

> SGS CATS
MINERALS SERVICES

STOCKPILE EVALUATION SERVICES



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WHEN YOU NEED TO BE SURE

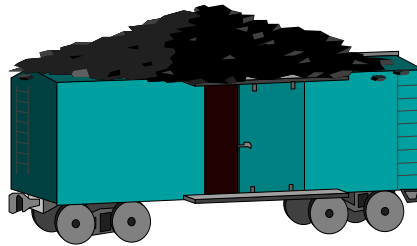


SGS



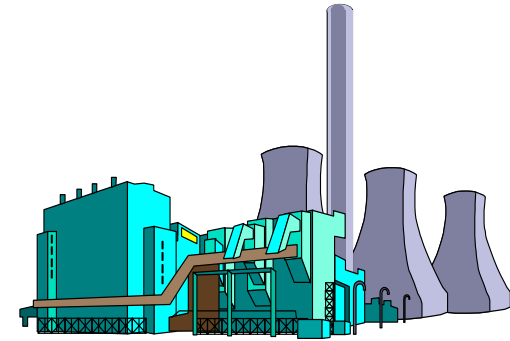
**Physical
Inventory**

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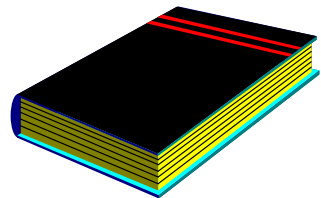


**Fuel
Receipt**

-



**Fuel
Consumption**



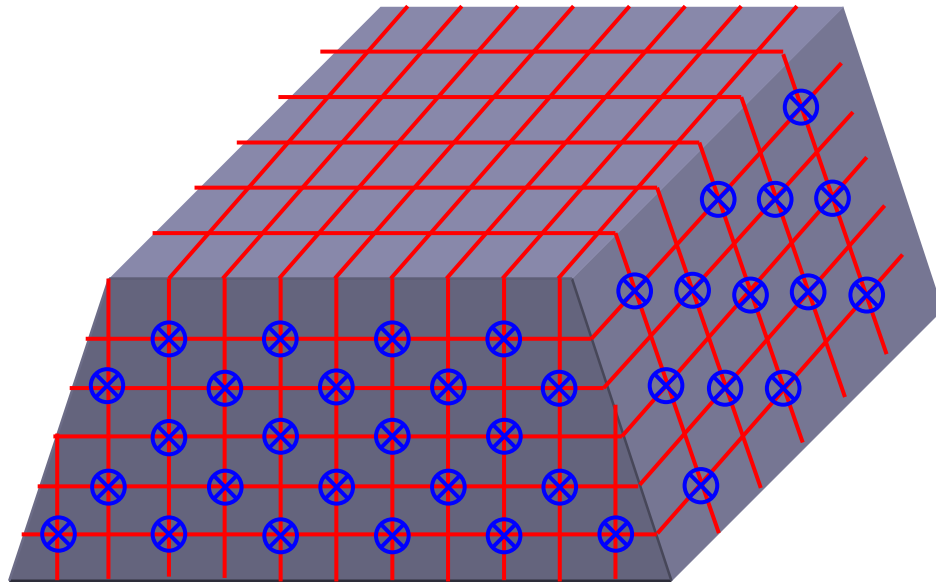
**Book
Inventory**

STOCKPILE EVALUATION: WHY?

- Evaluation of the stock. (inventory control)
- Accounting practice requirements (company listed at stock exchange) and excise duty.
- Emission Trading Scheme (Mass balance).
National Greenhouse and Energy Reporting (measurement) Technical Guidelines 2008 v.1.1 p 2.15
- Purchasing and stock administration.
- Stockpiles Management.

STOCKPILE EVALUATION: HOW?

