The Smart Next Generation PGNAA Cross-Belt Elemental Analyser

ALL SCAN

A Quantum Leap Forward in Compositional Analysis and Quality Control for the Cement Industry

- Leading Edge Smart Technology
- Simplified Calibration Procedures
- Lower Cost of Ownership

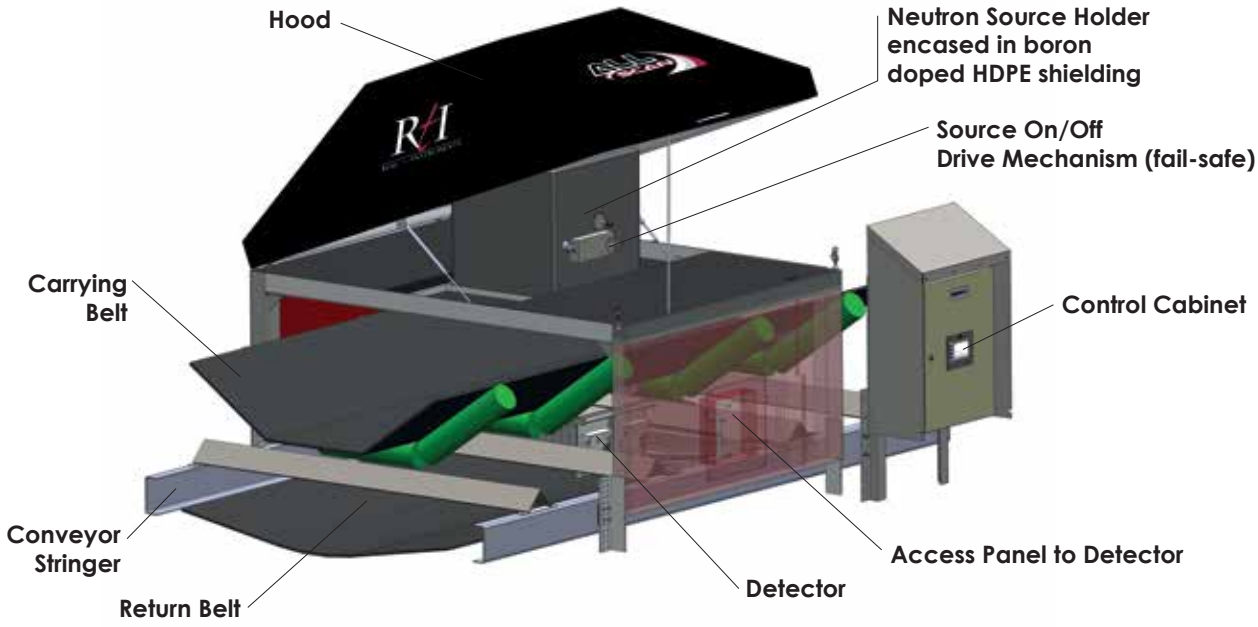
RHI REALtimeINSTRUMENTS

a division of Realtime Group Limited solutions for today and tomorrow

Leading Edge Technology for Cement On-line Analysis

The **AllScan**® is the most technically advanced cross-belt elemental analyser in the world today

Combining state-of-the-art nuclear technology (PGNAA) with ground-breaking spectral modelling (Dura-G™) **AllScan** delivers accurate, minute-by-minute elemental analysis and reporting of key process parameters.



At the heart of the **AllScan** is PGNAA - prompt gamma neutron activation analysis. The raw material feed stream on the conveyor is bombarded with neutrons emitted from a radioactive Cf^{252} 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 energy. By measuring the specific energy of the emitted gamma rays and the counts (= intensity) of gamma rays, an accurate analysis of the chemistry of the material is generated on a second-by-second basis.

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 analyser is active (= conveyor belt running with material) sources are positioned at the lower surface of the source holder block. With the analyser inactive (due to process operation, maintenance or power failures) the neutron 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.

The 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, and provided a fully simulated radiation model of the **AllScan**.

