Co-innovating tomorrow®

YOKOGAWA

Solutions to Boost Your Profitability

Mining, Mineral Processing and Metals

THE YOKOGAWA PHILOSOPHY

As a company, our goal is to contribute to society through broad-ranging activities in the areas of measurement, control and information.

Individually, we aim to combine good citizenship with the courage to innovate.

GLOBAL OVERVIEW

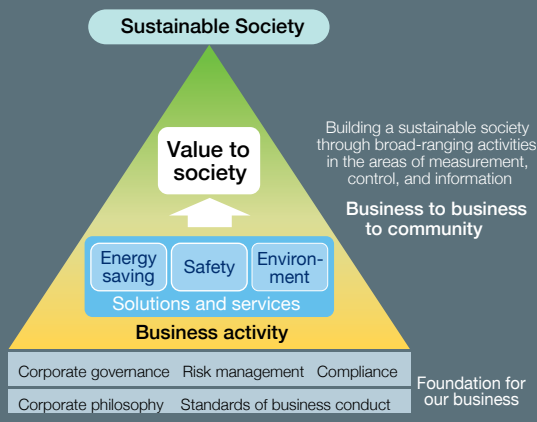
Corporate Data*

Corporate Name	Yokogawa Electric Corporation
Chairman & Director	Shuzo Kaihori
President & CEO	Takashi Nishijima
Headquarters	2-9-32 Nakacho, Musashino-shi, Tokyo 180-8750, Japan
Founded	September 1, 1915
Incorporated	December 1, 1920
Paid-in Capital	393.14 million USD
Number of employees	18,329 (consolidated) 2,537 (non-consolidated)
Subsidiaries and Affiliates	99 Overseas, 13 Japan

**As of March 31,2017*

YOKOGAWA MIDDLE EAST & AFRICA (YMA)
Local partnership, Global capabilities

Company name:	Yokogawa Middle East & Africa B.S.C. (c)
President and CEO:	Hideki Matsubayashi
Regional Headquarters:	PO Box 10070, Manama, Kingdom of Bahrain
Founded:	15 May, 1990
No of staff:	1500 (Highly-skilled multinational workforce)
Profile:	Process Control and Automation Solutions provider. Activities include Sales, Project Execution, Engineering, Sub-assembly, Manufacturing, Integration, Startup & Commissioning, Electrical and Instrumentation, After-sales service support (Lifecycle Agreement, Spare parts warranty management and Training), R&D, and participation in Human Capital Development Initiatives for Local Nationals
Middle East & Africa Network:	7 Affiliate Companies; 8 Engineering Centres, 23 Sales/Service offices and 11 Training Centres.



Quality in every aspect begins with the mind

GLOBAL EXPERTISE DEPLOYED LOCALLY

In order to provide the best support locally, Yokogawa has established 7 affiliate companies and 8 engineering centres in the region as follows:

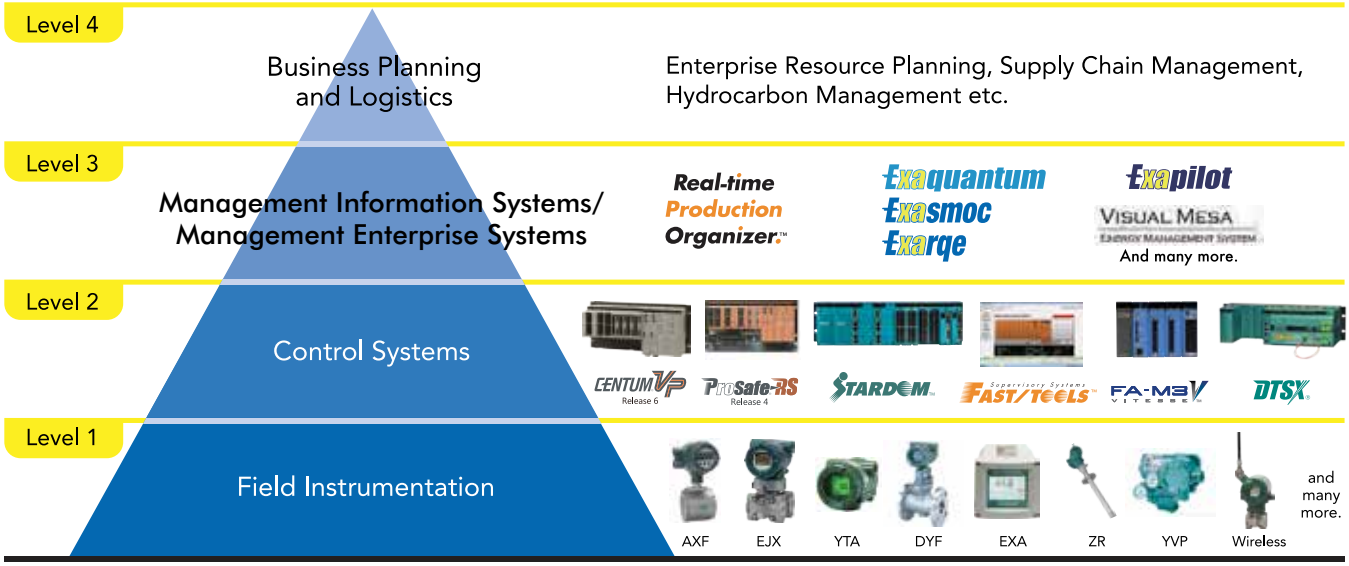
- Yokogawa Middle East & Africa – Abu Dhabi: A large scale Engineering Centre, FSM certified, for project execution and engineering.
- Yokogawa Saudi Arabia Company: for project execution, engineering, sub-assembly and research & development,
- Yokogawa Services Saudi Arabia Company: for after sales services, Training and Electrical & Instrumentation Construction work
- Yokogawa Engineering Middle East & Africa FZE - Jebel Ali Free Zone, UAE: for project execution and engineering.
- Yokogawa Engineering Bahrain (S.P.C): A large scale Engineering Centre, FSM certified, for project execution and engineering.
- Yokogawa South Africa (Pty) Ltd: for project execution and engineering.
- Yokogawa Nigeria Ltd

Yokogawa has a state-of-the-art Regional Response Centre headquartered in Bahrain which supports the service teams based in the following locations

- Al-Jubail, Dhahran, Yanbu, Rabigh & Udhailiyah in Saudi Arabia
- Abu Dhabi and Dubai in UAE
- Doha in Qatar
- Muscat, Sohar and Sur in Oman
- Kuwait
- Cairo in Egypt
- Basra in Iraq
- Johannesburg, Cape Town and Durban in South Africa
- Lagos in Nigeria
- Luanda in Angola
- The Republic of Congo
- Tunisia
- Algeria
- Kenya
- Zambia

BUSINESS OVERVIEW

Sensor to Enterprise Integration



INSTRUMENTATION

DATA ACQUISITION & RECORDING

Recorders & Data Acquisition Systems: SMARTDAC+

- GX, GP, GM, DX, FX Series Recorders & Data Acquisition Systems
- Smart User Interface, Smart Architecture & Smart Functionality.
- Modular Construction with Max. 100 channels per recorder.
- Multi-touch screen with zoom function
- Access to the history with single finger swipe
- Write freehand messages directly on the screen
- Generate Custom Reports.
- Inputs / outputs units up to 1000 channels for DAS
- Compliance with FDA and NADCAP standards

Controllers: UT Advanced temperature controllers

- Powerfull and simplicity Balance with 8 control algorithms
- Universal measurement inputs and control outputs (4-20mA, voltage, pulses)
- PID automatic tuning function
- Automation functions programming by LADDER
- Networking possibilities, Ethernet, RS485, Profibus-DB

Controllers: YS Series Single Loop Controllers

- Suitable for Power plants, Refineries, Chemical, Petrochemical, Sugar, Cement, and steel plants.
- Excellent legibility thanks to a full-dot, semi-reflective color LCD
- Offers the new GUI-based programming method.
- Powerful control and calculation functions with large programming capacity
- Nonvolatile memory for memory backup
- Fail-safe operation: Display and Manual operations are enabled even during a failure of either CPU.
- Select single-loop, cascade, or selector control without programming hassles.

LIQUID and GAS ANALYSERS

Transmitters measuring pH, conductivity, inductive conductivity, dissolved oxygen: FLXA202

- Modular design helps to replace sensor modules as per required measurement
- Dual sensor Input
- HART, Profibus or Fieldbus® Communication protocols for wide range of industrial environment
- Corrosion Resistant Aluminum enclosure with urethane or epoxy cover
- Touch screen with friendly and simple interface

SENCOM

Sensors and Electrodes

- Comprehensive range of sensors, holders and cables for pH, ORP, Conductivity, Inductive Conductivity and Dissolved Oxygen
- Heavy-duty construction for harsh environments
- FU20 All-In-One SENCOM® pH/ORP digital smart sensor with built-in intelligence & direct digital communication ensures quick and convenient maintenance & calibration
- Contact Conductivity cells for high/pressure temperature measurement up to 250C/40 bar
- PFA Inductive Conductivity sensor enables accurate concentration measurement for a range of acids & bases (H2SO4, NaOH, HCl, etc.)

Tunable Diode Laser Spectroscopy Analyzer TruePeak: TDLS 8OOO

- The TDLS 8OOO TruePeak Tunable Diode Laser (TDL) Analyzer is capable of measuring a number of near-infrared absorbing gases in harsh process environments.
- Able to make measurements under very challenging high temperature and pressure conditions as well as environments containing many corrosive, aggressive, and high particulate content materials, the TruePeak analyzer is one of the most robust process analyzers available.
- Combustion optimization for O2 and CO Values

Zirconium 02 Analyzer

- Process Temperature ranges from - 700°C to 1400°C
- Option of direct and remote mounting, with ATEX certification
- Self-diagnostics with predictive calibration
- 4-20 analog output with HART Communication

FLOW METERS

Mass Flow meters: ROTAMASS Total Insight

- A special detector coupling system makes the device highly independent from external loads or vibrations
- Advanced Diagnostics: Automatically detecting corrosion, clogging & gas presence
- Independent of mounting recommendations
- MID approved, 3A and EHEDG (for transaction counts, approval for weight and volume)
- Measurement Range from 0 to 5000 kg/min (500 t/h)
- Process Temperature range from - 200°C to 350°C
- Density measurement accuracy: +/- 1 g/l
- SIL2 certified for safety applications

Magnetic Flow meters: ADMAG Total Insight

- Advanced dual frequency excitation Method achieves stable measurement, zero stability and quick response
- Available with 2 or 4 wire options
- Wide range of coatings, electrodes and process connections
- Size option from DN2.5
- Minimum conductivity of 1mS/cm even with DM water
- Advanced diagnostic of Electrodes clogging detection
- SIL2 Certified safety applications

Variable Area Flow meters: ROTAMETER

- Original since 1905
- Material of construction with Glass tubes, plastic or metal
- Proven robust construction
- Qualified float blocking detection system

Vortex Flow meters

- High stability at Low-flow
- Immunity to pipe vibrations
- Reduced pipe Straight length (5D upstream / downstream minimum)
- Robust construction characterized by one piece design
- Process Temperature ranges from - 200°C to 450°C
- High Pressure Version up to DN400
- High accuracy Multivariable Version

PRESSURE & TEMPERATURE

Pressure, Differential Pressure and Lvevel Transmitter

- Guaranteed Long-term stability of 10 years without calibration
- Digital Cell outcome in liaise with atomic clock
- Wide Pressure measuring ranges from 0-700 Bar
- Differential pressure measurement output with compensated static pressure
- SIL2 Certified for all safety applications
- Multivariable transmitter with mass flow measurement
- High Accuracy of 0.025%
- Digital Remote Seal for Level measurement on tanks

Temperature Measurement

- Process Connections with clamp, flanged or screwed type
- Body with Aluminum and Stainless steel construction
- Integral and Remote version of transmitter
- With or without display
- Dual input sensor with HART 7
- SIL2 Certified safety applications
- Digital Accuracy class up to 0.02%
- Advanced Diagnostics to detect Sensor degradation
- High Accuracy with transmitter sensor matching function

Wireless Measurement Solutions

- Wireless ISA100.11a protocol
- Direct measurement of temperature and pressure
- Multi Protocol Wireless adaptor to convert 4-20 HART, DI/DO & pulse into Wireless ISA 100.11a
- Transmission distance up to 2400 m
- Lowest update rate time of 0.5 sec
- Battery life up to 10 years
- Field Gateway with Full redundancy option

CONTROL SYSTEM

DISTRIBUTED CONTROL SYSTEM (DCS)

Manufacturers today require a high degree of certainty and confidence to achieve timely production, as well as the flexibility to make changes in product and material specifications. This enables them to effectively respond to intense global competition and major market shifts.

