
12. 実施計画

12.1 事業のパッケージ

推奨するパッケージ案を表 12.1-1 に示す。当初、Eskom は吸収塔を独立したパッケージとして、そのほか、石灰石スラリー調製並びに脱水工程関連装置の組を別パッケージとし、さらに電気や制御などをそれぞれ別パッケージとした、7つのパッケージ案を作成していた。JICA 調査団は吸収塔と石灰石スラリー調製、脱水工程関連装置の組を合体させつつ、設計、調達と建設(据付)を分割するパッケージを提案した。吸収塔、石灰石スラリー準備、脱水を一体とした理由は、FGD システムの性能保証を確実にするためである。これらの FGD の 3 要素は 1 つのパッケージに統合されているべきである。設計、調達と建設(据付)を分割する理由は、豊かな経験を有する海外からの入札参加者が入札に参加しやすい環境とするためである。

表 12.1-1 推奨するパッケージ案

	Package	Contracting Arrangement
CP-1	Supply of Equipment Absorber, Limestone Slurry Preparation and Gypsum Dewatering	EPS
CP-2	Civil Work and Installation for CP-1	C
CP-3	Distributed Control System	EPC
CP-4	Power Supply System	EPC
CP-5	Waste Water Treatment Plant	EPC
CP-6	Rail and Materials Handling Systems for Limestone Supply and Gypsum Disposal	EPC
CP-7	Civil Work for CP-6	C
CP-8	Site Service	Service providing
CP-9	MCWAP connection	EPC

EPS: Engineering, Procurement and Supply

EPC: Engineering, Procurement and Construction

C: Construction (Civil Work and/or Installation)

出典: JICA 調査団にて作成

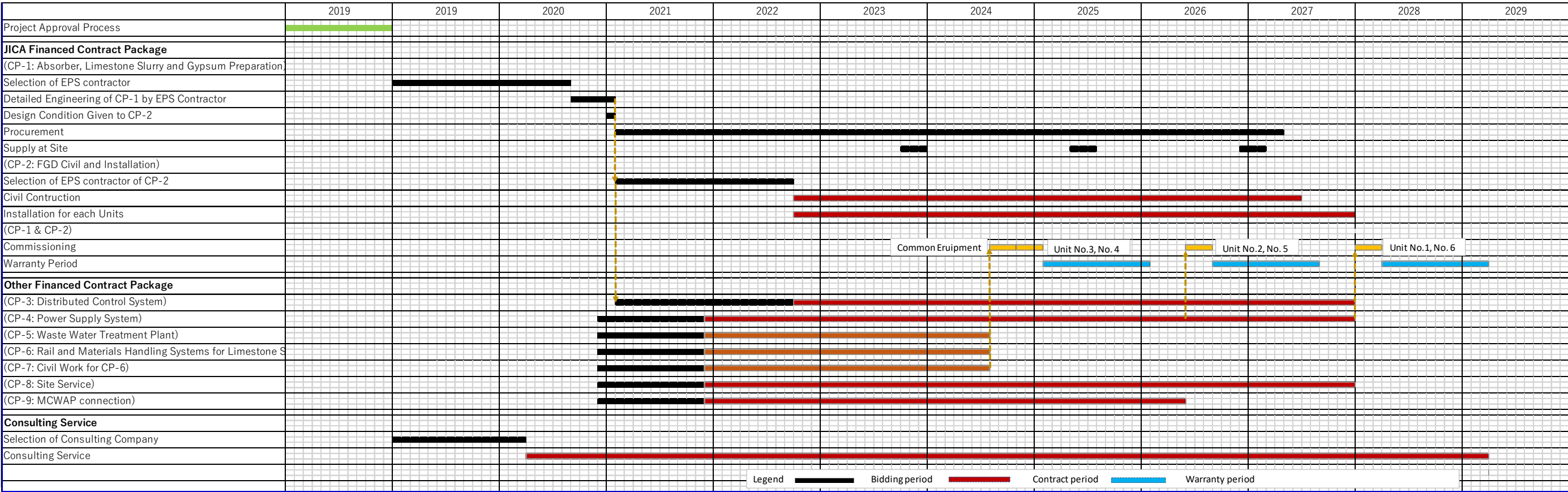
12.2 JICA 円借款の範囲

JICA 円借款の範囲は表 12.1-1 で示した CP-1 と CP-2 及びコンサルティングサービスとなる。

12.3 本事業実施計画

本事業工程計画を表 12.3-1 に示す。本事業の総所要時間は、JICA 円借款契約 (LA) の準備段階から現場で試運転試験の完了までの 111 カ月間と推定されている。今回構築する FGD は、既存の発電所が稼動していることに留意すべきである。既存のダクトと FGD ダクトを接続するには 1 ヶ月の作業が必要になるため、実際には発電所の各ユニットの停止を調整する必要がある。

表 12.3-1 施工工程計画



出典: JICA 調査団にて作成

(1) 仮設工事の留意点

本事業実施に当たり、仮設設備(事務所、加工工場、資機材仮置き場など)のスペースが必要となる。このためのスペースは、建設現場である発電所周辺に設けることが可能である。また当該エリアでは、本事業の開始時期である 2019 年末に竣工予定の発電ユニット建設計画が使用している仮設設備エリア(下図(b))があり、工期が合えば事務所、工場を有償にて利用することも可能である。このためには、客先、現発電ユニット建設計画側との調整が必要となる。現在の仮設事務所、仮設工場及び機器仮置き場について、図 12.3-1 に示す。



出典: Google Earth (2017 May 撮像)に基いて JICA 調査団にて作成

(a)	Temporary Office, Fabricating Lab and Material Storage Space
(b)	Temporary Gate & Transportation Entrance of Large Equipment

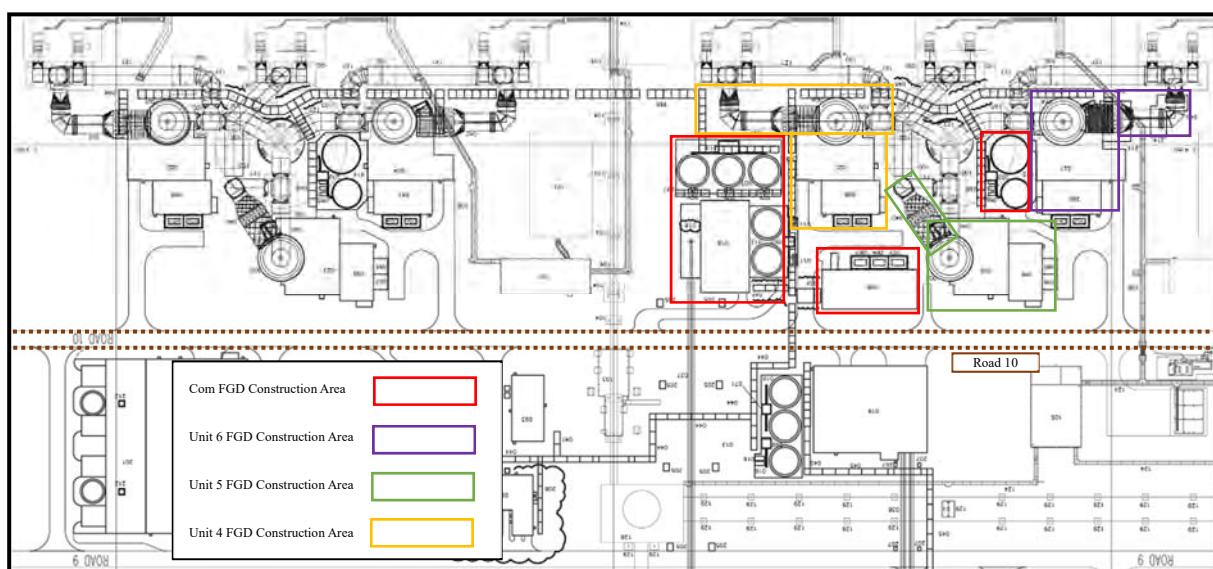
図 12.3-1 仮設区画

本事業用仮設電源は、発電所より供給が可能である。ただし現行発電ユニット建設計画側も仮設電源を使用しているため使用箇所については Eskom との協議が必要となる。

(2) 本工事の留意点

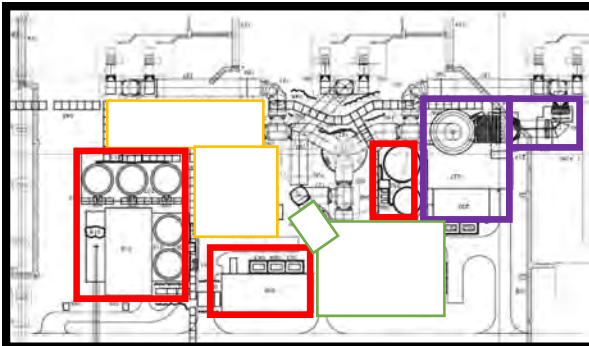
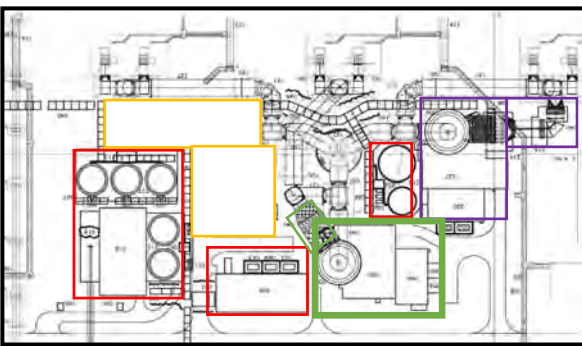
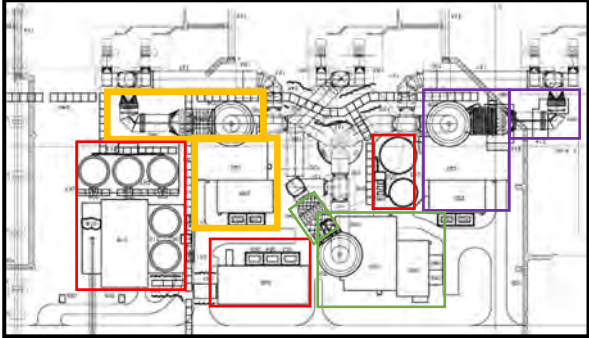
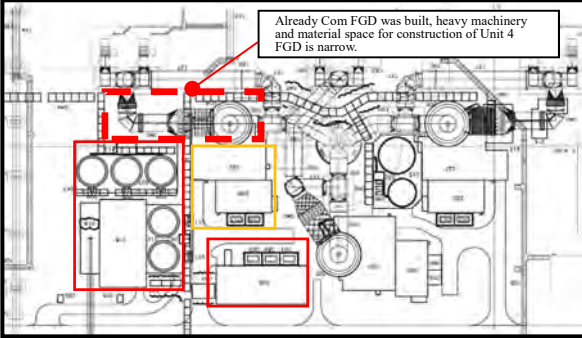
本工事は既存の発電設備が運転状態で施工するため、クレーンでの荷吊りやブームを旋回する際は細心の注意が必要である。施工順序は共用設備→ ユニット 6 FGD → ユニット 5 FGD → ユニット 4 FGD → ユニット 3 FGD → ユニット 2 FGD → ユニット 1 FGD となり、各ユニット運転開始後 6 年以内に FGD を設置する必要がある。ユニット 4 FGD の建設は、共用設備が先に建設されるため同建設場所が狭隘となる。狭隘な場所でのクレーン作業は、既設設備への損傷や作業進捗の遅れにつながるリスクがある。このリスクを回避するには、ユニット 4 FGD に近接する Com 設備(Sox 吸収液生成設備及び水タンク)を Road 10 側に寄せて建設する事が望ましい。施工順序及び狭隘箇所を表 12.3-3 に示す。

表 12.3-2 FGD の全体配置



出典: September 2017 に Eskom から受領したデータに基づいて JICA 調査団にて作成

表 12.3-3 建設の手順案

Step 1 (Construction of Com FGD and Unit 6 FGD)	Step 2 (Construction of Com FGD and Unit 5 FGD)
	
Step 3 (Construction of Com FGD and Unit 4 FGD)	Point of concerns for FGD Construction
	

出典: September 2017 に Eskom から受領したデータに基づいて JICA 調査団にて作成輸送の留意点

1) 輸送制限について

トレーラーが National Road を走行する際は、National Road Traffic ACT 93 of 1996 に従う。走行可能な車両サイズは表 12.3-4 に示すとおりであり、軸荷重制限を表 12.3-5 に示す。

表 12.3-4 国道における輸送の制限値

長さ	幅	高さ
18.5 m 未満	2.5 m 未満	4.65 m 未満

出典: National Road Traffic ACT 93 に基いて JICA 調査団にて作成

表 12.3-5 最大軸重

National Road Traffic Act-Reg. 240 (Defined maximum axle loads)			
REG. 240: (Max. axle mass load)	STEERING:	NON-STEER: (2 wheels/axle)	NON-STEER: (4 wheels/axle)
per wheel:	3850kg	4000kg	
per axle:	7700kg	8000kg	9000kg
2 axle unit:	15400kg	16000kg	18000kg
3 axle unit:	23100kg	24000kg	24000kg

出典: website of South African Sugarcane Research Institute のウェブサイト情報に基づいて JICA 調査団にて作成

2) メデュピ TPS への大型機器搬入口について

メデュ日火力発電所構内への大型機器搬入口は表 12.3-6 に示す。この入り口は現在仮設であり、数年後に本設入口の建設が予定されている。

表 12.3-6 メデュピ TPS の東門付近の様子

Temporary Gate	Gate for Transportation of Large Equipment
	

出典: JICA 調査団にて作成

12.4 プロジェクト費用の積算

12.4.1 建設費用の積算の前提条件

建設費用はメデューピ TPS において 800 MW 規模の湿式の FGD を 6 基設置するものとした。すべての費用は ZAR もしくは JPY にて表示されており、その交換率は 2018 年 12 月時点のものである。積算には EPS もしくは EPC、建設(Construction)会社の費用が含まれているが、資金調達費(financing cost)は含まれていない。資金調達費は、他の章で推定されている。

それぞれの建設会社は、自らの契約に規定された作業の実施責任を負うものとする。よく用いられる包括的な 1 パッケージによる EPC プロジェクトと異なり、発注者はターンキーが保障されておらず、発注者は各パッケージのインターフェースを制御、調整しなければならない。

建設費用の算出に当たっては、Eskom が作成した積算資料を参照している。

競争入札の後に決定される最終的なプロジェクト費用は、入札時点での全体的な市場状況、主要な機器を供給する国によって変動する。一般的に、技術面で進んでいない国は進んでいる国、日本、ヨーロッパ、米国などに比べ低価格で機器を供給可能である。しかし、機器の供給者は、建設費用の高低のみではなく、信頼性などのもっと広い観点で指標を視野に入れながら選択することを強く推奨する

12.4.2 建設費用の積算 (機器含む)

FGD (6 ユニット) の推定コストを表 12.4-1 に示す。本事業の建設コストは約 2,990 億円である。

基本的に、建設費用は Eskom による試算に基づいている。

表 12.4-1 FGD の建設費用の積算 (ZAR = JPY : 7.94)

No.	Item	Cost Mil. ZAR (Mil. JPY)
CP-1	Supply of Equipment Absorber, Limestone Slurry Preparation and Gypsum Dewatering (EPS)	7,862 (62,421)
CP-2	Civil Work and Installation for CP-1 (C)	3,689 (29,289)
CP-3	Distributed Control System	174 (1,385)
CP-4	Power Supply System	1,127 (8,952)
CP-5	Waste Water Treatment Plant	5,760 (45,735)
CP-6	Rail and Materials Handling Systems for Limestone Supply and Gypsum Disposal	2,351 (14,663)
CP-7	Civil Work for CP-6	1,513 (12,017)
CP-8	Site Service	1,484 (11,781)
CP-9	MCWAP connection	70 (557)
Total Cost		23,526 (186,799)

EPS: Engineering, Procurement and Supply, C: Construction

出典：JICA 調査団にて作成

12.4.3 裁定委員会

JICA は 2012 年に裁定委員会の手引きを作成した。さらに、(FIDIC: The International Federation of Consulting Engineers、仏文表記の以下のつづりの略称 Fédération Internationale Des Ingénieurs-Conseils)は 2010 年版 FIDIC MDB 統合版において裁定委員会の設立を義務化している。これらは建設プロジェクトの開始前に第 3 者の視点をもつ紛争解決機関の設立の潮流をしめしている。JICA 調査団は本事業のための裁定委員会の設立を推奨する。

裁定委員会は 1 人もしくは 3 人の常任委員により構成される常設機関であり、彼らは定期的な現地訪問を通して、深刻な紛争問題、つまり設訴訟となるのを避けるべく助言や裁定を与える。

発注者は入札の開始まえに裁定委員会の委員を決めなければならない。

FIDIC 契約案内(2000 年発行)では、3 人の裁定委員会であつ、月払いの報酬により定常的に稼働するモデルで 2000 年当時の価格で保証期間の終了までに 234 百万の支出を試算している。

12.4.4 本事業実施費用の積算

本事業の費用は、Eskom が基本設計業務を通して設計コンサルタントに積算させ、その後に時間の経過による条件変動などを加味して再積算した価格に遵った。

- ✓ 建設費（予備品含む）
 - ✓ 資金調達費
 - ✓ 管理費(施主の費用)
 - ✓ 公租公課
 - ✓ 予備費
 - ✓ 環境影響評価(EIA)にかかる費用
 - ✓ 地方政府、中央政府から許可や免許を取得するためにかかる費用
- 前述のとおり建設費用は約 2,990 億円となる。

資金調達費は前述のとおり、この後の財務経済分析の章にて積算している。

予備品は建設期間中に納入されているとし、予備品にかかる費用は建設費に含まれているべきである。予備品の品目と数量はアメリカのエネルギー庁(Department of Energy, USA)が発表している資料”COST AND PERFORMANCE BASELINE FOR FOSSIL ENERGY PLANTS”内の石炭発電所のモデルケースで示されている FGD の予備品並びに数量と同等以上とすることを推奨する。予備品として推奨する品目と数量の概要を表 12.4-2 に示す。高品質の製品が採用され、かつ、製造者により推奨されている方法で保守されるならば、予備品を使用しなくても少なくとも 7 年から 10 年の製品寿命が期待できる。しかしながら、運転開始から想定寿命にいたるまでに不具合が発生する恐れもあるため、予備品は準備しておくべきである。予備品は長期間にわたって性能が保たれるため、予備品は使用される。日本では、更新費用が年毎に建設費用の 3%程度かかるものとされており、本事業の FGD の機能を維持するために年毎に約 18 億円程度の費用がかかることを意味する。

本事業のために申請するプロジェクト費用を表 12.4-3 に示す。本事業実施のための費用積算は日本の円借款を想定している。物価上昇は外貨(FC: Foreign Currency)で 1.83%、内貨(LC: Local Currency)で 1.0%である。利子は、日本の円借款(建設費かかる費用に対する利率: 1.5%、 コンサルタントにかかる費用に対する利率: 0.01%)を適用する。

円借款の対象として適格な費用、建中金利、手数料などは表 12.4-2 に示されている通りである。

表 12.4-2 予備品として推奨する品目の種類と数量の概要

	Spare Item	Number
Sorbent Preparation and Feed	Limestone Weigh Feeder	1
	Limestone Ball Mill	1
	Auxiliaries	1
Flue Gas Clean up FGD & ESP	Pumps	1 respectively
	Belts	1
	Blower	1

出典: “Cost and Performance Baseline for Fossil Energy Plants Volume 1: Bituminous Coal and Natural Gas to Electricity”, DOE
 に基いて JICA 調査団にて作成

表 12.4-3 本事業実施費用 (単位: JPY in Million)

Item		Total		
		FC	LC	Total
A. ELIGIBLE PORTION				
I)	Procurement / Construction	73,845	4,240	107,507
	CP-1 Supply of Equipment Absorber, Limestone Slurry Preparation and Gypsum Dewatering (EPS)	62,421	0	62,421
	CP-2 Civil Work and Installation for CP-1 (C)	117	3,674	29,289
	Base cost for JICA financing	62,539	3,674	91,710
	Price escalation	4,593	180	6,024
	Physical contingency	6,713	385	9,773
II)	Consulting services	7,177	362	10,051
	Base cost	6,338	330	8,961
	Price escalation	498	14	661
	Physical contingency	342	17	479
Total (I+II)		81,022	4,602	117,559
B. NON ELIGIBLE PORTION				
a	Procurement / Construction	24,493	10,638	108,958
	CP-3 Distributed Control System (EPC)	208	148	1,385
	CP-4 Power Supply System (EPC)	1,343	958	8,952
	CP-5 Waste Water Treatment Plant (EPC)	6,860	4,896	45,735
	CP-6 Rail and materials handling systems for Limestone Supply and Gypsum Disposal (EPC)	12,463	277	14,663
	CP-7 Civil Work for CP-6 (C)	0	1,513	12,017
	CP-8 Site service	0	1,484	11,781
	CP-9 MCWAP connection	0	70	557
	Base cost	20,874	9,347	95,089
	Price escalation	1,392	324	3,964
	Physical contingency	2,228	967	9,905
b	Land Acquisition	0	0	0
	Base cost	0	0	0
	Price escalation	0	0	0
	Physical contingency	0	0	0
c	Administration cost	0	2,337	18,552
d	VAT	0	3,994	31,712
e	Import Tax	0	619	4,917
Total (a+b+c+d+e)		24,493	17,588	164,139
TOTAL (A+B)		105,515	22,189	281,698
C. Interest during Construction		16,056	0	16,056
	Interest during Construction(Const.)	16,051	0	16,051
	Interest during Construction (Consul.)	5	0	5
D. Front End Fee		1,227	0	1,227
GRAND TOTAL (A+B+C+D)		122,798	22,189	298,980
E. JICA finance portion incl. IDC (A + C)		86,554	4,602	123,090

出典: JICA 調査団にて作成

12.5 支出予想

すべてのパッケージを考慮した支出予想を表 12.5-1 に示す。2019 年度の支払いは支払い総額の約 4.9%となる。この支払いは主に着手金となる。2020 年度から 2024 年度までの支払いは支払い総額の約 20.6%、18.2%、20.6%、17.1%、10.0%で推移する。建設が完了する 2025 年度の支払いは支払い総額の約 4.9%となる。補償期間が終わる 2026 年度の支払いは支払い総額の約 3.9%となる。

表 12.5-1 すべてのパッケージを考慮した本事業の支出予想

Schedule	Payments	
Year	JPY in million	In %
FY2019 (Construction 1 st)	13,668	4.6%
FY2020 (Construction 2 nd)	61,675	20.6%
FY2021 (Construction 3 rd)	54,274	18.2%
FY2022 (Construction 4 th)	61,728	20.6%
FY2023 (Construction 5 th)	51,190	17.1%
FY2024 (Construction 6 th)	29,934	10.0%
FY2025 (Construction 7 th)	14,776	4.9%
FY2026 (Warranty)	11,735	3.9%
Total	298,980	100.00%

出典: JICA 調査団にて作成

Note: Including consultant fee for construction supervision

12.6 許認可と通関手続き

12.6.1 許認可

(1) 廃棄物に関わる手続き

全ての廃棄物管理に係る活動は国家環境管理：廃棄物法 National Environmental Management Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA) 及びその関連法により規定されている。廃棄物管理活動を規制し、人の健康や環境への負の影響が生じないようにするため NEM:WA では廃棄物管理ライセンスを定めている。政令で定めるリストにあげられている活動を実施する際には、活動を始める前に管轄機関からライセンスを取得しなければならない。

本事業における廃棄物処理に係る活動を表 12.7-1 に示す。

廃棄物に係る処理の手続きの詳細は、11.3.3 節に記載の通りである。

表 12.6-1 GN R718 (2008)に示される廃棄物管理活動

番号	活動の概要
Government Notice No.718 NEMA 2008 as amended on 2013: Category B	
7	The disposal of any quantity of hazardous waste to land.
10	The construction of a facility for a waste management activity listed in Category B of this Schedule (not in isolation to associated waste management activity).
Government Notice No.718 NEMA 2008 as amended on 2013: Category C	
2	The storage of hazardous waste at a facility that has the capacity to store in excess of 80m ³ of hazardous waste at any one time, excluding the storage of hazardous waste in lagoons or temporary storage of such wastes.

出典: Government Notice No.718 NEMA 2008 as amended GNR921 on 2013

(2) 水利用に係る手続き

本事業に係る活動のいくつかの水利用活動は、国家水法 (National Water Act, 1998 (Act No. 36 of 1998) (NWA)) の第 21 項に定義される活動に該当する。これらの活動を行うためには DWS から水利用許可を取得しなければならず、NWA (1998) の第 40 項及び 41 項に基づく申請が必要となる。本事業における水利用ライセンス申請書手続きを表 12.7-1 に示す。

水利用に係る処理の手続きの詳細は、11.3.4 節に記載の通りである。

表 12.6-2 水利用ライセンス申請書手続き

Step	Steps in processing of water use license applications	Maximum Days allocated	Cumulative days	Responsible
0	Pre-application enquiry	0	0	Applicant / Responsible authority
1	Application submitted	1	1	Applicant
2	Responsible authority acknowledges receipt of the application	10	11	Responsible authority
3	Applicant confirm arrangement for site inspection with an allocated case officer	5	16	Applicant
4	Site inspection to confirm water uses, determine information requirements and the need for public participation	20	36	Responsible authority / Applicant
5	Confirm requirements for water use license application technical report based on site visit and meeting	5	41	Responsible authority
6	Compilation, consultation and submission of water use license application technical report by applicant	105	146	Applicant
7	Reject / Accept water use license application technical report	10	156	Responsible authority
8	Assessment	139	295	Responsible authority / Applicant
9	Decision and communication to applicant	5	300	Responsible authority

出典 : Water Use Licence Application and Appeals Regulation, 2017 (Act No. 36 of 1998)

(3) そのほか開発行為に係る環境側面

環境側面においての許認可については、EIA が実施され、その緩和策が提案されている。詳細は 11.6 節から 11.9 節に記載の通りである。

(4) 労働側面

請負業者および供給業者の労働条件は、安全衛生および環境（SHE）の仕様によって保証されている。これらの仕様は、入札段階で候補請負業者に提供され、業者評価時に適応される。詳細は 11.6.10 節に記載の通りである。

(5) PPPFA

Eskom は PPPFA に基づく、国内の調達率について定め、財務省からの許可を得て置く必要がある。

12.6.2 通関（減税）手続き

段階託送(staged consignment)の適用により、減税が可能である。

段階託送は、最終仕向け地に向けた製品の寸法や規模に起因して、通常は分割して輸送されるプラントや製品を構成する数多くの構成品から成る。

段階託送で輸入する主たる利点は、段階的手法で輸入されるすべての品物に対して、最終的なプラントや製品に対する単一の関税率を適用することが、登録輸入者（importer of record:IOR）に許されることである。適用される関税率は、General Rules for Interpretation (“GRI”) の 2 (a) in Schedule 1 of the Harmonised System に定められた分類既定に基づく。

段階託送が適用されるための条件は以下のとおりである。

- 構成品は、組み立てられた場合にはプラントや製品を構成しなければならない
- 完成したプラントや製品は、関税率の Chapters 84 or 85 にて分類できなければならない
- 組み立て前もしくは分解されたプラントや製品は、500 トンを超える重量か、500m³ を超える輸送容積でなければならない

13. 財務経済分析

13.1 財務経済分析の目的・方法

財務経済分析は、内部収益率(IRR)、正味現在価値(NPV)を計算することによって、本事業の財務・経済的実行可能性を検討することを目的とする。

財務分析は、Eskom の視点から本事業の採算性を評価するために実施される。財務的内部収益率(FIRR)・財務的正味現在価値(FNPV)を得るために、便益(増分料金収入)と市場価格に基づいた費用を考慮したうえで、本事業の純便益が計算される。

財務費用に、価格上昇予備費、建中金利、その他財務費用は含まれない。FIRR と FNPV は金利支払い前のキャッシュフローに基づいて計算される。

経済分析は、国家経済の観点から本事業の採算性を評価するために実施される。経済的内部収益率(EIRR)・経済的正味現在価値(ENPV)を得るために、標準電力料金の一要素である環境課徴金の経済便益と経済費用を考慮して、本事業の純便益が計算される。

EIRR、ENPV の計算では、国家経済にとっての実際の費用を評価するため、本事業費用が経済費用に転換される。この点において、国家経済内の移転費用（例：税金）は、国にとって便益でも費用でもないので、計算から除かれる。

本事業のキャッシュフローは、IRR、NPV 計算のために準備される。これらの数字は、以下の計算式により算出される。IRR は NPV をゼロとする収益率に等しい。NPV 計算のために、事前に決められた割引率が使われる。

$$\sum_{t=1}^n \{(B-C)_t \div (1+r)^t\} = 0$$

B=便益, C=費用, t=t 年目(1,2,3...n), n=プロジェクトライフ, r=IRR

IRR、NPV 計算において、純増分便益・費用を決定するため、「本事業実施」、「本事業実施せず」の2つのケースが検討される。本事業はメデューピ TPS の敷地内に建設され、本事業による農産物などの便益の逸失が予期されていないため、「本事業実施」の場合の逸失便益は、本事業の純増分便益評価で予期されていない。

13.2 財務経済分析で使われる前提条件

このセクションでは、調査結果に基づき、IRR・NPV 計算に使われる主な前提条件を記述する。

13.2.1 財務・経済分析のケース

財務分析は2つのケースに分けられる。ケース1は、1) 発電所、2) FGD の合算費用と電力料金による便益に基づく。ケース2は、FGD のみの費用と FGD 関連費用に相当する電力料金の便益に基づく。

経済分析は1つのケースのみであり、FGD 関連費用と環境課徴金による収益に基づく。

表 13.2-1 財務経済分析のケース

分析	プロジェクト費用	便益
財務分析（ケース1）	発電所・FGD 合算費用	電力料金
財務分析（ケース2）	FGD 費用	FGD 費用を賄う料金
経済分析	FGD 費用	環境課徴金

出典：JICA 調査団にて作成

13.2.2 プロジェクトライフ、残存価額、価格ベース

Eskom が適用する会計原則によると、1) 建物・施設、2) 発電所の耐用年数は6年から80年と幅広い。さらに、建設スケジュールにより、メデュピ TPS、FGD ユニットの操業開始年は異なる。

分析を簡単にするため、本事業は、建設期間を含めて経済的耐用年数を50年とする。

表 13.2-2 資産種類に基づく減価償却年数

資産種類	減価償却年数（年）
建物・施設	10-40
発電所	6-80

出典：Eskom, “Annual Financial Statements 31 March 2017”, p. 34

経済的耐用年数に達した時点で、本事業の資産には残存価格がないと想定する²²。便益・費用は、2017年の南アフリカ・ランドで表示される。

13.2.3 メデュピ TPS の商業運転スケジュール

メデュピ TPS の商業運転は、表 13.2-3 に示す通り予定されている。ユニット4、5、6は、それぞれ2017年11月、2017年4月、2015年8月に商業運転を開始している。

財務分析ケース1の増分発電量は、商業運転スケジュールに基づいて計算されている。

²²操業終了時に施設・機材がスクラップとなり市場で販売されれば、多少の金銭的残存価値はあるかもしれない。しかし、金銭価値の評価は不確実性と難しさがあるため、財務経済分析では考慮しない。

表 13.2-3 メデューピ TPS の商業運転スケジュール

ユニット	商業運転開始日
ユニット 6	2015 年 8 月 23 日
ユニット 5	2017 年 4 月 3 日
ユニット 4	2017 年 11 月 28 日
ユニット 3	2019 年 6 月
ユニット 2	2019 年 12 月
ユニット 1	2020 年 5 月

出典: Eskom, “Medupi Power Station Project”, June 2017 (Presentation for JICA)

注: ユニット 4 は、当初予定 (2018 年 7 月) より早く、2017 年 11 月に商業運転を開始した。詳細は、Eskom のウェブサイト参照。(http://www.eskom.co.za/news/Pages/Novv28.aspx)

13.2.4 電力料金

(1) 財務分析 (ケース 1)

標準料金価格が、ケース 1 のキロワット時 (kWh) あたりの財務便益単価として使われる。現在の標準料金価格は、kWh あたり 89.13 セント (0.8913 ランド) であり、2017/18 年の複数年価格決定 (MYPD: Multi Year Price Determination) に基づき計算された。

Eskom は、2017 年 9 月に南アフリカエネルギー規制庁 (NERSA) に 2018/19 年収益申請を提出し、2018/19 年許容収益の増加 (2195 億ランド) を要求している。この増加により、kWh あたり 106.87 セント (1.0687 ランド) の標準料金価格となる²³。

NERSA は、2017 年 12 月 15 日に Eskom 収益申請に対する決定を下している。この決定に基づき、財務分析 (ケース 1) には、kWh あたり 93.79 セント (0.9379 ランド) を適用する。

(2) 財務分析 (ケース 2)

財務分析 (ケース 2) は、FGD 費用のみに基づいて実施するため、必要な費用すべてと資産に対するリターンをカバーする標準料金の適用は正当化できない。FGD 機器は、販売用電力を発電するものではないため、ケース 2 の料金は、財務的正味現在価値をほぼゼロにするよう計算し、電力料金への追加的費用としてのインパクトを検証する²⁴。

13.2.5 石炭

財務分析ケース 1 は、発電所・FGD 合算費用と発電所による発電電力向け料金に基づくので、石炭費用がケース 1 の財務費用に含まれる。

kWh あたりの石炭費用は、以下のように算出されている。この計算に基づき、財務分析 (ケース 1) には、0.175 ランド/kWh が適用される。

²³ 収益申請 (2018/19 年) のより詳細な説明は、「13.5.3 財務・ガバナンス課題への対策」を参照。

²⁴ この電力料金に関する詳細な説明は、「13.3.2 財務便益」を参照。

表 13.2-4 kWh あたり石炭費用

項目	数値	単位	計算式
A 石炭単価	393	Rand/ton	
B 石炭カロリー値	4696	kcal/kg	
C 発電端熱効率	41.2	%	
D 変換係数	860	kcal/kWh	
E kg あたり発電量	2.25	kWh/kg	CxC/E
kWh あたり石炭費用	0.175	Rand/kWh	A/E

出典：石炭費用単価は、Eskom, "Revenue Application FY2018/19" FIGURE 31: AVERAGE DELIVERED R/TON COAL COST, p. 77, August 2017 に基づく。

13.2.6 水

以下のように、発電所、FGD いずれにも水が利用される。水単価は立方メートル当たり 14 ランドと想定される²⁵。

表 13.2-5 発電所・FGD の必要水量

年間使用量想定(百万立方メートル/年)	
発電所	6.0
FGD	6.0 (ガスクーラーあり)

出典：JICA 調査団にて作成

財務分析（ケース 1）では、発電所・FGD 両方の水費用、ケース 2 では FGD のみの水費用を想定している。

水は国内で調達され、本事業への水の販売は、国の経済にとって収益でも費用でもないの
で、経済分析では、水費用は経済費用に含めない。

13.2.7 石灰石・石膏

FGD6 ユニット操業に、石灰石が 1 日あたり 3500 トン（126 万トン/年）消費されると想定されている。石灰石単価（トンあたり 475 ランド）にもとづき、GWh・ユニットあたりの石灰石費用は、2 万ランドと算出されている。

表 13.2-6 GWh あたり石灰石費用

項目	数値	単位	計算式
A 消費量/日/6 ユニット	3,500	トン/日/6 ユニット	
B 消費量/日/ユニット	583	トン/日/ユニット	A/6
C 消費量/年/ユニット	212,917	トン/年/ユニット	Bx365 日
D 石灰石単価/トン	475	ランド/トン	
E 石灰石費用/年/ユニット	101	百万ランド/年/ユニット	CxD
F 発電量/年/ユニット	5,008	GWh/年/ユニット	
G 石灰石費用/GWh/ユニット	0.02	百万ランド/GWh	E/F

出典：石灰石トンあたり単価は、石灰石(96 percent CaCO₃)単価に基づく。Table 3-2 Economic Evaluation Criteria, CAPITAL AND O&M COST ESTIMATES, Medupi FGD Retrofit Project, 29 September 2014 を参照。

²⁵ 水の消費量・費用の詳細分析については、「Table 6.2 1 Comparison of Wet FGD with/without gas cooler」を参照のこと。

FGD6 ユニット操業により、石膏は1日あたり 6000 トン（年間 219 万トン）の生産が見込まれる。しかし、FGD 操業により生産された石膏が国内外市場で販売できるかどうかは現時点では明らかでない。そのため、石膏販売収入は、本事業便益として考慮しない。

13.2.8 維持管理費用

資本・維持管理費用見積りに関する報告書によると、維持管理費用は EPC 費用の 1.25% と見積もられており、物品費用（0.75%）と労働費用（0.5%）で構成される²⁶。

よって、財務分析の維持管理費用は、発電所・FGD 合算 EPC 費用（ケース 1）、FGD 費用（ケース 2）の 1.25% と想定する。

経済分析の維持管理費用として、物品費用の 0.75% を想定する。労働費用は南アフリカ経済にとって、収益でも費用でもないとし、物品費用は海外へ支払われると想定する。

13.2.9 基準レート

基準レートは、FIRR、EIRR と比較することによって、それぞれ実施機関、国家経済の観点から本事業を実施すべきかどうかを判断する要素として使われる。

財務分析で使われる基準レートは、原則として資本機会費用の概念に基づき算出される。Eskom は、2018/19 年収益申請で資産利益率のベースとして、加重平均資本コストを 2.97% としている²⁷。Eskom の実際の税前加重平均資本コストは 8.4% である²⁸。しかし、消費者への悪影響を最小化するため、収益申請では 8.4% の代わりに 2.97% を使うことを決定した。

世界銀行とアフリカ開発銀行は、ディーゼル発電機など割高な電源の代替という重要な経済便益が生み出されると想定して、メデュピ TPS ロジェクト審査の経済分析において、それぞれ 10%、11% を社会的割引率の数字として採用している。しかし、「13.4.2 経済便益」で説明されているように、健康費用の削減は評価が困難で、SO₂ 排出と疾病率・死亡率の増加の因果関係は証明が難しく、本事業（FGD の設置）により、代替電源費用の節約のような具体的かつ大きな経済便益が生み出されるとは考えにくい。

よって、本報告書では、ENPV 算出に、財務分析の基準レートより若干低い 2% を適用する。

²⁶ パーセンテージの数字は、“3.7 MAINTENANCE MATERIAL AND LABOR COST”, CAPITAL AND O&M COST ESTIMATES, Medupi FGD Retrofit Project, 29 September 2014 の数字に基づく。

²⁷ Eskom, “Revenue Application FY2018/19”, TABLE 4: ALLOWABLE REVENUE, p. 28, August 2017.

