Bosch Holdings Consortium

ESKOM HOLDINGS SOC LTD

TASK 203 – BASIC AND DETAILED DESIGN OF MEDUPI RAIL YARD AND OFFLOADING FACILITY

CONTRACT NUMBER: 4600051676

ORDER NUMBER: 4501833635

BOSCH HOLDINGS CONSORTIUM PROJECT NUMBER: P1184-099-1

MEDUPI RAIL YARD AND OFFLOADING FACILITY

CONCEPT REPORT – EXECUTIVE SUMMARY

Report reference number: 1184-099-4-100-R-0001-Rev03 Concept Executive Summary Revision: 04 Total pages: 24

Report submitted by:

Bosch Holdings Consortium

13 March 2015

CONTROLLED DISCLOSURE

EXECUTIVE SUMMARY

Eskom is currently constructing the Medupi Power Station near Lephalale in the Limpopo Province. A flue gas desulphurisation plant (FGD), which reduces sulphur dioxide emissions by at least 90% by reacting it with a limestone sorbent, will be retrofitted at the Medupi Power Station. It will therefore be required to deliver limestone to the Power station via the existing rail network. A new Rail yard and associated materials handling system will therefore be required. The potential also exists for the FGD gypsum by-product from the Power station operations to be sold into the market, however the volumes and target clients to date have not yet been identified nor determined.

Bosch Holdings Consortium, hereafter referred to as the Consultant, received a task order from Eskom to carry out an Options study, Concept design as well as a basic design of the Materials handling system and a detailed design of the Rail Yard. The scope of the rail yard design therefore includes all the project stages from the pre-feasibility to the detail design phase, whilst the material handling is limited to basic design only.

The scope of work related to the Concept design as per the Task order is the following:-

- Electrical requirements
- C& I requirements
- Civil requirements
- Road and Rail requirements
- Walkway requirements
- Geotechnical and Hydrological studies
- Fire protection requirements
- Buildings and Services requirements
- Water Management requirements
- Fencing (Security fencing) requirements
- More comprehensive costing for different options (Capex and Life cycle costing)
- Environmental requirements
- Storm water protection requirements

The stakeholder's requirements for the project were captured in the Stakeholders Requirements Definitions (SRD) report (200-130118) that was approved by Eskom on 17 June 2014. The Design Criteria Report (200-130171) for the project was compiled by the Consultant and approved by Eskom on 17 June 2014.

The Concept Study carries forward the results of the Options Report (1184-099-4-100-R-0001-Rev02 Options study report) that was approved by Eskom on 29 October 2014. A comprehensive Train operations simulation report (1184-099-4-100-Rev02 Simulation report) was also compiled and approved by Eskom on 29 October 2014.

This Concept report, structured in three parts (Volumes 1 to 3), develops the preferred option identified in the Options report for the Medupi rail siding. A linear type yard layout was identified as the most suited option to take forward into the next phase of the project. The Concept report provides an overview of the engineering processes followed and the system design status at the end of the concept phase. The three volumes must be read together. The acceptance of the report will allow the Consultant to proceed to the basic design phase for the Materials handling and to the detailed design phase for the Rail Yard.

Volume 1 Rail Yard and Services

The rail yard will handle bulk limestone, to be used as a sorbent, for use in the retrofitted FGD plant. Depending on market demand, bulk gypsum will also be despatched via the rail yard.

The scope of the new rail yard is to provide the Medupi Power Station with a rail yard solution and rail operations that will ensure that the yard is capable to receive and off-load 1,200,000 t/a of Limestone and to load and despatch 400,000 t/a of FGD Gypsum.

This Volume covers the Concept Design of the proposed rail yard and all other services required to operate the yard. The next phase of the Rail Yard and Services part of the project will be the detailed design phase which will complete the project.

The following battery limits define the scope of the rail yard and services study:

- The rail layout within the Medupi yard itself
- Current Transnet Freight Rail train operating methodology
- Allowance for future signalling systems from the TFR mainline into and out of the yard
- Allowance for the associated future electrification of the yard
- Allowance for Rail Area Lighting
- All the associated facilities required for the maintenance and operation of the yard

Volume 2 Materials Handling

This Volume covers the Concept Design of the proposed Materials Handling system that will be required to off-load the Limestone and load the Gypsum. The next phase of the Materials Handling part of the project will be the basic design phase which will complete the project.

The Options study identified a tippler as the most appropriate technology choice for handling of the limestone. During the Concept phase, a further assessment was conducted to determine the most optimum choice of tippler i.e. a single wagon rotary tippler versus a single wagon side tippler. A detailed life cycle cost assessment was conducted and forms part of Volume 2.

For the limestone materials handling, the scope of work is from the tippler to discharge onto the stacking conveyor; the battery limit at the stockyard is the underside of the transfer chute to the stacking conveyor. For gypsum materials handling, the scope of this project covers from the stockyard to the rail wagon loading facility; the battery limit at the stockyard is the top of the reclaim hoppers.

Volume 3 Appendices

This Volume presents 20 appendices containing details such as drawings, diagrams, information, assessment reports and costing relevant to both Volumes 1 and 2.

MDR MINUTES OF MEETING AND ACTION LIST

The MDR meeting was held on 22 January 2015. The minutes of this meeting and the MDR action list is attached (see Appendix A). A separate meeting was held on 29 January to discuss the LPS (Fire protection and detection) issues. The minutes of that meeting is attached as Appendix B.

The C&I department provided final feedback on Rev2 on 19 February 2015. An action list was compiled (see Appendix C) and Rev3 was issued for approval. The C&I department approved Rev3 with comments on 27 February 2015. The action list was updated with these comments and incorporated into Rev4.

REVISIONS

Rev.	Status	Issued by	Date
01	Issued for review	Francois Retief	4/12/2014
02	Updated with Electrical and C&I changes	Francois Retief	29/1/2015
03	Updated with all MDR changes including C&I issues from 19 February 2015	Francois Retief	20/2/2015
04	Updated with final C&I issues after meeting held on 27 February 2015	Francois Retief	13/3/2015

CONTROLLED DISCLOSURE

APPENDIX A - MINUTES OF MDR MEETING HELD ON 22 JANUARY 2015

ESKOM HOLDINGS SOC LTD

TASK 203 – BASIC AND DETAILED DESIGN OF MEDUPI RAIL YARD AND OFFLOADING FACILITY

CONTRACT NUMBER: 4600051676

ORDER NUMBER: 4501833635

BOSCH HOLDINGS CONSORTIUM PROJECT NUMBER: P1184-099-1

MDR FOR THE APPROVAL OF THE CONCEPT DESIGN REPORT

DOCUMENT NUMBER: 1184-099-1-100-M-0019-1

Meeting held at Eskom Enterprise Park on the 22nd of January 2015 at 10:00am

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Attendees: F. Retief, M. Mzebetshana, R. Venter, D. van der Schyff, P. Basson, D. Smart, S. Manngo, D. Fransman, B. Van Wyk, T. Blom, R. Thijs, D. Bredenkamp, D. Bezuidenhoudt, W. Kusel, S. Inderlall, R. Ranaka, A. Wiid, K. Shebe (by phone)

Apologies: B. Tyson

Distribution: Eskom project team, Bosch Consortium project team

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		Action	*Date*
1	**Approval of Previous Minutes**	There were no previous minutes to approve. The objective of the MDR meeting is to approve the Concept design report. The Concept design report was handed to Eskom on 4 December 2014.	
2	**Matters Arising**	1. All the feedback received from Eskom up to the MDR meeting was compiled in a list and distributed at the meeting. A number of issues raised at the meeting were added to the list. Each item on the list was discussed and the resolution and actions were noted in the "Resolution" column. The MDR action list is attached to	

these minutes. Action: All

2. The information that needs to be sent from the Weighbridge to the Medupi central control room needs to be clarified. This is required for the next phase of the project i.e. basic and detailed design. Action. S. Manngo

3. An operational manual will be required for the train operations i.e. as part of the detailed design. This must clearly describe and outline the train operations in the yard. Action: D. vd Schyff

4. It was decided that a Side tippler is the preferred solution to be taken to basic design. The main reasons for this decision are the following:-

* The Side Tippler is the most cost-effective option if the full lifecycle cost is taken into account.

* The cycle time of the Side Tippler is adequate for the offloading of limestone.

* CAR wagon types are used in the design. Should TFR at a later stage demand (i.e. as part of the Service design) that another type of wagon is used, then it will impact the design of the Rotary tippler but there will be no impact if a Side tippler is used.

The impact (if any) of the difference in the power consumption between the Side tippler and Rotary tipplers needs to be investigated before the above decision is finalized. Action: F. Retief

5. B. Van Wyk (GTE – Electrical) stated that he is satisfied with the design philosophy and approve the Concept design subject to the Electrical items in the MDR action list being resolved.

6. Civil Engineering approved the Concept design subject to the Civil items in the MDR action list being resolved.

7. Materials handling (D. Smart and A. Wiid) approved

the Concept design subject to the BMH items in the MDR action list being resolved.

8. R. Renaka (Chemical COE) approved the Concept design.

9. S. Manngo (PED) approved the Concept design.

10. Approval by the Power station to be handled by Eskom. Action: M. Mzebetshana

11. K. Shebe (GTE – C&I) stated that feedback will be provided after the completion of an internal process to finalize all comments. Some issues mentioned are (1) All interfaces to be clearly defined, (2) make sure the availability is adequate, (3) align maintenance and spares with the Medupi power station systems. Action: K. Shebe

12. No feedback was received from LPS (Fire Engineering). It was decided that a meeting between Bruce Tyson and Roger Bosch will be facilitated in order to obtain approval of the Fire detection and protection services in the Concept design report. Action: F. Retief/ M. Mzebetshana

13. It was mentioned by Eskom that a HAZOP study needs to be done before the basic and detailed design is started. Eskom to provide the requirements of such a study to the Consultant. Action: M. Mzebetshana

14. Conclusion: The Concept design is approved subject to the following:-

* The issues as per the attached MDR action list is resolved

* Feedback and approval by the Power Station (see point 10 above)

* Feedback is received on the C&I issues (see point 11 above)

* Feedback is received on the Fire detection and protection issues (see point 12 above)

3 Next Meeting Not required

Prepared by: Francois Retief – 23/1/2015

MDR ACTION LIST

1	Vol1 Section 8.1 & Vol 2 – Section 9.1	How will DC be generated. UPS or chargers with battery bank ?	Electrical	UPS with battery back up. Concept report to be updated. Action: S. Inderlall
2	Vol1 Section 8.7.2 & Vol 2 – Section 9.6.2	Where will 110V DC come from ?	Electrical	From the UPS Concept report to be updated. Action: S. Inderlall
3	Vol1 – Table 6 on page 37 & Vol2 – Section 9.7 Electrical equipment list	A description of the concepts that will be use during the design phase to be added to give assurance that the design will be in accordance with Eskom's specifications, redundancy principles etc. Maybe backed-up by a concept single line diagram.	Electrical	A description of the concepts will be inserted before the electrical equipment list where reference will be made to Eskom's specifications. A single line diagram will be generated. Concept report to be updated. Action: S. Inderlall
4	Vol1 – Table 6 on page 37 & Vol2 – Section 9.7 Electrical equipment list	Section on Earthing and lightning protection to be added Section on power conditioning to be added Section on motors Section on VSD's Section on cables Type and sizing criteria Section on substations	Electrical	Sections on Earthing and lightning protection, power conditioning, motors, VSD's and cable type and sizing criteria will be included. W.r.t substations, a description of a typical Eskom substation will be included. Concept report to be updated. Action: S. Inderlall
5	Executive summary – Volume 2 Materials	…the battery limit at the stockyard is the top of the reclaim feeders. Feeders or hoppers ?	BMH	Noted, this will be corrected in the document – the term hoppers will be used. Executive summary to be

	Handling			updated. Action: F. Retief
6	Vol2 – Section 2	Later in the document and on the drawings you refer to hoppers, not feeders?	BMH	Noted, this will be corrected in the document as per the above item. Concept report to be updated. Action: D. Bezuidenhoudt
7	Vol 1 – Section 3.3 & Vol2 – Section 3.3	Add COLTO to abbreviations table	Civils	Will be added in abbreviations table in Vol 1 & Vol 2 Concept report to be updated. Action: W. Kusel
8	Vol 1 – Section 3.7 & Vol2 – Section 3.7	Obtain input from LPS CoE LDE – the fire protection for the BMH systems should be aligned with the rest of the Medupi FGD material handling systems.	BMH (LPS)	Information regarding the rest of Medupi FGD fire systems is required to ensure such. This relates to fire protection and fire detection. (related to email to B Tyson 24 November 2014) Roger Bosch to contact Bruce Tyson to resolve issue: Action: R. Bosch
9	Vol2 – Section 5.1.2	What is the reason for an intermediate horizontal conveyor? Doesn't the feeder belt discharge via a chute onto the inclined belt? The drawing does not show this clearly. Also note: the location of the belt feeder and incline belts on the Rotary Tippler arrangement drawing are out of position – they are conventionally located centrally under the hopper, not to the side.	BMH	There will multiple hoppers beneath the tipped rail wagon to receive the limestone, this is due to the length of the rail wagon, (and hence feeders). These will in turn discharge onto this horizontal conveyor which is required to discharge limestone to the inclined belt conveyor. This layout is based on a typical rotary tippler layout; the centreline of the hopper discharge and hence the belt conveyor is not necessarily central to the tippler, but we agree that they are also not necessarily off-centre. These details will be further developed during the basic design phase. Integrated split hopper with singel feeder as proposed at Kusile to be investigated for

				Basic design. Action: D. Bezuidenhoudt
10	Vol2 – Section 5.2.1	The function of the horizontal limestone belt conveyor needs to be clarified further.	BMH	Please see resolution for point 9 above.
11	Vol2 – Section 5.2.2	Controlled discharge of Gypsum. What is the proposed bin storage/discharge operating philosophy? i.e. do you propose having some buffer storage – which may require active mechanised discharge (screw conveyor type silo)? Or rather a chute-type bin, effectively containing minor material surge between wagon filling?	BMH	We propose some buffer storage which would provide for the changeover period between the two separate train sections. Further discussed in item 18.
12	Vol2 – Section 5.4	E, C&I is not a conventional term within Eskom. Rather say: Electrical, and C&I…	BMH	Will change all E, C&I to Electrical, and C&I Concept report to be updated. Action: S. Inderlall
13	Vol2 – Section 5.5.1	Second belt conveyor. Can't thus be eliminated ?	BMH	Please see comments as per point 9 above.
14	Vol2 – Section 5.5.1	The tippler will be controlled and monitored directly from the administration building and will be equipped with CCTV cameras in order to provide visual feedback to the control room operators. Is this type of operation an accepted & safe convention? No natural line of sight to the tippler for the Operator?	BMH	A separate control room with an operator at the tippler station will be provided; CCTV will be included for monitoring from the administration building. A separate control room at the tippler to be included in the basic design for the materials handling. Action: D. Bezuidenhoudt/ S. Inderlall The repositioning of the main admin building and control room to the tippler needs to be investigated in the next phase. Action: F. Retief
15	Vol2 – Section 5.5.2	Mobile earthmoving equipment will reclaim from the gypsum stockpile and discharge to belt feeders which discharge to the	BMH	Yes, this will be altered in the Concept Design Report. Concept report to be updated. Action: D.

		reclaim belt conveyor. Hoppers ?		Bezuidenhoudt
16	Vol2 – Section 5.5.2	The rail wagons will be manipulated and positioned by means of a rail wagon positioner arrangement and the feed to them will be controlled by a gate at the underside of the feed bin. This discharge control gate & hopper design will need careful consideration during basic design – gypsum flow-ability issues.	BMH	Noted, a number of options to ensure the gypsum flow are available.
17	Vol2 – Section 5.6 Safety Concept	Emergency exit routes from underground tunnel/pit areas considered?	BMH	Yes, two exit routes will be required at the tippler station/"pit". A minimum of one additional exit route (apart from at the end of the tunnel) will be required at the tunnel due to the length of the tunnel.
18	Vol2 – Section 8.3 Gypsum loading	An overhead surge bin, which will straddle the rail at the gypsum loading point, is required to provide control and surge capacity before loading into the rail wagons. Capacity of surge bin ? How will discharge be controlled? This needs to be carefully considered for this gypsum material which presents poor flow-ability.	BMH	The surge bin capacity proposed would be 250 tons. This would allow for the change over time between train sections. Due to the poor flow characteristic of gypsum the bin also has a minimum practical size (it could have been slightly smaller otherwise). We have discussed this with potential suppliers and they have used gypsum bins before without the need for screws or ploughs but these options are available – these details will be further developed during the basic design phase. The above will be investigated and implemented with the basic deisgn. Action: D. Bezuidenhoudt
19	Vol2 – Section 10.2	Temperature control on motor. Maybe state 'thermal overload' or	BMH	Will change temperature control to thermal motor

		'motor protections' C&I LDE to confirm.		protection. Concept report to be updated. Action: S. Inderlall
20	Vol2 – Section 10.2	Belt misalignment switches. Use belt drift switches.	BMH	"Belt misalignment switch" is acceptable and will leave as is. C&I LDE has confirmed this. Concept report to be updated. Action: S. Inderlall
21	Vol 1 & Vol2 – Section 3 Key design assumptions	Include items for walkways alongside tracks for train inspectors, and buildings to accommodate yard staff.	Rail Yard – Philip Van Heerden	Vol 1 Section 2.1.2 makes reference to the design specifications pertaining to walkways. A separate paragraph can be included in Section 3 with a more descriptive summary of the walkways and building requirements for yard staff Concept report to be updated. Action: D. vd Schyff
22	Vol 1 & Vol2 – Section 3.1	Ensure that TFR will be prepared to fit the number of CAR wagons required for the Medupi service with rotary couplers. (TFR may insist on fitting its entire CAR fleet to maintain flexibility of operation in serving other users, and charge Eskom for the refit).	Rail Yard – Philip Van Heerden	The TFR service design will address this issue. This item has been discussed in length with TFR and they confirmed that CAR wagons will not be fitted with rotary couplers. If a Side tippler is going to be used then rotary fitted wagons are not required any more.
23	Vol 1 – Sections 3.3, 4.5.2 and 14.1 & Vol2 – Sections 3.3, 4.5.2 and 13.1	Various earthworks specifications are proposed that include COLTO, TRH4 and Transnet's S410. In my view we should use only the S410 because: a. The yard space is relatively confined and difficult for a contractor to work on different specifications. b. TFR will be required to operate the yard and might be more agreeable in the knowledge that its specification was used.	Civils – Philip Van Heerden	The S410 does not make provision for geometric design of roads. Used the TRH4 for the geometric design of the service road. All layer works will be done to the S410 specifications. The report refers to the COLTO specification when referring to the Geotechnical Investigations report. The COLTO specification will be removed from section Normative Standards in both Vol 1 and Vol 2 of the reports Reference is made in 2.1.2 Perway Design to Transnet

				S410 for substructure. According to R&H Civil design reference should only be made to S410 and SANS1200DN. Concept report to be updated. Action: W. Kusel
24	Vol2 – Section 8.3	My information is that gypsum coagulates and would require agitation in the surge bin to convert it into powder form so that it could flow freely for loading into a railway wagon. A more practical solution might be to discharge the gypsum directly from an overhead conveyor into the wagons.	BMH – Philip Van Heerden	Feeding directly from the belt conveyor would present numerous problems in terms of feed regulation and uneven load distribution. See item 18 for further discussion on gypsum load out proposal.
25	Vol 1 – Section 13 & Vol2 – Section 12	A proposal should be included to drain the yard. This should include manholes with grids suitably protected from the ingress of ballast. The manholes should be connected to an underground pipe network leading storm water to discharge.	Civils – Philip Van Heerden	This is the proposed method to drain the yard. Indicated on cross section on drawing 0.84/40141. Will include a more detailed and clear section in Vol 1 and Vol 2 of the report. Concept report to be updated. Action: W. Kusel
26	Concept layout drawing 0.84/40134	Fence clashing with the stormwater trench. There is no space for an access road next to the fence. The fence will need to be rerouted or perhaps a retaining wall will be required ?	Civils – Tony Haupt	The fence position is dependent on the railway line position. Space should be provided for the service road of the fence. The retaining wall option will be investigated during the detail design stage. This will be dealt with in the next phase of the project. Action: W. Kusel
27	Concept layout drawing 0.84/40134	The terrace is over the stormwater trench. A large culvert an perhaps a redesign of the drainage system will be required.	Civils – Tony Haupt	The existing stormwater trench will be replaced by culverts to join the existing culverts. The existing stormwater culvert sizes will be reviewed in conjunction with the new proposed culverts. This will be dealt with in the next phase of the project. Action: W. Kusel

28	Concept layout drawing 0.84/40134	The fire water valve pit is under the embankment. It will be necessary to relocate it to the South.	Civils – Tony Haupt	Will relocated the valve pit to an appropriate position. This will be dealt with in the next phase of the project. Action: W. Kusel
29	Concept layout drawing 0.84/40134	The Limestone and Gypsum Substation is not indicated and there is a clash with the fence.	Electrical, Civils – Tony Haupt	Will include Eskom's planned Limestone substation in concept layout drawing. Will move the fence to a suitable position after final placement of Limestone and Gypsum Substation on the approved layout plan. This will be dealt with in the next phase of the project. Action: W. Kusel/ S. Inderlall
30	Concept layout drawing 0.84/40134	The fence is clashing with the access road for Gypsum Stockpile.	Civils – Tony Haupt	Will move fence to suit Gypsum stockpile access road This will be dealt with in the next phase of the project. Action: W. Kusel
31	Concept layout drawing 0.84/40134	This manhole is covered by the terrace.	Civils – Tony Haupt	The manhole should be relocated to the south of the terrace footprint. This will be dealt with in the next phase of the project. Action: W. Kusel
32	Substation and cable route 0.84/40138	This substation is shown in the incorrect position see drawing 0.84/3 Station Layout and 0.84/40134 Main Concept Layout.	Electrical – Tony Haupt	From drawing 0.84-567-01-08 (received from Mr Van Wyk) the planned limestone storage sub is indicated correctly on drawing 0.84/40134-Substation and cable route. This will be dealt with in the next phase of the project. Action: S. Inderlall
33	Substation and cable route 0.84/40138	This lighting mini sub is directly next to the Gypsum and Limestone Substation see drawing 0.84/3 Station Layout and 0.84/40134 Main Concept Layout.	Electrical – Tony Haupt	The lighting mini sub is a proposed mini sub where the position can be changed, there is a possibility of using existing ring feed mini subs at Medupi for lighting as discussed with Mr Van Wyk and there might not be a need for this mini sub.

				Position will be changed accordingly. Concept report to be updated. Action: S. Inderlall
34	Civils layout drawing 0.84/40141	The statement in the Civils layout drawing 0.84/40141 "Divert stormwater to new storm water culvert to be installed by others" needs to be looked at. All stormwater issues to be incorporated in the design of the Rail yard.	Civils – Tony Haupt	The overall stormwater operation and design will be reviewed during detail design stage. A new culvert was newly installed on site. Can this be confirmed by Eskom? This culvert size will be reviewed and incorporated into the overall stormwater design of the rail yard. The impact of all stormwater issues resulting from the rail yard area will be considered. It is not in the scope to look at stormwater issues outside the rail yard area. This will be dealt with in the next phase of the project. Action: W. Kusel
35	BMH layout for Side Tippler 0.84/40137	Walkway on inclined Gypsum belt to be included.	BMH	Concept report to be updated. Action: D. Bezuidenhoudt
36	Vol2 Materials handling	Process flow diagram required	BMH	Concept report to be updated. Action: D. Bezuidenhoudt

APPENDIX B - MINUTES OF MDR LPS MEETING HELD ON 29 JANUARY 2015

ESKOM HOLDINGS SOC LTD

TASK 203 – BASIC AND DETAILED DESIGN OF MEDUPI RAIL YARD AND OFFLOADING FACILITY

CONTRACT NUMBER: 4600051676

ORDER NUMBER: 4501833635

BOSCH HOLDINGS CONSORTIUM PROJECT NUMBER: P1184-099-1

CONCEPTUAL DESIGN - MDR FOR THE LPS (FIRE PROTECTION AND DETECTION)

DOCUMENT NUMBER: 1184-099-1-100-M-0021-1

Meeting held at Eskom Enterprise Park on the 29nd of January 2015 at 14h00

Attendees: F. Retief, R. Thijs, B. Tyson, R. Bosch, T. Haupt

Apologies: None

Distribution: Eskom project team, Bosch Consortium project team

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		Action	*Date*
1	**Approval of Previous Minutes**	There were no previous minutes to approve. The objective of the meeting is to approve the LPS (Fire protection and detection) section of the Concept design report. This meeting is in addition to MDR held on 22 January 2015.	
2	**Matters Arising**	1. The connection point of the potable water shown on drawing 0.84/4014 (see Volume 3, Appendix 8 of the Concept design report) was provided by Graham James. This point needs to be verified and confirmed. Action: T. Haupt	

2. The potable water pressure is 1 bar. This needs to be taken into account in the basic and detailed design. Action: W. Kusel

3. The fire water valve pit that is under the embankment was discussed. This is item 28 of the MDR list. A solution to this must be included in the detailed design. Action: W. Kusel

4. It was suggested that a list of terminal points be set up and maintained. This includes the potable and fire water connections. Action: R. Thijs

5. The fire monitoring system must interface to the CBMS (Central Building Management System) at the Medupi power station. The CBMS is in package 18 and the contact person is Abrie Nieuwoudt. The type of interface, protocol and the signals to be transferred must be defined in the next phase of the project. Action: S. Inderlall/R. Bosch

6. Municipal submission and local authority approval is not included in the scope of the task order and will be the responsibility of the contractor.

