n:

: scans wall from side to side, top to bottom, and receiving a radar signal every 0.5 to 1 f rotation. Depending on the size of the Scan full scan can take from approximately two o fifteen minutes. At each point on the wall the capable of detecting sub millimetre scale on. The SSR is placed in front of the wall that ıonitored. Data is transferred via a radio link to ry monitoring point (PMP). At the PMP data is and used to trigger deformation alarms using viewer suite software.

:

l **Safety:** It enables safe evacuation of people and equipment of the optimal point in time prior to the ırring.

d **Productivity:** Geo technical, Mining and engineer can make more informed and quick decision with information provided by the SSR.

output in risk area: Its provides precise and nformation on rock mass acceleration, which ning in high risk areas that otherwise could not be

Management of wet weather risk: The impact nts on slope stability and production can be more ıitored through the provision of enhanced feedback SR.

Mine Design & Ground Support: Mines have improved their return on investment as a result of the designed angle of the pit, whilst maintain safe ırough continuous SSR Monitoring.

Pit Life: SSR Monitoring in Conjunction with : management has enabled deeper pits, which prior yment of a SSR would not be possible.

ɔn:

ı of Slope Stability Radar (SSR) with visual imaging system gives a real time of displacement of strata or dumps well in f any failure and provide mine management ime to safely withdraw men and machinery ɔrone areas. SSR would not only increase : also the productivity and efficiency of perations.

Other Information related to installation and commissioning of SSR at Amod (G-19 Extn.) Lignite Mine:

Date of Installation & Commissioning: 10 March 2018

Installation & Commissioning By:

Sujyoti India (P.) LTD.
NEXUS point 2nd Floor,
Vidhan Bhavan Square,
Civil Lines. Nagpur 440 001
Ph: 0712-6653333
E- Mail: info@suiyoti.com

Installation & Commissioning during the tenure of:

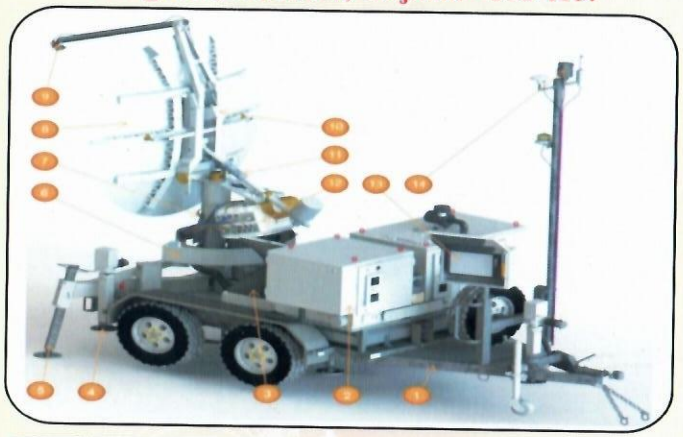
1. **Nominated Owner, GMDC Ltd, Ahmedabad:**
   Shri Arun Kumar Solanki (IAS); Managing Director
2. **Dy. Director General of Mines Safety (NW Zone):**
   Shri Narayan Rajak
3. **Director of Mines Safety (Surat Region) :**
   Shri Ramawatar Meena
4. **Sr. General Manger (LP), GMDC Ltd, Ahmedabad:**
   Shri A L Thakor
5. **General Manager (LP), GMDC Ltd, Ahmedabad:**
   Shri A K Makadia
6. **Agent and Manger, Amod (G-19Extn) Lignite Mine:**
   Shri Swagat Ray

SLOPE STABILITY RADAR (SSR)

(World's best Practice for Critical Slope Monitoring)

AMOD (G-19 EXTN.) LIGNITE MINE

Lignite Project Rajpardi, GMDC Ltd.
Jhagadia, Bharuch, Gujarat - 393 115.



