PICA Pipeline Inspection and Condition Analysis Corp.

Inspection Report

Bracelet™ Probe Inspection

ABC County Force Main Sites

Site # Main Street #254

PICA: BP Report # 36

(254 Main Street, Albertville, CA)

PICA USA
Los Angeles, California USA

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Data Analyst	Allen Rasko
Inspection Dates	August 15, 2018
Reviewer	Deidrich Lenz
Preliminary Report Date	August 17, 2018
Revision	0.2

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Inspection Test Site Information

Bracelet Probe Inspection		
Site information		
		Comments
Date Inspected:	15-August 2018	
Site ID:	Main Street #254	
Location:	254 Main Street	Albertville, CA
GPS or Google map coordinates:	34.0346 and -83.9094	
Pipe Size:	16 inches	
Material Type:	Ductile Iron	
Class:	Pressure Class 50 (Record Drawings)	Provided by Client
Nominal Wall Thickness:	0.340”	(Record Drawings)
Lining Details: internal	Unknown	(No information in Record Drawings)
Coating Details: external	Factory black coating. No poly-ethylene wrap	
Excavation Depth:	7 feet	
Scan Length:	8 feet	
Scan performed in Flow Direction:	Yes	
Weather:	85 - 95 F Degrees	
Excavation Wetness:	Dry	
Soil Type:	Red Clay and Sand	
Photos Taken:	Yes	
Piping painted and coated after buffing:	Yes	
Other observations:	No ARV close	

Note: Pipe classes used throughout this report are in accordance with ANSI/AWWA standards.

See Pipe Class/Thickness table at end of Appendix-3

Summary of Inspection Results: 254 Main Street

Moderate internal pitting detected. Moderate wall loss consisting of individual pits in local areas with some general wall loss.

No significant external pitting was found visually at the UT locations.

Table-1, Summary of Thickness Results

Location	Specified Nominal	Suspected Nominal	UT High Reading	UT Low Reading	UT Avg Thickness
3.25’	0.340”	0.340”	0.298”	0.225”	0.258
7’ - 7.5’	0.340”	0.340”	0.291”	0.247”	0.271”

UT = Ultrasonic Thickness.

The lowest UT measurement was 0.228” at 3.25’ at the spring line (position -12”).
Note: This was not in the scan area.

The highest UT measurement was found to be 0.309” at 1’.

The pipe at this location exhibits moderate internal corrosion (pitting).

Calculation of % wall loss is against the record nominal, of class 50, (0.340 wall”).

Detailed Inspection Results: 254 Main Street

The Zero Foot Reference (ZFR) was set on the pipe, as shown in Figure 1. There was no Bell edge to measure the ZFR from. Two scans were performed from -9” to 0” and from 0” to +9”. Note: further set up details can be found in Appendix 1 and 2.

No significant external corrosion (pitting) was found.

The data showed moderate corrosion (pitting) with some moderate general wall loss.

Ultrasonic Thickness (UT) measurements at a few selected locations based on BP scan data are listed in Table 1 on the following page. The smallest remaining wall thickness was 0.228”, representing: -**33%** wall loss compared to nominal wall thickness of 0.340” (Class 50 pipe).

Average of all UT readings is 0.276” a **19%** variation from nominal of 0.340”.

The following scale is used for wall loss description:

Minor: up to - 20% depth. (Could be caused by mill tolerance)
Moderate: 21% - 40% depth. (Likely caused by pitting corrosion)
Advanced: 41% - 70% depth. (Likely caused by pitting corrosion)
Severe Corrosion: 71% - 100% depth. (Likely caused by pitting corrosion)

Table 2. UT Thickness Measurements: 254 Main Street

Axial Distance from ZFR (feet)	Circumferential Distance from 12 o'clock (inches)*	UT Thickness Measurement (inches)	External Pits Depth Gauge Used (inches)
1	-12	0.304	
1	-9	0.309	
1	0	0.295	
1.5	9	0.292	
1.5	12	0.278	
2.2	-9	0.289	
2.2	0	0.291	
3.25	-12	0.247	
3.25	-9	0.237	
3.25	0	0.298	
3.25	9	0.278	
3.25	12	0.228	
4.5	-12	0.256	
4.5	-9	0.267	
4.5	0	0.284	
5.5	9	0.291	
5.5	12	0.273	
7	-12	0.267	
7	-9	0.268	
7.5	0	0.291	
7.5	9	0.284	
7.5	12	0.247	
Low at 3.25’	+12	**0.228**	
High at 1’	0	0.309	

*Negative and positive values were measured CCW and CW from 12 o’clock position, respectively

Note: The lowest UT measurement has been highlighted yellow.

