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**SCOPE OF WORK RECOMMENDATION OF: LEAK DETECTION ON RAND WATER PIPELINES
USING SATELLITE TECHNOLOGY- (RW10392960/21)**

PROJECT NUMBER : **OPEX**

PROJECT MANAGER: **Didier ILunga**

RECORD OF SCOPE OF WORK REVISIONS:

Date	Revision Number	Description of Each Revision
18 October 2021	0	Scope of Work Draft

TEAM MEMBERS

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1. PURPOSE

The purpose of this document is aimed at responding and seeking for approval of the project scope of work of a request for proposal for leak detection on Rand Water Pipelines using Satellite Technology. This is part of interventions taken by Pipeline Asset Management in terms of pipeline condition assessment and repair of leaking pipelines in the network. The objective of the project is to reduce water loss through leakage in Rand Water network, reduce the Non-Revenue Water (NRW) and restore the structural integrity of the pipeline material.

2. BACKGROUND

Rand Water is currently facing a continuous challenge of losing water due to leaks within its pipeline network. As a result, water leakage in distribution systems occurs for many reasons such as: age of pipes, working pressure in relation to design pressure, and pressure surges, quality of pipe materials, corrosion, excessive pressure, quality of installation, ground conditions and ground movement, vibration and traffic loading, depth of pipe installation, defects in pipes, damage due to excavation, poor quality of joints, ground conditions, incorrect back-fill and changes in temperature due to climate change. Common to all these is the development of a defect (holes, cracks and separation of joints) that provokes water leakage.

In addition, Rand Water is also experiencing serious problems with leaking and bursting of old steel pipelines, mainly, as a result of corrosion. It must be noted that corrosion has a very negative effect on the pipe integrity and lifespan of the pipe material, because it removes the material from steel pipes, thus reducing pipe wall thickness and creating leaks, which results in reducing of strength of the pipe wall over time. This has resulted in an increase in Non-Revenue Water losses, particularly avoidable potable water losses. Rand Water's avoidable losses are targeted at 4%, at most. However, the losses have almost doubled in recent times, currently losses are reported at 7%. Taking into consideration the current economic challenges and the fact that since 1990 South Africa has shifted from being classified as a water stressed (where its fresh water resources are between 1000m³ and 1700m³ per person per year) to a water scarce country (where its fresh water resources are less than 1000m³ per person per year). It is also understood that aging infrastructure and unaccounted for water losses pose a great risk to security of water supply.

It must be noted that, these challenges faced by Rand Water, as above-mentioned, which are

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related to the condition of its pipeline integrity, have a negative impact on the business in terms of revenue that is lost through Non-Revenue Water which has to be addressed in order to be reduced, as well as the pipeline lifespan that needs to be saved as the safe means of transportation of water in distribution systems. Strategies were put in place in order to protect the Rand Water core-business. Because of this, projects on leak detection and repair of leaking pipelines were initiated in order to address these challenges encountered by the business.

Rand Water management decided to conduct a pilot project through the Innovation Department, using satellite technology to detect leaks on a large scale of its drinking water pipelines. It must be noted that the Rand Water pipeline network spreads over a large geographical area and has a diverse range of pipe size, material and age.

Satellite leak detection is a new technological solution of detecting water leaks by analyzing spectral images captured by satellites and further processed using specialised algorithms or similar technology. This technology offered a rapid, cost effective, non-invasive and non-interruptive method for urban water leakage detection. Furthermore, the technology promised an efficient and accurate survey of the entire pipeline network at once which is innovative and a game changer. The technology may be used to monitor a large area of the water pipeline network and identify sites of leakages or potential leakages within a shorter period of time than that of currently available traditional technologies combined.

Traditional leak detection technologies used at Rand Water have not changed much in the last 30-40 years. During the last 10 -15 years, Rand Water has utilised more advanced technologies in the form of the Smartball and tethered Sahara system which are noted to have provided incremental improvement but still are largely limited due to operational changes that must be made on the pipeline, requirement to close off branch pipelines and the further limitation of only being able to do up to 10km sections per day. The cost of these technologies limit not only the area of coverage but also the desired outcome of deploying them in a cost effective manner. Using the Supply Chain Management (SCM) process, the project was issued as an open tender and the procurement strategy for the satellite pilot project provided for employing up to two service providers.

The results of the satellite technology offered from the pilot project indicate that the satellite leak technology can be useful in dealing with our aging infrastructure and reducing water losses resulting from pipeline leakage and as a result the technology was adopted and approved at Top

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Management Committee (TMC) held in December 2020 for roll-out at a scale that would cover the entire pipeline network.

