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MIDWEST VANADIUM PTY LTD

WINDIMURRA VANADIUM PROJECT
AREA 19 - MAGNETITE HANDLING CONTROL PHILOSOPHY

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CONTENTS

1.0 PROCESS DESCRIPTION

2.0 CONTROL PHILOSOPHY

2.1 Magnetite concentrate reclaim, conveying and Soda Ash metering system

2.2 Soda Ash delivery and unloading

3.0 EQUIPMENT

4.0 INSTRUMENTS

4.1 Analogue Indicators

4.2 Status Indicators

5.0 AUTOMATIC VALVES

5.1 ON/OFF Service

6.0 CONTROL LOOPS

7.0 CALCULATION BLOCKS

8.0 FUNCTIONAL PREREQUISITES

9.0 STARTUP

9.1 Start Sequence

9.1.1 Magnetite concentrate reclaim, conveying and soda ash metering system

9.1.2 Soda Ash Delivery and Unloading

10.0 SHUTDOWN

10.1 Shutdown Sequence

10.1.1 Magnetite concentrate reclaim, conveying and soda ash metering system

10.1.2 Soda Ash Delivery and Unloading

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1.0 PROCESS DESCRIPTION

Ref (P&ID: 6033-19-J-1001)

Concentrated magnetite ore is reclaimed from the concentrate stockpile produced by the beneficiation plant. The ore is fed to the magnetite conveyor (19CVR501) via a table feeder (19FDR501) at a nominal rate of 131 tonnes per hour.

Soda ash at a ratio of 3.9% of the magnetite feed rate, nominally 5.11 tonnes per hour is added directly to the magnetite conveyor via the soda ash feeder (19FDB501). The magnetite concentrate and soda ash mixture is discharged to the kiln mixing screw (19MXR501).

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2.0 CONTROL PHILOSOPHY

2.1 Magnetite concentrate reclaim, conveying and Soda Ash metering system

Concentrated magnetite ore is reclaimed from the concentrate stockpile produced by the beneficiation plant. The ore is fed to the magnetite conveyor (19CVR501) via a table feeder (19FDR501) at a nominal dry rate of 131 tonnes per hour. The discharge rate of the feeder is controlled to maintain a set feed rate to the rotary kiln (20KLN501) which is monitored by the magnetite conveyor weightometer controller (WIC195110).

A stockpile CCTV camera (19CAM501) is provided to enable the CCR operator to monitor the stockpile level and determine if there is enough magnetite ore above the table feeder.

Soda ash is discharged from the soda ash silo to the soda ash feeder (19FDB501), which subsequently discharges the soda ash onto the magnetite conveyor via the feeder discharge chute (19CHU503). The soda ash feed ratio to the magnetite feed is an operator input in the CCR and is restricted to between 3.0 and 5.5%. The soda ash mass flow rate is monitored via WT195104, which is a calculated figure based on the weight (WE195104) on the feeder and the speed (SE195104) of the feeder. The flow rate is controlled (WIC195104) to a setpoint provided by a ratio block (WY195110), which ratios the soda ash feed rate to the magnetite feed rate (WIC195110). The mass ratio and the moisture content of the magnetite concentrate are operator inputs in the CCR. The magnetite concentrate and soda ash mixture is discharged to the kiln mixing screw (19MXR501).

2.2 Soda Ash delivery and unloading

Soda ash powder is delivered to site (nominally every 3 days) in road train tankers. On arrival, the road tanker driver reports to the central control room (CCR) operator to obtain authorisation to enter the plant area. A concrete apron is provided at the unloading facility and any spillage can be hosed to the magnetite reclaim spillage sump (19PPS502).

The road train tanker is equipped with a blower to pneumatically transfer the soda ash to the soda ash silo (19BIN501). The soda ash silo is equipped with a reverse pulsed bag filter (19DEX501), which pulses on a timed sequence, to prevent the emission of dust to the environment. The bag filter operates automatically (by PDAH195116) when unloading and is also initiated by the driver from a local control panel. A level switch (LS195102) mounted in the silo provides a light alarm on the local panel to warn the driver to stop pumping and an audible alarm on detection of a high weight (WAH195101) that indicates over-filling of the silo is imminent. Load cells (WE195101) mounted on the soda ash silo measure and indicate the weight of soda ash in the silo.

