipe body, provided the noise level is not excessive.

6.3 Features in spiral welded pipe

The detection and sizing accuracy for anomalies in spiral weld area and the heat affected zone is the same as stated in 4.2 Detection and Sizing Accuracy for Girth Weld or Heat Affected Zone.

6.4 Features in seamless pipe

In general the detection and sizing accuracy for anomalies in seamless pipe depends on the actual noise level of the pipe material concerned. For low noise seamless pipe the specification for longitudinal welded pipe is valid, for higher noise levels the influence on specified values might be significant.

- The detection threshold and sizing accuracy will be as stated above plus typically 0 … 0.10t.
- Length and width sizing accuracy as stated above plus typically 0 … 10 mm (0.39").

7 IDENTIFICATION OF FEATURES

Probability of Identification

Feature		**Yes** **POI > 90%**	**No** **POI < 50%**	**May be** **50% ≤ POI ≤ 90%**
Internal/non-internal[1]		X		
Ext./midwall discrimination			X	
Additional metal/material	debris	X		
	touching metal to metal	X		
Anode		X		
Anomaly	arc strike			X
	artificial defect	X		
	buckle	X		
	corrosion	X		
	corrosion cluster	X		
	circumferential crack	X		
	axial crack		X	
	dent[2]	X		(X)
	dent with metal loss[2]	X		(X)
	gouging			X
	grinding			X
	girth weld crack			X
	girth weld anomaly	X		
	HIC			X
	lamination			X
	longitudinal weld crack		X	
	longitudinal weld anomaly			X

Feature		Yes POI > 90%	No POI < 50%	May be 50% ≤ POI ≤ 90%
	ovality	X		
	pipe mill anomaly	X		
	SCC		X	
	spalling	X		
	spiral weld crack			X
	spiral weld anomaly	X		
	wrinkle	X		
Crack arrestor			X	
Eccentric pipeline casing		X		
Change in wall thickness		X		
CP connection		X		
External support		X		
Ground anchor		X		
Off take		X		
Pipeline fixture		X		
Reference magnet		X		
Repair	welded sleeve repair	X		
	composite sleeve repair		X	
	weld deposit	X		
	coating		X	
Tee		X		
Valve		X		
Weld	bend	X		
	diameter change	X		
	wall thickness change (pipe/pipe connection)	X		
	adjacent tapering	X		

[1] The internal/non internal discrimination may be reduced for features smaller than 20 mm (0.79") extent (width) and 20% depth.
[2] POI greater 90% reached in combination with geometry inspection.

8 ABBREVIATIONS

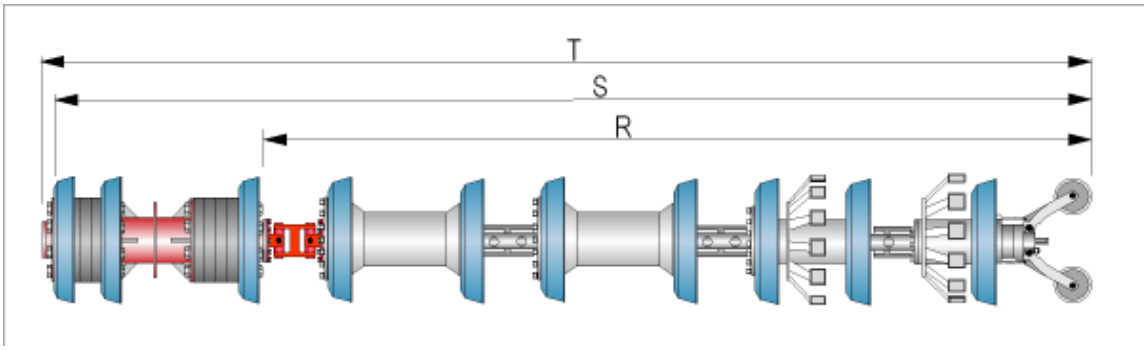
CP	Cathodic Protection
HIC	Hydrogen Induced Cracking
ID	Internal Diameter
MFL	Magnetic Flux Leakage
POD	Probability of Detection
POF	Pipeline Operators Forum
POI	Probability of Identification
RoCorr MFL-A	Magnetic Flux Leakage Metal Loss ILI Tool
SCC	Stress Corrosion Cracking
wt	Wall Thickness

