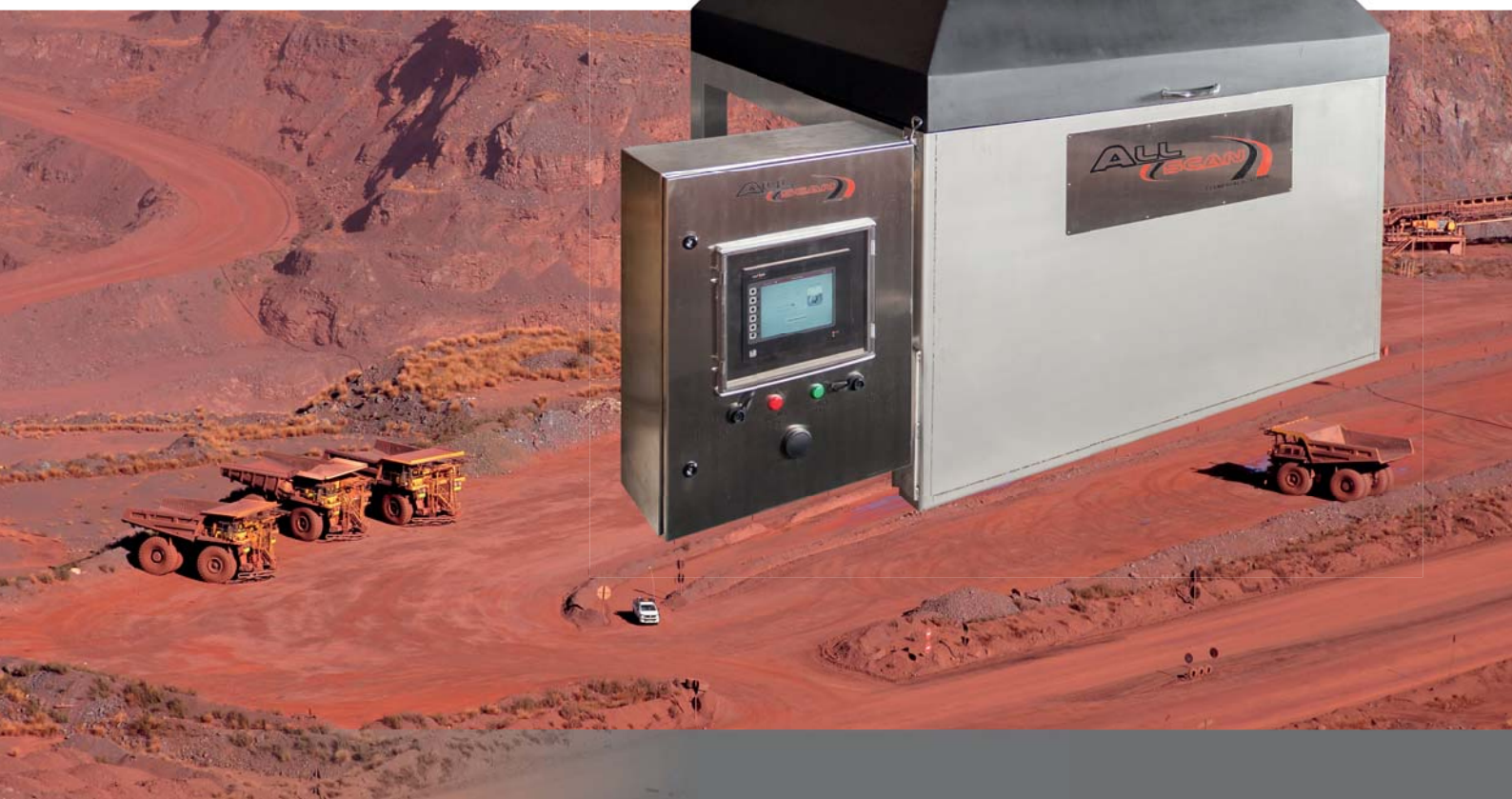


# The Smart Next Generation PGNAA Cross-Belt Elemental Analyser



## Innovative On-line Elemental Analysis Technology for Mining and Mineral Processing

- ▶ Superior Analytical Performance
- ▶ Simplified Calibration Procedure
- ▶ Low Cost of Ownership





# PGNAA Technology for On-Line Compositional Analysis of Mineral Ores

On-line PGNAA technology continuously measures the concentration of individual chemical elements of interest in mineral ores, ore mixes, sinters and concentrates.

## How PGNAA Works

Prompt Gamma Neutron Activation Analysis (PGNAA) is internationally accepted as the preferred option for high performance on-line elemental analysis. PGNAA works by exposing the raw material feed stream on the conveyor to neutrons emitted from a radioactive isotope. When neutrons collide with an element in the material gamma rays are emitted with specific energies unique to that

element - in effect creating a spectral signature for that element. The higher the concentration of an element in the material, the greater the number of gamma rays emitted with the corresponding specific energies. By measuring the specific energies of the emitted gamma rays and the intensity of each specific energy, an accurate analysis of the chemical elements of the material is generated in real-time.