²⁸ Eskom, “Revenue Application FY2018/19”, TABLE 6: COST OF CAPITAL, p. 57, August 2017.

13.2.10 所内率・送配電ロス

財務分析では、1) 消費者に到達した電力量と 2) 増分収益を算出するため、所内率（7.81%）、送電ロス（2.8%）、配電ロス（7.5%）の数字を使用する。

表 13.2-7 所内率・送配電ロス

項目	パーセンテージ
所内率	7.81%
送電ロス	2.8%
配電ロス	7.5%

出典：所内率は、Eskom, "Revenue Application 2018/2019", Table 29 Environmental Levy, August 2017 の 2017/18 年の予測に基づく。送配電ロスの数字は、Figure 11: Energy Wheel 2017/18 に基づく。

13.2.11 標準変換係数

標準変換係数（SCF）は、南アフリカ政府の政策、関税、補助金による市場のひずみのレベルを推定する指標である。ひずみがあると想定する内貨費用を、ひずみを除去し、経済費用に転換するときに、SCF を経済分析に適用する。

SCF は、以下の計算式、直近の貿易額・関税額に基づき、0.92 と計算される。数字はほぼ 1 になるので、国内市場価格にひずみはあまりないと結論できる。

$$SCF = \frac{\text{輸入(運賃保険料込み価格)} + \text{輸出(本船渡し価格)}}{[(\text{輸入} + \text{輸入関税}) + (\text{輸出} + \text{輸出補助金} - \text{輸出税})]}$$

表 13.2-8 標準変換係数

輸入	輸出	輸入関税	輸出税	輸出補助金	SCF
1,098	1,096	197	0	0	0.92

出典：輸入、輸出の数字は、“SA Trade Statistics for December 2016 (including BLNS)”に基づく。輸入関税は、“2016 Tax Statistics Chapter 5 Import VAT Customs Collections, Figure 5.1, 5.2”による。

注：輸入、輸出の数字は、2016 年 1 月～12 月の累積の数字だが、輸入関税は、2015 年 4 月から 2016 年 3 月の数字である。

労働費用に関しては、熟練労働者賃金には重要なひずみはないと想定する。非熟練労働者の場合、南アフリカには失業があり、2017 年第 3 四半期には失業率が 27.7%に達している²⁹。そのため、労働市場では最低賃金を下回る賃金が広まっていることもあり得る。そのため、非熟練労働者の本事業雇用による機会費用を賃金の 50%とし、同労働者の経済費用に相当すると想定する。

13.3 財務分析

ここでは、まずケース 1、2 の財務費用を提示する。次に、財務便益を特定し、数値化する。最後に前提条件、財務便益・費用に基づいて、FIRR、FNPV を算出し、提示する。

²⁹ Statistics South Africa, “Quarterly Labor Force Survey Quarter 3: 2017”, Table E: Unemployment rate by province, 31 31 October 2017

13.3.1 財務費用

財務費用は、本事業費用見積もりに提示されるプロジェクト費用に基づく。財務費用は、1) 初期投資費用と 2) 石炭、水、石灰石を含む年間維持管理費用から構成される。

本事業費用には、設計・調達・建設（EPC）費用、コンサルティングサービス、物理的予備費、価格上昇予備費、財務費用、管理費用、税金、その他費用が含まれる。一方、財務費用は実施機関の観点からプロジェクト実績を評価するために使われ、価格上昇予備費、建中金利、財務費用は除外される。

発電所・FGD は不可分のプロジェクトとみなすため、ケース 1 の財務費用には過去の支出、今後の支出を含めた石炭火力発電所費用が含まれる³⁰。過去・将来の費用は、基準レートにより割引され、現在価値に変換される。

表 13.3-1 発電所の過去支出費用の現在価値

	Total	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1. Past disbursement of Medupi power plant (Foreign cost)	18,662	2,068	3,056	2,808	3,280	2,527	1,347	503	944	531	745	853
2. Past disbursement of Medupi power plant (local cost)	69,015	2,424	5,603	6,570	9,612	8,611	6,357	5,955	6,226	5,731	5,926	6,002
3. Total past disbursement (1+2)	87,677	4,491	8,659	9,378	12,892	11,138	7,704	6,458	7,170	6,261	6,670	6,854
4. Present value of foreign cost	22,673	2,771	3,977	3,549	4,026	3,012	1,559	565	1,031	563	767	853
5. Present value of local cost	79,933	3,248	7,292	8,303	11,797	10,264	7,359	6,695	6,797	6,076	6,102	6,002
6. Total present value (4+5)	102,606	6,018	11,269	11,852	15,823	13,276	8,918	7,260	7,828	6,639	6,868	6,854

出典：Eskom 提供の数値に基づいて JICA 調査団にて作成

注：費用は、EPC 費用と予備費のみを含む。管理費、税、建中金利といった費用は含まれていない。

財務費用（ケース 1）の要約と年次支出は以下の表に示すとおりである。

表 13.3-2 本事業完工時の財務費用（ケース 1：発電所費用含む）

（単位：百万ランド）

項目	財務費用		
	外貨	内貨	合計
EPC 費用	7,876	3,674	11,550
コンサルティングサービス	798	330	1,129
価格上昇予備費	0	0	0
物理的予備費	889	403	1,291
建中金利	0	0	0
小計：適格ポーション	9,563	4,407	13,970
小計：非適格ポーション	2,909	17,264	20,173
発電所費用	917	12,676	13,593
合計	13,389	34,347	47,737

出典：JICA 調査団にて作成

注：メデューピ TPS 過去支出分の現在価値額は、この表に含めていない。

³⁰現在価値のもととなる理論から考えれば、発電所の過去の支出は埋没費用とみなされるべきであり、「プロジェクトあり」、「プロジェクトなし」のいずれでもこの費用に違いはないので、IRR 計算に影響を与えず、財務費用に含める必要はない。

表 13.3-3 財務費用年次支出（ケース 1：発電所費用含む）

(単位：百万ランド)

Year	発電所			FGD			合計
	外貨	内貨	小計	外貨	内貨	小計	
1 年目	678	6,438	7,116	0	0	0	7,116
2 年目	278	2,951	3,229	0	0	0	7,116
3 年目	(38)	3,287	3,248	615	981	1,596	4,826
4 年目	0	0	0	2,709	4,844	7,554	10,802
5 年目	0	0	0	2,357	4,130	6,488	6,488
6 年目	0	0	0	2,626	4,584	7,210	7,210
7 年目	0	0	0	2,122	3,691	5,813	5,813
8 年目	0	0	0	1,182	1,983	3,166	3,166
Total	917	12,676	13,593	12,473	21,671	34,143	47,737

出典：JICA 調査団にて作成

注：メデュピ TPS 過去支出分の現在価値額は、この表に含めていない。

財務費用（ケース 2）の要約、年次支出は、以下の表に示すとおりである。

表 13.3-4 本事業完工時の財務費用（ケース 2：発電所費用含まず）

(単位：百万ランド)

項目	財務費用		
	外貨	内貨	合計
EPC 費用	7,876	3,674	11,550
コンサルティングサービス	798	330	1,129
価格上昇予備費	0	0	0
物理的予備費	889	403	1,291
建中金利	0	0	0
小計：適格ポーション	9,563	4,407	13,970
小計：非適格ポーション	2,909	17,264	20,173
合計	12,473	21,671	34,143

出典：JICA 調査団にて作成

表 13.3-5 財務費用年次支出（ケース 2：発電所費用含まず）

(単位：百万ランド)

年	財務費用		
	外貨	内貨	合計
1 年目	0	0	0
2 年目	615	981	1,596
3 年目	2,709	4,844	7,554
4 年目	2,357	4,130	6,488
5 年目	2,626	4,584	7,210
6 年目	2,122	3,691	5,813
7 年目	1,182	1,983	3,166
8 年目	497	855	1,352
9 年目	363	602	966
合計	12,473	21,671	34,143

出典：JICA 調査団にて作成

13.3.2 財務便益

プロジェクトの財務パフォーマンスは、Eskom の観点から評価される。プロジェクトの財務便益は、電力販売による増分収益である。

メデュピ TPS 1 ユニット当たりの増分発電量は、以下のように計算される。

ユニット当たり年間総発電量 (GWh) : 794 MW x 8760 時間 x 80% (稼働率) x 90% (設備利用率) = 5008 GWh

財務便益の計算に使われる発電量はケース 1, 2 で異なる。ケース 1 では、所内率、送配電ロス差引後の消費者に到達した純増分電力を使うが、ケース 2 では、FGD 設置済みユニットにより発電された電力を使う。これは、ケース 2 の財務費用は FGD 関連費用のみで構成され、ケース 2 の財務便益は、FGD 付きユニットによる電力量に制限されるからである。

表 13.3-6 財務便益

分析	発電電力	便益
財務分析 (ケース 1)	各ユニットによる発電量	電力料金
財務分析 (ケース 2)	FGD 付きユニットによる発電量	FGD 関連費用をカバーする電力料金

出典：JICA 調査団にて作成

ケース 1 では、特定の年の増分収益の便益は、純増分発電量に平均電力料金 (kWh あたり 0.9379 ランド) を掛けて算出する。

ユニット・年あたり増分収益 = 純増分販売電力 x 0.9379 ランド/kWh

表 13.3-7 増分収益 (ケース 1 : 発電所費用あり)

(単位：百万ランド)

年	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Total
2018	0	0	0	3,846	3,846	3,846	11,539
2019	0	321	2,244	3,846	3,846	3,846	14,103
2020	2,564	3,846	3,846	3,846	3,846	3,846	21,796
2021 以降	3,846	3,846	3,846	3,846	3,846	3,846	23,078

出典：JICA 調査団にて作成

ケース 2 では、増分収益の便益は、FGD 付きユニットによる純増分発電量と仮定の電力料金 (0.0984 ランド/kWh) を掛けることにより算出され、結果として、ケース 2 の FNPV をほぼゼロにする。これは、FGD 施設が直接的に財務便益を生み出すものではなく、その代わりに、ケース 2 の財務分析は、FNPV をゼロとする料金レベルと、料金全体にどのようなインパクトを及ぼすかを推定することを意図しているためである。

FGD 付きユニット・年あたり増分収益 = 純増分販売電力 x 0.0984 ランド/kWh

表 13.3-8 増分収益（ケース 2：発電所費用なし）

(単位：百万ランド)

年	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Total
2018-2020	0	0	0	0	0	0	0
2021	0	0	0	0	0	168	168
2022	0	0	0	0	0	404	404
2023	0	0	0	67	135	404	606
2024	0	0	168	404	404	404	1,380
2025	236	404	404	404	404	404	2,255
2026 以降	404	404	404	404	404	404	2,424

出典：JICA 調査団にて作成

13.3.3 財務的内部収益率・正味現在価値

FIRR を得るため、便益・費用は、2017 年価格によりまとめられ、計算される。さらに、FNPV を算出するため、割引率 2.97%を使用する。この結果、ケース 1 の FNPV はプラスになる。

表 13.3-9 FIRR・FNPV（ケース 1：発電所費用あり）

FIRR	FNPV (百万ランド)	FNPV (百万ドル)
10.77%	252,058	17,876

出典：JICA 調査団にて作成

これまで発電所に支出された費用の数値は EPC・予備費用のみであり、管理費用、税など通常財務費用に含まれる費用が含まれていないため、この結果は、注意深く見るべきである。さらに、これまで建設された発電所（ユニット 4、5、6）の 2017 年までの増分収益は考慮されていない。

適用した電力料金は、IPP からの購入も含め、効率的な発電所、非効率な発電所の費用を反映していることにも留意すべきである。

一方、ケース 2 は FNPV がほぼゼロとなる料金を適用したため、FNPV は若干のプラスとなる。

表 13.3-10 FIRR・FNPV（ケース 2：発電所費用なし）

FIRR	FNPV (百万ランド)	FNPV (百万ドル)
2.97%	4	0

出典：JICA 調査団にて作成

ケース 2 に適用した料金は仮定のものであるが、料金全体への影響を分析する価値はある。もしケース 2 に適用した料金を配電電力量で割ると、kWh あたり 0.0984 ランドとなり、NERSA が決定した標準料金の 8.1%となる。この数字は、将来 FGD 関連費用回収のため、料金値上げへの圧力にもなりうることを示唆している。

表 13.3-11 ケース 2 に適用した料金の標準料金レベルへの影響

項目	数値	単位
A. ケース 2 仮定上の料金収入	2,424	百万ランド
B. 配電電力量	24,606	GWh
C. 仮定上のケース 2 適用料金 (A/B)	0.0984	ランド/kWh
D. NERSA 決定に基づく標準料金	0.9379	ランド/kWh
E. 標準料金に対する仮定上の料金の割合 (C/D)	10.49%	

出典：JICA 調査団にて作成

実際の状況はベースケースで想定されたものと異なるかもしれないので、ケース 1、2 それぞれに感度分析を実施する。感度分析では、1) 費用増加 (10%)、2) 建設遅延 (1 年)、3) 基準レート (8.4%³¹) を検討する。

ケース 1 の FNPV は、すべてのケースでプラスである。基準レートに 8.4%を適用しても、FNPV はプラスとなる。費用増加、建設遅延は、FIRR、FNPV に少しマイナスの影響を与える。

表 13.3-12 財務分析（ケース 1：発電所費用あり）感度分析

ケース	便益	費用	FIRR	FNPV	
			(%)	(百万ランド)	(百万ドル)
ベースケース	変化なし	変化なし	10.77%	252,058	17,876
費用増加 (+10%)	変化なし	+10%	10.51%	247,796	17,574
建設遅延 (1 年)	変化なし	変化なし	9.98%	240,049	17,025
基準レート (8.4%)	変化なし	変化なし	10.77%	36,325	2,576

出典：JICA 調査団にて作成

ケース 2（発電所費用なし）の FNPV は、ベースケース以外すべてマイナスとなる。ケース 2 想定料金は仮定のものであるが、本事業実施にあたり注意深い管理が必要という結論となる。

表 13.3-13 財務分析（ケース 2：発電所費用なし）感度分析

ケース	便益	費用	FIRR	FNPV	
			(%)	(百万ランド)	(百万ドル)
ベースケース	変化なし	変化なし	2.97%	4	0
費用増加 (+10%)	変化なし	+10%	2.47%	(2,965)	(210)
建設遅延 (1 年)	変化なし	変化なし	2.91%	(323)	(23)
基準レート (8.4%)	変化なし	変化なし	2.97%	(12,972)	(920)

出典：JICA 調査団にて作成

³¹ 8.4%は、Eskom の税前加重平均資本コストの数値である。

13.4 経済分析

このセクションでは、最初に本事業の経済費用（FGD 費用のみ）を特定する。次に、環境課徴金に基づき、経済便益を定量化する。最後に、前提条件、費用、便益に基づき、EIRR、ENPV を算出し、提示する。

13.4.1 経済費用

経済費用は、本事業費用見積もりに示される費用に基づいている。内貨建てプロジェクト費用項目は、それぞれ変換係数を適用し、経済費用に転換される。すでに国境価格となっている費用項目は、調整されない。

経済費用は、国家経済の観点から本事業のパフォーマンスを評価するために使われ、価格上昇予備費、関税・税金、建中金利は除外される。税金は、国家経済内の移転支出であり、実際の費用とはならないので含まれない。同様に、水も経済費用に含めない。

財務分析とは異なり、経済便益は、主に FGD 操業による SO₂ 削減によるものであり、経済費用には、FGD 関連費用のみ含まれており、発電所建設関連費用は除外されている。

表 13.4-1 完工時の本事業経済費用（FGD 費用のみ）

(単位：百万ランド)

項目	財務費用		
	外貨	内貨	合計
EPC 費用	7,876	3,372	11,248
コンサルティングサービス	798	303	1,101
価格上昇予備費	0	0	0
物理的予備費	889	370	1,258
建中金利	0	0	0
小計：適格ポーション	9,563	4,044	13,607
小計：非適格ポーション	2,909	11,609	14,519
合計	12,473	15,654	28,126

出典：JICA 調査団にて作成

表 13.4-2 経済費用年次支出

(単位：百万ランド)

年	経済費用		
	外貨	内貨	合計
1 年目	0	0	0
2 年目	615	713	1,328
3 年目	2,709	3,490	6,199
4 年目	2,357	2,981	5,339
5 年目	2,626	3,309	5,935
6 年目	2,122	2,666	4,788
7 年目	1,182	1,439	2,621
8 年目	497	619	1,116
9 年目	363	436	799
合計	12,473	15,654	28,126

出典：JICA 調査団にて作成

13.4.2 経済便益

(1) 経済便益定量化に関する制約

経済分析を始める前に、環境、健康に影響を与えるプロジェクトの経済分析に固有の難しさがあることに言及すべきであろう。疾病率・死亡率の低下という健康悪化に伴う費用の回避は、本事業の主要な経済便益とみなせる。しかし、メデュピ TPS の健康悪化に伴う費用回避の実証研究や厳密な調査がない。

(2) 環境課徴金

環境課徴金が発電による悪影響を受ける人間の健康費用、もしくは、そのような悪影響を防ぐ手段の費用という想定に基づき、経済分析では、経済便益算出の次善の策として、電力料金の 1 要素である環境課徴金³²を使用する。

2012 年 7 月以来、kWh あたり 3.5 セント (0.035 ランド) が環境課徴金として適用されており、経済便益算出に使用される。

(3) 経済便益

経済便益のフローは、表 13.4-3 に示すとおりである。

表 13.4-3 増分経済便益

(単位：百万ランド)

FY	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Total
2018-2020	0	0	0	0	0	0	0
2021	0	0	0	0	0	73	73
2022	0	0	0	0	0	175	175
2023	0	0	0	29	58	175	263
2024	0	0	73	175	175	175	599
2025	102	175	175	175	175	175	979
2026 onward	175	175	175	175	175	175	1,052

出典：JICA 調査団にて作成

13.4.3 経済的内部収益率・正味現在価値

これまでに記述、算出した前提条件、費用、便益に基づき、EIRR、ENPV を計算し、提示する。

EIRR を得るために、経済便益・費用がまとめられ、社会的割引率 (2%) により割引し、ENPV を算出する。EIRR は-3.25%となり、ENPV はマイナスとなる。しかし、もし環境課徴金を若干高くすれば (0.05904 ランド/kWh)、EIRR は 2%と基準レートと等しくなり、ENPV は若干のプラスとなる。

³² Eskom 収益申請 (2018/19 年) によると、2009 年 7 月以来、非再生可能エネルギー発電機による発電に対して、環境課徴金が課されている。環境課徴金は、国家徴税組織である南アフリカ歳入サービス (SARS) に納入される。“Environmental Levy on Electricity Generated in South Africa” を参照。
(<http://www.sars.gov.za/ClientSegments/Customs-Excise/Excise/Environmental-Levy-Products/Pages/Electricity-Generation-Levy.aspx>)

表 13.4-4 経済的内部収益率・正味現在価値

EIRR	ENPV (百万ランド)	ENPV (百万ドル)
-3.25%	(18,650)	(1,323)

出典：JICA 調査団にて作成

経済分析でも感度分析を行う。費用増加、建設遅延、より低い基準レート（1%）が検討される。

表 13.4-5 経済分析感度分析

ケース	便益	費用	EIRR	ENPV	
			(%)	(百万ランド)	(百万ドル)
ベースケース	変化なし	変化なし	-3.25%	(18,650)	(1,323)
費用増加 (+10%)	変化なし	+10%	-3.57%	(21,208)	(1,504)
建設遅延 (1 年)	変化なし	変化なし	-3.40%	(18,382)	(1,304)
低い割引率(1%)	変化なし	変化なし	-3.25%	(17,850)	(1,266)

出典：JICA 調査団にて作成

費用増加、建設遅延、より低い割引率の場合、いずれも ENPV はマイナスとなる。

13.5 Eskom の財務状況・ガバナンスの課題³³

本事業の財務経済分析に加えて、Eskom のビジネス事業体としての財務状況全般とガバナンスに関する課題について分析することは、ビジネスの継続と本事業融資の返済能力を分析するためにも重要である。

最初に直近 3 事業年度の財務諸表に基づき、損益計算書、貸借対照表、キャッシュフロー計算書、最近の流動性危機に焦点をあて、Eskom 財務状況全般を概観する。次に、ガバナンスが Eskom の財務状況に影響を与えているため、ガバナンスの課題についても提示し、分析する。第三に、財務・ガバナンスの課題に対処するため Eskom がとってきた、また今後とる手段について提示する。最後に、事業継続および融資返済のための Eskom 財務能力について分析する。

13.5.1 Eskom の財務状況

(1) Eskom 損益計算書

Eskom の最近の財務諸表によると、過去 3 事業年度では、収益が毎年 7～9%程度着実に増加してきた。金利・税金・償却前利益（EBITDA）は収益よりもさらに多く、2016 年は前年比 41.1%、2017 年は 14.4%増加している。

しかし、連結損益計算書では税引後利益を出しているものの、純財務費用が大きく増加しており、単体損益計算書では 2015 年、2017 年に税引後損失を出している。

³³ 当セクションの分析は、2018 年 4 月までに入手したデータ、情報に基づいている。

表 13.5-1 Eskom 連結損益計算書(2015-2017)

	Unit: ZAR in million			% change from previous year	
	2015	2016	2017	2016	2017
A. Total revenue	152,135	166,629	178,709	9.5%	7.2%
B. Operating expense (1+2+3)	(128,874)	(133,818)	(141,177)	3.8%	5.5%
1) Primary energy	(83,425)	(84,728)	(82,760)	1.6%	-2.3%
2) Employee benefit expense	(25,912)	(29,257)	(33,178)	12.9%	13.4%
3) Other expenses	(19,537)	(19,833)	(25,239)	1.5%	27.3%
C. Earning before interest, tax, depreciation and amortization (EBITDA) (A-B)	23,261	32,811	37,532	41.1%	14.4%
1) Depreciation and amortisation expense	(14,115)	(16,633)	(20,300)	17.8%	22.0%
2) Other expense	(2,807)	(455)	(1,731)	-83.8%	280.4%
D. Profit before net finance cost	6,339	15,723	15,501	148.0%	-1.4%
Net finance cost & other cost	(6,060)	(7,876)	(14,342)	30.0%	82.1%
E. Profit before tax (C-D)	279	7,847	1,159	2712.5%	-85.2%
Income tax	(37)	(2,696)	(271)	7186.5%	-89.9%
F. Net Profit after Income Tax	242	5,151	888	2028.5%	-82.8%
F. Net Profit after Income Tax (non consolidated)	(622)	3,136	(870)	-604.2%	-127.7%

出典：Eskom, “Annual Financial Statements 31 March 2017”, “Annual Financial Statements 31 March 2016”

注：Eskom の事業年度は 4 月開始、3 月終了である。2017 年度は、2016 年 4 月から 2017 年 3 月の年度を指す。

注：2016 年度の数字は、2017 年度適用の会計原則により修正されているが、2015 年度は修正されていない。

総収益に対する各項目の比率として示されている数値から、Eskom が操業費用を抑制しようと努力しており、財務費用増加が利益レベルへ悪影響を与えていることは明らかである。

総収益に対する操業費用の割合は、2015 年の 84.7%から 2017 年の 79.0%へ着実に減少している。特に、一次エネルギー費用は、同時期に 8 ポイント近く減少している。その結果、EBITDA は 2015 年の対総収益 15.3%から 2017 年の 21.0%へ改善している。

表 13.5-2 総収益に対する費用・利益の割合

	2015	2016	2017
A. Total revenue	100.0%	100.0%	100.0%
B. Operating expense (1+2+3)	-84.7%	-80.3%	-79.0%
1) Primary energy	-54.8%	-50.8%	-46.3%
2) Employee benefit expense	-17.0%	-17.6%	-18.6%
3) Other expenses	-12.8%	-11.9%	-14.1%
C. Earning before interest, tax, depreciation and amortization (EBITDA) (A-B)	15.3%	19.7%	21.0%
1) Depreciation and amortisation expense	-9.3%	-10.0%	-11.4%
2) Other expense	-1.8%	-0.3%	-1.0%
D. Profit before net finance cost	4.2%	9.4%	8.7%
Net finance cost & other cost	-4.0%	-4.7%	-8.0%
E. Profit before tax (C-D)	0.2%	4.7%	0.6%
Income tax	0.0%	-1.6%	-0.2%
F. Net Profit after Income Tax	0.2%	3.1%	0.5%

出典：Eskom, “Annual Financial Statements 31 March 2017”, “Annual Financial Statements 31 March 2016”に基づき JICA 調査団にて作成

一方、財務費用の負担は過去3年で、2015年の総収益の4%から2017年の8%へ倍増している。この増加は、主に、1) Eskom がメデュピ、クシレ TPS を含む大規模な投資プログラムを実施しており、2) これに伴い、債務残高も増加しているためである。

債務残高の増加に加えて、借入コストが債務増加よりも速いペースで急速に上昇している。2017年の借入コスト（5.8%）は、2015年（3.3%）のほぼ倍となる。

表 13.5-3 Eskom 債務残高・借入コスト

	2015	2016	2017
A. Debt securities and borrowings	277,458	306,970	336,770
% change from previous year		10.6%	9.7%
B. Finance Cost	9,105	11,366	19,589
% change from previous year		24.8%	72.3%
C. Borrowing cost (A/B)	3.3%	3.7%	5.8%

出典：Eskom, “Annual Financial Statements 31 March 2017”, “Annual Financial Statements 31 March 2016”に基づき JICA 調査団にて作成

注：財務費用は総額であり、銀行預金口座金利などの財務収益は差し引かれず、純財務費用ではない。

借入コストの上昇に対しては、Eskom への低い信用格付けが要因の一部として説明できる。信用格付けは、投資家、融資機関、その他利害関係者の Eskom に対する信用力を判断する重要な指標である。

表 13.5-4 2017年3月31日時点の Eskom 信用格付け

レイティング	Standard & Poor's	Moody's	Fitch: Local Currency
外貨	BB-	Ba1	n/a
内貨	BB-	Ba1	BBB-
スタンダードアローン	ccc+	b3	B-
見通し	悲観的	悲観的	悲観的

出典：Eskom, “Integrated report, p.89, March 31, 2017

注：スタンダードアローンは、親会社、関連会社、政府からの例外的な介入がない状態での債券発行者の信頼性に対する意見であり、信用格付けの1要素である。

ムーディーズは、Eskom 企業格付けを 2017 年 4 月に Ba1 から Ba2、2018 年 1 月に B1 に引き下げた。さらに、2017 年 11 月、スタンダード・アンド・プアーズは、Eskom の長期外貨・内貨建て信用格付けを B-に引下げ、悲観的な見通しを維持し、スタンドアローン評価を ccc+から ccc-に変更している³⁴。Eskom が 2018/19 年収益申請の公聴会で言及しているように³⁵、格付け機関は、Eskom の信用を投資に値せず、中期的には債務不履行の可能性が高いと評価している。

Eskom は、現在の信用格付けレベルによる借入コストの上昇と資金確保の困難を認識している³⁶。

(2) Eskom 貸借対照表

前項で説明したように、大規模資本プログラムの実施により、1) 固定資産（資産、設備、機材）と 2) 債券・借入³⁷の残高は、年率 10～13%増加している。

表 13.5-5 Eskom 連結貸借対照表(2015-2017)

	Unit: ZAR in million			% change from previous year	
	2015	2016	2017	2016	2017
Current assets	57,686	90,282	78,879	56.5%	-12.6%
Non-current assets	502,002	592,618	622,331	18.1%	5.0%
<u>-Property, plant and equipment</u>	<u>457,720</u>	<u>520,521</u>	<u>588,867</u>	<u>13.7%</u>	<u>13.1%</u>
Non-current assets held for sale	0	8,925	8,799	-	-1.4%
Total Assets	559,688	691,825	710,009	23.6%	2.6%
Current liabilities	74,635	74,037	78,607	-0.8%	6.2%
Non-current liabilities	366,634	427,545	453,777	16.6%	6.1%
<u>-Debt securities and borrowings</u>	<u>277,458</u>	<u>306,970</u>	<u>336,770</u>	<u>10.6%</u>	<u>9.7%</u>
Non-current liabilities held for sale	0	1,686	1,683	-	-0.2%
Equity	118,419	188,557	175,942	59.2%	-6.7%
Total Liabilities and Equity	559,688	690,139	708,326	23.3%	2.6%

出典： Eskom, “Annual Financial Statements 31 March 2017”, “Annual Financial Statements 31 March 2016”

注：2016 年度の数字は、2017 年度適用の会計原則により修正されているが、2015 年度は修正されていない。

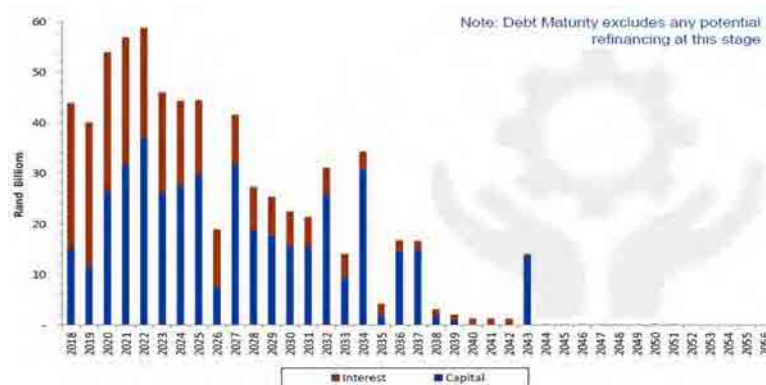
³⁴ 詳細は、Eskom のウェブサイトを参照。(http://www.eskom.co.za/news/Pages/Novv29B.aspx)

³⁵ Eskom, “Eskom 2018/19 Revenue Application” at NERSA Public Hearing Midland, November 16, 2017, p. 25

³⁶ 信用格付けに対する Eskom の見解は、“17.1 Impact of credit rating on funding”, Eskom “Integrated report 31 March 2017” を参照。

³⁷ 公共財政管理法 No.1 (1999) 第 8 章「融資、保証、他のコミットメント」のパート I「一般原則」、セクション 66 では、Eskom をふくむ国営企業が融資、その他の手段で借入することを認めている。しかし、政府保証付きの借入では、条件が付与されている。Eskom は、保証スキームを利用する前に、時期について財務省の同意を得る必要があり、財務省、公営企業省に定期的に保証利用状況について報告することが義務付けられている。

債務残高の増加は、今後 Eskom に更なる財務負担を課すことになりそうである。Eskom の推定によると、現在の債務の利息・元本支払いは、2022 年まで増加し、2023 年から数年は、400 億ランド以上を維持しそうである。



出典：Eskom, “Eskom 2018/19 Revenue Application” at NERSA Public Hearing Midland, November 16, 2017, p. 23

図 13.5-1 2017 年 3 月 31 日時点の Eskom 債務支払い期限プロファイル

(3) Eskom キャッシュフロー計算書

最近の Eskom のキャッシュフローを見ると、営業活動で生み出す現金では、メデュピ、クシレプロジェクトのような資本プログラムを含む投資活動に必要な金額を賄えていない。2017 年は、Eskom 事業は 458 億ランドを生み出す一方、その金額を 35%上回る 622 億ランドを投資している。

表 13.5-6 Eskom 連結キャッシュフロー計算書 (2015-2017)

	Unit: ZAR in million			% change from previous year	
	2015	2016	2017	2016	2017
Net cash flow from operating activities	27,311	37,242	45,841	36.4%	23.1%
Net cash flow from investing activities	(56,386)	(58,590)	(62,286)	3.9%	6.3%
Net cash flow from financing activities	17,954	40,927	7,855	128.0%	-80.8%
Increase/Decrease in Cash During the Year	(11,121)	19,579	(8,590)	-276.1%	-143.9%
Cash and cash equivalents at beginning of the year	19,676	8,863	28,454	-55.0%	221.0%
Movement of exchange rate etc.	308	12	561	-96.1%	4575.0%
Cash and cash equivalents at end of the year	8,863	28,454	20,425	221.0%	-28.2%

出典：Eskom, “Annual Financial Statements 31 March 2017”, “Annual Financial Statements 31 March 2017”

その結果、Eskom は、資本注入と追加借入により、現金不足を補う資金を確保する必要があった。資本に関しては、2016 年に Eskom は 230 億ランドの資本注入を受け、株主（南アフリカ政府）が劣後ローン（600 億ランド）の株式への転換に同意している³⁸。

Eskom は、資金確保のため政府保証に依存している。現在の対 Eskom 政府保証枠は 3500 億ランドである。保証ファシリティーは 2023 年 3 月まで延長されている。Eskom は、現在約 2910 億ランドまで保証枠を利用している³⁹。

