

Integrated Explosives Management System

TLC Engineering Solutions

System Description



- ▶ Manages all aspects of an open-cast mine's explosives system from the manufacturing of the explosive through the design of the blast to the explosive in the hole and beyond

Functions



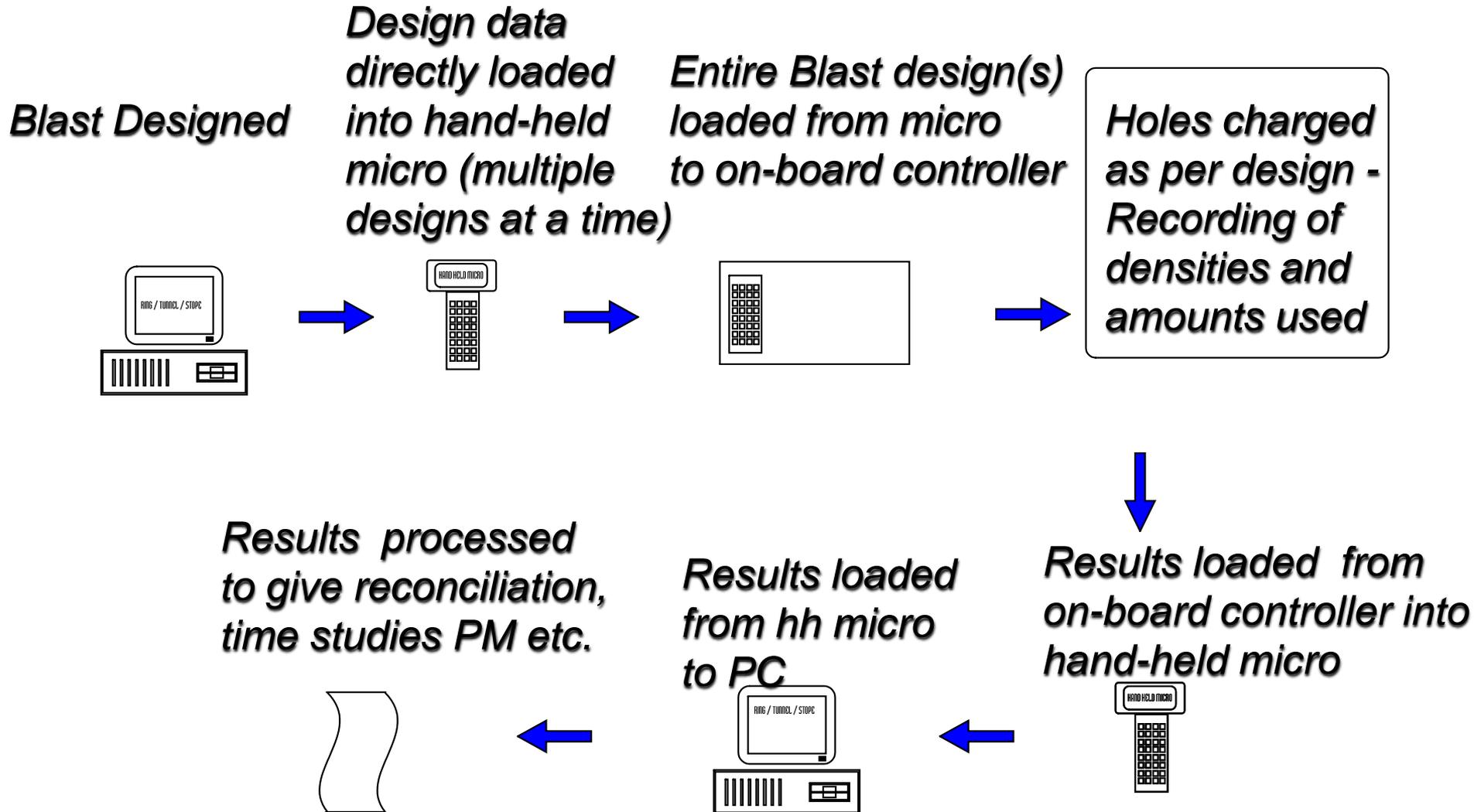
- ▶ *QUALITY CONTROL*
- ▶ *INVENTORY MANAGEMENT*
- ▶ *MANAGEMENT INFORMATION*
- ▶ *SCHEDULING*
- ▶ *HOLE CHARGING*
- ▶ *CLOSED-LOOP CONTROL OF TRUCKS*
- ▶ *RECONCILIATION*
- ▶ *RAW MATERIALS TRACKING*