7. Bruce Tyson approved the Concept design with respect to the LPS services and fire protection and detection.

3	**Next Meeting**	Not required

Prepared by: Francois Retief – 30/1/2015

APPENDIX C – C&I ACTION LIST PREPARED ON 20 FEBRUARY 2015 AND UPDATED ON 12 MARCH 2015

ESKOM HOLDINGS SOC LTD

TASK 203 – BASIC AND DETAILED DESIGN OF MEDUPI RAIL YARD AND OFFLOADING FACILITY

CONTRACT NUMBER: 4600051676

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MEDUPI RAIL YARD AND OFFLOADING FACILITY

CONCEPT REPORT – C&I ACTION LIST

Report reference number: 1184-099-4-100-R-0001-Rev01 Concept Design C&I action list Revision: 01 Total pages: 7

Item	Reference	Comment	Section	Resolution
1	General	There are two volumes of the concept design report which look similar. There are no sections explaining how the two volumes relate. There should be a preamble that describes all the volumes and all the supporting documentation of the concept design.	C&I	The Concept design report that was handed over to Eskom on 4 December 2014 is structured as follows: 1. Executive summary 2. Volume 1 – Rail Yard and services 3. Volume 2 – Materials handling 4. Volume 3 – Appendices The Executive summary descibes all the volumes and how they relate to each other. Volume 3 describes and lists all the supporting documentation.
2	General	The Concept design states that the rail yard will handle limestone. It doesn't mention the Bulk fuel oil and general cargo mentioned in the SRD and the Design Criteria report. The scope of the project should be clarified. If a change is scope is required then a Design Change to the SRD should be initiated.	C&I	The Bulk fuel oil and general cargo was removed from the Medupi Rail siding by Eskom. The ROD 200-70810 refers. This is also referred to in the Concept report – refer to Volume 1 - Section 4.2.3
3	Vol 1 – Section 9.2	The design states that train movement in the yard will be authorized by radio train orders and no signaling will be provided. The basis for this design decision is not clear. The lack of signaling equipment increases the chances of train accidents and also does not provide the CTC with oversight of the yard. The basis of excluding signalling from the scope should be clarified. It is expected that the design can still be done within the ambit of this project even though the implementation could be at a later stage.	C&I	This is not part of the scope of the task order and had been discussed extensively. The only requirement was to make provision in the rail design to accommodate the signalling and OHTE in the future. Please also refer to Volume 1 – Section 5.5.3.1 and Volume 1 – Section 9.3.
4	Vol 1 – Section 2.1.4	Why are some of the points being designed to be mechanical? The decision to make some points mechanical and others electrical	C&I	One could have automated the yard but it was viewed as part of the future signalling. The email from Danie van der Schyff dated 13

		should be clearly justified.		February provides an overview of the various options that were considered. This was incorporated in Rev3 of the Concept design report – refer to Volume 1 - Section 9.3. For a yard of this size with low traffic volumes the manual operated system is recommended.
5	Volume 3 – Appendix 22	The Network architecture drawing does not have a drawing number. The drawing number must be in the Eskom template.	C&I	The drawing has been updated with the number 0.84/43218 and is in the Eskom template – refer Volume 3 – Appendix 22
6	General	There's a control system layout drawing provided as part of the package. There are elements of the control systems that are not discussed as part of the design. BMS, Access Control etc. Description for design concepts and decision of the concepts should be provided and justified.	C&I	The Concept report was updated. Please refer to Volume 1 – Section 9.1 and Volume 2 – Section 10.1.
7	General	There are no Condition Assessment Systems provided as part of the scope. Why were they not provided. The responsibility for maintenance is not clear. Where are the Condition Assessment Systems?	C&I	We propose that Condition Assessment is considered in the next phase of the project.
8	General	How has the design considered future signalling design in their rail design? Has the type of track circuit been considered? Will it be a jointless or jointed track circuit? Is there any interlocking done on the tracks? How will train presence be managed on the tracks without a signalling system?	C&I	Train operation procedures and the operating concept for the materials handling are described in the Concept report. Refer to Volume 1 - Section 5.5.3 for a description of the shunt operations and Volume 2 - Section 5.5 for the Materials handling operating concept and Volume 2 - Section 8 for a description of the materials handling operations. We have also added the an additonal section on the general operating procideure – refer to Volume 1 Section

				5.5.3. More detailed operation procedures and control philosophy is not seen as part of the Concept design and will be part of the next phase of the project (i.e. basic design) and will be addressed accordingly. TFR (Rail Directives) will also formalise the final operating procedure based on our submission of siding operating procedure to them.
9	General	The Concept does not speak on dust suppression – this has to do with operator wellness and environmental considerations.	C&I	This has been discussed and agreed that it is not required due to nature of product. There will be dust extraction in the Tippler vault. Eskom BMH has advised and confirmed this is the case. This was again confirmed in the HAZOP workshop held on 12 February.
10	Volume 3 – Appendix 22	Network Architecture drawing shows redundant network how was this design decision arrived at? Are there redundant routes (physical and logical)?	C&I	The redundancy of the system is dependent on the reliability and availability required for the plant. The final availability and reliability requirements are not finalized at the stage of Concept Design and we should therefore be looking at the best case option based on the information know at the time. In terms of process followed, it is based on the experience we have had on similar installations where automation and operator busses/ networks tend to be redundant as this is also a single point of failure. For a concept design, the option of having two routes seemed justified with the view of finalising that in the basic design. The Concept report was updated. Please refer to Volume 1 – Section 9.1 and

				Volume 2 – Section 10.1.
11	Volume 1 – Section 5.1.1	The decision has been taken to use the Massive T4 in motion weigh bridge for standardisation purposes. MR indicated that the basis decision to standardise was not discussed in the Concept Design report. This will be an issue as the engineering and business justification is not mentioned.	C&I	Eskom indicated that they already identified the most appropriate technology during the Majuba project i.e. the Massive T4 in motion weighbridge. As such they indicated that they want to standardize technology at sites. The Concept design report has been modified and references to the T4 weighbridge has been removed. Refer to Volume 1 – Section 5.1.1. The choice of the appropiate make and model weigh bridge will be part of the next phase of the project.
12	General	There is no documented operating and control philosophy for the system in the concept report. This should also include the interlocks or interfaces between Eskom operations and Transnet operations.	C&I	Train operation procedures and the operating concept for the materials handling are described in the Concept report. Refer to Volume 1 - Section 5.5.3 for a description of the shunt operations and Volume 2 - Section 5.5 for the Materials handling operating concept and Volume 2 - Section 8 for a description of the materials handling operations. We have also added the an additonal section on the general operating procideure – refer Volume 1 Section 5.5.3. More detailed operation procedures and control philosophy is not seen as part of the Concept design and will be part of the next phase of the project (i.e. basic design) and will be addressed accordingly. TFR (Rail Directives) will also formalise the final operating procedure based on our submission of siding

				operating procedure to them.
13	General	The Concept Design mentions a Control Room but does not indicate if this a new control room, it's location and its operation. The team unanimously indicated that the concept of this room is not clear. The Medupi URS was specific in only allowing for 2 control rooms in Medupi, namely the Outside Plant Control Room and the Units Control Room – Why did the designers not consider just a control panel? How was the decision to add another control room at the yard arrived at which contravenes Medupi URS & were other options considered – where is this documented in the concept design?	C&I	The Rail Yard is separate from the main plant and therefore requires its own operations or control room that is local to the operations. This is common practice and is also a TFR requirement for this type of operations. Tutuka and Majuba are both done this way. It was discussed and minuted in the project progress meeting held on 17 October that the Majuba building requirements is to be used as a basis for the Medupi design. It was also minuted at the progress meeting on 17 October that a control room is required. At the progress meeting held on 6 November this was again discussed and confirmed and it was noted in the minutes that an elevated control room is required. The operatons or control room is an integrated part of the administration building and is required to house the Operator stations for the control of the materials handling and the weigh bridges plus give an overall visual of the rail yard. The operations of the yard are seen to be independent of the main Medupi control room. The requirement for a operations or control room is covered in the following sections of the Volume 1 of the report i.e. 2.1.3, 5.5.1, 7.2.4, 8.3, 9.1 and 9.5. The Concept report (both Volume 1 and 2) has been updated so that it is called a Rail yard operations room instead of a Rail yard control

				room.
14	General	The network architecture drawing shows dynamic IP addressing – why is this so – Eskom uses static addressing – where is the design process and decision on this documented.	C&I	The drawing 0.84/43218 has been updated to indicate static addressing – refer to Volume 3 Appendix 22
15	General	Maintenance responsibilities need to be clarified.	C&I	In In Volume 1 (Section 5.4.1) it is stated that "The maintenance of the rail yard will be undertaken by a contractor (Transnet) to the same standards as clearly covered in the Transnet maintenance manuals". In Section 5.4.3 is states that "The maintenance of the shunt locomotive will be undertaken by an approved contractor (Transnet) to the same standards as clearly covered in the OEM maintenance manuals. All other maintenance will be the responsibility of Eskom or a suitable subcontactor appointed by Eskom. The Concept report has been updated to reflect this – refer to Volume 1 – Section 2.1.1 and Volume 2 – Section 5.4.

Bosch Holdings Consortium

BOSCH HOLDINGS	7E Thabile Engineering	Thabo Consulting	NEMAI CONSULTING

ESKOM HOLDINGS SOC LTD

TASK 203 – BASIC AND DETAILED DESIGN OF MEDUPI RAIL YARD AND OFFLOADING FACILITY

CONTRACT NUMBER: 4600051676

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MEDUPI RAIL YARD AND OFFLOADING FACILITY

CONCEPT DESIGN REPORT VOLUME 1

RAIL YARD AND SERVICES

Report reference number: 1184-099-4-100-R-0001-Rev04 Concept Vol1 Rail Yard and Services Revision: 04 Total pages: 63

Report submitted by:

Bosch Holdings Consortium

13 March 2015

Bosch Holdings Consortium

BOSCH HOLDINGS	7E Thabile Engineering	Thabo Consulting	NEMAI CONSULTING

CONCEPT DESIGN REPORT FOR THE MEDUPI RAIL SIDING

DOCUMENT APPROVAL

CONSULTANT -- NAME	-- SIGNATURE	------------------------------ DATE
ESKOM CIVIL ENGINEERING -- NAME	-- SIGNATURE	------------------------------ DATE
ESKOM BMH DEPARTMENT -- NAME	-- SIGNATURE	------------------------------ DATE
ESKOM ELECTRICAL ENGINEERING -- NAME	-- SIGNATURE	------------------------------ DATE
ESKOM C&I DEPARTMENT -- NAME	-- SIGNATURE	------------------------------ DATE
ESKOM LPS (FIRE ENGINEERING) DEPARTMENT -- NAME	-- SIGNATURE	------------------------------ DATE
ESKOM CHEMICAL DEPARTMENT -- NAME	-- SIGNATURE	------------------------------ DATE
MEDUPI ARRANGMENT DESIGN -- NAME	-- SIGNATURE	------------------------------ DATE
MEDUPI POWER STATION -- NAME	-- SIGNATURE	------------------------------ DATE
ESKOM PED DEPARTMENT -- NAME	-- SIGNATURE	------------------------------ DATE

	COMMENTS	ORIGINATOR
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ABBREVIATIONS

Abbreviation	Description
A	amps
AC / ac	Alternating Current
AVI	Automatic Vehicle Identification
C&I	Control & Instrumentation
CMS	Control and Monitoring System
COLTO	Committee of Land Transport Officials
CSW	Continuous Surface Wave
CTC	Centralised Traffic Control
DC / dc	Direct Current
DCP	Dynamic Cone Penetrometer
FGD	Flue Gas Desulphurisation
HMI	Human Machine Interface
HVAC	Heating Ventilation and Air Conditioning
km/h	kilometres per hour
kV	Kilo Volts
kVA	Kilo Volt Amperes
kW	KiloWatts
l/s	litres per second
LAN	Local Area Network
m/20m/20m	Metre per 20metre per 20metre
m/s	metres per second
m^3	cubic metres
MAP	Mean annual precipitation
MCB	Miniature Circuit Breaker
MCCB	Moulded Case Circuit Breaker
mm	millimetres
Mtpa	Million tons per annum
OHTE	Overhead Traction Equipment
OPC	Open Platform Communications
ORS	Owner's Requirement Specification
OTT	ON-TRACK Technology
Perway	Permanent way (meaning the railway line)
PIS	Plant Information System

Abbreviation	Description
PLC	Programmable logic controller
SCADA	Supervisory control and data acquisition
SQL	Structured Query Language
t	Ton
t/a or tpa	Tons per annum
t/h or tph	Tons per hour
TFR	Transnet Freight Rail
UPS	Uninterrupted Power Supply
uPVC	Unplasticized Poly Vinyl Chloride
V	volts
VLR	Vertical Load Receptor

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

This concept study develops the preferred options identified in the Options report for the Medupi rail siding. This document provides an overview of the engineering processes followed and the system design status at the end of the concept phase. The document describes the results of technical assessments and compliance with stakeholder requirements, technical risks identified, lessons learned during the design process and outstanding issues for this design phase. This document further provides references to approve the design output documentation.

The rail yard will handle bulk limestone, used as a sorbent, for use in the retrofitted FGD plant. Depending on market demand, bulk gypsum will also be despatched via the rail yard.

The scope of the new rail yard is to provide the Medupi Power Station with a rail yard solution and rail operations that will ensure that the yard is capable to receive and off-load 1,200,000 t/a of Limestone and to load and despatch 400,000 t/a of FGD Gypsum.

This report covers the Concept Design of the proposed rail yard and all other services required to operate the yard. The next phase of the Rail Yard and Services part of the project will be the detailed design phase which will complete the project.

The following battery limits define the scope of the rail yard and services study:

- The rail layout within the Medupi yard itself;
- Current Transnet Freight Rail train operating methodology;
- Allowance for future signalling systems from the TFR mainline into and out of the yard.
- Allowance for the associated future electrification of the yard
- Allowance for Rail Area Lighting;
- All the associated facilities required for the maintenance and operation of the yard

2. SCOPE OF CONCEPT DESIGN

The Concept Study carries forward the results of the Options Report (1184-099-4-100-R-0001 REV02) which has been approved by Eskom. It will provide the engineering solutions for the optimisation of the materials handling, rail yard and all other associated rail systems and sub-systems. The scope of the Rail yard and services section focuses on the following end-state per discipline:

2.1 Disciplines

2.1.1 Train Operations

Based on the layout that was proposed during the Options Study, a final concept design of the train operations in the Medupi Yard is undertaken. The design takes into consideration all safety issues as will be considered by the Rail Safety Regulator.

Rail operations include the movement of the shunt locomotive in the yard as well as maintenance and fuelling facilities that may be required. The maintenance of the rail yard and shunt locomotive will be undertaken by a contractor (Transnet) to the same standards as clearly covered in the Transnet and OEM maintenance manuals. All other maintenance will be the responsibility of Eskom or a suitable subcontactor appointed by Eskom.

The rail process fits in with TFR's Operating Philosophy with regards to mainline locomotives, crews and turnaround time of 12hrs.

2.1.2 Permanent Way (Perway)

Transnet perway design guidelines are used as basis for the Concept design

- Manual E.10 – 1996 Railway Track Work
- Specification S116 – Rails
- Specification PWM 2/5 dated 1996 - Sleepers
- Specification S406 – Ballast
- Specification S410 – Substructure
- Specification for walkways - Drawing KY100 C301 dated 2009/05
- Manual for Track Maintenance 2012

2.1.3 Rail Systems (In-Motion Weighbridge)

Provision is made for the installation of two Trade and Metrology approved assized in-motion weighbridges.

One in-motion weighbridge will be positioned at the "Stop Board" on line 1 (run-off line from TFR mainline) leading towards the yard, to weigh all incoming and outgoing wagons. The other in-motion weighbridge will be positioned just after the load-out station to weigh and assess the loading profile of the FGD Gypsum loaded in the rail wagons.

Both in-motion weighbridges will be fitted with automatic vehicle identification (AVI) readers to identify the respective rail wagons. The in-motion weighbridges will be linked to send the required data to the Rail Yard operations room.

2.1.4 Rail Systems (Signalling and yard control)

Provision is made for the installation of the following mechanical turnouts:

- 60kg/m 1:12 Tangential turnout with Rail-bound crossing on concrete bearers with rodding to suite electric operated switch box according to VAE drawing No. 10008-000-00 in accordance with the current Transnet Freight Rail specifications applicable on the Thabazimbi to Lephalale rail infrastructure
- 48kg/m 1:12 Secant turnout with rail-bound crossing on concrete bearers complete with mechanical point sets (hand-tumblers) according to VAE drawing No. E7129 in accordance with the current Transnet Freight Rail specifications
- 48kg/m 1:9 Secant turnout with rail-bound crossing on universal concrete bearers complete with mechanical point sets (hand-tumblers) according to VAE drawing No. 4303-000-00 in accordance with the current Transnet Freight Rail specifications

Provision is made for a Rail yard operations room to monitor and control locomotive movements from a central point in the yard. The yard control will be achieved by implementing an open channel radio communication system whereby all train movements are verbally communicated. Each train driver will be aware of the authorised movements and can immediately report conflicting train movements to the Rail yard operations room.

Allowance (excluding design and costing) will be made for future signalling of the yard in accordance with Transnet Freight Rail specifications set out for the Waterberg post 2020 development.

2.1.5 OHTE

Allowance will be made for future installation of OHTE in the yard in accordance with Transnet Freight Rail specifications set out for the Waterberg post 2020 development.

2.1.6 Electrical Control and Instrumentation

The required electrical control and instrumentation scope of work for the Medupi rail yard project relate to the electrical power supply for the bulk material handling equipment, lighting for the rail yard, electrical feed for signalling and all other equipment that requires a power source.

The electrical system is expected to provide all equipment within the rail yard boundaries with electrical power. Three-phase power will be required since different equipment operate at different voltages. Consideration to existing equipment and systems being implemented at Medupi power station will be considered where the rail yard can integrate with the larger system installed.

2.1.7 Civil Services

The civil services layout was determined by the final perway alignment position. The bulk earthworks were designed and placed relative to the existing fence boundary. An access road will be provided to serve as a ring road to all facilities on the rail yard. The facilities will be serviced with potable water, fire water and septic tanks for the ablution facilities.

Stormwater channels and structures were designed to provide a division between storm water and the dirty water from the gypsum loading facility.

3. KEY DESIGN ASSUMPTIONS

3.1 TFR specifications for rail facilities in the Waterberg

TFR has been engaging with various companies individually on the future plans for the Waterberg and confirmed the required rail loading specifications and operational parameters for the design of future rail sidings, yards and loading facilities. The current Medupi yard design incorporated the required specifications as stipulated by Transnet and include the following:-

- The earthwork layers of the yard designed to 26 ton axle load bearings
- Provision for future OHTE installation in the yard
- Provision for in-motion weighbridges and automatic vehicle identification systems
- Gradients to required specification in yards

3.2 Train Operations

The proposed train operations was based on the following assumptions:-

- Annual tonnages to be transported by rail for each commodity (1,200,00 t/a of Limestone and 400,000 t/a of FGD Gypsum)
- Transnet Freight Rail operating a drop-off pick-up type of mainline service
- Transnet Freight Rail mainline locomotives will split the limestone train and position wagons at tippler
- CAR-type wagons used for the transport of Limestone (Type of coupler system still to be determined)
- CAR-type wagons used for the transport of the FGD Gypsum

- 12hrs train handling time applicable within the yard
- Private shunt locomotive required to perform the shunting in the yard (Outsourced to Transnet)
- Limestone offloaded by either a single wagon rotary tippler or a single wagon side tippler
- FGD Gypsum loaded by means of a rapid load-out station
- 342 operational days (365 days less 5 days holiday, 2 days single line operations and 16 days shutdown of corridor for maintenance)

3.3 Yard Layout

The design of the yard layout was based on the following assumptions:

- Transnet Freight Rail train operating procedures
- Track layout based on maximum train consists for each commodity;
- Line classification N2 and alternatively N1 line if 60kg/m rails could be procured from TFR;
- Maximum gradient to be 1:150 towards Thabazimbi with departure grade of 1:200,1:100 towards Lephalale and 1:800 on staging lines;
- The sub-structure is based on 26ton axle load;
- Vertical curves with permissible rate of change of 0.150m/20m/20m for yard and 0.040m/20m/20m on run-off line;
- Yard curvature 275m radii except at gathering roads which can be reduced to 200m;

The superstructure is based on 20 ton axle load and the perway material will consist of the following:

- Class 900A 48kg/m rail in 18m nominal lengths or 60kg/m rails if Eskom succeed in procuring second hand rails from Transnet;
- P2 reinforced concrete sleepers complete with new HDPE pads and Pandrol fastenings at 700mm spacing;
- Top of rail to formation level at 600mm;
- Ballast profile of 1200m³/km as per Transnet Freight Rail Maintenance Manual – 2002 Annexure 4 sh. 1 of 1;
- 200mm ballast under sleepers as per Transnet Freight Rail Maintenance Manual – 2002 Annexure 4 sh. 1 of 1
- 1 x 60kg/m 1:12 Tangential turnout with Rail-bound crossing on concrete bearers with rodding to suite electric operated switch box according to VAE drawing No. 10008-000-00 in accordance with the current Transnet Freight Rail specifications applicable on the Thabazimbi to Lephalale rail infrastructure
- 1 x 48kg/m 1:12 Secant turnout with rail-bound crossing on concrete bearers complete with mechanical point sets (hand-tumblers) according to VAE drawing No. E7129 in accordance with the current Transnet Freight Rail specifications
- 15 x 48kg/m 1:9 Secant turnout with rail-bound crossing on universal concrete bearers complete with mechanical point sets (hand-tumblers) according to VAE drawing No. 4303-000-00 in accordance with the current Transnet Freight Rail specifications
- 2 x Hays derailers to fit 48kg/m rails complete with timber bearers and fittings
- 1 x 40 or 48kg/m stop block complete with timber bearers and fittings.

3.4 Walkways

The following assumptions have been made regarding the walkways next to the rail tracks

- Walkways design shall be carried out in accordance with the TFR Specification for walkways as reflected on drawing no KY100 C301 dated 2009/05
- Walkways shall be provided along both sides of each track across structures where train crews regularly work on the ground for shunting, train inspections, etc.
- The walkway will be filled up to the level of the top of the ballast with material giving good drainage and a sound walking surface.
- The width of the standard walkway horizontal surface is based on the required clearance from the track and the minimum width required for safe passage next to the train. The minimum width of the walkway and ballast profile as measured from the outer rail, to the shoulder of the walkway will be 2000mm. The minimum standard walkway detail is therefore 700mm wide.
- The walkways will stretch along the full length of the tracks.

3.5 Bulk Earthworks

The following assumptions have been made regarding bulk earthworks:

The bulk earthworks layer works is designed to accommodate a 26t axle load. It is assumed that the existing stock piles will be cleared before the commencement of construction. A letter dated 6 August 2014 from Eskom requested the design team to review all earthwork designs due to the quality of material available from stockpiles, deteriorating from G5 to G6 and G7 (COLTO classification). For the concept design stage it is assumed that all materials G7 and higher will be imported from commercial sources.

See TRH4 Table 13 for material grading specifications.

3.6 Service Road

It is assumed for costing purposes that the service road will be constructed with imported material from commercial sources due to the shortage of suitable material on site.

3.7 Stormwater

The following assumptions have been made regarding stormwater:

The Stormwater will be modelled with a MAP 437mm as discussed with Eskom. It is assumed that the Medupi stormwater master plan including structure sizes will be available for the detail design stage. The dirty storm water from the Gypsum loading facility will be drained into a new pollution control dam that will be designed by the FGD project team.

3.8 Potable Water

The following assumptions have been made regarding potable water:

The Medupi plant operates with two separate water networks for fire and potable water. A connection point was provided by the client to connect to the existing potable water network. It is assumed that the existing water network will have sufficient pressure and capacity.

3.9 Fire Water

The following assumptions have been made regarding fire water:

The Medupi plant operates with two separate water networks for fire and potable water. A connection point was provided by the client to connect the existing fire water network. It is assumed that the existing fire water network will have sufficient pressure and capacity required. No provision will be made for fire water storage.

3.10 Sewerage

It was confirmed in a client agreement that the security post, locomotive workshop and administration building will be served with three container tank systems.

3.11 Fencing

The following assumptions have been made regarding fencing:

The existing three tier national key-point fence will be moved by Eskom to the north of the rail way site prior to construction. The existing service road fence will be used as the rail yard boundary fence.

3.12 Electrical

The following assumptions have been made regarding the electrical system:

- Electrical power will be distributed into the rail yard utilizing the proposed 6.6kV lime stone handling substation.
- Maximum of 5MVA will be required to run the rail yard.
- Cabling will be selected to have a volt drop better than 5%
- Existing mini-subs will be used for high mast lighting.
- Yard Lighting required will be at a 20 Lux minimum average.
- Future signalling will be required post 2020
- Future Electrification of Transnet freight rail lines will be required

4. DESIGN APPROACH

4.1 Design Inputs

4.1.1 Stakeholder Requirements

The stakeholder's requirements for the project was captured in the Stakeholders Requirements Definitions (SRD) report (200-130118) that was supplied to the client and signed off on 17 June 2014.

