

NEXT ORE

MOBILE BULK SORTING PLANT





Breakthrough Ore Sorting Technology

Magnetic Resonance is a highly precise, safe and fast technology providing exact quantitative mineralogical grade measurement of bulk mined material and enabling real-time digital process control.

Magnetic Resonance works by quickly pulsing radio waves into a moving sample of ore and measuring the response. The radio signal is tuned specifically to a signature resonant frequency unique to the target mineral. The response signal received is proportionate to the number of metal atoms within the sensor volume and in the tuned mineral phase.

The resonant frequency differs from mineral to mineral. This allows the sensor to measure very rapidly and very accurately, as the sensor will only perceive the presence of the tuned mineral and nothing else.

Sensitivities

The sensitivity of each mineral to detection also varies. As shown for each mineral in the table, the more sensitive the mineral is, the more quickly and accurately the MR system can deliver a measurement. For lower sensitivity minerals, a longer measurement interval time is required to deliver equal precision.

	Mineral	MR Sensitivity
Copper	Chalcopyrite	High
	Cubanite	High
	Covellite	Medium
	Chalcocite	Medium
	Enargite	Low
	Tennantite	Low
	Cuprite+delafossites	High
	Tenorite	Low
Arsenic	Arsenopyrite	High
	Orpiment	High
	Realgar	High
	Löllingite	High
	Niccolite	Medium
Iron	Hematite	High
	Magnetite	Very High
	Maghemite	High
	Pyrrhotite	High
Bi	Bismuthinite+others	Medium
Sb	Stibnite+others	High
Zr	Zircon	Low
Co	Cobaltite	High

MR Sensor

The MR sensor is an antenna that transmits and receives the radiofrequency signals. Shielding is installed ahead of and behind the sensor core on the conveyor to reduce electromagnetic noise and enclose the radiofrequency field.

The MR sensor transmits and receives radio signals every few milliseconds. The strength of the ore's response, averaged over a given duration, gives weight of target mineral in the corresponding volume of ore called a 'pod'. This mineralogical weight is combined with output from a belt weightometer to delivery a grade percentage, for the pod.

Features

- Large opening to avoid blockage and permit large particle sizes
- Fully penetrative of coarse and fine particles
- Fast, accurate measurement in as little as 2 seconds
- Factory calibrated, measurement not impacted by:
 - Moisture
 - Particle size
 - Host rock type
 - Changing trace elements

Health and safety

The MR sensor uses safe, non-ionising, radio frequency fields, similar in frequency to television or two-way radio communications.

Radio technology is safe to operate in the vicinity of humans. Shielding installed on the MR sensor not only shields the MR sensor for environmental noise, but also shields operators from the electromagnetic field such that field strengths are orders of magnitude below safe working limits.





The chalcopyrite MR sensor operates at 18.5MHz. This corresponds to the “High Frequency” band, which is the same as for broadcast radio, radio television, and 2-way radios.

