# Automation in Mining: Underground project

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Underground copper mining project
The mining site

Produce
- Copper. The world’s second largest copper reserves.
- Gold. The world’s single largest known gold reserve.
- Uses open-pit mining but needs to convert to underground mining in the Deep Ore Zone.

Location
- Papua Province, Indonesia

Reserve Base
- 2.8 Billion tonnes
  - 1.09 % Copper
  - 0.98g/t gold
  - 3.87g/t silver.

Mining
- Includes drilling and blasting, loading and hauling ore, and crushing to produce copper ore.

Processing (Concentrator Plant)
- Includes grinding, flotation, and dewatering to produce copper concentrate.
Underground copper mining project
The Project

**Project Scope:**
Delivery of Process- and train control system and Traffic Management system including electrical and software design, manufacturing, delivery of workshop tested equipment, simulated software applications and commissioning on site.
- Process Control System is Siemens PCS 7
- Interface (HMI) the Bombardier train safety & management control to PCS 7
- Catenary and rectifier stations are delivered by Siemens
- All equipment is workshop tested and all applications are simulated
- FAT (factory acceptance test) prior to delivery
- Time line – from conceptual to implementation: 3 years

**Three projects – Three Control Rooms:**
- Block Cave
- Deep Mine Lower Zone
- Common Infrastructure Project
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Block Cave
Project overview

Block Caving

- Block caving is a highly resource-efficient method of underground mining, in which large underground ore blocks are cut from beneath, allowing the ore to collapse under its own weight.
- After collapsing, ore is drawn through draw points and conveyed to a crusher.
- Block Cave haulage level will produce 160,000 ton per day at peak production.
- Driverless trains are remotely loaded from a central control room at the surface. After loading they are automatically sent to one of the 3 unloading stations.

Project Scope

- Electrical and software design.
- Manufacturing and delivery of equipment.
- Commissioning of the process and train control system for remote loading, transport and unloading of gold and copper ore.
Block Cave
Project overview

Haulage level layout
- 20 Chute galleries with a total of 121 loading points
- 3 Unloading stations
- 11 production trains
- 5 service locomotives
- 28 km rail
- Overhead catenary system 750 VDC with 3 rectifier stations
- Service shop for locomotives and wagons
- CCTV system for monitoring, surveillance and remote loading with a total of 220 cameras
- The central control room for monitoring and remote control is located on the surface. Integrated with adjacent systems
- The control room for maintenance access is located underground
**Block Cave**
Overview Process- & Train control system

- **SIMATIC PCS7**
  - Process Control System
  - One common operator interface for Process & Train Control

- **Bombardier**
  - Train Control
  - Derailing Sensors
  - Points & Derailers
  - Profile Detectors

- **Object Control Cabinet**
- **Weigh Bridges**
- **Gates & Barriers**
- **ATP / ATO**
  - On train
- **CCTV**
  - On train
- **Equipment in:**
  - Chute Galleries
  - Unloading Stations
  - Service Area
  - MCC, VFC, UPS, CCTV, Field Equipment

**Equipment**
- Siemens supply
- Bombardier supply
- Other 3rd party supply
- Siemens/3rd party supply

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Page 9 November 2016
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Block Cave
System and network layout

**Surface Control Room**
Redundant SIMATIC PCS7 systems
- Profinet communication
- Redundant Terminal bus for Siemens PCS7 connections of servers and clients
- Redundant Plant bus for Siemens PCS7 connections of all automation stations
- All networks use Siemens Scalance intelligent Industrial switches (Redundancy capability)
Block Cave
System and network layout

**Underground**

- 46 AS Siemens SIMATIC S7-410-5H CPU (when fully expanded)
- Redundant Profinet communication for local Siemens AS connections to I/O-nodes and OP-panels
- Double redundant WLAN communication with Siemens access points using iPCF
  - Rapid roaming
  - iPCF = industrial Point Coordination Function
    - Each Profinet IO device can respond within its cycle time on the Profinet IO controller
- Primary redundant antenna system
- Secondary redundant antenna system
- Automatic selection of the antenna system
- Integration of Sandvik Rock Breakers.
  - Sandvik has their own controller but it can handle only 4 crushers.
  - PSC 7 can remotely control all 121 crushers from any operator desk
Block Cave
System and network layout

**Media Network**
- Redundant media network
  - Above ground
  - Underground
- ProfiNet communication
- Siemens Scalance intelligent industrial switches (Redundancy capability)
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Deep Mine Lower Zone
Project overview

- The haulage level will produce 80,000 ton ore at peak production using trucks for transportation of the ore from loading to unloading on the haulage level
- Central control room for remote control and monitoring, remote control desks for rock breakers, loading of trucks and CCTV monitoring
Deep Mine Lower Zone
System and network layout

