INSPECTION INTELLIGENCE NDT GLOBAL

Casey Lajaunie
ILI Supervisor
Pipeline Integrity
Enbridge
5400 Westheimer Ct
Houston, TX 77056

Date 9 August 2019
Reference 70130.01
E-mail [redacted]

**Enbridge (formerly Spectra) 70130.01 Hardspot Reanalysis – Letter of Intent**

Dear Mr. Lajaunie,

We at NDT Global LLC are committed to serving and supporting our clients in any manner possible to help them manage the integrity of their pipeline assets.

The inspection in question was performed by NDT Systems and Services (America) Inc., a predecessor company that is no longer in business. The technology employed was magnetic flux leakage (MFL), which is no longer utilized by NDT Global LLC. However, the inspection data is still available in our company archives, and NDT Global retains the ability to provide analysis of the subject pipeline data and provide additional reporting and information to Enbridge regarding this asset.

Accordingly, please be advised that NDT Global LLC hereby commits to perform a full re-analysis of the hardspot inspection data for report #70130.01 of the 30" Tomp Line 15 (Tomkinsville to Danville), originally reported April 5, 2011.

For any questions, please don't hesitate to get in touch with me at:

e-mail: [redacted]
Phone: [redacted]
Fax:

Best regards,

[redacted]

Joe A. Campos
Chief Executive Officer

**NDT Global LLC**
15500 International Plaza Drive
Houston, TX 77032

www.ndt-global.com

# LINALOG® Hard Spot
# Inspection Report

| | | |
|---|---|---|
| Release Aa | 26 Jul 2011 | Initial Release by<br>NDT Systems & Services Inc. |
| Version 1 | 9 Sep 2019 | Re-analysis of Hard Spot data |

**Enbridge**

**75.5 mi. x 30" TOMP-DANV Line 15**

**Tompkinsville – Danville**

**Run Date: 05 Apr 2011**

**Job #: 70130.01**

**Run 1**

**NDT Global LLC**
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| Account Representative | Project Manager | Survey Analysts |
|---|---|---|
| Israel S. Soliz | Ken Harris | Adrian Bejarano |
| **Pipeline Inspector** | **Technical Writer** | David Goldingay |
| Justin Holt | Denise Wright | Isaac Velazquez |

09 September 2019

This inspection report including any recommendations made by the contractor relating to the pipeline has been prepared by the contractor to his best knowledge and belief. All recommendations are made in good faith and are a reliable expert opinion of the contractor, according to common practice prevailing in the pipeline industry. The report or measures based on it will not constitute a warranty of the quality, capacity, safety or fitness for purpose of the pipeline.

# Table of Contents

# Deliverables

## Hard Copy

- **Final Report** - printed copy of the inspection report.
- **Appendix** – printed copy of the results lists and personnel certificates.

## USB Drive

- **Final Report**– inspection report and appendix in PDF format.
- **Graphics** – data files.
- **LinaView Client Software** – client version of LinaView software, for use with project files and graphics.
- **Project Files** – LinaView database files.

# 1 Executive Summary

In 2011, Spectra Energy (now Enbridge) contracted NDT Systems & Services (America) Inc. to perform a Hard Spot survey for a 75.5 mile section of the 30" TOMP-DANV Line 15 pipeline, from Tompkinsville to Danville. NDT Systems and Services (America) Inc. is a predecessor of the business owned by NDT Global LLC., and is no longer in business. The primary objectives of this survey were to collect and analyze hard spot data for localized hardening indications.

On 15 Aug 2019, Enbridge requested a re-analysis of the 2011 data to provide any additional information and features potentially located in the pipeline.

**2011 Data Analysis:**

During the 2011 data analysis, there were **14** indications of hard spots that measured 200 – 300 Brinell and **2** indications of hard spots that measured 301 – 400 Brinell that were reported.

**2019 Data Analysis:**

During the 2019 re-analysis of the same dataset, our analysts reported **438** indications of hard spots that met the 200 – 300 Brinell criteria and **3** indications of hard spots that met the 301 – 400 Brinell criteria.