³⁸ “Note 24 Share Capital” in Eskom, “Annual Financial Statements March 31 2016”, p. 76 参照。

³⁹ 計画中の JICA 融資額の一部(5 億ドル)は、「交渉中の融資額」に既に含まれている。

表 13.5-7 Eskom 向け政府保証

	額（百万ランド）	上限に対する%
A. 対 Eskom 政府保証上限額	350,000	100.0%
B. コミットされた保証額	291,379	83.3%
C. 利用可能保証額（コミットされていない）(A-B)	58,621	16.7%
D. 交渉中の融資額	53,607	15.3%
E. 純利用可能保証額（C-D）	5,014	1.4%

出典：Eskom 財務部

注：表の数字は 2017 年 10 月時点の額である。

保証スキームは延長されたが、財務大臣は承認のレターにおいて Eskom に対する懸念を表明し、スキームに様々な条件を付与している⁴⁰。

キャッシュフローに対する悪影響の 1 つとして、Eskom の努力にもかかわらず増加する地方自治体の延滞債務が挙げられる⁴¹。Eskom の 2017/18 年中間決算によると、延滞額は、2017 年 3 月時点の 90 億ランドから、毎月平均 5 億ランド増加し、現在 124 億ランドに達している。

表 13.5-8 地方自治体の延滞債務

	単位：十億ランド、%、日			
	2015	2016	2017	2018 (中間)
A) 地方自治体延滞債務	5.0	6.0	9.4	12.4
前年比変化		20.0%	56.7%	31.9%
B) 月次売電収益	12.3	13.5	14.6	16.0
C) 地方自治体延滞債務の月次売電収益に対する割合(A/C)	40.6%	44.5%	64.4%	77.3%
D) 平均回収日数（地方自治体）	47.58	42.93	53.25	63

出典：Eskom. “Integrated Report”, p.35. Eskom, “Annual Financial Statements”, p.6 & 8, March 31, 2017、Eskom, “Eskom group interim results for the six months ended 20 September 2017”, p. 18, January 2018 に基づき JICA 調査団にて作成

注：月次売電収益（2018 年中間決算）は、2017 年 4 月から 9 月の 6 か月の収益に基づいて計算されている。

注：地方自治体の支払い条件の変更（最大 15 日から 30 日）が平均回収日数の長期化に部分的に寄与している。

さらに、月次売電収益に対する地方自治体延滞債務額の割合は、2015 年の 40.6%から 2017 年 3 月の 64.4%、2017 年 9 月の 77.3%へ上昇している。平均債務回収日数は、同時期に 42.93 日から 53.25 日、63 日に長期化している。この状況により、Eskom のキャッシュフロー管理に負担がかかり、事業の運転資金確保のための資金調達を強いられている。

(4) 最近の流動性危機

正確な数値はないが、メディア報道によると、Eskom は流動性危機に直面している⁴²。新聞記事によると、現在の手元運転資金は、事業を継続するために必要な通常の額よりも 20 分の 1 も少なく、2018 年 1 月には 50 億ランドも不足することになるかもしれない。

この状況はいくつかの要因により引き起こされている⁴³。まず、2017/18 年の収益申請に

⁴⁰ Minister of Finance, “Eskom Application for the Approval for the Availability Period Extension from March 2017 to 31 March 2023”, Ref. M4/1/5 (2179/16), March 22, 2017

⁴¹ 過去の地方自治体延滞債務削減に対する Eskom の努力については、“(a) Trade and other receivables”, “5.1.2 Financial instruments managed by various divisions and subsidiaries”, Eskom, “Annual Financial Statements March 31 2017”, p. 49 を参照。

⁴² Business Day, “Eskom runs out of cash as loan facilities dry up”, November 14, 2017,

⁴³ 2017 年 11 月 24 日 Eskom 財務部インタビューに基づく。

対する NERSA 決定に基づく料金増加は 2.2%に過ぎず、インフレ率を下回っている一方、操業費用の絶対額は増加し続けていた。Eskom の文書によると、この増加は、消費者にとって「実質的に電力料金の値下げ」の結果となった⁴⁴。次に、Eskom は、今年度子会社（エスコムファイナンスカンパニー）の売却ができず、キャッシュを追加で得ることができなかった⁴⁵。第三に、Eskom 財務諸表の会計監査承認が遅れ、貸し手からの信頼度が低下する結果となった。最後に、前述の通り、地方自治体の延滞債務の増加が、Eskom の資金繰りを厳しくしている。

(5) Eskom 中間決算(2017/4-9)

2017 年 4-9 月の Eskom 中間決算が 2018 年 1 月末に公表された。2018 年度前期は、電力料金値上げ（2.2%）と売上減少（マイナス 1.9%）により、総収益は前年同期と比べ、2 ポイントの減少となる 962 億ランドとなった。

減価償却費、金融費用の増加により、税引き後利益は 95 億ランドから 63 億ランドへ減少した。

表 13.5-9 Eskom 連結中間損益計算書 (2017/4-9)

	Unit: ZAR in million		% change from
	2017 (Interim)	2018 (Interim)	previous year
A. Total revenue	98,213	96,235	-2.0%
B. Operating expense (1+2+3)	(66,388)	(66,579)	0.3%
1) Primary energy	(40,380)	(41,257)	2.2%
2) Employee benefit expense	(15,758)	(15,153)	-3.8%
3) Other expenses	(10,250)	(10,169)	-0.8%
C. Earning before interest, tax, depreciation and amortization (EBITDA) (A-B)	31,825	29,656	-6.8%
1) Depreciation and amortisation expense	(10,068)	(10,877)	8.0%
2) Other expense	(1,875)	105	-105.6%
D. Profit before net finance cost	19,882	18,884	-5.0%
Net finance cost & other cost	(6,517)	(10,000)	53.4%
E. Profit before tax (C-D)	13,365	8,884	-33.5%
Income tax	(3,822)	(2,572)	-32.7%
F. Net Profit after Income Tax	9,543	6,312	-33.9%

出所: Eskom, “Eskom group interim results for the six months ended 20 September 2017”, January 2018

電力販売には季節変動の傾向がある。年度の前半 6 か月は、後半よりも収益が高い傾向にある。Eskom は、2018 年度は後半の収益減少により、純損失を予想している。

資産・プラント・機材に代表される固定資産は、大規模プロジェクトの実施継続により、年率約 10%で増加し続けており、債務も同様に増加している。

⁴⁴ Eskom, “Eskom 2018/19 Revenue Application” at NERSA Public Hearing Midland, November 16, 2017, p.2

⁴⁵ この売却計画については、IOL Business Report, “Eskom's home loan firm for sale”, July 17, 2016 を参照。
(<https://www.iol.co.za/business-report/companies/eskoms-home-loan-firm-for-sale-735154>)

表 13.5-10 Eskom 連結中間貸借対照表(2017/4-9)

	Unit: ZAR in million		% change from
	2017 (Interim)	2018 (Interim)	previous year
Current assets	90,282	71,400	-20.9%
Non-current assets	592,618	643,351	8.6%
-Property, plant and equipment	<u>557,300</u>	<u>614,195</u>	<u>10.2%</u>
Non-current assets held for sale	8,925	8,823	-1.1%
Total Assets	691,825	723,574	4.6%
Current liabilities	74,037	74,202	0.2%
Non-current liabilities	427,545	465,074	8.8%
-Debt securities and borrowings	<u>317,267</u>	<u>347,584</u>	<u>9.6%</u>
Non-current liabilities held for sale	1,686	1,680	-0.4%
Equity	188,557	182,618	-3.1%
Total Liabilities and Equity	691,825	723,574	4.6%

出所: Eskom, “Eskom group interim results for the six months ended 20 September 2017”, January 2018

低い利益、地方自治体の延滞債務増加のため、営業活動による純キャッシュフローは、前年同期の 320 億ランドから 220 億ランドへと著しく減少した。

表 13.5-11 Eskom 連結中間キャッシュフロー計算書 (2017/4-9)

	Unit: ZAR in million		% change from
	2017 (Interim)	2018 (Interim)	previous year
Net cash flow from operating activities	31,933	22,361	-30.0%
Net cash flow from investing activities	(29,262)	(29,663)	1.4%
Net cash flow from financing activities	(851)	(4,561)	436.0%
Increase/Decrease in Cash During the Year	<u>1,820</u>	<u>(11,863)</u>	<u>-751.8%</u>
Cash and cash equivalents at beginning of the year	28,454	20,425	-28.2%
Movement of exchange rate etc.	37	(55)	-248.6%
Cash and cash equivalents at end of the year	<u>30,311</u>	<u>8,507</u>	<u>-71.9%</u>

出所: Eskom, “Eskom group interim results for the six months ended 20 September 2017”, January 2018

Eskom は、2018 年度前半に必要な資金の 54%を確保したが、財務活動のキャッシュフローは前年同期の 8.5 億ランドのマイナスと比べて、45.6 億ランドのマイナスとなっている。その結果、2017 年 9 月時点の現金・現金同等物は、前年同期の 303 億ランドから 72%減少して、85 億ランドまで落ち込んでいる。

13.5.2 Eskom のガバナンスの課題

ガバナンス⁴⁶は、事業・財務パフォーマンスに影響を与える 1 つの要因である。しかし、Eskom のガバナンスには脆弱性があるように見える⁴⁷。2016/17 年には、8 人の取締役会役員が辞職している。管理職の何人かは、ガバナンスに関連する不正申し立てにより、停職となっている。

さらに、調達・ガバナンスに関連する報告書がある。これらの報告書では、調達、契約管理、文書管理、資本プロジェクト、財務、利害関係者管理、発電、ガバナンスの分野で 135 もの課題を指摘している⁴⁸。

ガバナンスの脆弱性は、財務管理に悪影響を与えているようである。2017 年の規則に反した支出は、操業費用の 2.1%に相当する 30 億ランドに達している。

表 13.5-12 Eskom の規則に反した支出

		単位：百万ランド、%	
		2016	2017
A	年初残高	418	348
B	当年度支出	106	4,043
C	容認額	(146)	(1,084)
D	回収不可能額（非容認）	(30)	(311)
E	年末残高 (A+B+C+D)	348	2,996
F	操業費用	135,778	143,241
G	操業費用に対する年末残高の割合 (E/F)	0.3%	2.1%

出典：Eskom, “Annual Financial Statements March 31 2017”に基づき JICA 調査団にて作成

不正な支出の種類は、関連規則の違反・不履行、無駄な支出、機材の窃盗、詐欺のような犯罪行為まで多岐にわたる⁴⁹。Eskom 取締役会は、不正な支出の根本原因を、人、プロセス、システム、ガバナンスの分野に分類している⁵⁰。

13.5.3 財務・ガバナンス課題への対策

Eskom は、財務・ガバナンスの課題の困難に対処、解決をするために様々な手段をとってきており、今後もとる予定である。これらの手段は、1) 収益の増加、2) 費用の管理、3) キャッシュフローの管理、4) ガバナンスの強化に集約される。

⁴⁶ この報告書におけるガバナンスは、経営陣、調達、支出管理に限定される。

⁴⁷ 例えば、ムーディーズ報告書では、「最近の Eskom が直面する流動性危機は、企業統治に対する疑念、リーダーシップの欠如、Eskom への信頼の低下により、貸し手が資金供与に消極的であるためである」と明確に記述している。詳細は、https://www.moodys.com/research/Moodys-downgrades-Eskom-ratings-to-B1B2Baa2za-NSR-review-for-downgrade--PR_378663

⁴⁸ 詳細は、“Eskom governance reviews of procurement processes”, in Eskom, “Annual Financial Statements March 31 2017”, p. 10 を参照。

⁴⁹ 不正支出の詳細な説明については、Eskom, “Annual Financial Statements March 31 2017”, Note 52, p. 113 を参照。

⁵⁰ Eskom, “Annual Financial Statements March 31 2017”, p. 10

(1) 収益の増加

2018/19 年収益申請

2017 年 8 月、Eskom は、2018/19 年収益申請を NERSA に提出した。申請において、Eskom は、許容収益を 2017/18 年の 2052 億ランドから 143 億ランド増加（前年比 7%増）の 2195 億ランドとし、消費者の利益と Eskom の財務持続性の間のバランスを達成するよう、NERSA に要求している。

申請収益は、1) 資産に対するリターン、2) 様々な費用項目からなる以下の計算式に基づいて算出されている。

$$\text{許容収益} = (\text{規定資産ベース} \times \text{WACC}) + \text{支出} + \text{一次エネルギー} + \text{IPP (国内)} + \text{海外調達} + \text{減価償却} + \text{IDM} + \text{調査・開発} + \text{税金} + \text{RCA}^{51}$$

注：WACC=加重平均資本コスト、IDM=統合需要管理、RCA=規定上の調整勘定

表 13.5-13 2018/19 年総許容収益の概要

				単位：百万ランド、%	
項目	式		2018/19 年申請	対 TAR 割合	
規定資産ベース	RAB		763,859		
WACC (%)	ROA	x	2.97%		
リターン			22,690	10.3%	
支出	E	+	62,221	28.3%	
一次エネルギー	PE	+	59,340	27.0%	
IPP (国内)	PE	+	34,209	15.6%	
海外調達	PE	+	3,216	1.5%	
減価償却	D	+	29,140	13.3%	
IDM	I	+	511	0.2%	
調査開発	R&D	+	193	0.1%	
税金	L&T	+	7,994	3.6%	
RCA	RCA	+	0	0.0%	
総許容収益	TAR		219,514	100.0%	

出典：Eskom. “Revenue Application FY2018/19”, TABLE 1: TOTAL ALLOWABLE REVENUE FOR 2018/19, August 2017, p.10.

注：今後 NERSA が MYPD3 期間の 2, 3, 4 年目の RCA 手続きをするという理解に基づき、収益申請には、RCA 申請が含まれていない。

Eskom の収益は、1) 標準料金消費者、2) 交渉した価格協定に基づく消費者、3) 海外消費者から回収される。もし上記収益申請がすべて承認された場合、標準料金は 19.9%の増加につながり、2017/18 年の 2.2%よりかなり大きい増加となる⁵²。

表 13.5-14 標準料金価格

	単位	2017/18 年 MYPD 決定	2018/19 年申請
標準料金収益	百万ランド	198,954	206,205
標準料金売上高	GWh	223,217	192,953
標準料金価格	セント/kWh	89.13	106.87
標準料金価格調整	%	2.2%	19.9%

出典：Eskom. “Revenue Application FY2018/19”, August 2017, p.14.

⁵¹ 規定上の調整勘定 (Regulatory Clearing Account) は、収益決定と実際の収益の相違を、将来の料金により調整する仕組みである。

⁵² NERSA が許容収益に対する決定を下すと、Eskom 料金・構造調整方法に従い、Eskom は、NERSA に電力料金・同料金構造調整申請を提出する必要がある。詳細は、Eskom, “Revenue Application FY2018/19”, “7 Indicative Standard Tariff Increase” p. 33 を参照。

2017 年 12 月 15 日、NERSA は Eskom 収益申請に対する決定を発表し、2018/19 年許容収益を 1903.48 億ランドとすることを承認した。この収益により、平均標準料金の上昇率は 5.23%となり、Eskom 申請の 19.9%を大幅に下回る⁵³。

2018 年 2 月、Eskom は、NERSA より収益申請決定理由の詳細を受け取っている。Eskom は、理由の詳細を検討し、公営企業省と相談したうえで、NERSA 決定に対する対応を決める予定である。

規定による調整勘定（RCA）申請

収益申請に加えて、NERSA は最近、規定による調整勘定（RCA）申請に対する決定のプロセス・スケジュールを発表した⁵⁴。第 2 年度（2014/15）、第 3 年度（2015/16）、第 4 年度（2016/17）の RCA 残高は、666 億ランドに達している。Eskom は、すでにこの金額を求める調整勘定申請を提出している。NERSA は 2018 年 6 月に決定を下す予定である。

表 13.5-15 規定による調整勘定の詳細

単位：百万ランド、%

RCA for 2016/17	RCA 2014/15	RCA 2015/16	RCA 2016/17	Total RCA	% contribution
Revenue	8,787	15,578	20,016	44,381	66.6%
Independent Power Producers	4,346	620	2,452	7,418	11.1%
Coal	574	3,258	(359)	3,473	5.2%
International Purchases	3,299	3,567	2,283	9,149	13.7%
Open Cycle Gas Turbines (OCGTs)	1,944	689	(1,259)	1,374	2.1%
Other Primary Energy	1,355	728	722	2,805	4.2%
Environmental Levy	(683)	-1180	(1,404)	(3,267)	-4.9%
Subtotal	19,622	23,260	22,451	65,333	98.0%
Other	(437)	372	1,418	1,353	2.0%
RCA balance	19,185	23,632	23,869	66,686	100.0%

出典：Eskom. “RCAs submitted for FY2014/15, FY2015/16, and FY2016/17”, Durban NERSA Public Hearing, April 19, 2018, p. 4

想定より低い売電量のため、収益のみで過去 3 事業年度 RCA 全体金額の 66.6%を占める。過去 3 か年の計画売電量と実際の売電量の差は、5~10%に相当する。Eskom は、景気後退、Eskom への信頼低下、その他の要因により、売上が低下したと分析している。

⁵³ NERSA Media Statement, “NERSA DECISION ON ESKOM’S REVENUE APPLICATION FOR 2018/19 FINANCIAL YEAR”, December 15, 2017. 同決定の理由詳細についてはまだ開示されていない。

⁵⁴ 審査・決定スケジュール・過程の詳細は NERSA ウェブサイトを参照 (<http://www.nersa.org.za/Admin/Document/Editor/file/News%20and%20Publications/Latest%20News/Media%20Statement%20-%20Revised%20Timelines%20for%20processing%20Eskom%20Regulatory%20Clearing%20Account.pdf>).

表 13.5-16 売電量の計画・実績値

	単位 : GWh, %		
	2014/15	2015/16	2016/17
A. Planned sales	229,183	235,210	239,113
B. Actual sales	216,274	214,487	214,601
C. Gap (B-A)	(12,909)	(20,723)	(24,512)
D. % of Gap in planned sales (C/A)	(5.6%)	(8.8%)	(10.3%)

出典 : Eskom. “RCAs submitted for FY2014/15, FY2015/16, and FY2016/17”, Durban NERSA Public Hearing, April 19, 2018, p. 5

Eskom は RCA 残高を徐々に回収し、残りは新規融資への担保として利用することを計画している。

(2) 費用の管理

Eskom は、大幅な費用削減のため様々な手段を採用している。2017 年に、Eskom は、自身の発電費用を 8.5%削減し 600 億ランドとし、一次エネルギー費用は 2.3%削減した⁵⁵。また、割高な開放サイクルガスタービン（OCGT）がピーク需要に対応するために使われていたが、新規石炭火力発電所が操業を開始するにつれ、同費用を 2016 年の 87 億ランドから 2017 年の 3.4 億ランドへ削減し、OCGT への依存を減らすことができた。費用は、170 億ランド削減の目標に対し、200 億ランドの削減を達成した。

さらに、Eskom は、2017/18-2021/22 の 5 か年計画の 5 つの重要目標のうち 2 つで費用管理の目標を設定している⁵⁶。

- 効率性と産業の再構築により、一次エネルギー支出を 5 か年で 430 億ランド削減する。
- 5 か年で資本支出を 250 億ランド削減する。

Eskom は、石炭調達契約を見直し、給与増加をインフレ以下に抑え、定年退職、自然減により、従業員を減らすことを現在検討している。

(3) キャッシュフローの管理

Eskom は、事業の持続的実施に向けてキャッシュフローを管理する必要がある。Eskom コーポレートプランは、短期的なキャッシュフロー管理に向けて、1) 操業・費用の効率性、2) 資本支出の管理、3) 債務返済の繰り延べオプションの評価という 3 つの方向性を示している。

さらに、Eskom は、自動メーター計測、前払いシステムの導入により、地方自治体延滞債務の回収によって、手元資金を増やす意図がある⁵⁷。

⁵⁵ 一次エネルギーコストの削減詳細については、Eskom, “Integrated results for the year ended March 31 2017”, July 19, 2017, p. 11 を参照。

⁵⁶ Eskom, “Corporate Plan FY2017/2018-FY2021/2022”, February 2017, p. 9. 詳細は、“7.7.4 Operating expenditure” と “7.7.6 Capital expenditure” を参照。

⁵⁷ 詳細は、“Strategies to improve debt collections”, Eskom, “Revenue Application FY2018/19”, p. 49 を参照。Eskom は、地方自治体に導入された自動メーター計測、前払いシステム の効果を認識している。fin 24 “R13.5bn municipal debt burden 'really beyond Eskom’”, April 18, 2018 を参照。

2018年2月末に、Eskomは200億ランドの短期融資ファシリティーに関する合意書を7つの金融機関と締結した。2018年8月にEskomは借り換えをしなければならないが、当面の運転資金は確保している。

(4) ガバナンスの強化

Eskomは、ガバナンス強化に向けた対策を開始している。

取締役会役員の任命

Eskomのガバナンス強化の重要なステップの1つとして、公営企業省大臣がEskom取締役会役員候補を内閣に提案した。取締役会役員は、2017年12月初旬に、3年の任期で内閣により承認された⁵⁸。この任命の後、2018年1月19日に、Eskom取締役会議長が辞任したが、すぐに新しい議長、取締役会メンバーが任命された。最高経営責任者（CEO）と最高財務責任者（CFO）は今後3か月以内に任命される。

Eskom経営計画の実施

Eskomは、2017年2月に2017/18-2021/22年経営計画を作成している。同計画は、Eskomが利害関係者と、どのように戦略を、公共財政管理法（PFMA）や公営企業省や財務省の関連規則に従い準備し、実施していくかについての文書である。Eskomは、現在2018/19-2022/23年度の経営計画を準備している。

5方向性計画

ガバナンスに関する課題に対処するため、Eskom経営陣は、5方向性計画を発表し、ガバナンスプロセスを再構築しようとしている⁵⁹。計画は、以下の5つの方向性から構成される。

1. 組織内部の倫理・不正行為監督政策を承認し、同フレームワークを強化する。
2. リーダーシップへの独立監査を実施する。

経営陣は、ライフスタイル・利害の衝突に関する定期的な監査を受ける。

3. 規則に合わない供給契約を解約する。
4. 意思決定権限をマネジメントの適切なレベルに与えることにより、内部ビジネスガバナンス過程を強化する。
5. 懲罰的訴訟・法的アクションを開始する。

本報告書作成の時点で、5方向性計画の詳細とその実施については、まだ明らかでない⁶⁰。

⁵⁸ 公営企業省の発表は、<http://www.eskom.co.za/news/Pages/Decc8B.aspx> を参照。

⁵⁹ OnlineTenders, “Eskom taking 'bold steps' to shift company's reputation”, <https://www.onlinetenders.co.za/news/eskom-taking-bold-steps-to-shift-companys-reputation>

⁶⁰ 新聞記事によると、Eskomは、2018年9月までに再建計画を最終化する予定である。(fin 24, “Eskom still heavily reliant on debt - Acting CEO”, April 24, 2018)

Eskom 職員による不正行為の調査

汚職への対処、ガバナンスの強化、関係者の信頼再建への努力の 1 つとして、Eskom は職員による不正行為を調査している⁶¹。Eskom は、職員による不正行為 239 ケースを調査し、2018 年 3 月までに 75 ケースの調査を終えている。

Eskom は、利益相反、汚職を避けるため、職員が Eskom とビジネスをすることを禁止する政策を導入する予定である。

(5) 利害関係者からの信頼性、Eskom 財務状況に対する影響

上記手段の結果についてはまだ明らかでないが、これらの手段により、金融機関を含む利害関係者の Eskom に対する信頼度に好影響を与え、信頼度を再構築し、資金への良好なアクセスを確保することにより、財務基盤を強化することが期待される。

例えば、取締役会新メンバーの任命は、利害関係者に良い印象を与えているようである。しかしながら、上記の手段は現在進行中、もしくは今後実施される予定であり、Eskom の財務状況、債務返済能力が改善するかどうかは、まだ明らかでない。

13.5.4 Eskom 借款返済財務能力の分析

Eskom が十分な財源で本事業、他のビジネスを継続し、本事業への融資を長期的に返済できるかどうかを予測するため、過去・将来の財務・ガバナンス状況に基づき、Eskom の財務能力を分析する価値がある。以下の表に、Eskom 財務能力を確認するためのモニタリング指標を挙げる。

表 13.5-17 モニタリング指標

指標	期限	情報源
1. 収益・費用・利益		
1.1 RCA 申請の結果	6/2018	NERSA
1.2 収益申請の結果	定期モニタリング	NERSA
1.3 売電量の傾向	定期モニタリング	Eskom
1.4 費用の管理	半年ごとのモニタリング	Eskom 財務諸表
1.5 EBITDA(金利・税金・償却前利益)の傾向	半年ごとのモニタリング	Eskom 財務諸表
2. キャッシュフローの管理		
2.1 運転資金融資の借換え	8/2018	Eskom 財務部
2.2 2019 年度 720 億ランドの融資による資金調達	定期モニタリング	Eskom 財務部
2.3 地方自治体からの延滞債務改修	定期モニタリング	Eskom 財務部
2.4 ネット・キャッシュフロー	半年ごとのモニタリング	Eskom 財務諸表
3. 監査済み財務諸表		
3.1 2018 年度監査済み財務諸表	7/2018	Eskom 財務諸表
3.2 2019 年度監査済み中間財務諸表	12/2018	Eskom 財務諸表
4. ガバナンス		
4.1 Eskom 再建計画の策定・実施	9/2018	Eskom プレスリリース
4.2 新 CEO・CFO の任命	5/2018	Eskom プレスリリース
5. 信用格付け		
5.1 信用格付けの変化	定期モニタリング	Eskom プレスリリース

出典: JICA 調査団にて作成

⁶¹ fin24, “Eskom investigating 239 cases of misconduct by officials”, April 18, 2018 を参照。

(1) 収益・費用・利益

1.1 RCA 申請の結果 [6/2018]

2018 年 6 月までに、NERSA は RCA 申請に対する決定を下す予定である。NERSA の決定は、収益レベルに影響を与えるだけでなく、Eskom の保有現金を増やし、売掛金とみなせる認可額を融資担保に使うことによって、借入れが容易になる。

さらに、RCA の承認は、信用格付け機関の認識に良いインパクトを与え、長期的には信用格付けを変化させるかもしれない。

1.2 収益申請の結果 [定期モニタリング]

A) 2019 年度収益申請に対するアクション

NERSA は、2017 年 12 月に Eskom の 2019 年度収益申請に対する決定を下している。Eskom は、2018 年 2 月に NERSA 決定理由の詳細を受け取っている。Eskom が決定に対し具体的な行動をとるかどうかは現時点で不明であるが、Eskom による対応は、今後確認する必要がある。

B) 2020 年度収益申請の結果

Eskom は、2020 年度収益申請を年内に提出する予定である。単年度か複数年度の申請か現時点で明らかでないが、収益予想と関係者の認識に影響を与えることは確かである。申請で、Eskom がどのように過去のパフォーマンスを分析し、現状を認識し、将来を予想しているか確認する必要がある。

1.3 売電量の傾向 [定期モニタリング]

電力料金は NERSA により規制され、適用年度の間は固定されている。収益計画と実績値の差異は、RCA により後から調整される。

表 13.5-18 売電量の計画・実績値

	単位 : GWh, %			
	2014/15	2015/16	2016/17	2018/19 (予測)
A. Planned sales	229,183	235,210	239,113	216,206
B. Actual sales	216,274	214,487	214,601	
C. Gap (B-A)	(12,909)	(20,723)	(24,512)	
D. % of Gap in planned sales (C/A)	(5.6%)	(8.8%)	(10.3%)	
E. Year to year growth of actual sales		(0.8%)	0.1%	

出典 : Eskom. “RCAs submitted for FY2014/15, FY2015/16, and FY2016/17”, Durban NERSA Public Hearing, April 19, 2018, p. 5 に基づき JICA 調査団にて作成 2018・19 年度の予測数字は、Table 12: Forecasted sales volume in Eskom, “Revenue Application FY2018/19”, August 2017, p. 42. に基づく。

そのため、料金が固定されている状況では、売電量の変化が、収益に影響を与える唯一の要素となる。Eskom のビジネス継続と融資返済能力評価の基礎となるため、収益だけでなく売電量も定期的にモニタリングし、過去の傾向と比較する必要がある。

1.4 費用の管理[半年ごとのモニタリング]

「13.5.3 (2)費用管理」で記述したように、Eskom は、操業費用の削減を図っている⁶²。収益同様、操業費用は、EBITDA（金利・税金・償却前利益）レベルを決定する要因である。それゆえ、1）一次エネルギー、2）人件費、3）他の費用からなる操業費用は、過去の傾向と比較し、モニタリングする必要がある。

表 13.5-19 総収益に対する費用の割合

	2015	2016	2017
A. Total revenue	152,135	166,629	178,709
B. Operating expense (1+2+3)	84.7%	80.3%	79.0%
1) Primary energy	54.8%	50.8%	46.3%
2) Employee benefit expense	17.0%	17.6%	18.6%
3) Other expenses	12.8%	11.9%	14.1%

出典：Eskom, “Annual Financial Statements 31 March 2017”, “Annual Financial Statements 31 March 2016”に基づき JICA 調査団にて作成

特に、一次エネルギー費用は、操業費用の中で最大支出費用項目であり、総収入の約 50% を占める。最近の報道によると、7 発電所で石炭備蓄量の要件を満たしていない。このため、石炭を追加で調達した場合、費用増加につながる可能性もある⁶³。

分析は、各費用項目の絶対値だけでなく、1）年間変化率、2）総収益に対する費用の割合にも注目し、異常値とその原因を特定すべきである。また、固定・変動費用の変化の詳細についても分析する必要がある。

1.5 EBITDA（金利・税金・償却前利益）の傾向 [半年ごとのモニタリング]

EBITDA は、総収入から操業費用を差し引いて算出される。もし EBITDA がプラスであれば、Eskom は事業継続に必要な金額を支出していると想定できる。

表 13.5-20 総収益に対する EBITDA の割合

	2015	2016	2017
A. Total revenue	152,135	166,629	178,709
B. EBITDA	15.3%	19.7%	21.0%

出典：Eskom, “Annual Financial Statements 31 March 2017”, “Annual Financial Statements 31 March 2016”

ただし、Eskom が操業、施設機器の最低基準を満たすために十分な支出をしているかどうか保証するものではない。よって、Eskom の操業に十分な支出がされているかどうか確認するため、運用指標も同様にモニタリングする必要がある⁶⁴。

過去 3 年の総収益に対する EBITDA の割合は着実に改善しているが、2018 年度は 2.2% にとどまる料金値上げにより、この数値が悪化する可能性があることに留意すべきである。

⁶² 「Eskom Holdings Corporate Plan FY2017/18–FY2021/22」の「3.4.3 Continue efficiencies in operating and capital costs to help achieve a sustainable tariff path for economy」で、いくつか具体的なターゲットを挙げ、費用管理について記述している。ただし、2018 年 9 月に最終化予定の再建計画で、改定される可能性もある。

⁶³ fin24, “Eskom warns coal stock levels below 20-day target at seven plants”, April 25, 2018. The requirement of coal stock is that of operation for 20 days.

⁶⁴ Eskom は、財務・運用指標を選び、モニタリングしている。Eskom, “Eskom integrated report”, March 31 2017 を参照。

(2) キャッシュフローの管理

2.1 運転資金融資の借換え[8/2018]

2018年2月末に、Eskomは200億ランドの短期借入れをしているが、2018年8月に返済する必要がある。融資額を考えると、返済日に借換えしなければならない。融資は運転資金用なので、融資借換えは、Eskomの事業継続への信頼性、能力を測るマイルストーンとなる。

2.2 2019年度720億ランドの融資による資金調達 [定期モニタリング]

Eskomは、2019年度に運転資金用の200億ランドを含む720億ランドを融資により調達する計画である⁶⁵。残りの520億ランドは、資本支出に充当される。今年度に必要な資金調達ができるかどうかは、運転資金の調達と資本プロジェクトの完成に影響を与える。

2.3 地方自治体からの延滞債務回収 [定期モニタリング]

Eskomは、1) 債務支払いに関する地方自治体との交渉・合意、2) スマートメーター、前払いシステムの導入、3) 債務不履行の地方自治体への送電停止により、売掛金未払い削減に注力している。しかし、地方自治体の債務残高は着実に増加している⁶⁶。

Eskomは、公営企業ポートフォリオ委員会で、議会、南アフリカ政府に全面的な支援を依頼している⁶⁷。地方自治体の負債残高の傾向は、Eskomの資金繰りに重要な影響があるため、定期的にモニタリングする必要がある。

2.4 ネット・キャッシュフロー [半年ごとのモニタリング]

Eskomが融資元本・利息を返済するために十分な現金を生み出しているかどうか確認することが非常に重要である。

Eskomのキャッシュフローは将来変化することが予想される。もし、電力需要と操業費用が一定であれば、料金値上げを反映して、営業活動が生み出す現金は増加する。資本プロジェクトが完工するにつれ、投資活動の赤字は減少する。本事業完工に伴い、借り入れが減少し、融資返済を開始するにつれ、財務活動による現金調達は、減少するかマイナスになる。

表 13.5-21 Eskom キャッシュフローの過去の傾向・予想

単位：百万ランド

	2015	2016	2017	予想される将来の傾向
営業活動からの現金	27,311	37,242	45,841	増加
投資活動からの現金	(56,386)	(58,590)	(62,286)	減少
財務活動からの現金	17,954	40,927	7,855	減少もしくはマイナスになる
期間中の現金の増減	(11,121)	19,579	(8,590)	
年初の現金・現金同等物残高	19,676	8,863	28,454	プラスを維持

出典：Eskom, “Annual Financial Statements 31 March 2017”, “Annual Financial Statements 31 March 2017”
に基づき JICA 調査団にて作成

⁶⁵ fin24, “Eskom still heavily reliant on debt - Acting CEO”, April 24, 2018.

⁶⁶ 地方自治体の過去の延滞債務傾向については、「表 13.5 8 地方自治体の延滞債務」を参照。

⁶⁷ fin24, “R13.5bn municipal debt burden 'really beyond Eskom'”, April 18, 2018.