Tool Data Sheet
18-Jun-2012

12" RoGeo·Xt
ROSEN Extended Geometry Tool
HiRes Dent and Geometry Mapping
XGP12"1.5V12.00

Technical Data

On board Service	Technology	Sensor details
HiRes ID Mapping	Intelligent Caliper [XGP]	
XYZ Mapping	INS	Low Bias IMU



Operational Specifications

Max. Inspection Range	250	miles
Max. Inspection Time	56.0	h
Velocity Range	0.33 - 16.41	ft./s
Max. Operating Pressure	2175	psi
Min. Operating Pressure	435	psi
Product Temperature Range	32 - 131	°F

Mechanical Specifications

Tool Length (T)	117.95	inch
Launch Length (S)	113.90	inch
Rear Sealing Length (R)	95.79	inch
Max. Operational Weight	3324.54	lbs
Max. Transport Tool Weight	3571.45	lbs

Inspection Specifications

Wall Thickness Range*	n/a
Max. Internal Coating / Cladding	n/a

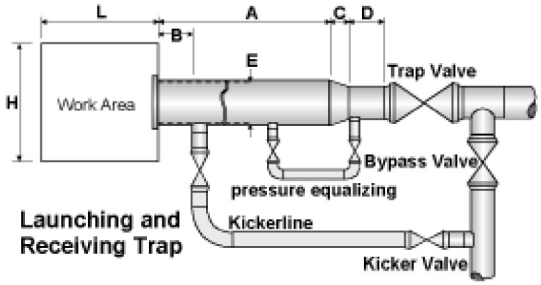
Pipeline Requirements

	12	inch
Min. Bend Radius	1.5	D
Min. Bore in Straight Pipe	9.76	inch
Min. Bore in 1.5D Bend	10.47	inch

* Higher wall thickness can be inspected at different specifications

Launcher and Receiver Requirements

Trap Dimensions	Launcher (minimum)	Receiver (minimum)	
A	117.95	117.95	inch
B	15.75	19.80	inch
C	8.00	8.00	inch
D	11.93	117.95	inch
E	14	14	inch
H	157.32	157.32	inch
L	157.32	157.32	inch



Performance Specification
June 2013

ROGEO XT
IN-LINE HIGH RESOLUTION GEOMETRY AND DENT ANALYSIS

ROSEN
empowered by technology

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1 INTRODUCTION

This document defines the ROSEN accuracy specifications for in-line inspection (ILI) activities performed with the ROSEN Extended Geometry Tool (RoGeo XT). This specification follows well established definitions applicable specifically to pipeline inspection, mainly found in “Specifications and Requirements for Intelligent Pig Inspection of Pipelines” formulated by the Pipeline Operators Forum (POF), version 2.1 (November 1998), version 3.2 (January 2005) and version 2009 (January 2009).

Further information about a particular in-line inspection tool can be provided as part of a particular inspection project. This information will be compliant with POF 2009 and will be derived from the specific pull-test certificate and the individual tool data sheet.

2 DETECTION OF FEATURES

2.1 Deformation Anomalies

The following deformations will be detected, localized and identified by RoGeo XT:
- Dents
- Buckles
- Wrinkles
- Roof topping
- Ovalities

2.2 Installations

The following installations will be detected, localized and identified by RoGeo XT:
- Type of valves
- Valve full open position
- Tees/Off-takes
- Wt changes
- Girth welds

3 DETECTION AND SIZING CAPABILITIES

3.1 OD-Changes, Ovalities and Dents

Internal diameter changes, ovalities and dents will be detected, localized and identified. In case of detecting dents, the information will be given in depth [%] of pipeline OD[2]. Information on accuracies is given in the table below.