A local control panel is provided at the unloading point to give the driver a local high level alarm, local "start loading" button and display of the bin weight (WI195101). Although unloading is locally initiated by the driver, the local control panel is not operable until authorisation has been provided from the CCR, including confirmation that an earth has been successfully achieved between delivery chassis and loading pipeline. Telephone communication shall be initiated by the driver to the CCR operator if loading valve is still inhibited.

3.0 EQUIPMENT

The following are the drives in this area:

Drive Name	Soda Ash Silo Bin Activator
Equipment Number	19ACT501
Drive Type	DOL
P&ID Number	6033-19-J-1001
Modes	Auto or Manual
Alarms	Standard Drive
Trend	R, Slow
Process Interlocks	Nil

Drive Name	Magnetite Conveyor
Equipment Number	19CVR501
Drive Type	Conveyor
P&ID Number	6033-19-J-1001
Modes	Auto or Manual
Alarms	Standard Conveyor
Trend	R, I, Slow
Process Interlocks	Will trip 19FDR501, 19FDB501 & 19SAM501 when Stopped

Drive Name	Soda Ash Silo Dust Filter
Equipment Number	19DEX501
Drive Type	DOL
P&ID Number	6033-19-J-1001
Modes	Auto or Manual
Alarms	Standard Drive
Trend	R, Slow
Process Interlocks	Closes HV195114 when Stopped

Drive Name	Soda Ash Feeder
Equipment Number	19FDB501
Drive Type	VSD
P&ID Number	6033-19-J-1001
Modes	Auto or Manual
Alarms	Standard Variable Speed Drive
Trend	R, MO, Fast
Process Interlocks	Will trip 19FDR501 & 19ACT501 when Stopped

Drive Name	Magnetite Reclaim Table Feeder
Equipment Number	19FDR501
Drive Type	VSD
P&ID Number	6033-19-J-1001
Modes	Auto or Manual
Alarms	Standard Variable Speed Drive
Trend	R, I, MO, Moderate
Process Interlocks	Will trip 19CVR501 when Stopped

Drive Name	Magnetite Reclaim Table Feeder Oil Pump
Equipment Number	19FDR501A
Drive Type	DOL
P&ID Number	6033-19-J-1001
Modes	Auto or Manual
Alarms	Standard Drive
Trend	R, Slow
Process Interlocks	Will trip 19FDR501 when Stopped

Drive Name	Magnetite Reclaim Spillage Pump
Equipment Number	19PPS502
Drive Type	DOL
P&ID Number	6033-19-J-1001
Modes	Auto or Manual
Alarms	Standard Drive
Trend	R, Slow
Process Interlocks	Nil

Drive Name	Magnetite Belt Sampler
Equipment Number	19SAM501
Drive Type	DOL
P&ID Number	6033-19-J-1001
Modes	Auto or Manual
Alarms	Standard Drive
Trend	R, Slow
Process Interlocks	Nil
Extras	Should be operated on an adjustable timer (e.g. operates once every hour)

NOTE: for trends letters indicate the following trends

R = Running status
I = Amps
MO = Motor output (for VSD and reversible drives)

4.0 INSTRUMENTS

4.1 Analogue Indicators

The following are the analogue indicators in this area:

Indicator Name	Soda Ash Silo Dust Filter Pressure			
Indicator Number	PDI-19-5116			
P&ID Number	6033-19-J-1001			
Indicator Type	Field Indicator			
Range	0 - 10 kPag			
Normal	1			
Alarms	HH	H	L	LL
Values	9	8		0
Priorities	Urgent	Control		Urgent
Process Interlocks	Nil			
Trend	Slow			
Extras	Phase - Gas			
Cascaded Loop	Nil			

Indicator Name	Soda Ash Bin Weight Indicator			
Indicator Number	WI-19-5101			
P&ID Number	6033-19-J-1001			
Indicator Type	Field Indicator			
Range	0 - 500 t			
Normal	300			
Alarms	HH	H	L	LL
Values	480	450	100	50
Priorities	Urgent	Control	Control	Urgent
Process Interlocks	Nil			
Trend	Slow			
Extras	WI195101A display on local panel			
Cascaded Loop	Nil			

4.2 Status Indicators

The following are the status indicators in this area:

Status Name	Soda Ash Silo High Level Switch
Status Number	LSH-19-5102
States	1 = Healthy, 0 = LAH
P&ID Number	6033-19-J-1001
Indication	LAH-19-5102
Extras	LAH-19-5102A light indication on local panel
Process Interlocks	LAH will Close HV-19-5114