Surface Control Room
- Redundant SIMATIC PCS7 systems
- ProfiNet communication
- Redundant Terminal bus for Siemens PCS7 connections of servers and clients
- Redundant Plant bus for Siemens PCS7 connections of all automation stations
- All networks use Siemens Scalance intelligent Industrial switches (Redundancy capability)
Deep Mine Lower Zone
System and network layout

**Underground**
- 18 AS Siemens SIMATIC S7-410-5H CPU (when fully expanded)
- Redundant Profinet communication for local Siemens AS connections to I/O-nodes and OP-panels
- Integration of Sandvik Rock Breakers.
  - Sandvik has their own controller but it can handle only 4 crushers.
  - SIMATIC PSC 7 can remotely control all crushers from any operator desk
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Common Infrastructure Project
Traffic Management System

- Ensuring safety for traffic
- Handling busses at shift change.
  - 300 people in/out every shift
  - 60 people per bus
- Handling trucks for material deliveries and light vehicle traffic.
- Controls two parallel tunnels for transport in and out from Ridge camp at the surface to 3 underground mines
Common Infrastructure Project
System and network layout

Surface Control Room
- Redundant PCS7 systems
- Profinet communication
- Redundant Terminal bus for Siemens PCS7 connections of servers and clients
- Redundant Plant bus for Siemens PCS7 connections of all automation stations
- All networks use Siemens Scalance intelligent Industrial switches (Redundancy capability)
Common Infrastructure Project
System and network layout

**Underground**
- 2 AS Siemens CPU410-5H
- Redundant ProfiNet communication for local Siemens AS connections to I/O-nodes and OP-panels
Underground copper mining project
SIMATIC Manager

Applications and interfaces
- SIMATIC Manager
- PCS7 – Control Module Types
- Asset Management (Maintenance Station)
- Process Historian
- WebServer and WebClient
- ProfiNet
- SafetyMatrix
- TIA – S7 and Panels
- Managers for Chute Control Desks (Remote loading) and Crusher Control Desk (Remote control of crushing robot)
- Integrated CCTV system
- Train control Interface
- Mine Site Interface
- Mine Gem Interface
- MIS Interface
Underground copper mining project
Operator stations remote control

Chute control desk
Crusher control desk
Underground copper mining project
Stainless steel E-house
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Conclusion
Siemens is the better partner for Automation in Mining

**Proven automation concept**
- Minimised production loss during the transition
- References at other underground mining facilities - LKAB Sweden.
- Project in cooperation with Midroc, a Siemens certified Mining Automation Solution Partner

**Safety & Security**
- Safety Matrix software connects the machines to SIMATIC PCS 7
- All is monitored remotely from the control room.
- SIMATIC PCS 7 is the only DCS that is TÜV certified for cyber security

**Siemens, a proven supplier in mining**
- Customer has Siemens Gearless Mill Drives
  - SAG mill 2 uses SIMATIC PCS 7 DCS
  - SAG mill 1 is in the process of converting to SIMATIC PCS 7
- Customer is using Siemens instrumentation (Level measurement on flotation)

**According to the Project Manager**
- “The goal is to implement every new project in a better and more efficient way than the last, and I already feel that we have taken the next step in terms of our new project here in Indonesia”
Thank you

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A wireless future for industry

IWLAN in real time

If a wireless solution for an application with real-time requirements is desired, for example, based on Profinet IO, Siemens turns to the iPCF (industrial Point Coordination Function) extension for the Scalance W700 portfolio, which ensures that each Profinet IO device can respond within its cycle time on the Profinet IO controller. Using a polling method, the access point cyclically queries each client module in its radio cell at very short intervals, and the transmission of information that is not time-critical is postponed until free cycle time is available again. This method ensures the communication in this radio cell.

WLAN for freely movable clients

Applications with freely movable wireless network devices, such as an automated guided transport system or a Simatic Mobile Panel 277F IWLAN, can make use of the iPCF-MC (industrial Point Coordination Function–Management Channel) extension, which also functions according to the polling method. iPCF-MC requires the use of an access point with two radio interfaces, known as a dual access point. One of the interfaces is used for exchanging data between the client module and the access point, and the second is used to send (broadcast) administrative messages. The second radio interface of each access point transmits on the same radio channel – called the management channel – and is setup so that the client modules can simultaneously receive administrative information from all access points within range, as soon as they are not participating in a data exchange. The wireless network node determines the best access point to connect to, based on the information received.

At a glance

- iPCF (industrial Point Coordination Function): Each Profinet IO device can respond within its cycle time on the Profinet IO controller.
- iPCF-MC (industrial Point Coordination Function–Management Channel): An access point with two radio interfaces (dual access point) is used.
- iREF (industrial Range Extension Function): Three different radio areas can be covered within a cell with three different antennas.
- Dual Client: Two client modules are connected in parallel with an Industrial Ethernet node.