ネット・キャッシュフロー（＝営業活動のキャッシュフロー－投資活動のキャッシュフロー）は、最低でもプラスで、融資の元利返済に十分な額である必要がある。Eskom が遅延や返済繰り延べなく融資を返済しているかどうかを確認する必要がある。

(3) 監査済み財務諸表

3.1 2018 年度監査済み財務諸表 [7/2018]

Eskom 事業年度は 3 月に終了するので、財務諸表はその後数か月以内に監査され、公表される。2018 年度（2017 年 4 月～2018 年 3 月）は赤字となる可能性があるため、財務諸表の詳細を分析し、Eskom の継続企業としての状態と将来の財務状況を分析、評価すべきである。財務諸表は、上記の指標のデータも提供している。

3.2 2019 年度監査済み中間財務諸表[12/2018]

2019 年度中間決算も詳細に分析すべきである。NERSA の決定により、2018 年 4 月から料金値上げが適用される⁶⁸。料金値上げ、その他の要因により、収益、費用、キャッシュフローが変動しているため、2019 年度中間決算を分析する必要がある。

もし RCA 申請への決定に基づく料金値上げが 2019 年度、もしくはそれ以降に予定されていれば、RCA 承認に基づく値上げによる今後の財務状況への影響も評価すべきである。

(4) ガバナンス

4.1 Eskom 再建計画の策定・実施 [9/2018]

Eskom は、財務、事業、ガバナンスの課題に対処する再建計画を準備中である。詳細は公表されていないものの、2018 年 4 月 18 日に、公営企業ポートフォリオ委員会で計画の発表をしている。再建計画は、2018 年 9 月までに最終化される予定である。

再建計画は、Eskom の事業・財務を改善する行動計画を詳述するので、実施状況と状況を評価する指標は定期的にモニタリングする必要がある。

4.2 新 CEO・CFO の任命 [2018/4]

CEO（最高経営責任者）、CFO（最高財務責任者）は、2018 年 1 月の取締役会メンバー（含む暫定 CEO、CFO）の任命後 3 か月以内に任命される予定であった。再建計画、および Eskom の財務、事業、ガバナンス状況の改善策の実施にも影響するため、CEO、CFO の任命状況をモニタリングする必要がある。

⁶⁸ 地方自治体への新電力料金の適用は、2018 年 7 月 1 日からである。

(5) 信用格付けの変化 [定期モニタリング]

Eskom の財務・ガバナンス状況は、上記指標によりモニタリングされるが、信用格付け機関の見方、信用格付けにも多大な影響を与え、それらは資金へのアクセス、借入コストにも影響を与える。信用格付け機関は、Eskom に対し低い信用格付けを維持しているが、最近の報道では、Eskom に対して複数の見方を示している⁶⁹。

13.6 本事業の期待効果(運用・効果指標)

運用指標は、本事業の運用状況を評価するためのものであり、本事業が適切に運用されているかどうかを定量的に確認するものである。

表 13.6-1 運用指標

指標	計算式	ターゲット
定格出力時の Sox 排出濃度 (Ppm or mg/m ³)	指標名の通り	500 mg/Nm ³
脱硫効率 (%)	$= (1 - \text{煙突排出量} / \text{ボイラ発生量}) \times 100$	90%
発電時間に対する FGD 稼働率(%)	$= (\text{年間脱硫運転時数} / \text{年間発電時間数}) \times 100$	100%

出典：JICA「円借款運用・効果指標リファレンス」(2014年7月)に基づいて JICA 調査団にて作成

注：SOx 排出濃度は、環境モニタリング危機により計測する必要がある。

定格出力時の SOx 排出濃度のターゲットは設計値の 500 mg/Nm³ とした。脱硫効率のターゲットは 96%純度の石灰石で設計炭の排ガスを処理したときの設計値の 90%とした。FGD システムが不具合無く運転するとして、FGD 運転時間はボイラー運転時間と同じとした。

効果指標は本事業のアウトカムを評価するためのものである。

表 13.6-2 効果指標

指標	計算式	ターゲット
SOx 削減量(トン/年)	= ボイラ発生－煙突発生量	281 トン/年 (=46.778ton×6unit) (3,500 - 500) x 2,225 x 8,760 x 0.8 / 1,000,000,000 =46.778ton/unit

出典：JICA「円借款運用・効果指標リファレンス」(2014年7月)に基づいて JICA 調査団にて作成

SOx 削減量のターゲットは、以下の計算に基づき 281 トン/年とした。

$$\text{SOx 削減量} = (A - B) \times C \times D \times E \times F = (3,500 - 500) \times 2,225 \times 8,760 \times 0.8 / 1,000,000,000 \times 6$$

$$= 281 \text{ トン/年}$$

A: 定格入力時の SOx 排出濃度 (3,500 mg/Nm³)

B: 定格出力時の SOx 排出濃度 (500 mg/Nm³)

C: 設計炭を燃焼時のボイラー最大連続蒸発量運転時の排ガスの時間当たり排出量 (2,225

⁶⁹ 例えば、最近 Fitch は、Eskom に対する信用格付けの維持を決めたが、新取締役会が実施している手段も認識している。Eskom の最近の報道発表「Fitch Ratings affirms Eskom's 'BB-' credit rating」(2018年5月2日)を参照。<http://www.eskom.co.za/news/Pages/2018May2.aspx>

Nm³/hour, dry)

D: 年間の時間 (8,760 hours = 365 days x 24 hours)

E: 稼働率 (0.8)

F: ユニット数

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LIMPOPO

PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
ECONOMIC DEVELOPMENT, ENVIRONMENT & TOURISM

Reference: 12/4/12L-W2/A3 Enquiries: Thivhafuni PO Telephone: 015 290 7022 Fax: 015 295 4836 Email: thivhafunipo@ledet.gov.za

Eskom Holding SOC Limited
PO Box 1091
JOHANNESBURG
2000

Fax: 013 230 4973

Dear License Holder

PROVISIONAL ATMOSPHERIC EMISSION LICENSE: ESKOM HOLDING SOC LIMITED – MEDUPI POWER STATION

Please find herewith a Provisional Atmospheric Emission License amendment issued in terms of section 40(1)(a) of the National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004) ("the Act") and on the basis of a decision taken with respect to an application for postponement of compliance timeframes with minimum emission limits identified in terms section 21 of the Act.

This Provisional Atmospheric Emission License supersedes Provisional Atmospheric Emission License Number 12/4/12L-W2/A2 and authorizes Eskom Holding SOC Limited – Medupi Power Station to carry out the solid fuel combustion installation (electricity generation), storage and handling of ore and coal, and storage and handling of petroleum products activities with the equipment as described in the Provisional Atmospheric Emission License (License Number 12/4/12L-W2/A3), on the premises at farms Naauwontkome 509 LQ and Eenzaamheid 687 LQ in Lephalale Local Municipality, Waterberg District Municipality, Limpopo Province.

This License does not relieve Eskom Holding SOC Limited – Medupi Power Station from the obligation to comply with any other applicable statutory requirements or legislation.

You are welcome to contact the Department should you have any queries in this respect.

Sincerely,

A handwritten signature in black ink, appearing to read 'Mphahlele TM', written over a horizontal line.

MPHAHLELE TM
SENIOR MANAGER
INTEGRATED POLLUTION AND WASTE MANAGEMENT

DATE: 01/04/2015



LIMPOPO

PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
ECONOMIC DEVELOPMENT, ENVIRONMENT & TOURISM

PROVISIONAL ATMOSPHERIC EMISSION LICENSE AS CONTEMPLATED IN CHAPTER 5 OF THE NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT, 2004, (ACT NO. 39 OF 2004)

The Provisional Atmospheric Emission License issued to **Eskom Holdings SOC Limited – Medupi Power Station** in terms of section 40(1)(a) of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) ("the Act"), in respect of Listed Activities No. 1.1, 2.4 and 5.1. The Provisional Atmospheric Emission License has been issued on the basis of a decision taken with respect to an application for postponement of compliance timeframes with minimum emission limits identified in terms section 21 of the Act and information that became available during processing of the application.

The Provisional Atmospheric Emission License is issued subject to the conditions and requirements set out below which form part of the Provisional Atmospheric Emission License and which are binding on the holder of the Provisional Atmospheric Emission License ("the License Holder").

This Provisional Atmospheric Emission License is valid for a period of five (05) years from the date of issuance. The Provisional Atmospheric Emission License expiration terminates the License Holder's right to operate the Listed Activities unless a complete Renewal application has been submitted to the relevant Licensing Authority no later than six (06) months prior to the expiration date of this License. If a complete renewal application has been submitted by the renewal application due date, this Provisional Atmospheric Emission License and all conditions contained therein shall not expire until the renewal License has been issued or denied. This protection shall cease to apply if, subsequent to a renewal application completeness determination, the applicant fails to submit by the deadline any additional information identified by the Licensing Authority as necessary to process the application.

The Provisional Atmospheric Emission License is valid until 01 April 2020

1. ATMOSPHERIC EMISSION LICENSE ADMINISTRATION

Name of the Licensing Authority	Department of Economic Development, Environment and Tourism
Atmospheric Emission License Number	12/4/12L-W2/A3
Atmospheric Emission Licence Issue Date	31 March 2015
Expiry date	01 April 2020
Atmospheric Emission License Type	Provisional
Review Date, not later than	When deemed necessary by the Licensing Authority

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2. ATMOSPHERIC EMISSION LICENSE HOLDER DETAILS

Enterprise Name	Eskom Holdings SOC Limited
Trading as	Medupi Power Station
Enterprise Registration Number (Registration Numbers if Joint Venture)	2002/015527/06
Registered Address	Megawatt Park, Maxwell Drive, Sunninghill, Sandton
Postal Address	PO Box 1091 Johannesburg 2000
Telephone Number (General)	011 800 3861
Industry Sector	Electricity Generation
Name of Responsible Officer/ Emission Control Officer	Johan Prinsloo
Telephone Number	013 656 4061
Cell Phone Number	083 655 9140
Fax Number	013 656 4973
Email Address	CJ.Prinsloo@eskom.co.za
After Hours Contact Details	083 655 9140
Land Use Zoning as per Town Planning Scheme	N/A

3. LOCATION AND EXTENT OF POWER STATION**3.1 Location and Extent of Plant**

Physical Address of the Premises/Plant	Lephalale
Description of Site (Erf)	Farm Naauwontkome; Farm Eenzaamheid
Coordinates of Approximate Centre of Operations	Latitude: 23.7038316°S Longitude: 27.5617951°E
Extent (km ²)	6.3
Elevation Above Mean Sea Level (m)	900
Province	Limpopo
District Municipality	Waterberg District Municipality
Local Municipality	Lephalale Local Municipality
Designated Priority Area	Waterberg – Bojanala Priority Area



3.2 Description of Surrounding Land Use (within 5 km radius)



Figure 1: Location of premises in relation to surrounding community

Euclid

Euclid Towers, 20 Hans van Rensburg Street, POLOKWANE, 0700, Private Bag X9484, POLOKWANE, 0700
Tel: 015 293 8300, Fax: 015 295 5297, website: <http://www.Limpopo.gov.za>

The heartland of southern Africa development is about people

4. GENERAL CONDITIONS

4.1 Process and ownership changes

The holder of the atmospheric emission License must ensure that all unit processes and apparatus used for the purpose of undertaking the listed activity in question, and all appliances and mitigation measures for preventing or reducing atmospheric emissions, are at all times properly maintained and operated.

No facilities (building, plant or site of works) related to the listed activity or activities shall be extended, altered or added to the listed activity without prior approval by the Licensing Authority. The investigation, assessment and communication of potential impact of such an activity must follow the basic assessment procedure as prescribed in the Environmental Impact Assessment Regulations published in terms of section 24(5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), as amended.

Any changes in processes or production increases, by the License Holder, will require prior approval by the licensing authority.

Any changes to the type and quantities of input materials and products, or to production equipment and treatment facilities will require prior written approval by the licensing authority.

The License Holder must, in writing, inform the Licensing Authority of any change of ownership of the enterprise. The Licensing Authority must be informed within thirty (30) days after the change of ownership.

The License Holder must immediately on cessation or decommissioning of the listed activity inform, in writing, inform the licensing authority.

4.2 General duty of care

The License Holder must, when undertaking the listed activity, adhere to the duty of care obligations as set out in section 28 of the NEMA.

The License Holder must undertake the necessary measures to minimize or contain the atmospheric emissions. The measures are set out in section 28(3) of the NEMA.

Failure to comply with the above condition is a breach of the duty of care, and the License Holder will be subject to the sanctions set out in section 28 of the NEMA.

4.3 Sampling and or analysis requirements

Measurement, calculation and or sampling and analysis shall be carried out in accordance with any nationally or internationally acceptable standard. A different method may be acceptable to the Licensing Authority as long as it has been consulted and agreed to the satisfactory documentation necessary in confirming the equivalent test reliability, quality and equivalence of analyses.

The License Holder is responsible for quality assurance of methods and performance. Where the License Holder uses external laboratories for sampling or analysis, accredited laboratories shall be used.



4.4 General requirements for License Holder

The License Holder is responsible for ensuring compliance with the conditions of this License by any person acting on his, her or its behalf, including but not limited to, an employee, agent, sub-contractor or person rendering a service to the holder of the License.

The License does not relieve the License Holder to comply with any other statutory requirements that may be applicable to the carrying on of the listed activity.

A copy of the License must be kept at the premises where the listed activity is undertaken. The License must be made available to the environmental management inspector representing the Licensing Authority who requests to see it.

The License Holder must inform, in writing, the Licensing Authority of any change to its details including the name of the emission control officer, postal address and/or telephonic details.

4.5 Statutory obligations

The License Holder must comply with the obligations as set out in Chapter 5 of the Act.

4.6 Payment of atmospheric emission License processing fee

The License Holder must pay the processing fee to the Licensing Authority within 30 days of receipt of atmospheric emission License processing fee invoice.

4.7 License Revisions, Termination and Reissuance

The License Holder may request the Licensing Authority to revise the conditions of this License by submitting an application that contains the information specified in Section 46 of the Act. The Licensing Authority will revise the License using the same procedures that apply to initial License issuance.

If the License Holder wishes to terminate the License, a written request must be submitted to the Licensing Authority explaining the reasons for the request and, if necessary for continued operation, submitting applications for any License or approvals that the License Holder avoided by establishment of the limits contained in this License.

This License may be terminated, revised, or revoked and reissued by the Licensing Authority for cause. Cause exists to terminate, revise, or revoke and reissue this License under the following circumstances:

- a) This License contains a material mistake;
- b) Inaccurate statements were made in establishing the terms or conditions of this License;
- c) Newly discovered material information or material change in environmental conditions, environmental technology or applicable law or regulations since the issuance of the existing License;
- d) The License Holder fails to comply with any condition of this License; or
- e) This License must be terminated, revised, or reopened and reissued to assure compliance with Air Quality Act requirements.

The Licensing Authority will use the same proceedings to terminate, revise, or revoke and reissue a License for cause as for initial License issuance. Before initiating proceedings to terminate, revise, or revoke and reissue a License, the Licensing Authority will provide the License Holder at least 30 days' advance written notice of Licensing Authority's intent to terminate, revise, or revoke and reissue the permit, except that the Licensing Authority may provide a shorter notice period in the case of an emergency.

4.8 Non-Compliance with Conditions

If the License Holder fails to comply with the conditions or requirements of the License, the Licensing Authority may by notice in writing call upon such holder to comply with such conditions or requirement within a reasonable period specified in the notice, and in the event of failure on the part of such holder to comply with the said conditions or requirement within the period so specified, the Licensing Authority may cancel the License or suspend the operation thereof for such period as he or she may deem fit.

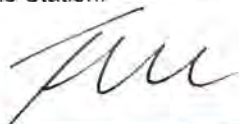
4.9 Appeal of Licence

- A. The License Holder must, within seven (07) calendar days of receipt of this license, inform all interested and affected parties and at least include the following:
- (i) That an Atmospheric Emission License has been issued to the applicant to proceed with the operation of the activities. If requested provide copies of this license.
 - (ii) That any appeals against the issuing of the license must be lodged with the Member of the Executive Council of Limpopo Department of Economic Development Environment and Tourism ("the MEC") as per chapter 2 of National Appeal Regulations Government Notice No. R.594 in Government Gazette No. 38303 of 8 December 2014.
 - (iii) The date on which the license was issued to the applicant in terms of section 40 of the Act and the date by which appeals must reach the MEC.
- B. Failure to inform interested and affected parties within the stipulated time period may result in the MEC considering requests from such parties for permission to submit late appeal favourably.
- C. An appeal lodged with the MEC must be submitted to the Department of Limpopo Department of Economic Development Environment and Tourism by means of one of the following methods:
- By post: Private Bag X 9484, **POLOKWANE**, 0700
By fax: (015) 291 5809
By hand: Evridiki Towers, 19 Biccadd Street, Polokwane 0700
- D. An appeal must be
- (i) submitted in writing
 - (ii) accompanied by:
 - a statement setting out the grounds of appeal;
 - supporting documentation which is referred to in the appeal and is not available to the relevant Licensing Authority
 - a statement that the appellant has complied with regulation 60(2) or (3) of NEMA EIA Regulations

5. NATURE OF PROCESS

5.1 Process description

The Station comprises six 800 MW units or boiler-turbine-generator sets. The total station capacity is 4 800 MW. Each boiler has five (05) mills allocated to it and nominally, four (04) are required for the boiler to reach full load. All the mills are vertical spindle mills and are fed from a common coal storage bunker. The bunker is supplied by two incline conveyors coming from the coal stock yard/staithes which are fed from the open coal stockyard. The coal stockyard is located on the Station.



From the mills which grind the coal into fine particles known as pulverized fuel (PF), PF is fed into the boilers via PF burners. To bring the boiler up to maximum operation, the boiler temperature has to be high enough to facilitate efficient combustion of PF. Correct boiler temperatures are achieved by starting-up the boiler using heavy fuel oil. The boiler is brought up to high temperature using oil burners before PF is injected into the boiler. During start-up, due to the fact that fuel oil is being burnt, exit emissions will greatly exceed those produced under normal operating conditions i.e. when PF is burnt.

Within the boiler, demineralised water is heated to form superheated steam which is sent to the turbines to turn the turbine blades. The turbine blades are attached to a shaft which rotates within the generator. The cooled steam from the turbine is sent to the condenser. In the condenser, spent steam is fed through a series of tubes which are isolated from the cooling water which is passed over the tubes. A heat exchange takes place and the spent steam condenses back into demineralised water or condensate, which is sent back to the boiler. The now heated cooling water is sent to the three (03) northern cooling towers where it is cooled through convection using a wet cooling system. The cooled cooling water is re-circulated back to the condenser. All units utilise a dry cooling system circulating the total condensate as the cooling medium in an indirect dry cooling system.

Once PF has been combusted in the boilers, two types of ash result: fly ash which stays buoyant in the exit flue gas stream and coarse ash (or bottom ash) which is too heavy to remain airborne and falls into the hopper at the bottom of the boiler. Once in the boiler hoppers, coarse ash is quenched using water in a submerged scrapper conveyor and sent to a common ash slurry sump. From the ash slurry sump, the coarse ash is sent via steel pipes to the ashing facility. Fly ash, or particulate matter (PM), is captured using a pulse jet fabric filter plant (PJFF) abatement technologies, before the flue gas exits the stacks, at a height of 220m above ground level.

5.2 Listed activity or activities

List of all Listed Activities, as published in terms of Section 21 of the AQA, authorised to be conducted at the premises by the License Holder:

Category of Listed Activity	Sub-category of the Listed Activity	Description of the Listed Activity
1 – Combustion Installations	1.1 – Solid Fuel Combustion Installations	Solid fuels combustion installations used primarily for steam raising or electricity generation
2 – Petroleum Industry	2.4 – Storage and Handling of Petroleum Products	Petroleum product storage tanks and product transfer facilities, except those under liquefied petroleum gas
5 – Mineral Processing, Storage and Handling	5.1 – Storage and Handling of Ore and Coal	Storage and handling of ore and coal not situated on the premises of a mine or works as defined in the Mines Health and Safety Act 29/1996



5.3 Unit process or processes

List of all unit processes associated with the listed activities to be undertaken at the premises.

Unit Process	Unit Process Function	Batch or Continuous Process
Boiler - Unit 1	Electricity Generation – 800 MW	Continuous
Boiler - Unit 2	Electricity Generation – 800 MW	Continuous
Boiler - Unit 3	Electricity Generation – 800 MW	Continuous
Boiler - Unit 4	Electricity Generation – 800 MW	Continuous
Boiler - Unit 5	Electricity Generation – 800 MW	Continuous
Boiler - Unit 6	Electricity Generation – 800 MW	Continuous
Coal stockyard	Coal Storage	Continuous
Excess coal stockyard	Coal Storage	Continuous
Fuel Oil Storage Tanks	Fuel Oil Storage	Continuous
Ashing facility	Ash Dump	Continuous

5.4 Hours of operations

Hours of operation of all unit processes associated with the listed activities at the premises.

Unit Process	Operating Hours	Days of Operation per Year
Boiler - Unit 1	00:00 – 24:00	366
Boiler - Unit 2	00:00 – 24:00	366
Boiler - Unit 3	00:00 – 24:00	366
Boiler - Unit 4	00:00 – 24:00	366
Boiler - Unit 5	00:00 – 24:00	366
Boiler - Unit 6	00:00 – 24:00	366
Coal stockyard	00:00 – 24:00	366
Excess coal stockyard	00:00 – 24:00	366
Fuel Oil Storage Tanks	00:00 – 24:00	366
Ashing facility	00:00 – 24:00	366



5.5 Graphical Process Information

APPLICABLE TO DIRECT DRY COOLED PLANT

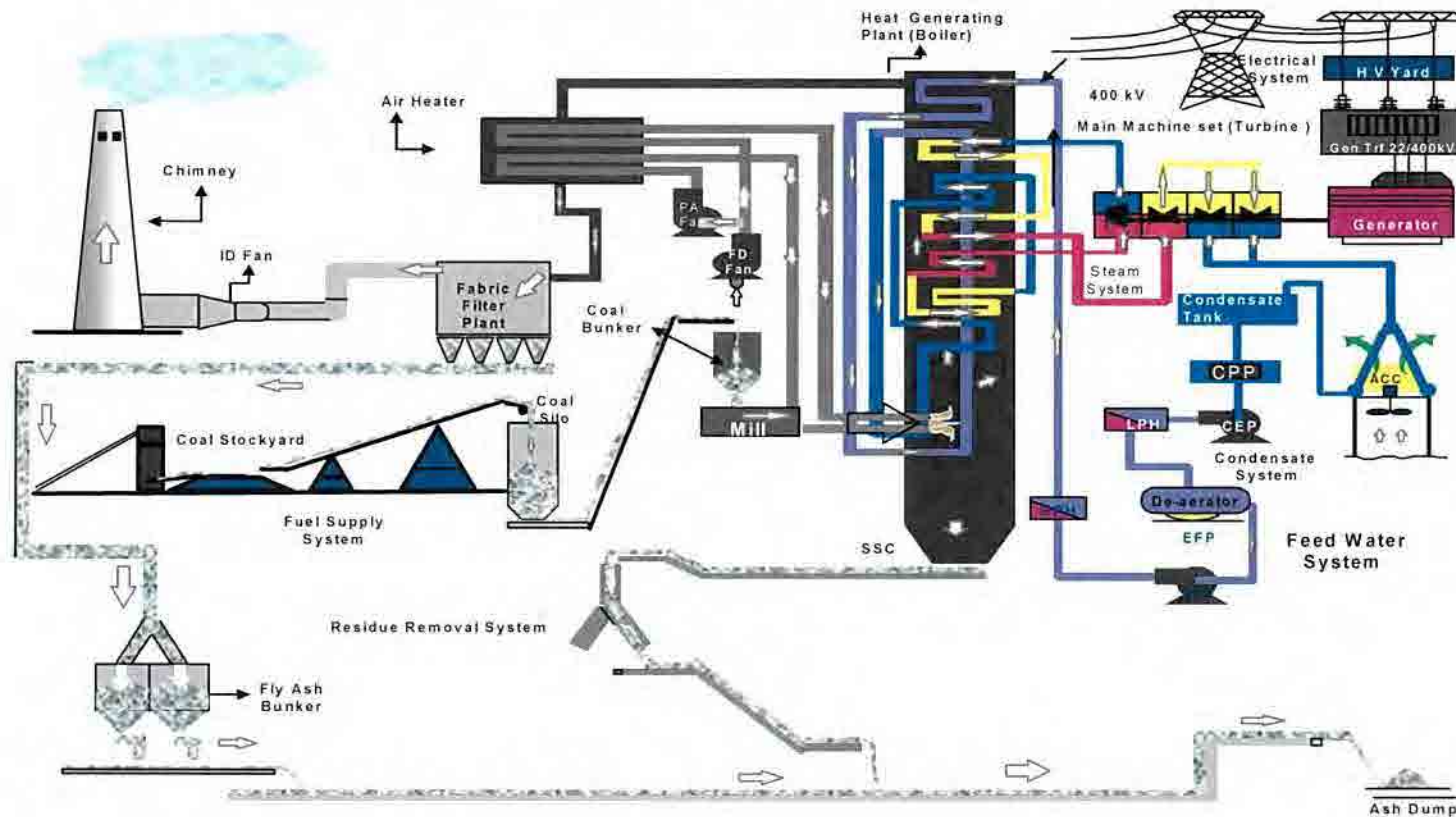


Figure 2: Process Flow Diagram Applicable to Direct Dry Cooled Plant

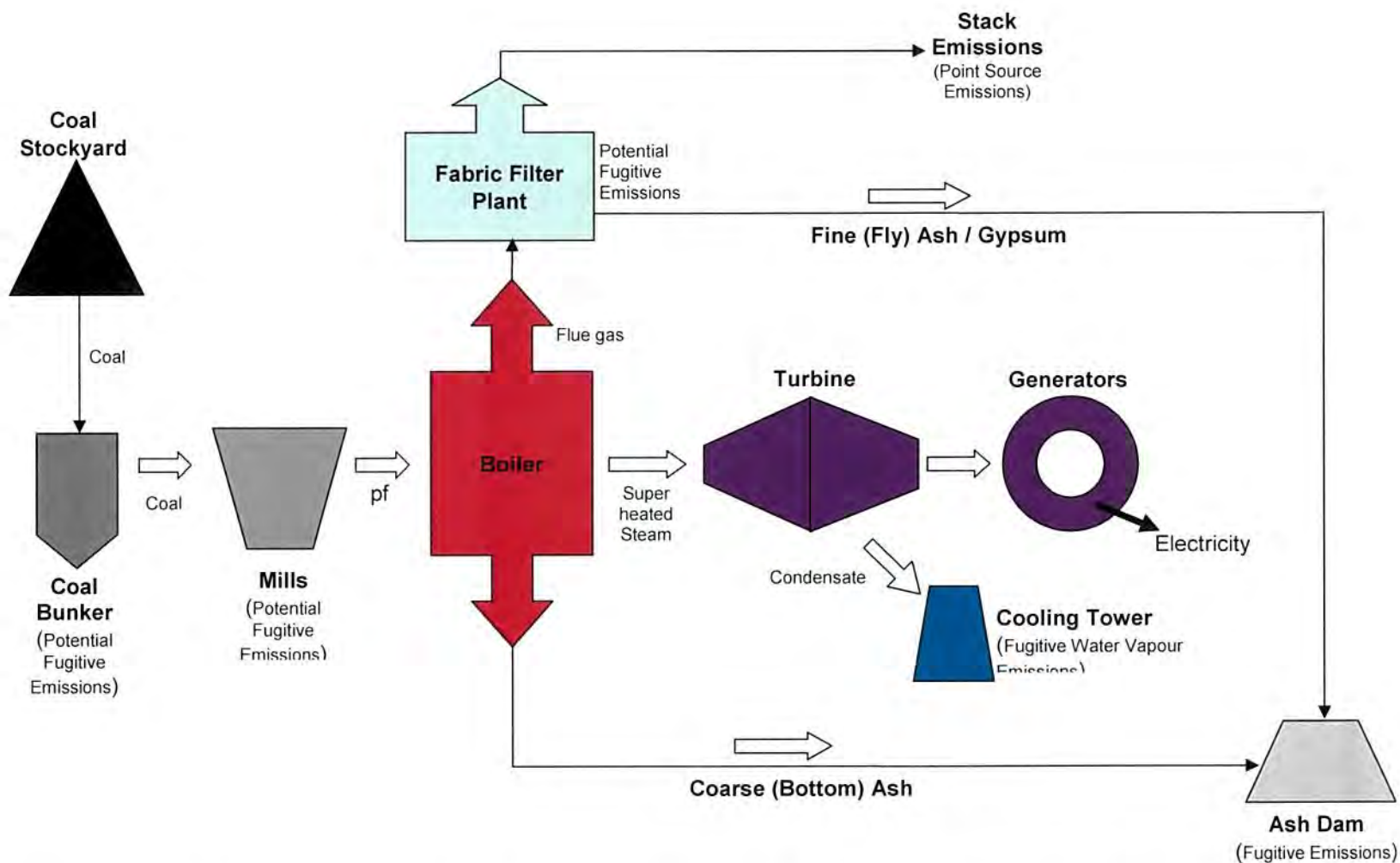


Figure 3: Process flow chart indicating inputs, outputs and emissions at the site of works, including points of potential fugitive emissions

6. RAW MATERIALS AND PRODUCTS

6.1 Raw materials used

Regulated Raw Materials		
Raw Material Type	Maximum Permitted Consumption Rate (Quantity)	Units (quantity/period)
Coal	1 875 000	tons/month
Fuel oil*	40 000	tons/month
Non-regulated Raw Materials		
Raw Material Type	Maximum Permitted Consumption Rate (Quantity)	Units (quantity/period)
Water	1 429 000	litres/month

* **Regulated raw materials** refers to those materials when increased or decreased may result in the change of air emissions output.

* **Non-regulated raw materials** refers to those materials when increased or decreased may not result in any change of air emissions output.

Limitations and Standards

6.1.1 The Coal consumption rate shall not exceed 1 875 000 tons per month.

6.1.2 The Fuel Oil consumption rate shall not exceed 40 000 tons per month

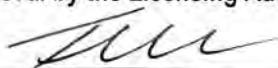
6.2 Production rates

Product Name	Maximum Permitted Production Capacity (Quantity)	Units (quantity/period)
Electricity	4 800	MW

6.3 Materials used in energy sources

Materials for Energy Source	Actual Consumption Rate (Quantity)	Units (quantity/period)	Materials Characteristics (Monthly Average)
Coal	1 875 000	Tons/month	Sulphur Content: 1.3 – 2.2% Ash Content: 35 – 39%
Fuel oil	40 000	Tons/month	Sulphur Content: 0.5 - 3.5% Ash Content: 0.02 - 0.1%

6.3.1 No fuel must be used with material characteristics with an exceedance of the largest value by over 10% without the approval by the Licensing Authority.



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6.4 Sources of atmospheric emission

6.4.1 Point source parameters

Point Source Code	Source Name	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Height Above Nearby Building (m)	Effective Diameter at Stack Tip/Vent Exit (m)*	Actual Gas Exit Temperature (°C)	Actual Gas Volumetric Flow (m³/hr)	Actual Gas Exit Velocity (m/s)	Emission Hours	Type of Emission (Continuous / Batch)
		South	East								
Stack 1	Stack 1	23.7028928°S	27.5614339°E	220	100	21.9	140	4 000 000	18 -24	24 hours	Continuous
Stack 2	Stack 2	23.7047792°S	27.5617951°E	220	100	21.9	140	4 000 000	18 -24	24 hours	Continuous

6.4.2 Area and or line source parameters

Area and or Line Source Code	Source Name	Source Description	Latitude (decimal degrees) of SW corner	Longitude (decimal degrees) of SW corner	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emission (Continuous / Intermittent)
A1	Coal stockyard	Storage and handling of coal	23.710818°S	27.550252°E	12	897	616.6	24	Continuous
A2	Excess coal stockyard	Storage and handling of coal	23.70941°S	27.52924°E	20	2000	2000	24	Continuous
A3	Ash disposal facility	Storage of ash	23.748821°S	27.515143°E	60	4200	4000	24	Continuous
A4	Fuel oil tank 2	Fuel oil storage	2623173.400 SW	57523.252 SW	12.7	12m	12m	24	Continuous
A5	Fuel oil tank 1	Fuel oil storage	2623235.4449 SW	57559.027 SW	12.7	12m	12m	24	Continuous



7. APPLIANCES AND MEASURES TO PREVENT AIR POLLUTION

7.1 Appliances and control measures

Associated Source Code	Appliances			Abatement Equipment Control Technology						
	Appliance /Process Equipment Number	Appliance serial number	Appliance Type / Description	Abatement Equipment Technology Name and Model	Abatement Equipment Technology Manufacture Date	Commission Date	Technology Type	Design Capacity	Minimum Control Efficiency (%)	Minimum Utilisation (%)
Stack 1	Boiler 1	To be provided as per Condition 7.1.1	Fabric filter plant	Fabric filter plant	2013 – 2017	2013 – 2017	Fabric filter plant	To be provided as per Condition 7.1.1	99.0%	100%
			Low NOx burners and Overfire air	Low NOx burners and Overfire air	2013 – 2017	2013 – 2017	Low NOx burners and Overfire air	To be provided as per Condition 7.1.1	70%	100%
	Boiler 2	To be provided as per Condition 7.1.1	Fabric filter plant	Fabric filter plant	2013 – 2017	2013 – 2017	Fabric filter plant	To be provided as per Condition 7.1.1	99.0%	100%
			Low NOx burners and Overfire air	Low NOx burners and Overfire air	2013 – 2017	2013 – 2017	Low NOx burners and Overfire air	To be provided as per Condition 7.1.1	70%	100%
	Boiler 3	To be provided as per Condition 7.1.1	Fabric filter plant	Fabric filter plant	2013 – 2017	2013 – 2017	Fabric filter plant	To be provided as per Condition 7.1.1	99.0%	100%
			Low NOx burners and Overfire air	Low NOx burners and Overfire air	2013 – 2017	2013 – 2017	Low NOx burners and Overfire air	To be provided as per Condition 7.1.1	70%	100%

Associated Source Code	Appliances			Abatement Equipment Control Technology						
	Appliance /Process Equipment Number	Appliance serial number	Appliance Type / Description	Abatement Equipment Technology Name and Model	Abatement Equipment Technology Manufacture Date	Commission Date	Technology Type	Design Capacity	Minimum Control Efficiency (%)	Minimum Utilisation (%)
Stack 2	Boiler 4	To be provided as per Condition 7.1.1	Fabric filter plant	Fabric filter plant	2013 – 2017	2013 – 2017	Fabric filter plant	To be provided as per Condition 7.1.1	99.0%	100%
			Low NOx burners and Overfire air	Low NOx burners and Overfire air	2013 – 2017	2013 – 2017	Low NOx burners and Overfire air	To be provided as per Condition 7.1.1	70%	100%
	Boiler 5	To be provided as per Condition 7.1.1	Fabric filter plant	Fabric filter plant	2013 – 2017	2013 – 2017	Fabric filter plant	To be provided as per Condition 7.1.1	99.0%	100%
			Low NOx burners and Overfire air	Low NOx burners and Overfire air	2013 – 2017	2013 – 2017	Low NOx burners and Overfire air	To be provided as per Condition 7.1.1	70%	100%
	Boiler 6	To be provided as per Condition 7.1.1	Fabric filter plant	Fabric filter plant	2013 – 2017	2013 – 2017	Fabric filter plant	To be provided as per Condition 7.1.1	99.0%	100%
			Low NOx burners and Overfire air	Low NOx burners and Overfire air	2013 – 2017	2013 – 2017	Low NOx burners and Overfire air	To be provided as per Condition 7.1.1	70%	100%

Appliances and control measures requirements:

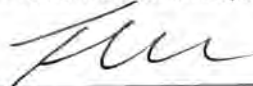
- 7.1.1 The control devices' details must be forwarded to the Licensing Authority thirty (30) days prior to commissioning of the equipment/technology.
- 7.1.2 Off-gases from each heat generating plant (Boiler) shall be vented via a fabric filter plant to a stack at all times the emissions unit is in process. Low NOX burners Overfire air must be utilized to control NOX emissions.
- 7.1.3 The License Holder must inspect all control systems, specified in the Appliances and Control Measures Table 7.1 above for the plant, weekly to ensure that they are operated and maintained in conformance with their designs.
- 7.1.4. The License Holder shall, continuously operate, and maintain a flue gas desulphurization (FGD) plant for control of SO₂ on all six units. The Flue Gas Desulphurisation plant shall be retrofitted in each unit within Six (06) years after the first commissioning of each unit and during the General Overhaul outages.