Digital Picture of Pipe

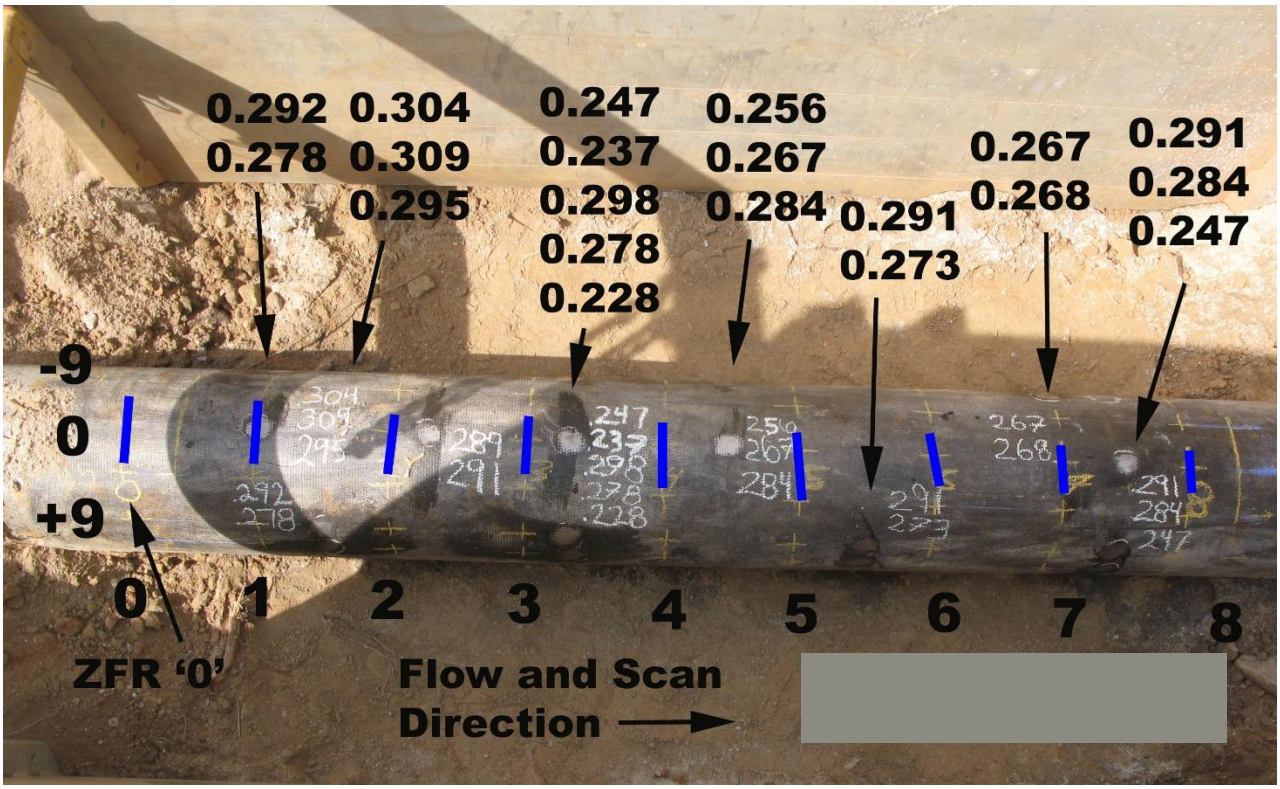

Figure 1. Showing the site with ZFR, Flow Direction and UT Locations.

