

Leica Geosystems **TruStory** Slope Monitoring at Adaro Tutupan Coal Mine/Indonesia



Tutupan mine is one of the largest open cut coal mines in Indonesia, situated in the South Kalimantan province 300 km from Banjarmasin. The mine has a total coal production of over 40 million tons per annum. The Tutupan's pit dimensions are approximately 16,000 x 2,500 x 250 m.

The Adaro Tutupan mine is a long standing customer, having used Leica Geosystems monitoring sensors for slope monitoring since June 2004.

Currently, 11 Leica Geosystems total stations with hundreds of monitoring prisms are installed in the pit slopes to perform slope stability monitoring. The monitoring prisms are installed on the slope surface with intervals of 100-150 m and the process of installing many more prisms to cover all the pit slopes is ongoing. The total stations measure distances between 800 and 2500 m in a nearly continuous measurement cycle.

In addition, six meteo sensors are installed within the mine, automatically measuring atmospheric conditions and changes. In order to receive reliable measurement data, the total station slope distance measurements need to be corrected with the calculated PPM.

Radio devices (Mikrotik 2.4 GHz) are used for data communication between the Leica GeoMoS Software in the main office, all total stations, and the meteo sensors. Each instrument uses a ComServer to convert the RS232 feed from total stations and meteo sensors into RJ45/IP for radio communication.

Leica GeoMoS monitoring software controls the total stations and the meteo sensors. As a result of using GeoMoS, the customer receives long term monitoring deformation of the pit slopes.

The monitoring data is used for the study of slope stability for the monitored areas to protect work-



■ Scope/Objective

Monitoring the open cut coal mining slopes' deformation to predict the time of slope failures and to protect personnel and equipments from slope failures

■ Customer/Institution

Adaro Indonesia, South Kalimantan, Indonesia

■ Challenge

Continuously operate the complete system within immediate distance to the excavation

■ Date

Project started in June 2004

■ Location

Banjarmasin, Indonesia



■ Project Summary

Instruments

Leica TM30 Monitoring Sensor
Leica TCRP1203 Total Stations
Leica TCRA1201 Total Stations
Leica Geosystems Monitoring prisms
STS DTM Meteo sensor

Software

Leica GeoMoS Monitor
Leica GeoMoS Analyzer

Communication

Mikrotik 2.4 GHz Radio Modem

Office

Leica GeoMoS

ers and equipment and to research the slopes' 'behavior', especially the failure history.

Due to the variations of soil/rock types inside the excavation area, studies to obtain accurate deformation level limits are in a continuous development process, carried out by the surveyors responsible for the monitoring data and by geotechnical engineers. The geo-technical engineers and surveyors also estimate the time of failure of the mining slopes using the "Inverse Velocity" analysis. The time of failure is a very important indicator used to predict collapse of the slopes that have accelerating trends in deformation/velocity.

In addition, the automatic monitoring measurements are an essential data set to verify geotechnical assessments or recommendations made by production engineers.

Since the monitoring system has been installed, the geodetic and geotechnical sensors controlled by the monitoring software have been able to detect some slope failures in advance. The experience that was gained due to these events is now applied to limit levels for the measured deformations of the pit slopes.

To perform nonstop, 24-hour slope space stability activities in the mine, the monitoring crews run three shifts to ensure the delivery of real time slope stability information to the responsible staff. The main challenge of this huge monitoring project is to maintain, for example, the data communication and to schedule service times for the installed equipment.

Besides geodetic sensors (total stations with meteo sensors) and

■ Benefits

- 24 hour slope stability monitoring to protect personnel and equipment from slope failures
- Predict time of failure
- Optimize the excavation

the Leica GeoMoS monitoring software, the Adaro mine also uses geotechnical monitoring sensors such as inclinometers, crackmeters and of course visual inspection/monitoring. Combining all variations of monitoring methods/technologies increases the reliability and accuracy of the deformation data. Responsible slope engineers gain confidence when two independent measuring technologies indicate the same measurement results. Nevertheless, a final visual inspection is done before large-scale actions are taken by the engineers.



A combined power supply station with a solar panel is used for data transmission to the main office for data analysis (top).



Several High-Precision Leica Geosystems total stations are used to monitor the slopes of the Adaro Tutupan Coal Mine (left).