Introduction to Remote Field Eddy Current (RFEC) Probe Technology

In its simplest form, an RFEC probe consists of two coils in a send-receive configuration. Figure 1 below shows a diagram of a simple RFEC probe in a deteriorated pipe. The exciter (emitter) coil transmits an electromagnetic field and the detector (receptor) coil receives a phase shifted, varying strength signal based on pipe wall thickness variations.

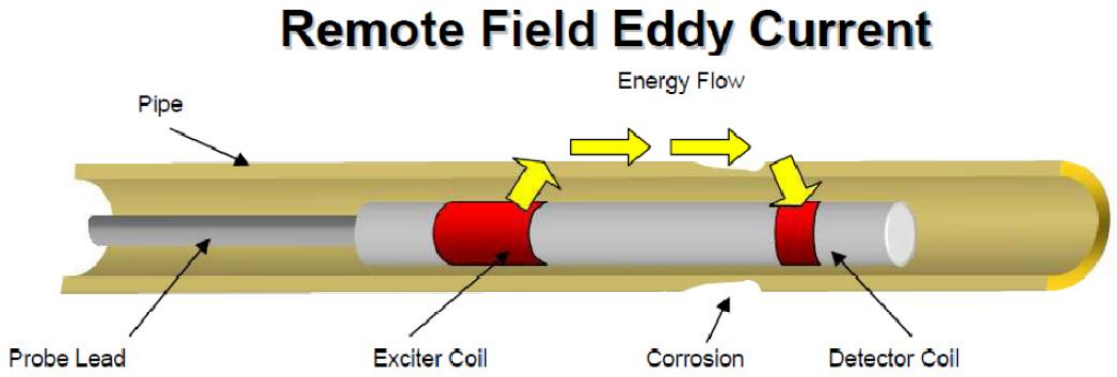

Figure 1. Basic Setup of RFEC probe in pipe.

The electromagnetic field is created by passing a low frequency current through the exciter coil. The field signal then travels from the exciter through the pipe wall, along the outside of the pipe and back through the wall to the detector coil. The signal phase shift and strength variations are analyzed by the probe software to provide anomaly details including pipe wall thickness change. The detector coil is set at a specific distance from the exciter coil (approximately three pipe diameters) and is "remote" enough that the exciter coil does not interfere with the recorded data.

Envirologics Detective™ Evaluation Description

Envirologics has incorporated the RFEC technology into the new Detective™ probe. After the pipe is cleaned, the Detective probe is pulled via the multi-conductor cable through the pipe using a winch system. A video camera is

concurrently pulled through the pipe recording a visual inspection of the pipe interior as seen in Figure 2.