Screen Captures of Bracelet Probe Scan Data

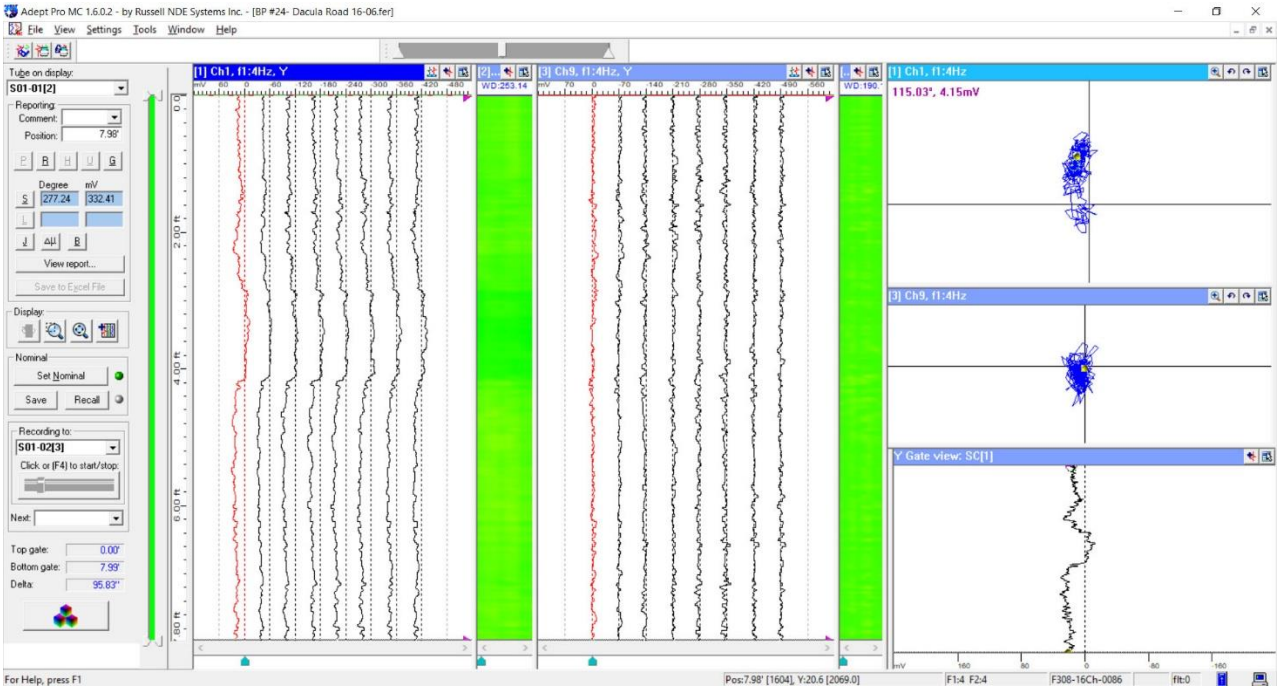

Figure 2. (Scan S01-01) BP data for a scan covering -9” to 0” circumference. (Probe centered at -4.5” position).