During the options phase the client required that the layout options be compared by means of project life cycle costing. First the unit cost to source the limestone from Lime Acres, Pienaarsrivier and Marble Hall was compared. Thereafter the unit cost for using wagons fitted with rotary couplers versus bottom discharge was also compared. Refer to the Options Study Report (1184-099-4-100-R-0001 REV02) in Volume 3 – Appendix 15.

4.1.2 Design Criteria Report

This document (200-130171) was compiled by the Consultant and signed off by the client of 17 June 2014.

4.2 Design process

4.2.1 Planning

A linear type yard layout was identified as the most suited option to take forward into the next phase of the project. The planning of this phase started with the approval process of the layout options phase and involved getting consensus on issues that were raised. These issues included balloon versus linear type layouts. Refer to the Options Study Report (1184-099-4-100-R-0001 REV02) in Volume 3 – Appendix 15.

Similarly a tippler was identified as the most appropriate technology choice for handling the limestone. A further assessment was conducted by the Consultants to determine the most optimum choice of tippler i.e. single wagon rotary tippler versus single wagon side tippler and this is discussed in more detail in the Concept design report Volume 2 (Materials handling).

4.2.2 Rail Yard Design Criteria

The design criteria that were agreed at the beginning of the project have been maintained and are listed in section 4.4 below.

The only change to the original design criteria relates to the number of wagons required for the transport of limestone which changed from 50 to 60 wagons. This is as a result of using the most suited rail wagon based on volumetric capacity to transport the limestone.

4.2.3 Options Development

The options were developed during the options phase of the project and are fully discussed in the Options study report (1184-099-4-100-R-0001-Rev02). Refer to Volume 3 Appendix 15 for a copy of this report.

Nine yard layout options were developed. These options have different rolling stock flows and material handling procedures in practice.

The most preferred layout option taken forward into the concept design phase was a more simplistic layout of layout option 1.

This was as a direct result of Eskom excluding the need to make provision for the handling of general cargo and bulk fuel oil. Refer to the Eskom Record of Decision (200-70810) approved on 13 October 2014.

4.2.4 Design Reviews

The design reviews are part of the regular meetings held between the Consultant's design team and the Eskom technical review teams. The reviews will culminate in the multidisciplinary design review (MDR) meeting which will be held after the completion of the draft concept report. A Hazop workshop will also be conducted as part of the detailed design review process.

4.2.5 Design Optimisation

The yard layout design that has been developed in this concept phase has undergone many reviews and has been optimised to meet the requirements of the stakeholders. A meeting with Transnet Freight Rail took place on 14 October 2014 and the results of the meeting led to further optimisation of the design.

The outcomes of the MDR and the Hazop will be used to incorporate final improvements in the detailed design.

4.2.6 Design finalisation

Before the start of the next phase which is the Detailed Design Phase, there is a need for design finalisation and a design freeze. Any issues that have not been finalised at this stage of the process will have to be excluded from the final design.

4.2.7 Specification

Specifications will be produced in the Detailed Design Phase

4.2.8 Quantities

A Bill of Quantities will be produced in the Detailed Design Phase although provision has been made for a high level Capex cost estimate as part of the concept study.

4.3 Design Verification

A site visit was conducted with the project design team and Eskom Technical Staff on 15 October 2014. Existing services and Eskom design requirements were verified on site. The site visit was concluded with a technical meeting addressing any outstanding information required. The design verifications were reviewed on an ongoing basis as part of the regular meetings held between the design team and the Eskom Technical review team.

4.4 Design Criteria

4.4.1 Train Operations

The rail operational process is based on the following criteria:

- All train will arrive at the Medupi Yard from the Thabazimbi direction.
- Limestone trains will arrive full and depart empty in 60 CAR-type wagon consist hauled by 4 Class 39 Diesel-Electric locomotives in a head-end traction configuration.
- FGD Gypsum trains will arrive empty and depart full in 50 CAR-type wagon consist hauled by 3 Class 39 Diesel-Electric locomotives in a head-end traction configuration.
- Train arrival and departure intervals will be dictated by the Transnet Freight Rail service design applicable to the Medupi Yard.
- The minimum design train length applicable to the yard clearance allowing for coupler play, draw-gear stretch and train handling is 969 m for a 60 CAR-type wagon train, including locomotives
- The maximum number of train-consists to be accommodated within the Medupi Rail Yard at any time is four.
- The ideal shunting locomotive configuration is one Class 36 Diesel-Electric locomotive.

4.4.2 Alignment Design

- Minimum Curve Radius - 200m at gathering roads
- Minimum staging gradient - 1:800
- Mainline turnout - 60 kg/m 1:12 tangential

- Yard turnouts - 48 kg/m 1:9
- Track Centres - 5.5 to 12m

4.4.3 Permanent Way Criteria (Loaded)

- Track structure - 20 ton Axle Load (Class N2)
- Gauge - 1065mm
- Rails - 48 kg/m
- Sleepers - P2 @ 700mm spacing
- Ballast - 1200m³/km

4.5 Codes and Standards

Various codes and standards including International standards, South African standards (Transnet and Eskom) will be applied in the design of the railway yard and associated infrastructure; these will be specified in the relevant technical specifications for each type of equipment. The following codes and standards have been used and considered in the development of this concept design:

4.5.1 Informative Standards

- TRH17: Geometric design of rural roads (Geometric Design)
- TRH14: Guidelines for road construction materials
- TRH4: Structural design of flexible pavements for interurban and rural roads

4.5.2 Normative Standards

- SANS 1200 (Bill of Quantities and cost estimates)
- SANS 10142-1 The wiring of premises SANS 10142- Wiring code
- SANS-10198 Selection, handling and installation of electric power cables not exceeding 33kV
- SANS-60439 Low-voltage switchgear and control gear assemblies
- SANS-10114 Artificial lighting of interiors
- SANS- 62305 Protection against lightning

4.5.3 Client Standards

- Eskom's station cabling and racking standard 200-11768
- Cabling will be selected to have a volt drop better than 5%
- Lighting will have a minimum average illumination level of 20 lux for outdoor as per SANS 10389-1 : 2003 Exterior lighting
- Eskom's Distribution Specification – Part 22: Medium-Voltage miniature substations for systems with nominal voltages of 11kV and 22KV- Document reference DSP 34-1621
- Earthing and lightning protection standard 200-11757
- Specification for switchgear and associated equipment for voltages up to and including AC 1090 V and DC 1200 V 240-56227516

4.5.4 Other Stakeholders Standards

- TFR - Manual E.10 – 1996 Railway Track Work
- TFR - Specification S116 – Rails
- TFR - Specification PWM 2/5 dated 1996 - Sleepers
- TFR - Specification S406 – Ballast
- TFR - Specification S410 – Substructure
- TFR - Specification for walkways - Drawing KY100 C301 dated 2009/05
- TFR - Manual for Track Maintenance 2012
- TFR S410 Specifications (Services roads and rail way layer works)
- TFR - Specification CEE-0018_ISS_90 for high mast lighting of outdoor areas
- TFR - Specification CEE-0003_ISS_90 for street lighting and yard lighting
- The Guidelines for Human Settlement Planning and Design (Roads, Water and Sanitation)

5. SYSTEM DESCRIPTION

5.1 Process Description

5.1.1 Rail Systems (In-Motion Weighbridges)

There are various Trade and Metrology approved in-motion weighbridge systems available. Provision is made for the installation of two in-motion weighbridges and automatic vehicle identification readers. One in-motion weighbridge will be installed at the entrance to the tippler to weigh incoming and outgoing wagons to determine the mass of the either the full or empty wagon. One in-motion weighbridge will be installed on the outgoing side of the FGD Gypsum load-out station to detect overloads and skew loading. A desktop computer and printer will be installed in the Rail yard operations room. Each of the in-motion weighbridge installations will be connected to the desktop computer in the Rail yard operations room. Triggering of the systems are done via through-beam presence detectors.

An example of a typical in motion weight bridge installation is shown below

Figure 1 – Typical in-motion weighbridge installation

5.1.2 Rail Systems (Shunt Locomotive)

The Class 36-000 model type GE SG108 and Class 36-200 model type GM-EMD SW1002 diesel-electric locomotives are the preferred locomotives used by Transnet for shunting operations in yards and sidings. The Class 36 is a general purpose locomotive that is equipped with two station controls for bi-directional operations.

Figure 2 – Class 36-000 locomotive

The specifications of the Class 36-000 locomotive is reflected in the table below:-

Table 1 - Class 36-000 Locomotive Specifications

Power Type	Diesel-electric
Designer	General Electric
Model	GE SG10B
AAR Wheel arrangement	Bo-Bo
Gauge	1,067 mm
Bogies	2.082 m wheelbase
Wheelbase	10.782 m
Width	2.727 m
Height	3.924 m
Axle Load	18,250 kg
Locomotive weight	72,000 kg average 73,000 kg maximum
Fuel Type	Fuel oil
Fuel Capacity	2 200 to 2 250 liters
Prime mover	GE 7FDL-8 4 stroke V8
Engine ROM range	385 rpm low idle 450 rpm idle 1,050 rpm maximum
Engine Type	Diesel
Aspiration	GE 1408 turbocharger
Generator	DC 10 pole GE 5GT-581C15
Traction motors	Four GE 5GE-761-A13 DC 4 pole * 665A 1 hour * 665A continuous at 15 km/h (9.3 mph)

Transmission	92/19 gear ratio
Multiple working	4 maximum

The performance figures of the Class 36-000 locomotive is reflected in the table below

Table 2 – Class 36-000 Locomotive Performance figures

Maximum speed	100 km/h
Power Output	875 kW starting 800 kW continuous
Tractive effort	176 kN starting 141 kN continuous at 14 km/h
Factor of adhesion	25% starting 20% continuous
Locomotive brake	28-LAV-1
Locomotive brake force	70% ratio at 345 kpa brake cylinder pressure
Train brakes	800 liters main reservoir. Compressor capacity at idle - 0.033m³/s Exhauster capacity at idle – 0.130m³/s
Safety systems	Vigilance control, two station controls

5.1.3 Rail Systems (In-Motion Weighbridges)

5.2 External Interfaces

5.2.1 Rail Systems (In-Motion Weighbridges)

An evaluation of the various in-motion weighbridge systems will have to be made to determine the external interfaces required with the local Medupi systems.

5.3 Control and Instrumentation System

Refer to drawing 0.84/43218 (Volume 3 Appendix 22) for the conceptual control system network architecture.

The Control system for the Medupi rail yard will be a standalone system where maintenance, spare keeping and monitoring will be handled from the main plant local to the rail yard.

Allowance will be made for the Control systems of the Medupi rail yard, to integrate to the other systems in the Medupi power station plant’s system. The standards and specifications will be in line with the current requirements for Control and Instruments systems installed at Medupi power station.

The Automation technology to be considered will be Programmable Logic Controllers and by implementing similar Architectures the required standardisation will be achieved across Medupi Power Station.

There will be a requirement for a Plant Information System (PIS) that will make near real time and historical plant information available to third party applications. All PIS databases will be accessible by third party software applications on the Clients by means of SQL series. These third party applications will only be able to read data from the PIS databases

Control and instrumentation cables will be armoured for outdoor applications. All cables will be shielded, with a minimum conductor section of 0.5 mm2. Cables above ground is to be laid in trays or on ladder racks and will be segregated from power cables in accordance with International standards. Cables will be labelled and conductors will be identified at terminations by ferrule number or suitable proprietary method.

Instrumentation will be provided from reputable vendors. Where possible instrumentation will be similar to current specifications installed at the main power plant

Instrumentation will be provided with the necessary ingress protection for the location. Instrumentation located outdoors will be protected with sunshades.

Instruments measurement principles will be properly chosen to meet the following requirements:

- Medium
- Servicing without interrupting process
- Installation possibilities and accessibility
- Ambient and process conditions
- Operational ranges and accuracy

An option would be to use the Siemens PLC. This technology is currently being used at Medupi power station's main plant. Using SIMATIC WinCC which is a SCADA and HMI system from Siemens, monitoring and controlling physical processes in Medupi Rail yard can be done successfully.

5.4 Maintenance Concept

5.4.1 Rail Systems (Rail infrastructure)

The reliability of the infrastructure is inbuilt in the components that are used in the construction. The design criteria that have been used are the standards set by Transnet for sidings and yards. The maintenance of the rail yard will be undertaken by a contractor (Transnet) to the same standards as clearly covered in the Transnet maintenance manuals. This should ensure a high reliability during operation of the Medupi yard.

5.4.2 Rail Systems (In-Motion Weighbridges)

Due to the remoteness of the site, it will be necessary to train in-house personnel as to the first-line repair procedure. It is recommended that contingency spares be supplied by the preferred supplier. With most of the local in-motion weighbridge systems the suppliers can access the data on the centralisation desktop computer by means of a VPN access that allows them to provide a far more rapid response to support queries since faults can be remotely diagnosed and solved. Should a fault be such that it cannot be rectified remotely, a technician will be dispatched within a predetermined reaction time as agreed between Eskom and the supplier.

5.4.3 Rail Systems (Shunt Locomotive)

The maintenance of the shunt locomotive will be undertaken by an approved contractor (Transnet) to the same standards as clearly covered in the OEM maintenance manuals.

The following inspections and maintenance schedules will be conducted at the locomotive shed at Medupi:

Table 3 – Local locomotive inspections and maintenance

Inspection Type	Interval	Duration
Fueling examination	Daily	1 hour
2 Weekly Inspection	14 days	1 to 2 hours
Type A Examination	30 days	8 hours
Type B Examination	91 days	2 days

The following maintenance schedules will be conducted at an approved locomotive maintenance facility located off-site from Medupi

Table 4 – Remote locomotive inspection and maintenance

Inspection Type	Occurrence	Duration
Type C Examination	182 days	2 – 3 days
Type D Examination	365 days	5 days

5.4.4 Electrical Control and Instrumentation

The electrical, control & instrumentation systems for the Medupi rail yard will be a standalone where maintenance, spares holding and monitoring should be individual procedures separate from the main plant.

When designing the electrical, control & instrumentation for Medupi rail yard, integration to the main Medupi power station plant's system will be considered, where equipment used and specifications to be installed will be in line with systems already installed at Medupi power station. Making provision for integration will assist with less down time at the rail yard if faults arise.

Physical buttons on control panels and operating desk are known as hardwired I/O's, they can easily be traced by wirings done on their terminals. Buttons implemented on SCADA/HMI screens to operate logic are considered as soft I/O's. They can be traced by checking in the logic.

Current control equipment installed in Medupi power station are Siemens PLC, this technology will be considered when specifying equipment for Medupi rail yard. By implementing this philosophy, a maintained standard will be achieved across the Medupi Power station.

5.5 Operating Concept

5.5.1 Rail yard operations room requirements

When considering the Rail yard operation room, there are a number of factors and equipment that need to be taken into account. This must all be under a common roof to create a Rail yard operations room which aims to achieve the following:

- Improved communications between operational staff
- Reduced manpower costs in terms of supervision requirements
- Reduced construction costs

There are two critical factors that must be considered when a Rail yard operations room is designed:

- Equipment and tools to perform the task
- The human factor

The human factor is to ensure that operators manning the system must be in an environment conducive for the task at hand e.g. lighting design, air-conditioning design must be considered.

The main areas of focus for the operator evaluation are as follows:

- Controls
- Visual Displays
- Work Space
- Seating
- Communications

- Movement around the control console
- Documentation requirements
- Emergency Requirements
- Personal belongings
- Bathrooms
- Kitchen area
- Relaxation area
- Thermal comfort
- Lighting
- Auditory Environment

The control of Gypsum loading will also be done from this room where two control desks must be available.

5.5.2 Rail Systems (In-Motion Weighbridges)

The in-motion weighbridge system detect and weigh each wagon to provide an accurate measurement of the mass and the load distribution within the wagon. The AVI Readers identifies the wagon number as read from the RFID tags on the Transnet wagons.

The information of the in-motion weighbridge and the AVI readers are automatically merged and reflected on a desktop computer in the Rail yard operations room. In-motion weighbridges are trigger-based and is self-arming. A trigger occurs when the train presence is detected at which point data acquisition begins. Real-time data is acquired from the in-motion weighbridge and AVI reader, followed by analysis and data extraction. The information is time and dated stamped to reflect the actual transaction time.

Typical data that can be extracted from in-motion weighbridges are:

- Current Status – This will include the condition of the equipment at each installation. The current status will also be visible, i.e. idle or acquisition mode.
- Current alerts – A list of alerts for the current rain will be displayed, in descending order of severity
- Traffic History – A scrollable list of historic transactions will be permanently visible. A simple select and click will permit the operator to view and print train consist detail.
- Alert history – A scrollable list of history alerts will be permanently visible. A simple select and click will permit the operator to view and print alert history.
- The following data is produced and available on the desktop computer:-
- Individual Wagon Mass
- Train Mass
- Left to Right Balance (mass distribution)
- Front to Back Balance (mass distribution)
- Wagon Speed
- Wagon Time / Date of weighing
- Unique Wagon Number (AVI output)

Refer to Volume 3 Appendix 17 for ON-TRACK Technology Massize-T4 Track-side Installation detail.

5.5.3 Rail System (Shunt Operations)

The rail process in the yard is described below. Unless otherwise stated all train movements and indexing of wagons in the yard are duly authorised by means of open radio communication before being executed..

5.5.3.1 General Operating Procedure

All train movement on the Thabazimbi to Lephalale mainline is controlled from Pyramid South. A train-control officer in the Track Warrant office at Pyramid South controls the movement of trains over the main line in the track warrant section between Rustenburg and Ellisras.

The Track Warrant train-control officer, in collaboration with the Medupi Yard Master, controls the movement of trains to and from the Medupi yard.

The Medupi Yard Master is responsible for the admittance and despatching of trains, and controls all movements in the Medupi yard. Whilst in the Medupi yard, Transnet Freight Rail personnel must strictly comply with the instructions of the Medupi Yard Master.

The Track Warrant train-control officer and drivers of trains communicate by means of train radios on the track warrant open channel. The Track Warrant train-control officer, area planner/yard master/control shunter at Thabazimbi, and the Medupi Yard Master communicate with one another by means of telephones.

The area planner at Thabazimbi must, before the despatch of a train to the Medupi yard, contact the Medupi Yard Master and confirm that the train can be accommodated for unloading limestone or loading gypsum in the Medupi yard. The Track Warrant train-control officer will in good time inform the Medupi Yard Master of a train en route to Medupi and furnish the expected time of arrival.

On arrival of the train at Medupi, the driver must bring the train to a standstill on the run-off line short of the stop board leading into the Medupi yard and not proceed further unless, or until, he/she has received from the Yard Master a private siding walkie-talkie and verbal authority at the board, to pass the board.

The Medupi Yard Master must, before authorising the driver to enter the Medupi yard, ensure that:

- The runaway points and all other hand-operated points are correctly set for the admittance of the train to the Medupi yard
- The line on which the train is to be admitted is clear and no conflicting movement will take place
- After being authorised to pass the stop board, the driver must proceed onto the designated line and bring the movement to a standstill short of the clearance mark at the forward end
- After the last wagons has arrived within the clearance marks of the yard, the driver must inform the Track Warrant train-control officer accordingly and the Medupi Yard Master must restore the runaway points to the normal position.
- In the case of an ordinary airbrake train, the load must thereafter be secured in accordance with the train operating instructions of Transnet.
- See detailed train operating procedures in the sections below for the respective limestone and gypsum train operations.

Upon departure, either the empty limestone or full gypsum train, will undergo a technical examination and the prescribed train despatching duties will be carried out. Before departing from the Medupi yard, the driver must return the private siding walkie-talkie to the Medupi Yard Master.

When all is in order for the train to depart, the driver must contact the Track Warrant train-control officer and obtain a track warrant token to enter the main line track warrant section and return to Thabazimbi. After the Track Warrant train-control officer has issued the track warrant token he/she must inform the Medupi Yard Master accordingly.

After having received the assurance from the Track Warrant train-control officer that a track warrant token has been issued to the Transnet driver, the Medupi Yard Master must correctly set the points in the exchange yard and the runaway points for the departure of the train and authorise the driver to depart.

After the train has entered the main line and is clear of the runaway points the Medupi Yard Master must restore the runaway points to the normal position.

5.5.3.2 Limestone (Rotary tippler & wagons fitted with rotary couplers)

A train consisting of 60 loaded CAR-wagons arrives from Thabazimbi, and proceeds via the runoff line and stops at the Stop Board leading into the Medupi Rail Yard.

The train is handed over from the TFR mainline control to the local yard control. All train movements in the Medupi yard are controlled by means of verbal communication on open channel radios.

Once authorised the mainline train with the limestone wagons proceeds via line 2 onto line 8. The TFR mainline locomotives proceed and cross over onto line 11 and stop once the 31st wagon is positioned at the clearance markers on line 8. A minimum brake application is made on the train and the brake pipe is closed between wagon 30 and 31. The back consist of 30 wagons are uncoupled at the clearance marker on line 8 and secured, whilst the front consist of 30 wagons are hauled onto line 11 by the TFR mainline locomotives. Once the points are set, the 30 wagons on the line 11 are pushed back until the first wagon is positioned within reach of the wagon indexer and secured on line 10. The brake pipe is closed off on the wagon in front of the TFR mainline locomotives. The TFR mainline locomotives un-couple from the wagon consist and proceed forward onto line 12, where the points are set towards line 13. Once the points are set the TFR mainline locomotives proceed via line 13 and line 6 onto line 2. Once clear past the point set, the points are set to allow the TFR mainline locomotives to move back and couple to the 60 empty CAR-wagons positioned on line 7.

During this time the end-off train device is removed from the last full wagon positioned on line 8 and placed on the last empty wagon positioned on line 7. The train is ready to depart the yard once the technical inspection of the wagons and applicable brake test has been completed. The local yard control hands the train control back over to the TFR mainline control and once authorised, the empty train departs for Thabazimbi on the next available train slot. The shunt locomotive moves into position on line 8 and couples onto the front of the loaded wagon consist.

Un-loading of the full wagons commence once authorisation is received that it is safe to do so. Once authorised the shunting locomotive move into position and couples onto the front of the 30 loaded wagons staged on line 8. The shunt locomotives hauls the full wagons onto line 11 via the cross over between line 8 and line 11. The train stops once the rear is clear of the point set leading onto line 10. The points are set and the shunt locomotives push the full wagons back onto line 10 until the first wagon is positioned within reach of the wagon indexer at the tippler and secured. The brake pipe is closed off on the wagon in front of the shunt locomotive, and the shunt locomotive un-coupled. In all cases, the prescribed safety and hand-shaking procedures have to be carried out prior to the commencement of the actual indexing and un-loading process.

The shunt locomotive proceeds via the necessary lines and moves into position on line 10 to remove the empty wagons from line 10. The un-loading process stops once the shunt locomotive has to clear wagons from line 10. Once authorised the shunt locomotive move and couples onto the front of the first empty wagon consist on the western side of the tippler on line 10. The brake pipe is connected through and the brake system fully charged by means of the compressor equipment of the shunting locomotive. The shunt locomotive hauls the empty 30 wagons onto line 2 and the train is stopped once clear of the points leading back onto line 7. The points are set whereupon the shunt locomotive proceed to propel the 30 empty wagon consist back onto line 7. The shunt locomotive stop the train once the first wagon is positioned at the furthermost clearance marker on line 7. The shunt locomotive can remain attached to the wagons or un-couple, stand clear and wait until the second consist of 30 wagons are unloaded before moving back onto line 10. The same process is repeated to remove the second consist of 30 wagons from the tippler and placing it on line 7.

Once the empty wagon consist is combined into a train, the prescribed technical inspection and A-brake test is performed. Thereafter an emergency brake application is made prior to the shunt locomotive being un-coupled from the train. The shunt locomotive obtain authorisation and proceed to the next location as required.

5.5.3.3 Limestone (Single wagon side tippler)

Same procedure as discussed above but with the following difference. Each full wagon is uncoupled from the wagon consist before it is placed at the tippler. Thereafter the empty wagons are coupled together and the brake pipes between the wagons coupled. Two additional shunters are required during the offloading of the wagons using the single wagon side tippler.

One shunter to assist with the uncouple of the wagons from each other prior to placement at the tippler and one shunter to assist with the movement control of the empty wagons once discharged from the tippler. When required the empty wagons can be placed on line 4 and loaded with gypsum instead of departing the yard as empty wagons.

5.5.3.4 FGD Gypsum

A train consisting of 50 empty CAR-wagons arrives from Thabazimbi, and proceeds via the runoff line and stops at the Stop Board leading into the Medupi Rail Yard. The train is handed over from the TFR mainline control to the local yard control. All train movements in the Medupi yard are controlled by means of verbal communication on open channel radios. Once authorised the full train proceeds via line 2 onto line 4 and the train stops once the first empty wagon is positioned under the load-out station and the 1st wagon within reach of the wagon indexer. A minimum brake application is made on the train and the brake pipe closed off on the first wagon in the train consist.

The TFR mainline locomotives un-couple from the empty wagon consist on line 4. Thereafter the mainline locomotive proceed via line 13 and line 6 onto line 3 where it couples to the 50 full CAR-wagons. During the mainline locomotive run-around activity, the end-off train device is removed from the last empty wagon positioned on line 4 and placed on the last full wagon at the rear of the train positioned on line 3. The full train is ready to depart the yard once the technical inspection of the wagons and applicable brake test has been completed. The local yard control hands the train control back over to the TFR mainline control. Once authorised, the full train departs for Thabazimbi on the next available train slot.