The number of hard spots found in this most recent 2019 analysis has increased, which is due to the significant improvements in hardware and software made available to our analysis team today versus the technology available in 2011.

- The gain in LinaView A-scan's used in 2011 (40-50) was typically much lower than the gain used in the current 2019 analysis (100 for axial scan, 70 for reduced axial scan). The gain settings used in the current analysis were utilized to ensure no hard spots (however minor) were omitted.
- The resolution and size for the monitors used in the 2011 analysis (typically 1280 x 768 and 17" size) are significantly lower than the resolution and size used currently (1920 x 1080 up to 2560 x 1440, and 24"/25" size).
- The hard spot at absolute distance 331147.612 ft. (reported at 387 Brinell in the 2019 analysis) is located in a potentially heavier wall pipe, where the magnetic field strength is lower than in the nominal wall pipe, possibly creating an exaggeration in the Brinell value. Therefore the Brinell tolerance for this feature is more likely to be on the lower side (-75 Brinell to +25 Brinell) than is normal (±50 Brinell).

# 2 Scope and Results of 2011 Inspection

Spectra Energy (now Enbridge) contracted NDT Systems & Services (America) Inc. to perform a Hard Spot survey for a 75.5 mile section of the 30" TOMP-DANV Line 15 pipeline, from Tompkinsville to Danville. NDT Systems and Services (America) Inc. is a predecessor of the business owned by NDT Global LLC., and is no longer in business. The primary objective of this inspection survey was to collect and analyze hard spot data for localized hardening indications within this pipeline segment.

# 3 Operational Details

## 3.1 Pipeline & Medium Information

| | |
|---|---|
| Pipeline Name | TOMP-DANV Line 15 |
| Launch – Trap | Tompkinsville – Danville |
| Length of Inspected Pipeline Section | 75.5 miles |
| Pipeline Diameter | 30" |
| Wall Thickness Range | **0.375"**, 0.380", 0.385", 0.387", 0.404", 0.406", 0.438", 0.462", 0.469", 0.485", 0.500", 0.625", 0.656" |
| Weld Type(s) | EFW, DSAW |
| Pipe Grade(s) | X52, X42, X60, X65 |
| Minimum Bend Radius | 3D |
| Usual Medium | Natural gas |
| Medium Used for Inspection | Natural gas |
| Average Flow Velocity during Inspection | 6.07 mph |

## 3.2 Inspection Run Details

An inspection survey was performed on 05 Apr 2011. The Linalog Max-LF tool was launched at 7:29 a.m. and trapped at 7:55 p.m. Natural gas propelled the tool for 12 hours and 26 minutes at an average speed of 6.07 mph. There was no debris reported. Of the 76 AGMs deployed, 2 were not detected.

## 3.3 Data Quality

During the survey, data was recorded by all channels, covering the complete circumference of the pipe wall and the entire length of the pipeline. The data was downloaded from the recorder flash drive to a hard drive, converted with the LinaView software suite, and reviewed by NDT personnel in the field. Internal diagnostics on the tool and visual inspection confirmed that the data quality was acceptable for full circumferential analysis. This survey (Job #: 70130.01) was accepted as the Log of Record.

# 4 2019 Summary of Re-analysis Results

## 4.1 Reporting Criteria

- The hard spot results are reported using the Brinell Hardness Scale.
- For each indication, the area of maximum hardness is reported.

## 4.2 Results

The results listed below are the total number of annotated hard spots in this section of pipeline. For a detailed listing, see the LinaView Pipeline Register. The tolerance of the reported hard spot measurements is ± 50 Brinell, which is in compliance with API Specification 5L, section 7.8.7.

