N.P. Inspection Services GmbH

Hildesheim, Germany

Final Report Nr. 09202

Pipeline Company
12“Pipeline from A – B

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N.P. Inspection Services GmbH
Am Flugplatz 13
D-31137 Hildesheim

Managing Director:
Johannes Peter Kallmeyer

Phone +49 (0) 5121-28126-0
Fax +49 (0) 5121-28126-66

e- mail: info@npinspect.com
http: //www.npinspect.com

Tax No. 2330 0302 160 3272
Trade Register: Hildesheim HRB 3343

VAT No. DE813573290

Bank Accounts:
Kreissparkasse Hildesheim
Account No.: 824 273, Bank Code: 259 501 30
SWIFT: NOLADE21HIK
Deutsche Bank
Account No.: 108 118, Bank Code: 259 700 74
SWIFT: DEUTDB259

Contents

1. NoPig Inspection Technology

The NoPig Pipeline Inspection System analyses the magnetic field of a pipeline from above ground. To induce the magnetic field, an inspection current is introduced between two contact points on the pipeline. The inspection current is produced in the current source module shown below.

The inspection current is the superposition of components at two frequencies, 9 Hz and 630 Hz. The component at 9 Hz fills up the whole cross section of the pipe and the other one at 630 Hz flows only on the outer surface of the pipe.

Normally the outer magnetic field induced by a current in a pipe without a defect is round and concentric about the geometric center of the pipe. The magnetic fields around a pipeline without a defect are frequency-independent.

The NoPig technology utilizes the “Skin-Effect” and other physical phenomena which are responsible for achievment of a frequency-dependent shift between the outer magnetic fields above defect regions. During the NoPig Pipeline Inspection the shift will be analyzed from above ground with the sensor array.

In the sensor array 6 magnetic sensors are installed in one line. The sensor array consists of four lines with a total of 24 magnetic sensors. Every sensor measures the horizontal component of the magnetic field. The acquisition and storage of collected data will be done in the back pack unit (trolley), which is connected to the sensor array. The following figure shows sensor array (rear) and back pack (front).

During the NoPig Inspection the magnetic field of the pipeline will be inspected step by step. The step length is exactly one meter. From magnetic field data the frequency-dependent shift in the vertical (Z_m) and the horizontal (y) directions will be calculated. A shift presence indicates the region with a defect.

Together with the shift, the depth of coverage and the position in x direction will also be stored.

2. NoPig Inspection Procedure

2.1. Preliminary Routine

The crew will evaluate the pipeline project site and oversee any necessary preparation of the ground above the line. This time period can be kept to a minimum as the pipeline right of way should be cleared before the crew arrives.

Any special electrical isolation of the pipeline and cathodic protection shut-off should be discussed in the Customer/Technician meeting prior to the Inspection run. The pipe book should be presented and discussed to determine where possible critical areas are located. This will help the evaluation process.

2.2. Inspection Run

Transportation to the pipeline site will be arranged by the customer as well as a technician to aid the NP Inspection Services GmbH personnel. Onsite, the crew will set up and calibrate the system.

The pipeline will be connected with the current wires. This will either be done on above ground areas of pipe, cathodic protection attachments or holes will have to be dug.

Wire connected by clamp:

The 2 connections necessary for the system to function must be no longer than 500 metres apart. After connection and calibration, the NoPig sensor array will be placed on the ground above the pipeline to be inspected. The pipeline locator of the system gives the precise location of the pipe under ground as well as the depth and is stored along with the

GPS data. At each inspection step, the array is placed directly on the ground. After the data acquisition is done, the array is then moved forward one step.

This step is generally 1 meter. In this manner, the distance between the connection points is inspected.

3. From the Data Collection to the Graphic Analysis

After the raw data is collected from above the pipeline, the following steps are necessary in the evaluation process.

The first step is the post processing of the inspection data. The post processing reduces external and internal interferences. External interferences include environment magnetic noise, interference from line power and influence of large metal objects directly adjacent to the pipeline. Internal interferences include system random and systematic uncertainities. The post processing is based on the spectral analysis and other skills.