Operation



- ▶ Explosives raw materials arrive at the mine
- ▶ QC is done and Stock is recorded
- ▶ Formulations are specified with the available raw materials
- ▶ Bench charging is planned using available formulations
- ▶ Raw materials are loaded onto the delivery truck
- ▶ The plans are loaded into the truck's controller
- ▶ The bench is charged directly from the bench plan
- ▶ The controller measures the explosives quantity
- ▶ Bench information is transferred from Truck to PC
- ▶ Blast performance is measured and reconciliation done
- ▶ Management reports are produced

Operating Flowchart



Quality Control Module



- ▶ As raw materials enter the mine, they are sampled according to predefined limits. Each batch is uniquely identified, so that tracking of each material is assured from the bench back to the raw material
- ▶ A history of acceptance limits and conformance is built up as the system is used. Exception reporting and X,r analysis is performed on each batch
- ▶ Each time raw materials leave the storage tanks, their batch numbers are recorded on the explosives delivery truck controller.
- ▶ Calibration data for all gauges and trucks used is done routinely and recorded
- ▶ VOD measurements are done, and their results entered into the system
- ▶ The results of field control checks are recorded to form a history
- ▶ All aspects of the QC module can be queried according to any form of search criteria. The structure of the database is relational

QC Module



Sishen Quality Control

SISHEN QUALITY CONTROL

Raw Materials Explosives Manufacturing Final Product

Gauge and Sensor Qualification	Gauge and Sensor Qualification	Gauge and Sensor Qualification
Hazard Operability Management	Hazard Operability Management	Hazard Operability Management
PRILL PPAN LAN	HEF PLANT	Field Control Checks
AN/CN Solution	TANK	Density Monitoring (Cup and In Hole)
OLD OIL	↓	Sleep Time Lab Samples
SULPHAMIC THIOUREA E21/E23	EXPLOSIVES DELIVERY	Velocity of Detonation
DIESEL	↓	
ALUMINIUM	BENCH ROW HOLE	Check Modem Connection

Explosives Formulations



- ▶ Each formulation is defined as an exact combination, by mass, of any of the available raw materials
- ▶ The formulation cost is calculated as being the sum of the constituent raw material costs
- ▶ Each raw material used retains its identity within the formulation for purposes of tracking in case of sub-optimal blasting performance
- ▶ Each formulation is mixed on the truck as it goes into the hole
- ▶ The formulation can consist of raw materials and compounds (such as emulsion, which contains its own raw materials)
- ▶ There is no limit to the number of formulation which the system can accommodate

Defining The Formula



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Formulas

Emulsion Materials

Available Formulas

- Formula 2
- Formula 3
- H205
- NewFormula
- WX 5
- bugggg
- single
- single2
- singleHEF

Name single

Auger	Material
1	
2	
3	
4	
5	

Total Percentage

Charge Rate	10	kg/min
Cost / kg	1	R/kg
Density (pre)	1	tonne/m3
Density (post)	1	tonne/m3

Color

Basic colors:

Custom colors:

Define Custom Colors >>

OK Cancel

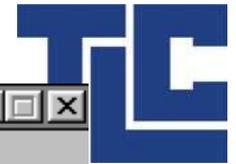
Save Delete Insert Done

Scheduling And Charge Planning



- ▶ Benches are scheduled in terms of plan by, charge by and blast by dates
- ▶ The hole plan is translated into a top view graphic, and a cross sectional graphic of each row
- ▶ The charging is done graphically on the cross sectional view of the rows
- ▶ As soon as the holes have been planned in terms of charge, the theoretical amounts of formulation is available as well as the projected cost of the bench
- ▶ Accessory usage is specified as part of the charge planning

Charging The Holes Graphically



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Benchs Reports Charging Formulas Controller Security Setup About