### 2019 Analysis

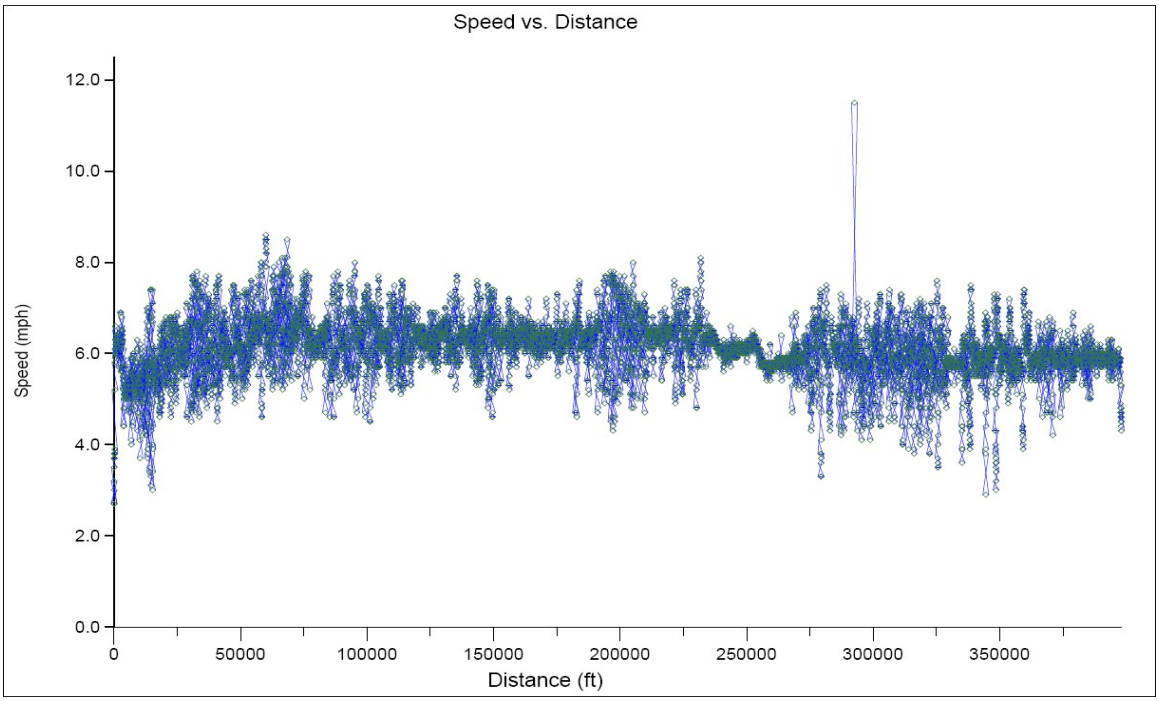
| 200 – 300 Brinell | 301 – 400 Brinell |
|---|---|
| 438 | 3 |

