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Table of Contents

1. Introduction.....	1
1.1 Project Overview.....	1
1.2 Purpose.....	1
1.3 Definitions	1
1.4 Units of Measure	2
1.5 Reference Documents	2
2. AWR System	2
2.1 Barge and Booster Stations.....	2
2.1.1 General.....	2
2.1.2 Operating Description	4
2.1.3 Booster Pumps, Barge Pumps and Dosing Pumps Start-up Philosophy and Procedure to Fill up the Pipelines.....	4
2.1.4 Duty to Stand-by Pump Switchover.....	8
2.1.5 Low-Lift Duty to Stand-By Pump Switchover	8
2.1.6 High Lift Duty to Standby Switch Over	10
2.1.7 Pump Shut Down Philosophy.....	12
2.1.8 Scheduled Maintenance on Mechanical Equipment	12
2.2 Procedure for Operation of Scour Valves	12
2.2.1 Procedure for Maintenance of Scour Valves.....	13
2.3 AWR Inspection Holes	13
2.4 Procedure for Operation of Air Valves	13
2.4.1 Procedure for Maintenance of Air-Valves	14
2.5 Procedure for Maintenance on Low Lift and High Lift Pumps	14
2.6 Lifting Equipment.....	15
2.7 Ventilation System	15
2.8 Control and Instrumentation Equipment.....	15
2.9 Electrical Equipment	15
2.10.....	16
Fire Equipment	
3. AWR Pipelines.....	16
3.1 General Pipeline Maintenance	16
3.2 Valve maintenance along the pipelines.....	17
4. Slurry System	19
4.1 General	19
4.2 Operating Description	19

4.3 Slurry Pumps Start-up Philosophy and Procedure to Fill up the Pipelines	20
4.3.1 Duty Pump Start Up Procedure.....	20
4.3.2 Standby Pump Start up Procedure.	23
4.4 Pump Shut Down Philosophy	27
4.5 Scheduled Maintenance on Mechanical Equipment.....	28
4.6 Procedure for Operation of Slurry Scour Valves	28
4.6.1 Procedure for maintenance of slurry scour valves	28
4.7 Procedure for operation of Air Valves	29
4.7.1 Procedure for Maintenance of Air Valves.....	29
4.8 Procedure for Maintenance on slurry pumps.....	29
4.9 Control and Instrumentation	30
4.10.....	Electrical Equipment
30	
5. Slurry pipelines	31
5.1 General Pipeline Maintenance	31
5.2 Valve maintenance along the pipelines.....	32
6. Environment Incident Management.....	33
6.1 Procedure	33
6.2 Specific Incidents	33
6.3 Recommended Actions	34
6.3.1 Incident Reporting and Managing	34
6.3.2 Ash Spill Incident	35
6.3.3 OHS and Environmental Incident:.....	35
6.3.4 Hydrocarbon Spill Incidents:.....	36
7. OEM Equipment Manuals	37

Table of Tables

Table 1: AWR Pump Operations at Different Levels.....	4
Table 2: AWR Pump Descriptions	4
Table 3: Pipeline equipment routine maintenance	16
Table 4: Operations and Maintenance	17
Table 5: Slurry Pump Operations at Different Levels.....	19
Table 6: AWR Pump Descriptions	20
Table 7: Pipeline equipment routine maintenance	31
Table 8: Operation and Maintenance.....	32

Appendices

Appendix A : OEM Equipment Manuals (TBC AFTER CONSTRUCTION)

¹ **Disclaimer:** This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Abbreviations

AWR	Ash Water Return
BEP	Best Efficiency Point
EOT	Electric Overhead Travelling
EPCM	EPCM Consultants SA
IO	Input/Output
MCC	Motor Control Centre
O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
OHS	Occupational Health and Safety
PIDs	Process and Instrumentation Diagrams
PLC	Programmable Logic Controller
SoW	Scope of Work
SWL	Safe Working Load
TBC	To Be Concluded (for final draft)
VSD	Variable Speed Drive

1. Introduction

1.1 Project Overview

EPCM Bonisana (PTY) Ltd (EPCM) has been appointed by Eskom Holdings SOC Ltd (ESKOM) as the contractor to design and supervise the construction of the Ash Transfer Link (slurry pipeline) between Kriel and Matla Ash Dam Complexes. Kriel Power station is a coal-fired power station consisting of six (6) units, which produces a combined base load of 3 000 MW. The power station has a remaining operating life of 9 years and is scheduled to be decommissioned in 2029.

The Kriel Power Station is located in Mpumalanga province, and it is approximately 5 km from the Matla Power Station.

During the burning of coal, ash is produced as a waste product, and it is disposed of at the Kriel Ash Dam Complex. The ash dam complex comprises ash dams 1, 2, and 3. The ash dam in recent years has become unstable. This has led to the initiation of the Kriel Ash Dam Extension 4 project due to the insufficient ashing space on the existing dams. The Kriel Ash Dam Extension 4 has been delayed due to unforeseen circumstances. Alternative measures have been implemented. Ash from Kriel Power Station has to be transferred to Matla Power Station's Ash Dam. The ashing of Kriel ash to Matla Ash dam will be required for the remaining life of the station. In addition to this, all water transferred with the slurry mixture must be returned to the Kriel AWR dam via the solution trench and ash water return system

1.2 Purpose

This operations and maintenance manual describes the general O&M procedures to be performed to ensure the safe use of the AWR and Slurry pump stations throughout their respective lifespans.

This draft version is only preliminary and will only be finalised after construction when all OEM O&M manuals have been received by the Engineer and the as-built information is available for the relevant updates.

1.3 Definitions

“Must” signifies a legal or statutory requirement.

“Shall” signifies a mandatory requirement.

“May” signifies a possibility or opportunity.

“Standby” Refers to the pump, pipeline, and other mechanical equipment not currently in operation.

“Duty” Refers to the pump, pipeline, and other mechanical equipment currently in operation.

“Low Lift” Refers to the barge pump system.

“High Lift” Refers to the booster pump system.

1.4 Units of Measure

Standard International (SI) units and symbols shall be used in all documents, drawings and specifications.

The use of commas or points to separate groups of digits is not acceptable.

Dimensions on drawings shall be expressed in millimetres, unless indicated otherwise on the drawings.

Certain nominal sizes of commercial items manufactured to a recognised national standard shall be expressed in units of the defining standard and no conversions to SI units need be made.