The wagon indexer engages onto the couplers between wagon 1 and 2. The loading of the wagons commence once authorisation is received that it is safe to do so. The wagon indexer sequentially move the train consist at slow speed through the load-out station whilst the wagons are loaded in-motion. Once a maximum of 10 wagons are loaded the operation stops, the wagon indexer disengaged, and move back and position between wagons 11 and 12. The shunt locomotives moves into position on line 13 and couple onto the rear of the loaded wagon rake. The brake pipe is connected through and the brake system fully charged by means of the compressor equipment of the shunting locomotive.

The brake pipe between wagons 10 and 11 are closed off and the full wagons un-coupled from the rest of the train. The wagon consist is hauled forward till the last wagon is clear of the point-set between line 5 and line 13. The points are set towards line 3 and the full wagons propelled forward towards the further most clearance marker on line 3. The train is stopped once the first wagon in the wagon consist is positioned at the clearance marker on line 3. A full brake application is made, the brake pipe closed off in front of the shunt locomotive and the shunt locomotive un-couple from the wagon consist. The shunt locomotive move back onto line 13 and stop once positioned clear on line 12.The loading process commence once the shunt locomotive clears line 13 and authorisation is received that it is safe to do so. In all cases, the prescribed safety and hand-shaking procedures have to be carried out prior to the commencement of the actual indexing and loading process.

The process is repeated to load and place the full wagons on line 3. Once the full consist of 50 wagons is combined into a train, the prescribed technical inspection and A-brake test is performed and an emergency brake application made prior to the shunt locomotive being un-coupled from the train. The shunt locomotive obtain authorisation and proceed to the next location as required.

5.5.4 Rail System (Shunt Locomotive)

There are various permutations available for the utilization of the shunt locomotive depending on prevailing conditions and traction requirements.

Section 5.5.3 describes the movement of the shunt locomotive during the offloading of the full limestone wagons and loading of the gypsum wagons.

5.6 Safety Concept

5.6.1 Electrical Control and Instrumentation

General safety design and installation requirements for the electrical system will be as follows:

- No electrical equipment should be mounted on removable walkways or structures.
- Live parts of electrical equipment mounted in enclosures should be shrouded or shielded to prevent unintentional contact (IP2X) by personnel.
- All enclosures and devices with switch disconnecting properties (MCB's, MCCB, switch-disconnectors) must, where applicable have provision for securing by means of padlocks.
- All electrical installations should be such that they are "fail safe", i.e. the failure of the Plant or any circuit, stops the associated drive in a safe state.

General safety design and installation requirements for the lighting system will be as follows:

- All areas where lighting is required should be designed with personnel safety as the first criteria.
- Lighting design and installations should be completed in such a manner as to ensure that lighting provided does not have an adverse effect on any employee's performance while performing their duties. These criteria must comply with the OHS Act.
- Unwanted lighting and glare should be considered to ensure that all employee's safety whilst walking or performing specific tasks is not compromised.

6. SITING

6.1 Site Selection

The rail yard site selection was governed by the following:

- The decision to use the existing rail way network to deliver limestone to the power station.
- The position and layout of the FGD plant.
- Available space within the existing Medupi Power Station fence boundaries.
- The availability of existing services such as potable water, fire water and stormwater drainage structures.

The location of the proposed private siding take-off point is situated at kilometre point 107+128m on the Thabazimbi – Lephalale railway line which is not electrified. TFR is in the process of electrifying the section of track from Thabazimbi. The Consultant and Eskom liaised with TFR in order to incorporate their requirements in the design process.

6.2 SITE CHARACTERISTICS

The general topography of the site can be classified as flat terrain that slopes from the south west to the north east with a slope between 0.5% and 1%. For the construction of the rail yard a large amount of bush clearing will be required as approved by the Environmental Impact Assessment.

Stockpiles on the northern side of the proposed rail yard area are currently in use for other construction projects in Medupi. These stockpiles are to be removed before the commencement of the rail yard construction.

The bulk earthworks for the proposed rail way embankment will require large quantities of fill material. Due to the shortage of material on site all fill material G7 and higher will be imported from commercial sources.

6.3 SITE LAYOUT

Refer to the Main Concept layout drawing no. 0.84/4041 in Volume 3 Appendix 1.

7. BUILDINGS AND SERVICES

7.1 INTRODUCTION

It is required that the rail yard be provided with the following serviced buildings:

- Administration and operations tower building for Eskom and Transnet Freight Rail employees
- Diesel locomotive workshop, utilities rooms and ablutions
- Security office
- Fuel Storage and Dispensing Facility
- Tippler building, including subsurface structure
- Conveyor transfer towers

The administration and operations tower building are proposed to be located in one structure. The diesel locomotive workshop, security office, tippler building and conveyor transfer towers are separate structures.

7.2 ADMINISTRATION AND OPERATIONS TOWER BUILDING

Refer to drawings 0.84/40142 and 0.84/40143 in Volume 3 Appendices 9 and 10.

7.2.1 Design Parameters

The following parameters were applied in sizing the administration building:

- Allow for a staff contingent of 18 (10 TFR & 8 Eskom - split into 3 shifts)
- Separate ablution and change room facilities for both males and females
- Disabled toilet
- Kitchen
- Entrance foyer
- Offices
- No sick or first aid room

- No dining or restroom required
- Onsite parking for 5 vehicles

The following parameters were applied in sizing the operations tower:

- Rail yard operations room to be elevated to provide a view of the tippler. Future gypsum offloading will be monitored by means of CCTV.
- To accommodate 2 control desks
- Server room
- Power room
- No toilet – shared with administration building

It was considered beneficial to make the Rail yard operations room part of the administration building, so as to share in the services.

7.2.2 Siting

The proposed facility is situated to the north east of the proposed tippler building on relatively flat terrain. It will be connected to the infrastructure new roads, and has a view of the tippler facility and the rail yard.

7.2.3 Design

Taking into account the generally harsh environment and the remote location, the approach has been on designing a sustainable and low maintenance building structure. The emphasis is on providing natural light and ventilation, and selected finishes that will stand up to the environment and essentially industrial use, and require minimal maintenance. The structure consists of steel columns and portal frames (for ease and speed of erection) and facebrick brick infill panels. No allowance has been made for green building technology, such as rain water harvesting or solar geysers in the budget estimate.

7.2.4 Administration Building Layout

The building is rectangular on plan, with a central entrance section comprising a foyer and male and female ablutions. The northern wing houses male and female lockers or change rooms, and shower rooms.

The southern wing contains open plan Shunter's room, a storage room, a small kitchen and associated store room. The manager's office is located on the south eastern side of the building. A central concrete stair provides access to the elevated Rail yard operations room. The operations room is raised to 4m above ground floor level. It accommodates two control desks. The server room and power room are located in the stair tower, in close proximity to the operations room.

The roof sheeting overhang provides shade to the operators in the Rail yard operations room, and offices at ground floor level.

7.2.5 Finishes

Floor finishes generally ceramic tiles, except for carpets in offices and epoxy screed to store rooms.

- Wall finishes – washable paint
- Ceilings – vinyl clad gypsum tiles 600 x 1200 externally face brick to match other buildings on site
- Doors veneered, natural timber finish
- Sanitary fittings all white
- Ironmongery stainless steel

- Windows and shop fronts aluminium powder coated with safety glazing

7.3 Diesel Locomotive Workshop, Utilities Rooms and Ablutions

Refer to drawing 0.84/40145 in Volume 3 Appendix 12.

7.3.1 Design Parameters

The following design parameters were applied in sizing the diesel locomotive workshop

- Electrical and communications room
- Wagon repair store / telemetry and train equipment store
- Valuables storage
- Components and equipment
- Wash bay
- Lubricants and consumables
- Compressor room
- Battery store
- Rest room area
- Kitchen
- Ablution and change room facilities for both males and females
- Office

The structure consists of a rectangular clad structure 30m long x 16m wide, which accommodates the locomotives under repair. This raised section of the structure will be clad in mild steel sheeting, on structural steel portal columns.

The utilities rooms and ablutions described above form part of a double storey lean to, located on one side of the locomotive workshop.

7.3.2 Siting

The proposed facility is situated adjacent the (preliminary) pollution control dam, elevated on relatively flat terrain.

7.3.3 Design

Taking into account the generally harsh environment and the remote location, the approach has been on designing a sustainable and low maintenance building structure. The emphasis is on providing natural ventilation, and selected finishes that will stand up to the environment and essentially industrial use, and require minimal maintenance. The structure consists of steel columns and portal frames (for ease and speed of erection) and face brick infill panels. No allowance has been made for green building technology, such as rain water harvesting or solar geysers in the budget estimate.

7.3.4 Finishes

Floor finishes generally ceramic tiles, except for carpets in offices and epoxy screed to store rooms.

- Wall finishes – washable paint
- Ceilings – vinyl clad gypsum tiles 600 x 1200 externally face brick to match other buildings on site

- Doors veneered, natural timber finish
- Sanitary fittings all white
- Ironmongery s/s
- Windows and shop fronts aluminium powder coated with safety glazing

7.4 Security Office

Refer to drawing 0.84/40144 in Volume 3 Appendix 11.

The building consists of an industrial facebrick building, constructed on a raft foundation.

The security office is located adjacent the fenceline. The structure accommodates one counter and one desk, a single toilet and a fridge.

The roof sheeting overhang provides shade protection to the guard.

7.4.1 Finishes

Floor finishes are generally ceramic tiles

- Wall finishes – washable paint
- Ceilings – rhino board
- Externally face brick to match other buildings on site
- External hardwood,
- Ironmongery stainless steel
- Windows aluminium powder coated with safety glazing

7.5 Fuel Storage and Dispensing Facility

The structure consists of an open bunded area for location of the diesel storage tank. This area will be constructed on imported layerworks. A sump will be used to capture and dispose of stormwater entering the bunded area. The open bunded area will be approximately 6m wide x 10,5m long, with the diesel tank located in the centre of the bund.

The dispensing structure will be located immediately adjacent the fuel storage facility, and will consist of a concrete slab 4m wide x 10,5m long. The area will be covered by a monopitch clad structural steel roof, supported on steel columns. Foundations for the columns will be located below the floor slab level.

7.6 Tippler Building, Including Subsurface Structure

This structure is described in more detail, under the mechanical scope of work. Refer to Concept report Volume 2 (Materials handling).

7.7 Conveyor Transfer Towers

These structures are described in more detail, under the mechanical scope of work. Refer to Concept report Volume 2 (Materials handling).

7.8 Mini Sub Requirements

A mini substation may be required where electrical power will be delivered from the main substation in the rail yard namely:

- Mini Substation for lighting

Alternatively existing mini sub “J ” may be used to supply the rail yard with lighting depending on available capacity. Refer to the drawing Substations & Cable Routes 0.84/40138 in Volume 3 Appendix 5.

The rail yard mini substations will be in accordance with Eskom’s specification.

7.9 Substation requirements

In the event that there is not enough capacity at the Eskom’s planned Limestone handling substation a new substation local to the rail yard will be required to supply both the bulk material handling and rail yard and services area.

A typical substation would include the following:

- 2 Step doors for access on either side of the substation
- Fire detection in the substation
- Fire protection in the basement
- 1 single door and 1 double on either side for access and entry of equipment
- Emergency doors with quick release facilities to exit the substation upon and emergency
- Emergency lighting
- HVAC considerations

7.10 Heating Ventilation and Air Conditioning (Hvac)

Non-effective air conditioning systems are often found to be the biggest singular source of discomfort to buildings. Although individual parameters of thermal comfort will vary from person to person the air conditioning system must be designed such that it provides the following parameters:

- Reliability
- Cooling and heating
- Humidity control
- Adequate air circulation
- Air filtration and pressurisation
- Sufficient fresh air
- Adjustability

Combined with the above, it is critically important that the system complies with the following:

- Air diffusion will not cause excessive drafts
- The HVAC system will not create disturbing noise.

Air conditioning systems will be designed such that varying ambient temperatures between day /night and summer / winter will not adversely affect the performance of the system.

8. ELECTRICAL DESIGN

8.1 Power Supply into the Rail Yard

Currently there is a planned 6.6kV limestone handling plant substation as part of the FGD plant where the supply for the rail yard will be delivered. An option would be to utilize either the 6.6kV or 11kV for electrical feed into the yard.

Relay rooms are required to feed local control points and yard equipment. In the yards substation there will be a transformer which steps down the incoming voltage from 6.6kV to 400V for LV equipment and 220 volts ac or 110 volts dc for control and instrumentation. DC will be generated by means of a UPS with a battery backup, the required DC voltage will be tapped off from the UPS.

8.2 Power for the Yard Lighting and Facilities

Currently the existing rail yard operations will be in accordance with Transnet Freight Rail. Therefore lighting in the rail yard will be as per TFR's standards.

Power will be distributed from the main substation in the rail yard into a yard lighting mini substation/kiosk, or an existing mini-sub.

8.3 Power for Rail System (Signalling and Yard Automation)

Currently there will be no signalling required for rail operation and is not applicable for the current design, since train movements on the current network are authorised by means of radio train orders.

Provision will be made for a Rail yard operations room to monitor and control yard movements from a central point in the yard.

8.4 Cable Route, Type and sizing criteria

Refer to the drawing Substations & Cable Routes 0.84/40138 in Volume 3 Appendix 5.

The risk to plant and personnel due to the failure of cable and connection failures is an important consideration. The most important items that are considered during the design phase are the size (length and effective area) of the cables, the type of cable used for the application, cable route, cable supporting and the fire risk of the cables. The cable route will be the most practical and economical route available and where possible cables will be installed on the northern and western sides of the street.

Electrical services will be kept on the opposite side of the road to telecommunication and water services where practically possible.

The types of cable mainly used for new installations are the flame retardant PVC cables and the halogen free (HF) cables. The most important difference in the properties of these two cable types is the high emission of acid gas (hydrogen chloride) from PVC cables in the case of fire whereas no hydrogen chloride gas is released from the halogen free cables. The hydrogen chloride (HCL) gas in combination with other toxic gases that are produced from the burning of PVC. This acid gas is also responsible for the corrosion to steel reinforcement of concrete, steel structures and electronic equipment printed circuit boards. The cables shall be XLPE insulated with flame-retardant reduced halogen emission PVC outer sheath (emit a mass of not more than 15% halogen). Acceptance criteria for insulation shall be in accordance with SANS 1411-2.

Cables shall be manufactured in accordance with SANS 1339 and SANS 1411 Parts 1, 2, 4 and 7.

In the cable size range of 35 mm² to 185 mm² 3½ core cables with a neutral core approximately ½ of the cross sectional area of the phase conductors shall be used. Cabling will be selected to have a volt drop better than 5%.

8.5 Electrical Power Requirements

As mentioned previously there is an already planned 6.6kV/400V substation that has been considered where electrical power will be distributed into the rail yard. All electrical, control and instrumentation equipment are rated at different voltage levels therefore Three-phase electrical power must be supplied into the rail yard.

Electrical power will be distributed from either 6.6kV, 11kV existing substation or the planned 6.6kV limestone handling substation into the main substation locally to the rail yard .Thereafter the voltage will be stepped down and distributed to various equipment on the rail and bulk material handling side.

8.6 Future Electrification Requirements

Transnet freight rail have a future plan of electrifying their existing network which will be used by Medupi for the bulk material handling of limestone and gypsum post 2020.

Electrical considerations must be taking into account when considering cable routes for lighting of the siding under train tracks, as well as positioning of masts will be critical to ensure that when maintenance for these medium and high masts arise, all clearances are maintained.

8.7 Switchgear General Specifications

8.7.1 General

- Switchgear should be supplied in accordance with specification 240-56227516
- Provisions will be made for UPS's in the substation for the switchgear control voltage

8.7.2 Circuit breakers

Circuit Breakers should be of the three pole, single mechanism type, with spring operating mechanism. Spring charging will be done by means of an 110V DC electric motor.

The circuit breakers should be in accordance with the requirements of IEC 62271.Testing of the breakers will be done in accordance with IEC 60060.

8.7.3 Isolating switches

The isolating switches should be of the centre rotating, side break type with manual operating mechanisms. All shaft movements will be facilitated by means of roller or ball bearings.

The centre insulator should rotate with the contact arm. Contacts will be silver plated and spring loaded.

The isolating switches should be in accordance with the requirements of IEC 62271.

Testing of the isolating switches will be done in accordance with IEC 62271.

Insulators used for isolators, should be tested in accordance with IEC 60168 and IEC 62217.

8.7.4 Current Transformers

Current transformers should comply with the requirements as stipulated in IEC 60044.

Insulated bushing material should be of porcelain or silicon rubber or composites and will be tested in accordance with IEC 60168 and IEC 62217.

Testing should be done in accordance with IEC 60060.

Multiple cores should be provided for the different protection requirements as well as for metering.

8.7.5 Voltage Transformers

Voltage transformers should comply with the requirements as laid down in IEC 60044.

Insulating bushings should be porcelain or composite rubber or composites and will be tested in accordance with IEC 60168 and IEC 62217.

Voltage transformers should be of the inductive type.

Testing will be done in accordance with IEC 60060

8.7.6 Surge Arrestors

The arrester should be capable of absorbing lightning and switching surges without damage to the equipment.

Testing will be done in accordance with IEC 60060.

8.8 Concept design description and equipment

Electrical power provided, shall be bulk, dual, AC supplies to low and medium voltage switchboards situated in electrical substations.

Circuits on these boards will be provided for the power supplies to the Plant i.e. motors, cubicles, power distribution boxes, variable speed drives etc. as per the power supplies required.

A dual supply auxiliary power system switchgear philosophy will be adhered to for ancillary plant i.e. when one board is isolated for maintenance purposes; only the electrical equipment supplied from that switchboard are out of operation, the Plant being fed from the other supplies shall remain in operation.

All concepts shall be in accordance with Eskoms standards and similar to the Medupi main plant, if not the same, philosophies shall be adhered to at all times when considering electrical infrastructure at the Medupi rail yard.

8.8.1 Power Conditioning

8.8.1.1 AC Power supply conditions

8.8.1.1.1 Normal AC supply conditions

Extremes of these parameters can occur simultaneously:

- Voltage: ± 5 percent
- Frequency: ± 2.5 percent
- Voltage unbalance: Negative Phase Sequence (NPS) voltage up to 0.02 of nominal Positive Phase Sequence (PPS) voltage
- The Zero Phase Sequence Voltage component can be up to 1% of the PPS component.
- The harmonic distortion of the supply voltage under normal operation will be as follows:
- The Total Harmonic Distortion (THD) of the voltage can be up to 5% of the fundamental component.
- The voltage waveform can contain harmonic components up to the 100th harmonic.
- The amplitude of any individual component can be up to 1% of the fundamental component.

Where variable speed drives are provided the harmonic current values as prescribed in this paragraph shall be adhered to. For all operating conditions, individual harmonic currents shall not exceed (these are measured at the electrical supply boards):

- rms amplitude of 100/n percent, where n is the harmonic number.
- sub-harmonic currents shall not exceed the RMS amplitude of 100n percent, where n is the fraction given by the sub-harmonic frequency divided by the fundamental frequency.

8.8.1.1.2 Abnormal AC power conditions

The supply voltage frequency can reach limits of up to 52.5 Hz and fall as low as 47.5 Hz. This condition can last for up to 1 minute.The amplitude and duration of temporary abnormal voltage conditions which can occur on the power supply are as follows:

- Short duration abnormal conditions: Short duration undervoltage conditions arise either due to a loss of supply or the supply voltage being depressed due to a short circuit on the network.
- Loss of power supply: When the supply is disconnected, the supply voltage either drops rapidly to 0% of nominal value or is sustained at low amplitude at a reduced frequency because of back generation of electrical drives. The initial voltage amplitude during these conditions is less than 80% of nominal value and decays with a time constant of up to 1.5 seconds. The time duration from loss of supply until supply restoration is between 1 second and 2.5 seconds.
- Short circuits: Depression of supply voltage due to short circuits can result in voltages as low as 0% of nominal value. The duration of the drop can be up to 1 second.
- Overvoltages: Overvoltages with amplitudes of 110% of nominal value can occur for up to 10 seconds.
- Medium duration power supply deviations: Voltage depressions of medium duration can be caused by the switching of load, such as starting induction motors. The supply voltage can fall as low as 75% of nominal value and the duration of this depression can be up to 15 seconds.
- **Power swings:** An alternative source of this abnormal condition is when power swings occur after a severe disturbance on the network. The supply voltage amplitude will oscillate at a frequency between 0.2 and 2 Hz. In this case, the voltage can fall as low as 65% of nominal and can rise up to 110% of nominal during a swing. The voltage will not fall below 70% for longer than 0.5 seconds. However, these oscillations, or repeated abnormal voltage conditions, can continue for up to 60 seconds.
- Long duration power supply deviations: Long duration abnormal supply voltage conditions usually originate from operating the plant at its limits. The supply voltage can be up to 110% of nominal value and can drop as low as 90% of nominal value. The duration of such abnormal conditions is up to 6 hours.

The following lightning and switching surge conditions can occur on the power supply system:

- Lightning impulse: Phase-to-earth and/or phase-to-phase lightning impulses with a front time of 1.2 µs, a time-to-half-value of 50 µs, a peak value up to that indicated in the Switchgear Parameter Table and with both positive and negative polarities, as described in IEC 60060-1.
- Switching impulse: Phase-to-earth and/or phase-to-phase switching impulses with a front time of 250 µs, a time-to-half-value of 2500 µs, a peak value up to that indicated in the table in paragraph 5.1 and with both positive and negative polarities, as described in IEC 60060-1.

8.9 SINGLE LINE DIAGRAM

The single line diagram (refer to drawing 0.84-40147 in Volume 3 Appendix 21) shows a high level concept layout of the rail yard area where the main supply will be from the Eskom planned limestone handling plant which feeds the rail yard and services as well as the bulk material handling area. A redundancy principal of 100% will be used which means at any giving point the rail yard will have a spare supply which will be able to carry the entire load of the rail yard. Two 6.6kV boards will further step down to 400V where the low voltage will be distributed from to various equipment ie. FGD plant, Limestone handling, Rail yard operations room, admin building and possible the rail area lighting.

Table 5 – Electrical Equipment List

Electrical Equipment List-Medupi Rail Yard				
Rail yard Substation	**Rail yard & Services**	**Bulk Material Handling**	**Admin Building**	**Operations Building**
Distribution board	**Weighbridge-Building**	**Limestone BMH**	Distribution board	Distribution board
Plug Points	Distribution board	Power supply for IP cameras	Plug Points	Plug Points
Power supply for IP cameras	Plug Points	Power supply for motors & VSD		Monitors
Sensors(fire)	Power supply for IP cameras	Power supply for auxiliaries	Mini substation	
	Mini-substation	Power supply for all C&I	***Lighting inside & outside***	***Lighting inside & outside***
Lighting inside & outside	***C&I***	Mini-substation	Cabling	Cabling
Cabling	Cabling	***C&I***	Lamps /florescent	Lamps /florescent
Lamps /florescent	Trenching	C&I equipment (load cells, sensors, etc.)	Power supply	Power supply
Power supply	Instruments (load cells, sensors, etc.)	Cabling		
	Power supplies	Trenching	***Air-conditioning***	***Air-conditioning***
Air-conditioning			Cabling	Cabling
Cabling	***Lighting inside & outside***	**FGD Gypsum BMH**	Air conditioning Unit	Air conditioning Unit
Air conditioning Unit	Cabling	Power supply for IP cameras	Power supply	Power supply
Power supply	Lamps /florescent	Power supply for motors & VSD		
	Power supply	Power supply for auxiliaries	***Electrical Rooms***	
Transformer(11kV/415v or 6.6kV/415v)		Power supply for all C&I	Power Room	
Cables to Transformer	***Air-conditioning***	mini-substation	Server Room	
Trenching	Cabling	***C&I***		
Bund wall	Air conditioning Unit	C&I equipment (load cells, sensors, etc.)		
Earthing	Power supply	Cabling		
Auxiliaries		Trenching		
Switchgear	***Yard Lighting***			
Circuit breaker	Distribution board			
Isolator	Cabling			
Current transformers	Luminaires + auxiliaries			
Voltage transformers	Masts			
metering units CT+VT	Trenching			
	Day/night sensors			
Panels				
Transformer protection panels				
Metering panels				
Equipment panels				

9. CONTROL AND INSTRUMENTATION DESIGN

9.1 Introduction

Control and instrumentation will be required for both the bulk material handling as well the rail yard and services.

The scope of the C&I project includes the following:

- SCADA and Control System
- Monitoring and Control for Bulk Materials Handling, Rail-yard Equipment
- Interface to Weighbridge standalone systems
- Plant Information system
- Building Management system including lighting management, CCTV, Access control, Intercom/ PA and Fire Detection systems
- Interface to Medupi Power plant
- Field Equipment

The C&I Architecture drawing 0.84/43218 (Refer to Volume 3 Appendix 22) will include a standalone PLC & SCADA system to the Medupi Power plant Control System with an interface to the Medupi Power plant Control system.

The facility control and instrumentation will provide services for the integrated monitoring and control of the Medupi Rail Yard to achieve a Facility-wide integrated system. There will be a local Plant Information System (PIS) which provide facilities for storing and transfer of information to the main power plant concerning the performance of the system, production, facility conditions and performance and provide data in order to obtain the required parameters.

The PIS information as well as information from the BMS can be accessed by the Medupi Power plant control room through the PIS interface and CBMS respectively.

Centralised operation will be deemed to include all actions that will normally be undertaken to accomplish normal and emergency start-up, routine loaded operations, and normal and emergency facility shutdown.