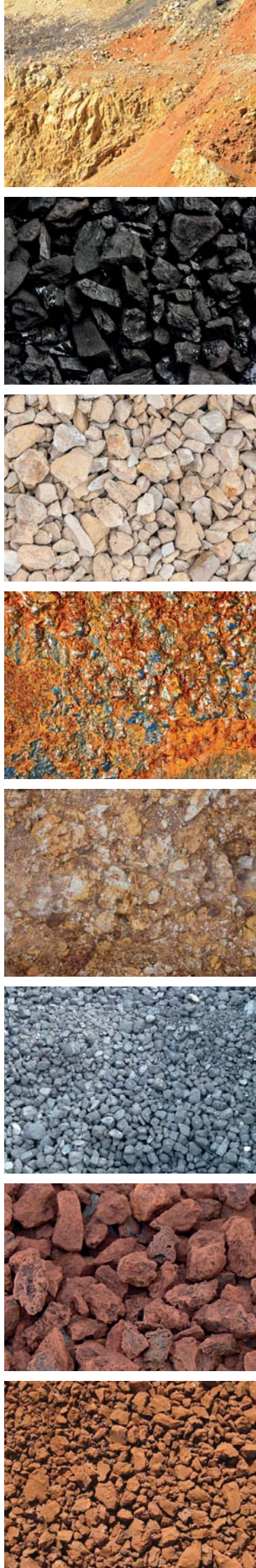


The AllScan uses PGNAA - Prompt Gamma Neutron Activation Analysis - widely recognized as the only option for accurate on-line elemental analysis of minerals

# Used in a Wide Range of Applications

On-line elemental analysis is used in a wide range of mineral applications throughout the production chain...  
...from extraction through to mineral manufacturing.

- Monitoring of ROM streams including screening
- Stockyard QC Management, including sorting and blending
- Optimising at key quality locations in minerals processing plants
- Quality control in metals production, for example blast furnace sinter process
- Product grading at bulk terminals and ship load outs



# Suitable for Most Minerals

Online PGNAA is suitable for most mineral ores, including:

- Iron ore
- Bauxite
- Copper
- Manganese
- Phosphates
- Sulphide and Laterite Nickel Ores and more

Detectable and measurable elements include:

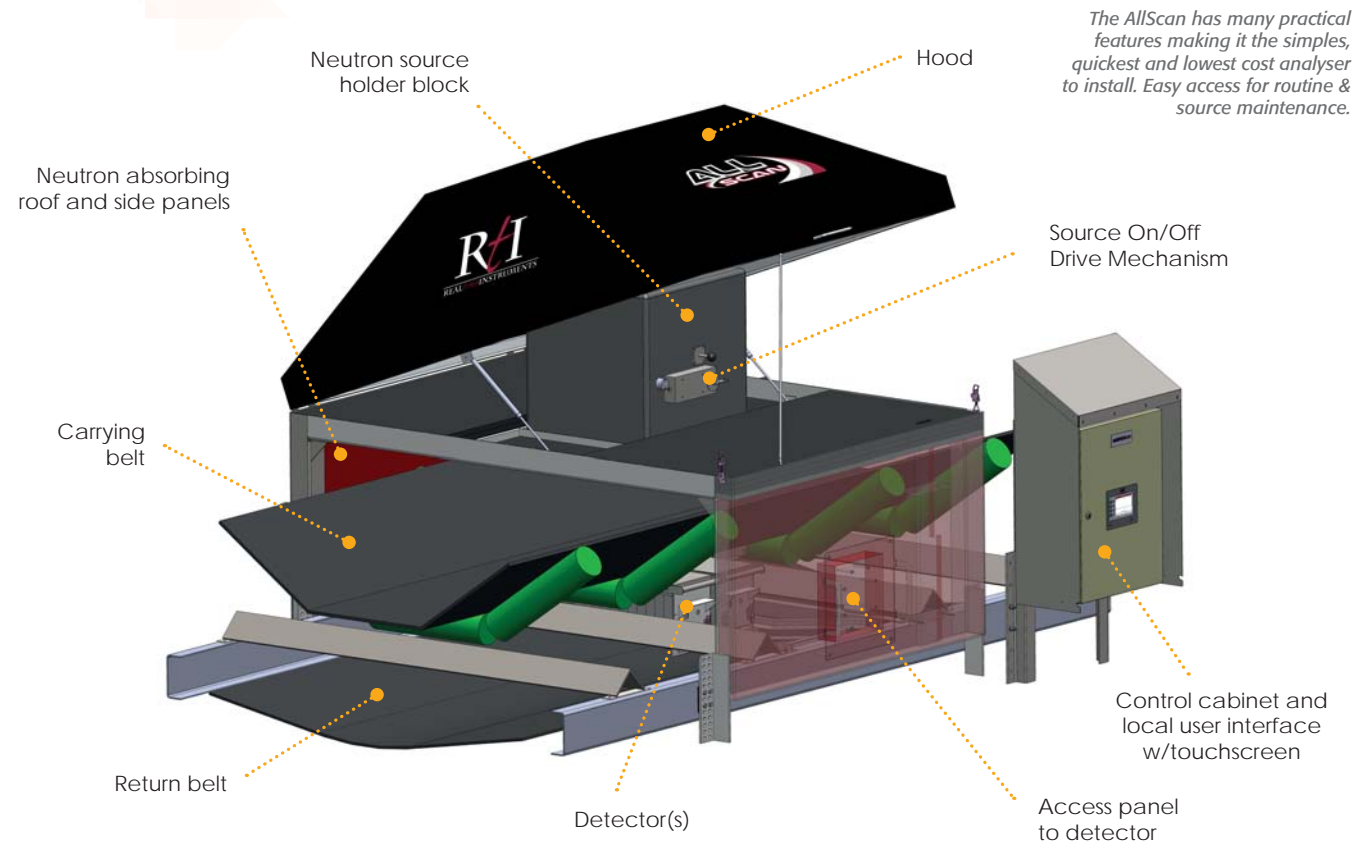
- |    |    |   |
|----|----|---|
| Ag | Cu | S   |
| Al | Fe | Si  |
| Au | K  | Ti  |
| Ca | Mg | V   |
| Cd | Mn | Zn  |
| Cl | Na | Moisture  |
| Co | Ni |   |
| Cr | P  | Even difficult to measure elements, like Phosphorus |