1.5 Reference Documents

21084-KMDD-PR-PID-001 to 006	Process and Instrumentation Diagrams
21084-KMDD-PR-RPT-003	Process Description
21084-KMDD-PR-RPT-005	Control Philosophy

2. AWR System

This section must be read with Section 4 of 21084-KMDD-PR-005 (Control Philosophy) and 21084-KMDD-PR-RPT-003 (Process Description).

2.1 Barge and Booster Stations

2.1.1 General

The AWR Pump Station has two pumping systems, namely the low lift (barge) setup and the high lift (booster) station setup with individual pipelines transferring the AWR water. The AWR high lift station has chemical dosing pump system comprising of 2 duty pumps and 1 standby pump. The pump sets are described as follows:

- 2 duty and 1 standby pumps (VSD controlled units) for (Low lift barge pumps). The pump sets comprise of end-suction centrifugal pumps, that are controlled with flowmeters (Tag Numbers FIT-401, FIT-402, FIT-403); for VSD set points.
 - Tag numbers P-301, P-303 are the low lift duty pumps.
 - Tag number P-302 is the low lift standby pump.
- 2 duty and 1 standby pumps (VSD controlled units) for (High lift Booster Pumps). The pump sets comprise of end-suction centrifugal pumps, that are controlled with flowmeters (Tag Numbers FIT-401, FIT-402, FIT-403); for VSD set points.
 - Tag numbers P-401, P-403 are the high lift duty pumps.
 - Tag number P-402 is the high lift standby pump.
- 2 duty and 1 standby chemical dosing pumps
 - Tag numbers P-501 and P-503 for the duty dosing pumps.
 - Tag number P-502 for the standby dosing pumps.

The low and high lift pumps are connected in series and work together to achieve the dynamic head requirements. One low lift pump is dedicated to one high lift pump during operation. The following low lift to high lift configurations are possible.

- P-301 to P-401 or P-402
- P-302 to P-401 or P-402 or P-403
- P-303 to P-402 or P-403

See Table 1 for pump descriptions. All pump systems/ pipelines are supplied with flow meters and pressure gauges.

All pumps will operate for 17 hours per 24-hour cycle.

The following procedures shall be performed:

1. Maintenance on mechanical equipment according to the OEM's O&M Manuals.
2. Switch-over between duty and standby pumps.
3. Draining (scouring)
4. Filling of the pipelines.

Refer to 21084-KMDD-PR-PID-003 and 21084-KMDD-PR-PID-004_1 for the PIDs for the low and high lift pumping stations.

Refer to 21084-KMDD-PR-PID-005 for the chemical dosing pump system.

2.1.2 Operating Description

During normal operating conditions, the pumps operate in manual mode and will be switched between standby and duty pumps as described below (it will be an operator intervention to switch between pumps).

Table 1: AWR Pump Operations at Different Levels

AWR Dam	Action	Level in AWR
Low level	Stop – Stop pumping when the dam level is low	TBC
High level	Start – Start pumping when the dam level is high	TBC

Table 2: AWR Pump Descriptions

Pump number	Description
Barge pumps (P-301, P-302, P-303)	2 Duty and 1 standby pump – 1343.5 m ³ /hour @ 67.7m head (355kW) Pumps from AWR dam to the booster pump station via two pipelines
Booster pumps (P-401, P-402, P-403)	2 Duty and 1 standby pump – 1343.5 m ³ /hour @ 67.7m head (355kW) Pumps from booster pump station to the solution trench at Kriel Power Station via three pipelines

2.1.3 Booster Pumps, Barge Pumps and Dosing Pumps Start-up Philosophy and Procedure to Fill up the Pipelines

Local intervention is required for start-up. The following procedure shall be adhered to: If the pump receives a start-up signal in manual mode, the sequence is as follow:

The pump sets have a built-in process controller to keep the line flow rate to above 1000 m³/hour, and within the BEP range of the pumps.

1. Permit to be applied for according to the Eskom permit to work system.
2. Partially open the isolation valves along the duty pipelines. Tag numbers:
 - a. GV-303

- b. GV-304
 - c. GV-402
 - d. GV-406
3. Fully open the isolation valves along the duty pipeline and pump system. Tag Numbers:
- a. GV-401
 - b. GV-405
 - c. GV-428
 - d. GV-429
 - e. GV-430
4. Fully close the isolation valves on the standby pipeline and common manifolds. Tag numbers:
- a. GV-305
 - b. GV-309
 - c. GV-310
 - d. GV-403
 - e. GV-404
 - f. GV-420
 - g. GV-421
5. Fully close the drain and scour valves of both the duty and standby pipelines. Tag numbers:
- a. GV-311
 - b. GV-312
 - c. GV-313
 - d. GV-417

- e. GV-418
 - f. GV-419
 - g. GV-425
 - h. GV-426
 - i. GV-427
6. Fully open the air-valves and fully open the air valve isolation valves. Tag numbers:
- a. PVCV-403
 - b. PVCV-402
 - c. PVCV-401
 - d. GV-424
 - e. GV-423
 - f. GV-422
7. Fully close the dosing system isolation valves. Tag Numbers:
- a. BV-513
 - b. BV-514
 - c. BV-515
8. Signal alarm to start the pumps and start the pump.
9. Only Low-lift duty pumps to be started (P-301 and P-303) until a pressure gauge (Tags PG-304 and PG-306) reading of 3 barg is achieved. Isolation valves GV-303 and GV-304 to be opened while pumps are operating.
10. If pressure gauge reading of 3 barg is achieved fully open isolation valves
- a. PG-304 for GV-303
 - b. PG-306 for GV-304
11. High-lift pump to be started when pressure gauge reading of 3 barg is achieved (Tags PG-401 and PG-403). Tag Numbers:
- a. PG-401 for P-401

- b. PG-403 for P-403
12. Isolation valves to be opened slowly until flow meter reading of 1343.5m³/hour is achieved. Tag Numbers:
- a. FIT-401 for GV-402
 - b. FIT-403 for GV-406
13. While running, check flow switch is active and ensure pressure transmitter feedback is between set values. Tag numbers:
- a. PIT-301
 - b. PIT-303
 - c. FS-301
 - d. FS-303
14. Confirm that water exits the pipelines at the discharge point.
15. Open the dosing system duty potable water isolation valves. Tag Numbers:
- a. BV-516
 - b. BV-518
16. Start the dosing pumps. Tag Numbers:
- a. P-501
 - b. P-503
17. Open the duty dosing isolation valves and suction valves. Tag Numbers:
- a. BV-501
 - b. BV-502
 - c. BV-503
 - d. BV-504
 - e. BV-509
 - f. BV-510

- g. BV-511
- h. BV-512
- i. BV-513
- j. BV-515

2.1.4 Duty to Stand-by Pump Switchover

Maintenance shall be performed on duty pumps according to the OEM's O&M Manuals. Maintenance shall be performed on the standby pumps as well according to the OEM's O&M Manuals.