Feature		OD [inch]	Accuracy[1]	Detection threshold	Comment
OD[2] changes			0.8 mm (0.03")	0.8 mm (0.03")	
Ovalities	Ovality		0.5%	0.5%	$Ovality = \frac{OD_{max} - OD_{min}}{OD_{max} + OD_{min}} * 100[\%]$
	Length		15.0 mm (0.59")		
	Orientation		12°		
Dents[3]	Depth	6"-16" 18"-28" 30"-38" 40"-48" >48"	±0.5% ±0.3% ±0.2% ±0.15% ±0.15%	2.5 mm (0.10")	
	Length		±7.6 mm (±0.30")		
	Width		±25.4 mm (±1.00")		
	Orientation		12°		
Roof topping	Depth		±0.8 mm (±0.03")	0.8 mm (0.03")	
Pipe Expansions	Depth		±1.5 mm (±0.06")	1.5 mm (0.06")	

[1] Values are given for a certainty level of 80%
[2] Or ID, respectively
[3] Including wrinkles and buckles

3.2 Bends

Component	Detection Threshold	Accuracy[1]
Bend radius	Up to 30 D	±15%
Bend orientation		±10°
Bend angle		±5°

[1] Values are given for a certainty level of 80%

3.3 XYZ Mapping

Every RoGeo XT tool can be equipped with an XYZ Mapping system to generate three-dimensional geographical pipeline coordinates. For further information please refer to the XYZ Mapping specifications.

4 LOCATION AND ORIENTATION CAPABILITIES

Axial position accuracy from reference marker	1:1000
Axial position from closest weld	±0.1 m (±4")
Circumferential position accuracy	±5°

The axial positioning accuracy is based on the following conditions:

- Distance between u/s and d/s marker/reference point < 2000 m (6560 ft.).
- Actual above ground distance to both u/s and d/s marker/reference points to be measured and correlated.
- Negligible difference between pipeline and soil contour.

5 SYSTEM CAPABILITIES

Sampling	a) Axial sampling	2.5 mm (0.10")
	b) Circumferential sampling	15.0 mm (0.59")
Circumferential coverage		100%
Probability of detection		95%

6 IDENTIFICATION OF FEATURES

Probability of Identification (POI) in accordance with geometry ILI tools.

Feature		Yes POI > 90%	No POI < 50%	May be 50% ≤ POI ≤ 90%
Debris		X		
Anomaly	arc strike[1]	(X)		x
	artificial defect[2]	X		
	buckle	X		
	dent	X		
	gouging[1]	(X)		X
	grinding[1]	(X)		X
	ovality	X		
	roof topping	X		
	wrinkle	X		
Change in wall thickness		X		
Off take		X		
Tee		X		
Valve		X		
Weld	bend	X		
	diameter change	X		
	wall thickness change (pipe/pipe connection)	X		
	adjacent tapering	X		

[1] POI greater than 90% reached in combination with an ID anomaly
[2] If internal (and greater than 25 mm (1.0") diameter)

7 NOTES CONCERNING PERFORMANCE SPECIFICATIONS

The specifications provided for RoGeo XT are applicable where run conditions, tool velocity, pipe grade, pipe cleanliness, sensor operation and data recorded are within the established parameters for the specific RoGeo XT used. These parameters are provided in the Tool Specification Sheet included in each Inspection Survey Report. Variations from the established parameters may result in reduced data quality or modification of the performance specifications.

8 ABBREVIATIONS

d/s	Downstream
ID	Internal Diameter
ILI	In-Line Inspection
OD	Outer Diameter
RoGeo XT	ROSEN Extended Geometry Tool
Tie-Point	Used reference/marker point with XYZ coordinates
u/s	Upstream
wt	Wall Thickness
XYZ	Easting, northing, height, latitude, longitude, height coordinates

Performance Specification
March 2012

ROGEO XYZ MAPPING
IN-LINE PRECISION PIPELINE ROUTE MAPPING

empowered by technology

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1 INTRODUCTION

This document defines the ROSEN accuracy specifications for the in-line inspection (ILI) with the RoGeo XYZ Mapping. It follows well established definitions applicable specifically to pipeline inspection, mainly found in “Specifications and Requirements for Intelligent Pig Inspection of Pipelines” formulated by the Pipeline Operators Forum (POF), version 2.1 (November 1998), version 3.2 (January 2005) and version 2009 (January 2009).

Further information about a particular in-line inspection tool can be provided as part of a particular inspection project. This information will be compliant with POF 2009 and will be derived from the specific pull-test certificate and the individual tool data sheet.