MR Sensor

Configurable feed

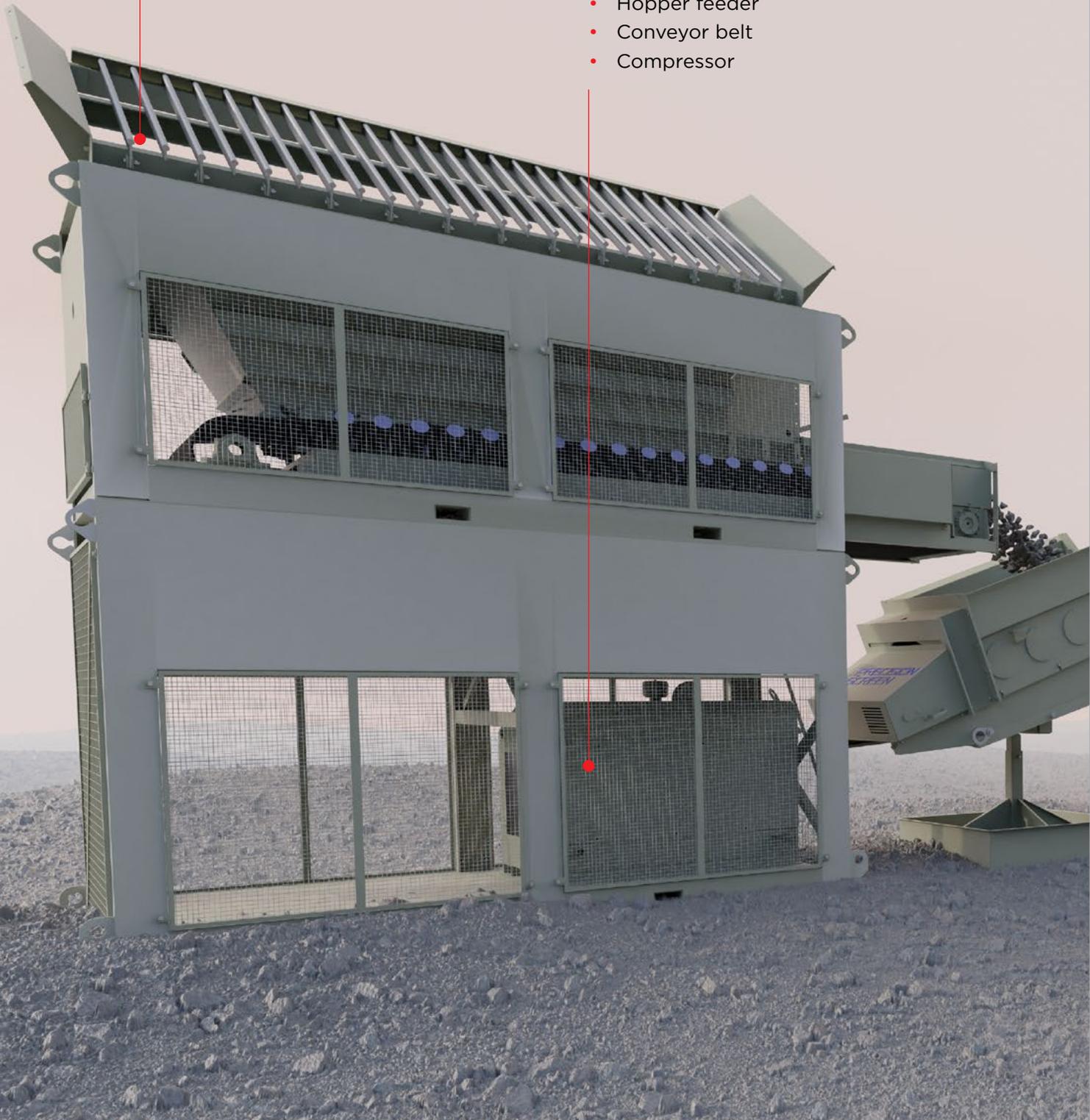
MBSP can be fed either from:

- Hopper feeder (shown)
- Mobile crusher

Optional diesel configuration

Enhanced mobility and operational flexibility with all subsystems run off diesel power:

- MR analyser
- Hopper feeder
- Conveyor belt
- Compressor



MR technology

- Fast, accurate mineral grade measurement
- Reliable measurements in seconds
- No recalibration required
- Wide aperture core

Mobile conveyor

- 100–600 tonnes per hour
- 900mm width
- 250mm particle top size
- Variable speed hydraulic motor
- Safety stop pull-rope
- Self-greasing idler rollers
- Adjustable discharge height (1–7m)
- Anti-rollback bars
- Integrated weightometer

2-way diverting chute

- Fast acting blade diverter
- Pneumatically actuated
- Replaceable Hardox wear plates