- Stockpiles are irregular in shape and heterogeneous in quality.
- Tonnage = $\int \text{Density } (z) \times \text{Volume } (z) \times dz$



How to Conduct a coal quantity survey with a minimum of error

- **INVENTORY PLANNING.**
- **COAL STOCKPILE PREPARATION.**
- **LOCATING DRILL SITES.**
- **VOLUME MEASUREMENTS.**
- **DENSITY, TOTAL MOISTURE AND CALORIFIC VALUE DETERMINATION.**



Overview

- **History since 1993.**
- **Customers in over than 10 countries.**
- **The range of our expertise coupled with our extensive experience.**
- **Custom built software for mass/energy balance determination.**
- **Dedicated teams utilising, high precision laser equipment and drilling technology.**
- **Accurate assessment of mass and energy balances for stockpiles of coal.**



Stockpile Survey work recently conducted by SGS

- **DELTA ELECTRICITY / Wallerawang, Mount Piper, Vales Point and Munmorah Power Stations.**
- **BHP - Surveys of Sulphur held in Adelaide.**
- **Scottish Power - Bi-annual coal stock surveys for Longannet & Cockerzie Power Stations, Scotland.**
- **Orica - Tri-Annual surveys of Rock Salt stock.**
- **SPE Management - Tri-Annual surveys of Woodchips held in Geelong, VIC.**
- **Cargill/Grain flow - 21 sites with more than 210 wheat stockpiles evaluated.**
- **British Coal - On the privatisation of British Coal, SGS were asked to measure ALL above ground coal stocks throughout the UK; including Scotland, Wales and Northern Ireland.**
- **Intervention Board - all stocks of grain held in the UK by the European Intervention Board were measured by SGS.**
- **Nyrstar - All stocks of Lead/Zinc Concentrate.**
- **Regular work in Northern France for the Ore Stocks held in smelting works, i.e. Manganese, Nickel & Iron.**
- **Coal stocks held in Belgium, Germany and Netherlands.**
- **Ore and coal stockpiles held in Italy.**
- **Israel - Two power stations required us to evaluate all their coal stocks.**
- **Various Stockpiles In United States of America.**



What can customers expect from us?

- Detailed report via email in PDF format and hard copy.

The report includes

- A description of work carried out, precise measurements of volume, density, calorific value and mass of stockpiled coal.
- A contour map and 3D images of the stockpile at different perspectives.
- A diagram showing the grid position of all drilling holes.

Principles of System and Methodology

A system has been designed using the best available technology, involving:

- **TOTAL STATION LASER topography or GPS TECHNOLOGY** for volume assessment of the stockpile.
(Equipment used: LEICA TPS 1203 – 2 mm distance accuracy or GPS Trimble system -15-20 mm position accuracy)
CIVILCAD software package
- **SPECIALISED UNDISTURBED DRILLING** for the density determination throughout the full depth of stockpile. Quality samples are whole and generated simultaneously.
(Geotechnical Drilling Rig - GEOPROB 7720 DT)
- In the future, after validation work has been completed we will employ **SCATTERING NUCLEAR TECHNOLOGY**.
(Nuclear gauge CPN 501DP for total moisture and density measurement)
- Samples are sent to our NATA accredited laboratory for further analysis to determine density, total moisture and calorific value. The samples are analysed in accordance with AS1038.1 , AS 3899 and AS1038.5.

Advantages of employing laser topography

- Electronically recorded high precision measurements.
- Computer control and volume calculation.
- A significant higher number of spatial coordinates from a stockpile.
- 2D / 3D graphical imagery.
- Eliminates necessity for any physical contact with a stockpile under most circumstances.
- Allowances made for uneven floor surface.
- Measurements are not sensitive to location, i.e. indoor – outdoor; against a wall – freestanding etc.