## 4.3 Special Report Notations

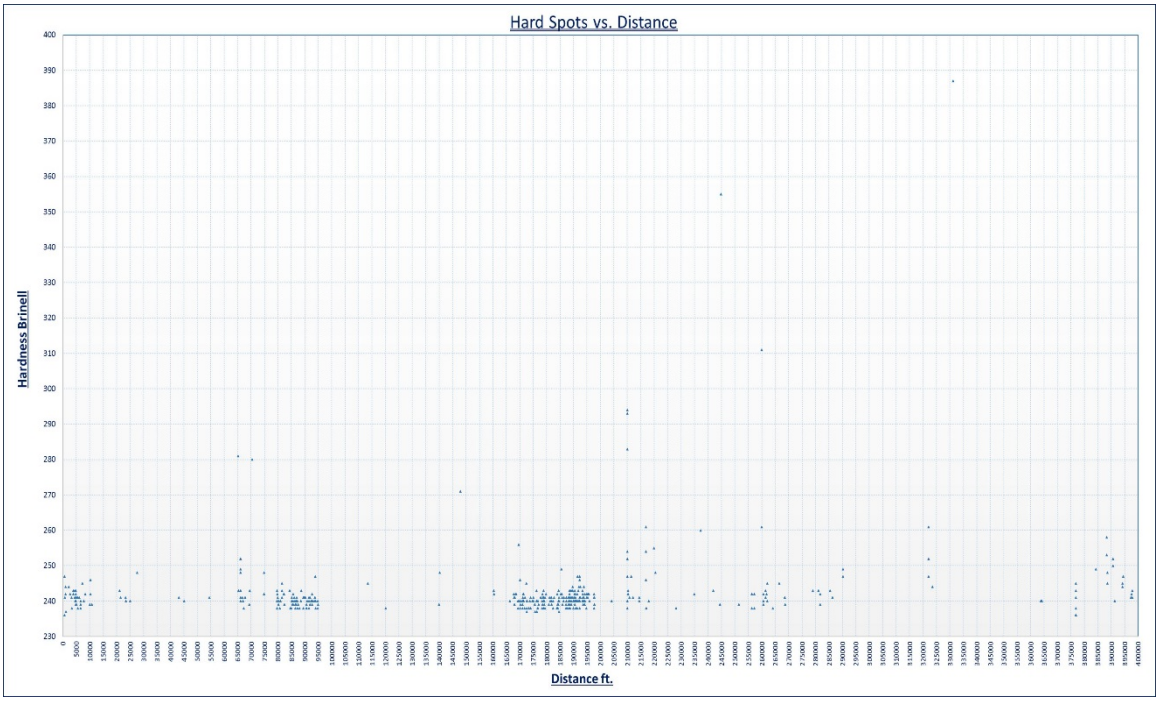
As denoted in the Pipeline Register, hard spots were identified by comparing the data collected from this survey with other known hard spots. “Known hard spots” are indications comparable in magnetic flux leakage signature that have been detected using the same technology in the same/similar pipeline environments. The known indications have been excavated and had their Brinell classifications confirmed and documented according to peak deflection, flux leakage characteristics, physical dimensions, and appearance.

## 4.4 Charts and Histograms

### 2011 Inspection – Tool Speed vs. Distance




### 2019 Re-analysis - Hard Spot vs. Distance



# 5 Overview of Appendix Contents

The following documents are included in the appendix folder:

| | |
|---|---|
| **Result Lists** | Spreadsheets containing detailed inspection result lists. |
| **Personnel Certificates** | Personnel certifications according to the *ILI PQ Personnel Qualification* standard. |

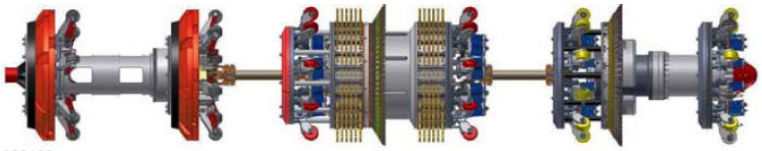
# 6 Overview of Results Lists

The following documents are included in the appendix folder:

| | |
|---|---|
| **Pipeline Register** | The Pipeline Register contains detailed information on the various anomalies and other pipeline features detected during this inspection run. |
| **Hard Spot List** | The Hard Spot List is a listing containing all hard spots detected during this inspection and contains information on distance, clock position, and Brinell rating. |
| **Severity List** | Anomalies according to the severity criterion. |

# 7 Tool Specifications

## 30" *Linalog*® Max-LF



389108

| | Imperial | Metric |
|---|---|---|
| Overall Tool Length | 176.7 in. | 4488 mm |
| Tool Mass | 3600 lb. | 1633 kg |

| Lengths | Imperial (in.) | Metric (mm) |
|---|---|---|
| Section 1 | 56.1 | 1425 |
| Section 2 | 60.4 | 1534 |
| Section 3 | 60.2 | 1529 |

### TYPICAL INSPECTION SPECIFICATION

**DETECTION PARAMETERS** (Grading @ 90% Confidence)

**Minimum Detectable Thresholds**

t < 0.380 in. (10 mm) = 0.380 in. (10 mm)
t ≥ 0.380 in. (10 mm) ≥ 1t (t = wall thickness)

| | | |
|---|---|---|
| Dent | 1 in. L x 1 in. W | (25 x 25 mm) |
| Ovality | 1 in. L x 2 in. W | (25 x 50 mm) |