Flexible discharge

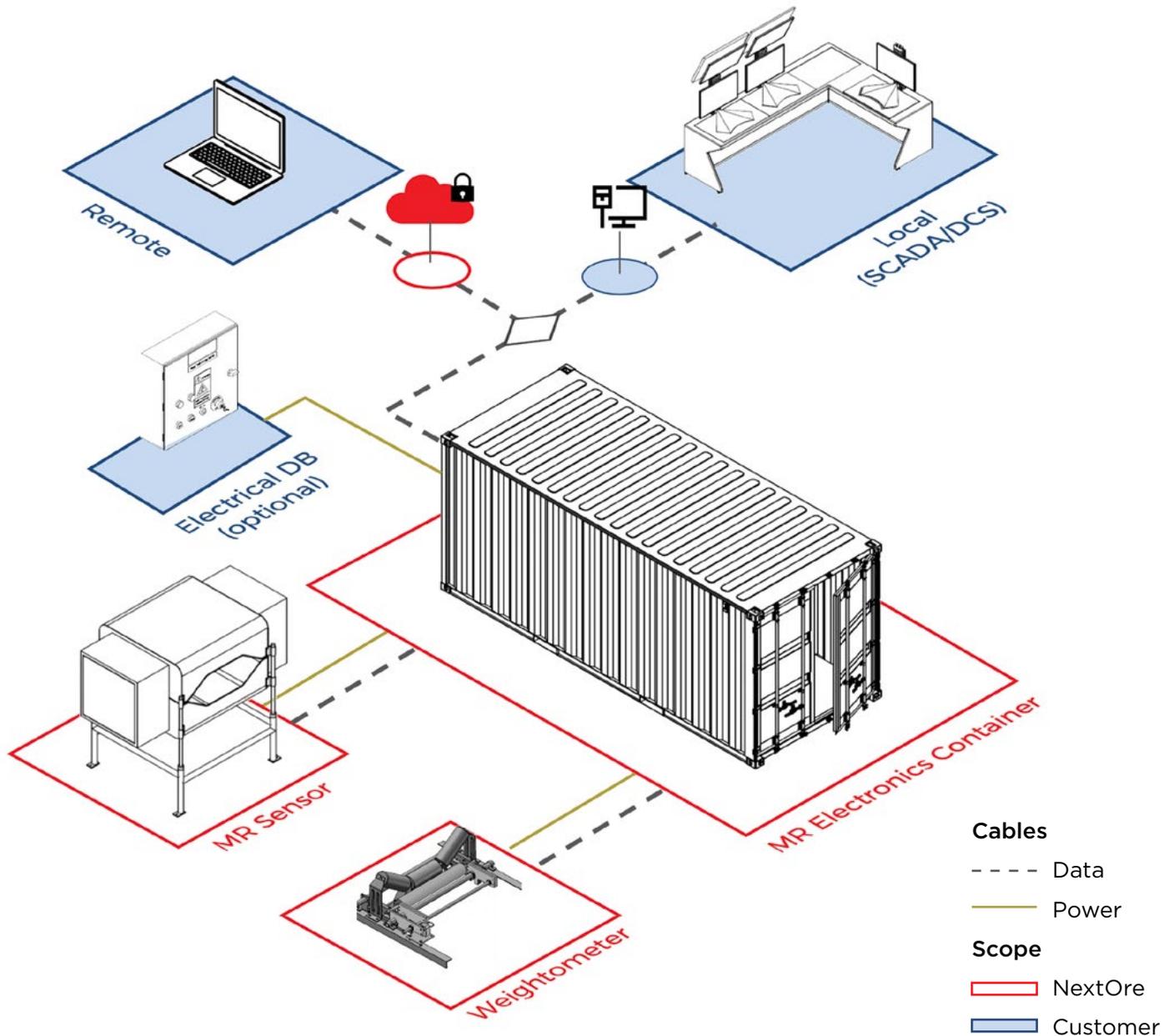
- Chute angle adjusts with conveyor height
- Options to discharge into stationary bays or into product stacker conveyors for increased stockpile capacity



Digital Process Control

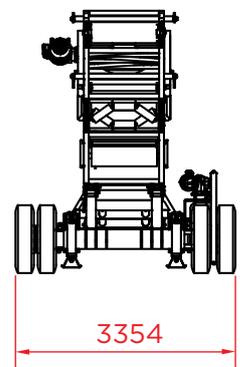
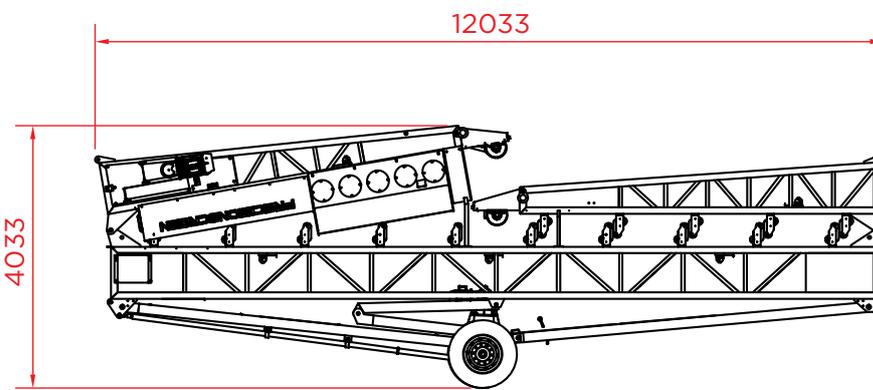
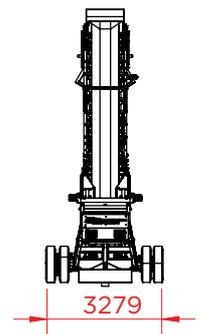
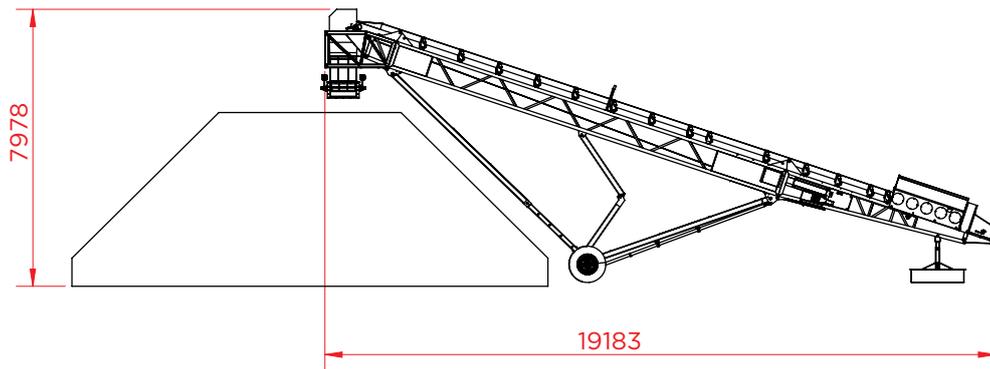
The environmentally controlled MR container houses the power and control systems of the MR analyser. On setting the cut-off grade, MRA computer autonomously coordinates controls of the diverter chute and the MR sensor.