7.2. Point source – maximum emission rates (under normal conditions)

Point Source Code	Pollutant Name	Maximum Release Rate			Duration of Emissions
		(mg/Nm ³)	Date to be Achieved By	Average Period	
Stack 1	SO ₂	3500 mg/Nm ³	01 April 2015	Daily	Continuous
		500 mg/Nm ³	01 April 2025	Daily	Continuous
	NOx	750 mg/Nm ³	01 April 2015	Daily	Continuous
	PM	50 mg/Nm ³	01 April 2015	Daily	Continuous
Stack 2	SO ₂	3500 mg/Nm ³	01 April 2015	Daily	Continuous
		500 mg/Nm ³	01 April 2025	Daily	Continuous
	NOx	750 mg/Nm ³	01 April 2015	Daily	Continuous
	PM	50 mg/Nm ³	01 April 2015	Daily	Continuous

Point source – maximum emission rates and requirements

- 7.2.1 Emissions to the atmosphere from each unit shall be limited as set out in the Table 7.2 when the processes are in operation. The License Holder must be in compliance with the emissions limitations in Table 7.2 at all times, except during periods of start-up, maintenance, and shutdown.



- 7.2.2 PM10 emissions shall not exceed 50 mg/Nm³, NO_x emissions shall not exceed 750 mg/Nm³, and SO₂ emissions shall not exceed 3500 mg/Nm³ during the period 01 April 2015 to 31 March 2025 and shall not exceed 500 mg/Nm³ from 01 April 2025, averaged daily under normal conditions of 273 K, 101.3 kPa and 10% oxygen (O₂).
- 7.2.3 The License Holder must prevent deviations from normal operating conditions that would result in emissions exceeding specified limit values, and shall scale back or halt its operations under excessive emissions if it is likely that the permitted levels of emissions would otherwise be exceeded.
- 7.2.4 The License Holder must develop a written start-up, maintenance, and shutdown plan that describe, in detail, procedures for operating and maintaining each boiler during periods of start-up, maintenance, and shutdown; and a program of corrective action for malfunctioning process, air pollution control, and monitoring equipment used to comply with the emission limitations in Table 7.2. The start-up, maintenance, and shutdown plan does not need to address any scenario that would not cause either unit to exceed an emission limitation. During periods of start-up, maintenance, and shutdown, the License Holder must operate each unit in accordance with the start-up, maintenance, and shutdown plan.
- 7.2.5 Deviations that occur during a period of start-up, maintenance, and shutdown are not violations if the License Holder demonstrates to the Licensing Authority satisfaction that the License Holder was operating in accordance with the start-up, maintenance, and shutdown plan. The Licensing Authority will determine whether deviations that occur during a period of start-up, maintenance, and shutdown are violations in accordance with Section 51 of the Act.
- 7.2.6 The License Holder must apply for an exemption from the conditions of the License in the event of equipment malfunction or breakdown within twenty four (24) hours of the incident. Should the normal start-up, maintenance, upset and shutdown conditions exceed 48 hours, Section 30 of the National Environmental Management Act (Act No. 107 of 1998), as amended, shall apply.
- 7.2.7 The duration of start-up (number of hours from fires in to synchronization) and shut down must be reported in the report required in terms of Condition 7.7.1. The number of hours for which emissions exceed the limit during Emergency Generation, and the number of hours declared as Emergency Generation by National Control, must be included in the report required in terms of Condition 7.7.1.

7.3. Point source – emission monitoring and reporting requirements

Point Source Code	Emission Sampling / Monitoring Method	Sampling Frequency	Parameters to be Measured	Parameters to be Reported	Reporting Frequency	Conditions Under Which Monitoring Could Be Stopped
Stack 1	Continuous emission monitoring (in-stack)	Continuous	Continuous (90% of hours in a year)	PM, SO ₂ , NO _x , CO ₂	As per Condition 7.7 of the License	Upon written approval by the Licensing Authority
Stack 2	Continuous emission monitoring (in-stack)	Continuous	Continuous (90% of hours in a year)	PM, SO ₂ , NO _x , CO ₂	As per Condition 7.7 of the License	Upon written approval by the Licensing Authority



Point source – monitoring and reporting requirements

- 7.3.1 The License Holder shall install, calibrate, and operate a Continuous Emissions Monitoring System (CEMS) each for Stack 1 and Stack 2 that measures Particulate Matter (PM₁₀), Sulphur Dioxide (SO₂), Oxides of Nitrogen (NO_x) and Carbon Dioxide (CO₂). The concentrations of the gaseous pollutants shall be corrected to 10% O₂ on a dry basis. The averaging period for the purposes of compliance monitoring shall be expressed on a daily average basis.
- 7.3.2 The CEMS shall be operated, calibrated and maintained continuously, dependent of the units' operation. The License Holder must measure and record valid continuous emission data for the parameters listed in Condition 7.3 during all periods of the units' operation including periods of unit start-up, shutdown, malfunction or emergency conditions, except for periods of CEMS quality assurance/quality control ("QA/QC"), routine maintenance, or uncontrolled malfunction. Nevertheless, the CEMS must be maintained to yield a minimum of 90% valid hourly average values during the reporting period. CEMS must be audited by a SANAS accredited laboratory at least once every two (02) years.
- 7.3.3 The License Holder shall conduct spot measurement or correlation stack tests to verify the accuracy of the continuous emission measurement. The Licensing Authority, or the Licensing Authority's duly authorized representative, may witness or conduct such test(s). Should the Licensing Authority opt to conduct such test(s), the operator shall provide all necessary sampling connections and sampling ports to be located in such manner as the Licensing Authority may require, power for test equipment and the required safety equipment, such as scaffolding, railings and ladders, to comply with generally accepted good safety practices. Such tests shall be conducted in accordance with the methods and procedures set out in this License or as otherwise approved or specified by the Licensing Authority.
- 7.3.4 All spot measurement or correlation stack tests to verify the accuracy of the continuous emission measurement and such other tests as specified in this License shall be conducted in accordance with an approved test method as contained in Schedule A of Section 21 Notice (Government Notice No. 893). Methods other than those contained in Schedule A may be used with the written consent of the National Air Quality Officer. Such methods shall be submitted to the Licensing Authority in writing at least thirty (30) days prior to any testing and shall contain the information set out by the Licensing Authority or as per Condition 7.8(A)(iii).
- 7.3.5 The License Holder shall notify the Licensing Authority prior to any isokinetic sampling, spot measurement or correlation stack tests, in accordance with Condition 7.8, so the Licensing Authority may have the opportunity to observe such tests. This notification shall include the actual date and time during which the test will be conducted and, if appropriate, verification that the tests will fully conform to a referenced method previously approved by the Licensing Authority.
- 7.3.6 In addition to installing, operating and maintaining a CEMS for monitoring and reporting of emissions, the License Holder shall install, maintain and operate an ambient air quality [Sulphur Dioxide (SO₂); Nitrogen Dioxide (NO₂), Carbon Monoxide(CO); Particulate Matter(PM₁₀ and PM_{2.5}); Ozone(O₃); and Mercury(Hg)] monitoring and associated meteorological stations in the Marapong residential area as well as at relevant areas upwind and downwind of the facility. An ambient air quality monitoring plan must be submitted to the Licensing Authority for approval as per Condition 7.9.
- 7.3.7 The License Holder shall also conduct public education and awareness campaigns focusing on air quality improvements and shall implement a program of support for initiatives aimed at improving air quality in the surrounding communities and performance reports must be submitted to the Licensing Authority as per Condition 7.7.1(V). A five year public education and awareness plan must be developed and submitted to the Licensing Authority for review and approval by the Licensing Authority as per Condition 7.9.



7.4. Area and or line source – management and mitigation measures

Area and/or Line Source Code	Source Name	Source Description	Description of specific measures	Required control efficiency (%)	Timeframe for achieving required efficiency	Method of monitoring measures' effectiveness
A1	Coal stockyard	Storage and handling of coal	- Compaction of strategic stockpile - Spraying of water for dust suppression	Fallout dust not to exceed dust fallout standards set out in Regulation 3 of the National Dust Control Regulation, 2013	Immediately	Dust fallout and PM10 monitoring
A2	Excess coal stockyard	Storage and handling of coal	- Compaction of strategic stockpile - Spraying of water for dust suppression	Fallout dust not to exceed dust fallout standards set out in Regulation 3 of the National Dust Control Regulation, 2013	Immediately	Dust fallout and PM10 monitoring
A3	Ash dump	Storage of ash	- Spraying of water for dust suppression - Rehabilitation of ash dump by planting vegetation	Fallout dust not to exceed dust fallout standards set out in Regulation 3 of the National Dust Control Regulation, 2013	Immediately	Dust fallout and PM10 monitoring
A4	Fuel oil tank 1	Fuel oil storage	- Monthly visual inspection of the exterior walls of the tank - Perform inventory reconciliation and annual leak detection tests	Fallout dust not to exceed dust fallout standards set out in Regulation 3 of the National Dust Control Regulation, 2013	Immediately	Dust fallout and PM10 monitoring
A5	Fuel oil tank 2	Fuel oil storage	- Monthly visual inspection of the exterior walls of the tank - Perform inventory reconciliation and annual leak detection tests	Fallout dust not to exceed dust fallout standards set out in Regulation 3 of the National Dust Control Regulation, 2013	Immediately	Dust fallout and PM10 monitoring



Area and or line source management and mitigation measures

- 7.4.1 The License Holder shall perform all necessary operations to minimize emissions arising from the coal stockpile, ash dump, coal and ash handling equipment, and any other associated infrastructure or activity. Measures including good housekeeping, compaction of stockpile, rehabilitation of ash dump by planting vegetation and spraying of water for dust suppression shall be implemented at all times as shall be necessary to minimize the generation of dust from the works and to prevent detrimental impacts on adjacent receptors.
- 7.4.2 The License Holder shall perform all necessary operations to minimize emissions arising from the fuel oil storage area, fuel oil handling equipment, and any other associated infrastructure or activity. The area shall be bunded to cater for double the volume of each tank at the minimum (i.e. 2400m³ per tank) with an additional freeboard of 300mm so that each tank has its own bunded area with a double volume bund and spare change. The bund shall be constructed of concrete with all joints sealed, excess water shall be discharged through a drain-off facility within the bunded area and oil traps shall be used to separate oil from water prior to release into the wastewater system. A sand-bitumen mix placed at the bottom of the tank shall be used to prevent leaking. Fuel oil tanks shall be fitted with a breather pipe with flame arrestor, full fire-water system and fire blanket system installed along the top of the bunker walls.
- 7.4.3 Periodic evaluation of the coal, ash dump and fuel oil storage sites' implemented control measures must be undertaken to identify the success of those measures, in-line with the requirements of the Fugitive Emissions Management Plan contemplated in Condition 7.9.
- 7.4.4 The License Holder shall conduct dust fallout monitoring/measurements in accordance with an approved test method at sites around the stockyard area, ash dump area as well as along the site boundary (at least upwind and downwind) to determine contributions from background sources.
- 7.4.5 Monitoring systems and control measures must be implemented to ensure prevention or mitigation of spontaneous combustion of coal stockpiles
- 7.4.6 Reviews of the monitoring results and effectiveness of implemented mitigation measures shall be carried out. Results of such reviews (including calibration data, monitoring protocol, measured dust concentrations, and data analysis) must be submitted to the Department in accordance with Condition 7.7.1. Records of specific dust events, dust complaints and site conditions including prevailing meteorology must be included in the report.
- 7.4.7 The License Holder shall keep readily accessible records showing the dimension of each storage vessel, an analysis showing the capacity of each storage tank and the maximum true vapor pressure of the stored liquid. Records shall be retained for the life of the facility. The License Holder shall also keep records sufficient to determine the throughput of fuel oil for each storage tank for use in the report as per Condition 7.7.1.
- 7.4.8 Emissions of Total Volatile Organic Compounds (TVOC) from fuel oil storage tanks' venting and working loss shall be estimated using methods approved by the Licensing Authority. Visual inspection of the exterior walls of the tanks results, fuel oil inventory reconciliation data, fuel oil throughput data and TVOC emission estimation results shall be submitted to the Licensing Authority as per Condition 7.7.1.
- 7.4.9 The License Holder must install and maintain appropriately designed stormwater management and treatment infrastructure to control and prevent pollution of water resources. Any runoff from the coal stockyard, ash dump and fuel oil storage area must be directed to the treatment system.
- 7.4.10 The License Holder must revise and submit a fugitive emission management plan as per Condition 7.9. The plan must identify all significant sources of fugitive emission and measures that will be implemented to address these fugitive sources. The plan must include detailed control methodologies/techniques, contingency plans, timeframes for implementation, assessment of efficiency, and regular monitoring and reporting systems/criteria.

7.5. Energy Conservation Measures

The License Holder shall evaluate its activities to improve energy utilization and efficiency. This information should be provided to the Licensing Authority upon request.

7.6. Cleaner Production Targets

The License Holder must investigate cleaner production processes and practices that are relevant to its operations with a view towards reducing energy consumption and atmospheric emissions related to the processes. This information should be provided to the Licensing Authority upon request.

7.7. Routine Reporting and Record-keeping

7.7.1 Monthly Reporting

The License Holder must complete and submit to the Licensing Authority a Monthly Report no later than thirty (30) days after the end of each reporting period. The report must include information for the period under review. The Monthly Report must include, but not limited to, the following:

I. Complaints Register

The License Holder must maintain a Complaints Register at its premises, and such register must be made available for inspections. The Complaints Register must include the following information on the complainant, namely, the name, physical address, telephone number, date and the time when the complaint was registered. The register should also provide space for noise, dust and offensive odours complaints. Furthermore, the License Holder is to investigate and, monthly, report to the Licensing Authority in a summarised format on the total number of complaints lodged. The complaints must be reported in the following format with each component indicated as may be necessary:

- a) Air pollution complaints received;
- b) Date the complaint was received and the date the facility responded;
- c) Investigations to determine the cause of the complaint;
- d) Results of the investigation, and
- e) Any actions taken to resolve the complaint.

The Licensing Authority must also be provided with a copy of the Complaints Register upon request.



II. Operation and Production Records

The License Holder must track and record the operation and production such that source-wide emissions can be estimated on a daily basis. Records must include, but not be limited to:

- a) Daily hours of operation
- b) Daily production Rate
- c) Daily fuel consumption rate
- d) Ash and sulphur content (%) of any Coal
- e) Sulphur content (%) of fuel oil combusted;
- f) Coal, Ash and Fuel oil throughput data
- g) Visual inspection of the exterior walls of the fuel oil tanks results and fuel oil inventory reconciliation data
- h) Documentation of any time periods when the unit process is operational and the Fabric filter plant and/or low NO_x burners are not fully operational

III. Emissions monitoring and measurements and performance against limits

The License Holder must record and report, in a summarised format, any performance and/or compliance testing of machinery and equipment that has a direct or indirect impact on the atmospheric emissions to the Licensing Authority. Any non-compliance must be described thoroughly in the report. The performance tests and compliance testing report should include (but not be limited to) the following information:

- a) Point sources monitoring and measurements results indicating performance against the specified emission limits in Table 7.2;
- b) Pollutant emissions trend including Greenhouse gas emissions;
- c) Fugitive emissions estimation/measurement information
- d) Start-up, maintenance, shutdowns or malfunction occurrence and duration;
- e) Major upgrades projects (i.e. abatement equipment or process equipment);
- f) Excess emissions, source code or name, emission standard exceeded, root cause analysis;
- g) Calculation of impacts/emissions associated with the non-compliance incidents and dispersion modelling of pollutants where applicable;
- h) Measures implemented or to be implemented to prevent recurrence; and
- i) Date by which measures were or will be implemented.



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IV. Spot/correlation stack tests

Records of all required compliance testing shall include the following:

- a) The date, place, and time of sampling or measurements;
- b) The date analyses were performed;
- c) The company or entity that performed the analyses;
- d) The analytical techniques or methods used;
- e) The results of all such analyses; and
- f) The operating conditions existing at the time of sampling or measurement

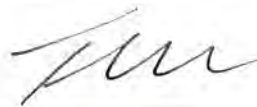
V. Air Quality Improvement and Social Responsibility

- a) Ambient air quality monitoring results;
- b) Air quality improvement initiatives;
- c) Public education and awareness campaigns;

7.7.2 Bi-annual Reporting

The License Holder must complete and submit to the Licensing Authority a Bi-annual Report no later than thirty (30) days after the end of each reporting period. The report must include information for the period under review. The Bi-annual Report must include, amongst others, the following items:

- a) Compliance with regard to each AEL condition
- b) Interpretation of all available data, tests and monitoring results regarding operation of the plant and all impacts on the environment
- c) Recommendations regarding non-compliance or potential non-compliance
- d) Target dates for the implementation of recommendations by the License Holder to achieve compliance
- e) Impact of implemented corrective action taken for identified non-compliance



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7.7.3 Annual Reporting

The License Holder must complete and submit to the Licensing Authority, an Annual Report as contemplated in paragraph 17 of Section 21 Notice (Government Notice No. 893) no later than thirty (30) days after the end of each reporting period. The report must include information for the year under review. The Annual Report must include, amongst others, the following items:

- a) Information specified in paragraph 18 of Section 21 Notice (Government Notice No. 893)
- b) Emissions performance (emissions trend including Greenhouse gas emissions), compliance statistics and Spot/verification tests annual data summaries
- c) Start-up, maintenance, shutdowns or malfunction occurrence and duration annual summary statistics
- d) Operation and production annual data summaries
- e) Annual summaries of deviations from License conditions or operations and maintenance plan and actions taken to resolve the problem

7.8. License Notification Requirements

A. The License Holder shall notify the Licensing Authority by letter or by electronic mail of the:

- i. Actual date of initial start-up of each unit, not less than fourteen (14) days prior to such date;
- ii. Actual date of commencement of commercial operation of each unit, not less than fourteen (14) days prior to such date;
- iii. Date upon which isokinetic stack sampling, spot measurement or correlation stack tests will commence, in accordance with Condition 7.3.5, within fourteen (14) days prior to such date. Notification may be provided with the submittal of the performance test protocol required in terms Condition 7.3.3 and 7.3.4. The notice must state the source to be tested, the proposed time of the test, the testing date(s) and the proposed testing methods and procedures.

B. The License Holder shall notify the Licensing Authority within twenty four (24) hours following the discovery of any failure of air pollution control equipment, process equipment, or of a process to operate in a normal manner, which results in an increase in emissions above the allowable emission limits set in Section 7.2 of this License.

C. In addition, the License Holder shall provide an additional notification to the Licensing Authority in writing or electronic mail within fourteen (14) days of any such failure described under Condition 7.8 (B). This notification shall include a description of the malfunctioning equipment or abnormal operation, the date of the initial malfunction, the period of time over which emissions were increased due to the failure, the cause of the failure, the estimated resultant emissions in excess of those allowed in Section 7.2, and the methods utilized to mitigate emissions and restore normal operations.

D. The License Holder is to notify the Licensing Authority within twenty four (24) hours of any other significant incidences (i.e. spillages, fires, leakages or other similar situations). Should such incidences pose a significant health risk or nuisance, notification of the incident is to be immediate. Where excessive emissions occur, which could cause adverse health or environmental impacts or nuisance, urgent corrective measures must be taken, by the License Holder, to contain or minimise the emissions through operational interventions. Remediation, if required shall be carried out to the satisfaction of the Licensing



Authority and/or any other governmental agencies. Any incident that has the potential to create significant health, safety or environmental risk or nuisance needs to be reported immediately to the relevant authority, Section 30 of the National Environmental Management Act (Act No. 107 of 1998), as amended, shall apply.

- E. Compliance with the notification provision shall in no way serve to excuse, otherwise justify, or in any manner affect any potential liability or enforcement action resulting from the occurrence.

7.9. Investigation and Reviews

The following investigations are required:

Location	License Conditions	Minimum Requirements	Timeframe
Plant Wide	Fugitive Emissions Management (revised)	Fugitive Emissions Management Plan developed, approved and under implementation as per the schedule agreed in the plan, to minimize nuisance impacts off-site	Six (06) months from the date of issue of this License.
Plant Wide	Operations and Maintenance Plan (revised)	A written start-up, maintenance, and shutdown plan that describe, in detail, procedures for operating and maintaining each unit during periods of start-up, maintenance, and shutdown; and a program of corrective action for malfunctioning process must be developed. The Maintenance Plan must illustrate how the facility will be operated and maintained in order to comply with the emission limits as specified in this License.	Six (06) months from the date of issue of this License.
Neighborhood	Five Year Public Education and Awareness Plan	Public Education and Awareness Plan must include strategies for reaching out to selected audiences, messages that promote maintenance/achievements of ambient air quality goals and messages tailored to make people from all walks of life aware of specific issues related to the facility's operations taking into account emissions to the atmosphere, their impacts on health and surroundings/environment as well as preventative measures. The plan must also include aspect of monitoring and evaluation (M&E).	Six (06) months from the date of issue of this License.
Neighborhood	Ambient Air Quality Monitoring Plan	An Ambient Air Quality Monitoring Plan must provide specifics of the monitoring network to be established including details of the monitoring sites considerations, location including street address and geographical coordinates of the identified sites, pollutants and meteorological parameters to be monitored, sampling and analysis method(s) for each parameter to be measured, monitoring objectives and spatial scale of representativeness for each monitoring site, data acquisition, management and reporting procedures, as well as necessary protocols, procedures and work instructions for effective management of the monitoring network.	Six (06) months from the date of issue of this License.



7.10. Start up, Maintenance and Shut-down Conditions

Unit Process	Description of Occurrence of Potential Releases (e.g. leakage, technology outage, etc.)	Pollutants and Associated Amount of Emissions	Briefly Outline Back Up Plan
Start-up	Fuel oil-assisted start-up to get the unit up to temperature	Particulate emissions in excess of 50 mg/Nm ³	Start-up is of limited duration
Shut-down	Plant failure /breakdown	Particulate emissions in excess of 50 mg/Nm ³	To be provided as per Condition 7.2.4
Bag leakages	Leaks in fabric filter plant bags will result in higher emissions of ash	Particulate emissions in excess of 50 mg/Nm ³	Leaking bags will be replaced
On-load rebags	Bags will be replaced if leaking or as part of normal maintenance cycle while unit is operating	Particulate emissions in excess of 50 mg/Nm ³	Bags will be replaced to maintain emissions performance

- 7.10.1 The License Holder shall, to the extent practicable, maintain and operate the facility including associated air pollution control equipment in a manner consistent with good practice for minimizing emissions.
- 7.10.2 Leaking bags must be replaced during bag leakages and as part of normal maintenance cycle in order to maintain emissions performance at all times, including periods of start-up, shutdown, shakedown, and malfunction.
- 7.10.3 During a period of start-up, shutdown, or malfunction, the License Holder shall operate all unit processes (including associated air pollution control equipment) in accordance with the procedure specified in the start-up, shutdown, maintenance and malfunction plan.
- 7.10.4 Determination of whether acceptable operating and maintenance procedures are being used will be based on information available to the Licensing Authority, which may include, but is not limited to, monitoring results, review of operating maintenance procedures and inspection of the facility.
- 7.10.5 The License Holder shall maintain records of the occurrence and duration of any start-up, maintenance, shutdown, or malfunction in the operation of each unit; any malfunction of the air pollution control equipment; or any periods during which a CEMS is inoperative.
- 7.10.6 Notification of a start-up, shutdown, or a malfunction shall be made by the License Holder in accordance with Condition 7.8



8. DISPOSAL OF WASTE AND EFFLUENT ARISING FROM ABATEMENT EQUIPMENT CONTROL TECHNOLOGY

The disposal of any waste and effluent arising from pollution mitigation measures proposed must comply with the relevant legislation and requirements of the relevant authorities.

Point or Area Source Code	Waste / Effluent Type	Hazardous Components Present	Method of Disposal
Stacks 1 and 2	Ash	Heavy metal trace elements and silica	Ash dump
Stacks 1 and 2	Fabric filter bags	Heavy metal trace elements and silica	Ash dump / waste disposal site
Once FGD is installed:			
Stacks 1 and 2	Gypsum	Heavy metal trace elements and silica	Co-disposal on ash dump OR distribution to market
Stacks 1 and 2	FGD waste water	Heavy metal trace elements and silica	Waste water treatment plant

9. PENALTIES FOR NON-COMPLIANCE WITH LICENSE AND STATUTORY CONDITIONS OR REQUIREMENTS

Failure to comply with any of the License and relevant statutory conditions and/or requirements is an offence, and the License Holder, if convicted, will be subjected to those penalties as set out in section 52 of the AQA.

10. ATMOSPHERIC EMISSION LICENSE ENDORSEMENT

SIGNATURE:

NAME:

DESIGNATION:

DATE:

T. M. Mphahlele
T. M. Mphahlele
Senior Manager
01/04/2015

Appendix 5.1 Metrological data

1. Monitoring Location

Station name	South latitude	East longitude	Height above sea level	Source
Medupi Monitoring Station	23° 44'	27° 32'	902 m	http://www.saaqis.org.za/ViewSite.aspx?SiteID=281
Ellisras Airport Station	23° 44'	27° 41'	851 m	http://rp5.co.za/Weather_archive_in_Ellisras

Source : Original data was obtained from Website in the table.



Source: JICA Survey Team

Figure App 5.1-1 Climate and Metrological Data Monitoring Station Map.

2. Wind velocity (WVL) and Wind direction (WDR)

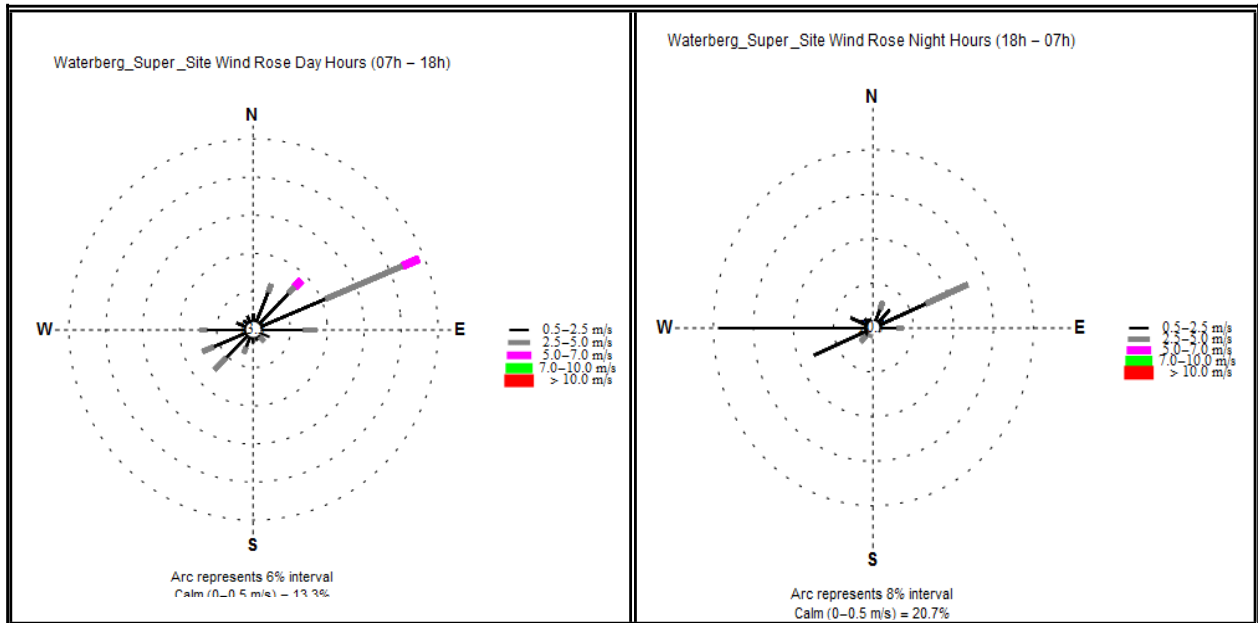
Table App. 5.1-2 Earth's Surface Wind Velocity at Medupi Monitoring Station (2016-2017)

Year	2016	2016	2016	2016	2016	2016	2017	2017	2017	2017	2017	2017	12 months	
Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Average	Max
Highest Hourly Mean	5.8	5.1	5.8	8	6.3	5.1	4.9	6.5	4.7	4.3	4.1	3.7	5.4	8
Highest Daily Mean	4.1	3.5	4	5	3.6	3.8	4	4	2.4	2.1	2.5	1.8	3.4	5
Highest10min Mean	6.9	6	6.8	8.6	7.9	6.8	6.4	8.3	5.4	5.8	5.2	4.5	6.6	8.6

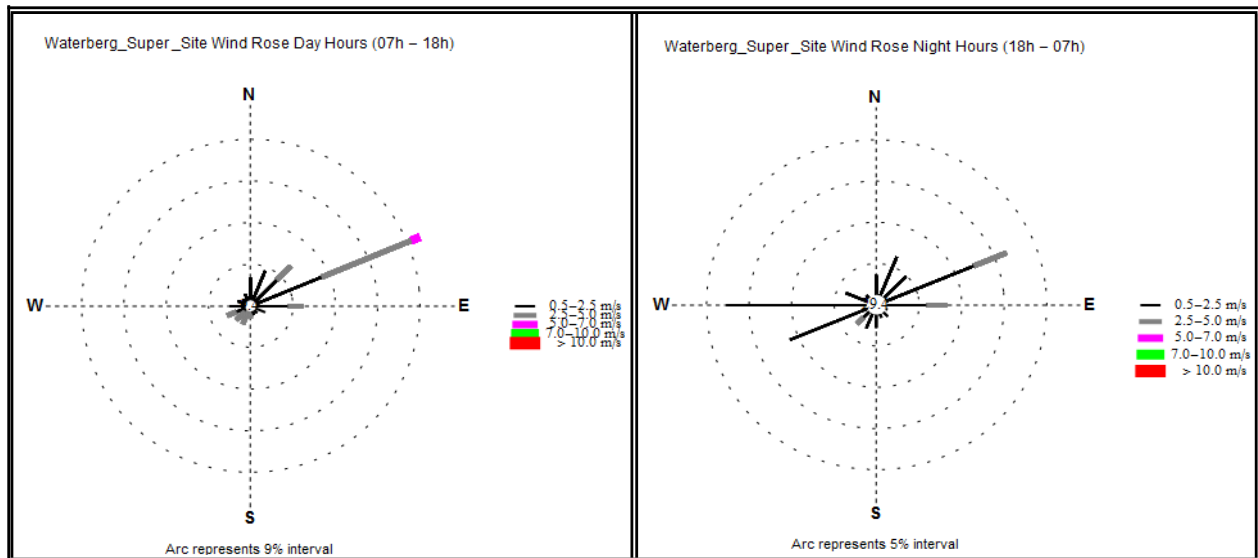
Source Medupi Air Quality Monthly Report, July 2016-June 2017, Eskom

Following figures show the daytime and night-time wind roses for July 2016-July 2017 at Medupi monitoring site. The center of the wind rose depicts the position of the air quality monitoring station. The positions of the spokes in the polar diagram represent directions from which the wind was blowing. The length of the segment indicates the percentage of the time the wind blew from that direction and the speed in the various categories are denoted by colours and width.