Status Name	Soda Ash Delivery Hand Switch
Status Number	HS-19-5114
States	1 = Open, 0 = Closed
P&ID Number	6033-19-J-1001
Indication	HS-19-5114 and HV-19-5114 position to be shown on DCS
Extras	Cannot be used to Open HV-19-5114 if LAH-19-5102 active, HS-19-5114A on local operation for local operation
Process Interlocks	Will send Open/Close signal to HV-19-5114

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5.0 AUTOMATIC VALVES

5.1 ON/OFF Service

The following are the automatic valves (ON/OFF service) in this area:

Valve Name	Soda Ash Delivery Valve
Valve Number	HV-195114
Valve Modes	Auto or Manual
P&ID Number	6033-19-J-1001
Process Interlocks	Nil
Fail Position	Closed
Indication	Open, Closed
Extras	Open position starts 19DEX501, Closed position stops 19DEX501

6.0 CONTROL LOOPS

The following are the control loops for the area:

Loop Name	Soda Ash Feed Rate Controller			
Loop Input	WT-19-5104			
P&ID Number	6033-19-J-1001			
Loop Type	STD PID Loop			
Modes	Auto, Manual & Cascade			
Range	0 - 10 t/hr			
Normal	5			
Alarms	HH	H	L	LL
Values	9	8	2	1
Priorities	Urgent	Control	Control	Urgent
Process Interlocks	WALL will stop 19FDR501 after 30sec delay			
Trend	PV, SP & OP, Fast			
Loop Output	0 - 100 %	SC-19-5104		
Action	Reverse			
Loop Tuning	Fast			
Extras	Ratioed to WIC195110 when in Cascade mode, Totaliser required (WQI195104)			
Cascaded Loop	WIC195110			

Loop Name	Magnetite Feed Rate Controller			
Loop Input	WIT-19-5110			
P&ID Number	6033-19-J-1001			
Loop Type	STD PID Loop			
Modes	Auto, Manual & Cascade			
Range	0 - 180 t/hr			
Normal	130			
Alarms	HH	H	L	LL
Values	165	145	35	20
Priorities	Urgent	Control	Control	Urgent
Process Interlocks	WALL will stop 19FDB501 after 30sec delay			
Trend	PV, SP & OP, Fast			
Loop Output	0 - 100 %	SC-19-5110		
Action	Reverse			
Loop Tuning	Fast			
Extras	Provides input to WY-19-5110, Totaliser required (WQI195110)			
Cascaded Loop	Nil			

7.0 CALCULATION BLOCKS

The following are the calculations required in this area:

Calculation Name	Soda Ash feed rate calculation
Calculation Number	WY-19-5110
Inputs	• Magnetite Feed Rate (***F***) = WIC-19-5110 (t/hr) • Magnetite Moisture (***M***) = Operator Input (Default 11.4) (%) • Soda Ash ratio (***R***) = Operator Input (Default 3.9) (%)
Outputs	Soda Ash feed rate (***S***) = Setpoint for WIC-19-5104 (t/hr)
Calculation	$(S) = \frac{(F)*(1-(M/100))*(R)}{100}$
Range	0 – 10 t/hr
Mode	Active when WIC-19-5104 is in CASCADE mode
Extras	Soda Ash ratio range restricted to 3.0 – 5.5%

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8.0 FUNCTIONAL PREREQUISITES

The operation of the Area described in section 2.1 requires the listed downstream areas of the plant to be operational:

Area	System	Associated Drawing	Associated Control Philosophy
19	Kiln Off Gas	6033-19-J-1002	6033-G-00-F-006
20	Kiln	6033-20-J-1002	6033-G-00-F-007
25	Leach Vats	6033-25-J-1002	6033-G-00-F-008

9.0 STARTUP

Due to the independent nature of operation of the soda ash unloading system the start-up sequence for this area will be described in two parts, namely:

- Magnetite concentrate reclaim, conveying and soda ash metering system
- Soda Ash delivery and unloading System

9.1 Start Sequence

The following are the sequences in this area:

9.1.1 Magnetite concentrate reclaim, conveying and soda ash metering system

Local Prerequisites

No.	TAG No.	Equip. No.	Description	Status
1			Plant services available	HEALTHY
2			All drives in start sequence	HEALTHY
3	BCS195117		Blocked chute sensor	HEALTHY
4	BCS195105		Blocked chute sensor	HEALTHY
5	BCS195119		Blocked chute sensor	HEALTHY
6	BDS195109A/B		Belt drift sensors	HEALTHY
7	BDS195112A/B		Belt drift sensors	HEALTHY
8	PWS195108A/B		Pull-wire sensors	HEALTHY
9	PWS195112A/B		Pull-wire sensors	HEALTHY
10	WE195104		Weightometer	HEALTHY
11	USS195107		Under-speed sensor	HEALTHY