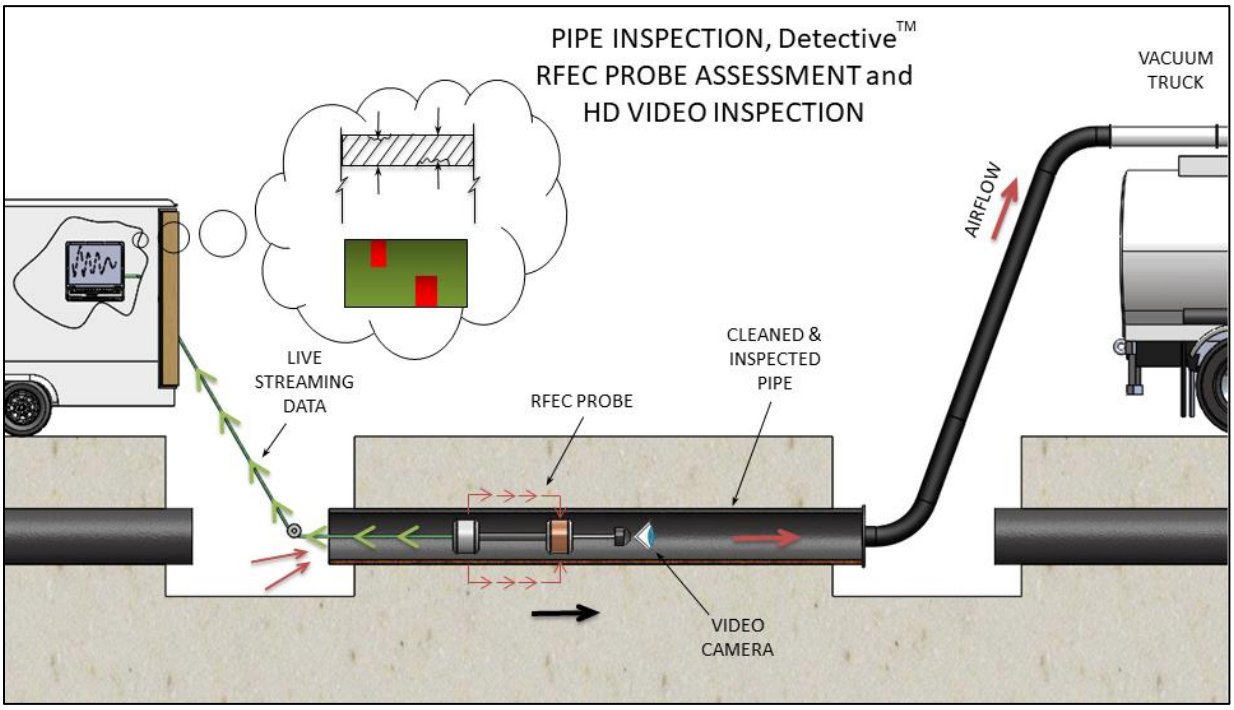

Figure 2: Envirologics Detective Evaluation Schematic

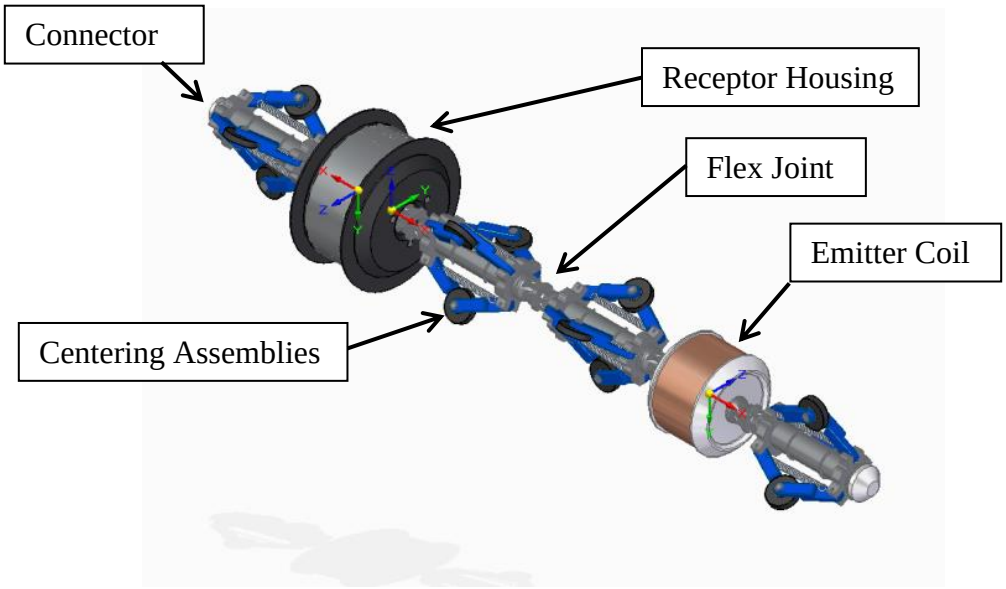

Figure 3: Envirologics Detective RFEC Pipe Assessment Probe

Just like conventional RFEC technology the Detective works by detecting changes in the electromagnetic (EM) field generated by the probe. The EM field interacts with the metal in the encompassing pipe and becomes stronger in areas of metal loss. On the Detective device, the EM field interactions are captured by on-board detector coils and the data is sent “live-streaming” through the multi-conductor

cable to the Eddy Current Main Frame processing unit. The data is processed then viewed "live" via the laptop software. Assessment data is stored on the computer for subsequent viewing and analysis.

Assessment and Video Data

The Detective software provides a simple, colour coded wall loss defects graph on a laptop screen to provide a quick audit of the pipe's health. The areas of concern are highlighted in red based on defect severity. The threshold can also be changed within the software post scan in order to improve assessment capability.

The concurrently recorded video inspection is used to aid in distinguishing defects (DFT) from pipe joint (JT) and service connection (SC) locations, which are also shown in red on the RFEC scan graph.

The simple interface data shown in Figure 4 allows the client to make quick decisions as to next steps in the rehabilitation process such as pipe repair (i.e. internal clamps), class 1 coating, class IV liner application, cathodic protection installations, or dig and replace of the pipe segment.