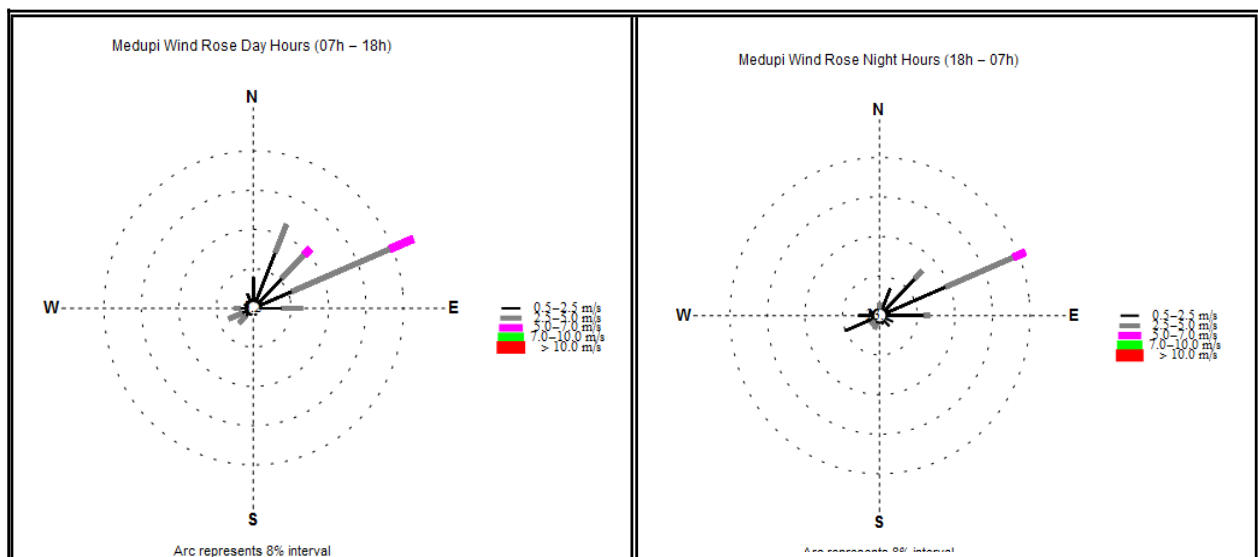
July 2016



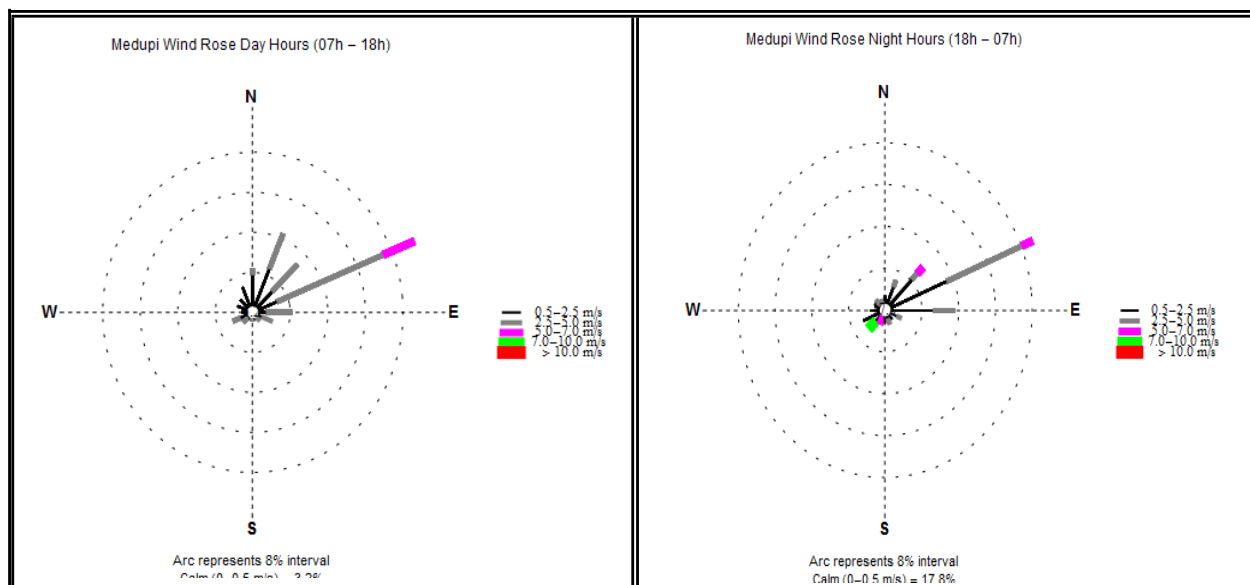
August 2016



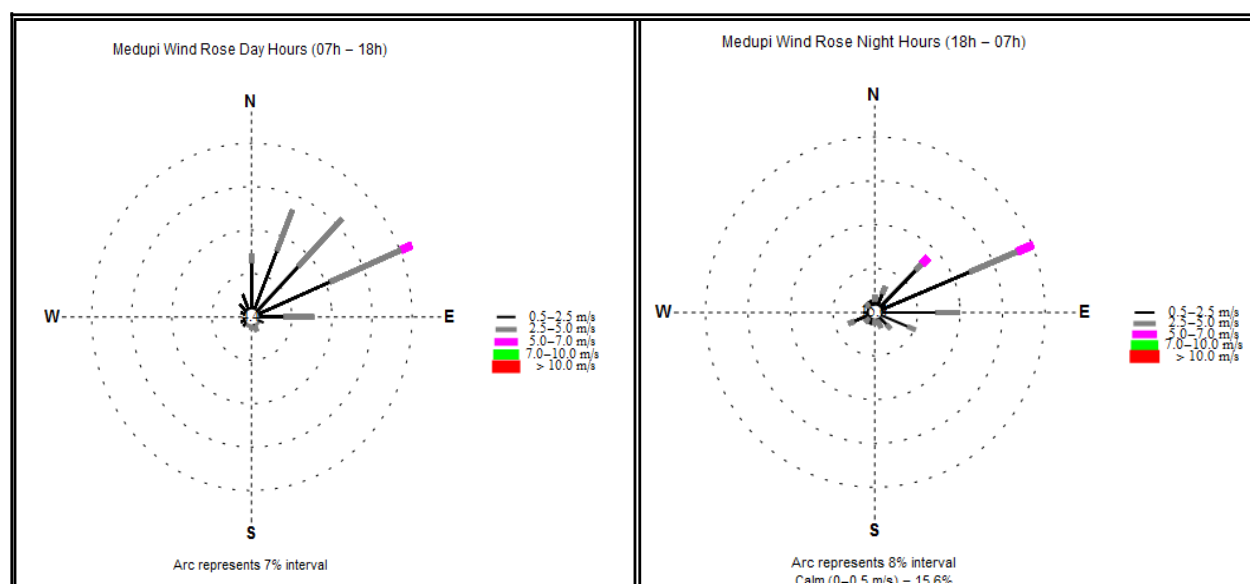
September 2016



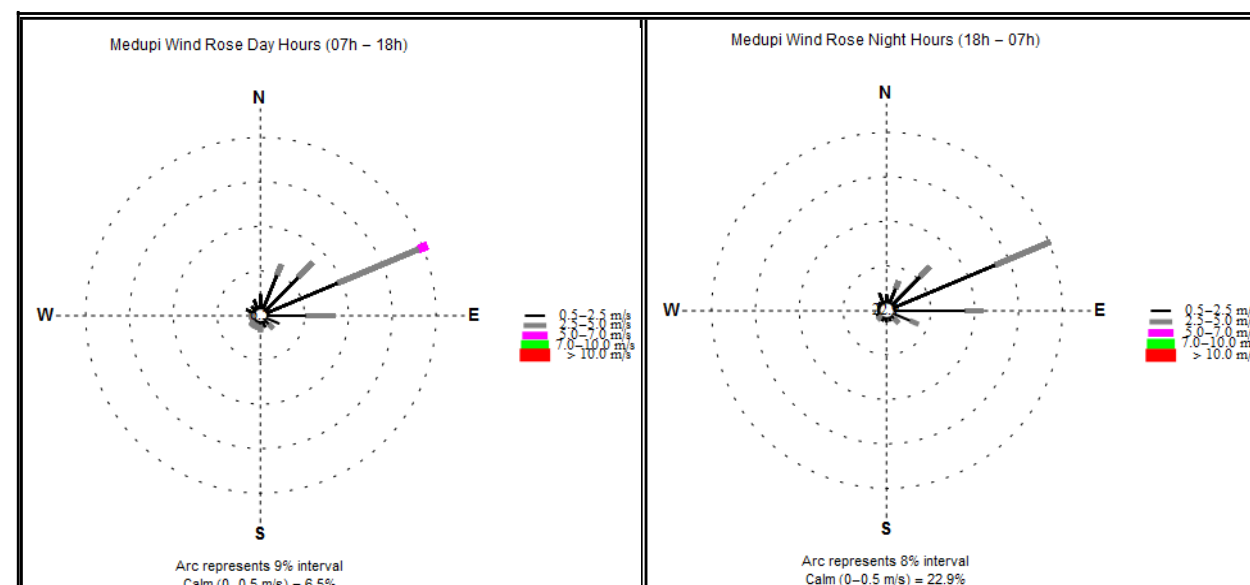
October 2016



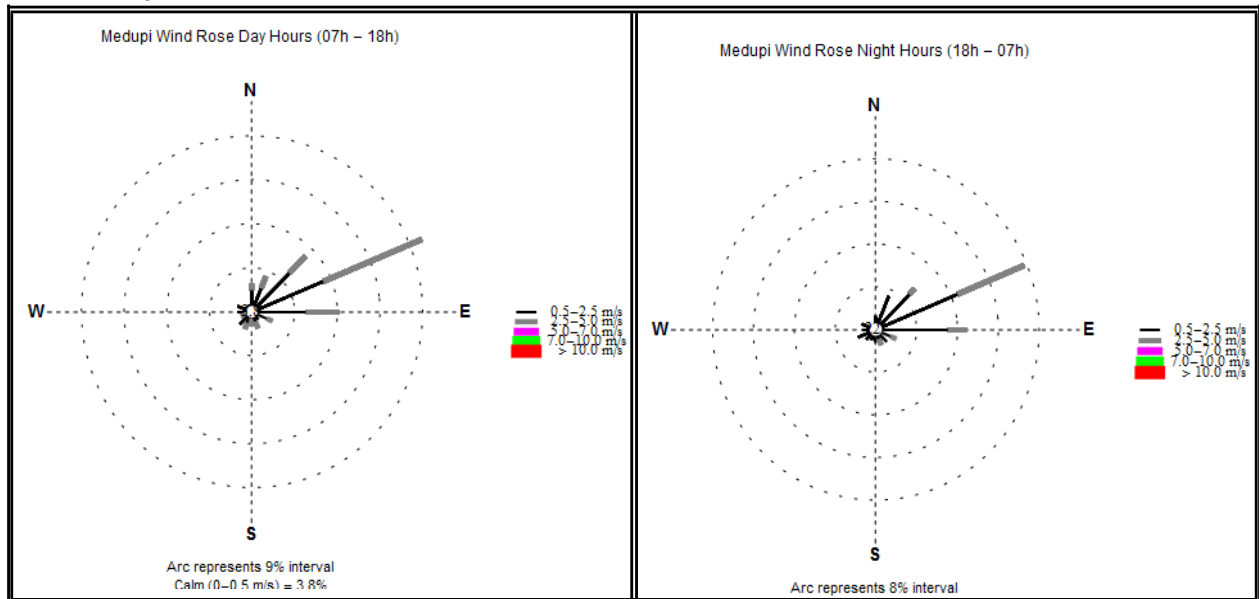
November 2016



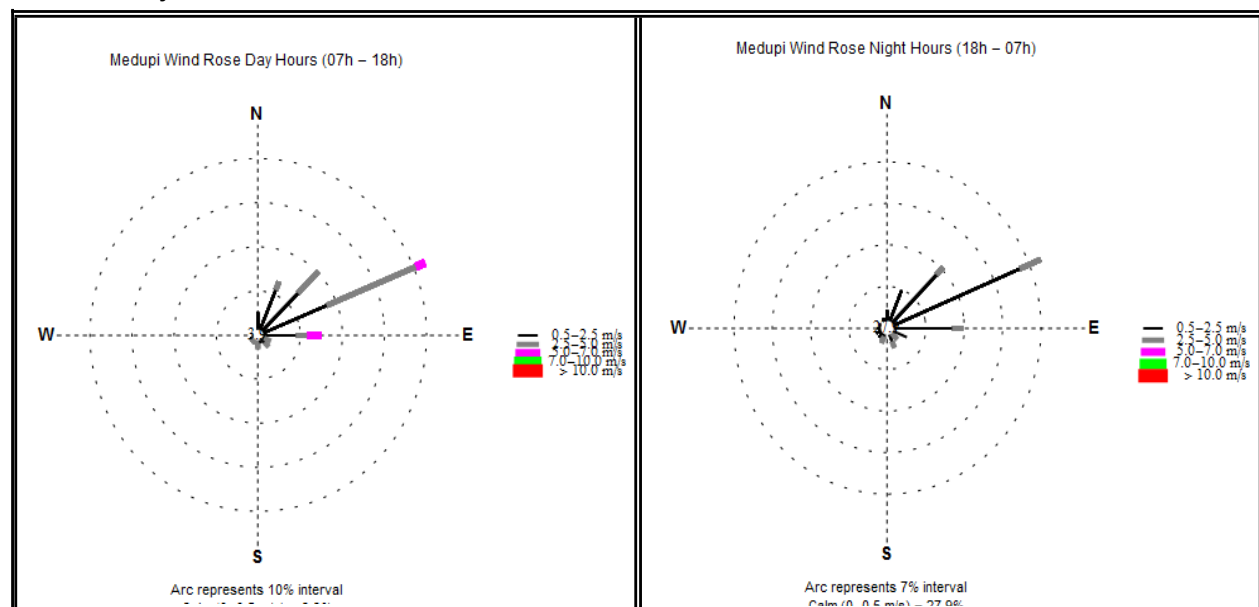
December 2016



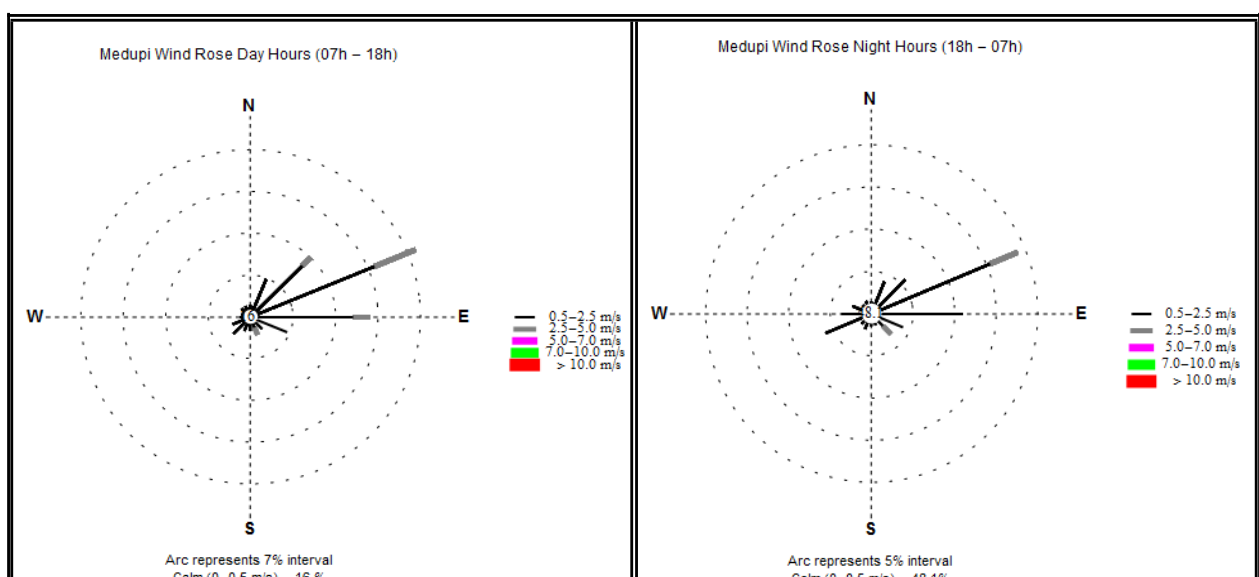
January 2017



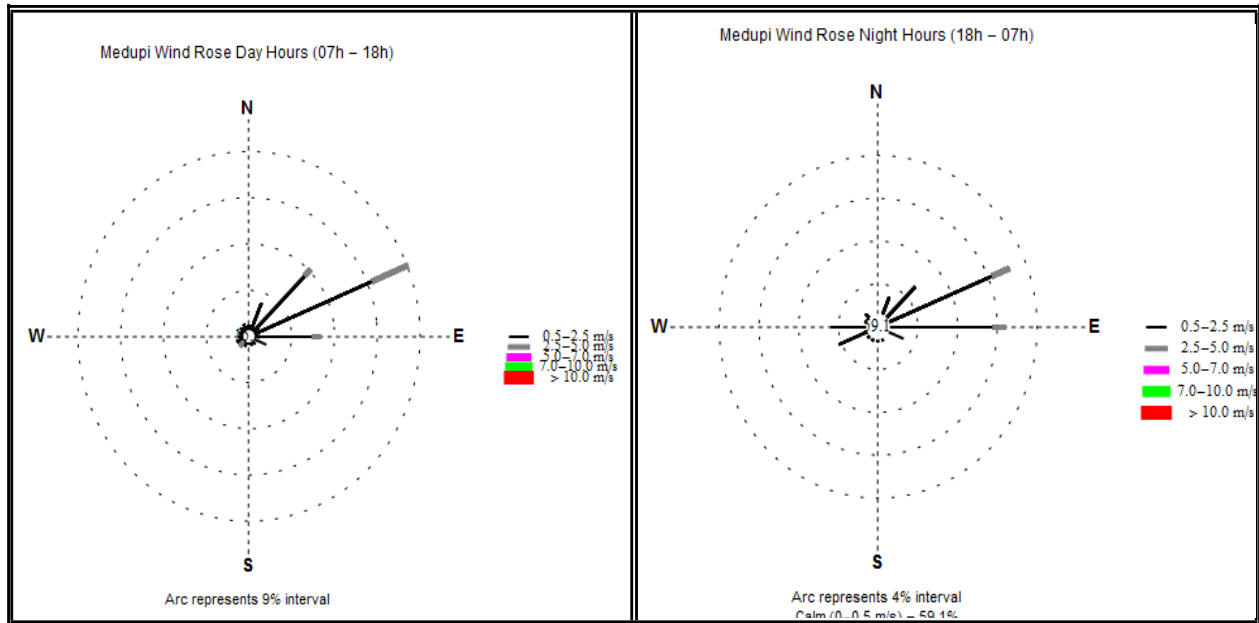
February 2017



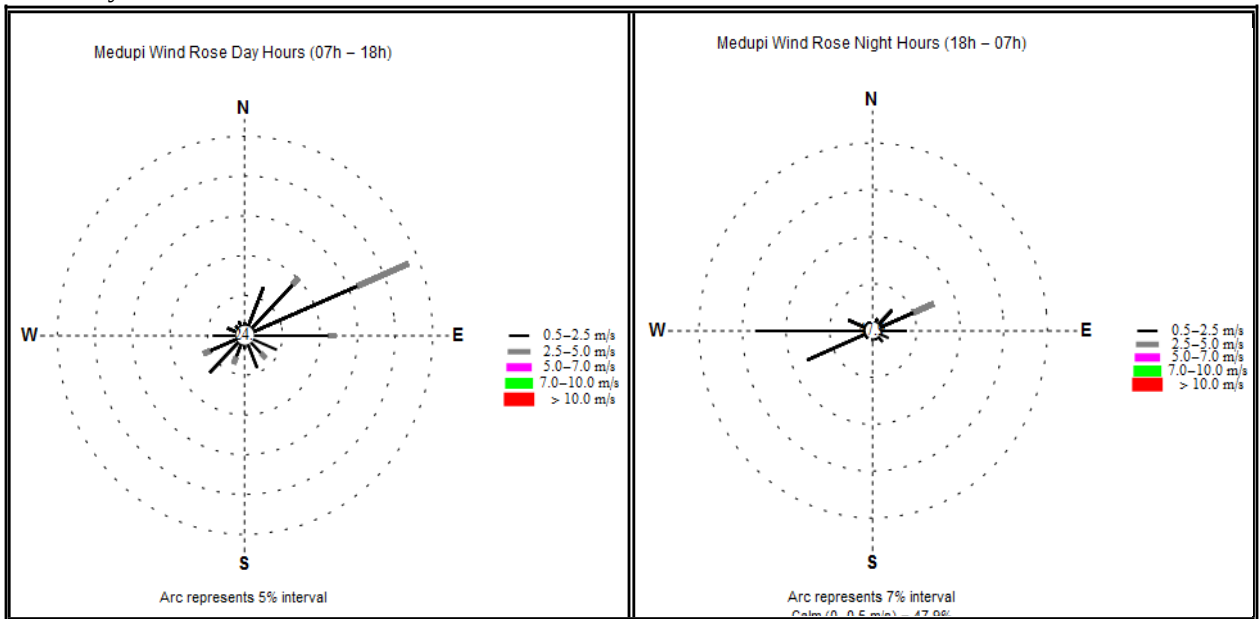
March 2017



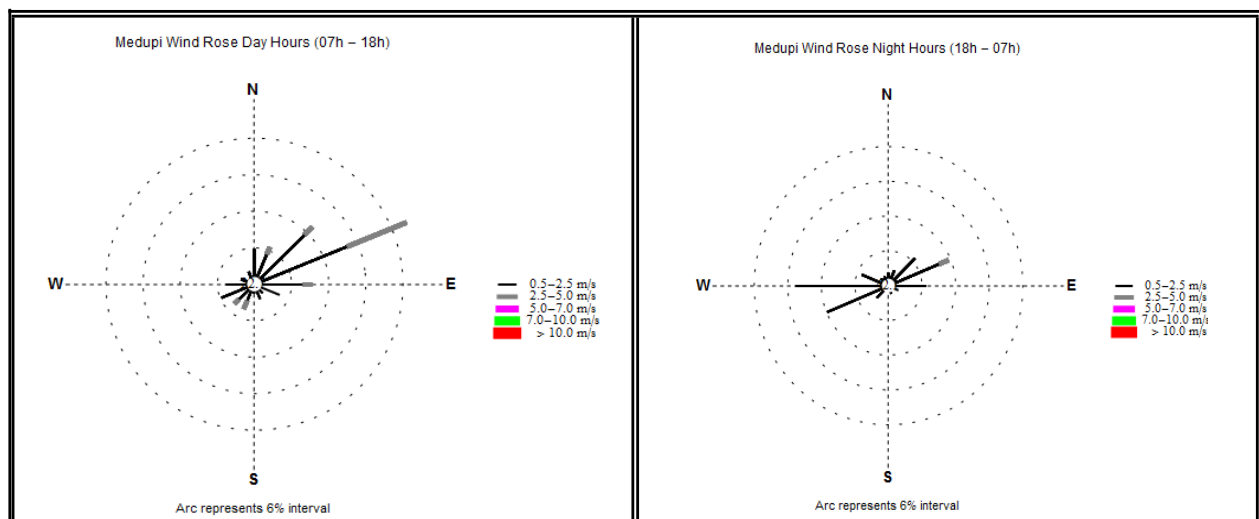
April 2017



May 2017



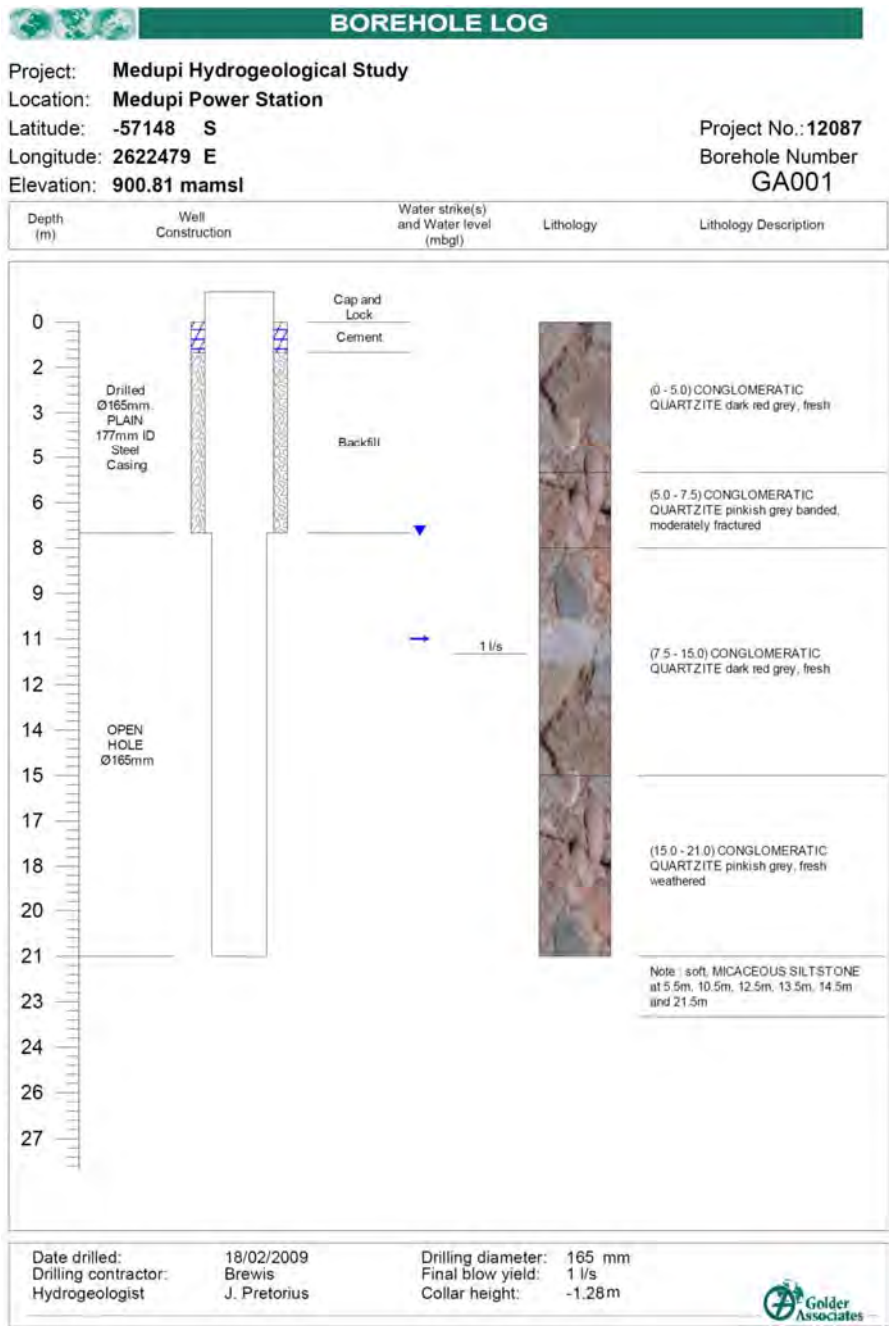
June 2017



Appendix 5.2 Geological data

The borehole logs on the site (close to planned area of FGD) are shown below.

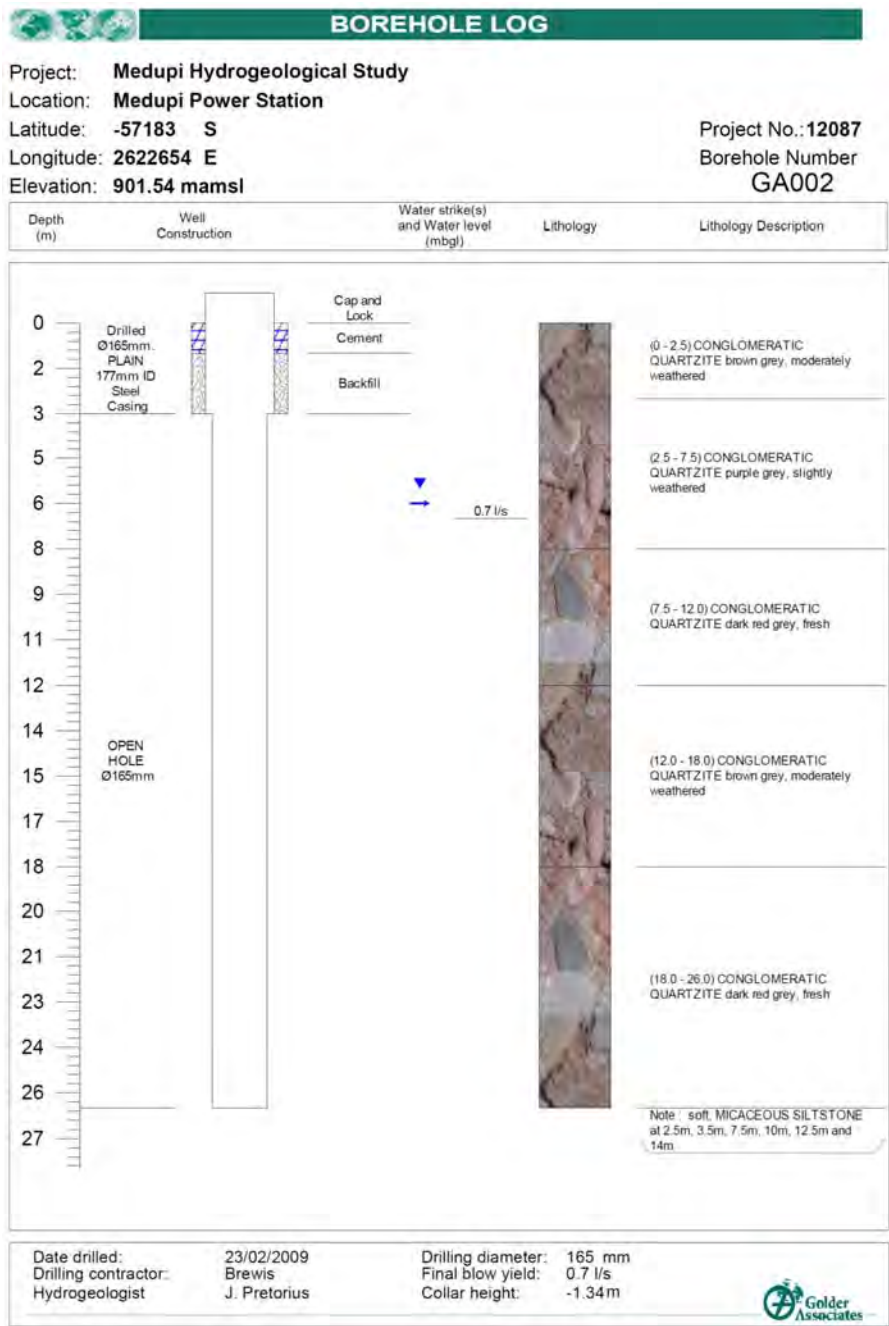
GA001 (Close to Unit 1)



Source MEDUPI POWER STATION SHALLOW GROUNDWATER STUDY/ June 2009

Figure App. 5.2-1 Borehole log “GA001”

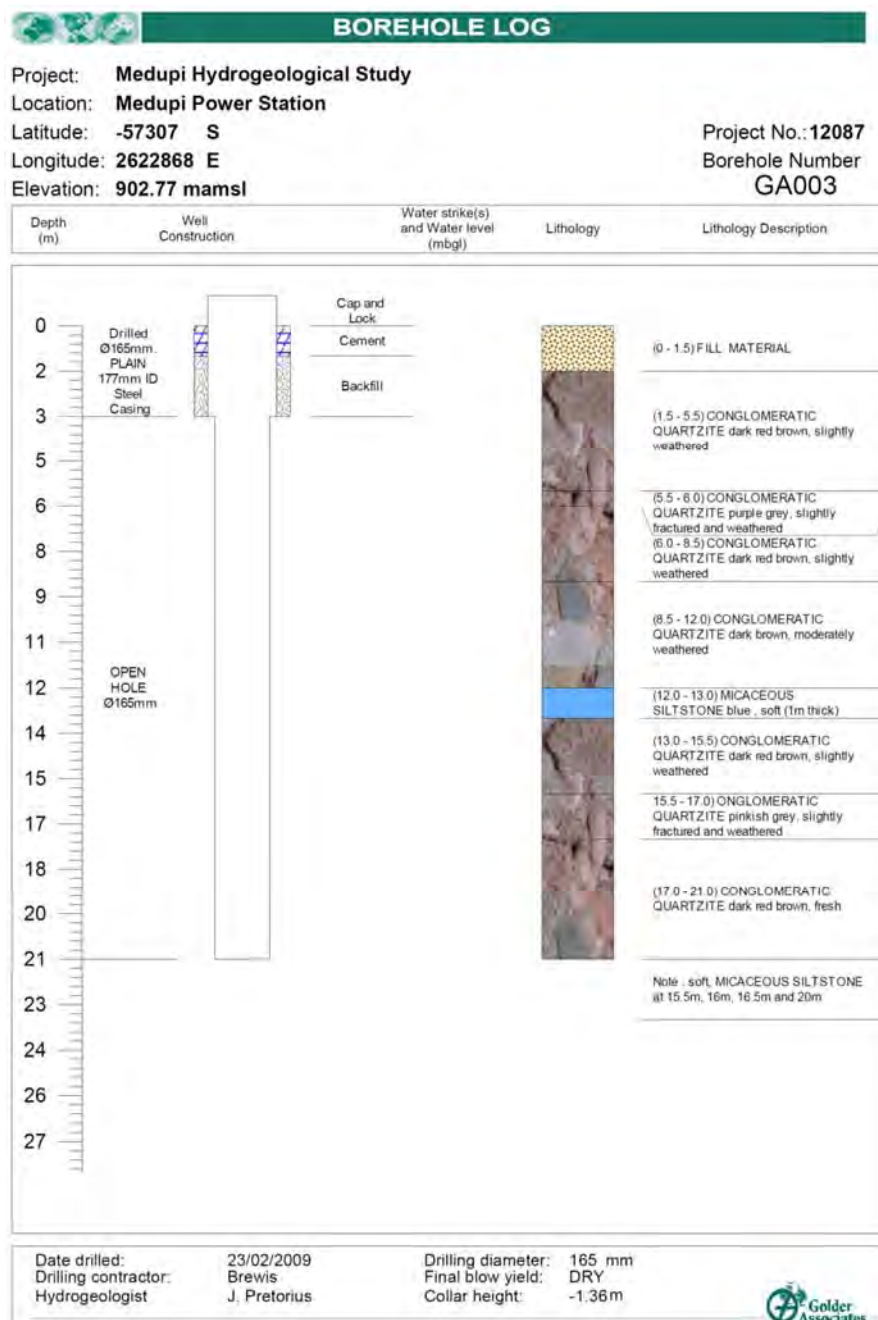
GA002 (Close to Unit 2)



Source MEDUPI POWER STATION SHALLOW GROUNDWATER STUDY/ June 2009

Figure App. 5.2-2 Borehole log “GA002”

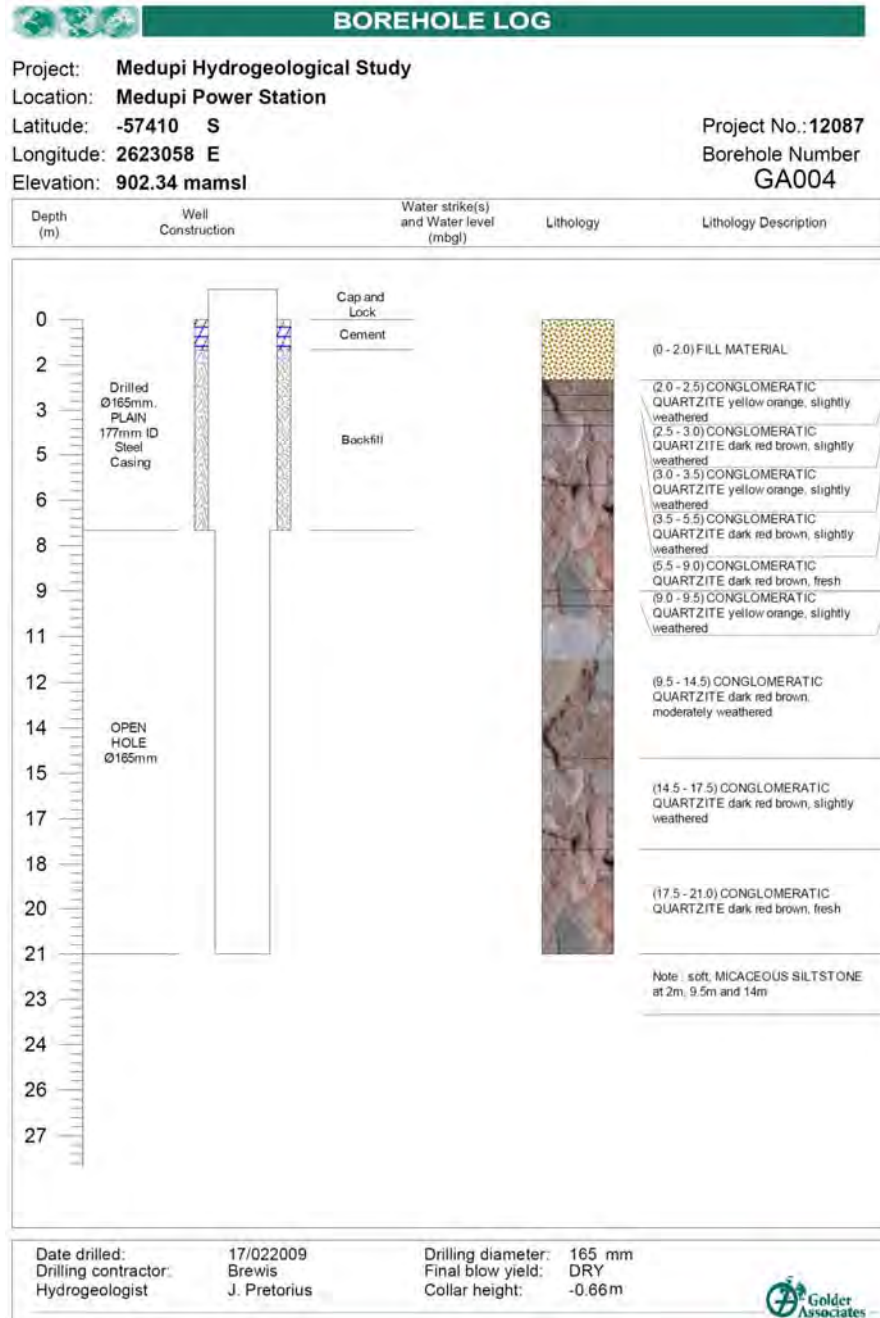
GA003 (Close to Unit 4)



Source MEDUPI POWER STATION SHALLOW GROUNDWATER STUDY/ June 2009

Figure App. 5.2-3 Borehole log “GA003”

GA004 (Close to Unit 6)



Source MEDUPI POWER STATION SHALLOW GROUNDWATER STUDY/ June 2009

Figure App. 5.2-4 Borehole log "GA004"

Appendix 7.1

Risk Management Framework (Medupi Retrofit)

Risk Management Framework

Project Name: Preparatory Survey on Flue Gas Desulfurization System at Medupi Power Station in Republic of South Africa

Country: Republic of South Africa

Sector: Energy

Potential project risks	Assessment
1. Stakeholder Risk	Probability: M
(Description of risk) Delay of the suspension of the operation due to <u>delay of water resource development</u> .	Impact: M
	Analysis of probability and impact: MCWAP phase 2 is under design and seeking fund. If some issues, i.e. delay of purchasing fund, land acquisition and approval of EIA, commencement of water supply will be delayed.
Water intake: If the gas heat exchanger is installed to FGD, the water consumption at Medupi power station in total can be saved from 13.4 mil. m ³ /year to 11.0 mil. m ³ /year. Existing water right from phase one (1) of Mokolo-Crocodile Water Augmentation Project (MCWAP) is 9.4 mil. m ³ /year. So water supply from phase two (2) of Mokolo-Crocodile Water Augmentation Project (MCWAP) is needed in order to operate all of FGD.	Mitigation measures:
	Adoption of water saving equipment (Gas Cooler). (less water needed methodology)
	Action during the implementation:
	Monitoring progress of TCWAP phase 2 closely.
	Contingency plan (if applicable):
	NO necessity
2. Executing Agency Risk	
2.1. Capacity Risk	Probability: L
(Description of risk) <u>Delay of the project implementation due to incapability of the project executing agency</u>	Impact: M
	Analysis of probability and impact: Eskom has experience to control and coordinate approximately 30 packages on boiler, turbine, generator and balance of power construction work on original Medupi PS construction.
If the executing agency is not capable enough for appropriate process of daily works, timely decision makings, or coordination with relevant authorities, the project implementation may be seriously delayed. Such an incapability may also lead to dispute with the project management consultant (PMC) or the contractor on contractual or payment issues.	Mitigation measures:
	A dedicated unit for the Project, PIU, has been proposed in the Study and Eskom should commit the establishment.
	Action during the implementation:
	PMC will assist the Eskom and PIU for timely and proper processes and decision makings. The Steering Committee will monitor the Project's progress and give instructions Eskom for improvement when necessary.
	Contingency plan (if applicable):
	NO necessity
2.2. Fraud & Corruption Risk	Probability: L
(Description of risk) <u>Corruptions in the procurement procedures of the PIU or the contractor in huge amount project generally.</u>	Impact: H
	Analysis of probability and impact: If happens and being exposed, however, the Project may not be proceeded.
	Mitigation measures:

If happens, corruption at any process of the project, such as procurement procedures of the PIU or the contractor, would prevent implementation of the project.	All procurement processes will be conducted strictly complying with both Eskom's guidelines and JICA's guidelines.
	Action during the implementation:
	JICA will monitor the procurement procedures of the PIU and the contractor through the concurrence processes. In the procurement of the contractors, PMC will assist and monitor the bidding procedures in compliance with both the Eskom's guidelines and the JICA's guidelines.
	Contingency plan (if applicable): NO necessity
3. Project Risk	
3.1. Dispute Risk (between Contractor and workers)	Probability: H
(Description of risk) <u>Delay and over budget of the project due to strike of labor.</u>	Impact: H
In South Africa, labor union has great power and selects frequently to do strike with long duration. It may be serious cause of both over budget and delay of construction work.	Analysis of probability and impact:
	There is high possibility of strike judging from original Medupi PS construction.
	Mitigation measures:
	Preparation of appropriate budget accounted into inflation ratio.
	Action during the implementation:
	Establishment of methodology to dissolve official strike. No tolerance for un-official strike. (Some un-official strikes occurred at original Medupi PS construction case)
	Contingency plan (if applicable): NO necessity
3.2. Dispute Risk (inter Contractors)	Probability: L
(Description of risk) <u>No achievement of intended performance due to any reasons, e.g. construction defects.</u> Unlike the EPC (Engineering, Procurement and Construction) scheme, each contractor of EPS (Engineering, Procurement and Supply) and construction burdens limited own responsibility.	Impact: M
	Analysis of probability and impact:
	There are some practice of separate EPS and construction contract in United States, so experienced manufacturer can make appropriate construction manual.
	Mitigation measures:
	Scope of responsibilities both EPS and construction contractor should be defined in each contract.
	Action during the implementation:
	EPS contractor should provide construction manual with construction contractor prior to commencement of erection of FGD.
	Contingency plan (if applicable): NO necessity
3.3. Program & Donor Risk	Probability: L
(Description of risk) <u>Bad debt due to delay of permission for power tariff revision based on investment to FGD, i.e. environmental measure.</u>	Impact: H
FGD does not produce financing benefit,	Analysis of probability and impact:
	NERSA (National Energy Regulatory of South Africa) does not understand necessity of power tariff revision accounted into expenditure for FGD.
	Mitigation measures:

but huge amount of capital cost and the operational cost will be spent. In the case permission for power tariff revision will delay, Eskom receives negative financial impact.	Establishment of estimation methodology for cost of pollution abatement.
	Action during the implementation:
	Submission of application for power tariff revision.
	Contingency plan (if applicable): NO necessity
3.4. Delivery Quality Risk	Probability: M
(Description of risk)	Impact: H
<u>Unfitting with original flue gas system due to lack of experience and/or capacity of engineering company.</u>	Analysis of probability and impact:
Incapability of engineering (design) works may occur lack of pressure and erosion.	Original (under construction) Medupi PS has high quality. Equipment for FGD also shall be designed and supplied by well-experienced manufacturer. So, it is sure that Medupi PS after FGD construction will keep high reliability.
	Mitigation measures:
	Preparation of appropriate Prequalification condition should be needed.
	Action during the implementation:
	PIU should adopt direct contract or bidding by short list.
	Contingency plan (if applicable): NO necessity
4. Other Risk	Probability: L
(Description of risk)	Impact: L
<u>Lower project's beneficial effects due to frequent failure in amount and viability of the electric supply derived from insufficient O&M skill.</u>	Analysis of probability and impact:
Incapability of O&M works may prevent the Project from generating the expected beneficial effects.	Possibility of O&M failure is not high because recent power plant is usually controlled by automatic control system in order to prevent human failure.
	Mitigation measures:
	To provide Off Job training service prior to commissioning period should be included in contract through manufacturer of FGD (EPS contractor).
	Action during the implementation:
	PIU will prepare budget including Off Job training and power plant manager will assign their staff as trainee to learn necessary knowledge.
	Contingency plan (if applicable): NO necessity
5. Overall Risk Rating	Probability: L
(Overall comments)	Impact: M

1/ Descriptions in the risk management matrix can be brief and concise. In order to record the description of each risk as well as the evidence for the team's assessment, a separate sheet should be prepared to describe the details.