The second step involves evaluating the post processed data in the “Insight” program. Based upon a given threshold level, the Detection and Sizing List (Excel Spead Sheet) will be generated. The detection and sizing list corresponds to each individual inspection section.

The columns give the position, horizontal and vertical shift in the magnetic field, information about the pipeline and the depth of coverage. The depth is given to the geometric center of the pipeline. All the information pertaining to the pipe is contained in the detection and sizing list.

The Graphic analysis is based on the detection and sizing list. It presents the schematic visualization as a bar of the inspected pipeline of app. 100 m length. The following colors are used:

Dark green	inspected area with Level 1 sensitivity
Light green	inspected area with Level 2 sensitivity
Red	detection area
Light orange	detection below detection level
Remarks	metal loss or other information
White	non-inspectable or not evaluated area

Photographs made during inspection are also shown. Every photograph shows the environment above the inspected pipe every 50 meters. The x position of the photograph is corresponds the one in the inspection direction. The depth of coverage is shown in the graph below the bar. Steel objects in the immediate vicinity of the pipeline can slightly influence the depth of cover stated.

4. Inspection

N.P. Inspection Services GmbH Inspection Order Number: 02 30 14 002

Customer: Company

Purchase Nr. A24 4562 m

Pipeline Data:

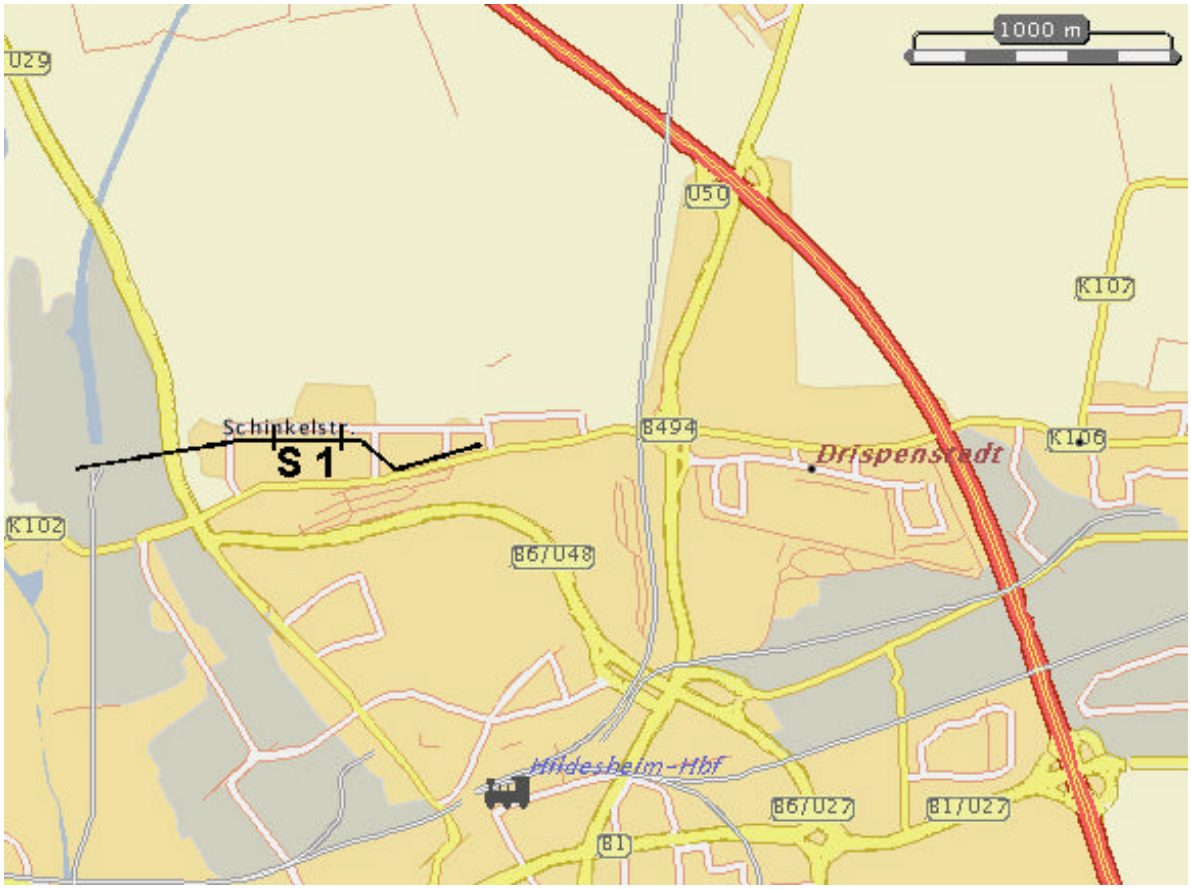
Pipeline Diameter:	12”
Wall thickness:	9,63 mm
Pipeline Manufacturing:	seamless
Type of Steel:	St 360 E
Manufacturing Date of the Pipeline:	1962
Installations:	unknown
Location of the welding	unknown