CENTUM VP is Yokogawa's latest integrated production control system, also known as a distributed control system (DCS). Nearly 40 years of knowledge and experience with DCSs has gone into its development.

Yokogawa has added significant new capabilities to CENTUM VP. The enhanced CENTUM VP becomes the platform for delivering four new innovations; Hyper-intuitive Operation, Total Automation Management, Intelligent Plant Conductor, and Sustainable Plant Operation.

CENTUM VP R6 assures plant operators of an optimum engineering environment spanning the entire plant lifecycle, from plant design and the engineering and installation of systems and devices to the start-up of production, maintenance, and renovation.

CENTUM VP R6 features an exciting expansion of Yokogawa's lineup of I/O devices with Smart Configurable IO and introduces crucial new control system components. Combined with an intuitive engineering environment, it dramatically reduces the time required to configure and install a control system.

This engineering platform, combined with the new generation of the universal inputs/outputs N-IO and Commissioning tool called FieldMate Validator provides increased flexibility in the implementation of projects to improve the quality and productivity while reducing the risks in project delivery.

It is accompanied by a support and a long-term service program to ensure a high level of functionality throughout the system life cycle and offers lowest Total Cost of Ownership.

Distributed Control System: CENTUM VP

- Suitable for conducting real-time processes
- True Global Distributed architecture
- Intuitive and user-friendly HMI with guaranteed 1 sec graphic update and refresh rate
- The World's First 1 Giga-bit fully Deterministic and Real-time Control Network
- Alarm Management System compliant to EEMUA191 and ISA-18.2 standards, integrated Alarm window for DCS, Safety and Asset Management System
- Wide protocol support based on OPC, Modbus, Ethernet, Profibus, FF, ISA100.11a etc.
- In-built Test function and Simulation capabilities
- Unique Pair and Spare Technology with special diagnostics and unprecedented reliability
- High availability process controller, Seven 9's (99.99999) hardware availability
- Redundancy at all levels (communication bus, CPU, I/O module), autonomous control stations
- Supports Smart Configurable IO Modules which reduces project schedule by decoupling of Application
- Development & Hardware design,
- Smart IO concept eliminates Marshalling and reduce overall system Footprint and Cost
- Enhanced Engineering Environment ensures consistent Engineering Information and data Integrity, manage Change and support Automation Lifecycle
- Supports Independent Field Wiring check without actual System Hardware, HMIs or Controllers
- Certified Marine Standards ABS, Lloyds, BV standards
- Cyber security Certified by ISA Secure® EDSA
- 25,000 plus System Install base Worldwide & backward compatibility with the earlier CENTUM systems

NETWORK CONTROL SYSTEM

SCADA Systems are typically used for supervisory monitoring and control of remotely and geographically distributed assets. They provide more open platform for interface with several makes and types of equipments and extend user friendly and flexible GUI environment.

Common applications include oil & gas production fields, pipelines, power, water & wastewater, mining and other industries.

Supervisory Control and Data Acquisition (SCADA) systems: FAST / TOOLS

- Proven Experience: Dedicated SCADA platform with more than 35+ years experience across various applications and industries
- Truly Web Based Supervision:

  -Client Applications can be run from any web-browser

  - Anytime, Anywhere access

  -No need to manage licenses and software installations on the client side -zero deployment clients possible
- Open Interface capabilities: Supports a wide range of Industry standard protocols and interfaces like Modbus, DNP3, IEC-60870-5, IEC-61850, OPC, ODBC, RDBMS etc.
- High Availability architectures : Possible with Secondary, Tertiary & Quaternary clustered servers.
- Collaborative Decision Support: Dashboard functionality for strategic management from single unified window so that operators move from mere transactions to interactions
- Alarm Management: Alarm analysis and Management compliant with EEMUA 191 and ISA 18.2 providing Centralized Alarm Management, Alarm Annunciation, Alarm notification (email, SMS), Alarm notification & trending etc.
- Platform and Operating system independent: Supports Windows, UNIX & LINUX & commercially of the shelf products
- Network Infrastructure independent: Supports multipath communications (Fiber Optics, Radio, Satellite, GSM/GPRS, Leased lines etc.) with high data integrity even with intermittent low bandwidth communication
- Audit trail & Playback: The system can be trailed any operator actions (5W's- Who? Where? When? What? Why?) and can be played back for Operator Training, Remote assistance by specialists & ease of information provision to maintenance department
- High Scalability: Highly flexible and scalable system from small HMI with few hundred tag points to enterprise wide systems which can go beyond few Million tag points.
- Security: Proven high security with best in class cyber protection.

- Modern Technologies : Supports cloud computing & Virtualization technologies.
- Enterprise Pipeline Management Solution (EPMS): supplements a basic pipeline management system with specific gas and liquid applications that enable a pipeline operator to manage delivery contracts and associated logistics in a time and energy efficient manner.

  EPMS delivers the following interrelated and integrated functions;

- Processing of meter inputs for accurate measurement and flow calculations
- Management of gas data with the device scheduler and EFM log up-loader
- Schedule and monitor gas nominations
- Monitor the line-pack along the pipelines and segments
- Maximum Allowable Operating Pressure, MAOP, monitoring
- Pipeline balance, storage and inventory calculations
- Schedule and track batches for efficient transportation of liquid products
- Monitor liquid pipelines for leaks, inventory and hydraulic profiling
- Drag reducing agent management and power management on compressors and pumps
- Controlling a manifold with the flow path manager
- Tracking and management of anomalies like pigs/ scrapers, merge/hot spots and interfaces

Next generation platform for secure fault tolerant operation of intelligent assets.

STARDOM control system provides openness, general versatility, low implementation cost and has been designed to make it possible to decrease the long term TCO (total cost of ownership).

Autonomous Controller: STARDOM

- Autonomous Network based control system
- Independent of Network infrastructure & communications- both wired as well as wireless
- Robust construction for harsh environments including wide operating temperature options -20 degree C to 70 degree C. Compliant with EMC standards and optional G3 coating also available depending on area of installation
- Data buffering capability avoids loss of critical data during network interruptions. The buffered can be automatically backfilled to host system supporting similar capabilities
- Available in compact and on-board, modular I/O version including low power consumption model (less than 3.0 W). Choice of platforms for redundant or consolidated applications also available.
- Full SMART field device support embedded for powerful asset management – HART, Profibus-DP, Modbus, Foundation Fieldbus, ISA 100 wireless etc.
- Embedded Web HMtl for easy remote asset
- Support Industry Standard Open communication protocols for third party interfaces- Modbus , DNP 3.0
- Process applications for RTU, flow, downhole sensing
- Fast processing speed for complex applications (5 msec task scan). Examples of applications : Turbine control, protection & others
- Support all 5 programming languages of IEC 61131-3
- Hot-swappable modules and PC-less maintenance flexibility with SD card operations. Online battery replacement also possible
- Error Correcting Code memory on durable hardware. Correction of single-bit errors in RAM prevents unexpected malfunctions
- On-line modifications without need to stop controller
- To make remote modifications and engineering

Yokogawa PLC FA-M3, offer the fastest update rates for high speed applications and are electrically and environmentally robust. The FA-M3 is designed and best known for its speed so it's only natural that it is named FA-M3V, where V stands for "Vitesse", which means speed in French.

Programmable Logic Controller: FA-M3V

- Enhanced High-speed IPRS (Instruction, Processing, Response and Scanning)
- CPU Cycle time of 100 micro second
- Wide Range of High Performance Modules
- Superior, Easy Temperature/PID Control
- Hardware Configuration is fully automatic and smart
- Versatile & User Friendly Programming Tools
- Built-in Ethernet Network Support
- Modular concept with wide selection of functions which provide high flexibility for easy development of different applications.

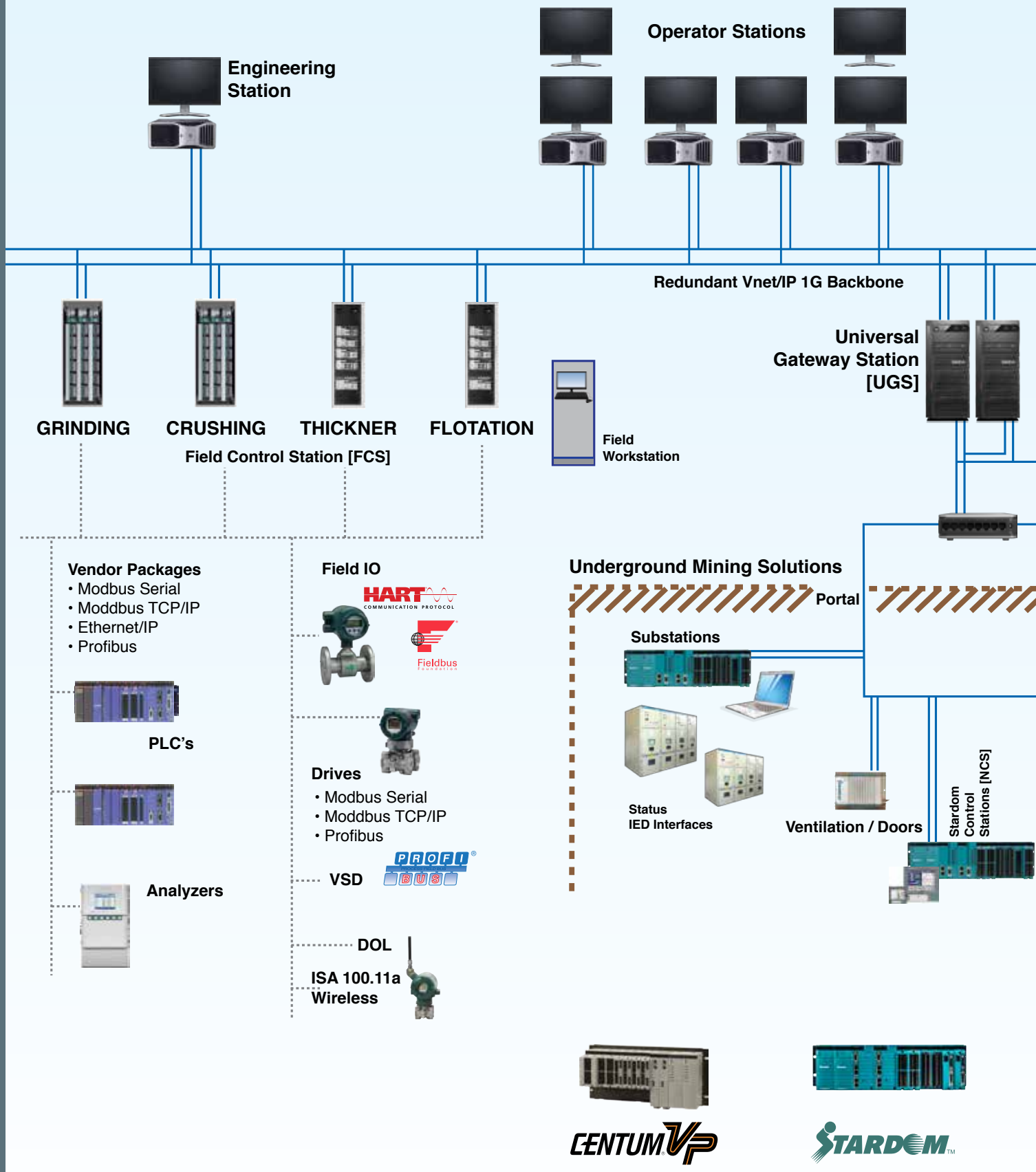
Yokogawa DTS Enhances Site Safety, Asset Monitoring & Facility Maintenance Function. DTS can be used for any area where temperature change can indicate process abnormalities, allowing for early detection and corrective action for safety. DTSX uses Optical Fiber as a sensor, which is safe to use in explosion and hazardous environments. It is immune from electrical induction and noises.