When maintenance is performed on a duty pump set; a switch over from duty to standby pump shall be performed.

The following procedure shall be followed when switching from a duty to standby pump.

2.1.5 Low-Lift Duty to Stand-By Pump Switchover

1. Permit to be applied for according to the Eskom permit to work system.
2. Switch off the applicable chemical dosing pump.
 - a. P-501 or P-503
3. Fully Close the applicable chemical dosing pump isolation valves.
 - a. BV-513 or BV-515
4. Switch off the applicable high lift pump (high lift pump in series with selected low lift pump to be switched off). Tag Numbers:
 - a. P-401
 - b. P-403
5. Switch off the selected low-lift duty pump. Tag numbers:
 - a. P-301
 - b. P-303
6. Close the isolation discharge valve of the switched off duty pump. Tag Numbers
 - a. GV-303

- b. GV-304
7. Ensure the drain valve of the switched off duty pump remains closed. Tag Numbers
 - a. GV-313
 - b. GV-311
8. Ensure the drain valve of the standby pump is fully closed. Tag Numbers:
 - a. GV-311
 - b. GV-313
9. Partially Open the discharge isolation valves of the stand-by pump:
 - a. GV-305
10. Open the common manifold isolation valve
 - a. GV-309 if P-301 is switched off
 - b. GV-310 if P-303 is switched off
11. Only Low-lift pumps to be started until pressure gauge reading of 3 barge (Tags PG-305) is shown.
12. Fully open the isolation valve. Tag number:
 - a. GV-305
13. High-lift pump to be started when pressure reading (Tags PG-402 or PG-401 or PG-403) shows a reading of 3 barge.
14. Fully open isolation valve until flow meter reading of 1343.5m³/hour is achieved. Tag numbers:
 - a. FIT-401 for GV-402
 - b. FIT-402 for GV-404
 - c. FIT-403 for GV-406
15. While running, check flow switch is active and ensure pressure transmitter feedback is between set values. Tag numbers:
 - a. PIT-303
 - b. FS-302

16. Open the dosing system duty potable water isolation valves. Tag Numbers:
 - a. BV-517
17. Open the standby dosing isolation valves and suction valves. Tag Numbers:
 - a. BV-505
 - b. BV-506
 - c. BV-507
 - d. BV-508
 - e. BV-514
18. Start the selected standby dosing pump. Tag Numbers:
 - a. P-502
19. Drain the switched off duty pump and Y-strainer. Tag Numbers;
 - a. P-101 and S-301
 - b. P-103 and S-303
20. Ensure the pumps are running near the specified duty points.
21. Check for leaks on all valves and other mechanical equipment.

2.1.6 High Lift Duty to Standby Switch Over

Maintenance shall be performed on duty pumps according to the OEM's O&M Manuals. Maintenance shall be performed on the standby pumps as well according to the OEM's O&M Manuals.

When maintenance is performed on a duty pump set; a switch over from duty to standby pump shall be performed.

1. Permit to be applied for according to the Eskom permit to work system.
2. Switch off the applicable chemical dosing pump
 - a. P-501 or P-503
3. Close the applicable chemical dosing pump isolation valves
 - a. BV-513 or BV-515

4. Switch off the dedicated low lift pump for the high lift pump. Tag Numbers:
 - a. P-301
 - b. P-303
5. Switch off the selected high lift pump (high lift pump in series with selected low lift pump to be switched off). Tag Numbers:
 - a. P-401
 - b. P-403
6. Fully Close the isolation discharge valve of the switched off duty pump:
 - a. GV-402
 - b. GV-406
7. Ensure the drain valve of the switched off duty pump remains closed
 - a. GV-417
 - b. GV-419
8. Ensure the drain valve of the standby pump is closed
 - a. GV-418
9. Open the discharge isolation valves of the stand-by pump
 - a. GV-404
10. Open the applicable common manifold isolation valve
 - a. GV-421 if P-401 is to be switched off
 - b. GV-420 if P-403 is to be switched off
11. Close the switched off duty pump suction isolation valve
 - a. GV-401
 - b. GV-405
12. Only Low-lift pumps to be started until pressure gauge reading of 3 barg is shown.
(Tags PG-305)

13. High-lift pump to be started when pressure gauge reading of 3 barg is shown (Tags PG-402).
14. While running, check flow switch is active and ensure pressure transmitter feedback is between set values. Tag numbers:
15. Open the dosing system duty potable water isolation valves. Tag Numbers:
 - a. BV-517
16. Open the standby dosing isolation valves and suction valves. Tag Numbers:
 - a. BV-505
 - b. BV-506
 - c. BV-507
 - d. BV-508
 - e. BV-514
17. Start the selected standby dosing pump. Tag Numbers:
 - a. P-502
18. Drain the switched off duty pump.
19. Ensure the pumps are running near the specified duty points.
20. Check for leaks on all valves and other mechanical equipment.

2.1.7 Pump Shut Down Philosophy

If any of the conditions below are met in manual mode, the pumps will shut down:

- Any of the motor protection signals trigger (flow, pressure, overload current).
- Isolation suction valves are closed/ intermediate position.
- Isolation discharge valve is closed.

2.1.8 Scheduled Maintenance on Mechanical Equipment

Scheduled maintenance shall be done as prescribed in the Operation and Maintenance Manual that is included in the Contractor's Data Pack (TBC):

2.2 Procedure for Operation of Scour Valves

1. All pipelines in series may be scoured simultaneously or individually.
2. Ensure that all air valves and air-valve isolating valves are fully open.

3. Fully close the discharge isolating valves of the booster pumps.
4. Ensure that the flow receiving area is cleared of debris and personnel.
 - a. The pipeline shall be scoured in sections when more than one scour valve is placed on a continuous downslope of the pipelines.
5. The highest scour valve shall be opened to drain a section of pipeline.
 - a. The flow shall be throttled by opening turning the spindle slowly.
6. The highest scour valve may be left open before the next highest scour valve is opened.
7. The next highest scour valve to be opened to drain the next section of pipeline.
 - a. The flow shall be throttled by opening the spindle slowly.
8. Ensure that flow from the scour piping exits to the correct designated location.
9. All scour valves shall be fully closed.