All local controls, control panels and other Human Machine Interfaces (HMI) located inside and outside the CCR, namely in equipment rooms, switchgear rooms or local to the Facility, will in general be regarded as operational facilities and the SCADA and/ or Control and Monitoring System will interface to these facilities and monitor all such operations.

A high-level computer system (HMI) will be provided with multiple operating stations and integrated with the control system to perform local control and monitoring, and for automatic comprehensive data logging and archiving with detailed analysis and reporting for maintenance management. On-line condition monitoring will be provided for equipment.

The communications between SCADA and the PLC as well as the Interfaces to the main power plant are considered to be redundant. This would achieve the best availability at this level however once the plants total availability requirements are confirmed the level of redundancy in all systems including PLC will be addressed. Due to the nature of operations its currently not foreseen to have redundancy at the Field level that requires control by the PLC's therefore no redundancy in the PLC's was allowed for.

9.2 Rail Yard and Services

Looking at the rail yard and services, currently no signalling will be required as all train movements on the current network are authorised by means of radio train orders.

I/O systems required may include the following:

- C&I will be required at the weighbridge
- Surveillance of the weigh bridge may be considered.
- Yard control system: Control system will consist of the basic hand operated point sets that will allow for safe and efficient shunting within the yard

9.3 Yard Control System

Given the fact that it is not a prerequisite that yards or sidings be signalled and taking into account the low number of trains that will be handled in the yard, it was identified that the most viable and safe train operating method will be by means of hand operated point sets. All shunt movements will be communicated between the train driver and shunters being by means of open channel handheld radios.

Three approved and well documented control systems were compared:-

- Manual Hand Tumblers
- Automated Yard Control
- Signalled with Central Traffic Control

9.3.1 Manual Hand Tumblers

- Manual hand tumblers in yard
- Points are set manually by shunt personnel
- Point set position indicated by the colour of the head of the tumbler, or
- By the arrow on the new VAE sets
- Shunting movements are communicated by means of hand held radios
- Recommended for small yards with low traffic flows such as the Medupi yard
- Low cost compared to other systems

Figure 3 - Manual hand tumbler

Figure 4 - New VAE sets with arrow

9.3.2 Automated Yard Control

- All the point-sets are automated
- System requires that track vacancy detection equipment on each track
- Position of point-set is indicated by a colour light (Not to be confused with a signal)
- System can either have a local points control or remote points control
- Local points control requires manual activation at each point-set by means of push buttons on the side of the indicator
- Alternatively it can be controlled remote from a control cabin

Figure 5 – Remote control point

- The remote control point will have a computer with a Visual Display Unit to indicate the specific position of each point-set within the yard
- Shunting movements are communicated by means of hand held radios

Figure 6- Points Indicators

- The system is recommended for medium size yards with medium traffic flows
- Opeation is less laborious than the hand operated tumblers due to power operated point-sets
- More expensive than manual hand tumblers

9.3.3 Signalled with Central Traffic Control

- Signalling system using multi-aspect colour light signals
- Electrically controlled point machines

Figure 7 – Example of a typical multi-aspect colour light signal

- Interlocking and power equipment that requires a relay or equipment room

Figure 8 – Example of relay or equipment room

- Requires track vacancy detection such as an electrical track circuit or axle counters


Figure 9 – Example of track vacancy detection equipment

- Points together with the signal and track vacancy is interlocked and no conflicting routes can be set up
- System requires a Centralised Traffic Control office
- Control of points and setting up of routes are done via input from the computer keyboard
- Movement of trains are graphically displayed on a Visual Display Unit

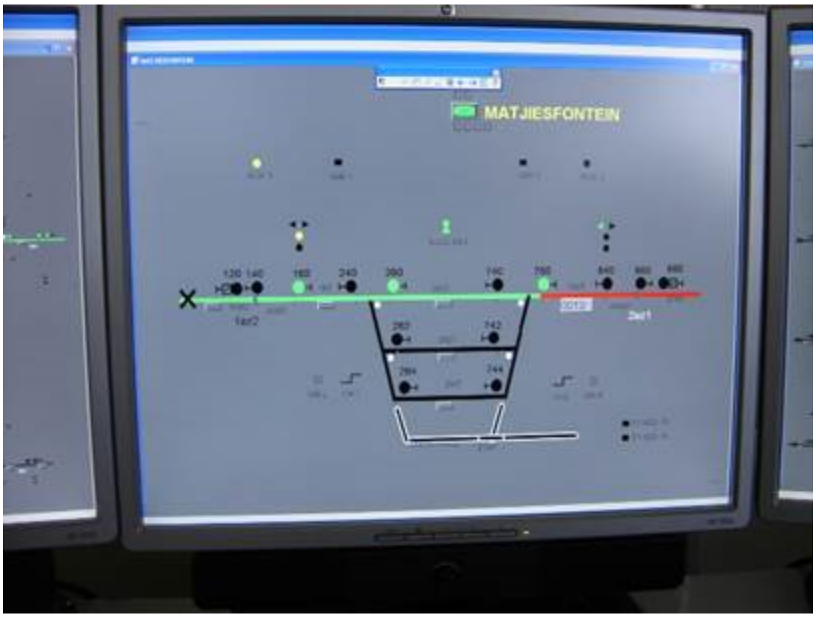

Figure 10 – Graphic display of route

- Should a fault condition occur the point set can be operated by means of a manual crank
- Shunting movements are communicated by means of hand held radios
- Recommended for large yards with high traffic flows
- System is very costly

9.4 Signals and Telecommunication

As mentioned in the previous section there will be no signals in the yard. All train movements on the current network are authorised by means of radio train orders. We do have information that signalling will be required in 2020 and provision is made in the design to accommodate the future signalling A dedicated electrical supply must be available for signalling together with backup power for safety and operational reasons.

9.5 Surveillance

Surveillance will be required for both security measures and monitoring of the rail yard & bulk material handling area. These cameras may monitor the rail yard, railway line, weighbridge as well as the specific areas of the BMH area.

IP cameras will be considered as opposed to analogue cameras due to the resolution and picture quality as well as the type of footage that is required. For example yard monitoring for security may require cameras that can be control by moving 360 degrees as well as zooming capability, whereas monitoring of the rail way line or conveyors maybe require cameras with fixed lenses that have no zooming capabilities.

All footage will be displayed in the Rail yard operations room where dedicated screens will be provided for viewing.

Long term Storage of footage will be provided and easily retrievable via a high resolution DVR.

10. RAIL REQUIREMENTS

Provision is made for a runoff line from the Transnet Freight Rail mainline into the Medupi Rail Yard, to allow the mainline train to rapidly exit the mainline and thus not to cause delays to train operation on the mainline.

Provision is also made for sufficient length of track on the western side of the yard, providing sufficient track to shunt 30 x CAR wagons from the tippler and place them onto the departure line within the yard.

The yard is designed to accommodate the simultaneous staging of two trains consisting of 60 type CAR-wagons within the limestone yard and two trains consisting of 50 type CAR-wagons within the gypsum yard.

Refer to the Concept layout drawing 0.84/40134 in Volume 3 Appendix 1 for more details.

11. YARD LAYOUTS

The proposed yard layout is situated on the western side of the Medupi Power Station. The yard is situated just north of Transnet Freight Rail mainline which runs between Thabazimbi and Lephalale.

The entrance into the yard is from the Thabazimbi side of the Transnet Freight Rail mainline and consist of a runoff section that can accommodate the longest train configuration envisaged to be handled within the siding.

The yard layout is in linear type configuration with six lines parallel to each other, and split into two separate yards and sections linked by means of a locomotive run-around line.

11.1 GYPSUM YARD

- Consist of the following lines/sections:
  - Line 3 – Gypsum departure line
  - Line 4/5 – Gypsum arrivals line with loading facility
  - Line 6 – Locomotive run-around line

11.2 LIMESTONE YARD

- Consist of the following lines/sections:
  - Line 6 – Locomotive run-around line
  - Line 7 - Limestone departure line
  - Line 8/9 - Limestone arrivals line and Not to go line
  - Line 10/11/12 - Limestone unloading line, shunt locomotive shed, shunting neck

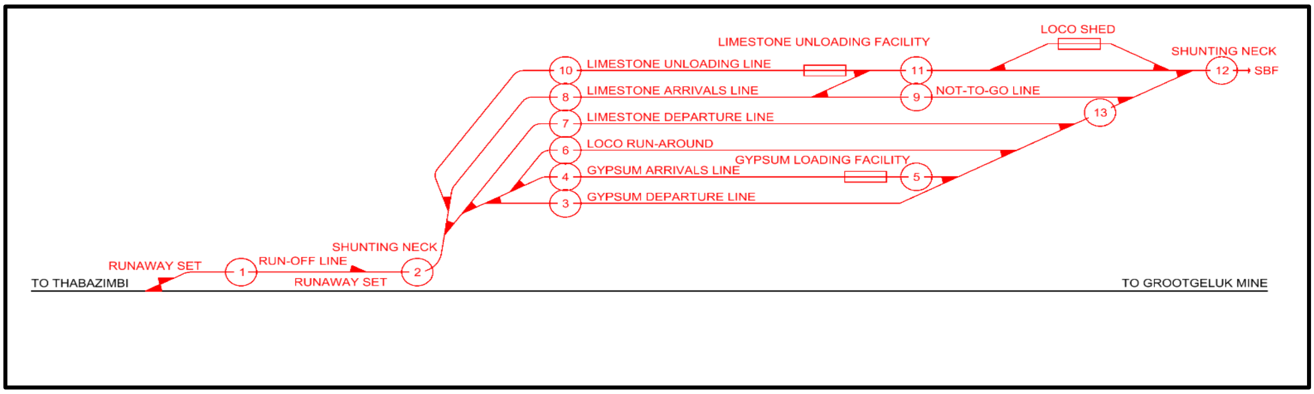

Figure 11 – Layout of Rail Yard

Refer to the Concept layout drawing 0.84/40134 in Volume 3 Appendix 1 and to the Rail plan and profile drawing 0.84/40135 in Volume 3 Appendix 2.

12. SERVICE ROAD REQUIREMENTS

Refer to drawing 0.84/40141 in Volume 3 Appendix 8.

The existing rail way is serviced by a 6m gravel road. It is proposed that the new service road connect to this gravel road at the existing rail way crossing. It is proposed that the service road will be designed on the same platform as the rail way to provide level access to all facilities.

The road alignment is be determined by the rail way layout. The road centreline is placed 6m from the rail centreline. The road will be designed and modelled using AutoCAD Civil3D.

Road cross and longitudinal sections will be generated for the service road. This will be accompanied by a detailed layout drawing with setting out data. The SANS 1200 will be used to compile a complete bill of quantities for the service road.

The service road will be designed to the following specifications:

- 6m wide gravel road
- Cross fall between 1:15 and 1:40
- Layer works as specified in the Transnet S410 specifications
- Geometric design to travel with reasonable ease with a 7t truck
- Maximum local depressions and bump of 50mm
- The road centreline will be placed 6m from the outside rail centreline
- Cut and fill slopes at 1:2

The service road will be designed as a 6m wide gravel ring road to service all facilities in the rail yard. The start position will be at the existing service road rail way crossing. The road layer works will be designed to the same standard as the rail way layer works. The road will have a cross fall between 1:15

and 1:40 for storm water drainage. No formal storm water drainage will be installed for the proposed gravel road. Guard rails will be installed on areas of fill more than 0.5m high.

13. STORMWATER AND DIRTY WATER REQUIREMENTS

Refer to drawing 0.84/40141 in Volume 3 Appendix 8.

The portion north of the rail way line drains to an earth lined channel at the north side of the rail yard. This channel drains from west to east and exits at a newly upgraded stormwater culvert. The size and capacity of the new culvert should be verified during detail design.

The clean rail way stormwater will be collected using concrete channels and underground pipes to drain into a new proposed earth lined channel that will drain to the newly upgraded culvert. This culvert size will be evaluated using the 1:20 year peak flow to determine the required culvert size due to the increased run off from the rail way yard.

The dirty stormwater from the gypsum loading facility will be collected into an independent concrete channel and underground pipe network that will drain to the proposed pollution control dam that will be designed by the FGD project team. The estimated run off contribution to the pollution control dam will be $0.05m^3/s$ for a 1:20 year return period.

The topographical survey will be used to determine catchment areas and flow paths with the assumed 437mm MAP. The rail way drainage and earth lined channels will be modelled in a Hydro cube model using the rational method for different return periods. The rational method will be used for all the 1:2 and 1:20 year return periods. All required structure sizes will be evaluated and sized accordingly

The Hydro cube analysis will provide peak flow values for the chosen return periods. Pipe, channel and culvert sizes will be determined from this analysis. The SANS 1200 will be used to compile a bill of quantities for stormwater structures.

14. CIVIL SERVICES AND REQUIREMENTS

14.1 Bulk Earthworks

The topographical survey and a site visit clarified numerous stockpiles on the proposed rail way site. It is assumed that all the stockpiles will be removed prior to construction. The bulk earthworks below the rail way main layer works will be constructed using G9 material.

From the topographical survey and final approved rail way layout an AutoCAD Civil3D model will be used to generate setting out data and measurement of quantities.

A detailed bulk earthworks layout drawing with setting out data and cross sections will be issued during detail design stage. Bulk earthworks quantities will be used to compile a SANS 1200 bill of quantities. The layer works will be constructed as per typical section on drawing 0.84/40141 in Volume 3 Appendix 8.

The positions and placement of the platform for the rail way layer works and bulk earthworks was determined by the final approved rail way layout. The platform was designed to ensure that the new toe line will not overlap the existing service road fence.

A letter dated 6 August 2014 from Eskom requested the design team to review all earthwork designs due to the quality of stockpiles deteriorating from G5 to G6 and G7 to COLTO classifications.

For the concept design stage it is assumed that all materials G7 and higher will be imported from commercial sources. With the final geotechnical report outstanding it was assumed (on advice from the Geotechnical Engineer) that the insitu material could be collapsible and would have to be compacted by an impact roller to ensure proper support.

The platform will be designed to accommodate the limestone unloading facility, locomotive shed, diesel storage and the gypsum loading facility on the same level as the rail way lines. The security office and accommodation building will be provided with separate platforms.

The bulk earthworks and rail way layer works will be designed according to the Transnet S410 specifications. All cut and fill slopes for the earthworks will be designed to 1:2. The bulk earthworks will consist of G9 material compacted to 93% MOD AASHTO in layers of 150mm. The rail way layer works will be designed for a 26t axle load to specifications.

14.2 Potable Water

Refer to drawing 0.84/40141 in Volume 3 Appendix 8.

Medupi is served by an existing independent potable water network. The connection chamber and position was provided by the client. It was assumed that the connection to the existing network will provide sufficient pressure and flow required for serving the buildings. The pressure and flows at the connection points will be confirmed prior to detail design.

The potable water network serving the facilities will be modelled during the detail design using the Water Mate package.

A detailed calculation report sheet will be generated during detail design illustrating the required pipe sizes and pressures at specific nodes. The SANS 1200 will be used to compile a bill of quantities for all the water pipes.

The potable water network will serve the security office, locomotive workshop and administration building with a stand tap and ablution facilities. Provision will also be made to serve the materials offloading facility and the gypsum loading facility with stand taps.

The following design parameters, which resulted in an estimated peak flow of 0.5l/s, were used as base for the potable water design:

- Population – 18 people
- Unit demand – 80 litres/person/day
- Peak Factor – 4
- Pipe material – 50mm uPVC Class12

It is proposed to install 50mm uPVC class 12 pipes to all buildings in the rail yard. All pipe sizes will be re-evaluated when pressures and flows are known at the connection point. The final pipeline positions and valve placement will be conducted after the approval of the layout plan.

14.3 Sewerage

Refer to drawing 0.84/40141 in Volume 3 Appendix 8.

The security office, locomotive workshop and the administration building will be serviced with an ablution facility with three independent container tank systems. The container tank option is proposed due to the general site topography, distance from the network and limited information regarding the existing sewers.

The sewer flows and required pipe sizes will be designed using Pipe Mate. SANS 1200 will be used to compile a bill of quantities for the sewers.

The following design parameters were used as base:

- Population – 18 people
- Unit demand – 80% of potable water consumption, thus 64litres/person/day
- Draining with a tank truck (Honey Sucker) every two weeks

14.4 Civil Works Relating To Electrical

Electrical civil work will be required for the following:

- Lighting Foundations
- Lighting Cable trenching
- Control cable trenching

All excavation, trenching and concrete work will be done to SANS 1200 specifications.

15. GEOTECHNICAL AND HYDROLOGICAL STUDIES

The following scope of work is proposed:

15.1 Desk Study Review

- A desk study review will be undertaken of all the available geotechnical and geological information pertaining to the site including published geological maps and geological and geotechnical reports.

15.2 Fieldwork Will Include The Following

- Test Pits
- Dynamic Core Penetrometer (DCP) Tests
- Continuous Surface Wave (CSW) Tests
- Construction Material Sampling
- Laboratory Testing

15.3 Geotechnical Report

A geotechnical report will be compiled presenting the information obtained during the site investigation including the prevailing site conditions, stratigraphy, material classification and characterisation, geotechnical parameters, preliminary foundation recommendations and recommendations for infill investigations if required. A factual interim report will be issued about one week after the completion of all fieldwork presenting the recorded soil profiles, DCP results and CSW logs but a final interpretive report will only be issued a week after receiving all laboratory results. Rockland will however endeavour to supply the design team with information as it becomes available to allow the design process to proceed with least interruption.

16. WALKWAY REQUIREMENTS

The walkways will be designed in accordance with the Transnet specifications for walkways as reflected in Transnet drawing KY.100.C.301 dated 2009/05. The walkways will be filled up to the level of the top of the ballast with material giving good drainage and a sound walking surface. The minimum distance from the rail to the edge of the walkway will be 2 metres to allow for a safe walking environment next to the track.

CONTROLLED DISCLOSURE

17. RAIL AREA LIGHTING REQUIREMENTS

17.1 Background

This section will take into consideration all railway yard lighting required to ensure the correct lux levels will be reached.

The aim is to always provide high quality lighting at minimum cost. This will be achieved by adhering to Transnet's Freight Rail specifications which will combine both medium (15m high) and high (25m high) masts to provide the correct lux level.

Transnet Freight Rail uses two specifications, namely CEE.0018 for High Mast Lighting and CEE.0019 for Medium mast lighting.

Transnet Freight Rail previously required an average illumination level of 3 lux at ground level in its marshalling yards. This has now been increased to a minimum level of 20 lux, depending on the task to be carried out.

Transnet Freight rail's rule of thumb is high masts will be used in larger areas and medium masts in smaller areas or where you have a long, but relatively narrow area.

Lamps utilized to obtain the correct lux level are 400 Watt High Pressure Sodium Discharge Lamps with associated control gear. Different Lamps are being looked at currently by TFR but the total installed cost as well as energy consumption is still higher than for High Pressure Sodium discharge lamps for the same amount of illumination on the ground.

17.2 Automatic Control of Lighting

Day/night sensor will be used for the automatic control of lighting to maintain the required 20 lux minimum average level of illuminance.

17.3 Emergency lighting

Where emergency lighting is required, it will switch on automatically or there will be adequate signage for quick and easy switching manually. The level of illuminance that the emergency lighting provides will at least be the design minimum for the anticipated emergency.

17.4 Lighting in signal boxes and control centres

The Lighting within any signal box, be it directly viewing rail traffic operations or any other circumstance, will have minimised glare and adjustable lighting levels incident upon the operators eyes e.g. dimmable lighting, down lights and desk lamps, as deemed most appropriate for each circumstance.

The Lighting in control centres will be designed in a way that ensures all operates to be able to see any indictors associated with railway operation.

17.5 Authorised walking routes

Authorised walking routes will be illuminated at levels appropriate to the hazards that may be encountered along their route.

As a minimum the maintained illuminance of walking routes will be 20 lux horizontal, measured at the walking surface.

The uniformity, in the horizontal axis, will be equal to or greater than 0.5.

17.6 Railway siding areas

Where sidings and staging areas form part of Rail track controlled infrastructure and are deemed to require illumination as a result of risk assessment, the maintained illuminance will be a minimum of 2 lux vertical, measured at a height of 1.0 m above rail level, and 10 lux horizontal, measured at rail level and may go up to a maximum of 20 lux depending on the task to be carried out.

The uniformity, in the vertical and the horizontal planes, will be equal to or greater than 0.5.

17.7 Emergency escape routes and exits

Where areas outside a station form part of an emergency escape route from Rail track controlled infrastructure, they will be signed and illuminated in such a way as to aid egress in the case of an emergency.

The route will be clearly defined and its associated signs will clearly indicate the direction to be taken for safety. As a minimum the route's maintained illuminance will be 2 lux vertically measured at a height of 1.0 m above the walking surface, and 10 lux horizontally measured at the walking surface.

The route's uniformity, in the vertical and the horizontal planes, will be equal to or greater than 0.5.

17.8 Location of luminaires and masts

All clearances when raising or lowering masts, as well as in AC & DC electrified line areas, the design w.r.t positioning of masts will be such that when staff are maintaining these in the proximity to live equipment, all clearances in all positions of raising and lowering will be maintained in according to the TFR specification.

17.9 Temporary Lighting

In the case where temporary lighting, including engineering worksites are required on rail track infrastructure and/or in close proximity to its boundaries continue to operate, that lighting required will also conform to TFR specifications.
In the cases where it is not possible to achieve these requirements, the specific safety hazards of the temporary lighting must be defined and enforced.
These may include for example; instructions for drivers, clear boundary's descriptions, the provision for specific instructions and notices for distribution and display to all persons affected by the temporary scheme.

17.10 Maintenance

Maintenance of built infrastructure must be carried out as per TFR procedures to ensure that the required illuminance is achieved at all times.

17.11 Lighting Equipment

Rail yard lighting equipment has various options available depending on the task to be performed. Medium and High masts are sometimes designed specifically for certain rail yards where considerations such as height, width, operation, maintenance, cost, luminaires and lux levels must be given some taught.

With regard to medium and high masts the following options are available:

- Highlight mast
- Floodlight mast

- Mid-hinged poles
- Scissor masts

17.12 Highlight Mast

Figure 12: Highlight Mast

Highlight masts are of tubular cones design with a constant rate of taper throughout their entire length and are built up from sections of no more than 3m in length and joined by friction fit only.

Access to the raising and lowering gear is provided through a vandal proof door in the base of the mast. Height vary from 20m to 40m.These masts can be used 360 area lighting and 180 floodlighting.

With regard to TFR rail yard use of masts, there is not flexibility of medium (12m & 15m) heights when it comes to the highlight mast.

17.13 Floodlight Mast

Figure 13: Floodlight Mast

Floodlight masts are of tubular cone design with a constant rate of taper throughout their entire length. Platforms both rectangular and circular consist of a framework with an expanded metal floor and access trapdoor. Access to the lights can be external or internal caged ladders, or the lights can be lowered for maintenance using the 'Raise-lite' mechanism. Height manufactured as required. The masts can be used for 360 area lighting and 180 floodlighting.

With regard to TFR rail yard use of masts, there is flexibility of medium & high mast but flood lighting in a rail environment is not ideal as this may be regarded as a hazard.

17.14 Mid-Hinged Masts

Figure 14: Highlight Mast

Mid-hinge poles are manufactured from square tubing at the bottom and round pipe at the top. Heights from 6m to 12m can be manufactured. The masts can be used for 360 area lighting and 180 floodlighting.

With regard to TFR rail yard use of masts, there is no flexibility of high mast (25m) but hinged masts are a concept that TFR approve off.

17.15 Scissor Masts

Figure 15: Scissor Mast

Scissor Masts have a constant rate of taper throughout their entire length and are of octagonal cross-section, consisting of three major sections. The lower half of the mast is divided into two fully enclosed half sections, which form an octagonal section in the operating position with no unsightly steps or protrusions.

A full octagonal section is joined to the top of the pivoting section by means of a site slip joint. The pivot is located approximately at the mid-point of the mast and consists of two full length stainless steel sleeves.

Height vary between 10m and 25m. These masts can be used 360 area lighting and 180 floodlighting.

Transnet Freight Rail have recommended scissor type mast's where the design can combine both medium and high masts to achieve the correct lux level. For purposed of the concept design this option will be explored with more detail.

For a permanent installation, Transnet Freight Rail has adopted the use of hinged type structures as in preference to the elevating high and medium mast light-cluster type for ease of maintenance.

The Mast's will be designed to carry out the specific quantities of luminaries on top in strict accordance with SABS 0225 code of practice for the design and construction of lighting masts.

Table 6 – Costing

25m mast	R 85 000.00
15m mast	R 75 000.00
12m mast	R 30 000.00
Foundation	R 20 000.00
DB and cabling	R10 000/pole
Lights: 4-lights x R6 000 @	R24 000 per pole
DB cabling and trenching	R50 000
Ps and Gs	R5 000 per pole
Sundries (nuts and bolts and earthing)	R5 000- per pole

Table 7 – Mast Costing

Cost per 25m mast	R 199 000.00
Cost per 15m mast	R 189 000.00
Cost per 12m mast	R 144 000.00

The above costing is a complete solution and involves all aspects of installing the mast.

These costs together with the combination of medium and high mast will form the basis of the cost implications that are required to achieve the required lux levels.

17.16 Lighting Design

Refer to the Rail yard lighting design layout drawing 0.84/40146 in Volume 3 Appendix 20.

Rail Yard lighting design will be done in accordance with Transnet Freight Rail specifications, there are a number of factors that must be considered whilst undertaking yard lighting such as intensity and contrasts.

In the case of intensity, lighting design will take into consideration the work being done in that specific area as certain intensities are most suitable for specific work being performed.