2 XYZ MAPPING

2.1 Accuracies for Differing Tie-Point Distances and Velocities

Values are given for a certainty level of 80%		**Tie-Point-Distance**				
		1000 m (3300 ft.)	**2000 m (6500 ft.)**	**4000 m (13000 ft.)**	**10000 m (33000 ft.)**	**25000 m (82000 ft.)**
Velocity	0.5 m/s (1.6 ft./s)	1.0 m (3.3 ft)	1.5 m (4.9 ft.)	8.0 m (26.2 ft.)	-	-
	1.0 m/s (3.2 ft./s)	0.7 m (2.3 ft.)	1.0 m (3.3 ft.)	3.0 m (9.9 ft.)	25 m (82.0 ft.)	-
	3.0 m/s (9.8 ft./s)	0.7 m (2.3 ft.)	1.0 m (3.3 ft.)	2.0 m (6.6 ft.)	10 m (32.8 ft.)	70 m (229.7 ft.)

3 LOCATION AND ORIENTATION CAPABILITIES

Log distances are determined based on direct measurements by an odometer system on the tool. Further corrections e.g. using marker locations may apply.

Axial position accuracy from reference marker	1:1000
Axial position from closest weld	±0.1 m (±4")
Circumferential position accuracy	±5°

The axial positioning accuracy is based on following conditions:
- Distance between u/s and d/s marker/reference point < 2000 m (6560 ft.).
- Actual above ground distance to both u/s and d/s marker/reference points to be measured and correlated.
- Negligible difference between pipeline and soil contour.

4 SYSTEM CAPABILITIES

4.1 IMU Specifications

	Gyro	Accelerometer
Bias	1 °/h	300 µg
Random walk	0.3°/sqrt(h)	40 µg (0.5 sec)
Scale factor error	300 ppm	500 ppm
Misalignment	0.25 mrad	0.25 mrad
Resolution	0.005 °/s	100 µg

5 IDENTIFICATION OF FEATURES

Probability of Identification (POI) in accordance with XYZ Mapping unit

Feature		**Yes** **POI > 90%**	**No** **POI < 50%**	**May be** **50% ≤ POI ≤ 90%**
Out of straightness / bending strain		X		
Pipeline movement		X		
Bends		X		
Weld	bend start and -end	X		
	girth welds	X		

6 NOTES CONCERNING PERFORMANCE SPECIFICATIONS

6.1 Notes

The specifications provided for the RoGeo XYZ Mapping are applicable where run conditions, tool velocity, pipe grade, pipe cleanliness, sensor operation, and data recorded are within the established parameters for the specific XYZ Mapping Tool used in each inspection survey. These parameters are provided in the Tool Data Sheet included in each Final Report. Variations from the established parameters may result in reduced data quality or modification of the performance specifications. Also the tie-in point DGPS coordinate accuracy as well as coordinate transformations (to special coordinate systems) may affect the XYZ data accuracy due to error propagation. A minimum of two tie-in points between launcher and receiver site are required. Additionally, launcher and receiver themselves must be used as tie-in points.

6.2 Comparison with other ILI results

Based on the location, identification and sizing performances specified for each system, inspection results can be compared to repeat runs with the same tools or other supplier's tools as outlined in the American Petroleum Institute, Pipeline Segment, Standard 1163, In-line Inspection Systems Qualification Standard, Appendix E, First Edition, August 2005.

7 ABBREVIATIONS

d/s	Downstream
ILI	In-Line Inspection
IMU	Inertial Measuring Unit
POI	Probability of Identification
SI	International System of Units
Tie-Point	Used reference/marker point with XYZ co-ordinates
u/s	Upstream
XYZ	Easting, northing, height; latitude, longitude, height co-ordinates

LAUNCHING PIGS PROCEDURE
12-INCH ANGP INLINE INSPECTION

VERMONT GAS SYSTEMS, INC.

MAY 29, 2018

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PURPOSE
The following procedure defines the steps to launch pigs during an online gas pigging operation

SCOPE
The Launching (pigging) tasks are required and performed during each phase in the life of a pipeline are for many different reasons and provide different applications, typically;

- Cleaning
- For inspecting

SAFETY CONSIDERATIONS

Minimum Required Personal Protective Equipment (PPE)	Foot Protection	Fire Retardant Clothing	4-Gas Monitor	Gloves	Hard Hat	Hearing Protection	Safety Glasses
							
	CAUTION: Check *Appendix* for additional PPE.						