2.2.1 Procedure for Maintenance of Scour Valves

1. The pipelines shall be drained as described in the above sub-section.
2. The scour valves may be removed and shall be replaced if the pipeline is to be filled before the maintenance procedure is completed.
3. Maintenance procedures according to the OEM's Manual shall then be performed on the removed scour valves.

2.3 AWR Inspection Holes

Tag Numbers: Xp-401, XP-402, XP-403

1. Inspection holes blind flanges shall only be loosened and lifted if the pumps are not in operation and the pipelines have been drained.
2. The high lift pump discharge isolation valve shall be fully closed. Tag Numbers
 - a. GV-402
 - b. GV-404
 - c. GV-406
3. Visual Inspection of the scaling near the inspection hole shall be performed.
4. The blind flanges and gasket shall be re-fitted and the fasteners shall be fastened.

2.4 Procedure for Operation of Air Valves

1. Air valves shall be in the open position for both the small and large orifice.

2. The isolation valves shall be fully open.
3. During the filling procedure of the pipelines and during the pumping operation the air valves shall remain open to allow air pockets to vacate the high points of the pipeline.
4. During draining of the pipelines, the air valves shall remain open to prevent vacuum conditions.

2.4.1 Procedure for Maintenance of Air-Valves

1. Maintenance of air valves may be performed during pumping operation or when the pumps are switched off.
2. If maintenance is performed during operation the isolating valve shall be fully closed.
3. If maintenance is performed during operation only one isolating valve may be closed at a time. Only one air valve maintenance procedure may performed at a time.
4. If maintenance is performed after the pipelines have been drained the isolating valve may be closed or open.
5. The air valve may be removed, and the maintenance procedure shall be performed according to the OEM's O&M Manual.
6. The air valve shall be replaced or re-fitted to the isolation valve.

2.5 Procedure for Maintenance on Low Lift and High Lift Pumps

1. Switch off the pump.
2. Close the suction and discharge isolation valves. Tag Numbers:
 - a. GV-303
 - b. GV-305
 - c. GV-304
 - d. GV-401
 - e. GV-403
 - f. GV-405
 - g. GV-402
 - h. GV-404
 - i. GV-406
3. Isolate the pump set at the MCC panel. Isolate the pump set by switching main isolator to "OFF" position and lock with padlock to avoid accidental start.
4. Perform the maintenance procedure according to the OEM's O&M Manual
5. Switch the main isolator to "ON" position

6. Open the discharge and suction isolation valves.
7. Start the pump

2.6 Lifting Equipment

A single girder EOT crane is installed in the AWR pump station.

The crane has a capacity of 5-ton. The purpose is to allow maintenance to be carried out for lifting pumps, motors, valves, pipes etc.

The SWL as indicated on the crane shall not be exceeded. Manually operated chain hoists should only be operated by operators with necessary training and valid training and operator certificates.

Maintenance shall be done strictly in accordance with the procedures as explained the manufacturers OEM's Manual.

Load and deflection tests shall be carried out annually by an authorised institution at 125% of the SWL of the hoist. A test certificate shall be issued by the institution upon completion of the test to demonstrate that the tests have successfully passed, and the crane is safe to be used.

2.7 Ventilation System

The MCC room is equipped with an axial fan to pressurise the room that will prevent dust from outside entering the room. It is also equipped with an air conditioner to keep equipment at a suitable temperature as per Eskom specifications. The ventilation system should be operational at all times. Inspections and maintenance of all fans and the air conditioner are required as prescribed in the instruction manuals furnished by the manufacturer.

2.8 Control and Instrumentation Equipment

All instrumentation and control equipment such as pressure gauges, pressure switches, flow meters, PLC's, switches, IO modules and the feedback interface panels should be tested and inspected yearly. Routine inspections and maintenance shall be done as per the OEM requirements.

All cables should be clear of debris and inspected when routine maintenance is conducted.

2.9 Electrical Equipment

All electrical equipment such as mcc panels, transformer and surroundings, emergency switches and stops, cable connections should be tested and inspected. Routine inspections and maintenance must be done as per the OEM requirements. Equipment such as the transformer and connection boxes shall be checked for hot connections.

All cables should be clear of debris and inspected when routine maintenance is conducted.

2.10 Fire Equipment

Fire extinguishers to be maintained according to the OEM’s O&M manuals

3. AWR Pipelines

3.1 General Pipeline Maintenance

Routine inspections shall be performed on the entire pipeline route to inspect for any possible leaks or possible damage caused to the pipeline. Where leaks are found where pipe spools are flanged the gaskets shall be inspected and relaced if required.

Periodical maintenance is required on the following equipment installed on the entire pipeline routes:

- Air valves
- Air valve isolating valves
- Flow meters
- Scour valves
- Control valves

The following maintenance schedule shall be performed as a minimum and in conjunction with all OEM’s O&M Manuals

Table 3: Pipeline equipment routine maintenance

Description	Weekly	Monthly			Annually
		1	3	6	
Inspect for leaks		x			
Inspect/dewater manhole or chambers		x			
Inspect air valves for leaks		x			
Exercise Valves full cycle			x		
Inspect valves seals for leaks					x
Apply lubrication				x	

Description	Weekly	Monthly			Annually
		1	3	6	
Inspect for corrosion				x	
Check meters for operation		x			

The following checks within the scope of the standard servicing and maintenance intervals for the overall system are recommended:

- Check for external leakages,
- Check for any damages,
- Check for fouling/ freedom of movement,
- Check for unusual noises.

3.2 Valve maintenance along the pipelines

The operations and maintenance shall be in accordance with the descriptions in the table below and OEM recommendations.

Table 4: Operations and Maintenance

EQUIPMENT DESCRIPTION	OPERATION	MAINTENANCE
Air valves	Remove mesh cover at top of airvalve and clean out debris from plunger.	Inspect every month under flow conditions.
Pressure sustaining valves	Pilot pressure sustaining function.	Test and verify sustaining function every 3 months under no-flow conditions. Valves should be maintained as per suppliers prescribed instruction manuals.