Customer defined ratios can also be reported, for example, Al:Si, Ca:Mg and Ni:Fe



# AllScan® - The New High-Performance Cross-Belt Elemental Analyser

## Technical Advantages that Deliver Real Benefits



### Higher Performance Online, Real-Time Results

Accurate minute-by-minute results, for multiple flow rates. Advanced PGNA design and Dura-G® technology allows significant improvement in performance of full elemental analysis (Fe, Al, Si, K, S, Ti, Ca, etc.) as well as Moisture, offering superior performance over a much wider range of bed depths than similar analysers.



### Unaffected by "high noise Elements"

The only PGNA analyser that maintains accuracy even on Steel cord belts as well as fire retardant belts containing chlorine.



### Easy to Install

AllScan® is considerably lighter than conventional Elemental Analysers, and bolts on to most conveyor structures without alterations or foundations required. Only 5 days for complete installation, commissioning and calibration.



### Safe

Through improved design AllScan® employs a smaller source, reducing required shielding and overall cost of life of the analyser. Personnel can safely work next to the Analyser without the use of toxic lead shields, which also makes it the lightest PGNAA on the market.



### Simple Calibration Verification

No more labour intensive material sampling. The analyser accuracy is verified through the use of calibration standards enabling rapid checks and returning to production quickly. Dynamic sampling will align the analyser with laboratory results.



### Low Running Costs

All military spec. components used in the analyser, eliminating the need for an air-conditioner and associated on-going maintenance in hot environments.



### Rugged and Reliable

Like all RTI Analysers and Gauges, the AllScan® has been purpose designed to work in harsh mine environments. 100% constructed from corrosion free materials, i.e. Stainless steel.



### Easy Operation

User-friendly colour touch screen with intuitive menus, housed in a IP66 stainless steel control enclosure for field or remote mounting. Flexible I/O and Multiple interface protocols are available to suit the Client's needs.



### Remote Access and Back-up

Includes a 3G interface linked to a secure website for full remote diagnostics as standard. Cloud based back-up for safe archiving of important data. Customised monthly operational, integrity & data reports are provided through the remote access for support agreements.



### No Belt Weigher Required

With the advanced analyses techniques employed by the analyser, the AllScan® does not require a belt scale input to function.

## Dura-G™ - a Unique Analytical Calculation Concept

A well-known challenge with the PGNAA technology is deconvoluting the highly complex raw spectrum, which includes not only the important elemental spectra, but also significant unwanted "noise/disturbance factors" from sample presentation, material depth variations, surrounding conveyor structure etc. These "presentation effects" can often be stronger than the "composition" effects.

The Dura-G™ technology built into AllScan however smartly separates these effects, i.e. it allows for all of the spectral components of the complex Prompt Gamma spectrum to be correctly allocated to Compositional or Presentation effects. Thus by the removal of the "noise components" from the complex raw Prompt Gamma spectrum, Dura-G creates a cleaned-up spectrum, which:

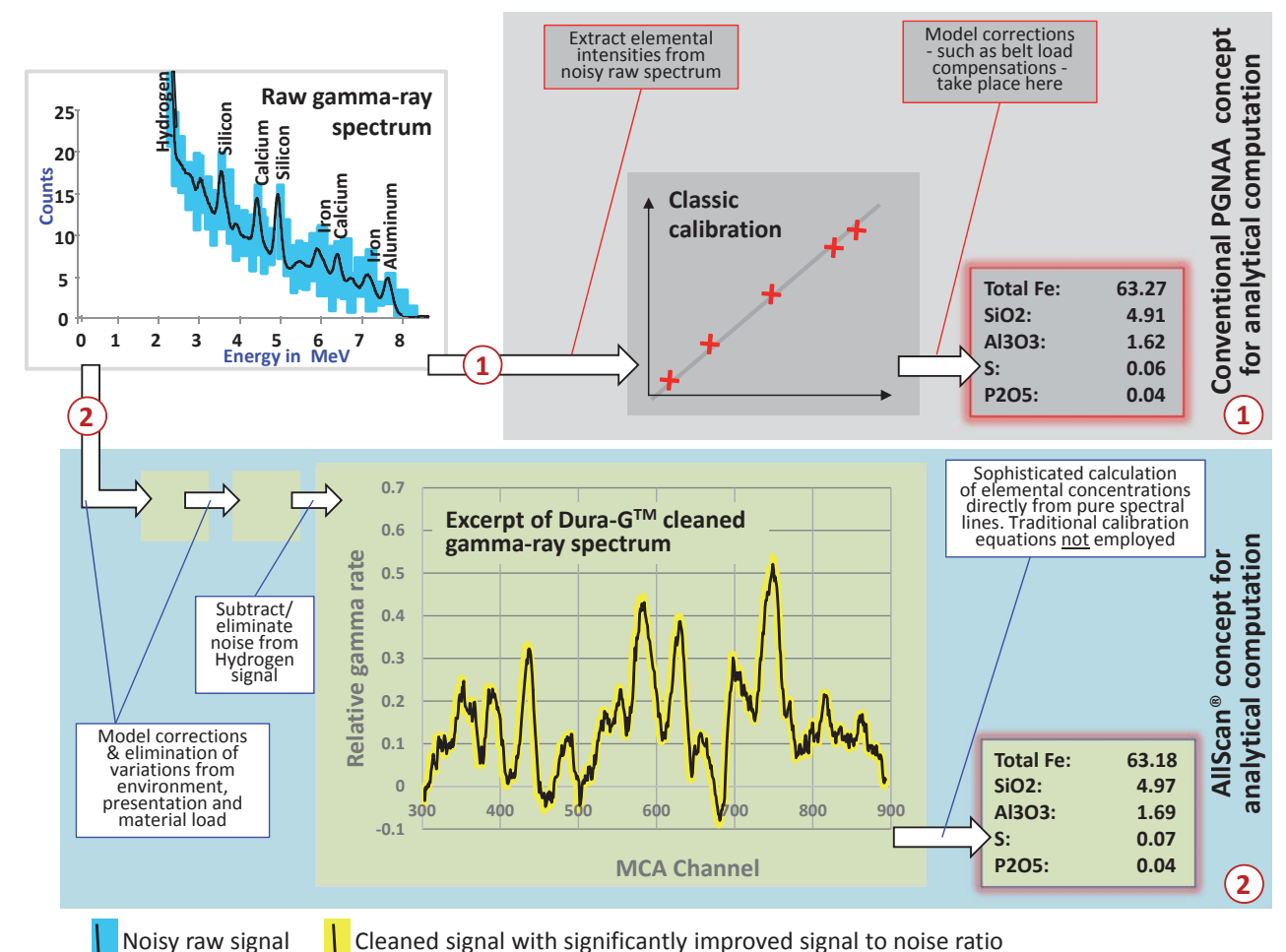
- increases the signal to noise ratio of the measured compositional signal and improves the de-convolution of same to provide output data with reduced measurement error compared to the traditional raw spectrum
- supports a sophisticated calibration sample free calibration methodology to provide an elemental analyser that is not defendant dependant on material or ongoing calibration techniques.

The Dura-G analytical calculation techniques employ advanced mathematical tools that have not previously been used in PGNA gamma spectrum analysis. The development of the AllScan

and its innovative calculation scheme was made in cooperation with University of North Carolina (USA) and other world leading radiation experts.

## ADVANCED NOISE ELIMINATION = GREATLY REDUCED CALIBRATION REQUIREMENTS

Dura-G is a unique modelling and calculation concept based on sophisticated algorithms that separate the effect of environment, belt load and profile variations on the measured spectra from the effect of elemental variations. In the processing, the significant noise attributable to hydrogen is also eliminated. The below illustration outlines how the unique AllScan concept differs from the conventional calculation concept used by other PGNA analysers on the market.





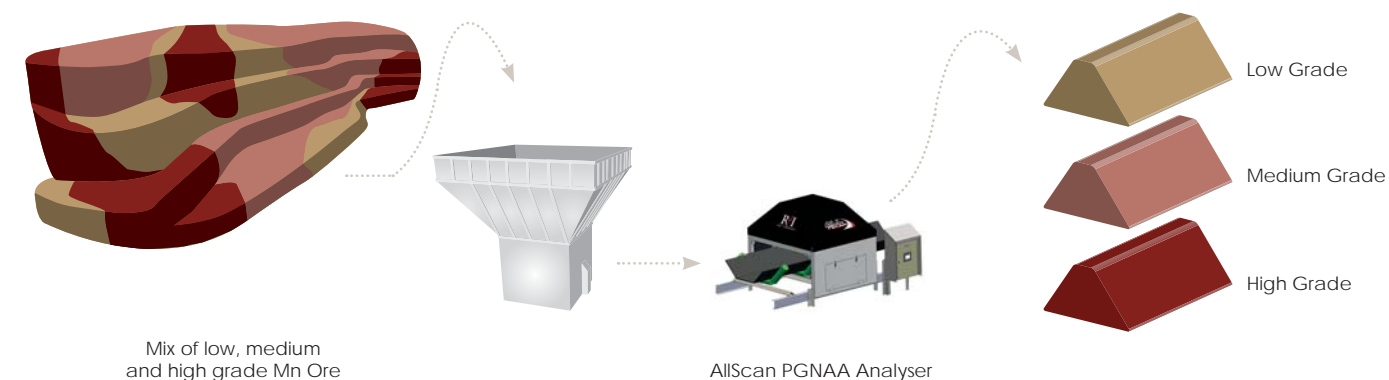
# Case Studies of On-Line Elemental Analysis in Mining and Minerals

## Sorting of Manganese

A Manganese mine operation has three qualities of ore - low, medium and high grade. The aim is to stock the ore according to the three different quality grades. However, due to logistic and operational issues it is not practical to control the feed to the ROM stockpiles via strategic operation of the dumper fleet.

Instead a PGNA analyser is required to enable the operation to achieve their sorting objectives.