Distributed Temperature Sensing

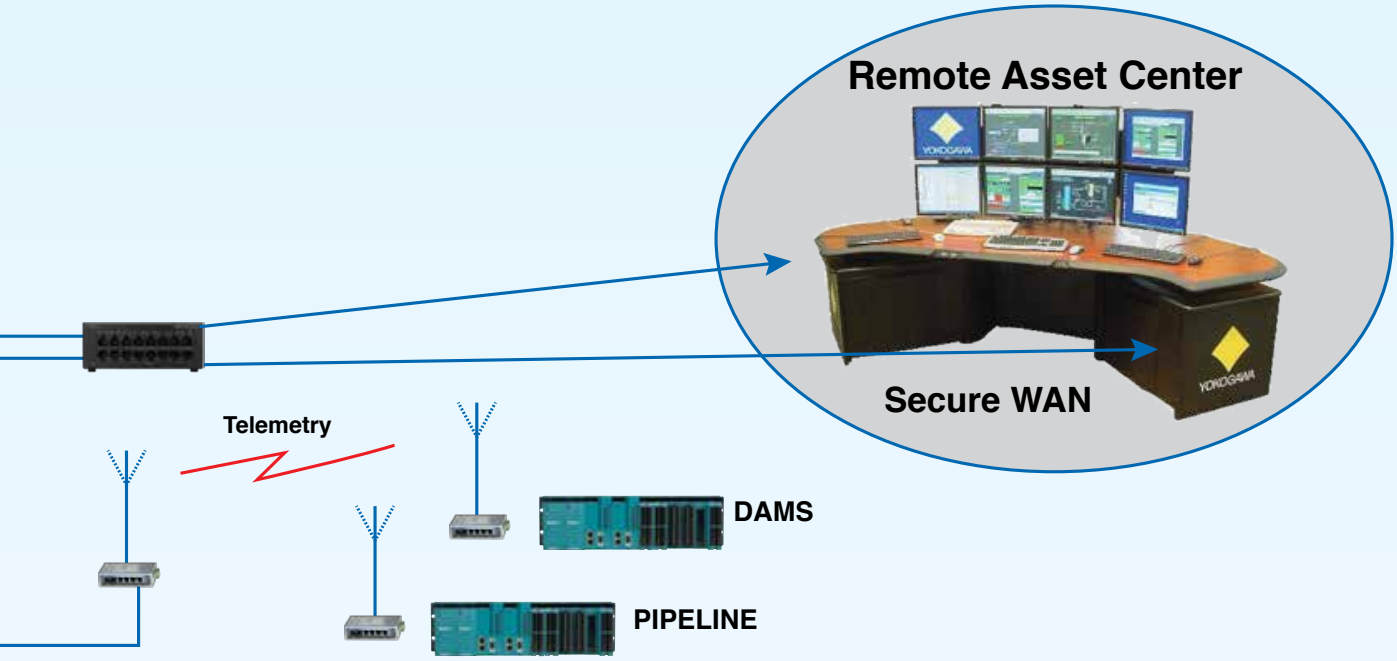
Applications:

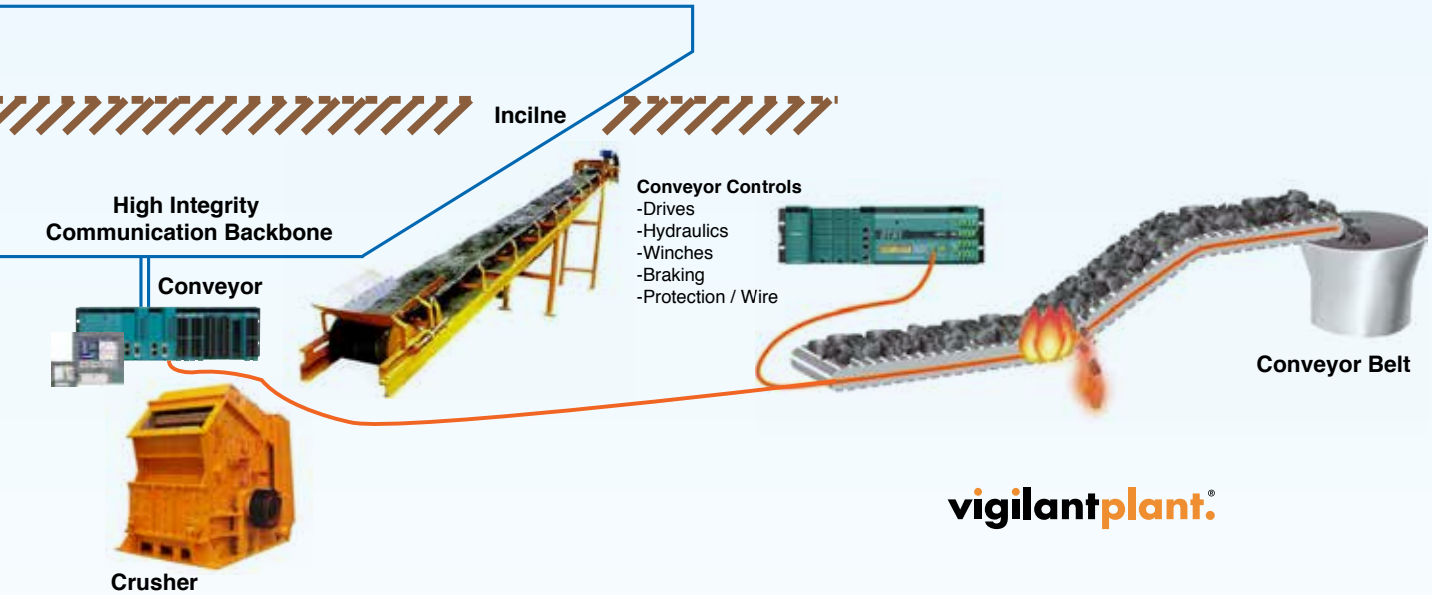
- Well bore temperature distribution monitoring.
- Heat buildup detection along Conveyor system.
- Cable tunnels, ducts, trays, rack, MCC where heat buildup could become a fire hazard.
- Pipeline leak detection.
- Furnace chamber deterioration diagnosis via external wall surface temperature profiling.

CONTROL SYSTEM SOLUTION FOR MINING INDUSTRY



"Yokogawa Control System solution is designed to cater to all types of Mining applications demanding flexible, scalable, reliable and truly open as well secured architecture. All range of control system modules; built-in with unprecedented features are available in order to design customer specific cost effective solution".





vigilantplant.

Supervisory Systems FAST/TOOLS™

FA-M3V VITESSE™

DTSX®

PROVEN APPLICATIONS; RELIABLE PRODUCTS

We present in a completely different way regarding the traditional automation business, in which we use multiple technologies and techniques with the objective of provide integrated solutions to specific “problems” in the mining area, optimizing productive processes in multiple levels (material flow, interaction between multiple processes, customer objectives), with the intention of adds value in the process of co-innovation.

In the next pages, you will find a set of proposals for specific solutions that allow us to differentiate ourselves and open work spaces with our clients.

We hope to see you soon...

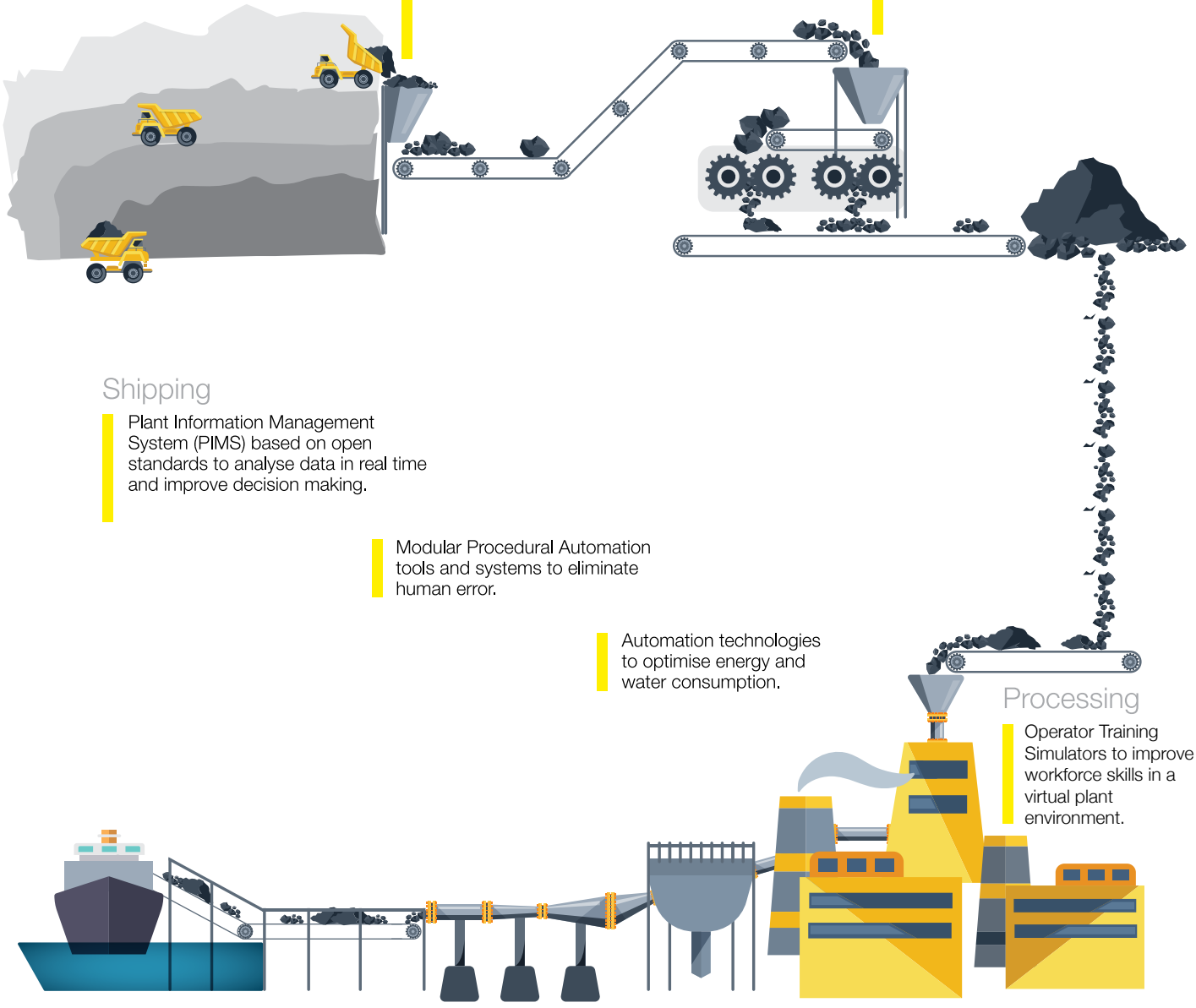
PROCESS AUTOMATION SOLUTIONS-PIT to PORT/ SENSOR to BOARDROOM

Mineral Extraction

Advanced Process Control to optimise and stabilise processes

Ore Crushing

Asset Management Software and tools to remotely monitor field device performance resulting in proactive, predictive maintenance and less downtime.



Shipping

Plant Information Management System (PIMS) based on open standards to analyse data in real time and improve decision making.

Modular Procedural Automation tools and systems to eliminate human error.

Automation technologies to optimise energy and water consumption.

Processing

Operator Training Simulators to improve workforce skills in a virtual plant environment.

SULFURIC ACID LEAK DETECTION

AREAS of INTEREST:

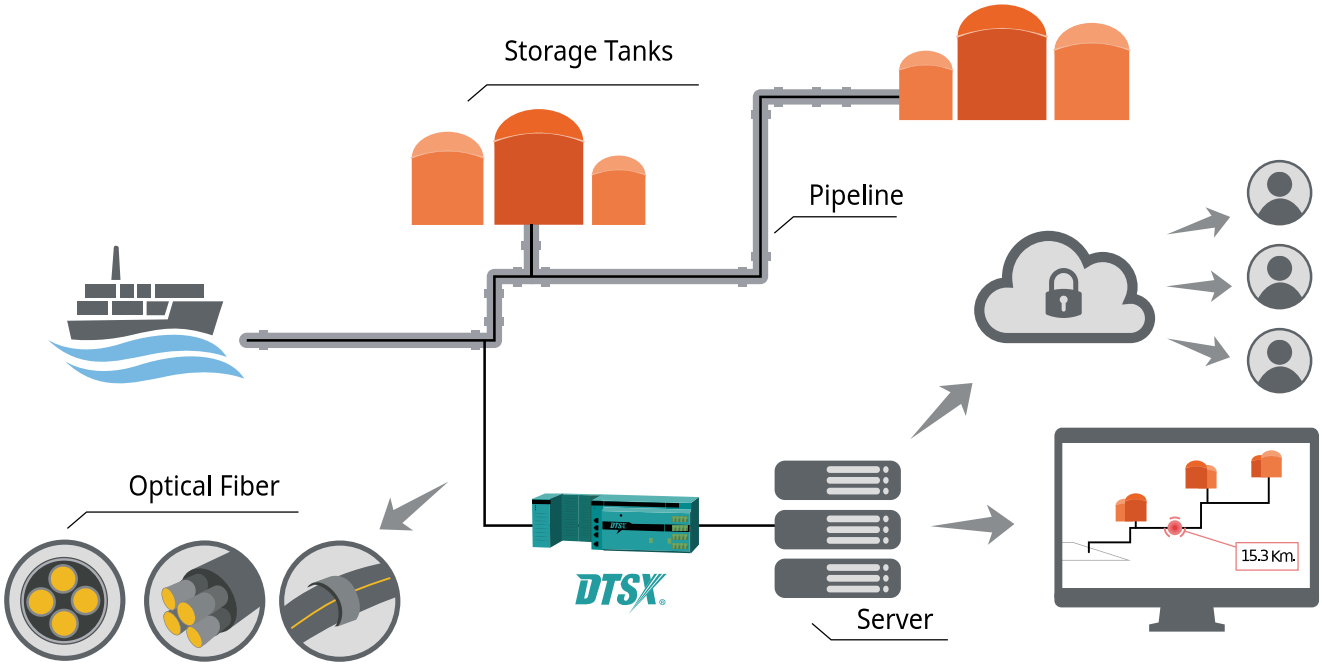
- Sulfuric acid plant.
- Sulfuric acid transportation.
- Sulfuric acid storage.
- Leaching.
- Solvent Extraction.