In the case of contrasts, when applying lighting design there will be a specific dark and bright areas unless there are a series of luminaires placed in close proximity which is not a practical way of designing.

These dark areas will be overcome by using a combination of high and medium masts to obtain the acceptable contrast and intensity.

17.17 Lux Levels calculations

Taking into account that TFR lamp requirements are, 400 Watt High Pressure Sodium Discharge Lamps with associated control gear which are normally used and 4 lamps are required at each mast, the following results can be concluded.

The total length of the siding is 3175m and the total length from the first train set to the loco shed is 1405m where lighting is required, therefore by utilizing 25 masts at 25 meters high in a single line formation to provide lighting for the rail area the minimum average of 20 lux can be achieved. Refer to drawing 0.84/40139 in Volume 3 Appendix 6.

Table 8 – Lighting Data

Type of Floodlights	**Type of floodlights**	**Scissor Type**
	Manufacturer / Model	Sectional Poles
	Wattage	400
	Manufacturer / Model	High Pressure Sodium discharge
Illumination Standards Compliance	Compliant with Standards (Yes / No)	Yes
	Standard Used for design	Transnet Freight Rail
Operation Data & Costs	Investment costs	R199 000.00 (25m Mast)
	Hours of Operation (Per Year)	4 380 (12 hours a day for 365 days)
	Number of hours at lower illumination (Per Night)	12 hours
Energy Costs	Cost per kW/h	R1.15

18. FIRE PROTECTION AND DETECTION SERVICES

Introduction and Terms of Reference

This section outlines the conceptual design of the fire services to be provided for the Medupi Rail Yard Project.

The design criteria used are the recommendations presented in the Fire Hazard and Risk Assessment Report. Refer to Volume 3 Appendix 13 for a copy of this report.

18.1 Fire Water

The connection chamber and position was provided by the client. The pressure and flows at the connection points will be confirmed prior to detail design.

The fire water network serving the facilities will be modelled using the Water Mate package.

A detailed calculation report sheet will be generated illustrating the required pipe sizes and pressures at specific nodes. The SANS 1200 will be used to compile a bill of quantities for all the water pipes.

The following design parameters were used as base for the fire water pipeline design:

- Minimum velocity = 0.7m/s

- Maximum velocity = 3.0m/s
- Pipe material – uPVC Class12

18.2 Fire Prevention

Reducing the risk of fire in the first instance is a logical precondition to fire prevention.

Reduction of risk can be accomplished by the Owner/Operator having specific interventions in place such as:

- Comprehensive planned maintenance and inspection plans to reduce the potential for mechanical fault and friction occurrences.
- Housekeeping plans to prevent accumulations of product and debris.
- Operators trained to manage incipient fires.
- Well-trained and equipped fire response teams to manage developed fires.
- Strict control over contractors. An effective hot work permit system should be in place. Flammable liquids and gases should not be permitted in the enclosure.
- Regular fire prevention inspections following suitable check lists.

These considerations have been taken into account in the development of this report.

18.3 Site Wide Protection

Site wide fire protection will be provided in the form of strategically located fire hydrants.

18.4 Fire Monitoring System

The fire detection/manual alarm call points system will be allocated to specific zones and each zone will be provided with an audible alarm and flashing light to assist in determining where the alarm trigger is located.

This system will report to a fire monitoring panel located in the rail yard facility security office and the panel will interface to the CBMS (Central Building Management System) at the Medupi power station.

The fire monitoring panel will consist of an electrical panel with various system status alert alarms and controls and zone status (on/off/alert/ready) indicator lights corresponding to geographical location of the fire zones. This panel has the ability to test/reset the various fire detection system components and interact with other remote monitoring devices or stations.

18.5 Lime Stone and Gypsum Systems

18.5.1 Product Considerations

Lime stone and gypsum and their associated dusts are not pyrophoric and they are sometimes used as inerting agents to decrease the risk of explosive atmospheres for pyrophoric substances such as coal dust.

Therefore special protection systems e.g. spray, fog or deluge systems are not required to protect against ignition of the products themselves.

18.5.2 Equipment Considerations

Research has shown that the most common causes of fire on conveyor and material handling systems are:

- Friction due to a belt losing traction and slipping on the drive roller, or due to a misaligned belt slipping off the rollers and jamming.
- Overheated material from ovens, kilns or dryers that have not been cooled sufficiently before being placed on the belt may also cause belt ignition. This is not the case on this project as product is not handled hot.
- Cutting and welding activities generating hot molten metal particles which can ignite the belt or accumulations of waste below. This is an operational and maintenance management matter.

To mitigate the causes of friction noted above the mechanical design of the loading/unloading systems and conveyors will incorporate the following:

- Design to ensure belt-loading systems discharge onto belts with minimal spillage.
- Belt-alignment and motion-sensing switches will be installed to detect when belts are not running correctly with automatic trips to stop the conveyors in the event of undue misalignment or slowing of the belt.
- Belt tension via automatic belt tensioners or systems will be sufficient to avoid slippage, abnormal wear and strain on drive components.
- Emergency tripwires will be provided along conveyor lengths.
- Conveyor belt over-speed/belt break detection will be provided.
- Fire retardant conveyor belting will be installed.

18.5.3 Fire Protection to Limestone Loading and Gypsum Unloading

Spray or deluge systems are not required at the loading area to protect against the substance itself.

Fixed fire protection is proposed to provide incipient fire protection to mechanical or electrical (e.g. motor drives or MCC panels) equipment or waste build-up by means of strategically placed fire extinguishers and hose reels.

18.5.4 Fire Protection to Limestone and Gypsum Conveyor Systems

The limestone conveyor system consists of:

- 3 x feeder conveyors
- 2 x belt conveyors (one of which is located in a tunnel)

The gypsum conveyor system consists of:

- 2 x belt conveyors

Water spray protection will be provided to head ends of the conveyors to protect against the possibility of a mechanical equipment failure in those areas. (Motor fire, gearbox oil fire etc.)

Further, fixed fire protection in the form of hose reels and fire extinguishers will be provided to provide incipient fire protection to mechanical or electrical (e.g. motor drives conveyor idler bearings) equipment or generally at transition points by means of strategically placed fire extinguishers.

18.5.5 Fire Detection and Alarm Systems to Loading/Unloading Areas and Conveyors

Fire detection will be provided at conveyor head and tail pulleys only.

The detection will be interlocked with the particular conveyor drive to stop the conveyor and any others interlocked to it upon detection of a fire. Strategically placed manual alarm call points will also be provided. All items will report to the fire monitoring panel.

18.6 Office and Operations Tower Building

The office and operations tower building will essentially fall under D3 Classification, Low Risk Industrial in terms of SANS 10-400 National Building Regulations and the fire protection will therefore consist of:

- Fire hose reels
- Fire extinguishers
- Manual alarm call points
- Smoke detection system.
- Audible local alarm and flashing light

Special protection will be provided as follows:

- Rail Yard operations room – gas suppression
- Electronic equipment room – gas suppression

The detection will be interlocked with the particular conveyor drive to stop the conveyor and any others interlocked to it upon detection of a fire. Strategically placed manual alarm call points will also be provided. All detection items will report to the fire monitoring panel.

18.7 Locomotive Shed

A locomotive shed and diesel storage facility will be provided to service the shunting locomotive.

This shed is approximately 600 m² service space for the shunting locomotive and has various offices and store rooms (180 m²) attached to one end of the building.

(Refuelling takes place outside the building at the diesel storage facility.)

Some workshop activities could include welding, grinding and torch cutting. It is assumed that normal workshop protocol will be followed in that these activities will be controlled and take place in suitably screened areas with fire extinguishers at hand.

The following fluids are also stored in small quantities within the building:

Table 9 – Chemicals and Fluids stored in buildings

Product		Usage
1.	Benzene Class 1 Flammable liquid	Cleaning agent
2.	Trichloro-ethylene	Cleaning agent
3.	Carbon tetrachloride	Cleaning agent
4.	Engine oil	Locomotive Engine
5.	Viscous oils	Gear boxes, link drive systems, axle bearing
6.	Hydraulic oil	Track machinery, axle drives, hydraulic gears
7.	Grease	Lubrication
8.	Battery Acid	Top-up batteries
9.	Radiator fluid	Top-up radiator

With the exception of Benzene these are all high flash point non-flammable products which are stored in small quantities.

A local standalone foam deluge system is proposed to provide fire protection to cover the benzene storage area.

This building will typically fall under SANS classification D3 Low Risk Industrial and considering the divisional areas and the activity/storage scenario already described, sprinklers cannot be justified.

In this case the fire protection and detection system will consist of the following:

- Fire hydrants
- Fire hose reels
- Fire extinguishers
- Local standalone foam deluge (benzine storage)
- Manual alarm call points
- Smoke detection system in rooms
- Fire detection within the workshop area

Strategically placed manual alarm call points will also be provided. All items will report to the fire monitoring panel.

18.8 Diesel Storage

A diesel storage facility will be provided to refuel the shunting locomotive.

This will consist of a storage tank in a bunded area alongside a covered road tanker decanting area.

Fire protection considerations for the fuel storage facility are as follows:

- Fuel type – diesel fuel considered combustible but not flammable
- Plant layout and geographic location
- Maximum storage capacity of the installation – 28000 liter;
- Individual storage vessel size and shape – one tank horizontal type
- Location of the storage facility – relatively isolated no high risk areas nearby.
- Low level of occupancy
- The tank is located within a bunded area.
- Size of the covered decanting area.

In this case the fire protection and detection system for this area will consist of the following:

- Fire hydrants
- Fire hose reels
- Fire extinguishers
- Manual alarm call points
- Fire detection within the tank and fuel offloading areas.

Strategically placed manual alarm call points will also be provided. All items will report to the fire monitoring panel.

18.9 Electrical Works

Electrical infrastructure will also require fire protection and detection systems.

The following services will be provided:

Substations (1 off)

- Fire extinguishers
- Smoke detection

Transformers (2 sets)

- Water deluge system
- Hydrants
- Fire detection

Strategically placed manual alarm call points will also be provided. All items will report to the fire monitoring panel.

19. FENCING AND SECURITY FENCING REQUIREMENTS

The decision was made by Eskom to move their existing security fence from its current position to the northern boundary of the rail way yard. The decision was made not to provide access to the Medupi plant from the rail way yard due to National Key-point Security issues. The existing service road fence will be used as the boundary fence to the rail yard. The only requirements will be to provide a new access gate and security office at the existing service road fence to the rail yard.

A typical detail drawing will be issued for the construction of the new access gate at the security office. The SANS 1200 will be used to measure the quantities for the new access gate and any additional work that would be required to accommodate the new gate in the existing service road fence.

Provision was made for a diamond mesh security fence, 2.4m high with corner end straining and gate posts according to Eskom specifications. The security gate will be designed as a double leaf gate with a 6m opening.

It must be noted that the connection to the existing fire water network will be outside the newly relocated Medupi Power Plant security fence boundary.

Refer to drawing 0.84/40141 in Volume 3 Appendix 8 for the proposed fencing layout.

20. COSTING EVALUATION

20.1 Capital Costs

Table 10 – CAPEX costing summary

TOTAL RAILWAY YARD	ZAR		83 420 900,00
RAILWAY YARD INFRASTRUCTURE	ZAR	61 376 900,00	
RAIL WAY YARD (IN-MOTION WEIGHBRIDGE)	ZAR	1 056 000,00	
ROLLINGSTOCK (SHUNT LOCOMOTIVE)	ZAR	20 988 000,00	
TOTAL CIVIL SERVICES and INFRASTRUCTURE	ZAR		104 111 810,00
CIVIL SERVICES	ZAR	104 111 810,00	
TOTAL ELECTRICAL CONTROL & INSTRUMENTATION	ZAR		4 975 000,00
YARD AREA LIGHTING	ZAR	4 975 000,00	
TOTAL STRUCTURAL AND BUILDING SERVICES	ZAR		12 051 250,00
DIESEL LOCO SHED	ZAR	7 391 250,00	
ADMINSTRATION BUILDING	ZAR	3 412 500,00	
SECURITY OFFICE	ZAR	250 000,00	
FUEL STORAGE AND DISPENSING	ZAR	997 500,00	
TOTAL FIRE PROTECTION AND PREVENTION	ZAR		28 200 000,00
FIRE PROTECTION AND PREVENTION	ZAR	28 200 000,00	
TOTAL CAPEX ESTIMATE MEDUPI RAIL YARD AND ASSOCIATED INFRASTRUCTURE	**ZAR**		**232 758 960,00**

The above CAPEX costing summary excludes engineering, procurement and construction management costs. The costing accuracy is +-30 % with a base date of January 2015. Refer to Volume 3 Appendix 18 for a detailed breakdown of the above costing summary.

20.2 Operational Costs

Table 11– Rail Yard Operating Cost (OPEX)

RAIL OPERATIONS	
DESCRIPTION	**AMOUNT (ZAR)**
Annual salaries for staff (Train operations only)	2 200 000.00
Annual maintenance cost – shunt locomotive	865 500.00
Annual fuel consumption (36642.86 liters @ R11 per lt)	403 100.00
ADD CONTINGENCIES (10%)	346 900.00
SUB TOTAL RAIL OPERATIONS	**3 815 500.00**
RAIL INFRASTRUCTURE MAINTENANCE	
DESCRIPTION	**AMOUNT**
Patrolling (2 x permanent patrolman)	280 000.00
Maintenance (P&G's and consumables)	240 000.00
ADD CONTINGENCIES (10%)	52 000.00
SUB TOTAL RAIL INFRASTRUCTURE MAINTENANCE	**572 000.00**
SUMMARY ANNUAL TOTAL OPEX	**4 387 500.00**

The costing accuracy of the OPEX cost above is +-30 % with a base date of January 2015.

21. DEVELOPMENT TEAM

The following people were involved in the development of this document:

21.1 Rail

- Dietricht Bredenkamp (Technical Director: Projects)
- Danie van der Schyff (Rail Operations Specialist)
- Leon Onverwacht (Civil Engineer: Civil)
- Neels Cronje (Rail Operations Specialist)
- Piet Koekemoer (Senior Engineering Technician: Perway Design)

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- L. Geldenhuys (Civils Lead Project Director)
- PJJ Basson (Civils Project Manager)
- WF Küsel (Civils Lead Engineer)
- C Prinsloo (Design Reviews)
- W Bekker (Civils CAD Operator)

21.3 Electrical Control and Instrumentation

- Shekar Inderlall (Electrical Engineer)
- Mike Da Silva (Electrical, Control & Instrumentation)
- Amantha Maharaj (Electrical Engineer-Design Review)

21.4 Buildings and Structural

- Errol Tromp (Structural Engineer)
- Johan Duvenhage (Architect)

21.5 Fire Protection Services

- Roger Bosch (Mechanical Engineer)

22. REVISIONS

Rev.	Status	Issued by	Date
01	Issued for review	Francois Retief	4/12/2014
02	Updated with Electrical and C&I changes	Francois Retief	29/1/2015
03	Updated with all MDR changes including C&I issues from 19 February 2015	Francois Retief	20/2/2015
04	Updated with final C&I issues after meeting held on 27 February 2015	Francois Retief	13/3/2015

Bosch Holdings Consortium

BOSCH HOLDINGS	Thabile Engineering	Thabo Consulting	NEMAI CONSULTING

ESKOM HOLDINGS SOC LTD

TASK 203 – BASIC AND DETAILED DESIGN OF MEDUPI RAIL YARD AND OFFLOADING FACILITY

CONTRACT NUMBER: 4600051676

ORDER NUMBER: 4501833635

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MEDUPI RAIL YARD AND OFFLOADING FACILITY

CONCEPT DESIGN REPORT VOLUME 2

MATERIALS HANDLING

Report reference number:1184-099-4-100-R-0001-Rev04 Concept Vol2 Materials Handling Revision: 04 Total pages: 34

Report submitted by:

Bosch Holdings Consortium

13 March 2015

Bosch Holdings Consortium

BOSCH HOLDINGS	7E Thabile Engineering	Thabo Consulting	NEMAI CONSULTING

CONCEPT DESIGN REPORT FOR THE MEDUPI RAIL SIDING DOCUMENT APPROVAL		
CONSULTANT -- NAME	-- SIGNATURE	------------------------------ DATE
ESKOM CIVIL ENGINEERING -- NAME	-- SIGNATURE	------------------------------ DATE
ESKOM BMH DEPARTMENT -- NAME	-- SIGNATURE	------------------------------ DATE
ESKOM ELECTRICAL ENGINEERING -- NAME	-- SIGNATURE	------------------------------ DATE
ESKOM C&I DEPARTMENT -- NAME	-- SIGNATURE	------------------------------ DATE
ESKOM LPS (FIRE ENGINEERING) DEPARTMENT -- NAME	-- SIGNATURE	------------------------------ DATE
ESKOM CHEMICAL DEPARTMENT -- NAME	-- SIGNATURE	------------------------------ DATE
MEDUPI ARRANGMENT DESIGN -- NAME	-- SIGNATURE	------------------------------ DATE
MEDUPI POWER STATION -- NAME	-- SIGNATURE	------------------------------ DATE
ESKOM PED DEPARTMENT -- NAME	-- SIGNATURE	------------------------------ DATE

	COMMENTS	ORIGINATOR
1		
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Table of Contents

Abbreviations

Abbreviation	Description
A	amps
AC / ac	Alternating Current
CCTV	Closed Circuit Television
C&I	Control and Instrumentation
CMS	Control and Monitoring System
COLTO	Committee of Land Transport Officials
CSW	Continuous Surface Wave
CTC	Centralized traffic control
DC	Direct Current
DCP	Dynamic Cone Penetrometer
FGD	Flue Gas Desulphurisation
HMI	Human Machine Interface
HVAC	Heating Ventilation and Air Conditioning
km/h	kilometres per hour
kV	Kilo Volts
kVA	Kilo Volt Amperes
kW	KiloWatts
l/s	litres per second
LAN	Local Area Network
m/s	metres per second
m^3	cubic metres
MAP	Mean annual precipitation
MCB	Miniature Circuit Breaker
MCCB	Moulded Case Circuit Breaker
mm	millimetres
OPC	Open Platform Communications
ORS	Owner’s Requirement Specification
PIS	Plant Information System
PLC	Programmable logic controller
SCADA	Supervisory control and data acquisition
SQL	Structured Query Language
t	Ton

Abbreviation	Description
t/a or tpa	Tons per annum
t/h or tph	Tons per hour
TFR	Transnet Freight Rail
UPS	Uninterrupted Power Supply
uPVC	Unplasticized Poly Vinyl Chloride
V	Volts

LIST OF TABLES

1. INTRODUCTION

This concept study develops the preferred options identified in the Options report for the Medupi rail siding. This document provides an overview of the engineering processes followed and the system design status at the end of the concept phase. The document describes the results of technical assessments and compliance with stakeholder requirements, technical risks identified, lessons learned during the design process and outstanding issues for this design phase. This document further provides references to approve the design output documentation.

The rail yard will handle bulk limestone, used as a sorbent, for use in the retrofitted FGD plant. Depending on market demand, bulk gypsum will also be despatched via the rail yard.

The scope of the new rail yard is to provide the Medupi Power Station with a rail yard solution and rail operations that will ensure that the yard is capable to receive and off-load 1,200,000 t/a of Limestone and to load and despatch 400,000 t/a of FGD Gypsum.

This report covers the Concept Design of the proposed Materials Handling system that will be required to off-load the Limestone and load the Gypsum. The next phase of the Materials Handling part of the project will be the basic design phase which will complete the project.

2. SCOPE OF CONCEPT DESIGN

The Concept Study carries forward the results of the Options Report (1184-099-4-100-R-0001 REV02) which has been approved by Eskom. The objectives of the concept design is to select the optimum rail off-loading facilities for limestone, rail loading facilities for gypsum and to generate a materials handling layout and concept to optimally integrate these systems into the rail yard and to the stockpile areas.

For the limestone materials handling, the scope of work is from the tippler to the stacking conveyor; the battery limit at the stockyard is the underside of the transfer chute to the stacking conveyor. For gypsum materials handling, the scope of this project covers from the stock pile to the rail wagon loading facility; the battery limit at the stock yard is the top of the reclaim hoppers.

The required throughput rates are 1,200,000 t/a and 400,000 t/a for limestone and gypsum respectively. The rail simulations have been completed and the rail infrastructure will be specified to handle these throughputs, this is described in the Concept Design Report Volume 1.

The two tippler technologies that have been identified for the concept design stage are the unit train rotary type tippler and the “Rotaside” type tippler (also called a Side tippler).

The required electrical control and instrumentation scope of work for the Medupi rail yard project will be all electrical power supplied to the bulk material handling equipment, lighting for the rail yard, electrical feed for signalling and all other equipment that requires a power source.

The electrical system is expected to provide all equipment within the rail yard boundaries with electrical power. 3 Phase power will be required since different equipment operate at different voltages. Consideration to existing equipment and systems being implemented at Medupi power station will be considered where the rail yard can integrate with the larger system installed.

3. KEY DESIGN ASSUMPTIONS

3.1 Bulk Materials Handling

The following assumptions have been made regarding the materials handling system:

- 342 annual operational days per annum (365 days less 5 days holiday and 18 days shut down for maintenance);
- A 12 hour duration train drop-off and collect cycle;

- The CAR wagons utilised for Limestone will be equipped with rotary couplers (necessary for the Rotary type tippler only);
- Capacities of downstream materials handling equipment in the case of Limestone, and upstream materials handling equipment in the case Gypsum will be sufficient in order not to constrain the unloading/loading facilities.

3.2 Bulk Material Properties

The following design inputs were utilised for the concept design:

The following properties of limestone have been assumed and utilised in the generation of the concept design.

Description	Value	Unit
Limestone throughput	1,200,000	t/a
Low bulk density (volumetric capacity)	1360	kg/m³
High bulk density (structural capacity)	1840	kg/m³

Table 1: Properties of limestone

The following properties of gypsum have been assumed and utilised in the generation of the concept design.

Description	Value	Unit
Gypsum throughput	400,000	t/a
Low bulk density (volumetric capacity)	1000	kg/m³
High bulk density (structural capacity)	1840	kg/m³

Table 2: Properties of gypsum

3.3 Bulk Earthworks

The following assumptions have been made regarding bulk earthworks:

The bulk earthworks layer works will be designed to accommodate a 26t axle load. It is assumed that the existing stock piles will be cleared before the commencement of construction. A letter dated 6 August 2014 from Eskom requested the design team to review all earthwork designs due to the quality of stockpiles deteriorating from G5 to G6 and G7 to COLTO classifications. For the concept design stage it is assumed that all materials G7 and higher will be imported from commercial sources.

The design and costing of the bulk earthworks in the Concept Design Report Volume 2 (Materials Handling) will only include excavation and backfilling for the materials handling facilities. All other bulk earthworks and layer works will be covered in the Concept Design Report Volume 1(Rail Yard).

See TRH4 Table 13 for material grading specifications.

3.4 Service Road

The service road design and costing will be covered in the Concept Design Report Volume 1 (Rail Yard and Services).

3.5 Stormwater

The following assumptions have been made regarding stormwater:

The stormwater will be modelled with a MAP 437mm as discussed with Eskom. It is assumed that the Medupi stormwater master plan including structure sizes will be available for the detail design stage. The dirty stormwater from the Gypsum loading facility will be drained into a new pollution control dam that will be designed by the FGD project team. The design and costing will be covered in the Concept Design Report Volume 1 (Rail Yard and Services).

3.6 Potable Water

For the design and costing of the potable water system refer to the Concept Design Report Volume 1 (Rail Yard and Services).

3.7 Fire Water

For the design and costing of the fire water system refer to the Concept Design Report Volume 1 (Rail Yard and Services).

3.8 Fencing

The following assumptions have been made regarding fencing:

The existing three tier national key-point fence will be moved by Eskom to the north of the rail way site prior to construction. The existing service road fence will be used as the rail yard boundary fence.

3.9 Electrical

The following assumptions have been made regarding the electrical system:

- Electrical power will be distributed into the rail yard utilizing the 6.6kV limestone handling substation.
- Maximum of 5MVA will be required to run the rail yard.
- Cabling will be selected to have a volt drop better than 5%
- Existing mini-sub to be used for high mast lighting
- Yard Lighting required will be at a 20 Lux minimum average
- Future signalling will be required post 2020
- Future Electrification of Transnet freight rail line’s will be required

4. DESIGN APPROACH

4.1 Design inputs

4.1.1 Stakeholder Requirements

The stakeholder’s requirements for the project was captured in the Stakeholders Requirements Definitions (SRD) report (200-130118) that was supplied to the client and signed off on 17 June 2014.

4.1.2 Design Criteria Report

This document (200-130171) was compiled by the Consultant and signed off by the client of 17 June 2014.

4.2 Design Process

Various rail yard options were considered at the options study phase of the project, each of which required a different concept for the materials handling infrastructure.

The options study determined the rail yard operating philosophy and the requirement to utilise the CAR type rail wagon with a tippler for off-loading of the limestone. Refer to the options study report (1184-099-4-100-R-0001-Rev02) in Volume 3 Appendix 15. The type of tippler will be selected as part of the concept design phase and is affected by the required throughput/cycle times, capital and operational costs and the type of rail cars available. The life-cycle costs are further discussed in the tippler lifecycle costing report in Volume 3 Appendix 14.

4.3 Design Outputs

The outputs of the concept design phase of the Materials handling part of the project are the two conceptual layouts as described in drawings 0.84/40136 (Refer to Volume 3 Appendix 3) and 0.84/40137 (Refer to Volume 3 Appendix 4). In addition to this a lifecycle cost analysis has been developed to assist with the concept selection for the tippler (Refer to Volume 3 Appendix 14).