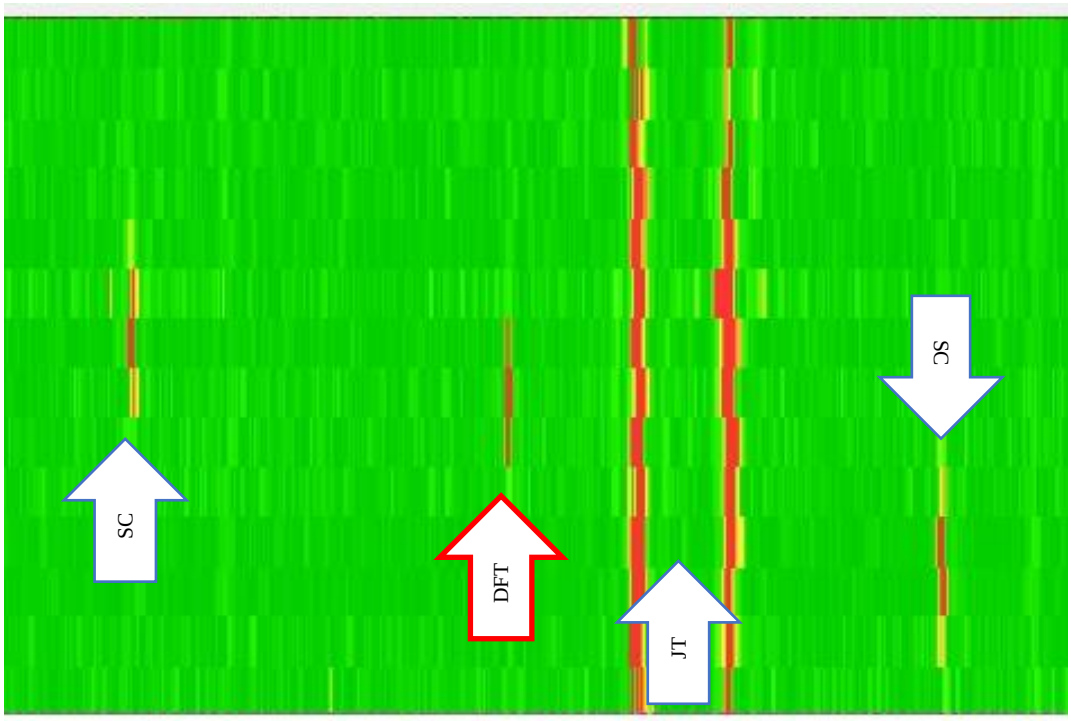

Figure 4: Simplified Detective assessment scan data, SC = Service Connection, JT = Pipe Joint and DFT = corrosion defect.

Figure 5 and Figure 6 below, show a defect in cast iron pipe as viewed concurrently by both the video camera and the RFEC probe. These simultaneous evaluation methods have the added benefit of helping to determine levels of internal vs. external corrosion.

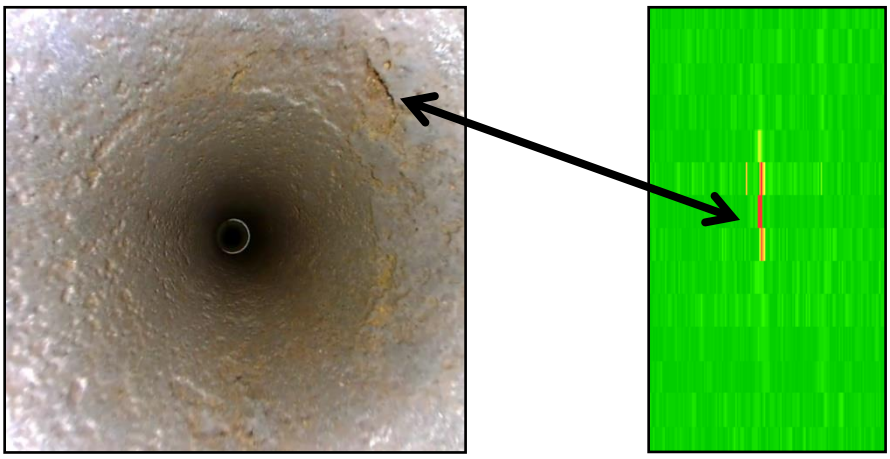

Figure 5: Video inspection of cleaned pipe showing corrosion defect

Figure 6: Probe assessment scan showing same corrosion defect

The figure below shows an example of assessment data as viewed on the laptop screen with a 50% through wall (TW) color threshold setting at which the data points turn red.