Size of Power Station stockpile

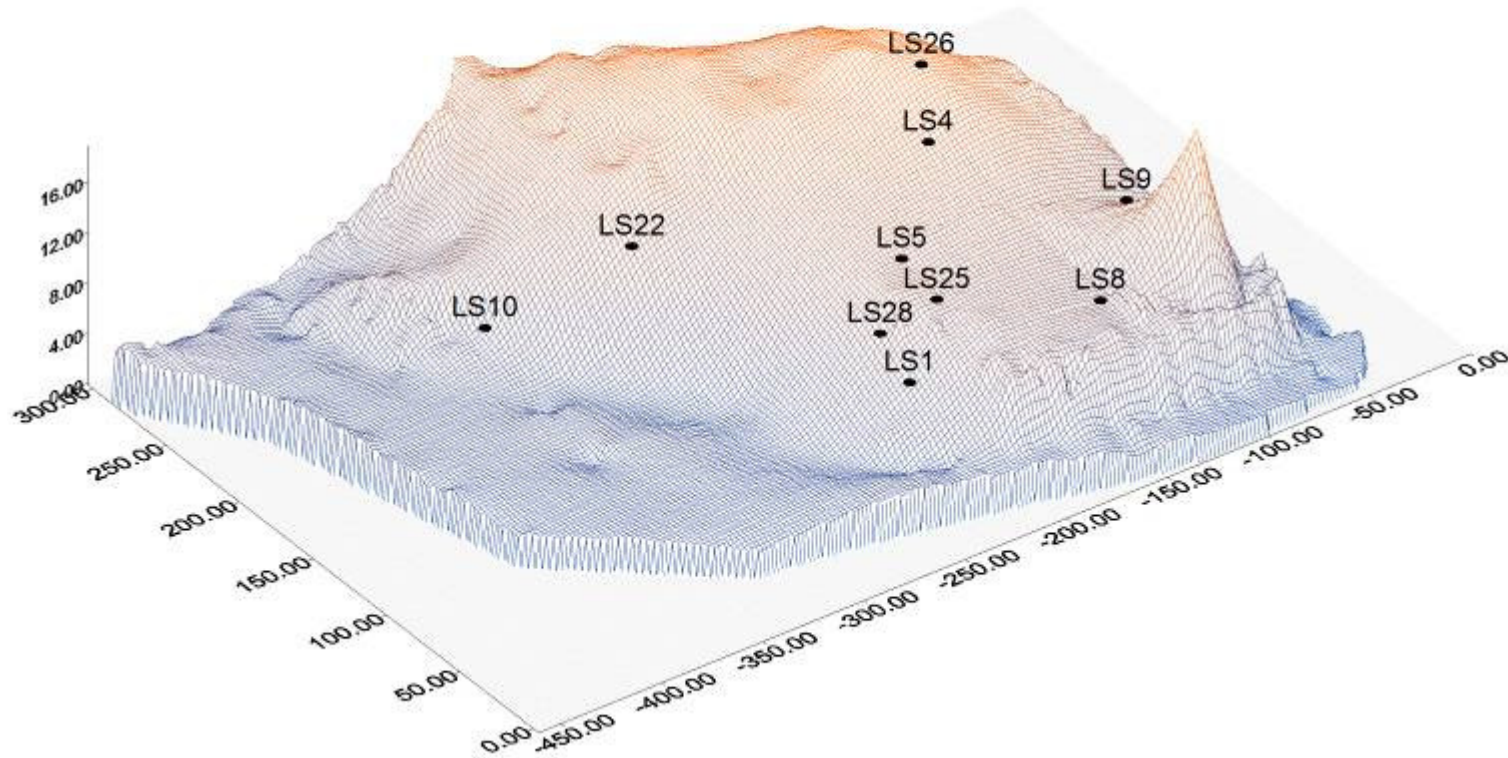






3D Representation of coal stockpile approx. 600,000 tonnes

3D SURFACE MAP SHOWING LONG TERM STORAGE MOUNT PIPER



Validation

- To establish accuracy, a comparison was made against the Institute of Petroleum reference method of tank calibration technique. This comparison showed a difference of 0.15% between volumes calculated by the two methods.
- For a coal stockpile the closest shape used was a cut off cone. The agreement between the model calculation and known volume was 0.2%.
- Based on SGS software validation analysis and comparison of data for mass from different stockpiles, the modelling value for mass for the repeatability and reproducibility should not exceed 1.5%.