The analyser is installed just after the primary crusher and just before a 750m conveyor which leads to the sorting gate at the entrance to the stockpile yard. The ore takes 15 minutes to reach the "sorting point" from the time it is analysed by the AllScan. This provides more than sufficient analysis time to enable the ore to be graded and directed to the appropriate stockpile.



## Blending of Bauxite

Online elemental analysis is increasingly being adopted in the mining and processing of bauxite. At an Alumina plant a PGNA analyser is required on the bauxite feed to the stockpile yard to calculate the Alumina Module (Al:Si ratio) of bauxite. The bauxite deposit has four distinct qualities characterized by the Alumina Module. These are Al:Si = 5-7; Al:Si = 7-9, Al:Si > 9 and Al:Si > 25.

In order to prolong the lifetime of the quarry the different grades of bauxite must be exploited in a balanced way. Currently

the Alumina plant experiences very high variation around the targeted Al:Si = 8 for the feed mix stream. Installation of an AllScan analyser combined with a new homogenizing stockpile results in significantly reduced variability of the Alumina Module in the feed mix stream out of the stockpile. It is anticipated that the installation of the AllScan will significantly extend the lifetime of the mine and result in substantial efficiencies in the Bayer refining process.



## Monitoring and Control for Iron Ore

Online elemental analysis is increasingly being adopted by the iron ore industry. Two applications in particular have gained popularity in recent years. These are:

- To monitor the chemical composition of iron ore as it is delivered to the shipping terminal.
- To control process circuits in washing, screening and sorting of ore into lumps and fines

### Monitoring of Deliveries to Shipping Terminal

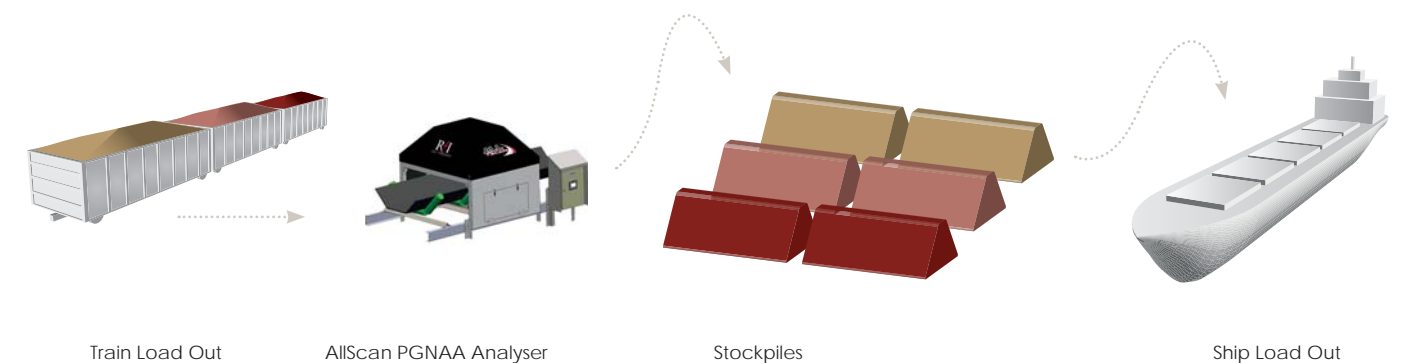
Whilst conventional sampling and lab analysis is still used to determine iron ore quality for contractual purposes, PGNA is increasingly being used to improve stockpile management. Typically an analyser is installed immediately downstream of the train load out station. Incoming ore is analysed for Fe content and moisture. This provides port operators with the ability to build and map stockpiles according to Fe content and moisture.

### Controlling Washing, Screening and Sorting

In addition to Fe, other key elements such as Al, Si and P are measured. In the event that an element of interest drifts out of the targeted analytical range, corrective action can be employed. On-line elemental analysis enables corrective action to be taken immediately the event occurs, thus minimising costs associated with inefficiencies in grading. In contrast, traditional auto-sampling and lab analysis only allows corrective action to take place many hours after the event resulting in significant grading anomalies and associated costs.

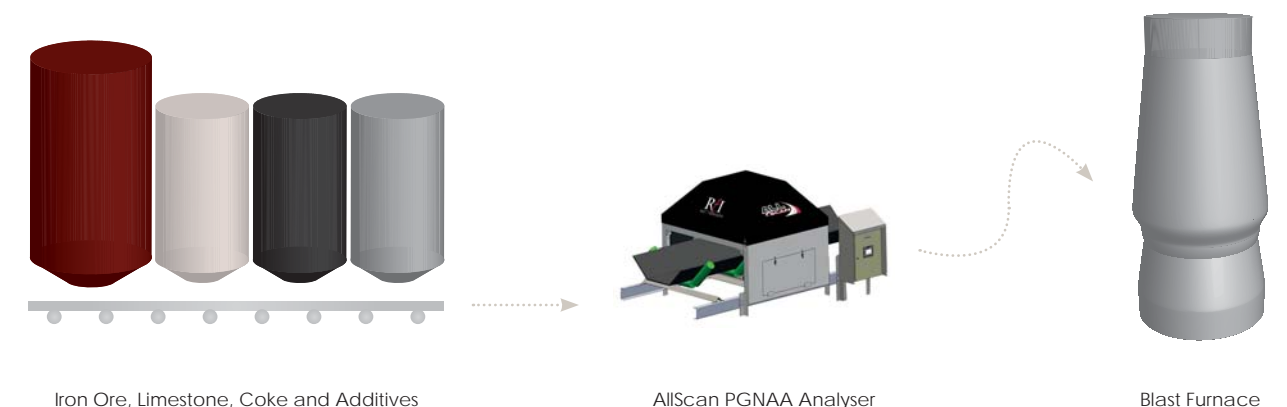
Recently a customer installed multiple AllScan analysers at an iron ore processing facility in Western Australia as an integral component of a major ore grading capital project. Six analysers are installed in the following process locations:

- Crushing station 1 discharge
- Crushing station 2 discharge
- Crushing station 3 transfer
- Fines transfer conveyor 1
- Fines transfer conveyor 2
- Lump transfer conveyor



## Feed Mix Optimization for Sinter Process

Blast Furnace feed mix with a tight chemical specification is fundamentally important in steel making. Typically the main feed components are supplied from a range of sources that can significantly differ in quality. Hence, achieving an optimum mix of iron ore, limestone, coke and other additives can be very challenging. A PGNAA Analyser combined with mix optimizing software that controls the feed to the furnace is an efficient way of achieving optimal feed chemistry to blast furnaces.





# AllScan Benefits and Features

A high-performance analyser developed with strong functionality, calibration simplicity and low cost of ownership in mind

## Superior Analytical Performance

### Dura-G™



The Dura-G modelling and calculation concept is based on sophisticated algorithms that separate the effect of environment, belt load and profile variations on the measured spectra from the effect of elemental variation. This results in a dramatically improved signal to noise ratio and hence accuracy.

### Dura-Sum™

AllScan features another innovative calculation methodology. Traditionally a PGNAAs device will report calculated sets of elemental composition data every 1/2 - 1 minute. Either these frequent raw values or averaged values over a few minutes or a moving, filtered average, is passed on the plant control system and/or application specific 3rd party accounting and optimizing software. AllScan can deliver 1 minute raw elemental composition values as here described. But, in addition Dura-Sum provides a powerful algorithm that eliminates the need for time-based averaging of data in order to obtain stable results. All radiation based analysers have a certain amount of unavoidable random error in the measured output. The statistical approach of Dura-Sum strips the random noise away to show the signal trend more clearly. This means that significant changes in elemental composition can be reported almost instantaneously, rather than minutes later.

## Clever Calibration Procedure

The Dura-G concept means that a conventional sample based calibration scheme is replaced by a calculation methodology where 'clean' elemental library spectra are combined and fitted to match the measured and cleaned spectrum. As classic calibration samples are not involved the factory calibration procedures are fast and cost effective. The initial on-site commissioning requires only a few static reference samples for verification of analytical performance. Together, installation and commissioning is typically 3 - 4 days.



The Dura-G derived calibration concept is a significantly more robust calibration compared to traditional concepts, resulting in much less frequent (or none at all) recalibration. However, in accordance with good QA practices the analyser accuracy should regularly (e.g. every 6 months) be verified against the set of delivered reference standards.

### Ability to Measure Phosphorus



## Low Set-Up and Whole of Life Costs

### Cost Saving Configuration



The selection of rugged industrial control hardware components and the advanced Dura-G™ calculation methodology eliminate the need for air conditioning equipment for detectors and control equipment for the specified -20 to +50°C (14 - 122°F) operational temperature range.

### Hassle-free Installation of the Lightweight Construction



With a typical weight of only 1400kg, the analyser is lighter than most other PGNAAs Analysers, and bolts on to most conveyor structures without any alterations or foundations required.

- ▲ Few days required from installation and commissioning
- ▲ Small initial source loading, and consequently smaller replenishment amounts
- ▲ Once-only initial set-up calibration
- ▲ Moisture determination possible without added equipment
- ▲ Auto-diagnostics
- ▲ Smart alerts via text and email
- ▲ Remote access for customisation support and diagnostics

These all contribute to AllScan having a very competitive cost of ownership.

## Strong Functionality

### Superior Safety Design

The AllScan is engineered to the highest international radiation safety standards.

- Employs the smallest source amount of all PGNAAs analysers
- No radiation safety exclusion zone required due to very low dose rates
- Intrinsically-safe, fail-safe automatic source "on/off" mechanism
- Source holder is certified fire and drop-tested
- No fire suppression system required
- Source holder located on top of the analyser for easy removal, and may also serve as storage unit

The AllScan geometry has the  $Cf^{252}$  source(s) placed above the conveyor belt and the detector(s) placed below. This arrangement facilitates a special source "on/off" feature: when the conveyor belt is running with material, the source is positioned at the lower surface of the source holder block. With the analyser not running or empty sources are automatically retracted to a position in the centre of the heavily shielded neutron source block. This mechanism ensures a significant reduction (75 - 95 %) in ambient neutron flux under 'analyser stop' conditions, and thereby enhances the radiation safety aspects of the analyser installation.

### Multiple User-Interface Options

The analyser status and delivered data can be accessed in a number of ways:

- Rugged graphical touchscreen HMI interface located at analyser
- Ethernet or RS485 web browser interface accessible from standard PC, iPad or iPhone
- 3G modem web browser interface independent of plant PLC system (eliminating IT security issues)

- Convenient data access features including extensive graphics, tabulation, data tracking and data export utilities

### No limitations with PVC (Cl) or Fe in conveyor belt material



A well-known limitation of conventional PGNAAs technology is that conveyor belts containing PVC and/or steel cords will cause significant deterioration of the resultant analytical performance to a degree that the PGNAAs supplier will try to avoid the application. As for the PVC case, chlorine has a very high neutron capture rate and produces a very large Cl signal. With a large Cl signal the signals from other elements are 'lost' in the spectra (poor signal to noise ratio). With Dura-G the Cl signal is removed prior to de-convoluting the spectra. For belts with steel cords, the added, unwanted Fe contribution is in a similar way removed from the raw spectra as an 'environment disturbance' early in the processing. This approach has proved superior to other Fe-level compensation methods.