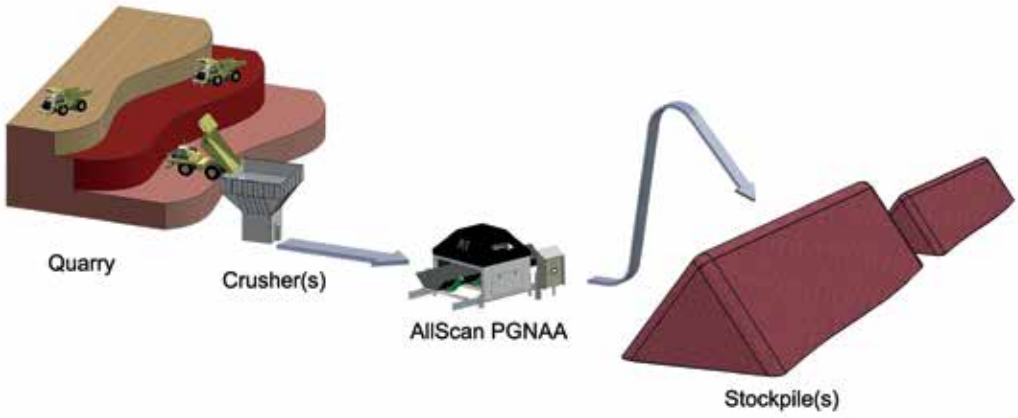
Cement Quality Control Applications

Accurate real time data on the composition of raw material feed streams before stockpiles or raw mills increases product quality and contributes to reduced production costs.

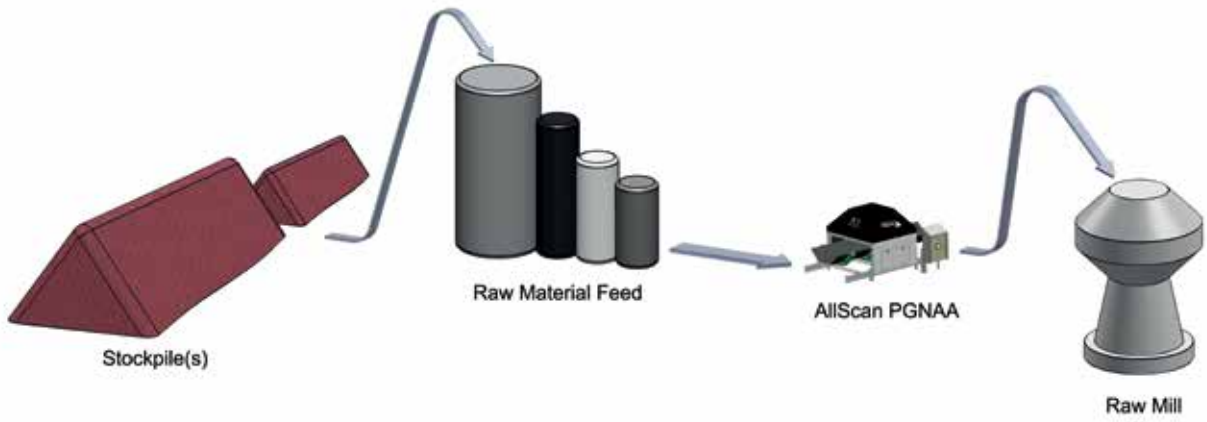
Utilising the various interface options available users can access analytical data on a minute-by-minute basis, rolling average and interval basis. The **AllScan**® measures and reports analytical data of relevance for cement production, such as: **SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, Na_2O, K_2O, S, Cl** etc. + Moisture as well as customer-defined derived cement chemistry modules like **LSF, KH, SIM, ALM** etc.

The use of **AllScan** in **Quarry and Stockpile management applications** facilitates significant improvements in pre-blending performance through improved utilisation of quarry materials and homogenised building of the stockpiles to desired target chemistry with minimum variations.

The **AllScan** is typically installed on the conveyor between crusher(s) and stockpile(s). The **AllScan** continuously reports the elemental composition of the material on the conveyor belt. This information is used to keep track of the pile build-up and may optionally be used to direct haul trucks to different sections of the quarry in order to best exploit the quarry.



Another application for the **AllScan** is to deliver the on-line analysis data for a **Raw Mill quality control application**. Here the analyser is placed on the conveyor downstream of the feeders and upstream of the raw mill. The on-line analytical data is the basis for QC optimising schemes, which reduces the variability in the raw mix product, and ultimately the kiln feed. Consistent kiln feed chemistry in turn leads to better quality clinker and lower fuel consumption per ton of clinker produced.



In both applications the data from the **AllScan** is seamlessly transferred to the plant control system and is typically interfaced to 3rd party QC optimization software to improve quarry operations, stockpiling and raw mix proportioning.

AllScan interfaces by means of applicable electrical standards and communication protocols with well-known DCS and PLC type Plant Control Systems as well as QC optimization software from leading suppliers of cement specific quality control software.