PERSONAL PREPARATION
All personnel onsite are required to read and sign the JSA each day of the operation.

STOP WORK AUTHORITY
Every employee and contractor onsite is responsible and authorized to stop any work when a potentially unsafe condition, act, error, omission, or lack of understanding is identified that could result in an undesirable event.

CONSIDERATION FOR IGNITION SOURCES
Caution must be taken to eliminate the possibility of ignition due to static electricity. A pole made of a non-conductive material should be used to load or unload a pig or ILI tool. The pig/pole should be grounded to the Receiving or receiving barrel and the earth.

The area around the launcher and receiver shall be considered a hazardous area due to the potential presence of natural gas or other volatile gases or liquids during the blow down of a barrel, purging of a barrel, or any time a closure door is open. Use a calibrated gas monitor to evaluate the air quality and gas content prior to any insertion or retrieval of any pig. All sources of ignition shall be removed and the appropriate fire protection devices shall be utilized.

Stand to the side of a closure door while opening. If the closure door is hinged on the side, stand to the non-hinged side of the door. Great care must be taken to ensure that all gas in the barrel has been blown down during the Receiving and receiving of a pig or ILI tool.

Take caution during the blowing down and purging of the launcher and receiver barrels. Hazards such as power lines, public highways, railroads and houses must be identified. Consider wind

speed and direction as well as the volume of gas or volatile product to be vented. Determine how each of these hazards must be handled during the blow down or purge. Additional caution must be taken when blowing down a launcher or receiver containing odorized gas. Likewise, if it is necessary to purge the launcher or receiver barrel with nitrogen to completely removed volatile liquids; special procedures for handling the nitrogen must be included in the work plan.

FIRE EXTINGUISHER PREPARATION

Make sure that at least 1 fire extinguisher is on site. Check the extinguishers to make sure they are charged and not out of date.

SURFACE GREASE

All surfaces that come in contact with mating surfaces, such as the threads of the closure door, should be cleaned and liberally greased with light, all-purpose grease before each use.

LAUNCHER AND RECEIVER BARREL

Ensure ball valves, used as launcher or receiver valves, have the body bleeds blown down before the barrel door is open. The non-pressure side seat can relieve pressure that might have built up in the body of a ball valve.

VENTING (BLOWING DOWN) AND PURGING

Allow only personnel that are involved in the venting and purge operations to be in the immediate vicinity. All other personnel shall be upwind or to the side a minimum of 25 ft. from the point of discharge.

Do not allow public traffic near the venting and purging operations.

Stop or divert traffic as necessary.

Vehicles or equipment that can cause ignition shall be located at least 100 feet upwind or to the side from the blow-off vent.

Require personnel to wear the proper ear protection.

Do not vent the gas-air mixture or the gas-nitrogen-air mixture into overhead electrical wires or when an electrical storm is present.

Establish radio communications between key operating points as required.

Notify local authorities and nearby residents of the possible loud noises during purging.

All vents should be controlled with a shutoff valve.

Take caution during the blowing down and purging of the launcher and receiver barrels

DEFINITIONS

PPE - Personal Protective Equipment

psi - pounds per square inch

LAUNCHING PROCEDURE

Note: All vessels are to be considered pressurized regardless of the readings on the gauges connected to.
Note: If a leak is present, all equipment must be de-pressurized to 0 psig before any work can be done to fix the leak.

Starting conditions

a. Trap is pressurized.
b. The Mainline Trap Valve (Valve A), Mainline Bypass Valve (Valve B), and the Kicker Line Valve (Valve C) are open.
c. The Vent Valves (Valve D), Drain Valves (Valve E), and Equalization Valves (Valve F) are closed.
d. Verify in-field conditions match procedure starting conditions. If trap is already empty and depressurized, skip to step 6.3.
e. Slowly close the Mainline Block Valve (Valve A).
f. Slowly close the Kicker Valve (Valve C).

TRAP IS ISOLATED FROM PIPELINE.

Slowly vent the trap by opening the Vent Valves (Valve D).