Drilling operation and Density Analysis

- Conducted in accordance with the SGS test plan. Each sample is contained within a plastic sleeve as a part of the continuous sampling technique and sealed with a plastic cap on each end in order to preserve the original condition of the coal.
- The number of the drill holes (DH) is based on ASTM 6347, which dictates a minimum of 8 DH per stockpile.
- The total moisture and density analyses are conducted in accordance with **AS1038.1** and **AS 3899** procedures. Each sample is carefully analysed for wet density and then dry density. The difference determines the moisture content (Total Moisture).
- The technique used is an absolute method, weighing the undisturbed coal which fills a capture tube of known volume within the plastic sample tubes.
- We have determined that the accuracy of our density measurements to be $\pm 1\%$.

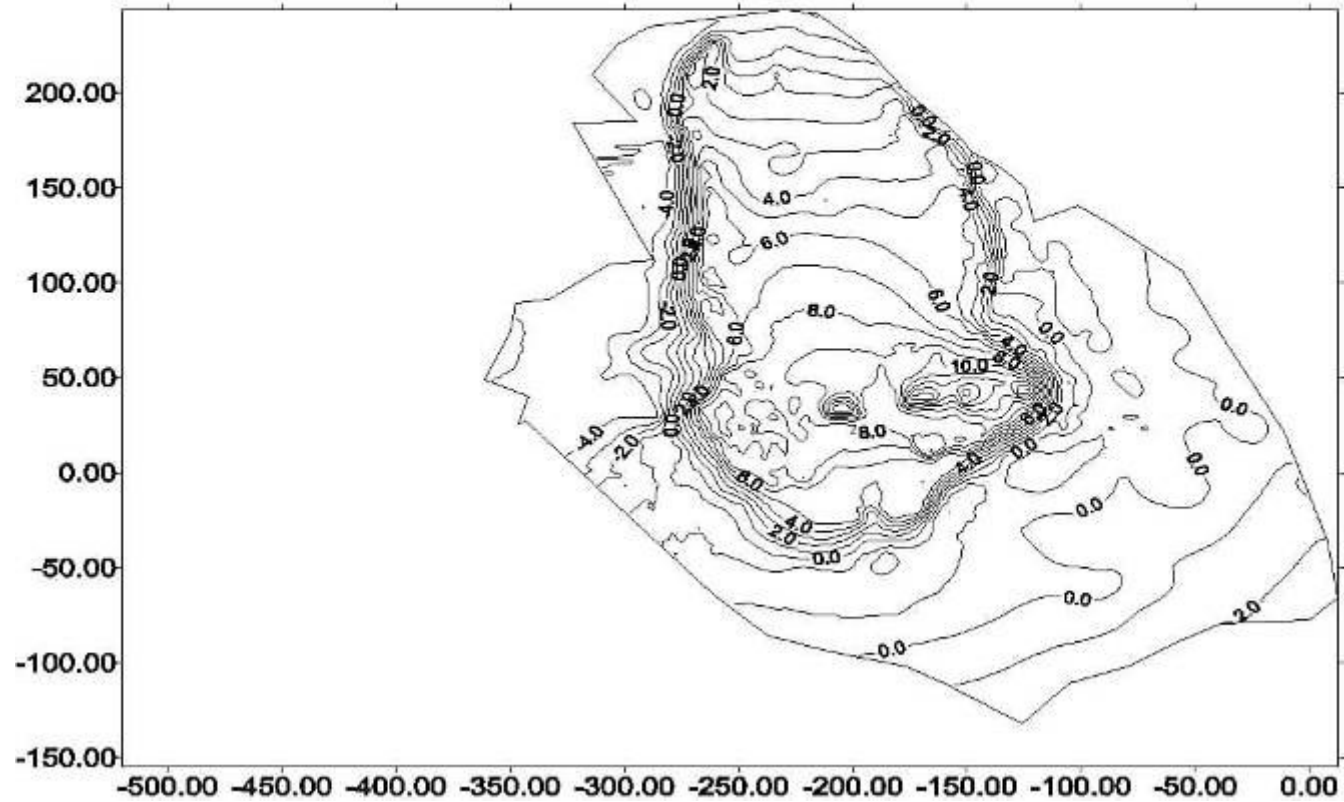


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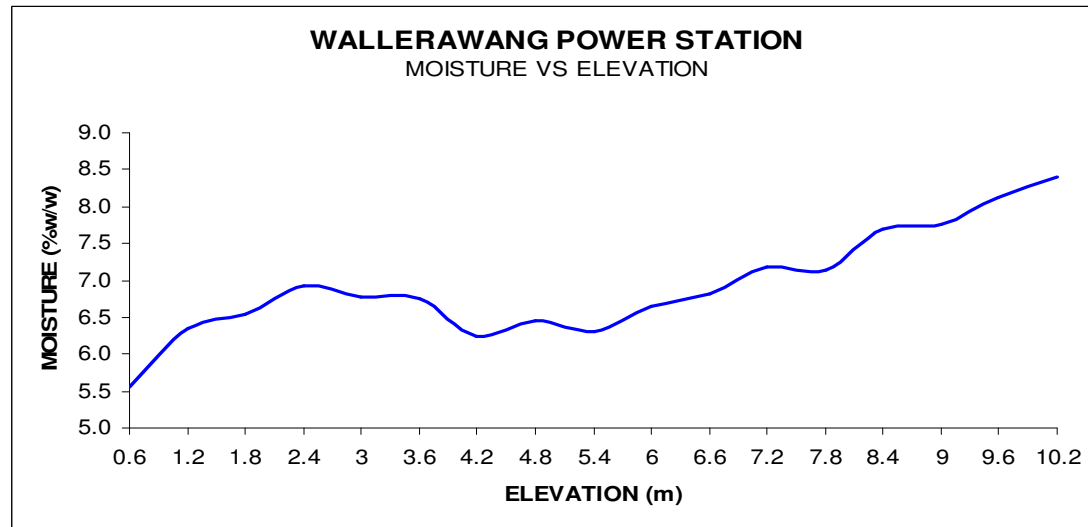
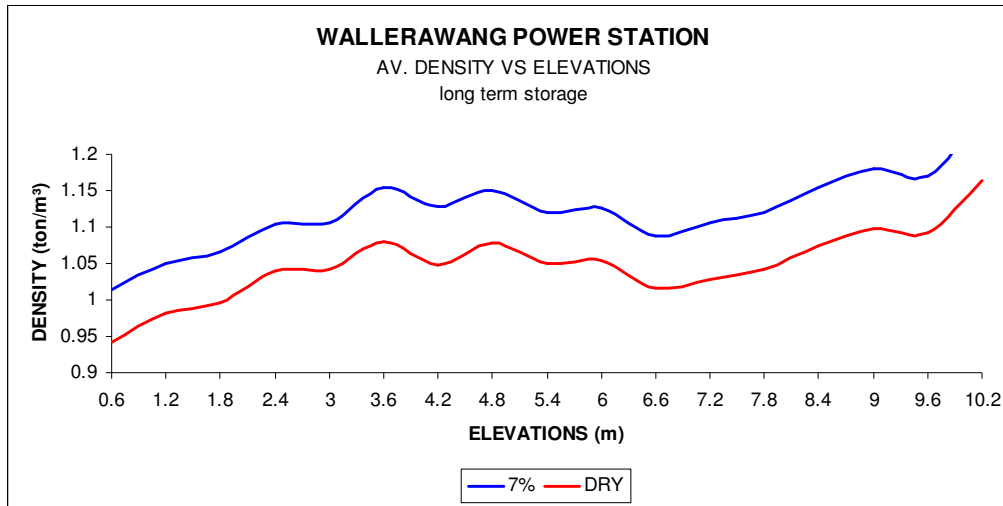
Contours showing heights