Dura-G™, a Unique Analytical Calculation Concept

Efficient, advanced noise elimination = sample free calibration

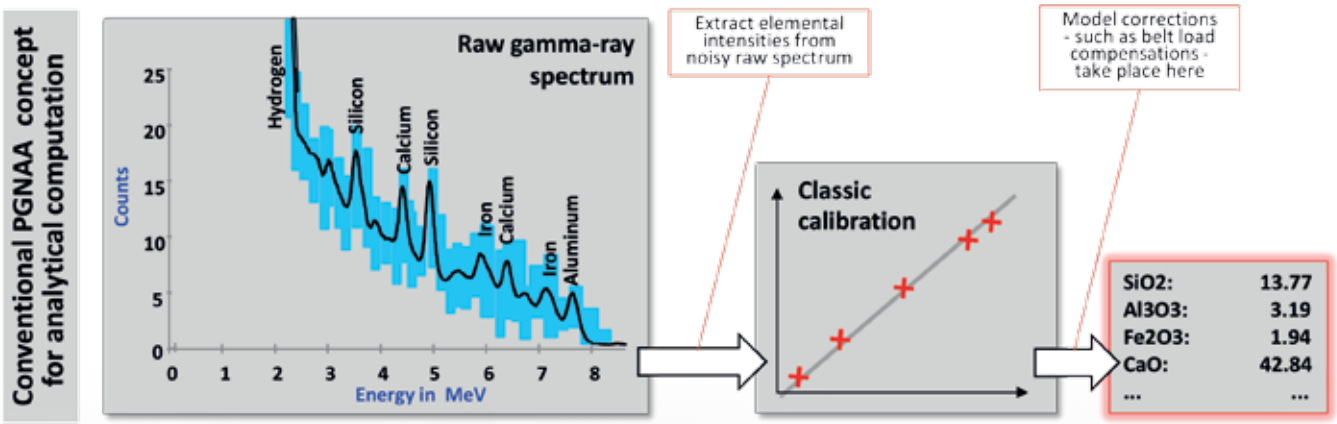
A well-known challenge with the PGNAA technology is a highly complex raw spectrum comprising of all the individual elemental spectra plus significant "noise/disturbance factors" from sample presentation, material depth variations, hydrogen signal etc. All of these factors make up the "presentation effects" and can often be stronger than the "composition effects". **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. Thus, by smart removal of "noise components" from the complex raw Prompt Gamma spectrum, Dura-G creates a cleaned-up spectrum, which:

i) considers all the spectral components independently and ensures these components are correctly allocated to the separate Composition and Material Presentation effects

ii) 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

iii) supports a sophisticated sample free calibration methodology to provide an elemental analyser that is not dependant on material or ongoing calibration techniques

The Dura-G technology smartly separates the composition and presentation effects, i.e. it allows for all of the spectral components of the complex Prompt Gamma spectrum to be correctly allocated to Composition or Presentation effects. 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 players in the market:



Noisy raw signal

Cleaned signal with significantly improved signal to noise ratio

...with a Multitude of Important Benefits

Smart software replaces costly components and services

Cost saving analyser configuration

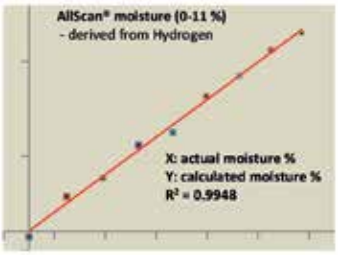
The selection of rugged industrial control hardware components and the advanced Dura-G™ calculation methodology ***eliminate the need for air conditioning*** equipment for detectors and control equipment for the specified -10 to +50°C (14 - 122°F) operational temperature range. With a typical weight of only 1400kg, the analyser is lighter than most other PGNAA Analysers, and bolts on to most conveyor structures without any alterations or foundations required.

Cost saving, time efficient calibration and installation

The Dura-G cleaned spectrum also 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 a 3 - 4 days activity. A single calibration holds for all bed depths, and the calibration never needs to be re-done. 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.