TRAP IS COMPLETELY DRAINED AND VENTED. GAUGES READ 0 psi.

a. With the Vent Valves (Valve D) open, open the Closure Door.
b. With a grounded push-rod, insert the pig until the first cup forms a seal on the reducer (Point ①). Large pigs can be pulled in. Refer to the Tool Pull-In Loading Procedure.
c. Close and secure the Closure Door.
d. With Vent Valves (Valve D) open, slowly Open Kicker Valve (Valve C) until flow begins to enter the trap.
e. When trap is filled and air is purged, close Vent Valve (Valve D).
f. Allow trap pressure to equalize with mainline pressure.

TRAP IS COMPLETELY FILLED WITH GAS AND EQUALIZED WITH PIPELINE.

1. Close the Equalization Valve (Valve F).
2. Close the Kicker Valve (Valve C).
3. Slowly Open the Mainline Valve (Valve A).
4. Slowly Open Kicker Valve (Valve C).

THE TOOL IS READY FOR LAUNCH

a. Verify with personnel at the receiver location that the receiver is ready to receive.

b. Slowly close the Mainline Bypass Valve (Valve B) until pig moves through the mainline valve (Valve A) and passed the mainline tee.

Note: You may have to fully close the Mainline Bypass Valve to launch the tool. This will increase flow through Valve C until tool moves through Valve A and past the mainline Tee into the pipeline.

TOOL IS LAUNCHED

1. Open the Mainline Bypass Valve (Valve B) fully.
2. Verify with personnel at the receiver location that the tool/pig has launched.

TOOL RUN OPERATIONS REQUIREMENTS

General Tool Run Operation Requirements

a. The pressure and volumetric flow rate of the drive medium supplied at launch is to be maintained as a constant value.

b. Only small changes in venting should be made at extended intervals allowing sufficient time for the line to stabilize and the effects of the change to be observed before making any further increase or decrease in vent output

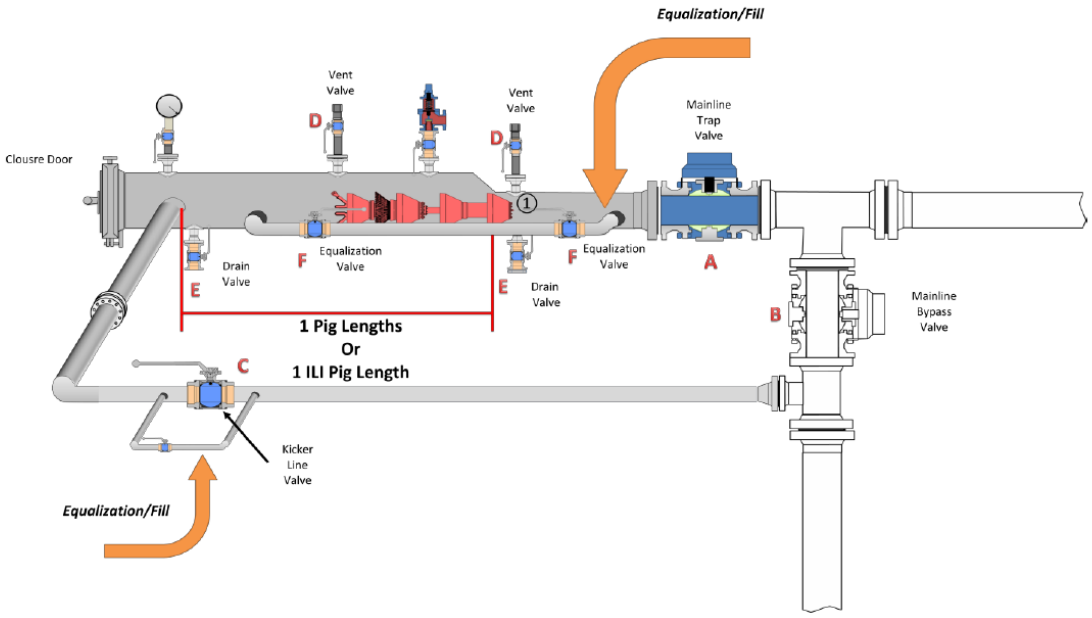
c. Monitor flows and pressures to ensure correct and continuous operation

TRACKING REQUIREMENTS

General Tracking Requirements

1. After the Intelligent/cleaning pig has been launched, the tool must be tracked and the launch end must be monitored to ensure that they operate continuously and at the correct flow rate.
2. Monitor AGM's to check when the tool passes using both a transmitter receiver and an acoustic amplifier.
3. Tool passes are to be recorded on the tracking sheet and communicated to applicable field personnel that may include the launcher and receiver locations, field lead, and gas control at the time of each pass.