Appendix 7.2

Comparison between JICA safety guidance and RSA regulation

JICA Safety guidance			RSA regulation			Remark
Item	Section	Description	Section	Description		
General Rules						
Purpose						
Purpose	1.1.1	-	The Guidances contain the basic policies for safety management, and technical guidance on specific methods for safe execution of works in order to prevent occupational accidents and public accidents on ODA construction projects for public and other facilities.		NA	
			By fully understanding these Guidances and complying with the regulation therein, Project Stakeholders will be in a position to respect the basic human rights of all parties involved in ODA construction projects. This will help prevent the occurrence of occupational and public accidents by creating a culture of safety, and help realize social development in the recipient country. This is the purpose of these Guidances.		NA	
Composition of the Guidances	1.1.2	-	The Guidances are composed of the following six chapters: Chapter 1 General Rules Chapter 2 Basic Policies for Safety Management Chapter 3 Contents of the “Safety Plan” Chapter 4 Contents of the “Method Statements on Safety” Chapter 5 Technical Guidance for Safe Execution (by the Type of Work) Chapter 6 Technical Guidance for Safe Execution (by the Type of Accident)		NA	
Out-of-scope items	1.1.3	-	Since the Guidances specifically contain the recommended practice for safety management for ODA construction works, these Guidances are not intended to cover the occupational health and sanitation or environmental or social considerations related to works other than general construction works.		NA	
Scope of Application						
Relevant projects	1.2.1	-	The Guidances apply to works for public and other facilities to be constructed with Technical Cooperation, ODA loan (project type) and General Grant Aid which JICA implements (hereinafter "ODA Projects").		NA	

			Although the Guidances do not apply to plant works based on EPC (Engineering, Procurement, and Construction) Contracts which cover a whole range of design, procurement of materials, and construction, this does not preclude the application of the whole or part of the clauses or sub-clauses of these Guidances to policies for safety management of those projects.			NA	
Relevant parties	1.2.2		These Guidances apply to all Project Stakeholders involved in ODA Projects, including the Employer, Engineer, Contractor, subcontractors, and workers.			NA	
Applicable provisions	1.2.3		All provisions contained in these Guidances are the basic requirements to be complied with by the Project Stakeholders to ensure safety of ODA Projects.			NA	
Plans for Safety Management							
			In the Guidances, two plans for the safety management for construction work sites shall be prepared and implemented by the Contractor, namely the "Safety Plan" and "Method Statements on Safety." The Contractor/Tenderer shall prepare the Safety Plan in the pre-construction stage. The Contractor shall however prepare Method Statements on Safety in the construction stage.				
Safety Plan	1.3.1.1		The Contractor/Tenderer shall prepare the Safety Plan at the pre-construction stage and submit it to the Employer/Engineer.			JST seems that Contractor Health and Safety Plan(HSE plan) prepared by contractor based on provision specified in Eskom Contract Regulation has almost same contents.	
	1.3.1.2		The Safety Plan is positioned as the basic plan for safety management in ODA construction works at site and establishes basic policies on the general safety management and operation for the entire works at site.				
	1.3.1.3		Chapter 3 "Contents of the Safety Plan" specifies the items to be incorporated into the Safety Plan.				
	1.3.1.4		The Tenderer shall submit his Safety Plan to the Employer/Engineer at the time specified in the Tender Documents. The Contractor shall submit the Safety Plan to the Employer/Engineer at the time specified in the contract documents. If no submission deadline is specified in the contract documents, the Contractor shall submit the Safety Plan to the Employer/Engineer no later than seven (7) days prior to the commencement of the relevant works.				
	1.3.1.5		The Employer/Engineer shall review the Safety Plan prepared and submitted by the Contractor/Tenderer taking				

			into account the need to maintain safety during construction works at site.				
Method Statements on Safety	1.3.2.1		The Contractor shall prepare a Method Statements on Safety at the construction stage and submit the statements to the Employer/Engineer.				
	1.3.2.2	0	The Method Statements on Safety shall define a detailed plan to implement and manage safety in ODA Projects and shall include specifics for the safe execution of works and safety measures for each type of work in accordance with the execution plans specifying the method or sequence for implementation.				
	1.3.2.3	-	In Chapter 4 "Contents of the Method Statements on Safety" specifies the items to be incorporated in the Method Statements on Safety.				
	1.3.2.4	-	The Contractor shall submit the Method Statements on Safety to the Employer/Engineer prior to commencement of the relevant works according to the execution plans or their equivalent document. If the submission date of the Method Statements on Safety is specified in the contract documents or other applicable documents, then this deadline shall be followed.				
	1.3.2.5	-	The Employer/Engineer shall review the Method Statements on Safety prepared and submitted by the Contractor from the viewpoint of maintaining safety during construction works at site.				
Roles and Responsibilities of Project Stakeholders							
Precedence	1.4.1	-	The roles and responsibilities of Project Stakeholders specified in the contract documents shall take precedence over these Guidances.				
Employer	1.4.2	(1)	The Employer shall endeavor to strictly comply with the relevant laws and regulations of the recipient country and use the Guidances to ensure the safety of the Project Stakeholders during construction works at site and protect nearby local residents, and any other third parties, from every potential accidental risk foreseen to arise from the construction works at site.			Article 5 (a) prepare a baseline risk assessment for an intended construction work project; (b) prepare a suitable, sufficiently documented and coherent site specific health and safety specification for the intended construction work based on the baseline risk assessment contemplated in paragraph (a); (c) provide the designer with the health and safety specification contemplated in paragraph (b); (d) ensure that the designer takes the prepared health and safety specification into consideration during the design stage; (e) ensure that the designer carries out all responsibilities contemplated in regulation 6; (f) include the health and safety specification in the	Construction Regulations-2014
		(2)	The Employer shall, in collaboration with the Engineer, review the Safety Plan and the Method Statements on Safety prepared by the Contractor and provide notice, suggestion or guidance for improvement to the Contractor if there are any risks to safety.				
		(3)	The Employer shall, in collaboration with the Engineer, make sure the work is carried out in accordance with the Safety Plan and the Method Statements on Safety				

			prepared by the Contractor and provide notice, suggestion or guidance for improvement.			tender documents;	
		(4)	The Employer shall endeavor to create an environment where all Project Stakeholders positively participate in activities to promote safety on construction sites.			(g) ensure that potential principal contractors submitting tenders have made adequate provision for the cost of health and safety measures;	
		(5)	When two or more Contractors carry out work at the same construction site, the Employer shall establish an environment for mutual cooperation and coordination on safety management.			(h) omitted (i) omitted (j) omitted (k) omitted	
		(6)	The Employer shall notify the Contractor of natural conditions, social conditions or any other factors that may affect the management of safety for constructions works at site.			(l) discuss and negotiate with the principal contractor the contents of the principal contractor's health and safety plan contemplated in regulation 7(1), and must thereafter finally approve that plan for implementation; (m) ensure that a copy of the principal contractor's health and safety plan is available on request to an employee, inspector or contractor; (n) take reasonable steps to ensure that each contractor's health and safety plan contemplated in regulation 7(1)(a) is implemented and maintained; (o) ensure that periodic health and safety audits and document verification are conducted at intervals mutually agreed upon between the principal contractor and any contractor, but at least once every 30 days; (p) ensure that a copy of the health and safety audit report contemplated in paragraph (o) is provided to the principal contractor within seven days after the audit; (q) stop any contractor from executing a construction activity which poses a threat to the health and safety of persons which is not in accordance with the client's health and safety specifications and the principal contractor's health and safety plan for the site; (r) where changes are brought about to the design or construction work, make sufficient health and safety information and appropriate resources available to the principal contractor to execute the work safely; and (s) ensure that the health and safety file contemplated in regulation 7(1)(b) is kept and maintained by the principal contractor.	
Engineer	1.4.3	(1)	The Engineer shall have a full understanding of the roles and responsibilities of the Employer on the management of safety for construction works at site and, together with the Employer, appropriately implement activities to manage safety, including these obligations specified in the contract documents.				

		(2)	The Engineer shall, in collaboration with the Employer, review the Safety Plan and the Method Statements on Safety prepared by the Contractor and provide notice, suggestion or guidance for improvement to the Contractor if there are any risks to safety.				
		(3)	The Engineer shall, in collaboration with the Employer, make sure the work is carried out as per the Safety Plan and the Method Statements on Safety prepared by the Contractor and provide notice, suggestion or guidance for improvement.				
Contractor	1.4.4	(1)	The Contractor shall be responsible for operation and management of safety on construction sites.			Section (1) of Article 7 (a) provide and demonstrate to the client a suitable, sufficiently documented and coherent site specific health and safety plan, based on the client's documented health and safety specifications contemplated in regulation 5(1)(b), which plan must be applied from the date of commencement of and for the duration of the construction work and which must be reviewed and updated by the principal contractor as work progresses; (b) open and keep on site a health and safety file, which must include all documentation required in terms of the Act and these Regulations, which must be made available on request to an inspector, the client, the client's agent or a contractor; and (c) on appointing any other contractor, in order to ensure compliance with the provisions of the Act-	Construction Regulations-2014
		(2)	The Contractor shall appropriately prepare the Safety Plan at the appropriate time in the pre-construction stage in accordance with the relevant laws and regulations of the recipient country and these Guidances. In the construction stage, the Contractor shall appropriately prepare the Method Statements on Safety, which shall specify the details of safe methods to implement safety measures prior to the start of each item of work and submit the document to the Employer and Consultant for review.			(i) provide contractors who are tendering to perform construction work for the principal contractor, with the relevant sections of the health and safety specifications contemplated in regulation 5(1)(b) pertaining to the construction work which has to be performed; (ii) ensure that potential contractors submitting tenders have made sufficient provision for health and safety measures during the construction process;	
		(3)	The Contractor shall make appropriate revision or correction whenever any insufficiency or suggestion for improvement relating to safety is raised following the review of the Safety Plan and the Method Statements on Safety.			(iii) ensure that no contractor is appointed to perform construction work unless the principal contractor is reasonably satisfied that the contractor that he or she intends to appoint, has the necessary competencies and resources to perform the construction work safely;	
		(4)	The Contractor shall undertake work according to the Safety Plan and the Method Statements on Safety they prepared. Whenever the Safety Plan or the Method Statements on Safety need to be amended in consideration of the latest site conditions, social and environmental conditions and/or any other relevant			(iv) ensure prior to work commencing on the site that every contractor is registered and in good standing with the compensation fund or with a licensed compensation insurer as contemplated in the Compensation for	

		particulars. The Contractor shall without delay update and maintain the documents for review at will by the Employer and Engineer.			Occupational Injuries and Diseases Act, 1993; (v) appoint each contractor in writing for the part of the project on the construction site; (vi) take reasonable steps to ensure that each contractor's health and safety plan contemplated in subregulation (2)(a) is implemented and maintained on the construction site; (vii) ensure that the periodic site audits and document verification are conducted at intervals mutually agreed	
	(5)	The Contractor shall take into account the safety of nearby local residents and any other parties, as well as all Project Stakeholders of the construction project.				

		(6)	The Contractor shall carry out construction works for the safety of nearly local residents and any other third parties, as well as Project Stakeholders of the project.		upon between the principal contractor and any contractor, but at least once every 30 days; (viii) stop any contractor from executing construction work which is not in accordance with the client's health and safety specifications and the principal contractor's health and safety plan for the site or which poses a threat to the health and safety of persons; (ix) where changes are brought about to the design and construction, make available sufficient health and safety information and appropriate resources to the contractor to execute the work safely; and (x) discuss and negotiate with the contractor the contents of the health and safety plan contemplated in subregulation (2)(a), and must thereafter finally approve that plan for implementation; (d) ensure that a copy of his or her health and safety plan contemplated in paragraph (a), as well as the contractor's health and safety plan contemplated in subregulation (2)(a), is available on request to an employee, an inspector, a contractor, the client or the client's agent; (e) hand over a consolidated health and safety file to the client upon completion of the construction work and must, in addition to the documentation referred to in subregulation (2)(b), include a record of all drawings, designs, materials used and other similar information concerning the completed structure; (f) in addition to the documentation required in the health and safety file in terms of paragraph (c)(v) and subregulation (2)(b), include and make available a comprehensive and updated list of all the contractors on site accountable to the principal contractor, the agreements between the parties and the type of work being done; and (g) ensure that all his or her employees have a valid medical certificate of fitness specific to the construction work to be performed and issued by an occupational health practitioner in the form of Annexure 3.	
Subcontractor	1.4.5	(1)	Each subcontractor shall carry out construction works in compliance with the relevant laws and regulations of the recipient country applicable to the construction work and these Guidances.		Section (2) of Article 7 (2) A contractor must prior to performing any construction work- (a) provide and demonstrate to the principal contractor	Construction Regulations-2014

		(2)	Each subcontractor shall establish and maintain safe and sanitary site conditions according to the instructions of the Contractor.			a suitable and sufficiently documented health and safety plan, based on the relevant sections of the client's health and safety specification contemplated in regulation 5(1)(b) and provided by the principal contractor in terms of subregulation (1)(a), which plan must be applied from the date of commencement of and for the duration of the construction work and which must be reviewed and updated by the contractor as work progresses; (b) open and keep on site a health and safety file, which must include all documentation required in terms of the Act and these Regulations, and which must be made available on request to an inspector, the client, the client's agent or the principal contractor; (c) before appointing another contractor to perform construction work be reasonably satisfied that the contractor that he or she intends to appoint has the necessary competencies and resources to perform the construction work safely; (d) co-operate with the principal contractor as far as is necessary to enable each of them to comply with the provisions of the Act; and (e) as far as is reasonably practicable, promptly provide the principal contractor with any information which might affect the health and safety of any person at work carrying out construction work on the site, any person who might be affected by the work of such a person at work, or which might justify a review of the health and safety plan.	
		(3)	Each subcontractor shall cooperate with other subcontractors engaged on the construction site in accordance with the instructions of the Contractor.				
		(4)	Each subcontractor shall receive from the Contractor an explanation on the Safety Plan and the Method Statements on Safety prepared by the Contractor. Each subcontractor shall pass on the explanation received from the Contractor to their employees and have them fully comply with those explanation to ensure safety.				
Workers		(1)	Each worker shall carry out construction work in compliance with the relevant laws and regulations of the recipient country applicable to construction work and these Guidances.			No discription regaring duties of workers in Safety Regulation,2014	
		(2)	Each worker shall follow the instructions given by the Contractor and their managers.				
		(3)	Each worker shall cooperate with the Contractor and their managers to maintain safety at the construction site.				
		(4)	Each worker shall pay attention to their own safety as well as to the safety of their co-workers, all Project Stakeholders, as well as the nearly local residents and any other third parties affected by the work.				

		(5)	Each worker shall comply with the Safety Plan and the Method Statements on Safety prepared by the Contractor and the rules applicable to the entire construction works at site.				
		(6)	When undertaking work, each worker shall use protective equipment for safety and sanitation, either designated or provided, in an appropriate manner and at the appropriate time and location.				
Basic Policies for Safety Management							
Basic Principles of Safety Management							
Basic principle 1: Safety is a top priority	2.1.1		All Project Stakeholders shall put top priority on safety and use their best endeavours to eliminate the occurrence of accidents.			NA	
Basic principle 2: Elimination of causes	2.1.2		The Contractor shall identify every possible danger in each process of construction work, and examine, analyze and eliminate the causes of such danger and take appropriate action to ensure the safe execution of the work.			NA	
Basic principle 3: Thorough precautions	2.1.3		The Contractor shall give consideration to in advance the inherent risk of accidents at each stage of construction work, review appropriate measures to cope with such risks, and commence work once these preventive measures have been implemented.			NA	
Basic principle 4: Thorough compliance with relevant laws and regulations	2.1.4		2.2 Compliance with Relevant Laws and Regulations shall be complied with.			NA	
Basic principle 5: Thorough prevention of public accidents	2.1.5		All Project Stakeholders shall implement safety management measures taking the interests of third parties duly into consideration in order to prevent public accidents.			NA	
Basic principle 6: Thorough implementation of PDCA cycle for safety management	2.1.6		2.3 PDCA for Safety Management shall be complied with.			NA	
Basic principle 7: Thorough sharing of information	2.1.7		All Project Stakeholders shall share all safety-related information they possess in a manner and at times as appropriate in the circumstances.			NA	

Basic principle 8: Thorough participation of all Project Stakeholders	2.1.8		All Project Stakeholders shall actively participate in activities related to safety management at construction sites.			NA	
Compliance with Relevant Laws and Regulations							
Compliance with laws and regulations of recipient countries	2.2.1		In addition to following the Guidances the Contractors shall conduct ODA Projects in compliance with all related laws and regulations of the recipient country.			The scheme of The Construction Health and Safety Technical Committee is stimulated in Article 31 of Construction Regulations-2014. The Committee has power to advise the chief inspector on construction related codes, standards and training requirements: Provided that any accredited or approved training must be in accordance with South African Qualifications Authority standards;	Construction Regulations-2014
Survey of relevant laws and regulations	2.2.2		The Contractors shall survey all relevant laws and regulations applicable to construction work in the recipient country prior to the commencement of the ODA Project. The Employer/Engineer shall provide information on the relevant laws and regulations to the Contractor and provide maximum assistance to the Contractor on the procedures that they should take as per the relevant laws and regulations				
Confirmation of the relevant laws and regulations	2.2.3		The Contractor shall prepare the Safety Plan and its Method Statements on Safety in compliance with the relevant laws and regulations.				
			The Employer/Consultant shall review the relevant laws and regulations noted therein and instruct the Contractor to consider any additional laws or regulations not considered by the Contractor.				
Confirmation of the compliance levels	2.2.4		The Employer/Consultant shall check the Contractor's compliance with the relevant laws and regulations on a regular basis. If the Contractor fails to comply with the relevant laws and regulations, the Employer/Consultant shall instruct the Contractor to so comply.				
PDCA for Safety Management							
Basic principle of PDCA for safety management	2.3.1		The basic principle of PDCA for safety management shall be the cycle of "Plan, Do, Check, Act" with "Plan" being the process of establishing the Safety Plan and its Method Statements on Safety, "Do" being the specific implementation of the plan thus established, "Check" being the observation and confirmation of the safety management process, and "Act" being the implementation of improvements to the implemented plans based on the past performance to ensure the continuous development of field site safety standards. The cycle of these processes				

			shall be defined as PDCA for safety management. The Contractor shall have chief responsibility for the implementation of safety management.				
Formulation of the "Plan"	2.3.2		As part of the "Plan" the Contractor/Tenderer shall formulate the Safety Plan as the basic safety management.				
			The Contractor shall then formulate a Method Statements on Safety as the more detailed safety management plan for implementation.				
Broad Publication at the "Planning" stage	2.3.3		The Contractor shall document the items necessary to ensure safety at construction sites, disclose the same to all Project Stakeholders and ensure that those items are fully understood at the "Planning" stage.				
"Do"	2.3.4		The Contractor shall implement safety management on construction sites according to the Safety Plan and its Method Statements on Safety as formulated at the "Planning" stage.				
Observation and confirmation ("Check")	2.3.5		The Employer/Engineer shall review the Contractor's implementation of the "Doing" stage in accordance with the Safety Plan and the Method Statements on Safety and give guidance where it is in any way insufficient or incorrect.				
			The Contractor shall check their own implementation of the "Doing" stage and implement improvements where insufficient in any way.				
			The managing office's safety managers shall make regular observations and undertake checks.				
Disclosure of results at the "Check" stage	2.3.6		The Contractor shall document and disclose the results of the "Check" stage to the Project Stakeholders.				
"Act"	2.3.7		The Contractor shall examine specific methods of implementing safety measures or related management systems and take corrective action based on their results at the "Checking" stage. In addition, the Contractor shall review their Safety Plan and the Method Statements on Safety and submit revised versions to the Employer/Engineer.				
			The Employer/Engineer shall review the submitted documents.				
Broad publication of the results of the "Acting" stage	2.3.8		In case the Safety Plan or the Method Statements on Safety is revised, the Contractor shall document the revision and disclose such revision to the Project Stakeholders. In particular, the Contractor shall explain the types of work to which such change is to be				

			implemented and ensure that, prior to the commencement of the relevant work, the change is understood by workers who engage in such work.				
Investigation of causes of occupational accidents	2.3.9		If an occupational accident takes place, the Employer, Engineer and Contractor shall suspend construction work to the extent necessary during the necessary period and investigate the cause. The Contractor shall remove the cause in accordance with the basic principles of safety management, clarify measures to prevent the risk of accidents occurring and resume work with the approval of the Employer.				
			The Contractor shall re-examine the Safety Plan and the Method Statements on Safety based on the results of the examination and revise them as required. The Employer/Engineer shall review those documents if revised.				
Continuous improvement	2.3.10		The Contractor shall ensure that the PDCA safety management process is implemented and continuously improved in order to maintain safety at construction sites.				
Contents of the “Safety Plan”							
Composition of the Safety Plan							
Items for inclusion in the Safety Plan	3.1.1		(1) Basic Policies for Safety Management (2) Internal Organizational Structure for Safety Management (3) Promotion of the PDCA Cycle (4) Monitoring (5) Safety Education and Training (6) Voluntary Safety Management Activities (7) Sharing Information (8) Response to Emergencies and Unforeseen Circumstances				
Compliance with items for inclusion	3.1.2		Since items that constitute the Safety Plan as described in Clause 3.1.1 apply generally to all ODA Projects, the Contractor shall incorporate all those items into their Safety Plan.				
			Items other than those specified in Clause 3.1.1 "Items for inclusion in the Safety Plan" which arise with respect to the scope of work or the conditions for construction, shall also be specified in the Safety Plan.				
Basic Policies for Safety Management							
			The Contractor shall determine the basic policies for safety management applicable during construction (hereinafter the "Basic Policies") based on the scope of work, the environment				

			where the works are performed, relevant laws and regulations of the recipient country, contract documents and other applicable documents or data incorporated into the contract. It is also recommended to describe the basic policies of the managing office.				
Internal Organizational Structure for Safety Management							
		(1)	Establish an internal organizational structure for safety management.				
		(2)	Appoint appropriate personnel, including a supervisor responsible for safety management and safety officers, within the internal organizational structure and clarify their respective roles, responsibilities and authority.				
		(3)	In accordance with any requirements under the contract documents, consider establishing an organization appropriate to manage safety, such as a safety committee, which may be composed of appropriate Project Stakeholders including the Employer, Consultant, and subcontractors				
Promotion of the PDCA Cycle							
			The Contractor shall set out the basic principles for promotion of the PDCA Cycle at construction sites in accordance with Clause 2.3 "PDCA for Safety Management".				
Monitoring							
		(1)	The Contractor shall undertake tests at all areas on site to determine the extent of implementation of and compliance with safety management principles in accordance with the Safety Plan. In addition, the Contractor shall undertake tests to determine the extent of implementation of strategies for the safe execution of each type of work in accordance with the Method Statements on Safety.				
		(2)	The Contractor shall report to the Employer/Engineer in accordance with the contract documents in the event of injury attributable to an occupational accident or construction work. On receipt of such report, the Employer/Engineer shall notify the competent governmental organization and JICA of the accident or injury in accordance with the relevant laws and regulations of the recipient country and the contract documents. The Employer, Engineer and Contractor shall keep records of all such reports and maintain them until the completion of the work.				

		(3)	The Contractor shall collect and analyze information on dangerous incidents that do not result in occupational accidents but may lead to such accidents ("near-misses") and utilize that information to prevent future occupational accidents.				
			The Employer/Engineer shall monitor the Contractor's implementation of safety management principles and give appropriate guidance to the Contractor where they find any safety-related problems.				
Safety Education and Training							
		(1)	Compliance with laws and regulations of the recipient country on education and training on safety				
		(2)	Education to all Project Stakeholders (and to all new entrants to the site) on: 1) An overview of the construction site 2) General rules on the construction site including the Safety Plan 3) Protective gear 4) Items necessary to ensure safety when carrying out work in addition to 1) through 3) above				
		(3)	Education on the Method Statements on Safety for the assigned work				
		(4)	Education when changes are made to work				
		(5)	Education and training for special workers 1) Workers engaged in work that is regulated by the laws and regulations of the recipient country 2) Operators or drivers of construction machinery or equipment 3) Workers engaged in work in excavated areas, shafts, underground passages or tunnels 4) Workers handling explosives and engaged in blasting work 5) Workers engaged in work that uses compressed air 6) Workers engaged in reinforcing bar work, concreting work, or formwork 7) Workers engaged in other kinds of work belonging to special categories				
		(6)	Education and training for emergency response personnel				
		(7)	Education for third parties (other than Project Stakeholders) when they enter the work area				

		(8)	Training for emergencies and unforeseen circumstances				
		(9)	Activities to promote safety awareness				
		(10)	Language used for education and training				
		(11)	Confirmation and recording education and training				
Voluntary Safety Management Activities							
		(1)	Morning meetings on safety				
		(2)	Foreseeing hazardous activities				
		(3)	Tool box meetings				
		(4)	Safety rota systems				
		(5)	Regular, monthly and periodic inspections				
		(6)	Sorting, decluttering and cleaning				
		(7)	Safety conventions				
		(8)	Safety patrol				
		(9)	Near-miss reporting system				
		(10)	Other activities				
Sharing Information							
		(1)	Description of education for new entrants				
		(2)	Other information necessary to maintain safety				
Response to Emergencies and Unforeseen Circumstances							
Response to emergencies	3.9.1	(1)	The priority of saving human lives				
		(2)	The establishment of an emergency communication network				
		(3)	Procedures for responding to emergencies				
		(4)	Responding to first-aid treatment				
		(5)	Reporting on accidents and injuries				
Responding to unforeseen circumstances	3.9.2	(1)	Emergency evacuation procedures				
		(2)	The establishment of an emergency communication network system				

		(3)	Procedures for responding to unforeseen circumstances				
		(4)	Collection of weather information				
Contents of the "Method Statements on Safety"							
Contents of the "Method Statements on Safety"							
Responding to unforeseen circumstances	4.1.1	(1)	The Contractor shall include the specifications and quantity of any construction plant and machinery to be used for the works.			JST seems that Contractor Health and Safety (HSE) Plan prepared by contractor based on provision specified in Eskom Contract Regulation has almost same contents. Employer Policies and Procedures Safety, Health and Environmental Requirements Schedule Part 9 Section 4	
		(2)	The Contractor shall include any equipment and tools to be used for the works.				
		(3)	The Contractor shall include the specifications and quantities of any major materials to be used for the works.				
		(4)	The Contractor shall include the required qualifications and licenses required for each type of work.				
		(5)	The Contractor shall include the order of command for the works specifying the relevant supervisors for each type of works. At times, the process for monitoring the implementation of works may be unclear, especially in cases involving subcontractors. As such, in order to avoid any confusion, the Method Statements on Safety should specify the relevant supervisors for each type of work (including subcontract works).				
		(6)	The Contractor shall categorize each item of work and set them out according to the works schedule				
		(7)	The Contractor shall specify the procedure for the execution of major work operations for each type of work.				
		(8)	The Contractor shall include all foreseeable risks for each work item.				
		(9)	The Contractor shall review and include precautionary measures to prevent occurrence of foreseeable risks, including information on the type of protective gear required for the works.				
Method Statements on Safety - Template	4.1.2		A template for a Method Statements on Safety is shown below for guidance. A form different to that below is acceptable as long as it fully satisfies the requirements as set out in Clause 4.1.1 "Items for inclusion in a Method Statements on Safety".				
Applicable Standards for the "Technical Guidance for Safe Execution of Works"							

Technical Guidance for Safe Execution of Works	4.2.1.1		The Technical Guidance applies to the type of work set out in Clause 1.2.1 "Relevant projects".				
	4.2.1.2		The Technical Guidance provides the minimum safety standards for the management of works and accidents that are commonly applied in ODA Projects, according to the type of works in question. The Technical Guidance is generally applied when the Contractor plans and executes the safety management principles and the Consultant tests and confirms the same. It is recommended that prior to determining an agreed plan and procedure for the execution of the works, safe work methods and procedures and strategies for safety be fully reviewed in light of foreseeable risks of accident (if any) and with reference to the Technical Guidance, and that the results of that review be compiled in writing in a Method Statements on Safety in order to eliminate or reduce the risk of accidents occurring.				
			Such recommended application of the Technical Guidance, however, does not preclude any party from adopting in their construction contract any other standards which are more comprehensive and stringent than those stipulated in the Technical Guidance. This is particularly the case with respect to individual contracts which require special attention to safety measures such as those concerning the construction of very long bridges, underground work, submarine work, or work near existing traffic or construction projects.				
Applicable Standards for the Method Statements on Safety	4.2.2		When any risk specified in Clause 4.1.1(8) "Foreseeable risks" is foreseen, that risk shall be identified with reference to the checklist shown in Clause 4.2.3. The counter measures for those foreseeable risks must comply with the provisions of the corresponding items shown in Chapter 6 "Technical Guidance for Safe Execution (by the Type of Accident)".				