EQUIPMENT DESCRIPTION	OPERATION	MAINTENANCE
Gate valves for air valves or scour valve	Manually turn the hand wheels.	<p>Actuate every 3 months under no-flow conditions.</p> <p>Valves should be maintained as per suppliers prescribed instruction manuals.</p>
Check valve	Automatically stop flow in one direction	Inspect every 3 months underflow conditions.
Exposed pipework, supports with flanges and gaskets	N/A	Inspect for any leaks every monthly, report if defects are detected.

4. Slurry System

This section must be read with 21084-KMDD-PR-RPT-003 (Process Description) and Section 3 of 21084-KMDD-PR-005 (Control Philosophy).

4.1 General

The Slurry Pump Station has two pumping systems, namely the fly ash sump pump system and the coarse ash sump pump setup with individual pipelines transferring the slurries. The pump sets are described as follows:

- 2 duty pumps (VSD controlled units) each servicing the fly ash and coarse ash systems.
 - Tag Numbers: P-101 and P-103
- 1 standby pump (VSD controlled unit) servicing both the fly ash and coarse ash systems.
 - Tag Numbers: P-102

The pump sets comprise of end-suction centrifugal slurry type pumps, that are controlled with flowmeters for VSD set points.

See Table 5 for pump descriptions. All pump systems/ pipelines are supplied with flow meters and pressure gauges.

Refer to 21084-KMDD-PR-PID-001 and 21084-KMDD-PR-PID-002_1 and 21084-KMDD-PR-PID-002_2 for the PIDs for the slurry pumping system.

4.2 Operating Description

During normal operating conditions, the pumps operate in manual mode and will be rotated between standby and duty pumps as described below (it will be an operator intervention to rotate between pumps).

Table 5: Slurry Pump Operations at Different Levels

Slurry sumps	Action	Level in AWR
Low level	Stop – Stop pumping when the sump level is low	TBC
High level	Start – Start pumping when the sump level is high	TBC

Low-low and high-high levels can also be introduced during commissioning phases.

Table 6: AWR Pump Descriptions

Pump number	Description
Fly ash slurry pump P-101	1 Duty pump – 1617m ³ /hour and 58m head (500kW) Pump from Slurry pump station at Kriel power station to the Matla Ash dam via two pipelines (one duty and one standby)
Coarse ash slurry pump P-103	1 Duty pump – 1617m ³ /hour @ 58m head (500kW) Pump from Slurry pump station at Kriel power station to the Matla Ash dam via two pipelines (one duty and one standby)
Coarse and Fly Ash Pump P-102	1 Standby pump – 1617m ³ /hour @ 58m head (500kW) Pump from Slurry pump station at Kriel power station to the Matla Ash dam via two pipelines (one duty and one standby)

4.3 Slurry Pumps Start-up Philosophy and Procedure to Fill up the Pipelines

4.3.1 Duty Pump Start Up Procedure

Local intervention is required for start-up or shutdown.

If the pump receives a start-up signal in manual mode, the sequence is as follow:

These pump sets have a built-in process controller to keep the line flow rate to above 1000 m³/hour, and within the BEP range of the pumps.

1. Permit to be applied for according to the Eskom permit to work system.
2. Select which Ash Dam to pump to:
 - a. Kriel Ash Dam
 - b. Matla Ash Dam
3. Select which discharge pipeline to pump through:
 - a. For Pumping to Kriel Ash Dam

- i. TP 201B for Pump P-101
 - ii. TP 204B for Pump P-103
 - a. For pumping to Matla Ash Dam
 - i. KMA-205-CSPN16-500NB-BBA/PFA for Pump P-101
 - ii. KMA-208-CSPN16-500NB-BBA/PFA for Pump P-103
- 4. Fully close the standby suction and discharge isolation valves. Tag numbers:
 - a. GV-110
 - b. GV-111
 - c. GV-102
 - d. GV-108
 - e. GV-109
- 5. Fully open the duty suction isolation valves along the duty pipeline and pump system.
Tag Numbers:
 - a. GV-101
 - b. GV-107
- 6. If pumping to Matla Ash Dam fully close the discharge isolation valves. Tag Numbers:
 - a. GV-209 for P-101
 - b. GV-202 for P-101
 - c. GV-212 for P-103
 - d. GV-201 for P-103
- 7. If pumping to Kriel Ash Dam fully close the discharge isolation valves: Tag Numbers:
 - a. GV-205 for P-101
 - b. GV-208 for P-103
- 8. If pumping to Matla Ash Dam fully open the discharge isolation valves. Tag numbers:
 - a. GV-205 for P-101

- b. GV-208 for P-103
9. If pumping to Kriel Ash Dam fully open the discharge isolation valves. Tag numbers:
- a. GV-209 for P-101
 - b. GV-202 for P-101
 - c. GV-212 for P-103
 - d. GV-201 for P-103
10. Fully open the cross-over system isolation valve for the selected discharge pipeline. Close the other isolation valves. Note that the same discharge pipeline shall not be used for both duty pumps. If a different discharge pipe is to be used then pumps to be switched off and the previous steps to be repeated.
- a. If pumping from P-101 to one of the pipelines listed below. Open the selected list items valves and close the other list item valves. Tag Numbers:
 - i. GV-213 if pumping to KMA-205-CSPN16-500NB-BBA/PFA
 - ii. GV-215 and GV-214 if pumping to KMA-206-CSPN16-500NB-BBA/PFA
 - iii. GV-215 and GV-216 if pumping to KMA-207-CSPN16-500NB-BBA/PFA
 - iv. GV-215 and GV-217 if pumping to KMA-208-CSPN16-500NB-BBA/PFA
 - b. If pumping from P-103 to one of the pipelines listed below. Open the selected list items valves and close the other list item valves. Tag Numbers:
 - i. GV-237 if pumping to KMA-208-CSPN16-500-BBA/PFA
 - ii. GV-228 if pumping to KMA-207-CSPN16-500-BBA/PFA
 - iii. GV-227 and GV-238 if pumping to KMA-206-CSPN16-500-BBA/PFA
 - iv. GV-227 and GV-226 if pumping to KMA-205-CSPN16-500-BBA/PFA
11. Fully close all the duty and standby pipelines scour valves. Tag Numbers:
- a. GV-235
 - b. GV-233
 - c. GV-231
 - d. GV-229
12. Fully open the duty pipelines Air Valves and Air Valve Isolation Valves. Tag Numbers:
- a. PVCV-204