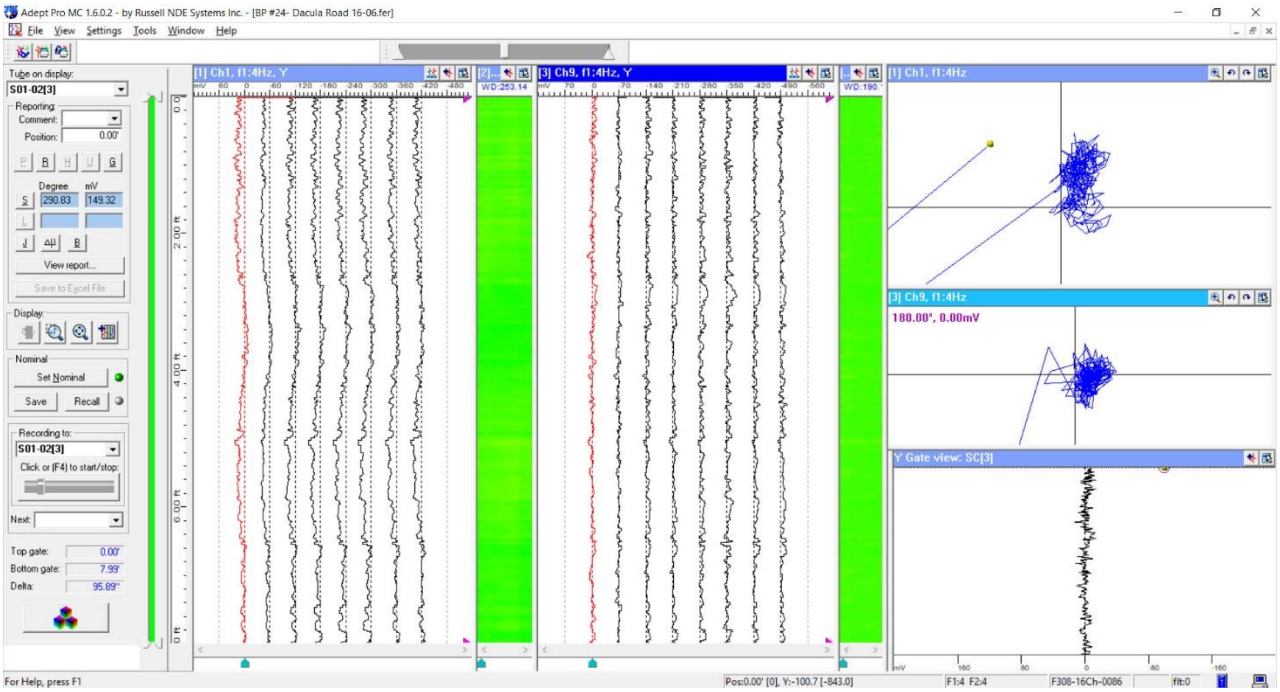

Figure 3. (Scan S01-02) BP data for a scan covering 0” to +9” circumference (Probe centered at +4.5” position).

Appendix 1: Technology Background

The Bracelet™ and Blanket™ probe system is Russell NDE Systems' latest external pipe inspection tool. The probes are flexible, and one Probe can fit on pipe sizes 6" and larger.

The Bracelet™ probe works on the principle of through-transmission (TT) Electromagnetics. Typical magnetic field pattern generated by the Bracelet™ is shown in Figure A1-1. The probe can detect internal and external wall loss in bare or coated ferromagnetic pipes (i.e., steel, cast and ductile-iron pipes). The threshold of detection (TOD) for local and general internal defects is respective 15-20% and 10-15% wall loss depending on corrosion morphology.