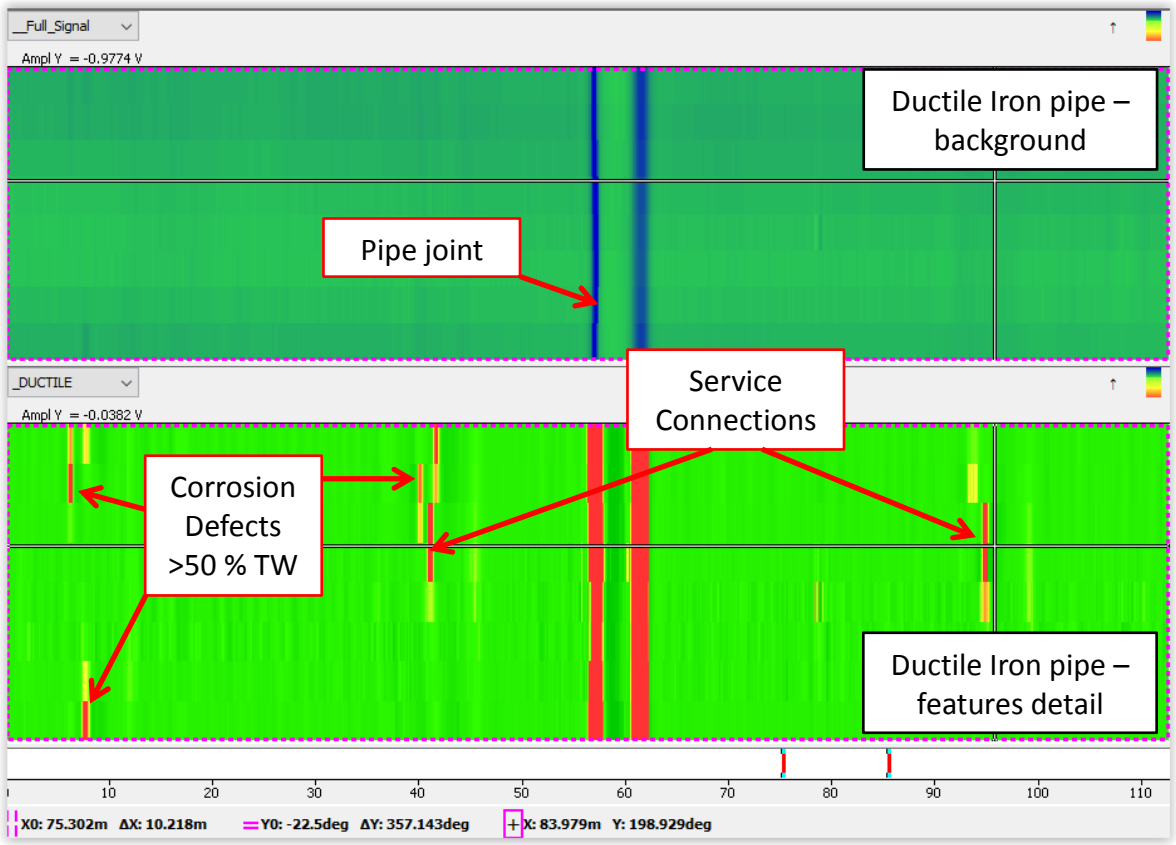

Figure 7: Assessment data as viewed on computer screen, 50% through wall (TW) threshold setting

The figure below is an example of assessment data that will be provided to the customer, indicated locations of joints and service connections.