**Minimum Sizeable Depth**

| | | |
|---|---|---|
| Pitting Corrosion | 15% Pipe Body | 25% HAZ |
| General Corrosion | 10% Pipe Body | 20% HAZ |
| Deformation | 0.10 in. (2.5 mm) | |

**SIZING ACCURACY** (Grading @ 80% Confidence)

| | Depth: Pitting | Depth: General Metal Loss |
|---|---|---|
| Pipe Body | ± 10% | ± 10% |
| Heat-affected Zone (HAZ) | ± 15% | ± 15% |

| | | |
|---|---|---|
| Pitting | Length | ± 0.25 in. (6.4 mm) |
| | Width | ± 0.75 in. (19 mm) |
| General Metal Loss | Length | ± 0.75 in. (19 mm) |
| | Width | ± 1.00 in. (25 mm) |
| Deformation | Length | ± 0.10 in. (2.5 mm) |
| | Width | ± 1.00 in. (25 mm) |

**LOCATING ACCURACY**

Axial: ± 0.3% General; ± 1 in. (25 mm) Localized
Circumferential: ± 5°

**Sensor Count**

186 Corrosion
‡ 62 Deformation
62 ID/OD
‡ 186 HardSpot/ Reduced Field

### TOOL PARAMETERS

| | Imperial | Metric |
|---|---|---|
| Temperature Range | 32° to 160° F | 0° to 71° C |
| Inspection Speed Range | <0.5 to 9.0 mph | <0.2 to 4.0 m/s |
| Optimum Speed Range | 3.0 to 7.0 mph | 1.3 to 3.1 m/s |
| Maximum Operating Pressure | 3250 psi | 22.41 MPa |

| | Time | Distance |
|---|---|---|
| Run Duration | 210 hr. | 210 mi. |
| | | 338 km |

*Wall Thickness Inspection Range

| | | |
|---|---|---|
| 0.188 in. | To | 0.625 in. |
| 4.8 mm | To | 15.9 mm |

### PIPELINE CONDITIONS

| Bend (90°) | Back to Back Transition inch | Back to Back Transition mm | Minimum ID in Bend inch | Minimum ID in Bend mm |
|---|---|---|---|---|
| 1.5D | 0 | 0 | 28.0 | 711 |
| 3D | 0 | 0 | 26.0 | 660 |
| 5D | 0 | 0 | 25.7 | 653 |

| | | |
|---|---|---|
| Straight Pipe (Fittings) | 25.7 | 653 |
| Straight Pipe (Continuous) | 26.6 | 676 |

**Comments**

*Increased wall thickness inspection available
‡Optional inspection services available

INS/GPS available
Contact NDT Sales person for details

This information is intended for the use of NDT Systems & Services customers only. The above data is standard specification only. If pipeline requirements or conditions are not within these parameters, please contact NDT Systems & Services (America) Inc at 713-799-5430 for specific applications. This information is subject to revision without notice and is not to be construed as a warranty or guarantee of any nature.

# 8 Feature Specifications

## 24" to 42" Linalog Max

### MFL Table 1 : Identification of Features

| Feature | Yes POI>90% | No POI<50% | Maybe 50%<=POI<=90% |
|---|---|---|---|
| **Int./ext./midwall discrimination (Not Midwall)** | X | | |
| **Additional metal / material** | | | |
| - debris | | | X |
| - touching metal to metal | | | X |
| **Anode** | | | X |
| **Anomaly** | | | |
| - arc strike | | | X |
| - artificial defect | ■ | | |
| - buckle | | | ▲ |
| - corrosion | X | | |
| - corrosion cluster | X | | |
| - crack | | | ■ |
| - dent | | | ▲ |
| - dent with metal loss | | | ▲ |
| - gouging | | | ▲ |
| - grinding | | | ▲ |
| - girth weld crack | | | ■ |
| - girth weld anomaly | X | | |
| - HIC | | X | |
| - lamination | | | ■ |
| - longitudinal weld crack | | X | |
| - longitudinal weld anomaly | X | | |
| - ovality | | X | |
| - pipe mill anomaly | | | X |
| - pipe mill feature anomaly | | | X |
| - SCC | | X | |
| - spalling | | | ■ |
| - spiral weld crack | | X | |
| - spiral weld anomaly | | | X |
| - wrinkle | | | ▲ |
| **Crack arrestor** | | | X |
| **Eccentric pipe 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 |