**CONTOUR MAP SHOWING LONG TERM STORAGE
WALLERAWANG**

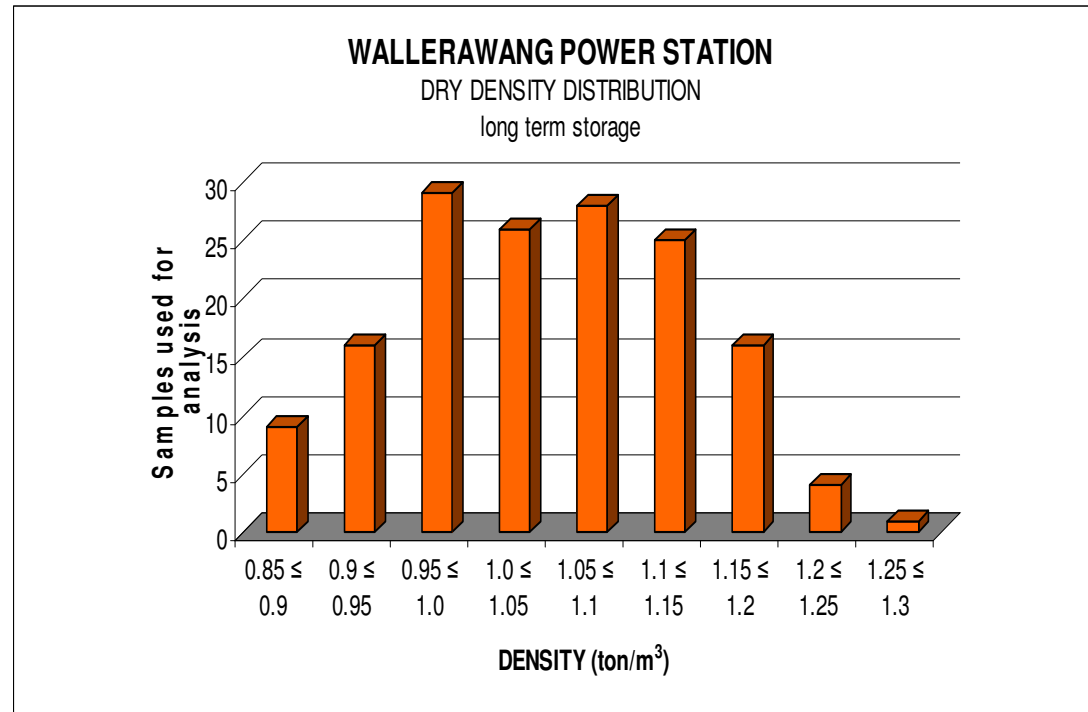




Sample of Density and Total Moisture Distribution



Dry density distribution



Technology development

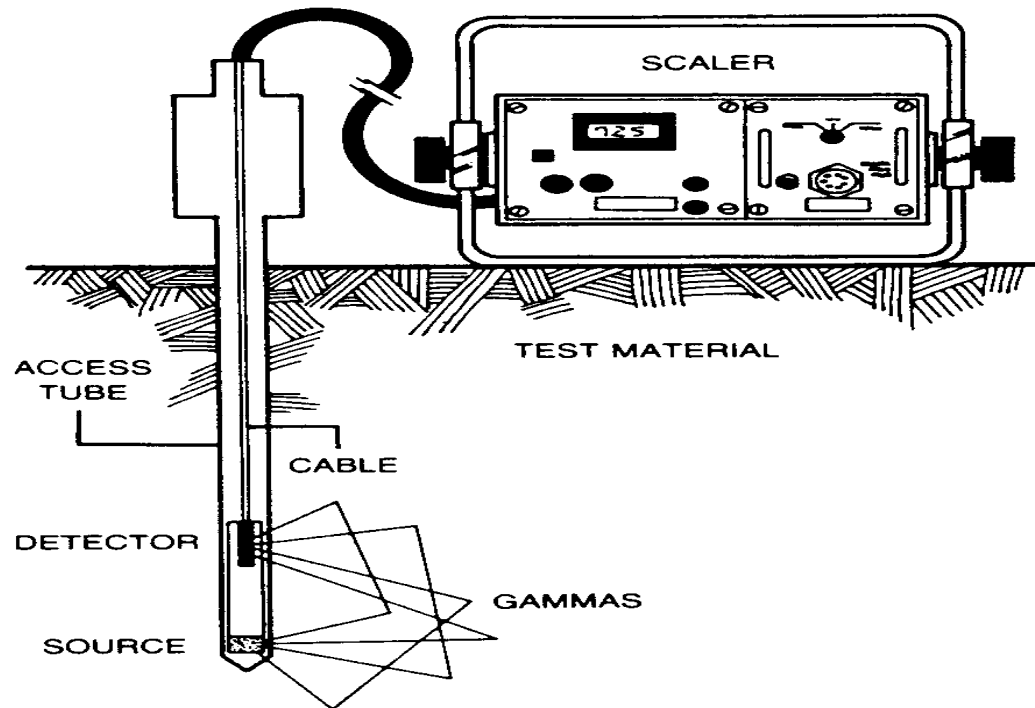
- We are currently calibrating our new Nuclear Backscatter gauge for the total moisture and density. Model No: CPN 501DR- Using 10 mCi Cs 137 and 50 mCi Am 241/ Be.