4.4 Design Verification

A site visit was conducted with the project design team and Eskom Technical Staff on 15 October 2014. Existing services and Eskom design requirements were verified on site. The site visit was concluded with a technical meeting addressing any outstanding information required. The design verifications were reviewed on an ongoing basis as part of the regular meetings held between the design team and the Eskom Technical review team.

4.5 Codes and Standards

Various international and South African standards will need to be applied in the design of the system; these will be specified in the relevant technical specifications for each type of equipment. The following codes and standards have been used and considered in the development of this concept design:

4.5.1 Informative standards

- ISO 9001 Quality Management Systems;
- ISO 5048 - Continuous mechanical handling equipment - Belt conveyors with carrying idlers - Calculation of operating power and tensile forces;
- The Guidelines for Human Settlement Planning and Design (Roads, Water and Sanitation);
- TRH17: Geometric design of rural roads (Geometric Design);
- TRH14: Guidelines for road construction materials; and
- TRH4: Structural design of flexible pavements for interurban and rural roads.

4.5.2 Normative standards

- Occupational Health and Safety Act 85/1993;

- South African National Building Regulations;
- SANS 10160 - The General Procedures and Loadings to be Adopted in the Design of Buildings;
- SANS 10100 The Structural Use of Concrete;
- Part 1: Design.
- Part 2: Materials and Execution of Work.
- SANS 10161 The Design of Foundations for Buildings;
- SANS 10162 The Structural Use of Steel;
- Part 1: Limit States Design of Hot-Rolled Steelwork.
- Part 2: Limit States Design of Cold-Formed Steelwork.
- Part 3: Allowable Stress Design.
- Part 4: The Design of Cold Formed Stainless Steel Structural Members.
- SANS 10389-1 : 2003 Exterior lighting
- SANS 10142-1: The wiring of premises
- SANS-10198 Selection, handling and installation of electric power cables not exceeding 33kV
- SANS-60439 Low-voltage switchgear and control gear assemblies
- SANS-10114 Artificial lighting of interiors
- SANS- 62305 Protection against lightning
- SANS 1200 (Bill of Quantities and cost estimates)

4.5.3 Client standards

- 240-55864499: Specification for Belt Conveying Systems Standard
- 240-54937439: Fire Protection/Detection Assessment
- 240-54937450: Fire Protection & Life Safety Design Standard
- 240-56737448: Fire Detection and Life Safety Design
- 240-56227516: Specification for switchgear and associated equipment for voltages up to and including AC 1090 V and DC 1200 V
- 200-11757: Earthing and lightning protection standard
- 200-11768: Station cabling and racking standard
- Eskom’s Distribution Specification – Part 22: Medium-Voltage miniature substations for systems with nominal voltages of 11kV and 22KV- Document reference DSP 34-1621

4.5.4 Other Stakeholders Standards

- Transnet Specification CEE-0003_ISS_90 will be applied to the luminaires for street lighting and yard lighting
- Transnet specification CEE-0018_ISS_90 will be applied to the high mast lighting of outdoor areas
- Transnet S410 Specifications (Services roads and rail way layer works)

5. SYSTEM DESCRIPTION

5.1 Process Description

5.1.1 Limestone rail wagon off-loading

This section discusses the rail wagon off-loading operation of limestone. The rail yard operation is described in detail in the Concept Design Report Volume 1 (Rail Yard and Services). The two concepts that have been developed for limestone off-loading are described below.

Option 1 – Rotaside Type Tippler (Side Tippler)

The rail wagons are manually uncoupled, and a sidearm charger will then position the individual rail wagon within the tippler. The side tippler will then off-load the rail wagon into the under-ground hoppers and return the empty rail wagon to the rail. The side arm charger will then reposition the empty rail wagon beyond the tippler before collecting the next full rail wagon.

Option 2 - Unit Rotary Type Tippler

In the rotary type tippler the rail wagons remain coupled, and a sidearm charger will position the rail wagons within the tippler. The rotary tippler will then rotate about the axis of the rail wagon couplers to discharge the limestone into the under-ground hoppers. The tippler will then rotate back and return the empty rail wagon to the rail.

While the tippler is in operation, the side arm charger will traverse back and attach at the next coupling. Once the rail wagon is empty and has been returned to the rail, the side arm charger will traverse forward in order to move the empty wagon out and the next full wagon into the tippler.

5.1.2 Limestone material handling

Limestone from the Tippler will be dumped into the feed hoppers below the tippler. Belt feeders or apron feeders will feed to a horizontal conveyor, in the vault beneath the tippler, which will discharge to an inclined belt conveyor. The inclined belt conveyor will discharge to the limestone stacking conveyor and in turn the downstream equipment.

5.1.3 Gypsum rail wagon loading

This section discusses the rail wagon loading operation of gypsum. The rail yard operation is described in detail in the Concept Design Report Volume 1 (Rail Yard and Services).

The rail wagons will be shunted to the gypsum loading facility, and then moved to within the loading station by a rail wagon positioner. An overhead feed bin will discharge to the rail wagons as they are manipulated by the side arm charger.

5.1.4 Gypsum material handling

Gypsum will be manually reclaimed from the stockpile by wheeled or track-type loaders feeding to reclaim hoppers. The reclaim hoppers will discharge to two gypsum reclaim belt conveyors, one of these will discharge to an inclined belt conveyor which will discharge to the feed bin described above, the other gypsum reclaim belt conveyor does not form part of the scope of this project.

5.2 System Components

5.2.1 Limestone handling

The limestone handling system will consist of the following equipment:

- Rail wagon tippler – Rotary or “Rotaside” type tippler.

- Hoppers – the hoppers to which the tippler discharges. These will be equipped with either belt or apron feeders.
- Horizontal limestone belt conveyor – located in the tippler vault.
- Inclined limestone belt conveyor –discharges the limestone to the stacking belt conveyor.

5.2.2 Gypsum handling

The limestone handling system will consist of the following equipment:

- Gypsum reclaim hoppers – receive gypsum from mobile reclaim equipment and discharge to the gypsum reclaim belt conveyor.
- Gypsum reclaim belt conveyor – discharges to the Inclined gypsum belt conveyor.
- Inclined gypsum belt conveyor – discharges to the bin at the loading facility.
- Gypsum bin – an overhead bin feeding the rail wagons with a controlled discharge.

5.3 Control and Instrumentation System

Refer to drawing 0.84/43218 (Volume 3 Appendix 22) for the conceptual control system network architecture.

The Control system for the Medupi rail yard will be a standalone system where maintenance, spare keeping and monitoring will be handled from the main plant local to the rail yard.

Allowance will be made for the Control systems of the Medupi rail yard, to integrate to the other systems in the Medupi power station plant's system. The standards and specifications will be in line with the current requirements for Control and Instruments systems installed at Medupi power station.

The Automation technology to be considered will be Programmable Logic Controllers and by implementing similar Architectures the required standardisation will be achieved across Medupi Power Station

There will be a requirement for a Plant Information System (PIS) that will make near real time and historical plant information available to third party applications.. All PIS databases will be accessible by third party software applications on the Clients by means of SQL series. These third party applications will only be able to read data from the PIS databases

Control and instrumentation cables will be armoured for outdoor applications. All cables will be shielded, with a minimum conductor section of 0.5 mm2. Cables above ground are to be laid in trays or on ladder racks and will be segregated from power cables in accordance with International standards. Cables will be labelled and conductors will be identified at terminations by ferrule number or suitable proprietary method.

Instrumentation will be provided from reputable vendors. Where possible instrumentation will be similar to current specifications installed at the main power plant

Instrumentation will be provided with the necessary ingress protection for the location. Instrumentation located outdoors will be protected with sunshades.

Instruments measurement principles will be properly chosen to meet the following requirements:

- Medium
- Servicing without interrupting process
- Installation possibilities and accessibility
- Ambient and process conditions
- Operational ranges and accuracy

An option would be to use the Siemens PLC.. This technology is currently being used at Medupi power station's main plant. Using SIMATIC WinCC which is a SCADA and HMI system from Siemens, monitoring and controlling physical processes in Medupi Rail yard can be done successfully.

5.4 Maintenance Concept

The maintenance of the rail yard and shunt locomotive will be undertaken by a contractor (Transnet) to the same standards as clearly covered in the Transnet and OEM maintenance manuals. All other maintenance will be the responsibility of Eskom or a suitable subcontactor appointed by Eskom.

The bulk materials handling equipment will require scheduled maintenance as per common maintenance practices for a tippler station and its associated equipment. Mechanical equipment will be designed/selected to have a sufficient design life to allow adequate maintenance intervals and equipment availability provided that reasonable maintenance procedures are adhered to. Maintenance access to the equipment on the southern side of the main Medupi security fence will be via the road entrance at the south-western end of the rail yard and it is suggested that maintenance of this facility is treated as a standalone activity from the remainder of the plant.

The electrical, control & instrumentation systems for the Medupi rail yard will be a standalone where maintenance, spares holding and monitoring should be individual procedures separate from the main plant.

When designing the electrical, control & instrumentation for Medupi rail yard, integration to the main Medupi power station plant's system will be considered where equipment used and specifications to be installed will be in line with systems already installed at Medupi power station. Making provision for integration will assist with less down time at the rail yard if faults arise.

Physical buttons on control panels and operating desk are known as hardwired I/O's, they can easily be traced by wirings done on their terminals. Buttons implemented on SCADA/HMI screens to operate logic are considered as soft I/O's. They can be traced by checking in the logic.

Current control equipment installed in Medupi power station are Siemens PLC, this technology will be considered when specifying equipment for Medupi rail yard. By implementing this philosophy, a maintained standard will be achieved across the Medupi Power station.

5.5 Operating Concept

5.5.1 Limestone handling

The side arm charger will position the rail wagon within the tippler. The rail wagon clamps will be actuated and ensure the wagon is adequately secured before the tippler will lift the individual rail wagon over the underground hopper. The tippler will then return to the horizontal position before the rail wagon clamps are released and the side arm charger pushes the rail wagon out of the tippler. The side arm charger will then place the next full rail wagon within the tippler.

Each of the hoppers will be discharged by a belt or apron feeder which will discharge to a short belt conveyor running parallel to the rail line. This belt conveyor will discharge to a second belt conveyor which will feed the stacker conveyor.

The "Rotaside" type tippler station is likely to require 4 shunters to operate the yard while the rotary type tippler is estimated to require 2 shunters.

The tippler will be controlled from a control cabin at the tippler building and will be monitored from the Rail Yard operations room in the administration building by means of a CCTV camera system. In addition to this, the shunters and the operators should be equipped with radio communications equipment.

5.5.2 Gypsum handling

Mobile earthmoving equipment will reclaim from the gypsum stockpile and discharge to hoppers which will discharge to the reclaim belt conveyor. The gypsum is then transferred to the inclined gypsum conveyor which will feed a bin which straddles the gypsum loading area in order to load the rail wagons. The rail wagons will be manipulated and positioned by means of a rail wagon positioner arrangement and the feed to them will be controlled by a gate at the underside of the feed bin.

The gypsum loading station will be controlled and monitored directly from the administration building area and will be equipped with CCTV cameras in order to provide visual feedback to the operators in the Rail yard operations room.

5.5.3 Rail yard operations room requirements

When considering a Rail yard operations room there are a number of factors and equipment that need to be taken into account which must be all under a common roof which creates a central Rail yard operations room which aims to achieve the following:

- Improved communications between operational staff
- Reduced manpower costs in terms of supervision requirements
- Reduced construction costs
- Providing one central point of focus for the entire rail yard operations

There are two critical factors that must be considered when a Rail yard operations room is designed:

- Equipment and tools to perform the task
- The human factor

The human factor is to ensure that operators manning the system must be in an environment conducive for the task at hand e.g. lighting design, air-conditioning design must be considered.

The main areas of focus for the operator evaluation are as follows:

- Controls
- Visual Displays
- Work Space
- Seating
- Communications
- Movement around the control console
- Documentation requirements
- Emergency Requirements
- Personal belongings
- Bathrooms
- Kitchen area
- Relaxation area
- Thermal comfort
- Lighting
- Auditory Environment

The control of Gypsum loading will also be done from this room where two control desks will be available. The ablution facility will be shared with the admin building.

5.6 Safety Concept

General safety requirements for the mechanical equipment are as follows:

- Standard guarding, emergency stop and interlock principles will be specified to allow for a safe working environment for all personnel accessing the plant.
- All rotating equipment will be effectively guarded as required by the Occupational Health and Safety Act 85/1993;
- All equipment will be specified to include emergency stop facilities, including belt conveyors which will be equipped with pull wire trip switches on all accessible sides.

General safety regarding access to mechanical equipment:

- The tippler "vault" will have a minimum of two separate points of entry/exit.
- The tunnel from the tippler "vault" along the Inclined Limestone Belt Conveyor will have sufficient access for maintenance as well as the required escape routes. A barrier will be provided between the rail yard area and the Medupi power station area within the tunnel with access to the conveyor on either side of this barrier.
- Elevated sections of conveyor belts will have a walkway on either side.
- The Inclined Gypsum Belt Conveyor will be equipped with a suitable barrier between the rail yard area and the Medupi power station area and suitable access will be provided to the conveyor on either side of the barrier.

General safety design and installation requirements for the electrical system will be as follows:

- No electrical equipment should be mounted on removable walkways or structures.
- Live parts of electrical equipment mounted in enclosures should be shrouded or shielded to prevent unintentional contact (IP2X) by personnel.
- All enclosures and devices with switch disconnecting properties (MCB's, MCCB, switch-disconnectors) must, where applicable have provision for securing by means of padlocks.
- All electrical installations should be such that they are "fail safe", i.e. the failure of the Plant or any circuit, stops the associated drive in a safe state.

General safety design and installation requirements for the lighting system will be as follows:

- All areas where lighting is required should be designed with personnel safety as the first criteria.
- Lighting design and installations should be completed in such a manner as to ensure that lighting provided does not have an adverse effect on any employee's performance while performing their duties. These criteria must comply with the OHS Act.
- Unwanted lighting and glare should be considered to ensure that all employee's safety whilst walking or performing specific tasks is not compromised.

6. SITING

6.1 Site Selection

The rail yard site selection was governed by the following:

- The decision to use the existing rail way network to deliver limestone to the power station.

- The position and layout of the FGD plant.
- Available space within the existing Medupi Power Station fence boundaries.
- The availability of existing services such as potable water, fire water and stormwater drainage structures.

6.2 Site Characteristics

The general topography of the site can be classified as flat terrain that slopes from the south west to the north east with a slope between 0.5% and 1%. For the construction of the rail yard a large amount of bush clearing will be required as approved by the Environmental Impact Assessment.

Stockpiles on the northern side of the proposed rail yard area are currently in use for other construction projects in Medupi. These stockpiles are to be removed before the commencement of the rail yard construction.

The bulk earthworks for the proposed rail way embankment will require large quantities of fill material. Due to the shortage of material on site all fill material G7 and higher will be imported from commercial sources.

6.3 Site Layout

Refer to the Main Concept layout drawing no. 0.84/4041 in Volume 3 Appendix 1.

7. BUILDINGS AND SERVICES

Please refer to the Concept Design Report Volume 1 (Rail Yard and Services).

8. MECHANICAL DESIGN

8.1 Limestone off-loading

A typical cycle time through a Side tippler arrangement with a side arm charger is 180 to 300 seconds per rail wagon, including positioning of the rail wagon within the tippler. In order to position the uncoupled rail wagons within the tippler, the side arm charger can traverse through the tippler assembly.

A typical cycle time through a Rotary tippler arrangement with a side arm charger is 75 to 180 seconds per rail wagon, including positioning of the rail wagon within the tippler. For this type of tippler the side arm charger cannot traverse through the tippler assembly and will move and position the train from the inlet side to the tippler.

The required feed rate onto the inclined belt conveyor will be set by the tippler cycle time, this equates to an average offloading rate of 1200 t/h for the Side tippler and 2880 t/h for the Rotary type tippler. In order to reduce the design conveying rate of the bulk materials handling equipment it is suggested that a delay is placed between the tippling operations of the rotary tippler, if applicable; this will require a longer off-loading cycle, which can be accommodated within the required 12 hour turnaround time, but will allow lower costs for the bulk materials handling equipment. The hoppers, feeders and conveyors will be adequately sized to suit the capacity of the selected concept.

The Side Tippler (Refer to drawing 0.84/40137 in Volume 3 Appendix 4) is the preferred limestone off-loading concept due to the lower estimated overall lifecycle cost. Refer to Volume 3 Appendix 14 for the report that compares the lifecycle cost of the Rotary and the Side tippler. The required off-loading time does not place a high demand on the tippler station, so the additional expense of a rotary type tippler station is not warranted to achieve a higher cycle time.

The tippler will be equipped with a side arm charger arrangement for the effective handling and positioning of the rail wagons at the tippler station.

8.2 Limestone materials handling

The options study for the rail yard determined the positions of the limestone off-loading facility. This position, along with the position of the limestone stockpile, provides the constraints within which the limestone handling equipment layout has been developed. With these constraints considered, and in order to achieve the simplest layout with the least possible number of transfer points, the conveyor route as described in drawings 0.84/40136 (Volume 3 Appendix 3) and 0.84/40137 (Volume 3 Appendix 4) has been developed for the limestone handling.

8.3 Gypsum loading

An overhead surge bin, which will straddle the rail at the gypsum loading point, is required to provide control and surge capacity before loading into the rail wagons. Additionally, the surge bin will allow for the reclaim operation from the gypsum pile to continue while the changeover between the train sections is made. The expected time between train sections is approximately 9.5 minutes and this will be allowed for as a minimum.

Due to the available 12 hour turnaround time a high speed train loading operation is not required, a lower speed operation allows lower capacity equipment as well as a smaller bin feeding to the rail wagons. There is however a minimum practical speed at which the rail wagon positioning and filling operations can occur and it is suggested that the rail wagon positioner is set to stop for a set time between each rail wagon. This will allow the surge bin capacity as well as the required gypsum reclaim rate to be significantly lower, reducing the required equipment capacities. However, due to the flow characteristics of gypsum, a minimum practical size surge bin will be required.

8.4 Gypsum materials handling

The options study for the rail yard determined the position of the gypsum loading facility. This position, along with the gypsum stockpile location, provides the constraints within which the gypsum handling equipment layout has been developed.

The gypsum stockpile will be manually reclaimed by mobile wheeled or tracked loaders feeding reclaim hoppers which will feed onto two gypsum reclaim belt conveyors. One of these gypsum reclaim belt conveyors will discharge to an inclined conveyor feeding a single elevated surge bin which will provide the necessary buffer capacity before the gypsum is discharged to the receiving rail wagons. The second gypsum reclaim belt conveyor will discharge to another belt conveyor which will feed onto either of the two overland ash conveyors; this is required for the use-case when the gypsum will be discharged to the ash dumps. The gypsum loading station will be equipped with a wagon positioner arrangement for the effective handling and positioning of the rail wagons.

9. ELECTRICAL DESIGN

9.1 Power supply into the rail yard

Currently there is a planned 6.6kV limestone handling plant substation as part of the FGD plant where the supply for the rail yard will come from. An option would be to utilize either the 6.6kV or 11kV existing substation for electrical feed into the yard.

Relay rooms are required to feed local control points and yard equipment. In the yards substation there will be a transformer which steps down the incoming voltage from 6.6kV to 400V for LV equipment and 220 volts ac or 110 volts dc for control and instrumentation. DC will be generated by means of a UPS with a battery backup, the required DC voltage will be tapped off from the UPS.

9.2 Power for the yard lighting and facilities

Currently the existing rail yard operations will be in accordance with Transnet Freight Rail. Therefore lighting in the rail yard will be as per TFR's standards.

Power will be distributed from the main substation in the rail yard into a yard lighting mini substation/kiosk, or an existing mini-sub.

9.3 Power for Rail System (signalling and yard automation)

Currently there will be no signalling required for rail operation and is not applicable for the current design, since train movements on the current network are authorised by means of radio train orders.

Provision will be made for a Rail yard operations room to monitor and control yard movements from a central point in the yard.

9.4 Cable Route selection

Refer to the drawing Substations & Cable Routes 0.84/40138 in Volume 3 Appendix 5.

The risk to plant and personnel due to the failure of cable and connection failures is an important consideration. The most important items that are considered during the design phase are the size (length and effective area) of the cables, the type of cable used for the application, cable route, cable supporting and the fire risk of the cables. The cable route will be the most practical and economical route available and where possible cables will be installed on the northern and western sides of the street.

Electrical services will be kept on the opposite side of the road to telecommunication and water services where practically possible.

The types of cable mainly used for new installations are the flame retardant PVC cables and the halogen free (HF) cables. The most important difference in the properties of these two cable types is the high emission of acid gas (hydrogen chloride) from PVC cables in the case of fire whereas no hydrogen chloride gas is released from the halogen free cables. The hydrogen chloride (HCL) gas in combination with other toxic gases that are produced from the burning of PVC. This acid gas is also responsible for the corrosion to steel reinforcement of concrete, steel structures and electronic equipment printed circuit boards. The cables shall be XLPE insulated with flame-retardant reduced halogen emission PVC outer sheath (emit a mass of not more than 15% halogen). Acceptance criteria for insulation shall be in accordance with SANS 1411-2.

Cables shall be manufactured in accordance with SANS 1339 and SANS 1411 Parts 1, 2, 4 and 7.

In the cable size range of 35 mm^2 to 185 mm^2 3½ core cables with a neutral core approximately ½ of the cross sectional area of the phase conductors shall be used. Cabling will be selected to have a volt drop better than 5%.

9.5 Electrical Power Requirements

As mentioned previously there is an already planned 6.6kV/400V substation that has been considered where electrical power will be distributed into the rail yard. All electrical, control and instrumentation equipment are rated at different voltage levels therefore Three-phase electrical power must be supplied into the rail yard.

Electrical power will be distributed from either 6.6kV, 11kV existing substation or the planned 6.6kV limestone handling substation into the main substation locally to the rail yard. Thereafter the voltage will be stepped down and distributed to various equipment on the rail and bulk material handling side.

9.6 Switchgear general specifications

9.6.1 General

- Switchgear should be supplied in accordance with specification 240-56227516
- Provisions will be made for UPS's in the substation for the switchgear control voltage

9.6.2 Circuit breakers

Circuit Breakers will be of the three pole, single mechanism type, with spring operating mechanism. Spring charging will be done by means of an 110V DC electric motor.

The circuit breakers will be in accordance with the requirements of IEC 62271.Testing of the breakers will be done in accordance with IEC 60060.

9.6.3 Isolating switches

The isolating switches should be of the centre rotating, side break type with manual operating mechanisms. All shaft movements should be facilitated by means of roller or ball bearings.

The centre insulator should rotate with the contact arm. Contacts will be silver plated and spring loaded.

The isolating switches should be in accordance with the requirements of IEC 62271.

Testing of the isolating switches should be done in accordance with IEC 62271.

Insulators used for isolators, should be tested in accordance with IEC 60168 and IEC 62217.

9.6.4 Current Transformers

Current transformers should comply with the requirements as stipulated in IEC 60044.

Insulated bushing material should be of porcelain or silicon rubber or composites and should be tested in accordance with IEC 60168 and IEC 62217.

Testing should be done in accordance with IEC 60060.

Multiple cores should be provided for the different protection requirements as well as for metering.

9.6.5 Voltage Transformers

Voltage transformers should comply with the requirements as laid down in IEC 60044.

Insulating bushings should be porcelain or composite rubber or composites and should be tested in accordance with IEC 60168 and IEC 62217.

Voltage transformers should be of the inductive type.

Testing should be done in accordance with IEC 60060

9.6.6 Surge Arrestors

The arrester will be capable of absorbing lightning and switching surges without damage to the equipment.

Testing should be done in accordance with IEC 60060.

9.7 Concept design description and equipment

Electrical power provided, shall be bulk, dual, AC supplies to low and medium voltage switchboards situated in electrical substations. Circuits on these boards will be provided for the power supplies to the

Plant i.e. motors, cubicles, power distribution boxes, variable speed drives etc. as per the power supplies required.

A dual supply auxiliary power system switchgear philosophy will be adhered to for ancillary plant i.e. when one board is isolated for maintenance purposes; only the electrical equipment supplied from that switchboard are out of operation, the Plant being fed from the other supplies shall remain in operation.

All concepts shall be in accordance with Eskoms standards and similar to the Medupi main plant, if not the same, philosophies shall be adhered to at all times when considering electrical infrastructure at the Medupi rail yard.

9.7.1 Power Conditioning

9.7.1.1 AC Power supply conditions

9.7.1.1.1 Normal AC supply conditions

Extremes of these parameters can occur simultaneously:

- Voltage: ± 5 percent
- Frequency: ± 2.5 percent
- Voltage unbalance: Negative Phase Sequence (NPS) voltage up to 0.02 of nominal Positive Phase Sequence (PPS) voltage
- The Zero Phase Sequence Voltage component can be up to 1% of the PPS component.
- The harmonic distortion of the supply voltage under normal operation will be as follows:
- The Total Harmonic Distortion (THD) of the voltage can be up to 5% of the fundamental component.
- The voltage waveform can contain harmonic components up to the 100th harmonic.
- The amplitude of any individual component can be up to 1% of the fundamental component.