In sulfuric acid transport pipelines, product leaks are absolutely undesirable condition, since they can cause people injuries and environmental damage.

Due the layout of these pipes (mostly long and relatively unattended runs), their inspection is tedious and requires special attention.

Using optical fiber and DTSX technology, it is possible to detect sulfuric acid leaks with a precision of 1m along the pipeline, allowing rapid containment and repair action.

Our solution covers the selection of optical fiber, detailed engineering, supplies, field implementation and commissioning.



Continuous pipeline and equipment monitoring related to transport or sulfuric acid storage.

Leak detection with a spatial resolution of 1m along the pipeline.

Incorporated trends and alarms.

Simplified and friendly user interface.

CONVEYOR BELT CONDITIONS MONITORING

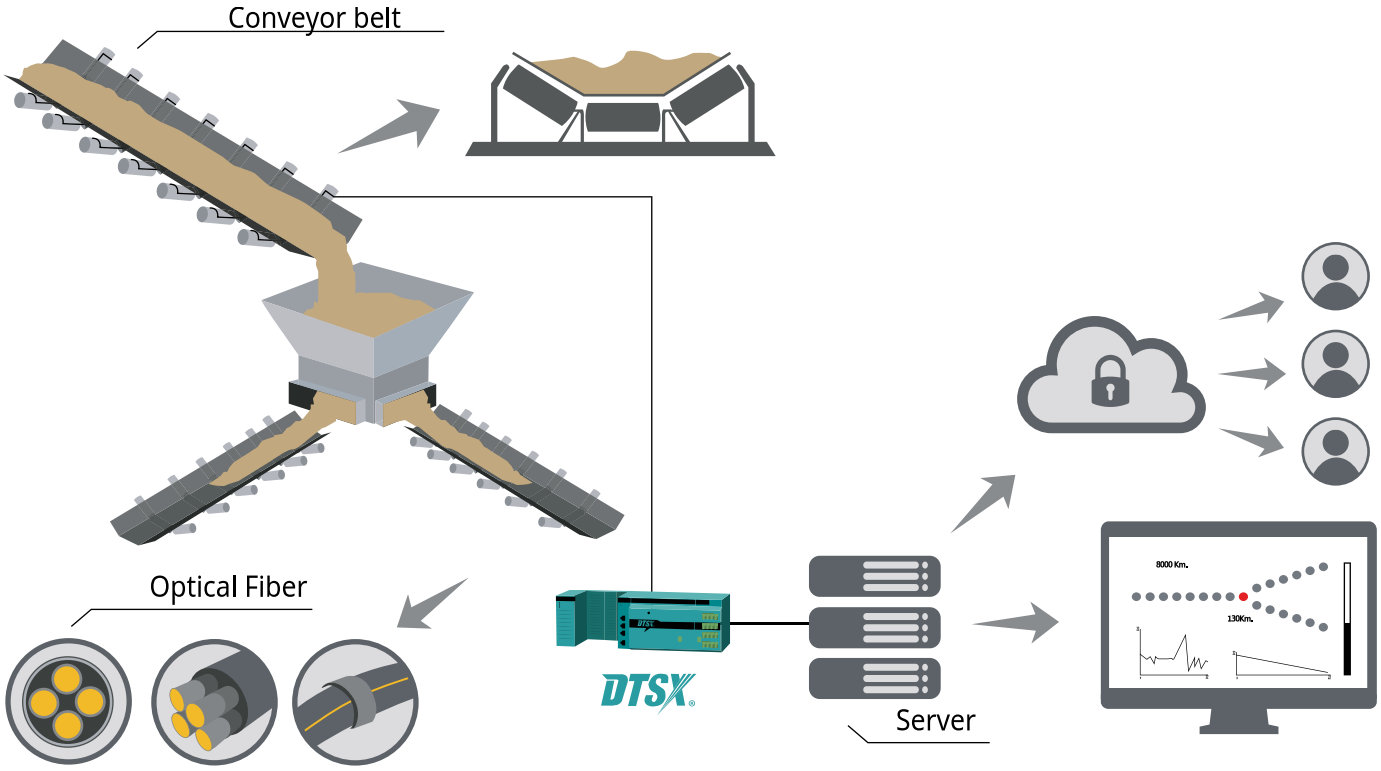
AREAS of INTEREST:

- Crushing
- Material handling

Conveyor belts have hundreds or thousands of idlers depending on their length, the early detection of the operational status of each one of them is a tedious and expensive task to perform for the maintenance and operation team.

Using optical fiber and DTSX technology it is possible to measure and detect the state of each of the idlers in real time, reducing inspection and repair time. In short, a diagnostic tool that allows to detect failures before reaching undesirable condition or damage, with the consequent loss of production.

Our solution covers the selection of optical fiber, detailed engineering, supplies, field implementation and commissioning.



Continuous conveyor belt idler monitoring.

Specific idler status identification.

Can be connected to enterprise ERP (SAP or Maximo) to inspection, maintenance or reparation tasks.

Incorporated trends and alarms.

Simplified and friendly user interface.

LEAK DETECTION IN TAILINGS DUMP

AREAS of INTEREST:

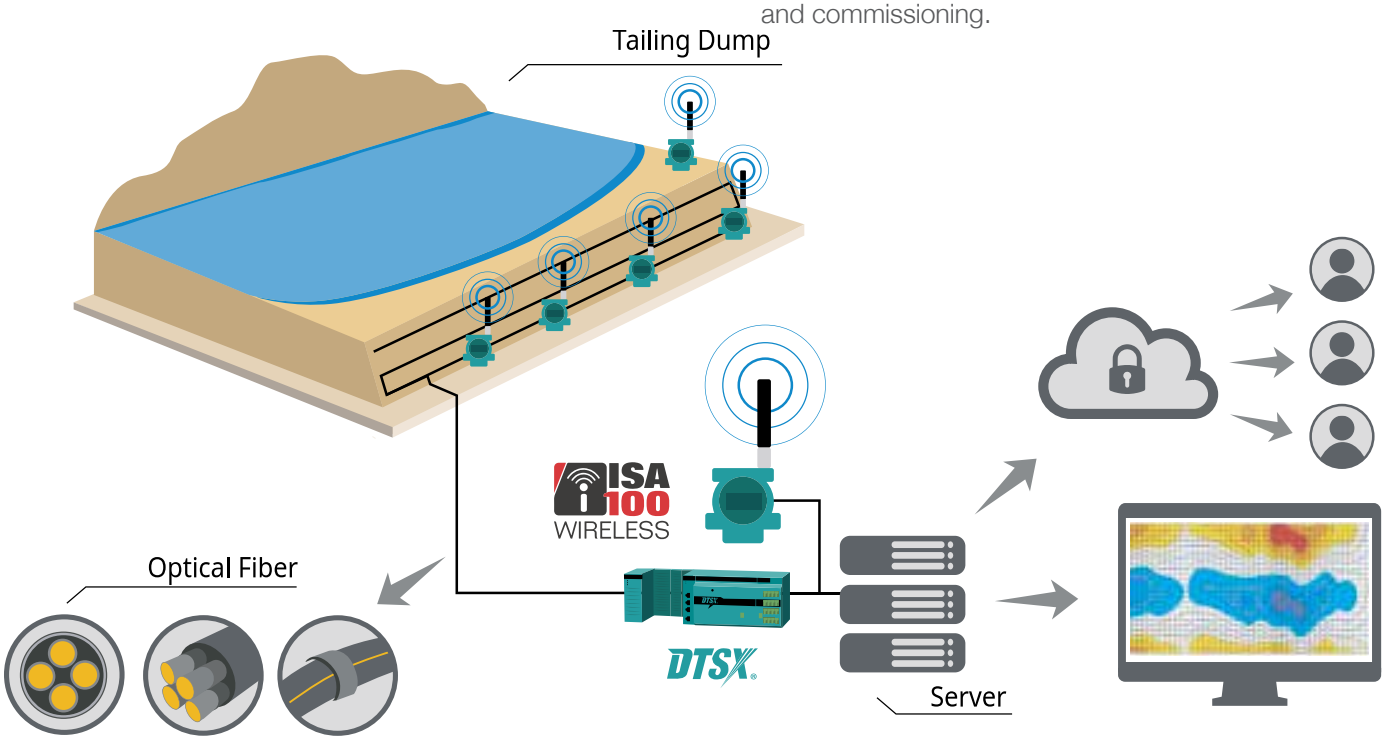
- Tailings Dump.

Tailings dumps are civil works that allow tailings to be contained in exclusive areas for disposal. Leaks in these, imply structural damage, environmental damage and in some cases, can put communities at risk.

Due the size of the dump, their inspection over time is complex and can pass many months between inspections.

Using optical fiber, DTSX and ISA100 technology it is possible to detect leaks by measuring temperature changes or punctually in check points, thus allowing the real time monitoring of these structures over time.

Our solution covers the selection of optical fiber, detailed engineering, supplies, field implementation and commissioning.



- Continuous tailing dump monitoring.
- Leak detection with a precision of 1m.
- Simplified and friendly user interface.
- Incorporated trends and alarms.

THERMAL PROFILE IN FURNACES AND CONVERTERS

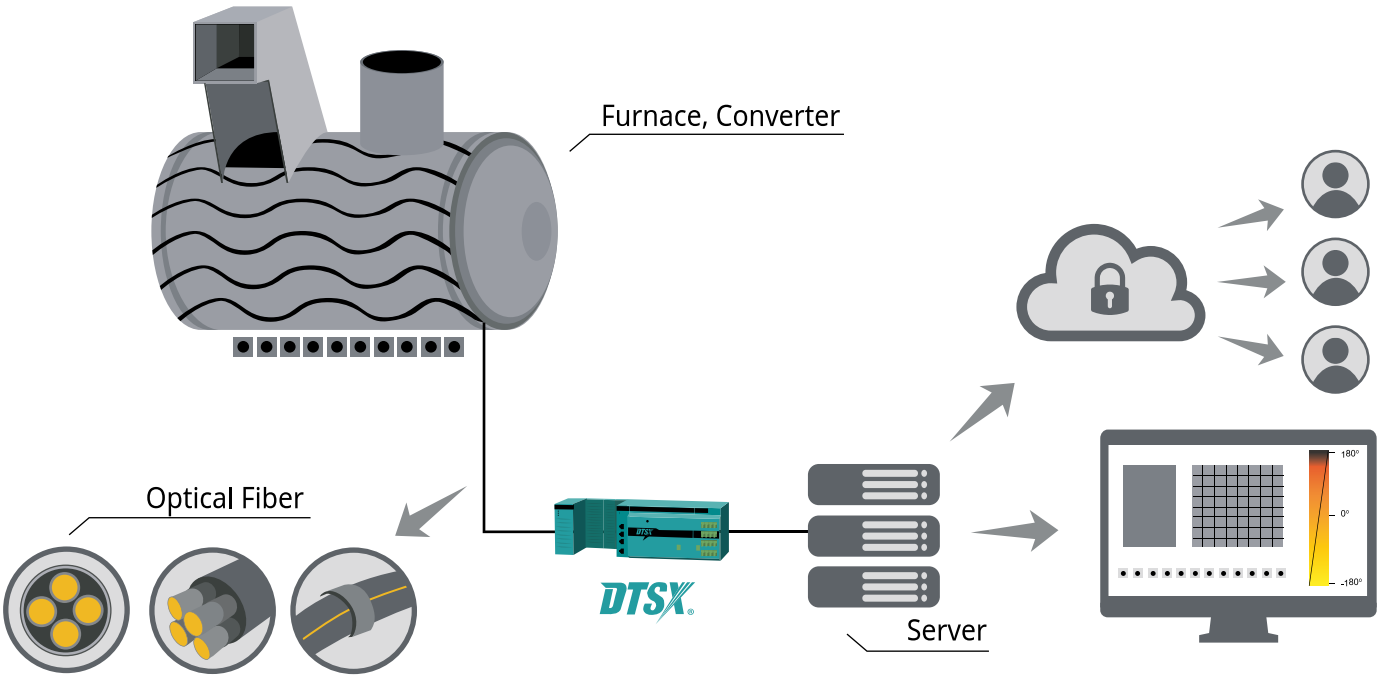
AREAS of INTEREST:

- Smelting.
- Converters.
- Roasting.