The Strategic Asset Management Division under the COO portfolio was tasked with the responsibility of implementing a project of condition assessment for leak detection using satellite technology at a large scale to scan the Rand Water entire network and validate the identified leaks by pinpointing these on the ground using complementary leak detection acoustic technologies.

3. PROJECT AIM

The aim is to deploy satellite based technologies to detect leaks on Rand Water pipelines. The project aims to achieve the following:

- Satellite image to capture the entire Rand Water pipeline network at once;
- An algorithm is used for remote detection of probable locations of water saturated areas below the Earth's surface (soil saturation degree);
- The satellite radar image is done with SAR technology using L-band of a frequency of 1.3 GHz;
- One satellite radar image should cover the area up to 3500 square kilometers;
- Satellite radar image and analysis of the Area of Interest (AOI) detecting critical water saturation areas (soil saturation degree) in delivered GIS application with provided soil moisture map of ground saturation areas;
- The algorithm recognizes and removes all other hydrological phenomena: lakes, pools, drainage systems, water supply systems, sewage systems and other entities;
- Detection of probable water saturation locations with an accuracy of at least +/- 1m.
- Detection of probable water saturation locations on top soil of the earth's surface;
- Detection of probable water saturation locations as a result of water leakages from water supply systems recognizes the water leakages in the capacity of minimum 0.1 l/min;
- Indication of probable ground saturation locations in GIS application in different layers, analytical report in the form of GIS report, for each individual location;
- The GIS application is immediately available to Rand Water as a web application and as a smart phone application;

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- Training of Rand Water staff for the use of the delivered GIS application (GIS web portal and GIS mobile field application) will be fully (up to 5 working days training);
- The first scan of the entire network with the report and access to the GIS application with the analysis data within a maximum of 60 days from the signing of the contract.

4. PROJECT OBJECTIVES

The objectives of the project are as follows:

- Conduct a satellite scan of the entire Rand Water pipeline network;
- Provide an indication of the number of leaks identified on the scanned area;
- Leaks identified should be within a 1-meter distance on the identified pipeline;
- Identified leaks shall be validated using other complementary leak detection acoustic technologies;
- The complete project including the final report will be available within 4 months from date of appointment of the service provider.

5. SCOPE OF WORK

The scope of work consists of the following tasks:

- Conduct a leak detection on Rand Water's entire Pipeline Network utilising a Satellite Technology
- To provide leakage locations with pinpoint accuracy, regardless of pipe material or demographic density.
- Integrate and synchronise the results of identified leaks with Rand Water GIS system, Rand Water maintenance management system as applicable and /or Data Analytics Centre for continuous related data acquisition and analysis;
- The identified leaks should be within a 1meter distances on the identified pipeline; and the identified leaks shall be validated using other complementary leak detection technologies such as correlators or physical excavation.

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- The results of the project will be used to prioritise the leak repairs and to enhance network and hydraulic planning section at Rand Water.

6. KEY PERFORMANCE INDICATORS

Key performance indicators include the following:

- Satellite image to capture the entire Rand Water pipeline network in 1 day;
- Use of proven satellite technology using S wave (Secondary wave) type wavelengths;
- Ability to scan and detect probable leaks over the entire network within 2 months from contract sign-off.
- Generation of a leak report and imagery with the location of the leak(s);
- Validation of identified 200 leaks; and
- Integration of the information with the existing Rand Water GIS system.

The tangible outcomes and/or benefits of this project in terms of cost effectiveness (this may include the reduction in energy consumption, reduction in chemical usage, etc.) and provide quantifiable targets where applicable:

- Reduction of time to identify and repair leaks;
- Public perception that every avenue is being pursued by Rand Water to reduce water losses especially in the drought scenario;
- Non-interrupted supply: Infrastructure is in service whilst technology is being employed.

The intangible outcomes and/or benefits to Rand Water:

- Reputation improvements from perception that Rand Water is being a responsible operator;
- Training and skills development opportunities;
- Identification of leaks and enhanced risk profiling of pipelines;
- Facilitates and enhances planning.

7. PROJECT TIMELINES AND COST ESTIMATES

- Estimated Amount for the Satellite Leak Detection Project is R50 million per year, as a result, this will bring the total amount to the value of R100 million for a period of 2 years.

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- Operating Budgetary provision will be made under Special Projects for 2021/2022 financial for this work to commence in November 2021.
- The procurement processes will be concluded in this financial year (2021-2022) to ensure implementation starts in November 2021.

8. RECOMMENDATION

It is therefore the scope of work for the Leak Detection on Rand Water Pipelines Using Satellite Technology be approved by stakeholders in order to source the service provider via Supply Chain Management processes to provide services to Rand Water for a period of two years.

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