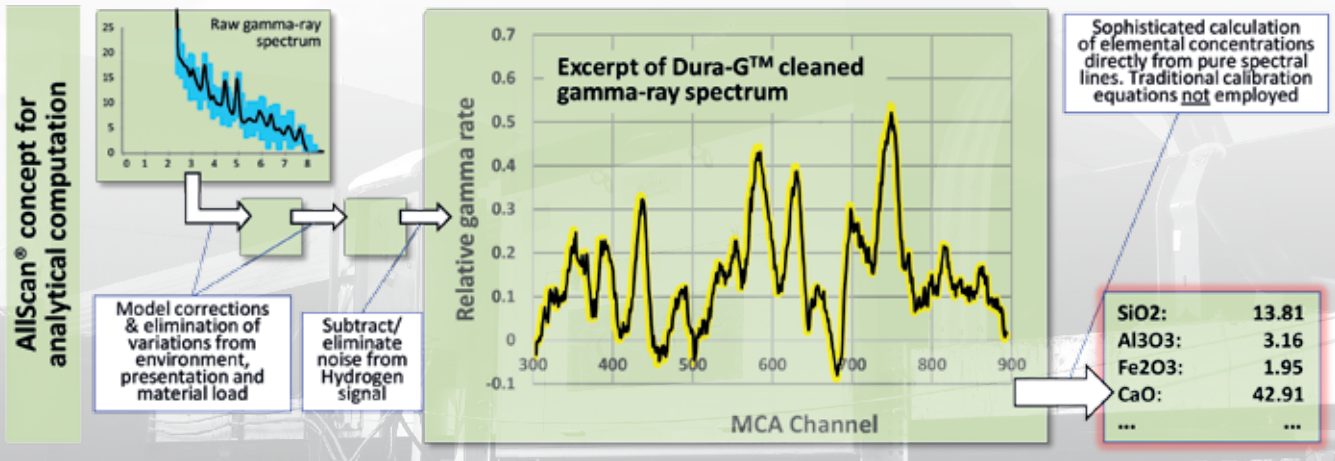
Moisture determination at no extra cost

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, the **MoistScan**® is an available optional device.



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

A well-known limitation of conventional PGNAA 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 PGNAA 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 may in a similar way be removed from the raw spectra as an 'environment disturbance' early in the processing. This approach has proved superior to other Fe-level compensation methods.



AllScan® – Additional Benefits and Features

Developed with strong functionality and low cost of ownership in mind

Safety first

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

- Employs the smallest source amount of all PGNAA analysers applied for cement
- 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-tested to 800°C for 30 minutes and drop-tested to 9 metres
- Source holder, which also may serve as a storage unit, is located on top of the analyser for easy removal if required
- No fire suppression system required
- Light Weight (Lightest PGNA analyser on the market)

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 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.

Dura-Sum™

AllScan brings another innovative calculation methodology. Traditionally a PGNAA device will report calculated sets of elemental composition data every ½ - 1 minute. Either these frequent raw values or averaged values typically over 5 - 10 minutes or a moving, filtered average, is then consecutively used by associated 3rd party accounting and optimising software. AllScan may indeed 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 in minutes.

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)
- The convenient data access features include extensive graphics, tabulation, data tracking and data export utilities
- Daily backup to the cloud for rapid software and calibration recovery, and monthly reporting.

Upgradability

Old installations of other brand PGNAA analysers may be upgraded with AllScan electronics, detectors and software to enhance current 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 noncorrosive materials. The local user interface is also IP67 rated with a sun-proof, water and dust resistant cover.

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

Low Cost of Ownership

Installed and set up correctly, the **AllScan** is virtually trouble-free. Apart from periodic source top-ups, only minimal ongoing maintenance is required. Details include:

- Rugged control components and no air conditioner required
- Hassle-free installation of the lightweight construction
- 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.

Product Support - Remote Services

RTI has 35 years cumulative experience in the design, manufacture, implementation and servicing of on-line analytical instrumentation and a proud history of supporting the global cement 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
- Alternative 3G mobile phone interface eliminating remote access IT security issues
- Automatic generation of text messages (SMS) and emails with key status info and warning/alarm messages
- Daily backup to the cloud for rapid software and calibration recovery, and monthly reporting

Complete On-line Quality Control Scheme from Quarry to Kiln

Via our alliance with OEM Partners in Quarry and Stockpile Management Software and Raw Mix Proportioning Software RTI offers a complete measurement and process control solution from the quarry to the kiln.

Global Reach – Global Expertise

RTI includes a global network of Sales Engineers and Technical Specialists in online instrumentation and process control with offices in the Asia's, America's, Europe, Oceania, Africa and Middle East.

Real Time Instruments (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.

RTI
REALtimeINSTRUMENTS

Specifications

Measurement Technique	Prompt Gamma Neutron Activation Analysis (PGNAA).
Analytical Data Reported	User Defined. Typical reported elements comprise: **SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, Na_2O, K_2O, S, Cl, (TiO_2, Mn_2O_3), Moisture** Typical Modules: **LSF, KH, SIM, ALM, C3S, C2S, C3A, C4AF** Optional trace Element calibrations for: **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 - 96 Inch)
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^{252} (2.6 years half-life). For large belt width or high performance applications 40µg Cf^{252} is used. Typically, an initial 20µg Cf^{252} 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 -10 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.

Locations

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Global Headquarters

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