■ This will be reported as an anomaly but accurate identification depends upon the size and shape of the item.

▲ Mechanical anomalies do not represent simple metal losses and therefore do not lend themselves to definable limits of detection and identification. These anomalies can represent sites of metal displacement, metallurgical changes, and localized work hardening. While mechanical anomalies are typically detected by the NDT system, the primary constituent in setting operating parameters for NDT MFL tools is optimal corrosion detection and characterization.

### MFL Table 2 : Detection and Sizing Accuracy for Anomalies in Body of Long Seam Welded Pipe*

| | General Metal Loss | | Pitting | | Axial Grooving | | Circumf. Grooving | |
|---|---|---|---|---|---|---|---|---|
| Depth at POD = 90% | 0.05t | | 0.08t | | 0.15t | | 0.05t | |
| | 80% | 90% | 80% | 90% | 80% | 90% | 80% | 90% |
| Depth sizing accuracy at 80% and 90% confidence | ± 0.10t | ± 0.13t | ± 0.10t | ± 0.13t | ± 0.10t | ± 0.13t | ± 0.10t | ± 0.13t |
| Width sizing accuracy at 80% and 90% confidence | ± 1.00" | ± 1.29" | ± 0.75" | ± 1.00" | ± 0.75" | ± 1.00" | ± 1.00" | ± 1.29" |
| Length sizing accuracy at 80% and 90% confidence | ± 0.75" | ± 1.00" | ± 0.25" | ± 0.32" | ± 0.25" | ± 0.32" | ± 0.25" | ± 0.32" |

*Specifications for seamless pipe are dependent on the magnitude of the seamless noise.

### MFL Table 3 : Detection and Sizing Accuracy in Girth Weld or Heat Affected Zone

| | General Metal Loss | Pitting | Axial Grooving | Circumf. Grooving |
|---|---|---|---|---|
| Depth at POD = 90% | 0.20t | 0.25t | 0.30t | 0.20t |
| Depth sizing accuracy at 80% confidence | ± 0.15t | ± 0.15t | ± 0.15t | ± 0.15t |
| Width sizing accuracy at 80% confidence | ± 1.00" | ± 0.75" | ± 0.75" | ± 1.00" |
| Length sizing accuracy at 80% confidence | ± 0.75" | ± 0.25" | ± 0.25" | ± 0.25" |

### MFL Table 4 : Detection and Sizing Accuracy for Crack or Crack-like Defects

| | Axial Crack | Circumf. Crack | Spiral Crack |
|---|---|---|---|
| Depth at POD = 90% of crack with L = 10" | N/A | 0.25t | N/A |
| Minimum crack opening | N/A | 0.004" | N/A |
| Depth sizing accuracy at 80% confidence | N/A | ± 0.15t | N/A |
| Length sizing accuracy at 80% confidence | N/A | ± 0.50" | N/A |

### MFL Table 5 : Detection and Sizing Accuracy for Dents and Ovalities

| | Dent | Ovality* |
|---|---|---|
| Depth at POD = 90% | N/A | N/A |
| Depth sizing accuracy at 80% confidence | N/A | N/A |
| Width sizing accuracy at 80% confidence | N/A | N/A |
| Length sizing accuracy at 80% confidence | N/A | N/A |
| Ovality at POD = 90% | N/A | N/A |

*Ovality = (IDmax-IDmin)/(IDmax+IDmin)

### MFL Table 6 : Location Accuracy

| | Location |
|---|---|
| Axial from girth weld | ± 1.00" |
| Axial from marker | ± 0.3% distance traveled from marker |
| Circumferential | ± 5° for all tools except for tool statements below;<br>± 10° for 42" and 28" diameter tools;<br>± 15° for 30" LF and 40" diameter tools. |

# 9 Installing LinaView 8

If you already have a previous version of LinaView (or TruView) installed, you must first uninstall the current version.