- b. PVCV-201
 - c. GV-236
 - d. GV-230
13. Fully open the selected discharge point valve and fully close the other discharge point valves. Fully open one selected list item and fully close the other selected list items. If a different discharge point is to be selected repeat the previous steps. Tag Numbers:
- a. KMA-205-CSPN16-500NB-BBA/PFA.
 - i. GV-239
 - ii. GV-240
 - iii. GV-241
 - iv. GV-242
 - b. KMA-206-CSPN16-500NB-BBA/PFA
 - i. GV-243
 - ii. GV-244
 - iii. GV-245
 - iv. GV-247
 - c. KMA-207-CSPN16-500NB-BBA/PFA
 - i. GV-248
 - ii. GV-249
 - iii. GV-250
 - iv. GV-251
 - d. KMA-208-CSPN16-500NB-BBA/PFA
 - i. GV-252
 - ii. GV-253
 - iii. GV-254
 - iv. GV-255
14. Signal alarm to start the pumps and start the duty pumps.

4.3.2 Standby Pump Start up Procedure.

1. Permit to be applied for according to the Eskom permit to work system.
2. Switch off the selected duty pump. Tag Numbers:
 - a. P-101

- b. P-103
3. Select which Ash Dam to pump to:
 - a. Kriel Ash Dam
 - b. Matla Ash Dam
4. Select which discharge pipeline to pump through:
 - a. KMA-106-CSPN16-500NB-PFA for P-102
 - b. KMA-104-CSPN16-500NB-BBA for P-102
5. Select which discharge pipeline to pump through:
 - a. For pumping to Kriel Ash Dam
 - i. TP 202B for P-102
 - ii. TP 203B for P-102
 - b. For pumping to Matla Ash Dam
 - i. KMA-206-CSPN16-500NB-BBA/PFA for P-102
 - ii. KMA-207-CSPN16-500NB-BBA/PFA for P-102
6. Fully open the standby suction valves. Tag numbers:
 - a. GV-110
 - b. GV-111
 - c. GV-102
7. Fully open the standby discharge valve. Tag Numbers:
 - a. GV-108 if KMA-104-CSPN16-500NB-BBA is selected.
 - b. GV-109 if KMA-106-CSPN16-500NB-PFA is selected.
8. Fully close the non-selected standby discharge valve. Tag Numbers:
 - a. GV-108 if KMA-104-CSPN16-500NB-BBA is selected.
 - b. GV-109 if KMA-106-CSPN16-500NB-PFA is selected.

9. Fully close the switched off duty suction isolation valves along the duty pipeline and pump system. Tag Numbers:
 - a. GV-101 for P-101
 - b. GV-107 for P-103
10. If pumping to Matla Ash Dam fully close the switched off duty discharge isolation valves. Tag Numbers:
 - a. GV-209 for P-101
 - b. GV-202 for P-101
 - c. GV-212 for P-103
 - d. GV-201 for P-103
11. If pumping to Kriel Ash Dam fully close the switched off duty discharge isolation valves: Tag Numbers:
 - a. GV-205 for P-101
 - b. GV-208 for P-103
12. If pumping to Matla Ash Dam fully close the standby discharge isolation valves. Tag numbers:
 - a. GV-210 if GV-108 is fully open
 - b. GV-204 if GV-108 is fully open
 - c. GV-211 if GV-109 is fully open
 - d. GV-203 if GV-109 is fully open
13. If pumping to Matla Ash Dam fully open the standby discharge isolation valves. Tag numbers:
 - a. GV-206 if GV-108 is fully open
 - b. GV-207 if GV-109 is fully open
14. If pumping to Kriel Ash Dam fully close the standby discharge isolation valves. Tag Numbers:
 - a. GV-206 if Gv-108 is fully open

- b. GV-207 if GV-109 is fully open
15. If pumping to Kriel Ash Dam fully open the discharge isolation valves. Tag numbers:
- a. GV-210 if GV-108 is fully open
 - b. GV-204 if GV-108 is fully open
 - c. GV-211 if GV-109 is fully open
 - d. GV-203 if GV-109 is fully open
16. Fully open the cross-over system isolation valve for the selected discharge pipeline. Close the other isolation valves. Note that the same discharge pipeline shall not be used for both operating pumps. If a different discharge pipe is to be used then pumps to be switched off and the previous steps to be repeated. Tag numbers:
- a. If pumping from P-102 with GV-108 fully open and GV-109 fully closed to one of the pipelines listed below. Open the selected list items valves and close the other list item valves. Tag Numbers:
 - i. GV-219 if pumping to KMA-206-CSPN16-500NB-BBA/PFA
 - ii. GV-218 if pumping to KMA-205-CSPN16-500NB-BBA/PFA
 - iii. GV-220 and GV-225 if pumping to KMA-207-CSPN16-500NB-BBA/PFA
 - iv. GV-221 and GV-237 if pumping to KMA-208-CSPN16-500NB-BBA/PFA
 - b. If pumping from P-102 with GV-109 fully open and GV-108 fully closed. Open the selected list items valves and close the other list item valves. Tag Numbers:
 - i. GV-225 if pumping to KMA-207-CSPN16-500-BBA/PFA
 - ii. GV-222 and GV-237 if pumping to KMA-208-CSPN16-500-BBA/PFA
 - iii. GV-223 if pumping to KMA-205-CSPN16-500-BBA/PFA
 - iv. GV-224 if pumping to KMA-206-CSPN16-500-BBA/PFA
17. Fully close all the scour valves along the duty pipelines. Tag Numbers:
- a. GV-235
 - b. GV-233
 - c. GV-231
 - d. GV-229
18. Fully open the Air Valves and Air Valve Isolation Valves
- a. PVCV-203

b. PVCV-202

c. GV-234

d. GV-232

19. Fully open the selected discharge point valve and fully close the other discharge point valves. Fully open one selected list items and fully close the other selected list items. If a different discharge point is to be selected repeat the previous steps. Tag Numbers:

a. KMA-205-CSPN16-500NB-BBA/PFA.