Charging Sheet

R.	H.	Formula	m	Formula	m
1	1	single2	0.7		
1	2	single2	14.6		
1	3	single2	1.3		
1	4	singleHEF	6.2		
1	5	buggggg	8.5		
1	6	single2	0.8		
1	7	singleHEF	5.9	WX 5	4.9
1	8	buggggg	1.8	Formula 3	8.3
1	9	buggggg	1.8	Formula 3	8.3
1	10	buggggg	1.9	Formula 3	8.3

Hole Plan

Formulas

Formula	kg/min	R/kg
Formula 2	63.0	1.5000
Formula 3	118.5	9.8000
H205	400.0	0.0000
NewFormu	0.0	0.0000
WX 5	400.0	2.0000
buggggg	0.0	0.0000
single	10.0	1.0000
single2	10.0	1.0000
singleHEF	55.6	2.0000

ROW - 1

Depth -0.1 m Rock Type

Bench Scheduling



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Benches

BENCH	DRILL BY	OK	PLAN BY	OK	LOAD BY	OK	BLAST BY	OK
▶ 06/06/10	20/05/96	<input type="checkbox"/>	20/05/96	<input checked="" type="checkbox"/>	20/05/96	<input type="checkbox"/>	20/05/96	<input type="checkbox"/>
07/06/13	15/04/96	<input checked="" type="checkbox"/>	15/04/96	<input checked="" type="checkbox"/>	15/04/96	<input checked="" type="checkbox"/>	15/04/96	<input type="checkbox"/>
22/33/44BB	14/01/96	<input checked="" type="checkbox"/>	26/01/96	<input type="checkbox"/>	02/02/96	<input type="checkbox"/>	21/03/96	<input type="checkbox"/>
44/55/66DD	16/01/96	<input checked="" type="checkbox"/>	28/01/96	<input checked="" type="checkbox"/>	04/02/96	<input type="checkbox"/>	23/03/96	<input type="checkbox"/>
77/88/99E	29/02/96	<input checked="" type="checkbox"/>	29/02/96	<input type="checkbox"/>	05/03/96	<input type="checkbox"/>	24/04/96	<input type="checkbox"/>
88/88/88	06/06/96	<input type="checkbox"/>	06/06/96	<input type="checkbox"/>	06/06/96	<input type="checkbox"/>	06/06/96	<input type="checkbox"/>

Bench Name

Comments

	Planned	Done	Actual
Drilling	<input type="text" value="20/05/96"/>	<input type="checkbox"/>	<input type="text"/>
Planning	<input type="text" value="20/05/96"/>	<input checked="" type="checkbox"/>	<input type="text" value="12/06/96"/>
Loading	<input type="text" value="20/05/96"/>	<input type="checkbox"/>	<input type="text"/>
Blasting	<input type="text" value="20/05/96"/>	<input type="checkbox"/>	<input type="text"/>
Controller Loaded		<input checked="" type="checkbox"/>	<input type="text" value="27/06/96"/>
Controller UpLoaded		<input type="checkbox"/>	<input type="text"/>

Reconciliation



- ▶ The system accepts a budget cost, a planned cost and an actual cost. Reconciliation between these three quantities is a measure of the drilling quality, the accuracy of the closed-loop control system, and the calibration of the delivery trucks
- ▶ Reconciliation between stock due to stock-taking and measured amounts is done, as the actual usage is accurately recorded on the delivery truck. This highlights discrepancies due to truck calibration, theft or fraud

Reporting



- ▶ Exception reporting from QC module
- ▶ Date-to-date reporting of costs and quantities
- ▶ Bench-by-bench reporting of costs and quantities
- ▶ Inventory reporting

Explosives Truck Controller



- ▶ Functions for calibration, checking, and running independently without the balance of the system)
- ▶ The Bench plan is loaded into the computer
- ▶ The operator checks that the batch numbers of the components in the truck have been correctly assigned
- ▶ The controller prompts for the row number and the hole number
- ▶ The hole depth is measured, and entered into the controller
- ▶ The densities are checked and entered into the controller
- ▶ The holes are charged, and the exact amounts of raw materials used are measured
- ▶ Bench results are loaded into via a hand-held data transfer device onto the computer
- ▶ The controller is microprocessor based, and employs standard closed-loop control methodology. It is constructed for very rugged conditions
- ▶ Up to 5 benches of 200 holes per bench may be stored in the controller at any one time

Contact Details



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