In furnaces and converters, thermal insulation inside of these can suffer mechanical damage over time due different factors, causing a possible risk situation for the people operating around them or the process.

Thermography or spot measurements are common to perform the detection. Using optical fiber and DTSX technology, it is possible to monitor the surface temperature of these equipments in real time, reproducing a thermal map that allows the early detection of the points where the insulation has been damaged.

Our solution covers the selection of optical fiber, detailed engineering, supplies, field implementation and commissioning.



- Continuous thermal profile monitoring.
- Simplified and friendly user interface.
- Incorporated trends and alarms.
- Hot/cold zones detection.

ELECTRO WINNING OR ELECTRO REFINERY CELLS MONITORING

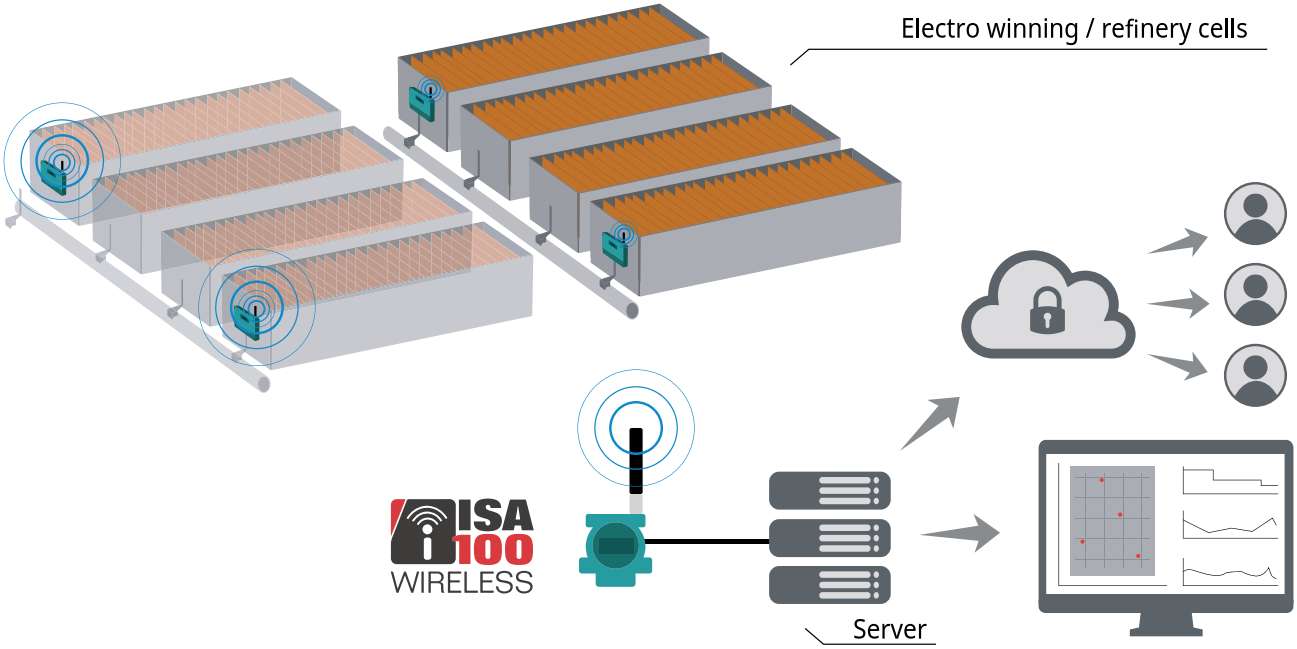
AREAS of INTEREST:

- Electro winning.
- Electro refinery.

For electro winning or electro refinery cells, determining the correct operational condition is a routine and tedious task. By measuring the voltage in the bars and the temperature of the electrolyte in its discharge, it is possible to precisely determine its state, detecting short circuit condition, bad contacts or unexpected flows. In the case of electro winning, the non-optimal operation of the cell in mid to long term can causes damage to cathodes.

Using ISA100 technology it is possible to perform these measurements in real time, allowing operators know the precise place of short circuit or abnormal flows for each one of the cells, increasing the utilization of the plant.

Our solution covers equipment selection, detailed engineering, supplies, field implementation and commissioning.



- Continuous electro winning or electro refinery cells operational condition monitoring.
- Wireless system.
- Inventory calculation inside each cells and inside the facility.
- Energy calculation for each cell and total of facility.
- High density and real time information display.
- Incorporated trends and alarms.
- Simplified and friendly user interface.

CONTROL LOOP LIFE CYCLE

AREAS of INTEREST:

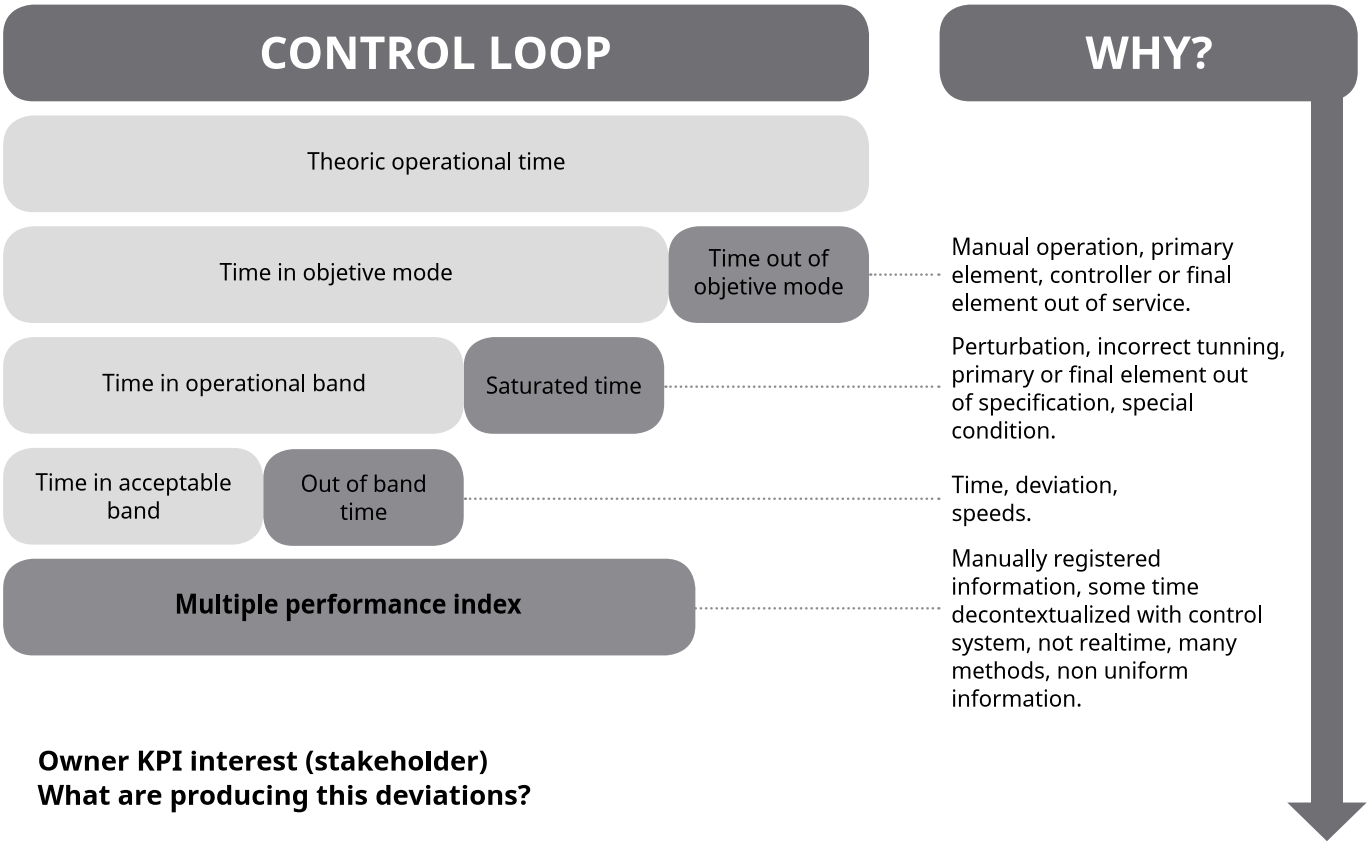
- General Plant.

Dozens or hundreds of control loops daily support plant operations to achieve production and/or safety objectives. The proper tuning and monitoring of their performance over time, leads to an improvement of production, reducing the variability and disturbances rejection that are natural to the process.

Tracking each loop over time is a relevant task that consumes resources from the maintenance and operations team.

A control loop management system promotes the continuous improvement of these, detecting their behavior over time and allowing the focus of the efforts in a specific way.

Our solution implements an effective system of monitoring and continuous improvement, covering the activities of surveying these, implementation of metrics, study of dynamic behavior, tuning, reporting and optimization.



Control loop life cycle implementation oriented to continuous improvement.

Implementation of key performance indicators related and a tracking system based on them along the time.

Control loop tuning tool. High density and real time visualization.

Incorporated trends and alarms.

Simplified and friendly user interface.

CAUSE/EFFECTS PLANT SHUTDOWNS

AREAS of INTEREST:

- General Plant.

Day by day there are some equipment's that stops in the processes without necessarily stopping the production chain. To achieve operational excellence, determining the root cause with its consecutive economic impact is crucial to the application of continuous improvement processes.

The correlation between ecause and economic effect is often a long-term task requiring multiple disciplines within the enterprise.

By implementing Exaquantum DTA, it is possible to perform cause-effect analysis in a short time, with clear metrics that will guide the efforts required within the company to achieve operational excellence.

Our solution implements effective real time tracking, considering equipment supply, detail engineering, field solution implementation and commissioning.

PRODUCTIVE MACHINE		WHY?
Theoretical operational time		
Operational time	Unplanned stops	
Effective time	Availability losses	Stops, adjustments, general conditions change.
Net production time	Speed losses	Dead time, small stops, speed reduction.
Productive time	Quality losses	Quality deviations, specifications, opperation points.
Global equipment effectivity = %Available x %Speed x %Quality		Manually registered information, some time decontextualized with control system, nto realtime, many methods, non uniform information.

Owner KPI interest (stakeholder)
What are producing this deviations?

Monetary losses determination due operations and equipment failures.

Failures and shutdown cause/effect correlation production impact.

KPI implementation and tracking system along the time.

Simplified and friendly user interface.