S. No.	Name of the Components
1	Trailer
2	Power supply
3	Toolbox
4	Electric jacks
5	Tripod legs
6	Energy chain
7	External circulator
8	Dish antenna
9	Feed horn
10	Visual Capture
11	Elevation Actuator
12	Radar Electronics Module (REM)
13	User Interface
14	Weather Station

- **Improved Safety**
- **Improved Management of wet weather risk**
- **Increased Productivity**
- **Improved Mine Design & Ground Support**
- **Increase output in risk area**
- **Increased Pit Life**

nd:

·19 Extn.) Lignite Mine, Lignite Project f M/s GMDC Ltd is operated at a working ;0m to 150 m range. Geological formation e consists of top soil (3m-5m), Silica sand ı), ball clay (3m-6m) and Lignite (4m-6m). is highly charged with water and thus the ɛpage is very huge. Further due to flow of Nalla" (NE side), "Karjan canal" (SE side) decha nallah" (N) surrounding the mine, gh rate of make up of water inside the pit draulic gradient and that gets trapped in led dump . The floor of the mine is friable fails to withstand the cumulative load of dump. Owing to such adverse geotechnical Amod (G-19 Extn.) Lignite Mine had d dump slope failure 04 (four) times since its rom 2007. However, it is a matter of great ıd relief that there are no loss/harm to s and machineries till date because of such ; occurrences.

ɔnal method of monitoring of sides ɔ slope:

re does not occur at a stance. Some of the ıing signs of slope instability are tension, normal water flows, bulges or creeps and the toe. Conventional monitoring methods n regular surveying of the sides and slopes ıches and dumps using the most modern ɜtruments and associated software. This ovides displacement information only for a . Indication of multiple site displacement be monitored with conventional method /hich dump failure may get unnoticed.

Step Forward:

With reference to the DGMS (Tech)(S&T), circular no. 2 of 2010 and DGMS (Tech) circular no. 8 of 2013 and instruction issued by Director, Mines Safety - Surat Region regarding installation of suitable slope monitoring system for real time monitoring of displacements of strata and dumps well in advance for ensuring timely withdrawal of men and machinery in case of any impending slope failure. In line with the statute, GMDC management responded very quickly to install one Slope Stability Radar (SSR) in Amod (G-19 Extn.) Lignite Mine which is first of its kind in India in Lignite Mines. The installation of SSR at Amod (G-19 Extn.) Lignite Mine took place on 10th March 2018 and prior to that such installation took place in 6(six) mines of other minerals in India and 449 worldwide. SSR is the latest technology for critical slope monitoring in mining sector.

Introduction of SSR:

Slope Stability Radar (SSR) is best practice technology used to measure and monitor the stability of rock walls and slopes. As a measuring instrument, it is an invaluable tool assisting geotechnical engineers and specialists in geotechnical planning and tracking, while also helping with decision making and managing risk.

SSR Measurement Technique

The technique that makes slope stability radar work is Interferometry. It's a differential phase based technique used to measure small changes in the range of the wall surface. The SSR transmits a signal to the wall, which is reflected. The SSR now has a reference for the wall's position. The wall may then move up to several millimetres due to a failure. The SSR transmits and receives another signal, and compares it to the previous one. The change in phase between the two signals is

Inverse Velocity Method - How to predict the time of Failure?

Predicting the time of failure is a topic of major concern in the field of geological risk management. Several approaches, based on the analysis of displacement monitoring data, have been proposed in recent years to deal with the issue. Among these, the inverse velocity method surely demonstrated its effectiveness in anticipating the time of collapse of rock slopes displaying accelerating trends of deformation rate.

Specification:

Make : Ground Probe (unique measurement System) Brisbane, Australia
Model : SSR 450 XT
Weight : 1900Kg
Width :2056M
Length :4.32M
Dish Dia.: 1.80M
Operating Temp. : 25^0 to + 55^0 C
Storage Temp. : 40^0 to +80^0 C
Altitude : 0 to 5000M
Humidity : 5% to 99%
Rainfall : 0 to100mm/h
Wind Gust : Up to 88km/h
Wind Speed : up to 160km/h
Angle of view:
Horizontal :270^0
Vertical :100^0
Operating Range : 50M to 35000M
Detectable Area :
At 50M : 0.3MX0.3M Failure
At 3500M : 30.5Mx30.5M Failure
Measurement precision : ±0.1mm
Pixel Angular Dimension : 0.5^0
Power Supply:
In- built 12 Volt DC Generator/Batteries or
100-250 volt AC at 50-60Hz.
Operating Frequency : 9548.5 MHZ