SAMPLE SETUP DIAGRAM



RECEIVING PIGS PROCEDURE
12-INCH ANGP INLINE INSPECTION

VERMONT GAS SYSTEMS, INC.

MAY 29, 2018

TABLE OF CONTENTS

PURPOSE
The following procedure defines the steps to Receive pigs during an online gas pigging operation

SCOPE
The Receiving (pigging) tasks are required and performed during each phase in the life of a pipeline are for many different reasons and provide different applications, typically;

- Cleaning
- For inspecting

SAFETY CONSIDERATIONS

Minimum Required Personal Protective Equipment (PPE)	Foot Protection	Fire Retardant Clothing	4-Gas Monitor	Gloves	Hard Hat	Hearing Protection	Safety Glasses
							
	**CAUTION:** Check *Appendix* for additional PPE.						

PERSONAL PREPARATION
All personnel onsite are required to read and sign the JSA each day of the operation.

STOP WORK AUTHORITY
Every employee and contractor onsite is responsible and authorized to stop any work when a potentially unsafe condition, act, error, omission, or lack of understanding is identified that could result in an undesirable event.

PROCEDURE FOR EVACUATION

a. In the event of an emergency occurring within or affecting the work site, the following decisions ensures the appropriate key steps are taken:

b. Advise all personnel of the emergency.

c. Activate the emergency notification sequence to alert the appropriate responders and initiate emergency notification within the building.

d. Evacuate all persons to the identified assembly area and account for everyone including visitors and clients.

e. All personnel will proceed to the primary safe area immediately located at the identified emergency assembly area for their location.

f. Whenever possible, all equipment shall be secured before leaving the site as detailed in the SJA meeting.

CONSIDERATION FOR IGNITION SOURCES

Caution must be taken to eliminate the possibility of ignition due to static electricity. A pole made of a non-conductive material should be used to load or unload a pig or ILI tool. The pig/pole should be grounded to the Receiving or receiving barrel and the earth.

The area around the launcher and receiver shall be considered a hazardous area due to the potential presence of natural gas or other volatile gases or liquids during the blow down of a barrel, purging of a barrel, or any time a closure door is open. Use a calibrated gas monitor to evaluate the air quality and gas content prior to any insertion or retrieval of any pig. All sources of ignition shall be removed and the appropriate fire protection devices shall be utilized.

Stand to the side of a closure door while opening. If the closure door is hinged on the side, stand to the non-hinged side of the door. Great care must be taken to ensure that all gas in the barrel has been blown down during the Receiving and receiving of a pig or ILI tool.

Take caution during the blowing down and purging of the launcher and receiver barrels. Hazards such as power lines, public highways, railroads and houses must be identified. Consider wind speed and direction as well as the volume of gas or volatile product to be vented. Determine how each of these hazards must be handled during the blow down or purge. Additional caution must be taken when blowing down a launcher or receiver containing odorized gas. Likewise, if it is necessary to purge the launcher or receiver barrel with nitrogen to completely removed volatile liquids; special procedures for handling the nitrogen must be included in the work plan.

FIRE EXTINGUISHER PREPARATION

Make sure that at least 1 fire extinguisher is on site. Check the extinguishers to make sure they are charged and not out of date.

SURFACE GREASE

All surfaces that come in contact with mating surfaces, such as the threads of the closure door, should be cleaned and liberally greased with light, all-purpose grease before each use.

LAUNCHER AND RECEIVER BARREL

Ensure ball valves, used as launcher or receiver valves, have the body bleeds blown down before the barrel door is open. The non-pressure side seat can relieve pressure that might have built up in the body of a ball valve.

VENTING (BLOWING DOWN) AND PURGING

Allow only personnel that are involved in the venting and purge operations to be in the immediate vicinity. All other personnel shall be upwind or to the side a minimum of 25 ft. from the point of discharge.