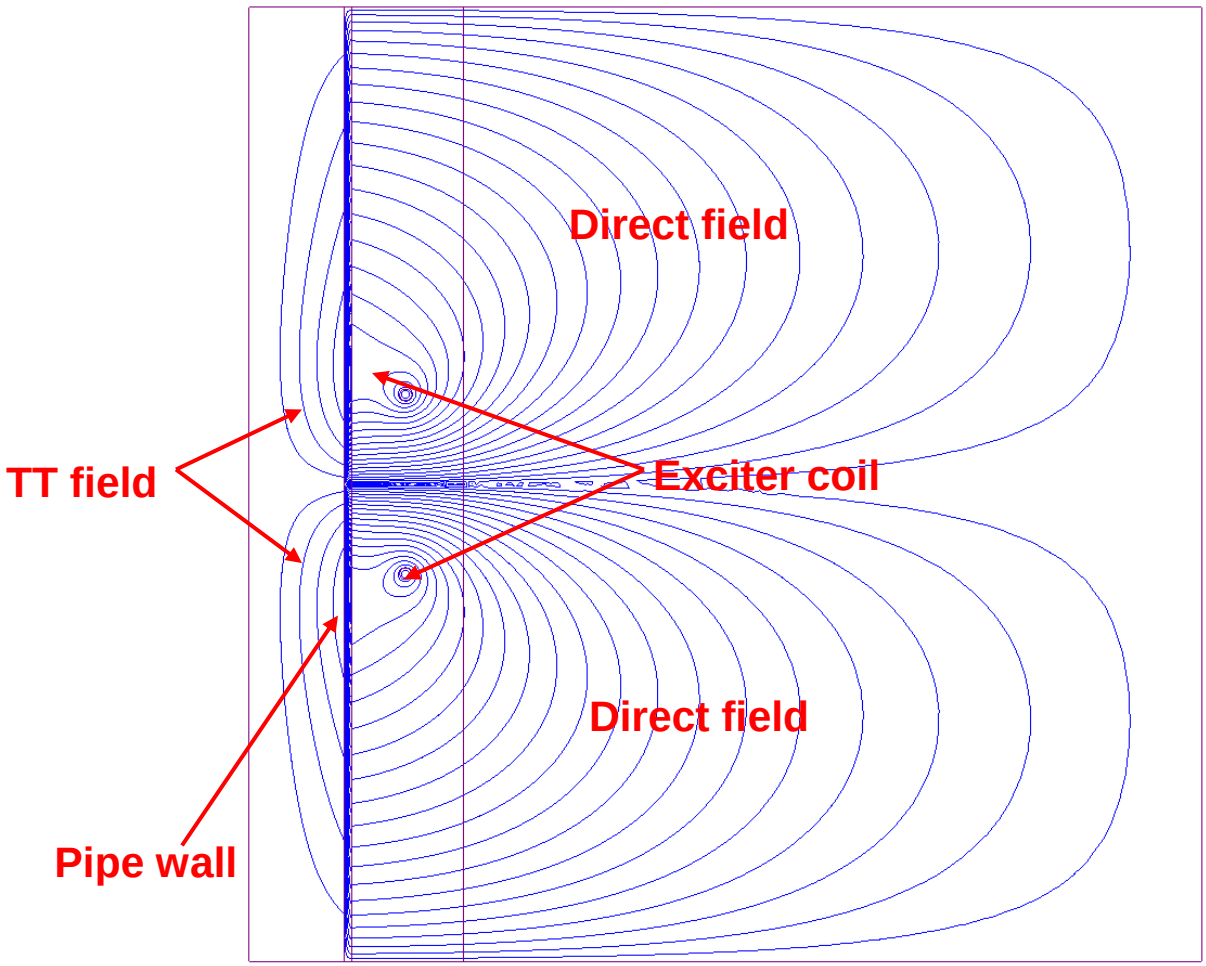

Figure A1-1. Typical magnetic field pattern of a Bracelet™ Probe.

Appendix 2. The Bracelet Probe Technique: Typical Setup

Scan numbering and clock position

Clock position was defined by looking in product flow direction, as shown in Figure A2-1. The pipe crown area along the pipe length was examined. A total of 2 to 3 scans usually centered at 12 o'clock were performed to cover the crown area. Circumferential distance was measured clockwise (CW) as a positive number or counter-clockwise (CCW) as a negative number from the 12 o'clock position.

Coverage

The Bracelet Probe (BP) typically covers a 9" axial swath for each scan on a pipe; therefore, several scans are required for full 360-degree inspection coverage.

Measurements

A "Zero Foot Reference" (ZFR, or Datum Line) was marked on each pipe and indicates the start of each BP scan. The scanning direction is from upstream (US) to downstream (DS), as shown in Figure A2-2. Axial distance increases downstream (DS) from the ZFR. Axial distance increases downstream (DS) from the ZFR. Note: measurements provided by the Bracelett Probe are +/- 2".

Scanning Speed

The probe was scanned at a speed of 1-2 feet per minute on the pipe, as shown in a photo in Figure A2-3. The BP data and distance information were gathered and stored in the laptop computer while the data was displayed real-time on the computer screen. The data was analyzed on site and any defects were noted and marked on the pipe with UT (Ultrasonic Testing) performed if needed for confirmation of BP results. Typical setup for Ferroscope and laptop computer is shown in Figure A2-4. The laptop was connected to the Ferroscope for data gathering and real-time data display.

Mill tolerance

For general wall variation that is less than 20%, we report it as mill tolerance variations. Unless there are clear pit indications, we do not differentiate between mill variations and internal wall loss due to pitting.

It is common to have mill variations of up to +/-20% in brand new DI pipe, due to the spin-cast technique. Wall loss due to pitting becomes easier to call if there are definite pitting signals and wall variation exceeding 20%. Pitting shows in the third strip chart from the left and general wall variation shows in the first strip chart from the left.