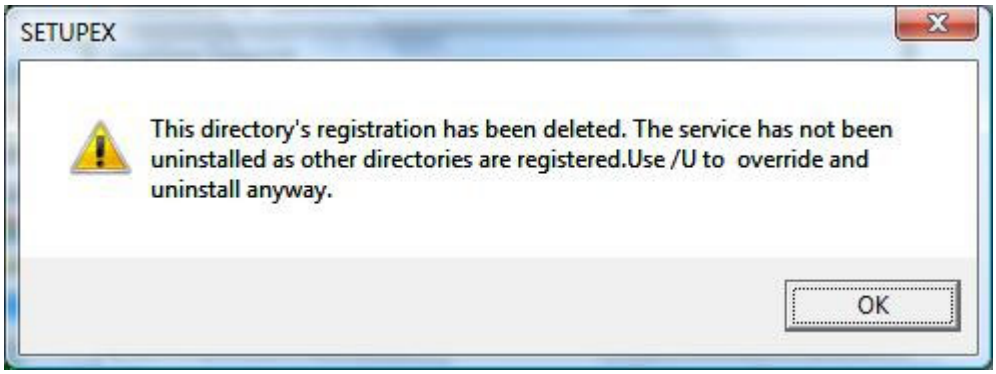
**YOU MUST HAVE ADMINISTRATIVE PRIVILEGES TO INSTALL LINAVIEW 8.**

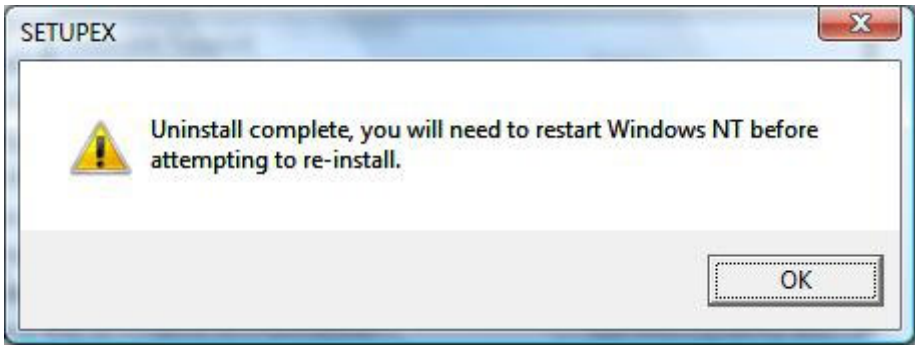
**LinaView 7.1.2 and later will only operate on Windows XP, Windows Vista, Windows 7, and Windows 10. The 32- and 64-bit versions of these systems are supported.**

### Remove the current version:

1. From the Start menu, select Control Panel.
   a. For Windows XP
      i. Double click on Add/Remove programs.
      ii. Click on the LinaView Client (TruView Client) name and then Add/Remove (on Windows XP this button is called Change/Remove).
      iii. Select the option to remove the program.
      iv. If you are uninstalling a version of TruView (pre-version 6.0.4) you must use Windows Explorer to delete the TruView directory and all of its files (normally this will be C:\Program Files\TruView).
   b. For Windows Vista, Windows 7, and Windows 10
      i. Click on the Programs and Features item.
      ii. Click on the LinaView Client name and then click the Uninstall/Change button at the top of the list.