Start Sequence

Prerequisite	Step No.	Description
	1	Set Magnetite conveyor (19CVR501) to AUTO and input feed rate Set Point
Step 1	2	Start Magnetite conveyor (19CVR501)
	3	Set Magnetite reclaim table feeder (19FDR501) to AUTO
Step 3	4	Start Magnetite reclaim table feeder (19FDR501)
	5	Set Soda ash feeder (19FDB501) to AUTO
Step 5	6	Start Soda ash feeder (19FDB501)
	7	Set Soda ash silo bin activator (19ACT501)
Step 7	8	Start Soda ash silo bin activator (19ACT501)

9.1.2 Soda Ash Delivery and Unloading

Prerequisites

No.	TAG No.	Equip. No.	Description	Status
1			Plant services available	HEALTHY
2			All drives in start sequence	HEALTHY
3	HV195114		Soda Ash unloading control valve	HEALTHY
4	PDT195116		Soda Ash Silo Dust Filter pressure differential sensor	HEALTHY
5	WE195101A/B/C		Soda Ash Silo load cells	HEALTHY
6	WAH195101		Soda Ash Silo high weight alarm	NOT ACTIVE
7	LAHH195102		Soda Ash Silo high-high level alarm	NOT ACTIVE

Start Sequence

Prerequisite	Step No.	Description
	1	*Authorisation for driver to enter plant area received*
Step 1	*2*	*Driver connects truck earth*
	3	*Authorisation from CCR to unload and* local panel activated
Step 3	*4*	*Road tanker connected to soda ash delivery point*
	5	Set Soda ash dust filter (19DEX501) to AUTO
	6	Start Soda ash dust filter (19DEX501)
Step 6	7	Open soda ash delivery valve (HV195114)
Step 7	8	Start road tanker blowers

10.0 SHUTDOWN

Due to the independent operation of the soda ash unloading from the magnetite concentrate reclaim, conveying and soda ash metering system, the shutdown sequence for this area will be described in two parts, namely:

- Magnetite concentrate reclaim, conveying and soda ash metering system
- Soda ash delivery and unloading system

10.1 Shutdown Sequence

The following are the controlled shutdown sequences in this area:

10.1.1 Magnetite concentrate reclaim, conveying and soda ash metering system

There are two scenarios in which this system may be shutdown, namely:

- Crash Stop
- Controlled Stop

A crash stop represents a temporary interruption to plant production as a result of a downstream equipment interlock or a deliberate stop of equipment initiated by the CCR operator. Due to the immediate stoppage, the magnetite feed conveyor and soda ash feeder remain loaded with material. Start-up after a crash stop is initiated by the CCR operator via a group start sequence at the PLC. No sequence is provided for a crash stop; rather all equipment is stopped instantaneously.

A controlled stop is a sequenced shutdown of the area to accommodate a planned shutdown to facilitate maintenance of equipment. When a controlled stop is initiated, the stop sequence ensures the magnetite conveyor and the soda ash conveyor are run empty. To enable a controlled shutdown, local interlocks are overridden.

Stop Sequence

Prerequisite	Step No.	Description
	1	Stop Magnetite reclaim table feeder (19FDR501)
Step 1	2	Wait for zero reading on WE195110 (magnetite conveyor weightometer)
	3	Stop Soda ash silo bin activator (19ACT501)
Step 2	4	Stop Soda ash feeder (19FDB501)
Step 4 + time delay	5	Stop Magnetite conveyor (19CVR501)

10.1.2 Soda Ash Delivery and Unloading

Stop Sequence

Prerequisite	Step No.	Description
LAHH195102	1(a)	Activate soda ash silo (19BIN501) level siren (SIR195103)
		or
	1 (b)	*HS195114A local Stop selected*
Step 1(a) or (b)	*2*	*Driver locally stops blowers and confirmation that blowers are stopped received by CCR*
Step 2 & 1(a)	3	Stop soda ash silo level siren
Step 2	4	Close HV195114 (ZSC energised)
Step 4	5	Stop soda ash silo dust filter (19DEX501) fan
Step 4	*6*	*Tanker manually disconnected from loading point*