- i. GV-239
- ii. GV-240
- iii. GV-241
- iv. GV-242

b. KMA-206-CSPN16-500NB-BBA/PFA

- i. GV-243
- ii. GV-244
- iii. GV-245
- iv. GV-247

c. KMA-207-CSPN16-500NB-BBA/PFA

- i. GV-248
- ii. GV-249
- iii. GV-250
- iv. GV-251

d. KMA-208-CSPN16-500NB-BBA/PFA

- i. GV-252
- ii. GV-253
- iii. GV-254
- iv. GV-255

20. Signal alarm to start the pumps and start the duty pumps.

4.4 Pump Shut Down Philosophy

If any of the conditions below are met in manual mode, the pumps will shut down:

- Any of the motor protection signals trigger (flow, pressure, overload current).
- Isolation suction valves are closed/ intermediate position.
- Isolation discharge valve is closed.

These pump sets have a built-in process controller to keep the flow between 1000m³/hour and 2500 m³/hour.

4.5 Scheduled Maintenance on Mechanical Equipment

It is recommended that scheduled maintenance should be done as prescribed in the Operation and Maintenance Manual that is included in the Contractor's Data Pack (TBC):

4.6 Procedure for Operation of Slurry Scour Valves

1. All pipelines in series may be scoured simultaneously or individually.
2. Ensure that all air valves and air-valve isolating valves are fully open.
3. Fully close the discharge isolating valves of the slurry pumps.
4. Ensure that the flow receiving area is cleared of debris and personnel.
 - a. The pipeline shall be scoured in sections when more than one scour valve is placed on a continuous downslope of the pipelines.
5. The highest scour valve shall be opened to drain a section of pipeline.
 - a. The flow shall be throttled by opening turning the spindle slowly.
6. The highest scour valve may be left open before the next highest scour valve is opened.
7. The next highest scour valve to be opened to drain the next section of pipeline.
 - a. The flow shall be throttled by opening the spindle slowly.
8. Ensure that flow from the scour piping exits to the correct designated location.
9. All scour valves shall be fully closed.

4.6.1 Procedure for maintenance of slurry scour valves

1. The pipelines shall be drained as described in the above sub-section.
2. The scour valves may be removed and shall be replaced if the pipeline is to be filled before the maintenance procedure is completed.
3. Maintenance procedures according to the OEM's Manual shall then be performed on the removed scour valves.

4.7 Procedure for operation of Air Valves

1. Air valves shall be in the open position for both the small and large orifice.
2. The isolation valves shall be fully open.
3. During the filling procedure of the pipelines and during the pumping operation the air valves shall remain open to allow air pockets to vacate the high points of the pipeline.
4. During draining of the pipelines the air valves shall remain open to prevent vacuum conditions.

4.7.1 Procedure for Maintenance of Air Valves

1. Maintenance of air valves may be performed during pumping operation or when the pumps are switched off.
2. If maintenance is performed during operation the isolating valve shall be fully closed.
3. If maintenance is performed during operation only one isolating valve may be closed at a time. Only one air valve maintenance procedure may be performed at a time.
4. If maintenance is performed after the pipelines have been drained the isolating valve may be closed or open.
5. The air valve may be removed, and the maintenance procedure shall be performed according to the OEM's O&M Manual.
6. The air valve shall be replaced or re-fitted to the isolation valve.

4.8 Procedure for Maintenance on slurry pumps.

1. Switch off the pump
2. Close the suction and discharge isolating valves
 - b. GV-101
 - c. GV-102
 - d. GV-110
 - e. GV-111
 - f. GV-107
 - g. GV-108
 - h. GV-109
 - i. GV-205
 - j. GV-206
 - k. GV-207

- l. GV-208
 - m. GV209
 - n. GV-210
 - o. GV-211
 - p. GV-212
 - q. GV-201
 - r. GV-202
 - s. GV-203
 - t. GV-204
3. Isolate the pump set at the MCC Panel. Isolate the pump set by switching main isolator to "OFF" position and lock with padlock to avoid accidental start.
 4. Perform the maintenance procedure according to the OEM's O&M Manual.
 5. Switch the main isolator to "On" position.
 6. Open the discharge and suction isolation valves.
 7. Start the pump.

4.9 Control and Instrumentation

All instrumentation and control equipment such as pressure gauges, pressure switches, flow meters, PLC's, switches, IO modules and the feedback interface panels should be tested and inspected yearly. Routine inspections and maintenance shall be done as per the OEM requirements.

All cables should be clear of debris and inspected when routine maintenance is conducted.

4.10 Electrical Equipment

All electrical equipment such as mcc panels, transformer and surroundings, emergency switches and stops, cable connections should be tested and inspected. Routine inspections and maintenance must be done as per the OEM requirements. Equipment such as the transformer and connection boxes shall be checked for hot connections.

All cables should be clear of debris and inspected when routine maintenance is conducted.

5. Slurry pipelines

5.1 General Pipeline Maintenance

Routine inspections shall be performed on the entire pipeline route to inspect for any possible leaks or possible damage caused to the pipeline. Where leaks are found where pipe spools are flanged the gaskets shall be inspected and relaced if required.

Periodical maintenance is required on the following equipment installed on the entire pipeline routes:

- Air valves
- Air isolating valves
- Flow meters
- Scour valves
- Control valves

The following maintenance schedule shall be performed as a minimum and in conjunction with all OEM's O&M Manuals

Table 7: Pipeline Equipment Routine Maintenance

Description	Weekly	Monthly			Annually
		1	3	6	
Inspect for leaks		x			
Inspect air valves for leaks		x			
Exercise Valves full cycle			x		
Inspect valves seals for leaks					x
Apply lubrication				x	
Inspect for corrosion				x	
Check meters for operation		x			

The following checks within the scope of the standard servicing and maintenance intervals for the overall system are nonetheless recommended:

- Check for external leakages,
- Check for any damages,
- Check for fouling/ freedom of movement,
- Check for unusual noises.

5.2 Valve maintenance along the pipelines

The operations and maintenance shall be in accordance with the descriptions in the table below and OEM recommendations.

Table 8: Operation and Maintenance

EQUIPMENT DESCRIPTION	OPERATION	MAINTENANCE
Air valves	Remove mesh cover at top of air valve and clean out debris from plunger.	Inspect every month under flow conditions.
Pressure sustaining valves	Pilot pressure sustaining function.	Test and verify sustaining function every 3 months under no-flow conditions. Valves should be maintained as per suppliers prescribed instruction manuals.
Gate valves for air valves or scour valve	Manually turn the hand wheels.	Actuate every 3 months under no-flow conditions. Valves should be maintained as per suppliers prescribed instruction manuals.
Check valve	Automatically stop flow in one direction	Inspect every 3 months under flow conditions.