OPERATIONAL IMPROVEMENTS ASSISTED WITH OPERATIONAL PROCEDURES

AREAS of INTEREST:

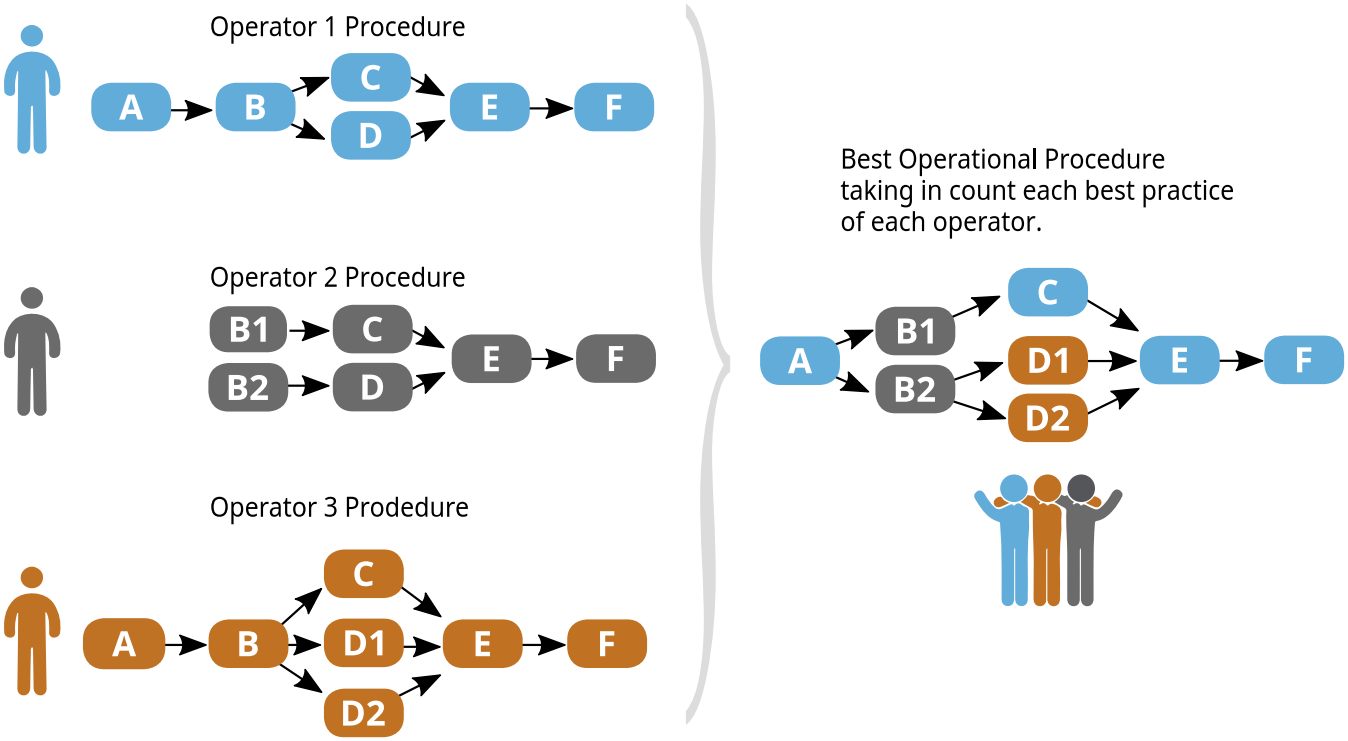
- General Plant.

Along the time, the ways of operating a plant or the people who do the operation changes. Keeping the knowledge about how to perform tasks is crucial to prevent past experiences or to standardize the operation.

Usually, knowledge is stored in procedures based on texts (paper), which require continuous updating and training.

With Exapilot, it is possible to translate this knowledge in digital form, which is connected to the control system, allows operators to access previously programmed sequences and, in an assisted way, guides the actions required in specific situations (eg plant detentions, Changes in production levelse, plant startup, emergency detention sequences, etc.)

Our solution implements a system of management of best practices, considering the supply, detail engineering, solution implementation, start-up and training.



Best practices implementation across the operational environment.

Assisted operational sequences (starts, stops, production changes, ramp-up, others).

Decrease knowledge lost due operator change or rotation along the time.

Simplified and friendly user interface.

CONDITION MONITORING IN ROTATORY EQUIPMENTS

AREAS of INTEREST:

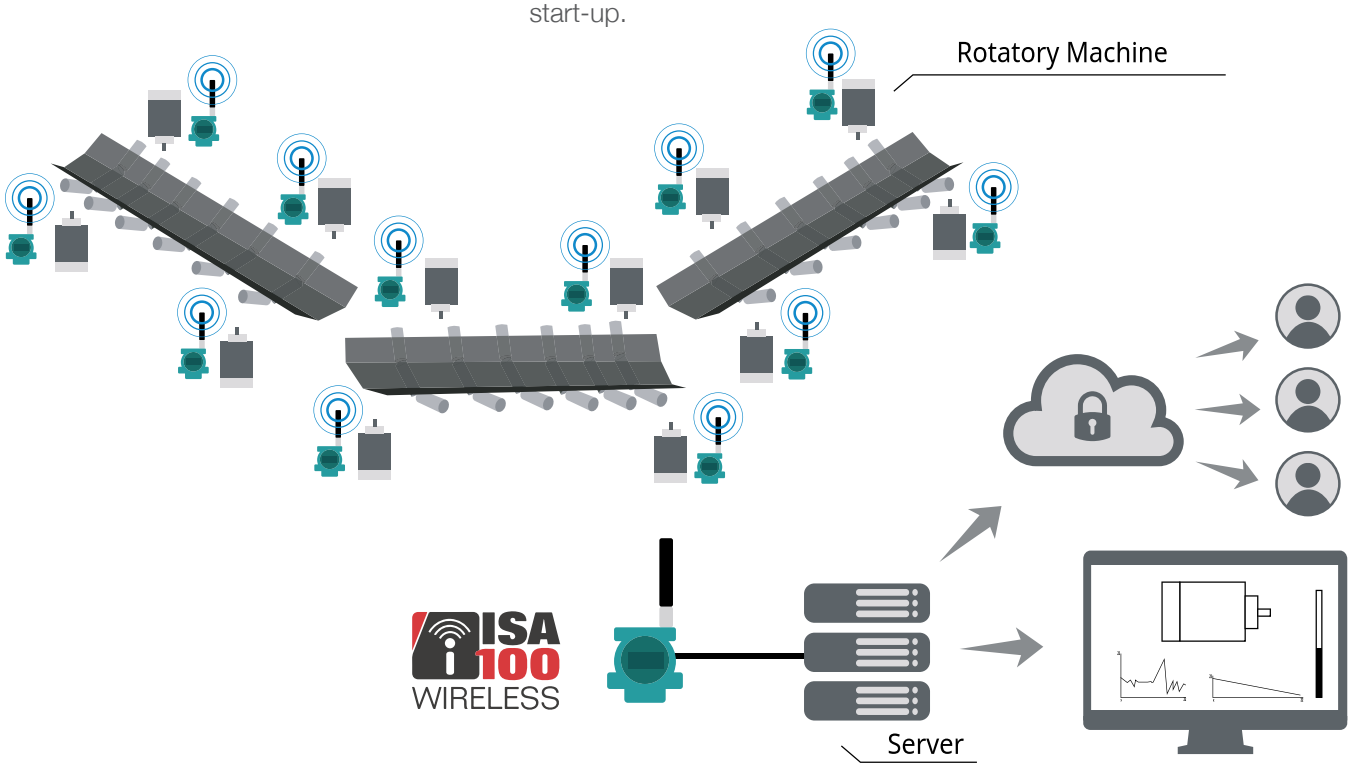
- General Plant.

A fundamental element to perform predictive maintenance or a higher order schema in a plant is to have reliable and periodic information of equipment status, with it, it is possible to correlate them with operating conditions over time and predict when and where to repair.

Typically, condition measurements are performed manually, the information is stored in maintenance charts, requiring further processing to correlate the information.

With ISA100 technology and monitoring system, it is possible to monitor in real time the conditions of the machinery and correlate this information with operational conditions, establishing a base line of conditions and its subsequent use in continuous improvement.

Our solution implements effective monitoring and tracking in real time, considering equipment supply, detailed engineering, implementation and start-up.



Real time rotatory equipment monitoring.

Wireless system.

KPI implementation and tracking system along the time.

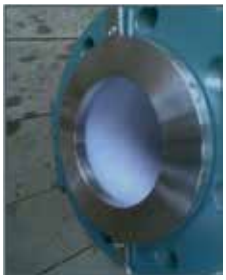
Can be connected to enterprise ERP (SAP or Maximo) to inspection, maintenance or reparation tasks.

Incorporated trends and alarms.

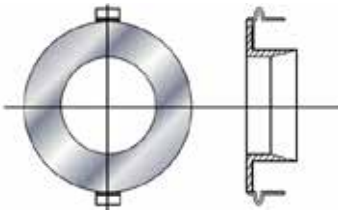
Simplified and friendly user interface.

HYDROCYCLONE INLET FEED FOR COPPER & GOLD MINES

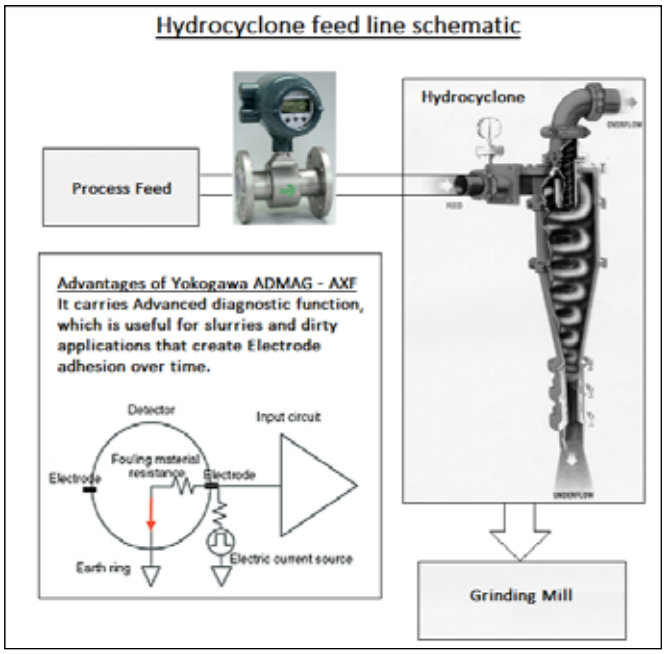
Applications:
Hydrocyclone Inlet feed line contain coarse and fine materials, it cause major abrasive leads wear of the flow meter rapidly.
Features:
• ADMAG AXF Flow meter - PFA liner with Metal Hat Earthing ring for ✓ line size >200 mm • ADMAG CA Flow meter - Ceramic liner for ✓ line size <=200 mm • Enhanced Dual frequency excitation.
Benefits:
• The optimize slurry particle classification in cyclone will help to maximize cyclone overflow quantity.



Metal Hat (SUS 316)

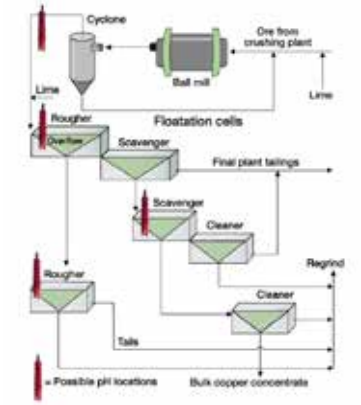


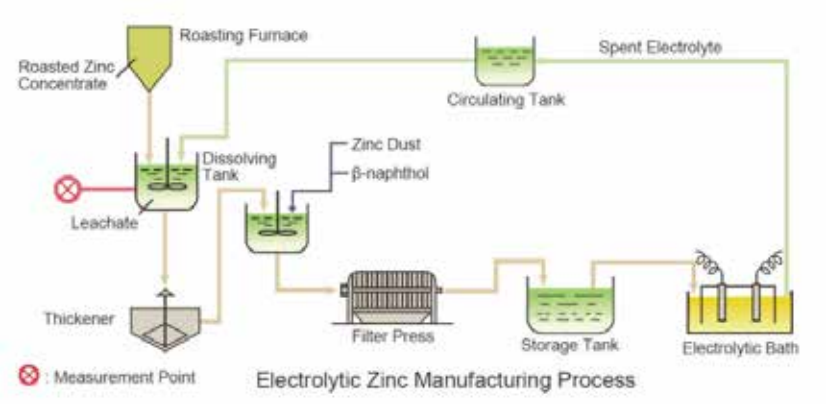
Front View Side View

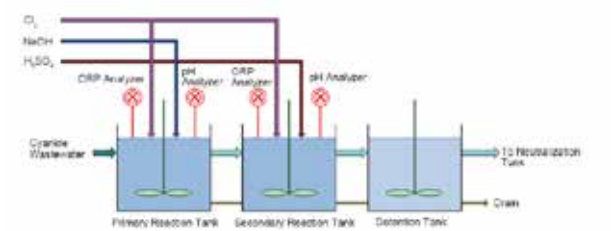


LIQUID ANALYZERS FOR MINING

Separating Minerals by Floatation







Oxidation Monitoring in the Cyanide Wastewater Treatment Process

FLXA202 2-Wire Transmitter

Sencom Monitoring

- Various applications dedicated solutions
- Stable & continuous measurement
- Reduction in operating costs
- Eliminates manual cleaning. Jet cleaning is possible

MINING COMPANIES USING YOKOGAWA PRODUCTS

Mining Company	Mineral											
	Coal	Copper	Gold	Iron Ore	Lead	Mineral Sands	Nickel	Uranium	Zinc	Diamond	Cobalt	Platinum
ACACIA Mining												
Aditya Birla												
Anglo Coal												
Anglo Gold Ghana												
Anglo Gold												
Anglo Gold Joel												
Alacer												
Arrium												
Ambatovy Nickel												
Barrick Gold												
Base Titanium Mining												
BCL- Botswana												
BHP Billiton Mitsubishi												
BHP Billiton Nickel West												
Bloomfield Coal												
Botswana Ash												
Caledon Coal												
Citic Pacific Mining												
Chambishi Metals PLC												
Crocodile Gold												
Cristal Mining												
Dundee Precious Metals												
De Beers Marine												
ERA												
Evolution Mining												
First Quantum Minerals												
FQM Kanshishi												
GlencoreXstrata Murrin Murrin												
Gold Fields												
Heathgate												
Hillgrove												
Iluka Resources												
Integra Coal												
IMPLATS												
Kingsgate												
MMG												
Mopani Nkana												
Mopani Mufulira												
Mitsubishi Cape Flattery Silica												
Murray Zircon												
Navigator Resources												
Newcrest												
Newmont												
Norseman Gold												
Norton												
Oceana Gold												
Panoramic Resources												
Peabody												
Pilbara Iron Company												
Resolute												
Rio Tinto												
Shansteel Sierra Leone												
Sibelco												
Silverlake Resources												
St Barbara												
Snow Peak Mining												
Stami Gold Mining												
Tronox												
Uranium One												
Vale												
Wesfarmers												
Williamson Diamond Mine Ltd (WDL)												
Yancoal												
Xstrata												

Instruments Both Control systems and Instruments

WHY MINERS CHOOSE US

RELIABLE CONTROL SYSTEMS

Customer: DeBeers Marine

Location: Cape Town, South Africa

Project: Install a distributed control system (DCS) for five marine diamond mining vessels owned by Debmarine Namibia.