Where variable speed drives are provided the harmonic current values as prescribed in this paragraph shall be adhered to. For all operating conditions, individual harmonic currents shall not exceed (these are measured at the electrical supply boards):

- rms amplitude of 100/n percent, where n is the harmonic number.
- sub-harmonic currents shall not exceed the RMS amplitude of 100n percent, where n is the fraction given by the sub-harmonic frequency divided by the fundamental frequency.

9.7.1.1.2 Abnormal AC power conditions

The supply voltage frequency can reach limits of up to 52.5 Hz and fall as low as 47.5 Hz. This condition can last for up to 1 minute.The amplitude and duration of temporary abnormal voltage conditions which can occur on the power supply are as follows:

- Short duration abnormal conditions: Short duration undervoltage conditions arise either due to a loss of supply or the supply voltage being depressed due to a short circuit on the network.
- Loss of power supply: When the supply is disconnected, the supply voltage either drops rapidly to 0% of nominal value or is sustained at low amplitude at a reduced frequency because of back generation of electrical drives. The initial voltage amplitude during these conditions is less than 80% of nominal value and decays with a time constant of up to 1.5 seconds. The time duration from loss of supply until supply restoration is between 1 second and 2.5 seconds.

- Short circuits: Depression of supply voltage due to short circuits can result in voltages as low as 0% of nominal value. The duration of the drop can be up to 1 second.
- Overvoltages: Overvoltages with amplitudes of 110% of nominal value can occur for up to 10 seconds.
- Medium duration power supply deviations: Voltage depressions of medium duration can be caused by the switching of load, such as starting induction motors. The supply voltage can fall as low as 75% of nominal value and the duration of this depression can be up to 15 seconds.
- Power swings: An alternative source of this abnormal condition is when power swings occur after a severe disturbance on the network. The supply voltage amplitude will oscillate at a frequency between 0.2 and 2 Hz. In this case, the voltage can fall as low as 65% of nominal and can rise up to 110% of nominal during a swing. The voltage will not fall below 70% for longer than 0.5 seconds. However, these oscillations, or repeated abnormal voltage conditions, can continue for up to 60 seconds.
- Long duration power supply deviations: Long duration abnormal supply voltage conditions usually originate from operating the plant at its limits. The supply voltage can be up to 110% of nominal value and can drop as low as 90% of nominal value. The duration of such abnormal conditions is up to 6 hours.

The following lightning and switching surge conditions can occur on the power supply system:

- Lightning impulse: Phase-to-earth and/or phase-to-phase lightning impulses with a front time of 1.2 µs, a time-to-half-value of 50 µs, a peak value up to that indicated in the Switchgear Parameter Table and with both positive and negative polarities, as described in IEC 60060-1.
- Switching impulse: Phase-to-earth and/or phase-to-phase switching impulses with a front time of 250 µs, a time-to-half-value of 2500 µs, a peak value up to that indicated in the table in paragraph 5.1 and with both positive and negative polarities, as described in IEC 60060-1.

9.7.2 Earthing and Lightning

The earth mat under the civil foundations shall be designed in accordance with IEC 61024, IEEE 80 and IEEE 142. The design calculations use the lightning density information applicable to the site, soil sample resistivity results and the building physical parameters

Provision shall be made to enable the earthing of items of plant and Plant to an earth mat, either directly to the power station main earth mat, or to a separate earth mat that is then again connected to the main station earth mat (at two points).

The earthing of moving equipment, stackers, and conveyors shall be in accordance with the earthing and lightning protection standard 84ELEC001.

9.7.3 Electric Motors & Variable Speed drives

Electric motors shall comply with specification GGS 0802. Three phase motors shall be preferred over single phase motors. No 400 V motor exceeds a rating of 132 kW. A specific concession to this requirement may be granted by the Engineer after review. A soft start facility may be utilised, provided that the maximum starting current does not exceed 1500 A.

DC or uninterruptible power supplies (UPS) shall be fitted to the AC control supply of the 400 V boards to keep the motor contactor operating coils energised during voltage depressions lower than 0.85 Vn and lasting up to 1 second. The electrical motors therefore run during such abnormal power supply voltage variations.

All motors shall be supplied and installed with all items necessary for their correct operation. This includes mounting plates, bolts, jacking bolts, shims, couplings, auxiliary lubrication and cooling equipment.

Electric motors shall be supplied from individual switchgear circuits each having its own protection and situated in its own compartment. Where more than one motor is supplied from a distribution board each one shall be individually protected.

All motors shall undergo a routine test at the factory before delivery to site.

The variable speed drives shall have all the necessary ancillary plant for a complete working installation. The associated Plant (as applicable) include motors, power transformers, power line converters, DC link reactors, power load inverters and electronic control cubicles for control, monitoring, alarm and protective functions.

The equipment shall be self-contained, with all the necessary auxiliary and control AC/DC supplies derived within the equipment.

9.8 Single Line Diagram

The single line diagram (refer to drawing 0.84-40147 in Volume 3 Appendix 21) shows a high level concept layout of the rail yard area where the main supply will be from the Eskom planned lime stone handling plant which feeds the rail yard and services as well as the bulk material handling area. A redundancy principal of 100% will be used which means at any giving point the rail yard will have a spare supply which will be able to carry the entire load of the rail yard. Two 6.6kV boards will further step down to 400V where the low voltage will be distributed from to various equipment ie. FGD plant, Limestone handling, Rail yard operations room, admin building and possible the rail area lighting.

9.9 Electrical Equipment List

Electrical Equipment List-Medupi Rail Yard

Rail yard Substation	Rail yard & Services	Bulk Material Handling	Admin Building	Operations Building
Distribution board	**Weighbridge-Building**	**Limestone BMH**	Distribution board	Distribution board
Plug Points	Distribution board	Power supply for IP cameras	Plug Points	Plug Points
Power supply for IP cameras	Plug Points	Power supply for motors & VSD		Monitors
Sensors(fire)	Power supply for IP cameras	Power supply for auxiliaries	Mini substation	
	Mini-substation	Power supply for all C&I	***Lighting inside & outside***	***Lighting inside & outside***
Lighting inside & outside	***C&I***	Mini-substation	Cabling	Cabling
Cabling	Cabling	***C&I***	Lamps /florescent	Lamps /florescent
Lamps /florescent	Trenching	C&I equipment(load cells, sensors, etc.)	Power supply	Power supply
Power supply	Instruments(load cells, sensors, etc.)	Cabling		
	Power supplies	Trenching	***Air-conditioning***	***Air-conditioning***
Air-conditioning			Cabling	Cabling
Cabling	***Lighting inside & outside***	**FGD Gypsum BMH**	Air conditioning Unit	Air conditioning Unit
Air conditioning Unit	Cabling	Power supply for IP cameras	Power supply	Power supply
Power supply	Lamps /florescent	Power supply for motors & VSD		
	Power supply	Power supply for auxiliaries	***Electrical Rooms***	
Transformer(11kV/415v or 6.6kV/415v)		Power supply for all C&I	Power Room	
Cables to Transformer	***Air-conditioning***	mini-substation	Server Room	
Trenching	Cabling	***C&I***		
Bund wall	Air conditioning Unit	C&I equipment(load cells, sensors, etc.)		
Earthing	Power supply	Cabling		
Auxiliaries		Trenching		
Switchgear	***Yard Lighting***			
Circuit breaker	Distribution board			
Isolator	Cabling			
Current transformers	Luminaires + auxiliaries			
Voltage transformers	Masts			
metering units CT+VT	Trenching			
	Day/night sensors			
Panels				
Transformer protection panels				
Metering panels				
Equipment panels				

Table 3: Electrical equipment list

10. CONTROL AND INSTRUMENTATION DESIGN

10.1 Introduction

Control and instrumentation will be required for both the bulk material handling as well the rail yard and services.

The scope of the C&I project includes the following:

- SCADA and Control System
- Monitoring and Control for Bulk Materials Handling, Rail-yard Equipment
- Interface to Weighbridge standalone systems
- Plant Information system
- Building Management system including lighting management, CCTV, Access control, Intercom/ PA and Fire Detection systems
- Interface to Medupi Power plant
- Field Equipment

The C&I Architecture drawing 0.84/43218 (Refer to Volume 3 Appendix 22) will include a standalone PLC & SCADA system to the Medupi Power plant Control System with an interface to the Medupi Power plant Control system.

The facility control and instrumentation will provide services for the integrated monitoring and control of the Medupi Rail Yard to achieve a Facility-wide integrated system. There will be a local Plant Information System (PIS) which provide facilities for storing and transfer of information to the main power plant concerning the performance of the system, production, facility conditions and performance and provide data in order to obtain the required parameters.

The PIS information as well as information from the BMS can be accessed by the Medupi Power plant control room through the PIS interface and CBMS respectively.

Centralised operation will be deemed to include all actions that will normally be undertaken to accomplish normal and emergency start-up, routine loaded operations, and normal and emergency facility shutdown.

All local controls, control panels and other Human Machine Interfaces (HMI) located inside and outside the CCR, namely in equipment rooms, switchgear rooms or local to the Facility, will in general be regarded as operational facilities and the SCADA and/ or Control and Monitoring System will interface to these facilities and monitor all such operations.

A high-level computer system (HMI) will be provided with multiple operating stations and integrated with the control system to perform local control and monitoring, and for automatic comprehensive data logging and archiving with detailed analysis and reporting for maintenance management. On-line condition monitoring will be provided for equipment.

The communications between SCADA and the PLC as well as the Interfaces to the main power plant are considered to be redundant. This would achieve the best availability at this level however once the plants total availability requirements are confirmed the level of redundancy in all systems including PLC will be addressed. Due to the nature of operations its currently not foreseen to have redundancy at the Field level that requires control by the PLC's therefore no redundancy in the PLC's was allowed for.

CONTROLLED DISCLOSURE

10.2 Bulk material handling

Looking at the bulk material handling side, I/O systems required can include the following:

- Over speed trip of the tippler
- Thermal motor protection
- Blocked chute detection
- Belt drift switches
- Emergency stop and pull-wire trip switches
- Belt under-speed switches

10.3 Yard Control System

Yard control will be by means of local and remote control, where all control and instrumentation equipment signals required will be taken back to the Rail yard operations room.

10.4 Surveillance

Surveillance will be required for both security measures and monitoring of the rail yard & bulk material handling area. These cameras may monitor the rail yard, railway line, weighbridge as well as the specific areas of the BMH area.

IP cameras will be considered as opposed to analogue cameras due to the resolution and picture quality as well as the type of footage that is required; For example yard monitoring for security may require cameras that can be controlled by moving 360 degrees as well as zooming capability, whereas monitoring of the rail way line or conveyors maybe require cameras with fixed lenses that have no zooming capabilities.

All footage will be displayed in the Rail yard operations room in the rail yard where dedicated screens will be provided for viewing.

Long term Storage of footage will be provided and easily retrievable via a high resolution DVR.

11. SERVICE ROAD REQUIREMENTS

Refer to drawing 0.84/40141 in Volume 3 Appendix 8.

The existing rail way is serviced by a 6m gravel road. It is proposed that the new service road connect to this gravel road at the existing rail way crossing. It is proposed that the service road will be designed on the same platform as the rail way to provide level access to all facilities.

The road alignment is determined by the rail way layout. The road centreline is placed 6m from the rail centreline. The road will be designed and modelled using AutoCAD Civil3D.

Road cross and longitudinal sections will be generated for the service road. This will be accompanied by a detailed layout drawing with setting out data. The SANS 1200 will be used to compile a complete bill of quantities for the service road.

The service road will be designed to the following specifications:

- 6m wide gravel road
- Cross fall between 1:15 and 1:40
- Layer works as specified in the Transnet S410 specifications
- Geometric design to travel with reasonable ease with a 7t truck

- Maximum local depressions and bump of 50mm
- The road centreline will be placed 6m from the outside rail centreline
- Cut and fill slopes at 1:2

The service road will be designed as a 6m wide gravel ring road to service all facilities in the rail yard. The start position will be at the existing service road rail way crossing. The road layer works will be designed to the same standard as the rail way layer works. The road will have a cross fall between 1:15 and 1:40 for storm water drainage. No formal storm water drainage will be installed for the proposed gravel road. Guard rails will be installed on areas of fill more than 0.5m high.

The service road design and costing is covered in the Concept Design Report Volume 1 (Rail Yard and Services).

12. STORMWATER AND DIRTY WATER REQUIREMENTS

Refer to drawing 0.84/40141 in Volume 3 Appendix 8.

The portion north of the rail way line drains to an earth lined channel at the north side of the rail yard. This channel drains from west to east and exits at a newly upgraded stormwater culvert. The size and capacity of the new culvert should be verified during detail design.

The clean rail way stormwater will be collected using concrete channels and underground pipes to drain into a new proposed earth lined channel that will drain to the newly upgraded culvert. This culvert size will be evaluated using the 1:20 year peak flow to determine the required culvert size due to the increased run off from the rail way yard.

The dirty stormwater from the gypsum loading facility will be collected into an independent concrete channel and underground pipe network that will drain to the proposed pollution control dam that will be designed by the FGD project team. The estimated run off contribution to the pollution control dam will be $0.05m^3/s$ for a 1:20 year return period.

The topographical survey will be used to determine catchment areas and flow paths with the assumed 437mm MAP. The rail way drainage and earth lined channels will be modelled in a Hydro cube model using the rational method for different return periods. The rational method will be used for all the 1:2 and 1:20 year return periods. All required structure sizes will be evaluated and sized accordingly

The Hydro cube analysis will provide peak flow values for the chosen return periods. Pipe, channel and culvert sizes will be determined from this analysis. The SANS 1200 will be used to compile a bill of quantities for stormwater structures.

13. CIVILS SERVICES AND REQUIREMENTS

13.1 Bulk Earthworks

The topographical survey and a site visit clarified numerous stockpiles on the proposed rail way site. It is assumed that all the stockpiles will be removed prior to construction. The bulk earthworks below the rail way main layer works will be constructed using G9 material.

From the topographical survey and final approved rail way layout an AutoCAD Civil3D model will be used to generate setting out data and measurement of quantities.

A detailed bulk earthworks layout drawing with setting out data and cross sections will be issued during detail design stage. Bulk earthworks quantities will be used to compile a SANS 1200 bill of quantities. The layer works will be constructed as per typical section on drawing 0.84/40141 in Volume 3 Appendix 8.

The positions and placement of the platform for the rail way layer works and bulk earthworks was determined by the final approved rail way layout. The platform was designed to ensure that the new toe line will not overlap the existing service road fence.

A letter dated 6 August 2014 from Eskom requested the design team to review all earthwork designs due to the quality of stockpiles deteriorating from G5 to G6 and G7 to COLTO classifications. For the concept design stage it is assumed that all materials G7 and higher will be imported from commercial sources. With the final geotechnical report outstanding it was assumed (on advice from the Geotechnical Engineer) that the insitu material could be collapsible and would have to be compacted by an impact roller to ensure proper support.

The platform will be designed to accommodate the limestone unloading facility, locomotive shed, diesel storage and the gypsum loading facility on the same level as the rail way lines. The security office and accommodation building will be provided with separate platforms.

The bulk earthworks and rail way layer works will be designed according to the Transnet S410 specifications. All cut and fill slopes for the earthworks will be designed to 1:2. The bulk earthworks will consist of G9 material compacted to 93% MOD AASHTO in layers of 150mm. The rail way layer works will be designed for a 26t axle load to specifications.

The cost for bulk earthworks in this report only includes the excavation and backfilling cost to all materials handling facilities. All other bulk earthworks and rail way layer works will be measured in the Concept Design Report Volume 1 (Rail Yard and Services).

13.2 Potable water

Refer to drawing 0.84/40141 in Volume 3 Appendix 8.

Medupi is served by an existing independent potable water network. The connection chamber and position was provided by the client. It was assumed that the connection to the existing network will provide sufficient pressure and flow required for serving the buildings. The pressure and flows at the connection points will be confirmed prior to detail design.

The potable water network serving the facilities will be modelled during the detail design using the Water Mate package.

A detailed calculation report sheet will be generated during detail design illustrating the required pipe sizes and pressures at specific nodes. The SANS 1200 will be used to compile a bill of quantities for all the water pipes.

The potable water network will serve the security office, locomotive workshop and administration building with a stand tap and ablution facilities. Provision will also be made to serve the materials offloading facility and the gypsum loading facility with stand taps.

The following design parameters, which resulted in an estimated peak flow of 0.5l/s, were used as base for the potable water design:

- Population – 18 people
- Unit demand – 80 litres/person/day
- Peak Factor – 4
- Pipe material – 50mm uPVC Class12

It is proposed to install 50mm uPVC class 12 pipes to all buildings in the rail yard. All pipe sizes will be re-evaluated when pressures and flows are known at the connection point. The final pipeline positions and valve placement will be conducted after the approval of the layout plan.

The potable water design and costing will be covered in the Concept Design Report Volume 1 (Rail Yard and Services).

13.3 Civil Works relating to Electrical

- Lighting Foundations
- Lighting Cable trenching
- Control cable trenching

All excavation, trenching and concrete work will be done to SANS 1200 specifications.

14. GEOTECHNICAL AND HYDROLOGICAL STUDIES

The following scope of work is proposed:

14.1 Desk study review

- A desk study review will be undertaken of all the available geotechnical and geological information pertaining to the site including published geological maps and geological and geotechnical reports.

14.2 Fieldwork will include the following

- Test Pits
- Dynamic Core Penetrometer (DCP) Tests
- Continuous Surface Wave (CSW) Tests
- Construction Material Sampling
- Laboratory Testing

14.3 Geotechnical Report

A geotechnical report will be compiled presenting the information obtained during the site investigation including the prevailing site conditions, stratigraphy, material classification and characterisation, geotechnical parameters, preliminary foundation recommendations and recommendations for infill investigations if required. A factual interim report will be issued about one week after the completion of all fieldwork presenting the recorded soil profiles, DCP results and CSW logs but a final interpretive report will only be issued a week after receiving all laboratory results. Rockland will however endeavour to supply the design team with information as it becomes available to allow the design process to proceed with least interruption.

15. FIRE PROTECTION REQUIREMENTS

This is discussed in Concept Design Report Volume 1 (Rail Yard and Services).

16. STRUCTURAL REQUIREMENTS

The structural work pertaining to bulk materials handling includes the tippler station, the gypsum loading station and all bulk materials handling support structures and transfer towers. The Side tippler or “Rotaside” tippler structure will consist of a concrete basement formed approximately 11m below ground level, with concrete retaining walls surrounding the perimeter of the basement. Access will be via concrete staircases. The steelwork inserts required to support the tippler will be cast integrally with the concrete structure. A suspended concrete slab with the required cut outs, to suit mechanical requirements, will be formed at floor level. The structure will be covered with a steel portal roof structure and mild steel sheeting. This is to prevent the ingress of rainwater into the basement, and provide all weather access for offloading operations.

Limestone will be conveyed below ground in a concrete tunnel, which daylights as the conveyor climbs at the specified gradient. Thereafter, the conveyors will be supported on concrete sleepers at ground level, spaced at approximately 2,5m intervals.

As the conveyors leading into the transfer towers rise above grade, small box girders with walkways on one side will support the conveyor and span between steel trestles. The steel trestles will be located at approximately 15m centres, and will be founded on concrete foundations on engineered layerworks.

Transfer towers will consist of braced steel structures, with mentis grating forming the access floors at the various required levels within the transfer houses. Access will be via steel staircases, and facilitate “walk on” access between conveyor walkways and transfer tower floor levels.

Each transfer tower will have the minimum number of fire escape routes as required by legislation. Similarly, the conveyor tunnel will be fitted with a transverse fire escape tunnel and concrete framed stair well.

17. TECHNOLOGY REQUIREMENTS

17.1 Maturity of Selected Technology

The use of both rotary unit wagon tipplers and “rotaside” type tipplers is common in industry. This has been the case for a number of years, and the technology used for this type of equipment is well developed. The same applies to the general bulk materials handling equipment that will be used such as belt or apron feeders, hoppers, belt conveyors and overhead feed bins as well as to auxiliary equipment such as standalone dust separation equipment.

17.2 New Technology Required

No new or immature technologies have been selected as part of the design for this concept study.

18. COSTING EVALUATION

18.1 Capital costs

TOTAL LIMESTONE HANDLING - SIDE TIPPLER OPTION				177 616 324
	BMH EQUIPMENT	ZAR	132 242 324	
	CIVIL WORKS	ZAR	3 430 000	
	STRUCTURAL WORKS	ZAR	41 944 000	
TOTAL LIMESTONE HANDLING - ROTARY TIPPLER OPTION				178 739 324
	BMH EQUIPMENT	ZAR	111 117 324	
	CIVIL WORKS	ZAR	11 241 000	
	STRUCTURAL WORKS	ZAR	56 381 000	
TOTAL GYPSUM HANDLING				62 442 000
	BMH EQUIPMENT	ZAR	59 280 000	
	CIVIL WORKS	ZAR	INCLUDED IN STRUCTURAL	

STRUCTURAL WORKS	ZAR	3 162 000	
TOTAL ELECTRICAL CONTROL & INSTRUMENTATION			8 589 000
ELECTRICAL	ZAR	1 924 000	
CONTROL AND INSTRUMENTATION	ZAR	6 665 000	
TOTAL CAPEX ESTIMATE BULK MATERIALS HANDLING AND ASSOCIATED INFRASTRUCTURE - SIDE TIPPLER OPTION	**ZAR**		**248 647 324,00**
TOTAL CAPEX ESTIMATE BULK MATERIALS HANDLING AND ASSOCIATED INFRASTRUCTURE - ROTARY TIPPLER OPTION	**ZAR**		**249 770 324,00**

Table 4: CAPEX costing summary – materials handling

The above CAPEX costing summary excludes engineering, procurement and construction management costs. The costing accuracy is +-40 % with a base date of January 2015. Refer to Volume 3 Appendix 19 for a detailed breakdown of the above costing summary.

18.2 Life-Cycle Cost Assessment

A lifecycle cost assessment was conducted to provide a comparison of the overall costs to the Client between the Rotary and Side tippler options.

The assessment shows that the overall lifecycle costs of the Side tippler will be significantly lower than for the Rotary tippler. Refer to Volume 3 Appendix 14 for the detailed life cycle cost analysis report.

19. DEVELOPMENT TEAM

The following people were involved in the development of this document:

19.1 Material handling/Mechanical

- Darius Bezuidenhoudt (Mechanical Engineer)
- Dave Chappelow (Bulk materials handling consultant)

19.2 Civil Infrastructure

- L. Geldenhuys (Civils Lead Project Director)
- PJJ Basson (Civils Project Manager)
- WF Küsel (Civils Lead Engineer)
- C Prinsloo (Design Reviews)
- W Bekker (Civils CAD Operator)

19.3 Electrical Control and Instrumentation

- Shekar Inderlall (Electrical Engineer)

- Mike Da Silva (Electrical, Control & Instrumentation)
- Amantha Maharaj (Electrical Engineer-Design Review)

19.4 Buildings and Structural

- Errol Tromp (Structural Engineer)
- Johan Duvenhage (Architect)

19.5 Fire Protection Services

- Roger Bosch (Mechanical Engineer)

20. REVISIONS

Rev.	Status	Issued by	Date
01	Issued for review	Francois Retief	4/12/2014
02	Updated with Electrical and C&I changes	Francois Retief	29/1/2015
03	Updated with all MDR changes including C&I issues from 19 February 2015	Francois Retief	20/2/2015
04	Updated with final C&I issues after meeting held on 27 February 2015	Francois Retief	13/3/2015

Bosch Holdings Consortium

BOSCH HOLDINGS	Thabile Engineering	Thabo Consulting	NEMAI CONSULTING

ESKOM HOLDINGS SOC LTD

TASK 203 – BASIC AND DETAILED DESIGN OF MEDUPI RAIL YARD AND OFFLOADING FACILITY

CONTRACT NUMBER: 4600051676

ORDER NUMBER: 4501833635

BOSCH HOLDINGS CONSORTIUM PROJECT NUMBER: P1184-099-1

MEDUPI RAIL YARD AND OFFLOADING FACILITY
CONCEPT REPORT VOLUME 3
APPENDICES

Report reference number: 1184-099-4-100-R-0001-Rev04 Concept Vol3 Appendices Revision: 04 Total pages: 03

Report submitted by:

Bosch Holdings Consortium

13 March 2015

CONTROLLED DISCLOSURE

Appendix	Description	Drawing number
1	Main Concept layout drawing	0.84/40134
2	Rail Plan and Profile drawing	0.84/40135
3	BMH layout drawing for Rotary Tippler	0.84/40136
4	BMH layout drawing for Side Tippler	0.84/40137
5	Substation & Cable Routes	0.84/40138
6	Lighting Design - Shunting Neck	0.84/40139
7	Lighting Design - Staging Yard	0.84/40140
8	Civil services Concept layout drawing	0.84/40141
9	Administration & Operations Tower Building - Plans	0.84/40142
10	Administration & Operations Tower Building - Elevations & View	0.84/40143
11	Security Office – Plan, Elevations & View	0.84/40144
12	Loco Workshop, Utilities and Ablutions – Plan & Elevations	0.84/40145
13	Fire hazard and risk assessment report	-
14	Rotary and Side Tippler lifecycle costing report	-
15	Options Study report	-
16	Simulation report	-
17	ON-TRACK Technology - Massize T4 installation detail	-
18	Costing detail Volume 1 (Rail Yard and Services)	-
19	Costing detail Volume 2 (Materials handling)	-
20	Rail lighting layout drawing	0.84/40146
21	Single line diagram - Electrical	0.84/40147
22	Concept control network architecture - typical	0.84/43218

23	Materials handling Process Flow Diagram (PFD)	0.84/43219