      **NOTE:** During the initial phase of the un-install, a dialog box displays indicating that you need to restart your computer, or that the registration entry has been deleted. In either case, this dialog will display **BEHIND** the installation dialog box. You **MUST** bring it to the foreground and click the OK button before the un-install will complete.






2. If you are uninstalling a LinaView version (6.0.4 or later) **DO NOT** delete your LinaView directory.
3. If there is a file named gpdtemp.ini in your LinaView directory, delete it.
4. Reboot your computer before continuing.

### Install LinaView 8 from CD:

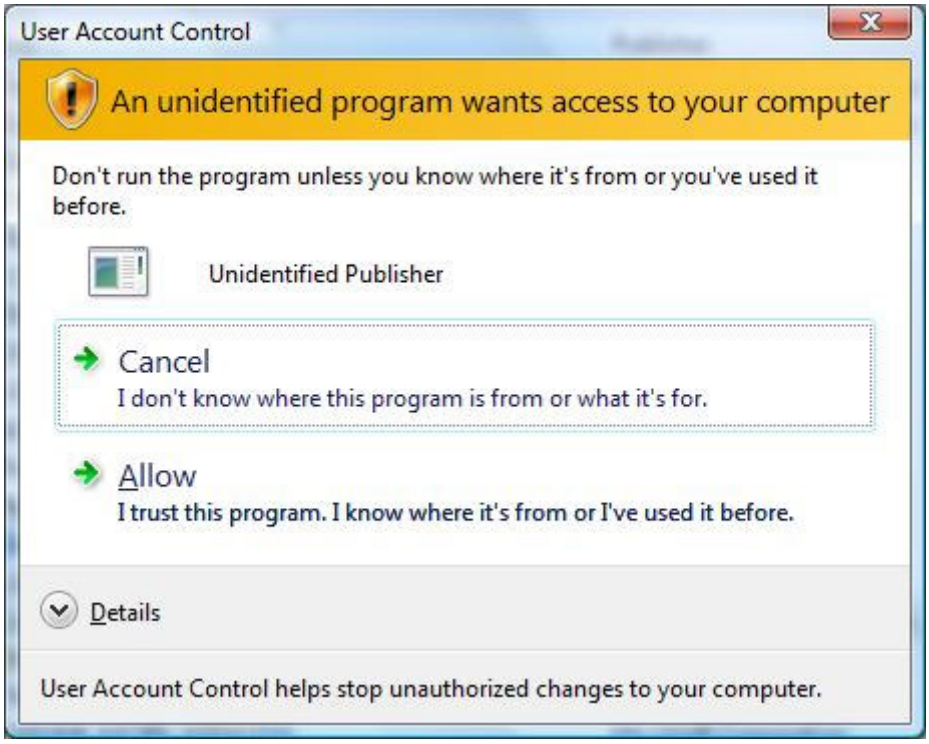
1. If you have not already done so, reboot your computer.
2. Insert the LinaView CD in your CD ROM drive.
   a. Manually start the installation.
      i. From the Start menu choose Run
      ii. Browse the CD ROM drive and click on the LinaViewCLient.exe file (for 64-bit systems this file is named LinaViewClient(x64).exe).
      iii. Click OK.
3. Follow the screen instructions to complete the installation of LinaView 8.

### Install LinaView 8 from a local disk or network location:

1. From the Start menu choose Run.
   a. Browse the directory containing the LinaView installation package and click on the LinaViewClient.exe file (for 64-bit systems this file is named LinaViewClient(x64).exe).
   b. Click OK.

   **NOTE:** If you are installing on Windows Vista , Windows 7, or Windows 10, the User Account Control (UAC) will display indicating that an unknown program is trying to access your computer. You must allow this in order to install LinaView.

   - If you are logged on to an administrator account, press the Allow button.
   - If you are not logged on to an administrator account, type the administrator password and press the Allow button.




**NOTE:** During the installation of LinaView, you may receive an error message indicating that some items could not be installed because they are protected files. You may safely ignore this error message and continue the installation. There will be no adverse effects to this action.