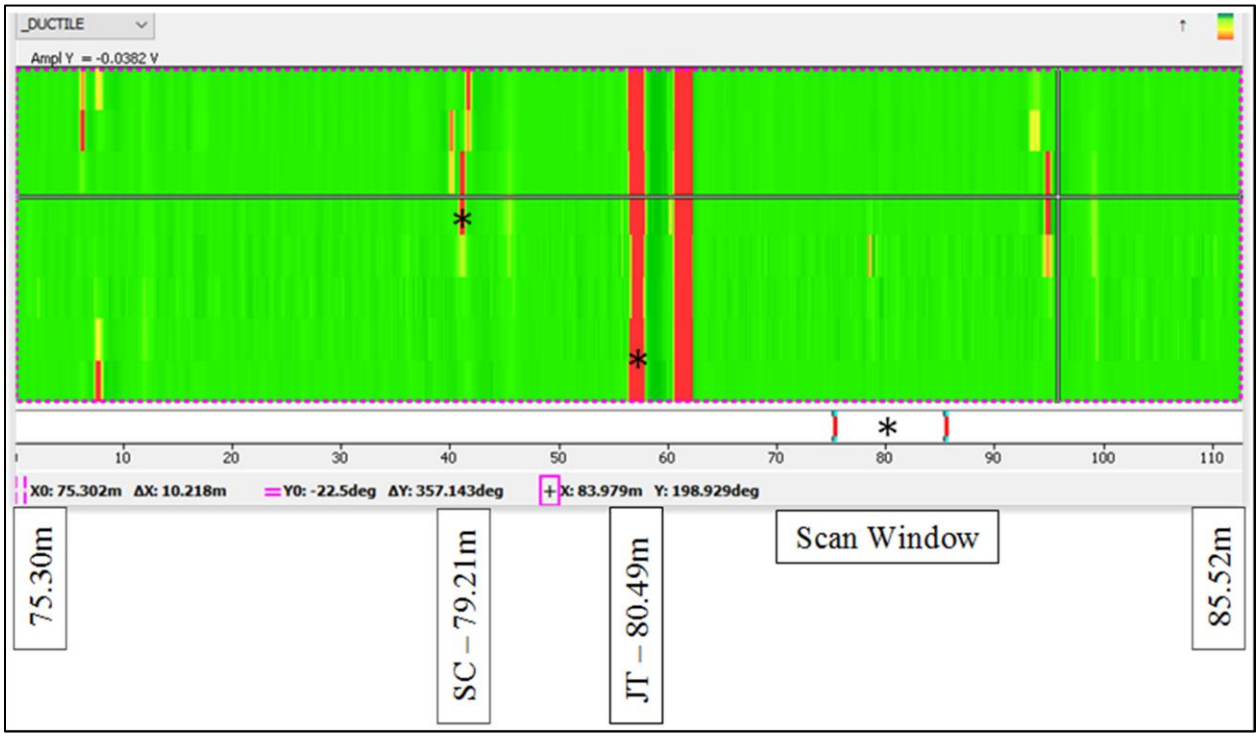

Figure 8: Scan data provided in PDF format

Included with the assessment data will be a video inspection log similar to that shown. The log is used to locate such features as service connections, joints, pipe conditions such as leaks that were discovered during the CCTV inspection. The video inspection and RFEC assessment data will be correlated by distance of features starting with 0m = start of pipe scan.

TOMAHAWK SYSTEM

Tomahawk™ System
Video Inspection Log

Project:_____ Company:_____

Pipe #:_____ From Near Pit #:_____ To Far Pipe #:_____ Date:_____

Inspector:_____ Cleaning Inspection: ☐ Lining Inspection: ☐

Video Log: Enter length of pipe (m): ☐

Enter Distance From Near End (m)	Distance From Far End (m)	Feature: Service Connect.	Joint	Hydrant Tee	Main Line Tee	Elbow/Bend	Pipe Wall	Repair Sleeve	Issue: Tuberculation	Pipe Defect	Leak	Lining Defect	Other	Description

Figure 9: Video inspection log form to be completed during CCTV inspection

Data Provided to Customer:

1. Color scan from assessment probe every 10 to 20m in PDF format, with distance of features shown, similar to figure 8.
    a. Defect severity criteria to drive color pallet.
    b. Service connections and joint locations to be labelled.
2. Video inspection log completed for each pipe section, similar to figure 9.
3. Video inspection file.

Current Specifications:

1. Pipe must be pre-cleaned and restored to full internal diameter.
2. Access pits are required and a minimum of 1.22m of pipe must be removed for access into pipe.
3. Pipe size: 150mm and 200mm, other sizes pending.
4. Materials (metallic): cast iron, ductile iron and steel.
5. Accuracy:
    a. 150mm pipe: ±15%
    b. 200mm pipe: ±20%
6. Minimum Defect Resolution:
    a. 150mm pipe: 12mm @ 60% through wall
    b. 200mm pipe: 15mm @ 60% through wall
7. Can navigate past service connection protrusion of 19mm and through up to 22.5° bends.
8. Speed through pipe: 5 meters per minute.
9. Maximum length of scan: 450 meters.