A local link by modbus TCP/IP is available for real-time monitoring and sorting adjustment by DCS or SCADA.





Dimensions



SIDE VIEW

FRONT VIEW

Specifications



Magnetic resonance sensor	
Manufacturer	NextOre
Model	MRA-XX-900
Measurement type	Mineral concentration
Maximum particle size	250mm
Measurement interval	1-8 seconds
Pod size	25 - 1,000 kg
Measurement precision	1 σ < 10% rel. (i.e. for avg. 0.30%Cu < 0.03%Cu)
Power consumption	15KVA

Magnetic resonance electronics	
Manufacturer	NextOre
Dimensions	20' (5.9m x 2.4m x 2.4m)
Weight	4,500kg (gross)
External interface	HMU touch panel
Internal interface	Environmentally controlled workstation
Modem	3G / 4GLTE, Wifi, or ethernet
Digital output (optional)	Modbus TCP/IP
Remote data platform	MQTT + MS Azure

Power options	
Local electrical (option 1)	
Voltage	Any (transformer included)
Type	3-phase, 4- or 5-wire
Total power consumption	32KVA
Diesel generator (option 2)	
Make	Kubota
Model	V2203-E2BG
KVA (Prime / Standby)	31 / 35
Fuel capacity	120L
Fuel consumption (75% load)	7.05L/hr

FAQs

What does the Magnetic Resonance Analyser “sense” in ore?

Whereas some other sensors measure characteristics of ore like density, surface composition/colour, or permittivity/conductivity, the Magnetic Resonance Analyser is capable of delivering real-time readings of the weight of the target mineral in the ore. This is combined with data collected from a weightometer to deliver accurate grade measurement of the ore stream on a metre-by-metre basis.

What accuracies can Magnetic Resonance measurements achieve?

The Magnetic Resonance sensor has delivered sensing resolutions less than 0.05% copper*.

How is NextOre’s technology different from competing sensing and sorting technologies?

Magnetic Resonance is a true bulk sorting technology. Because the radio waves easily penetrates tens of centimetres into the ore, it does not need a direct line of sight to each particle. The sensor can be mounted to existing conveying equipment without the requirement for special preparation. Sorting of ore at typical mining rates is achieved without the requirement for complicated and costly materials handling and preparation equipment like screening, crushing & washing.

The sensor delivers highly accurate, real-time grade measurements and instructs a diverter to selectively remove material below a cutoff grade programmed by the operator as opposed to estimating whether material should be rejected or not based on grade of the sensed material.

* Mineral dependant.

What size material can be measured and sorted?

Primary crushed ore with top size below 250mm is recommended (for MBSP).

Does the presence of magnetic or paramagnetic material interfere with the measurement?

No it does not, the measurement is tolerant of high levels of magnetic minerals such as pyrrhotite and magnetite.

Will Magnetic Resonance-based sorting work for my operation?

The main characteristics to assess when determining the applicability of Magnetic Resonance-based sorting are ore mineralogy and the variability of grades within the ore, called heterogeneity. The very first stage of analysis by NextOre will include an assessment of the minerals for detection, the in-situ heterogeneity of the ore, and the expected ore “mixing” that will occur as a result of operations prior to sorting.

Are there any safety restrictions associated with the use of Magnetic Resonance sensing?

No, the technology uses low energy radio waves similar to those of a microwave or AM radio and are easily shielded with thin metal sheets.



NEXT
ORE



**MAGNETIC RESONANCE
TECHNOLOGY
DEVELOPED BY CSIRO**

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