Bracelet Probe Calibration

Probe calibration was performed using the defects found in the pipe. The two detector arrays in the BP detect general wall variations (GWV) and local wall loss (LWL), which can be calibrated by using the GWV and LWL defects detected in the pipes at excavation sites. The wall thickness in the GWV and LWL areas was measured by the UT instrument and was used to calibrate the BP.

Ultrasonic System Calibration

The UT system was calibrated against a set of machined step wedges made of ductile iron. The step thicknesses are 0.100”, 0.200”, 0.300”, 0.400” and 0.500”

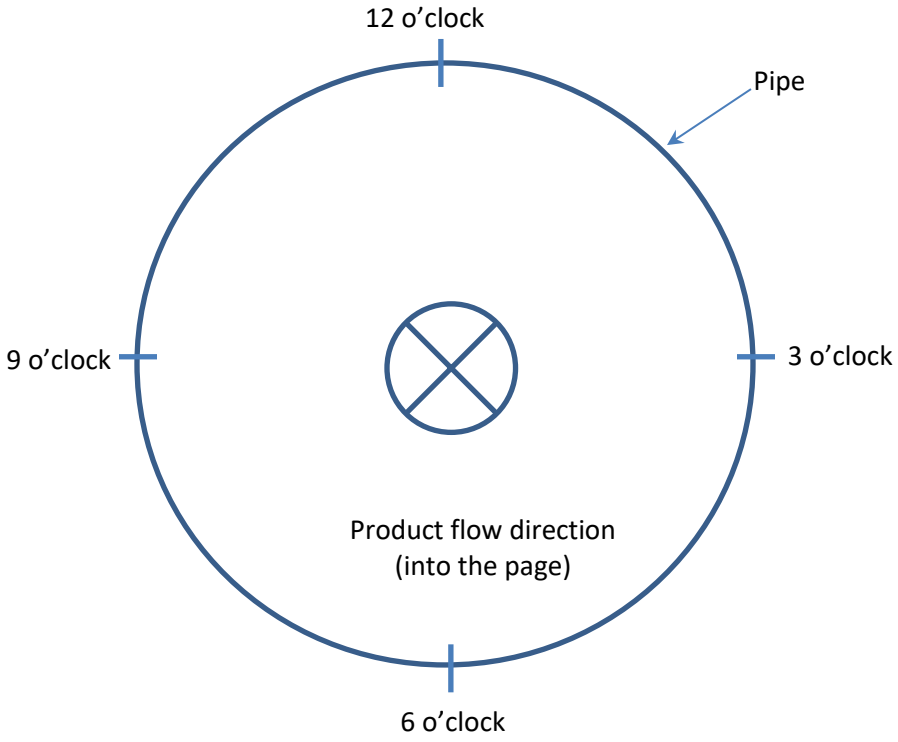

Figure A2-1. Pipe Cross Section Clock Definition vs. Product Flow Direction.

Zero Foot Refrence (ZFR) '0' Location

Figure A2-2. Bracelet™ Probe placed at the start location.

Equipment

Figure A2-3. Typical BP scanning a pipe.

Figure A2-4. Typical setup for Ferroscope and Laptop computer at job site.