Other pipeline data:not known

Every 50 m a photograph of the site facing in the direction of the pipeline inspection has been made.

The pipeline evaluation contained in this report is based upon the information provided by the pipeline operator.

The inspection was done in one section.



Overview of the inspected pipeline

4.1. Pipeline Section 1

Pipeline is parallel to the airport. Start is 32 metres from the Schinkelstraße in east direction.

4.1.1. Description Section 1

Date:	17.10.02		
Supervisor:	P. Marold		
Inspection System:	Current source Module II		
	Sensor Array II		
	Backpack II		
	Calibration Table II		
Pipeline Map Number:	52 26 002 03 and 52 26 002 04		
Total Section Length:	100 m		
Start Position:	The start position is 32 m behind the Schinkelstraßs		
Contact posts	***First:*** Temporary CP post		
	Second: Temporary CP post		
Coordinates:	***0m:***	5210.5772N	956.5455E
	100m:	5210.5777N	956.6918E

4.1.2. Inspection Conditions Section 1

Inspection direction is according the given direction in the map 52 26 002 03 and 52 26 002 04. The Inspection direction has been dictated by the customer.

4.1.3. Results Section 1

Dependent on the data collection situation in section 1 the following detection levels are used.

Sensitive detection level 1:

From start position to 92 m the sensitive detection level 1 is given. The reference defect in this regions has 50 mm diameter and a peak metal loss of 50 %. One defect within the stated specification was found:

14 m detection 60 % wall loss

Below the sensitive detection level the following indication was given:

69 m detection below level 1

This indication is below the threshold level stated for the inspection and therefore can not be 100% identified.

Reduced detection level 2:

Section 1 has some region with reduced detection level. From 92 m to 100 m the detection level 2 is used. In this region the coverage is between 1.5 m and 2 m. The reference defect has 300 mm diameter and a peak metal loss of 50 %. No defects within the stated specification were found in region with reduced detection level.

4.1.4. Graphic Analysis Section 1

The inspected pipe is shown as a bar.

Depth of coverage is shown as a graph in blue.