Highlights: De Beers Marine, a specialist technical engineering support specialist to the diamond mining industry, chose Yokogawa's CENTUM VP DCS based upon the faultless performance of the system under harsh operating conditions and the low cost of ownership from Yokogawa's long-term migration policies.

ZERO UNPLANNED DOWNTIME

Customer: Evolution Mining

Location: West Wyalong, New South Wales, Australia

Project: for Optimise a distributed control system (DCS) the Cowal Gold Mine - Processing Plant.

Highlights: Evolution increased gold production by 220% and achieved zero unplanned downtime over 10 years by optimising their CENTUM VP distributed control system (DCS) from Yokogawa.

FULLY INTEGRATED SAFETY CONTROLLER

Customer: Sierra Gorda SCM

Location: Chile, South America

Project: Install a Safety Instrumented System for copper mine production

Highlights: Sierra Gorda SCM installed Yokogawa's ProSafe-RS safety instrumented system to achieve absolute compatibility with their third party distributed control system (DCS). The ProSafe-RS is the world's first truly integrated safety PLC for the process industries. It puts an end to costly DCS - SIS design and integration issues.

CONTROL CAPABILITY OF FIELD INSTRUMENTS

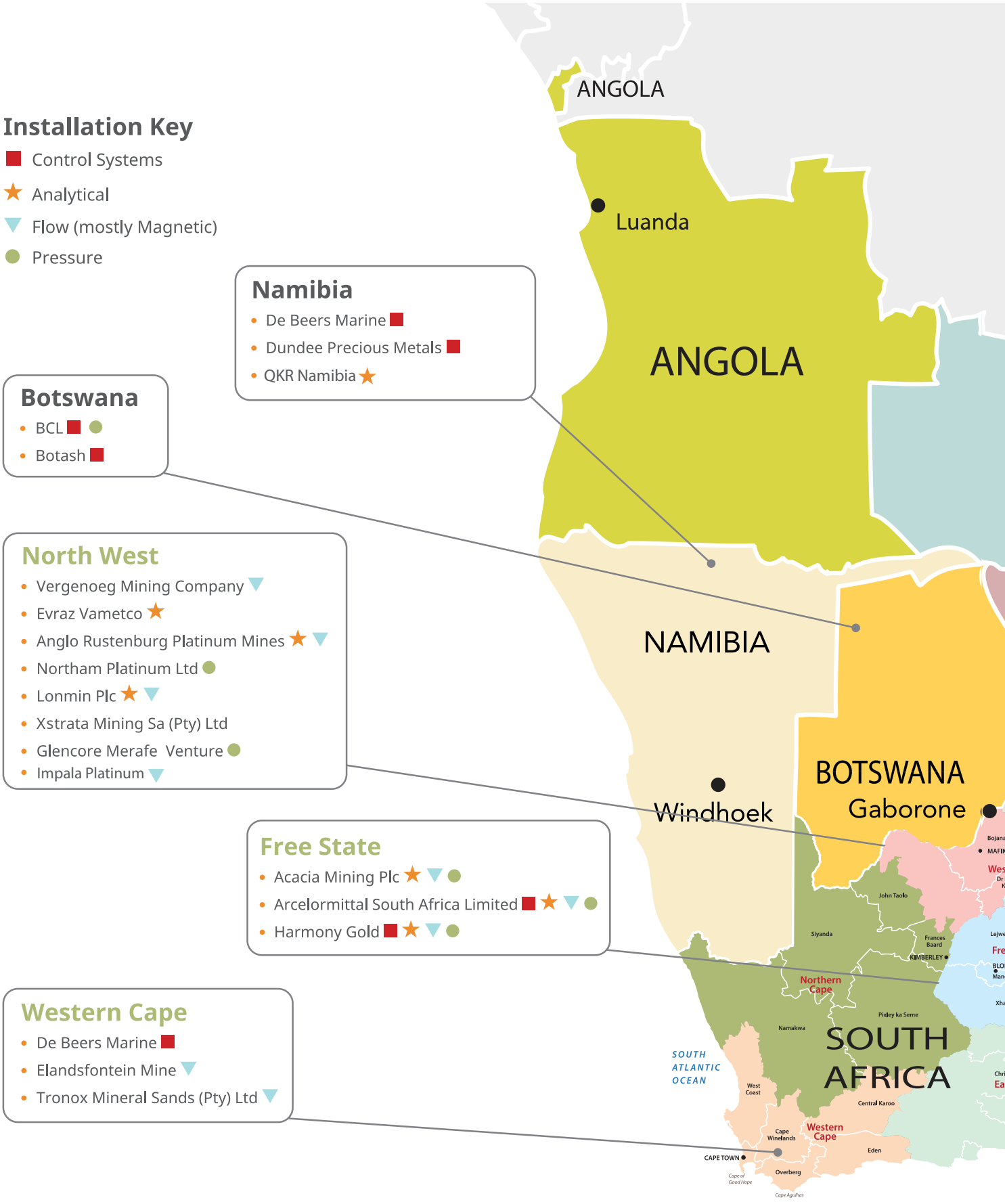
Customer: Minera Escondida

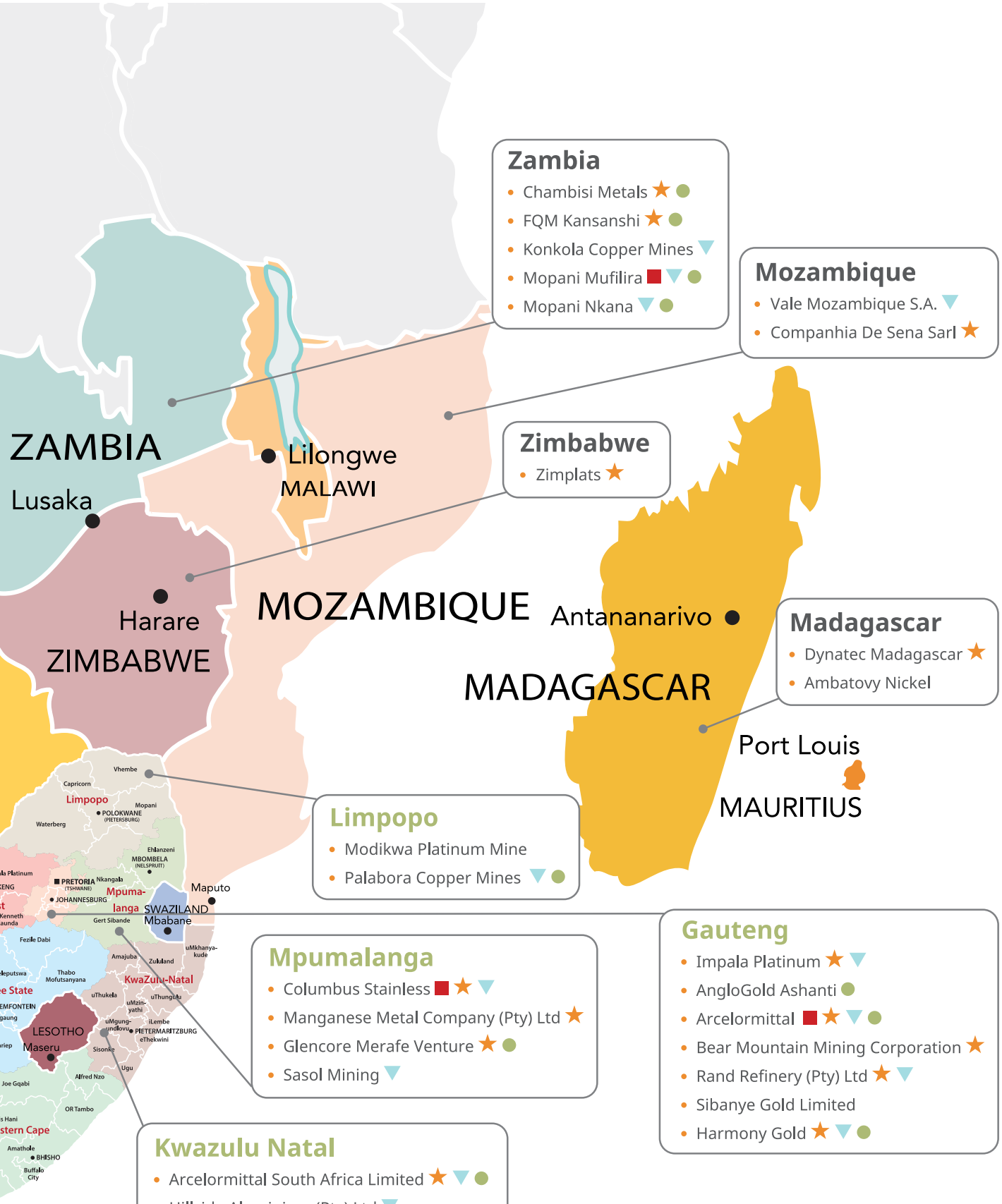
Location: Chile, South America

Project: Install vertical temperature measurement system

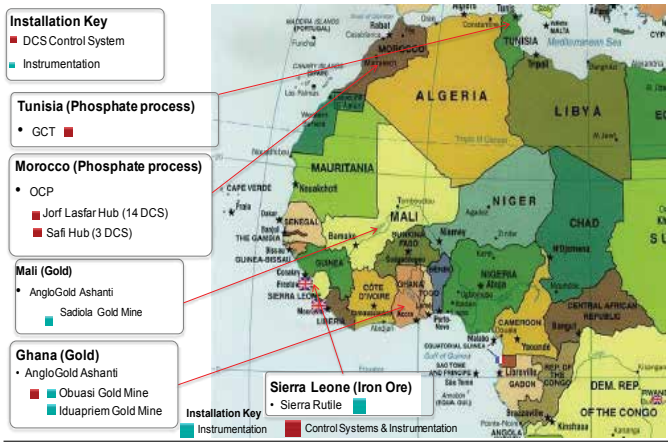
Highlights: Yokogawa installed a distributed temperature sensor solution, the DTSX200, to measure temperature distribution over the length of Minera Escondida's optical fibre cable. The low power consumption DTSX200 was chosen for it's ability to be installed in remote areas, operate on solar power and offer control capability.