### Archiving of analytical data



The analyser software archives all incoming spectral information rather than converting the spectrum to data and archiving a subset of extracted data. The archiving of spectra proves very useful whenever there is a desire to add data to the existing calibration database. In this way the calibration may be continually refined, being made more robust, precise, and accurate. The software is "stateless" in the sense that once a calibration standard is run or dynamic calibration data is obtained it can be run and re-run as many times as desired to optimise the calibration and performance

AllScan's lightweight, compact design means that no structural modifications or additional supports are required. The design features easy access to the source holder. The User Interface can be located at the analyser or in the MCA.

of the Analyser. This unique feature minimises the effort to get the analyser up and running so it begins adding value to the operation in a very short time

### Moisture Analysis

The calculation step during which the Hydrogen noise is eliminated facilitates calculation of the material moisture content with good accuracy and precision directly from the Hydrogen spectra. Thus, it is not required to add a separate cost bearing moisture metering device (e.g. Microwave technology), when moisture analysis is required. However, for customers requesting a genuine moisture measurement, RTI's patented MoistScan® technology is optionally integrated into AllScan.

### Upgradability

Old installations of other brand PGNAAs analysers may be upgraded with AllScan electronics, detectors and software to enhance operational performance

### Rugged Construction



The AllScan is manufactured out of non-corrosive materials. The 316 stainless steel control cabinet is IP66 rated. The cabinet is further protected from the environment with a 316 stainless steel over-shield. The frame is constructed of stainless steel and the analyser shielding is made of Boron-doped HDPE and other non-corrosive materials. The local user interface is also IP67 rated with a sun-proof, water and dust resistant cover.

- ▲ Non-Corrosive
- ▲ High Grade HDPE Shielding
- ▲ High Grade Stainless Steel
- ▲ IP67 Rated User-Interface

# Economic Benefits of the AllScan

Utilising available seamless interface options, users of AllScan can access composition analysis of mineral ores/bulk materials on a minute by minute basis, rolling average and interval basis. Pending the specific application details some or all of these operational benefits will be experienced:

- ▶ **Prolonged lifetime of mine/quarry**
- ▶ **Cost savings via reduced requirements for conventional sampling and lab analysis**
- ▶ **Increased throughput rates**
- ▶ **Reduced effect of process upsets**
- ▶ **Consistent product quality with lower variation**
- ▶ **Reduced energy consumption in pyro-processes**

With the lowest cost of ownership on the market AllScan offers the best return of investment to reach these important benefits.

# Product Support and Remote Services

**WE SUPPORT  
OUR CUSTOMERS  
THROUGHOUT  
THE WORLD  
VIA A GLOBAL  
NETWORK OF  
SALES ENGINEERS  
AND TECHNICAL  
SPECIALISTS.**

Real Time Instruments (RTI) has extensive experience in the design, manufacture, implementation and servicing of on-line analytical instrumentation and a proud history of supporting the global mining industry. State-of-the-art diagnostics and remote services include:

- On-board monitoring of detector and electronic status
- Web based connectivity to the AllScan support team for diagnostics and troubleshooting
- 3G mobile data interface eliminating remote access IT security issues
- Automatic generation of text messages (SMS) and emails with key status info and warning/alarm messages