Do not allow public traffic near the venting and purging operations.

Stop or divert traffic as necessary.

Vehicles or equipment that can cause ignition shall be located at least 100 feet upwind or to the side from the blow-off vent.

Require personnel to wear the proper ear protection.

Do not vent the gas-air mixture or the gas-nitrogen-air mixture into overhead electrical wires or when an electrical storm is present.

Establish radio communications between key operating points as required.

Notify local authorities and nearby residents of the possible loud noises during purging.

All vents should be controlled with a shutoff valve.

Take caution during the blowing down and purging of the launcher and receiver barrels

DEFINITIONS

PPE - Personal Protective Equipment

psi - pounds per square inch

RECEIVING PROCEDURE

Note: All vessels are to be considered pressurized regardless of the readings on the gauges connected to.

Note: If a leak is present, all equipment must be de-pressurized to 0 psig before any work can be done to fix the leak.

Starting conditions

1. The trap is empty and depressurized.
2. The Mainline Bypass Valve (Valve B) is open.
3. The Mainline Block (Valve A) and the Return Line Valve (Valve C) are closed.
4. Drain Valves (Valve E) and Vent Valves (Valve D) are open.
5. Verify the trap is empty by opening the closure door and viewing the inside to the trap.
6. Inspect all elastomers on the closure door and all faces.
7. Close the closure door.
8. Verify the closure door is closed and secure.

TRAP IS ISOLATED FROM PIPELINE AND THE TRAP IS COMPLETELY DRAINED AND VENTED. GAUGES READ 0 psi:

a. Verify in-field conditions match procedure starting conditions.

b. Close the Drain Valves (Valve E)

c. With the Vent Valves (Valve D) open, fill the trap by slowly opening the Return Bypass Valve (Valve C).

d. When the air is purged out of the trap, close the Vent Valves (Valve D).

e. Allow the trap pressure to equalize with mainline pressure.

TRAP IS COMPLETELY FILLED WITH GAS AND EQUALIZED WITH PIPELINE.

1. Open the Return Bypass Valve (Valve C) fully.
2. Open the Mainline Trap Valve (Valve A).

TRAP IS READY TO RECEIVE PIG

1. When the pig is approaching the receiver site location (~ 1 mile away), partially close the Mainline Bypass Valve (Valve B) to prevent the pig from stopping between the Tee and the mainline (Valve A).
2. When the pig has passed the mainline valve (Valve A), verify pig location with a transmitter receiver.

PIG IS IN RECEIVER

1. Open the Mainline Bypass Valve (Valve B) fully.
2. Slowly Close the Mainline Trap Valve (Valve A).
3. Slowly Close the Return Bypass Valve (Valve C).

TRAP IS ISOLATED FROM PIPELINE.

Open the Vent Valves (Valve D).

TRAP IS COMPLETELY DRAINED AND VENTED. GAUGES READ 0 psi.

1. With the Vent Valves (Valve D) open, open the Closure Door following manufacturer's recommendation for opening the closure door.
2. With a grounded push/pull-rod, remove the pig.
3. Inspect all elastomers on the closure door and all faces.
4. Close and secure the closure door.
5. Notify Launcher of successful retrieval of tool

TOOL RUN OPERATIONS REQUIREMENTS

General Tool Run Operation Requirements

a. The pressure and volumetric flow rate of the drive medium supplied at launch is to be maintained as a constant value.

b. Only small changes in venting should be made at extended intervals allowing sufficient time for the line to stabilize and the effects of the change to be observed before making any further increase or decrease in vent output

c. Monitor flows and pressures to ensure correct and continuous operation

TRACKING REQUIREMENTS

General Tracking Requirements

1. After the Intelligent/cleaning pig has been launched, the tool must be tracked and the launch end must be monitored to ensure that they operate continuously and at the correct flow rate.
2. Monitor AGM's to check when the tool passes using both a transmitter receiver and an acoustic amplifier.
3. Tool passes are to be recorded on the tracking sheet and communicated to applicable field personnel that may include the launcher and receiver locations, field lead, and gas control at the time of each pass.

SAMPLE SETUP DIAGRAM