Appendix 3. Data Screen Example

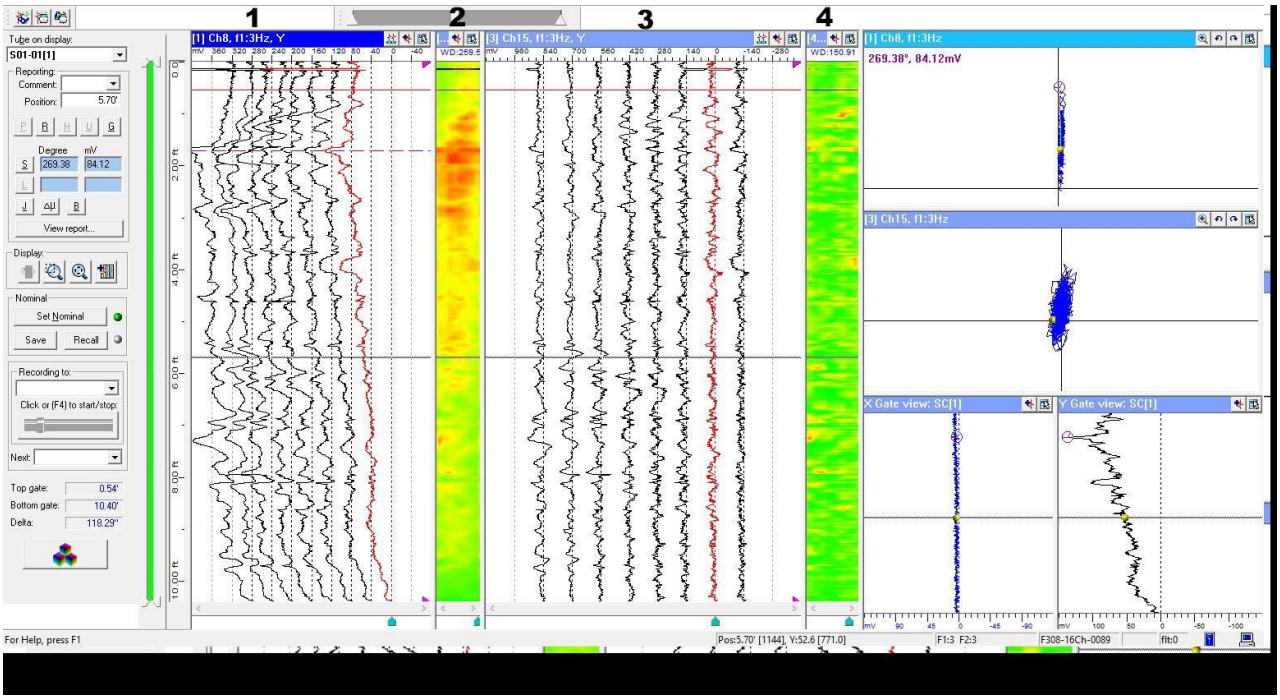

Figure A2-5. Example Screen Capture of Data

The example above shows a Screen Capture of a 10-foot pipe with numerous and deep pitting along the entire length. The picture has been labelled with a number above each chart column, which represents as follows:

Chart 1 and 2: Absolute coils for viewing General Wall Loss

Chart 3 and 4: Differential coils for viewing Pitting

Chart 2 and 4: Color maps for viewing the Data

For Chart 1: As a general guideline when the line trace moves to the left there is less material, as it moves to the right the wall is thicker.

Pipe Class/Wall Thickness table.

Thickness Class

Table 3. Special Thickness Classes of Ductile Iron Pipe.

SIZE Inches	OUTSIDE DIAMETER Inches	THICKNESS CLASS Inches						
		50	51	52	53	54	55	56
3	3.96	—	0.25	0.28	0.31	0.34	0.37	0.40
4	4.80	—	0.26	0.29	0.32	0.35	0.38	0.41
6	6.90	0.25	0.28	0.31	0.34	0.37	0.40	0.43
8	9.05	0.27	0.30	0.33	0.36	0.39	0.42	0.45
10	11.10	0.29	0.32	0.35	0.38	0.41	0.44	0.47
12	13.20	0.31	0.34	0.37	0.40	0.43	0.46	0.49
14	15.30	0.33	0.36	0.39	0.42	0.45	0.48	0.51
16	17.40	0.34	0.37	0.40	0.43	0.46	0.49	0.52
18	19.50	0.35	0.38	0.41	0.44	0.47	0.50	0.53
20	21.60	0.36	0.39	0.42	0.45	0.48	0.51	0.54
24	25.80	0.38	0.41	0.44	0.47	0.50	0.53	0.56
30	32.00	0.39	0.43	0.47	0.51	0.55	0.59	0.63
36	38.30	0.43	0.48	0.53	0.58	0.63	0.68	0.73
42	44.50	0.47	0.53	0.59	0.65	0.71	0.77	0.83
48	50.80	0.51	0.58	0.65	0.72	0.79	0.86	0.93
54	57.56	0.57	0.65	0.73	0.81	0.89	0.97	1.05

NOTE: *To convert inches (in.) to millimeters (mm), multiply by 25.4.*