EQUIPMENT DESCRIPTION	OPERATION	MAINTENANCE
Exposed pipework, supports with flanges and gaskets	N/A	Inspect for any leaks every monthly, report if defects are detected.

6. Environment Incident Management

This procedure details the process to be followed by in case of any spillage which occurs at, or as a result of, Kriel to Matla Ash Link Facilities.

6.1 Procedure

In the case of any environment spillage, Eskom’s Environmental Incident Management Procedure (240-133087117) shall be followed

6.2 Specific Incidents

Incident	Eskom Incident Type Classification	Possible Causes	Preventive Measures
Minor Ash Slurry Release	Ash spill incident Incidents with an OHS and potential environmental consequence	<ul style="list-style-type: none"> Pinhole Leak; Flange leak; Equipment Leak; Aging equipment. 	<ul style="list-style-type: none"> Inspection & Maintenance Plan
Major Ash Slurry release	Ash spill incident Incidents with an OHS and environmental consequence	<ul style="list-style-type: none"> Pipe Rupture; Sabotage; Aging equipment. 	<ul style="list-style-type: none"> Inspection & Maintenance Plan Pump Shutoff head to prevent pipe rupture. Safety Instrument to prevent pipe rupture. Operator intervention.
Minor Ash Water release	Incidents with an OHS and potential environmental consequence	<ul style="list-style-type: none"> Pinhole Leak; Flange leak; Equipment Leak; Aging equipment. 	<ul style="list-style-type: none"> Inspection & Maintenance Plan

Incident	Eskom Incident Type Classification	Possible Causes	Preventive Measures
Major Ash Water release	Incidents with an OHS and environmental consequence	<ul style="list-style-type: none"> • Aging equipment. 	<ul style="list-style-type: none"> • Inspection & Maintenance Plan • Pump Shutoff head to prevent pipe rupture. • Safety Instrument to prevent pipe rupture. • Operator intervention.
Chemical Release	Incidents with an OHS and potential environmental consequence	<ul style="list-style-type: none"> • Accidental Spills • Improper Handling • Pinhole Leak; • Flange leak; • Equipment Leak; • Pipe Rupture; • Sabotage; • Aging equipment. 	<ul style="list-style-type: none"> • Eskom standard operating procedure • Inspection & Maintenance Plan • Chemical Bund to contain Chemicals. • Pump Shutoff head to prevent pipe rupture. • Safety Instrument to prevent pipe rupture. • Operator intervention.
Oil release	Hydrocarbon spill incidents	<ul style="list-style-type: none"> • Accidental Spills • Improper Handling • Pinhole Leak; • Flange leak; • Equipment Leak; • Sabotage; • Aging equipment. 	<ul style="list-style-type: none"> • Eskom standard operating procedure • Inspection & Maintenance Plan

6.3 Recommended Actions

6.3.1 Incident Reporting and Managing

- Follow Eskom Environmental Incident Management Procedure for incident reporting,

6.3.2 Ash Spill Incident

Clean up Procedure:

- In the event of an ash spillage, refer to the Safety Data Sheet (SDS) for both fly ash and bottom ash to ensure proper handling.
- All personnel or contractors involved in containing or cleaning up the spillage must be equipped with the recommended Personal Protective Equipment (PPE).
- Follow the procedures outlined in the SDS for handling and containing accidental releases of ash.

Operation Response:

- Immediately halt the Ash Slurry pumping operation upon discovering the spillage.
- Initiate a thorough investigation to identify the root cause of the leak and assess its severity.
- Evaluate the possibility of resolving the issue within a reasonable timeframe.
- If a quick resolution is not feasible, switch to the standby pipeline for ashing operation. If this is a slurry pipeline, the line is to be flushed to remove ash slurry from the line and replaced with flush water. After flushing or in the case of the ash return water or if the spill is major and flushing the line is not possible, the pumps should shut down and the section of pipeline / infrastructure where the spill occurred is to be drained through the scour or alternative drain valves. After drainage the area in question is to be repaired.
- After repair works the pipeline is to be filled and pump start up may occur to put the system into operation.
- The spilled ash is to be cleaned up by maintenance personnel. Specific equipment to be used is to be determined by extent of the spill and tools and plant available to maintenance personnel.
- Implement a comprehensive maintenance plan to address and rectify the underlying challenge effectively.

6.3.3 OHS and Environmental Incident:

Clean up Procedure:

- Consult the Safety Data Sheet (SDS) for the specific chemical involved in the spillage to understand proper containment and clean-up procedures.

- Ensure that all personnel or contractors involved in the clean-up process have access to and wear the recommended Personal Protective Equipment (PPE).
- Adhere to the guidelines specified in the SDS for handling and containing accidental releases of the chemical.

Operation Response:

- Cease the operation of the chemical process immediately after detecting the spillage.
- Conduct a thorough investigation to determine the root cause of the spillage and assess potential risks.
- Evaluate the feasibility of resolving the issue within a reasonable timeframe.
- If a quick resolution is not attainable, switch to a standby unit for continued operation.
- Develop and implement a comprehensive maintenance plan to address and resolve the underlying issue efficiently.
- In the absence of a standby unit, evaluate emergency operation methodologies or consider suspending the system until a safe and reliable solution is established.

6.3.4 Hydrocarbon Spill Incidents:

Clean up Procedure:

- Refer to the Safety Data Sheet (SDS) for the specific oil that has been spilled to understand the appropriate containment and clean-up procedures.
- Ensure that all personnel or contractors involved in the spillage clean-up have access to and utilize the recommended Personal Protective Equipment (PPE).
- Follow the guidelines outlined in the SDS for handling and containing accidental releases of the hydrocarbon.

Operation Response:

- Immediately halt the operation of the equipment involved upon the detection of the spillage.
- Initiate a thorough investigation to determine the root cause of the spillage and assess its severity.
- Evaluate the possibility of resolving the issue within a reasonable timeframe.

- If a prompt resolution is not feasible, activate an available standby unit to continue operations.
- Develop and implement a comprehensive maintenance plan to effectively address and rectify the underlying challenge.
- In the absence of a standby unit, assess emergency operation methodologies, or consider suspending the system until a safe and reliable solution is established.

7. OEM Equipment Manuals

Preservation Manuals for the mechanical equipment to be included in Appendix A after procurement and installation of equipment.

Appendix A: OEM Equipment Manuals (TBC AFTER CONSTRUCTION)