Picture of the nuclear gauge lowered in the pilot hole for density/ total moisture reading.



Density/Total moisture measurements

Nuclear Backscatter Density Measured "In Situ"

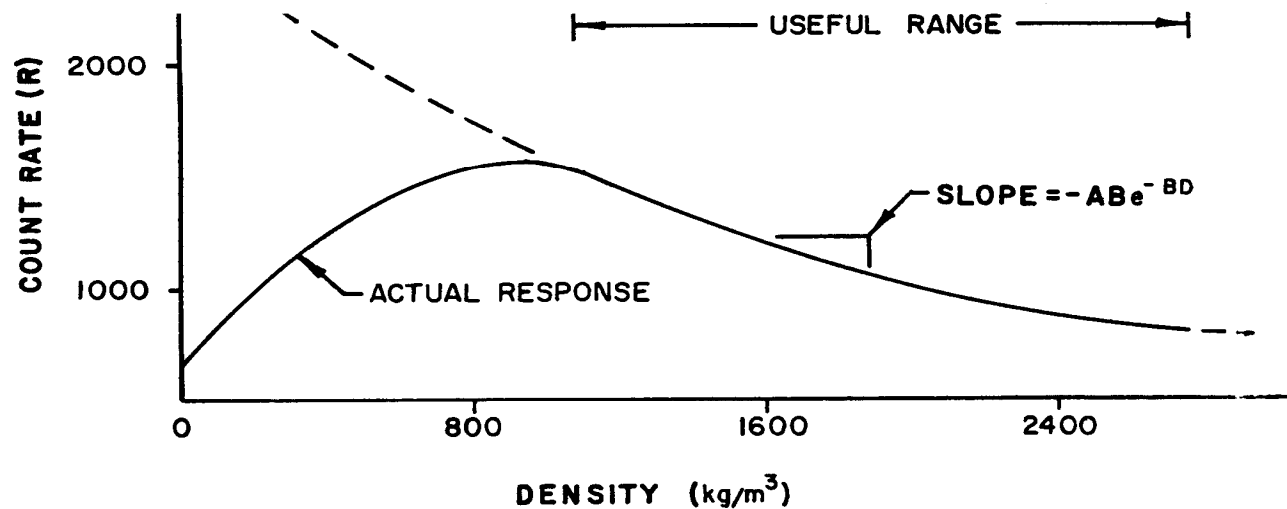


**Figure A-1
BACKSCATTER GEOMETRY**

On site calibration

Nuclear Backscatter Density Measured

BACKSCATTER DENSITY RESPONSE



Backscatter Density Response
Figure 10-5

Calibration of Nuclear gauge
Nuclear Backscatter Density Measured



Surface and Volume measurements



- **HDS 8800 Laser Scanning system for mining.**
- **VELOCITY: up to 50 points/sec.**
- **ACCURACY: mesh up to 5mm x 5mm pitch → 40 points/m²**
- **PRECISION: each single point as a tolerance of 4 mm @ 100 m**
- **VERSATILITY: computer analysis of stockpiles.**

Laser scan: Some results



GPS system installed on quad bike

- Volumetric survey for 300,000 tonnes stockpile could be completed in 4 hours.



Conclusion

- This technique ,developed by SGS, provides accurate and comprehensive reporting of volume, total moisture, density, calorific value of the stockpiled coal.
- When this system is used in its entirety we have determined an accuracy level of +/- 1.92% for the assessment of stockpile energy balance.
- The SGS team works independently and does not require major assistance from the client. Our team works in accordance with each client's relevant Safety Management Plan and SGS safety procedures.