YOKOGAWA MINING INSTALLED BASE IN SOUTH AFRICA AND AFRICAN ANGLOPHONE REGIONS




ZAMBIA
Lusaka
Lilongwe
MALAWI
Harare
ZIMBABWE
MOZAMBIQUE
Antananarivo
MADAGASCAR
Port Louis
MAURITIUS
Maputo
SWAZILAND
Mbabane
LESOTHO
Maseru
Limpopo
Mpuma-
langa
KwaZulu-Natal
Gauteng
PRETORIA
JOHANNESBURG
POLOKWANE
PIETERMARITZBURG
Zambia
Chambisi Metals
FQM Kansanshi
Konkola Copper Mines
Mopani Mufilira
Mopani Nkana
Mozambique
Vale Mozambique S.A.
Companhia De Sena Sarl
Zimbabwe
Zimplats
Madagascar
Dynatec Madagascar
Ambatovy Nickel
Limpopo
Modikwa Platinum Mine
Palabora Copper Mines
Mpumalanga
Columbus Stainless
Manganese Metal Company (Pty) Ltd
Glencore Merafe Venture
Sasol Mining
Gauteng
Impala Platinum
AngloGold Ashanti
Arcelormittal
Bear Mountain Mining Corporation
Rand Refinery (Pty) Ltd
Sibanye Gold Limited
Harmony Gold
Kwazulu Natal
Arcelormittal South Africa Limited
Hillside Aluminium (Pty) Ltd
Richards Bay Mining Proprietary Limited

Yokogawa Mining Installed Base in North & West Africa



Yokogawa Mining Installed Base in East Africa

Kenya
- ❖ Base Titanium (Mineral Sands)
- ❖ Bamburi Cement Limited (Cement)
- ❖ National Cement Limited (Cement)

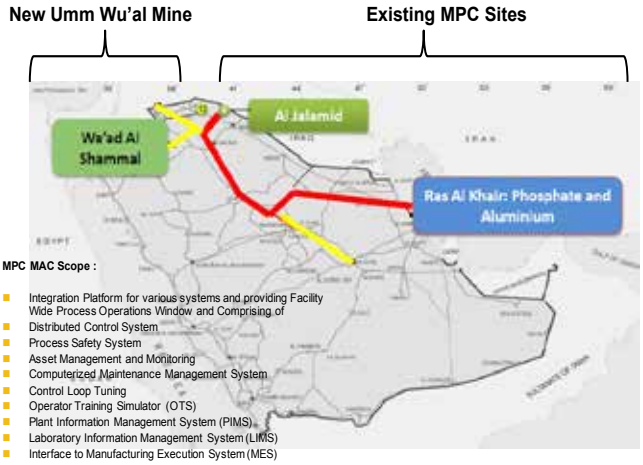
Tanzania
- ❖ Bulyanhulu Mine (Gold)*
- ❖ North Mara Gold Mine (Gold)*
- ❖ Buzwagi Gold Mine (Gold)*
- ❖ Williamson Diamond Mine (Diamond)**

*Part of Acacia Mining Group
**Part of Petra Diamonds Group

Installation Key
Instrumentation
Control Systems & Instrumentation

Yokogawa Mining Installed Base in Australia

MA'ADEN Phosphate Yokogawa's Major Installed Base



MPC MAC Scope :
- Integration Platform for various systems and providing Facility Wide Process Operations Window and Comprising of
- Distributed Control System
- Process Safety System
- Asset Management and Monitoring
- Computerized Maintenance Management System
- Control Loop Tuning
- Operator Training Simulator (OTS)
- Plant Information Management System (PIMS)
- Laboratory Information Management System (LIMS)
- Interface to Manufacturing Execution System (MES)

Al-Amar Gold Mining, MA'ADEN Saudi Arabia

Al-Amar Mine Project is located at Central Saudi Arabia, 210km west of Riyadh.

Project Profile:

- Deposit: Gold, copper, zinc, vein type, open down dip.
- Mining method: Uphole retreat stopping
- Process route: Comminution, copper flotation, carbon-in-leach technology, zinc floating, dry tailing disposal
- Production: 200,000 tons per year

Yokogawa Scope Of Work

Integrated Plant SCADA / PLC / Network :
- FAST/TOOLS SCADA
- STARDOM PLC
- 24VDC UPS Charger & Battery
- Fibre-Optic TCP/IP Network

YOKOGAWA IN THE SMELTING AND REFINING INDUSTRY

Outotec's Ausmelt TLS smelting processes incorporating Yokogawa Centum DCS control systems

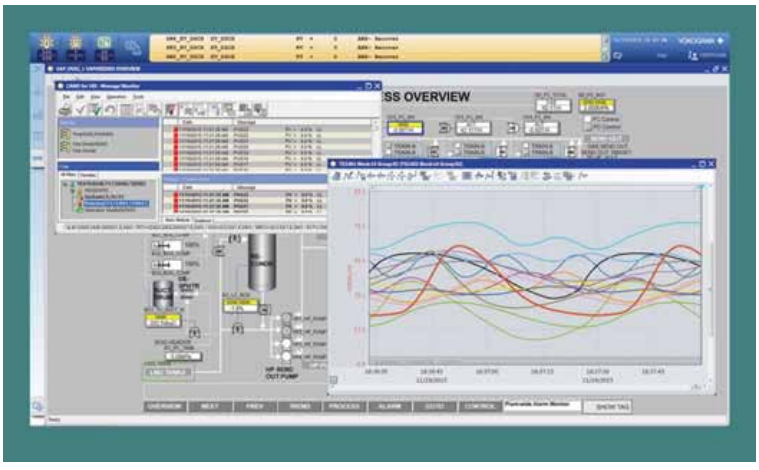
Distributed Control Systems

CENTUM VP

Release 6

Location of Smelters:

- Daye non-ferrous metals - China
- Wuxin Copper - China
- HCHM Hulunbeier - China
- Huludao Copper - China
- Yunnan Tin Copper - China
- Hindustan Zinc Chanderiya - India
- Karabash Copper - Russia
- Dundee Precious Metals - Namibia



Smelters and Refineries

Alumina Smelters:

Alcoa Alcoa Port Henry, Victoria
- AXF Flow Meters, EJX Pressure Transmitters and Analytical products

Alcoa Pinjarra, Western Australia
- AXF Flow Meters, EJX Pressure Transmitters and Analytical products

Rio Tinto's Queensland Alumina, Queensland
- AXF Flow Meters, EJX Pressure Transmitters and Analytical products

Pacific Aluminium's Boyne Smelter, Queensland
- DY Flow Meters, EJX Pressure Transmitters and Analytical products

BHP Billiton Worsley Alumina, Western Australia
- DY Flow Meters, EJX Pressure Transmitters and Analytical products

Tomago Smelting, NSW
- DY Flow Meters, EJX Pressure Transmitters and Analytical products

Pacific Aluminium Tomago, NSW
- AXF Flow Meters and EJX Pressure Transmitters

Pacific Aluminium Tomago, NSW
- AXF Flow Meters and EJX Pressure Transmitters

Pacific Aluminium Gove, Northern Territory
- Analytical products, AXF Flow Meters and EJX Pressure Transmitters

Zinc Smelters:

Sun Metals, Queensland
- DY Flow Meters, EJX Pressure Transmitters and Analytical products

Nyrstar Hobart, Tasmania
- AXF Flow Meters and EJX Pressure Transmitters

Nyrstar Port Pirie, South Australia
- AXF Flow Meters, EJX Pressure Transmitters and Analytical products

ENGINEERING CAPABILITIES

Yokogawa Middle East & Africa has accumulated considerable experience in the execution & implementation of projects. Combining a full understanding of customer requirements with professional management of multiple vendors, YMA is strongly positioned to deliver the set objectives of any project. YMA's Project Execution Team applies excellent communications with all parties including the Contractor, End user, Licensor, etc. to ensure successful project delivery.

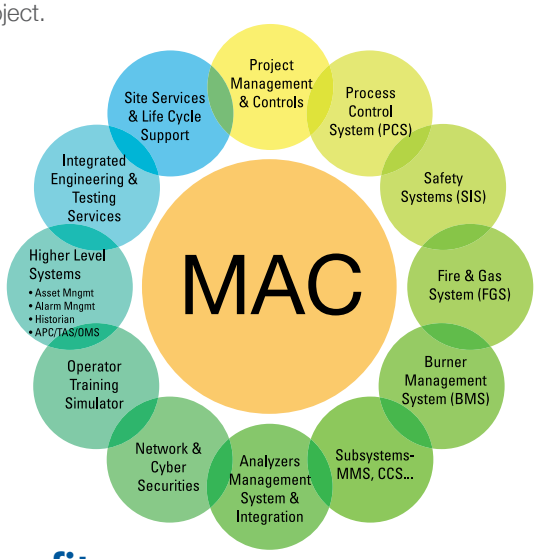
YMA PROJECT EXECUTION CAPABILITIES

Green Field Projects

Basic and detailed engineering, system hardware assembly and wiring, procurement of non Yokogawa products, system engineering, complete integrated testing at factory, installation, site acceptance testing, commissioning, hand over and maintenance.

Main Automation Contractor "MAC"

The MAC approach involves earlier involvement in the project, which reflects a greater influence over the costs and benefits of a project.



Benefits

a) Total project management including sub-contractors management

b) Total instrumentation and installation design and engineering

c) Total systems integration including communication with sub-systems

d) Procurement of necessary materials through Yokogawa worldwide network

e) Single responsibility/single window

f) Shorter delivery time

Front End Engineering Design "FEED"

YMA has bundled its project and industry expertise to conduct the FEED study to ensure that the design will meet the project's time, budget, ROI and operating cost criteria.

Functional Safety Management

YMA implements a TUV certified Functional Safety Management system based on the standards IEC 61508:2010 and IEC 61511:2003 covering the aspects of Management of Functional Safety, Documentation, Functional Safety Assessment and company specific Safety Lifecycle Phases.
YMA has 3 FSM certified facilities (Bahrain, Abu Dhabi and Dubai). This certification covers integration of E/E/PE-safety related Systems and Safety Instrumented Systems for the process industry specifically to cover the activities configuration, application programming, assembly, test and safety loop calculations.

Brown Field Projects Systems Migration/Replacement Projects (Hot/Cold Cutover)

For "Lifecycle Excellence" initiatives, Yokogawa provides solutions for replacement, revamp and/or migration of legacy systems (DCS/SIS/F&G) without time frame constraints or interruption of plant operation. Minimum shut down time, smooth migration/replacement plan and non-interruption of operation are key to customer satisfaction. The YMA project team approach ensures easy migration or expansion of earlier versions of CENTUM and ProSafe-RS. Other vendor's obsolete system(s) can also be replaced by Yokogawa's latest systems (DCS/SIS/F&G) using tools developed for engineering such replacements.

YMA's team of experts specialize in the site works related to transfer of control loops, safety loops, instruments and systems based on hot or cold cutover methodologies, enabling customers to decrease risk and downtime and to increase operational performance.

SERVICES

A WIDE RANGE of SERVICES MENU

There is a wide range of services which commence from the time of system delivery to site

- Managing Lifecycle Agreements (LCA)
- System installation, start-up & Commissioning service
- 24/7 emergency on call service and remote system diagnosis
- Scheduled on-site service
- Application enrichment service
- System software upgrade service
- Preventive Maintenance Visits
- Telephonic support for technical assistance
- Customer training (Standard and Customized)
- Spare parts management
- Environmental diagnosis and deterioration analysis
- Response center support (RCMA)

The services form a set of Service Level Agreements (SLA), from which customers can select which one fits their need and budget.

TRAINING

Eastern Africa policy of development through diversification has shown significant results allowing to maintain a high growth rate compared to many other countries in the world.

However, the rapid growing and emergent industries are facing the challenge of reaching a high Industrial Automation expertise and knowledge level in the areas of control and field instrumentation.

To achieve this ambitious objective, Yokogawa is working jointly with our esteemed Eastern African customers to propose a comprehensive suite of training courses and programs, building a bridge between higher education and Industry.

Pioneer in Industrial and Process Automation since more than 100 years, Yokogawa is the reference trainer with proven Oil & Gas expertise and experience.

It offers the best educational tools, gathering classroom training, practical hands-on sessions on specialized training benches, dynamic simulation and even possibility of individual E-learning.

The following courses among many others are offered by Yokogawa:

a) Systems Training:

- Distributed Control System (DCS) Training courses: CENTUM VP Essentials, Engineering and Maintenance
- Systems Advanced Training: ProSafe RS Engineering, Profibus and Exaquantum
- SCADA Training: STARDOM and Fast/Tools Engineering and maintenance
- PLC and Controller: FA-M3 and Yokogawa Controller configuration and maintenance
- Systems and Solution Software Training: Foundation FieldBus
- Plant Resource Management and Consolidated Alarm Management Software

b) Field Instrumentation Training:

- Fundamentals of Process Control
- Electrical and electronics essentials for instrumentation
- Specialized physics, measurement and Engineering Units for Instrumentation
- Process Documents & Drawing in Oil & Gas Instrumentation
- Principles of operation, calibration and maintenance of field instruments
- Transmitters and signal transmission
- Advanced field instruments communication technology

Those training modules offering the possibility of being assembled to design comprehensive vocational training programs suiting technicians or engineers.

Yokogawa training courses are organized on request at customer sites, South Africa or Bahrain.

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YOKOGAWA