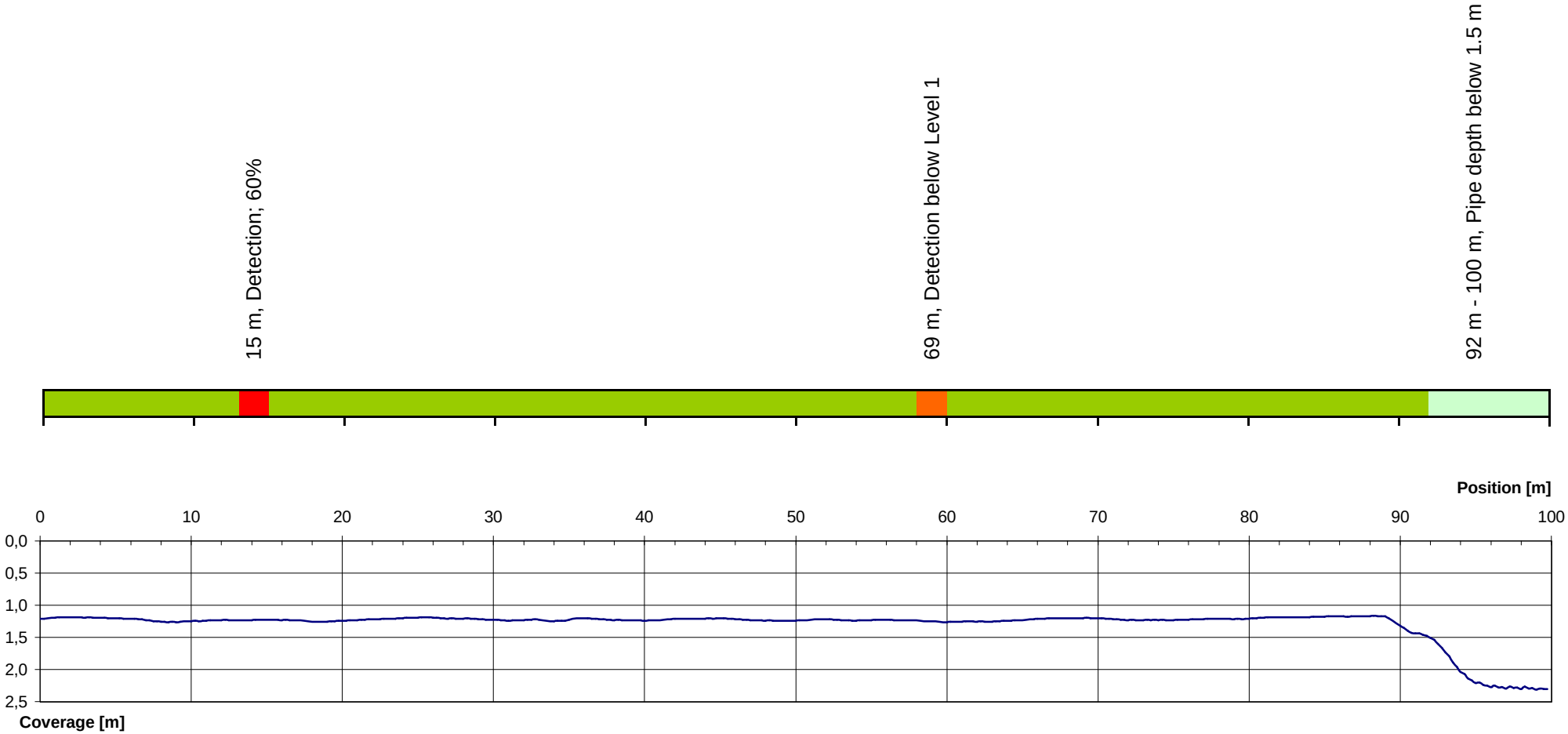
4.1.4 Graphic Analysis Section 1

0 m - 100 m

Colour Legend

Detection Area
Detection below detection level
Inspected Area, Level 1
Inspected Area, Level 2

Remarks



Pictures 0 m - 100 m

0 m - 50 m

50 m - 100 m

5. Results Overview

To reduce the influence of interferences, a post-processing method especially developed in consideration of the interference nature was applied. This procedure was performed during evaluation. As a result we could evaluate the majority of the inspected pipeline at Level 1 sensitivity.

We have defined two different levels of the system resolution: Level 1 and Level 2. The estimated system resolution at Level 1 is 50% peak metal-loss defect with a diameter of 50 mm. The dark green color marking is used in the Graphic analysis to show regions which are inspected with the Level 1 sensitivity. One defect within the stated specification was found:

14 m detection 60 % wall loss

Below the Level 1 detection level the following indication was given:

69 m detection below level 1

The estimated system resolution at Level 2 is 50% peak metal-loss defect with a diameter of 300 mm. The light green color is used in the Graphic analysis to show regions which are inspected with the Level 2 sensitivity. Due to the depth of coverage larger than 1.5 m, level 2 has been used for some region of this pipe.

The depth of coverage charts refer to the depth of the geometric center of the pipeline.

6. Appendix

CD ROM with:

- Detection and Sizing Lists
- Graphic analysis
- Complete Final Report