### Global Reach – Global Expertise

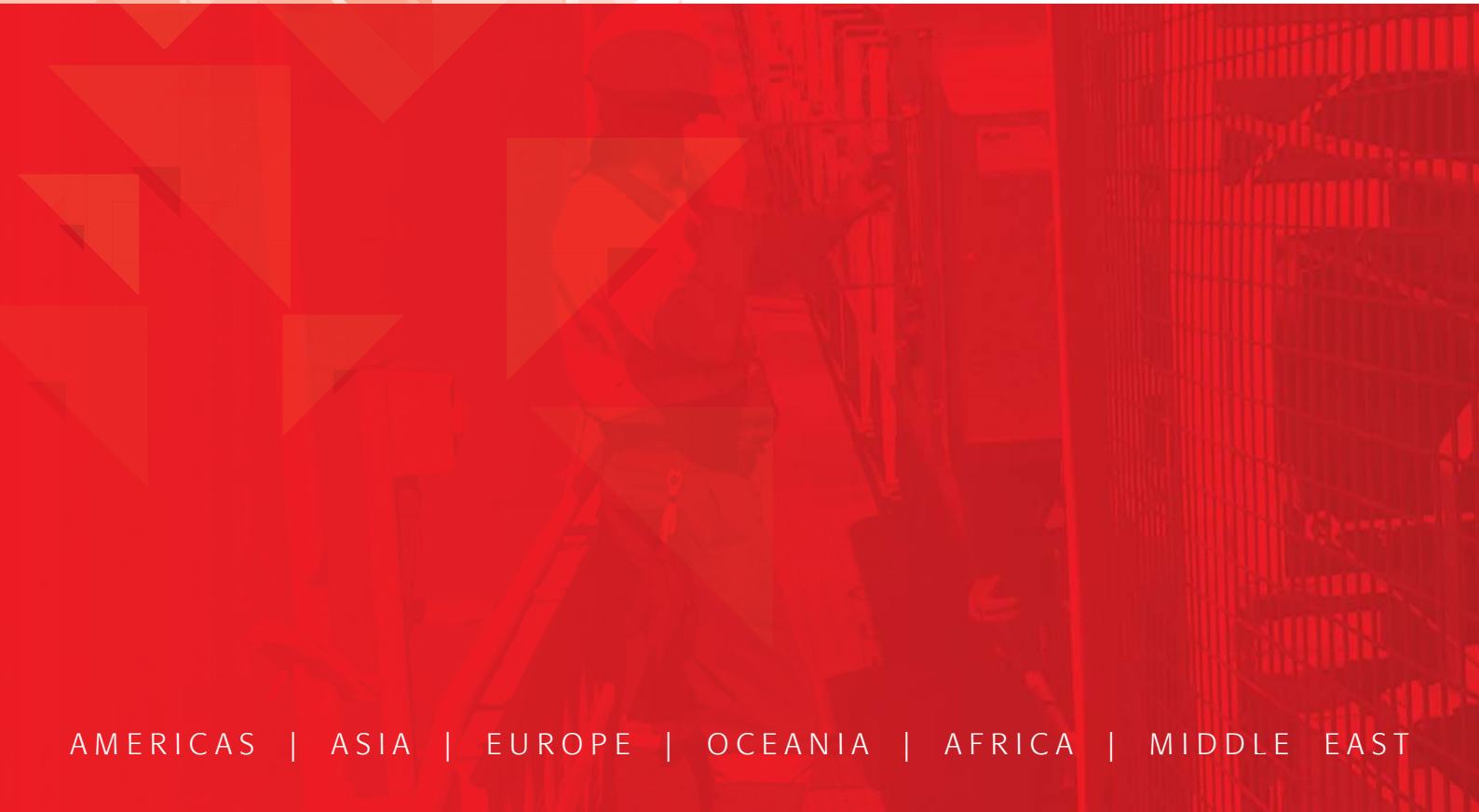
RTI specialises in the manufacture of world class on-line instruments and integration with process control systems. Our focus is predominantly the cement, minerals, coal, and power industries. We support our customers throughout the world via a global network of Sales Engineers and Technical Specialists.

We support our customers throughout the world via a global network of Sales Engineers and Technical Specialists experienced in online instrumentation and process control, based in the Asia, Americas, Europe, Oceania, Africa and Middle East.

# Specifications

Measurement Technique	Prompt Gamma Neutron Activation Analysis (PGNAA).
Analytical Data Reported	User Defined. Most elements can be reported depending on concentration and accuracy required. Typical elements include Ag, Al, Au, Ca, Cd, Cl, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, P, S, Si, Ti, V, Zn, Moisture. User-defined modules can also be reported, e.g. Ca:Si, Si:Mg, Ni:Fe Optional trace elements include: Hg, As and Se
Moisture	Derived from Hydrogen signal - standard Integrated MoistScan® Microwave Technology (optional) for the measurement of Free Moisture
Weight	1200 - 1500kg (2645 - 3305lb) depending on size of belt
Belt Widths	750 - 2400mm (30 - 96in)
Dimensions	Length - 2000mm (78in). Height - manufactured according to belt width. For an 1800mm (70in) belt, height is approximately 1950mm (76in) with hood open and 1400mm (55in) with hood closed
Troughing Angle	35°; 45°
Source	Standard analyser is loaded with 20µg Cf <sup>252</sup> (2.6 years half-life). For large belt width or high performance applications 40µg Cf <sup>252</sup> is used. Typically, an initial 20µg Cf <sup>252</sup> source is topped up with 10µg after 2.5 years and again after 5 years. Disposal occurs at 7.5 years
Source Holder	Automatic Source Drive with automatic fail safe in event of power loss Physical Isolation Point Complies with all radiation safety requirements
Radiation Exposure	Typically below 5µSv/hour outside and around the exterior of the Analyser Average 1.3µSv/hr on or near the catwalk beside the Analyser
Communications	At the Analyser - 10" graphite LCD colour Touchscreen Local Operator Interface Analyser to Customer PLC System – Modbus over RS-485 (default standard). Most industrial communication protocols over Ethernet (TCP/IP), RS-485, RS-422, RS-232 Facility for OPC client/server link Remote Support - 3G Wireless, Built-in web server allows remote view or control from any internet connected PC, Tablet or Smart Phone
Operating Temperature	Sensitive parts of the AllScan® are sealed from the environment. The Analyser is designed to operate in all outdoor weather conditions from -20 to +50°C (14 - 122°F) in high or low humidity or precipitation
Power	Instrument quality 120/240VAC; single phase; 2400W; 50/60Hz; at analyser control
Control Cabinet	IP66 rated, 316 stainless steel cabinet 800mm wide x 600mm high x 300mm deep (31in wide x 23in high x 12in deep)
Frame	Industrial-grade 316 stainless steel framing, Non-corrosive 316 stainless steel fasteners, High-grade HDPE shielding
No Belt Weigher required	The AllScan analyser does not require a belt scale input to function. Proprietary technology makes the requirement for a feed rate input obsolete





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