Checklist for foreseeable risks	4.2.3	1) Does the work involve a risk that workers will fall from high places? If the answer is yes, comply with the provisions of Clause 6.1 "Measures for Prevention of Fall Accidents". 2) Does the work involve a risk that flying or falling objects will hit workers? If the answer is yes, comply with the provisions of Clause 6.2 "Measures for Prevention of Accidents involving Flying or Falling Objects". 3) Does the work involve a risk that workers will be crushed by the collapse or fall of sediment or structures? If the answer is yes, comply with the provisions of Clause 6.3 "Measures for Prevention of Accidents involving Collapse of Structures". 4) Does the work involve a risk that workers will be caught or entangled by machines or structures? If the answer is yes, comply with the provisions of Clause 6.4 "Measures for Prevention of Accidents involving Construction Machinery". 5) Does the work involve a risk of explosion? If the answer is yes, comply with the provisions of Clause 6.5 "Measures for Prevention of Explosion Accidents". 6) Does the work involve a risk of fire? If the answer is yes, comply with the provisions of Clause 6.6 "Measures for Fire Prevention". 7) Does the work involve a risk that the general public or any other third party will suffer adverse effects? If the answer is yes, comply with the provisions of Clause 6.7.1 "General rules for prevention of third-party accidents". 8) Does the work involve a risk that underground facilities, aerial lines, or surrounding facilities will be damaged? If the answer is yes, comply with the provisions of Clauses 6.7.2 "General rules on preventing accidents relating to underground utilities or facilities" and 6.7.3 "General rules on preventing accidents relating to aerial utilities including aerial lines". 9) Does the work involve the risk of traffic accidents? If the answer is yes, comply with the provisions of Clause 6.8 "Measures for Prevention of Traffic Accidents".				
Applicable Standards for	4.2.4	5.1 Excavation Work				
		5.2 Pile Foundation Work				

the Technical Guidance for Safe Execution (by the Type of Work)			5.3 Formwork and Form Shoring System Work				
			5.4 Reinforcing Bar Work				
			5.5 Concrete Work				
			5.6 Work over water				
			5.7 Demolition Work				
			5.8 Work where there is danger of oxygen deficiency				
			5.9 Slings Work				
Applicable Standards for protective gear	4.2.5		Any use of protective gear in the aforementioned types of work shall comply with the provisions specified in Clause 6.9 Protective Gear.				
Technical Guidance for Safe Execution (by the Type of Work)							
Excavation Work							
Understanding of conditions for construction	5.1.1.1	(1)	Properties and characteristics of the ground to excavate, groundwater, artesian water, water inflow, and the presence of high-temperature gas or toxic gas	13: Excavation	-	13.CR 13: Excavation 13. (1) A contractor must- (a) ensure that all excavation work is carried out under the supervision of a competent person who has been appointed in writing for that purpose; and (b) evaluate, as far as is reasonably practicable, the stability of the ground before excavation work begins. (2) A contractor who performs excavation work- (a) must take reasonable and sufficient steps in order to prevent, as far as is reasonably practicable, any person from being buried or trapped by a fall or dislodgement of material in an excavation; (b) may not require or permit any person to work in an excavation which has not been adequately shored or braced: Provided that shoring and bracing may not be necessary where- (i) the sides of the excavation are sloped to at least the maximum angle of repose measured relative to the horizontal plane; or (ii) such an excavation is in stable material: Provided that-	Construction Regulations-2014
		(2)	The depth and area for excavation				
		(3)	Working space available for excavation work, underground buried utilities or facilities, and aerial utilities such as aerial line.				
		(4)	Natural properties such as topography, meteorology or oceanographic phenomena				
Cofferdam walls and timbering	5.1.1.2	(1)	The Contractor shall consider the following requirements when determining the type of cofferdam wall and timbering: 1) The Contractor shall undertake a comprehensive review based on the relevant conditions for construction once he has a full understanding of various characteristics including water cut-off performance, constructability, and rigidity of the timbering. 2) The Contractor shall check the level of safety against stress, strain, deformation and displacement as well as determine risk of piping, boiling and heaving based on the particular ground properties.				

		(2)	The structure shall be sufficiently strong to prevent ground failure regardless of the local conditions where such structure is constructed, including ground properties, geology, cracking, ground water content, seepage water, and the status of buried utilities or facilities which may compromise safety during excavation work.		
		(3)	Materials to be used for such a structure shall be sufficient to withstand applied stress, strain, deformation and displacement, and be of good quality, free of cracking, deformation, and corrosion.		
Excavation slope for open cutting	5.1.1.3		When the slope is cut using open cutting techniques, the Contractor shall determine the excavation gradient that would prevent ground failure, required for the particular excavation conditions and other relevant factors.		
Procedure for execution of the works	5.1.1.4		The Contractor shall determine in advance the excavation procedure and responsible supervisors for the particular conditions for the construction and other relevant factors.		
Drainage plan	5.1.1.5		The Contractor shall plan for appropriate drainage of water during excavation based on the conditions of the ground to excavate, including groundwater, artesian water, ground water content, and presence of seepage water, as well as the presence of inflow of surface water to the excavation area.		
Ventilation plan	5.1.1.6		The Contractor shall consider the appropriate ventilation required during excavation, based on the properties of the ground to excavate, dust that may be generated during work, the presence of toxic gas and other relevant factors.		
Construction machinery and equipment plan	5.1.1.7		When excavation machines are used, the Contractor shall select machines appropriate for the conditions for construction, the scale of work, the period of work, and other relevant factors. In addition, the Contractor shall determine in advance the traveling routes for excavation machines, loading machines, and transporting machines, the earth and material loading sites and how to access the sites.		
Protective gear	5.1.1.8		Workers shall wear protective gear such as safety helmets or protective boots during work. When working at a place where there is a risk of falling from heights, they shall use safety belts.		
					(aa) permission has been given in writing by the appointed competent person contemplated in subregulation (1) upon evaluation by him or her of the site conditions; and (bb) where any uncertainty pertaining to the stability of the soil still exists, the decision from a professional engineer or a professional technologist competent in excavations is decisive and such a decision must be noted in writing and signed by both the competent person contemplated in subregulation (1) and the professional engineer or technologist, as the case may be; (c) must take steps to ensure that the shoring or bracing contemplated in paragraph (b) is designed and constructed in a manner that renders it strong enough to support the sides of the excavation in question; (d) must ensure that no load, material, plant or equipment is placed or moved near the edge of any excavation where it may cause its collapse and consequently endangers the safety of any person, unless precautions such as the provision of sufficient and suitable shoring or bracing are taken to prevent the sides from collapsing; (e) must ensure that where the stability of an adjoining building, structure or road is likely to be affected by the making of an excavation, steps are taken to ensure the stability of such building, structure or road and the safety of persons; (f) must cause convenient and safe means of access to be provided to every excavation in which persons are required to work, and such access may not be further than six meters from the point where any worker within the excavation is working; (g) must ascertain, as far as is reasonably practicable, the location and nature of electricity, water, gas or other similar services which may in any way be affected by the work to be performed, and must before the commencement of excavation work that may affect

Prevention of ground collapse	5.1.2.1	(1)	The Contractor shall have excavation work undertaken strictly in accordance with the instructions of the responsible supervisor and in accordance with the excavation procedure and methods.		any such service, take the steps that are necessary to render the circumstances safe for all persons involved; (h) must ensure that every excavation, including all bracing and shoring, is inspected- (i) daily, prior to the commencement of each shift; (ii) after every blasting operation; (iii) after an unexpected fall of ground; (vi) after damage to supports; and (v) after rain, by the competent person contemplated in subregulation (1), in order to ensure the safety of the excavation and of persons, and those results must be recorded in a register kept on site and made available on request to an inspector, the client, the client's agent, any other contractor or any employee; (j) must cause every excavation which is accessible to the public or which is adjacent to public roads or thoroughfares, or whereby the safety of persons may be endangered, to be- (i) adequately protected by a barrier or fence of at least one metre in height and as close to the excavation as is practicable; and (ii) provided with warning illuminates or any other clearly visible boundary indicators at night or when visibility is poor, or have resort to any other suitable and sufficient precautionary measure where subparagraphs (i) and (ii) are not practicable; (j) must ensure that all precautionary measures stipulated for confined spaces as determined in the General Safety Regulations, 2003, are complied with by any person entering any excavation; (k) must, where the excavation work involves the use of explosives, appoint a competent person in the use of explosives for excavation, and must ensure that a method statement is developed by that person in accordance with the applicable explosives legislation; and (l) must cause warning signs to be positioned next to an excavation within which or where persons are
		(2)	The Contractor shall not place or store excavated earth and sand near excavated slopes. In case the earth and sand has to be temporarily stored near an excavated slope, the Contractor shall take appropriate measures to prevent collapse of the excavated slope or falling of the earth and sand into the excavated area.		
		(3)	When the surface of the ground falls as a result of rain, wind or water flowing from the ground surface to the excavation site, the Contractor shall implement protective measures such as covering the slope surface with protective sheets or nets.		
		(4)	The responsible supervisor shall immediately evacuate workers to a safe place when there is a risk of ground collapse or landslide.		
		(5)	The Contractor shall cancel excavation work when there is a risk that workers will be exposed to danger during those excavation works as a result of bad weather such as strong wind or rainstorms.		
		(6)	When bad weather due to sudden change or a natural disaster occurs, the responsible supervisor shall immediately suspend the work and evacuate workers to a safe place.		
Prevention of falls	5.1.2.2	(1)	Where works are undertaken at a place more than two metres above ground level, the Contractor shall construct scaffolding prior to the commencement of work. Where it is impossible to construct scaffolding, workers use protective gear to prevent themselves from falling, such as safety belts or fall arrestors. Where safety belts are used, the Contractor shall ensure that equipment is affixed to which the belts may be attached.		
		(2)	The Contractor shall install stoppers or similar equipment at appropriate locations to prevent construction vehicles or machines from falling into an excavation area.		

Prevention of accidents caused by flying or falling objects	5.1.2.3	(1)	Workers shall wear safety helmets to avoid hazards by earth and sand and other flying or falling objects during excavation work.		working or carrying out inspections or tests. Employer Policies and Procedures Safety, Health and Environmental Requirements Schedule Part 9 Section 4	
		(2)	The Contractor shall provide methods to prevent objects falling, such as baseboards, on excavated slopes to prevent objects from falling into the excavation site.			
		(3)	The Contractor shall ensure that no materials, equipment, excavated earth and sand or other materials are placed near excavated slopes.			
		(4)	When materials, machines, etc. are transferred from ground surface into an excavation site, the Contractor shall provide all feasible means to protect workers in the excavation site such as ropes and suspension bags.			
		(5)	When heavy objects are transported to an excavation site with hoisting equipment, the Contractor shall use appropriate hoisting attachments to prevent workers from entering or staying under the cargo. The Contractor shall station flagmen or signalmen to ensure safe operation by operators.			
Prevention of accidents caused by construction machinery	5.1.2.4	(1)	Excavation machines shall be operated by qualified personnel or their equivalent.			
		(2)	Flagmen shall be stationed in the following locations when excavation machines are being operated: 1) At locations where a work is undertaken in the vicinity of a road, building or any other facility 2) At locations where visibility is poor 3) On the edge of a cliff 4) At locations where there is a risk of earth and sand falling or collapsing 5) At locations where work is undertaken with excavation machines in the vicinity of other workers 6) At locations where work is undertaken on a road 7) When an excavation machine moves backwards			
		(3)	Standardized signs or signals shall be established to facilitate accurate and smooth communication among operators, flagmen, signalmen and workers.			
		(4)	When operating excavation machines or other equipment, the places where such machines are operated shall be off-limits.			

		(5)	No operators shall leave the operator's cabin while keeping the machines in an unstable condition or with the engines running.				
		(6)	No operators shall park excavation machines on a slope or on weak/fragile ground.				
		(7)	Excavation machines shall strictly be used within the range for safe use and only for its intended use.				
		(8)	When work with an excavation machine is undertaken at a place where there is a risk of a rock fall, appropriate protective measures such as head guards shall be provided in the operator's cabin.				
		(9)	When workers use rock drills, attention shall be drawn to the following: 1) Stabilizing the foothold and keeping the work place in order. 2) Using sufficiently long air hoses for rock drills. 3) When work is undertaken on a slope, making sure that no drills will fall or slide downward. Workers shall also wear protective gear such as safety belts whenever necessary.				
		(10)	The guidance specified in Clause 6.4 "Measures for Prevention of Accidents Involving Construction Machinery" is complied with.				
		(1)	When work is undertaken on a public road, the Contractor shall adopt appropriate measures to prevent the entry of unauthorized personnel including third parties into the work area, such as barricading the work site and stationing the watch-personnel and traffic-control personnel.				
		(2)	When work is undertaken on a public road, workers shall wear reflector vests.				
		(3)	Where buried utilities or facilities are located under the ground of a work site or where excavation is undertaken in the ground near a structure, then if damage to those utilities, facilities or structures by overturning or collapsing is likely, the Contractor shall take appropriate measures prior to the commencement of work, so as to prevent the risk, such as the relocation or reinforcement of the utilities, facilities or structures.				
		(4)	When earth and sand is backfilled over buried utilities or facilities, the Contractor shall undertake backfilling according to the predetermined specifications, without applying unsymmetrical pressure or damaging the buried utilities or facilities.				
Prevention of public accidents and traffic accidents	5.1.2.5						

Working environment	5.1.2.6	(1)	Where there is seepage water at or an inflow of surface water to a work site, the Contractor shall properly treat such water prior to the commencement of any work.			
		(2)	The Contractor shall provide lighting strong enough to ensure safe excavation at the excavation site, taking into account the depth of excavation and the working environment.			
		(3)	When powder dust is generated from work, workers shall wear protective gear such as respirators when undertaking the work.			
		(4)	When loud noise is generated from the works, workers shall wear protective gear such as earplugs when undertaking the work. Since verbal communication is difficult in such circumstances, the Contractor shall determine an alternative means of communication in advance.			
		(5)	The Contractor shall install ventilation equipment as required to properly maintain the air quality at an excavation site. Particularly when a mechanical apparatus that houses an internal combustion engine is installed at an excavation site, installation of ventilation equipment is necessary to prevent accidents by exhaust gas poisoning.			
Inspection of excavation sites	5.1.2.7	(1)	The Contractor shall inspect the ground and the area surrounding at an excavation site as follows: 1) Inspection timing a) Before the start of work and at the beginning of each work shift b) After the occurrence of heavy rain or an earthquake 2) Items to be checked a) The ground to be excavated b) The condition of seepage water at an excavation site			
		(2)	In case the ground inspection indicates a risk of ground failure, the responsible supervisor shall immediately suspend excavation work and take appropriate anti-failure measures. The Contractor shall clarify the appropriate method of excavation or means to prevent ground failure taking into account the particular ground conditions, and resume the work only after confirming there is no likelihood of ground failure.			

		(3)	The Contractor shall ensure that mechanical equipment such as excavation machines or rock drills undergo predetermined inspection before the commencement of work and at any predetermined time, so to ensure that equipment is free of all defects. The Contractor shall immediately remove or repair here any equipment that is found to be defective, prior to the start of work.			
When installing cofferdam and timbering, the Contractor shall:	5.1.3.1	(1)	Install cofferdam and timbering in accordance with the predetermined sequences.			
		(2)	Commence excavation only after it is clear that the necessary structurals of the cofferdam and timbering have been precisely safely installed in their correct positions.			
		(3)	Firmly fix the cofferdam wall and timbering to prevent dislocation caused by vibrations and/or other external forces such as excavation works. In addition, the Contractor shall align the structurals of all timbering in a linear fashion and normal to the cofferdam wall.			
		(4)	Not place heavy materials on the structurals of the timbering.			
		(5)	Not use the timbering structurals for suspension used in the protection of buried utilities or facilities unless otherwise specified. The Contractor shall install another structurals columns suspended for purpose of protection separatively from the timbering.			
		(6)	Regularly inspect the cofferdam walls and timbering for deformation of the structurals, slackening of the fastening portions, or changes in groundwater or the surrounding ground level of the cofferdam wall and timbering during the construction. The Contractor shall undertake such inspections even during a periods when no work is being undertaken.			
		(7)	Ensure that when any anomaly is observed in the cofferdam wall and timbering, the responsible supervisor shall immediately evacuate workers to a safe place and take all necessary action to cope with the observed abnormal phenomenon. The responsible supervisor shall notify the appropriate manager in charge of the work suspension and also take appropriate action while the work is suspended.			
		(8)	Comply with the guidance specified in Clause 5.9 "Slinging Work".			
		(9)	Comply with the guidance specified in Clause 6.4.2 "Measures for mobile crane work".			

Inspection of cofferdam and timbering	5.1.3.2		The Contractor shall inspect cofferdam walls and trench timbering as follows: 1) Inspection timing a) Before the start of work and at the beginning of each work shift b) After the occurrence of a heavy rain or an earthquake 2) Items to be checked a) Creak, warp, and damage of structurals b) Degree of compression of timbering c) Slackening of the connections and joints of structurals d) Clearance in the back of the cofferdam wall				
Pile Foundation Work							
Understanding of the execution conditions	5.2.1.1	(1)	Properties and characteristics of the ground, artesian water, and the presence of high-temperature gas and toxic gas			No discription regarding pile foundation work in Safety Regulation,2014	
		(2)	Depth to the bearing stratum, working space available for pile foundation work, and utilities such as underground cables and aerial lines				
		(3)	Natural properties such as topography, meteorology or maritime phenomena				
Procedure for execution of the works	5.2.1.2		The Contractor shall determine in advance the procedure and the responsible supervisor for the pile foundation work based on the particular the conditions for construction and other relevant factors.				
Construction machines	5.2.1.3	(1)	The Contractor shall always level the place where construction machines are positional or operated, check for their respective bearing capacities, and provide appropriate measures, so as to prevent the machines overturning.				
		(2)	The Contractor shall not undertake work simultaneously at place right above or below the construction machines, and shall ensure that no person is present underneath hoisted cargo, such as structurals.				
		(3)	When handling, inspecting or servicing construction machines, the Contractor shall stop engines to prevent accidents, such as injuries to workers involving moving parts of machines.				
		(4)	When two or more pile drivers are used for one limited working site, the Contractor shall maintain sufficient clearance between the pile drivers.				
Protective gear	5.2.1.4		Workers shall wear safety helmets, protective boots and other protective gear when undertaking work. Workers shall use safety belts where there is a risk of falling.				

At the time of placing a pile driver	5.2.2.1	(1)	Take measures to prevent entry of unauthorized workers into the work range.			
		(2)	Take measures to prevent collapses of pile drivers.			
		(3)	For positioning of pile drivers on soft ground, check the strength of the ground and take necessary measures to prevent slides and over turning, including ground improvement or the use of iron plates.			
		(4)	When supports and trestles of pile drivers may cause sliding, provide appropriate reinforcement using, for example, stakes or wedges.			
		(5)	Always maintain good drainage at places where pile drivers are used.			
		(6)	Undertake slinging work in a safe and secure manner within the rated loads.			
		(7)	Not use hoisting wire ropes and hanging hooks that are deformed, cracked or damaged.			
		(8)	Use marks and other means for hoisting wire ropes, so as to prevent excessive winding.			
		(9)	Not use the following wire ropes for pile drivers 1) Hoisting wire ropes that do not satisfy the standards prescribed in the relevant laws and regulations of the recipient country. 2) Ropes with joints 3) Ropes with noticeable form breaks or corrosions			
		(10)	When a pile driver is assembled, use the pile driver only after checking the following conditions and making sure no issues pertain thereto: 1) The existence of slacks or injuries to the joints of machine parts 2) The installation conditions of hoisting wire ropes, sheaves and pulley blocks 3) The functions of brakes and ratchets of hoisting devices 4) The installation conditions for winches			
At the time of pile driving work	5.2.2.2	(1)	Ensure that workers use earplugs as appropriate for the work. Since verbal communication is difficult in such circumstances, the Contractor shall determine an alternative means of communication in advance.			
		(2)	Maintain a wide ground contact area with the pile driver, and use planking, square timbers and other means as needed.			

		(3)	When climbing leaders, install main ropes and use fall arrestors and safety belts.				
		(4)	Take measures to prevent entry of unauthorized workers into the work range.				
		(5)	Always inspect the structurals of the pile driver and hoisting equipment, and immediately repair or replace defective items prior to use.				
All-casing method	5.2.3.1	(1)	Take measures to prevent entry of unauthorized workers into the work area.				
		(2)	When moving machinery with tractions or jacks, ensure that work shall be undertaken strictly in accordance with the instructions of the responsible supervisor.				
		(3)	Always maintain jacks and pulleys and use the prescribed wire ropes.				
		(4)	Ensure that no person approaches the boring gantry during operation of the hammer grabs, and maintain a "no access" policy for this purpose.				
		(5)	Ensure that workers are allowed to enter a casing only after ventilation equipment is installed inside, toxic gas is measured and safety is confirmed in advance.				
		(6)	For putting tremies or reinforced frames, operators, slinging workers and signalmen are assigned, and the work is undertaken in accordance with established signals.				
		(7)	When work ceases, take measures such as installing protection nets, so as to prevent workers from falling into the casing.				
Reverse circulation drilling method	5.2.3.2	(1)	Assembling, dismantling and moving of gantries shall be undertaken strictly in accordance with the instructions of the responsible supervisor.				
		(2)	For putting tremies or reinforced frames, operators, slinging workers and signalmen are assigned, and the work is undertaken in accordance with established signals.				
		(3)	While ramming down or drawing casings, only those workers necessary to undertake the work shall be allowed to approach the gantry, and there is no access to the relevant work area for that purpose.				
Formwork and Form Shoring System Work							
Procedure for execution of the works	5.3.1.1		The Contractor shall determine the procedures for assembling and dismantling of forms and form shoring system, and appoint the responsible supervisors.			No discription regarding formwork and form shoring system work in Safety Regulation,2014	

Structure and materials of forms and form shoring system	5.3.1.2	(1)	The Contractor shall construct forms and form shoring system to a firm structure matching the shape and dimensions of the concrete structure, concrete placement method and other relevant conditions. The Contractor shall determine the specifications of the structure and materials based on the particular strength analysis.			
		(2)	The Contractor shall consider loading in the vertical and horizontal direction, and lateral pressure of the concrete in the structural review of the form shoring system. The Contractor shall also determine the structural specifications in consideration of special loads not previously expected.			
		(3)	The Contractor shall ensure that the materials used for forms and form shoring system have sufficient strength and are free of damage, deformation or corrosion.			
Protective gear	5.3.1.3		Workers shall wear protective gear such as safety helmets, protective boots and gloves when undertaking work. Workers shall use safety belts where there is a risk of falling.			
At the time of fabrication of forms	5.3.2.1	(1)	Always arrange materials and tools in an orderly manner at form fabrication workshops.			
		(2)	Always inspect machinery and tools used to fabricate forms, and ensure the safety device functions properly prior to use.			
		(3)	Take measures to ensure that no unauthorized workers have access to the form fabrication workshop.			
		(4)	Ensure that two workers carry lengthy or heavy goods.			
		(5)	Take measures to prevent cargo collapse or scattering when storing form materials or fabricated forms.			
		(6)	Ensure that fabricated forms are free of protrusions such as nails.			
At the time of assembly of forms	5.3.2.2	(1)	When there is a risk of workers being injured by reinforcing bars, etc. after tripping or falling, the Contractor shall take security measures such as covering of reinforcing bars with protective sheets before performing the assembly work.			
		(2)	Form assembly places shall always be kept in order.			
		(3)	Measures of no-entry of unauthorized workers shall be taken.			

		(4)	Where work is undertaken at a place more than two meters above ground level, the Contractor shall construct scaffolding prior to the commencement of work. Where it is impossible to construct scaffolding, workers shall use protective gear to prevent falls, such as safety belts or fall arrestors when conducting the work. Where safety belts are used, the Contractor shall affix appropriate equipment to connect the belts.			
		(5)	Once reinforcement fabricated, the Contractor shall not use rebars as access platforms or working floors.			
		(6)	The Contractor shall ensure that heavy or big forms are handled by not a single worker but by two or more workers.			
		(7)	The Contractor shall firmly affix assembled forms so as to prevent their collapse by wind or vibration.			
At the time of dismantle of forms	5.3.2.3	(1)	Ensure that form dismantle places are always kept in order.			
		(2)	Prevent other workers from entering any authorised access areas.			
		(3)	Stock dismantled form materials, nails or other fixings, and structurals by type, and at a place that does not disturb dismantling work.			
		(4)	Where work is undertaken at a place more than two meters above ground level, construct scaffolding prior to the commencement of work. Where it is impossible to construct scaffolding, workers shall use protective gear to prevent falls, such as safety belts or fall arrestors, when conducting work. Where safety belts are used, the Contractor shall ensure that appropriate equipment is affixed to which the belts may be connected.			
		(5)	Ensure that no work is undertaken simultaneously at places right above or below any dismantling work being undertaken, so as to avoid accidents caused by flying or falling objects. No forms or any other objects shall be thrown from higher to lower levels or directly dropped.			
At the time of form shoring system assembly and dismantle		(1)	When assembling form shoring system, prepare assembling diagrams in advance, and assemble the shoring system according to the drawings.			
		(2)	Assemble form shoring system according to the assembling diagrams. No assembling diagrams shall be modified without prior permission.			

		(3)	Ensure that the responsible supervisor shall directly supervise assembling and dismantling of form shoring system.			
		(4)	Take measures to prevent settlement of strut posts of the form shoring system.			
		(5)	Take measures to fasten the posts of the struts, so as to provide reinforcing lateral battens, as well as to prevent the sliding of the strut posts.			
		(6)	Take measures to ensure that there is no unauthorized access to the area where the assembly or dismantle of form shoring system is being undertaken.			
		(7)	Use lifting nets or hanging bags, etc. to lift up or down materials, equipment or tools.			
		(8)	Where work is undertaken at a place more than two meters higher or lower than the ground level, construct scaffolding prior to the commencement of work. Where it is impossible to construct scaffolding, workers shall use protective gear for prevention of falls such as safety belts or fall arrestors when conducting the work. Where safety belts are used, the Contractor shall ensure that appropriate equipment is affixed, to which the belts may be connected.			
		(9)	Not use the outsides of the assembled reinforcing bars or forms as access platforms or working floors.			
		(10)	Suspend work in case of danger caused by bad weather such as strong wind or rainstorms.			
		(11)	Not dismantle form shoring system before the prescribed strength of concrete is ascertained.			
		(1)	Determine the sequence of concrete placing and the placing height in advance to prevent unsymmetrical pressures on the form shoring system, and place the concrete uniformly.			
		(2)	Inspect the shoring system and undertake repairs if any anomaly is found prior to concrete placing.			
At the time concrete is laid	5.3.3.2	(3)	During concrete placing, inspect the conditions of shoring system to make sure the shoring system is always in a safe state. When any anomaly is observed in the form and form shoring system, immediately suspend the placing work, and take appropriate measures to cope with the circumstances.			
Reinforcing Bar Work						

Procedure for execution of the works	5.4.1.1		The Contractor shall determine the execution procedure and the responsible supervisor for fabrication of rebars in advance based on the particular conditions for construction and other relevant factors.			No description regarding reinforcing bar work in Safety Regulation,2014	
Protective gear	5.4.1.2		Workers shall wear safety helmets, protective boots and gloves when undertaking work. Workers shall use safety belts where there is a risk of falling.				
At the time of rebar bending	5.4.2.1	(1)	Always arrange materials and tools in an orderly manner at rebar bending workshops.				
		(2)	Inspect machines and tools used to fabricate rebars prior to commencement of the work, use appropriate tools, and not use defective ones.				
At the time of rebar transport	5.4.2.2	(1)	Use two or more workers to transport long size rebars, and shall not allow transportation in an unusual or unreasonable manner.				
		(2)	Bundle and carry rebars, when they are not already bundled.				
		(3)	Ensure that attention is drawn to the front and back of transporting workers so as to avoid contact with others. Special attention shall be necessary for bent long size bars.				
At the time of rebar fabrication	5.4.2.3	(1)	Construct scaffolding prior to the commencement of work when undertaking work at a place more than two meters above ground level. Where it is impossible to construct scaffolding, workers shall use protective gear, such as safety belts or fall arrestors, so as to prevent falls when undertaking work. Where safety belts are used, the Contractor shall ensure that appropriate equipment is affixed to which the belts may be connected.				
		(2)	Secure safety paths at areas where reinforcing bar work is undertaken by, for example, providing steel plates on which to walk. When footboards are used, they shall be securely fixed on both ends to prevent overturning.				
		(3)	Ensure that workers are careful not to have their hands, arms or feet caught by rebars during fabrication work.				
		(4)	Take measures to protect against rebars projecting at places where work is being undertaken on a higher level and there is a risk of workers' falling.				
		(5)	Provide appropriate supports to rebars for walls, columns or similar vertical structural, so as to prevent their fall or collapse.				
Concrete Work							

Procedure for execution of the work	5.5.1.1		The Contractor shall determine the execution procedure and the supervisor responsible for concrete work in advance based on the conditions for construction and other relevant factors.				
Protective gear	5.5.1.2		Workers shall wear safety helmets, protective boots and gloves when undertaking work. Workers shall use safety belts where there is a risk of falling.				
At the time of assembly and use of concrete plant	5.5.2.1	(1)	Specify the supervisor responsible for assembly and operation of the concrete plant, and ensure that the plant is operated strictly in accordance with the instructions of the supervisor and in accordance with the assembling diagram. The plant shall be used only after the Contractor has undertaken tests prior to operation.				
		(2)	Station flagmen at gateways of concrete plant facilities as needed.				
		(3)	Establish safety paths in concrete plant facilities to separate traffic roads of walkers and vehicles.				
		(4)	Ensure that lighting for concrete plant facilities is sufficient for the work environment.				
		(5)	Install ventilation equipment in measuring rooms or at other places where work generates dust and soot. Workers shall also use protective equipment such as dust masks when working in such places.				
		(6)	Turn off machinery prior to undertaking maintenance to or repairing the concrete plant.				
At the time of concrete transport	5.5.2.2	(1)	Establish in advance the routes, that concrete mixers shall take from the concrete plant to the area where the concrete is to be laid.				
		(2)	When concrete mixers run on public roads, check the traffic conditions of relevant neighbouring routes, and take measures to prevent traffic accidents and other necessary measures.				
		(3)	When concrete mixers run through other work areas, contact and coordinate the relevant supervisors in those areas, to ensure that safety measures are fully implemented, routes are appropriately indicated and safety passage are maintained.				
		(4)	Determine in advance the travelling speeds applicable at the construction sites and ensure that operators do not exceed speed limits. Speed limit signs shall be put up at easily visible places and flagmen shall be stationed as necessary.				

No description regarding reinforcing bar work in Safety Regulation, 2014

		(5)	Implement measures to prevent runaway vehicles when operators leave the driver's cabin to discharge concrete from concrete mixers, such as using brakes or stoppers.			
		(6)	Ensure that concrete mixer operators wear safety helmets when discharging concrete.			
		(7)	When transferring concrete to the area where it is to be laid with a lifting machine, ensure that the access under the transfer range of the conc.-bucket is strictly restricted and take measures to prevent the leak of concrete from the bucket.			
At the time concrete is laid	5.5.2.3	(1)	Determine in advance the method and procedure, the range and speeds, etc. for laying the concrete, and ensure that the concrete is laid strictly in accordance with the instructions of the responsible supervisor.			
		(2)	Ensure that workers laying concrete wear protective gear such as protective gloves and boots to prevent the concrete being in direct contact with the skin.			
		(3)	Lay concrete in accordance with the predetermined procedures, and avoid laying concrete in a concentrated portion.			
		(4)	When shoots are used to lay concrete, place the shoots appropriately, so as to prevent overflow of concrete in consideration of the property of concrete, the method for laying the concrete, the shape and gradient of shoot and the connecting method.			
		(5)	Where there is a risk of workers falling from high places, take measures to prevent falls, such as the installation of scaffolding, provision of handrails and the mandatory use of safety belts when laying concrete.			
		(6)	Always check forms and form shoring system when laying concrete, so that work can be undertaken in a safe and secure manner.			
		(7)	Clearly specify the waiting areas and travelling routes for concrete mixers and their stationary positions where concrete is being laid, so as to prevent concrete mixers being involved in accidents or collisions.			
		(8)	Station flagmen at the stationary positions for concrete mixers and at locations where concrete is being laid.			
		(9)	When concrete is released for laying from stationary concrete mixers, install vehicle stoppers to firmly prevent the wheels of the vehicles from moving.			
	5.5.2.4	(1)	Inspect concrete pump placers as appropriate prior to use.			

At the time the concrete pump placer is in use	(2)	Ensure that communication with operators of concrete pump placers and workers holding hose tips is maintained by: 1) Installing necessary communication equipment such as radios or bells. 2) Establishing and following standardized signals.			
	(3)	Undertake concrete pumping operations, including start-up, shutdown, and adjustment of discharge, during pumping of concrete, in accordance with the signals sent from the hose end.			
	(4)	Securely connect transport pipes to hoses and between transport pipes using couplings and other tools.			
	(5)	Take measures to prevent falling off or swaying of transport pipes, including fixing the pipes to a firm structure.			
	(6)	When positioning concrete pump placers, check the ground condition of the positioning area and take appropriate measures as necessary to prevent vehicles from overturning.			
	(7)	Station flagmen to guide concrete mixers in order to prevent contact between the concrete pump placer and concrete mixer. To avoid collisions with concrete pump placers, the Contractor shall provide vehicle stopper at places where concrete is discharged from the concrete mixer.			
	(8)	Ensure that flagmen for concrete mixers are not positioned between concrete mixers and pump placers to prevent them being caught between them.			
	(9)	When the boom of a concrete pump placer is extended close to an aerial line, take measures to prevent contact between the boom and the aerial line.			
Work over Water					

Understanding of execution conditions	5.6.1.1		The Contractor shall understand the following conditions for construction in advance: 1) Water depth, topography, and geology 2) Local characteristics mainly concerning maritime phenomena and meteorology 3) Traffic conditions in the work area, including traffic routes on the water or fairways 4) The presence of underwater obstacles such as sunken ships 5) The presence of buried utilities such as communication cables, power cables, gas pipes or water pipes 6) Aerial lines and other similar utilities around the work area			Medupi FGD retrofit project does not include work over water.	
Procedure for execution of the works	5.6.1.2		The Contractor shall specify in advance the procedure for executing the work and the supervisor responsible for the work over the water taking into account the particular conditions for construction and other relevant factors.				
Protective gear	5.6.1.3		Workers shall use life jackets when undertaking work. They shall use safety belts when working in areas where they may fall and be injured by flying or falling objects or collide with permanent or temporary structures.				
When working over water	5.6.2	(1)	Implement the following measures when undertaking work over water: 1) Measures to prevent workers from falling into water 2) Development of systems to rescue workers if they fall into water				
		(2)	Ensure that workers do not undertake work over water alone.				
		(3)	Implement measures to ensure safety against floods, rainstorms, or sea waves during work over water.				
		(4)	Collect information on water levels or tide levels in conjunction with the work.				
		(5)	Prescribe and communicate emergency response measures to all relevant workers in advance.				
		(6)	Put in place protective gear for ready use, including life preservers and ropes.				
		(7)	Draw particular attention to lighting during night work and station watch-personnel as appropriate.				
		(8)	Prohibit the overboarding and the overloading of any vessel.				
		(9)	Install and regularly maintain lifesaving appliances at the appropriate positions in the boat.				

		(10)	Take safety measures when undertaking work on a river with dams located upstream against water release from the dam reservoir.				
		(11)	Suspend work during stormy weather such as heavy rainfall or strong winds.				
Demolition Work							
Understanding of the conditions for construction	5.7.1.1		(1) Understanding of the structure conditions 1) Structural strength, scale, shape, structural sections, interior and exterior finishes, and the building services of the structure 2) Previous uses of the structure (presence of chemical substances, flammable materials and other hazardous materials) 3) Status of damage, wear, corrosion, and deterioration of the structure and its structural (2) Understanding of the surrounding environmental conditions This includes topography, geology, structures in the neighbouring area (particularly hospitals and other facilities susceptible to vibration, noise or dust), public transportation such as railroads or roads, underground materials and utilities, aerial utilities and other restricting conditions.	14: Demolition work		14.CR 14: Demolition work 14. (1) A contractor must appoint a competent person in writing to supervise and control all demolition work on site. (2) A contractor must ensure that before any demolition work is carried out, and in order to ascertain the method of demolition to be used, a detailed structural engineering survey of the structure to be demolished is carried out by a competent person and that a method statement on the procedure to be followed in demolishing the structure is developed by that person. (3) During a demolition, the competent person contemplated in subregulation (1) must check the structural integrity of the structure at intervals determined in the method statement contemplated in subregulation (2), in order to avoid any premature collapses. (4) A contractor who performs demolition work must- (a) with regard to a structure being demolished, take steps to ensure that- (i) no floor, roof or other part of the structure is overloaded with debris or material in a manner which would render it unsafe; (ii) all reasonably practicable precautions are taken to avoid the danger of the structure collapsing when any part of the framing of a framed or partly framed building is removed, or when reinforced concrete is cut; and (iii) precautions are taken in the form of adequate shoring or other means that may be necessary to prevent the accidental collapse of any part of the structure or adjoining structure; (b) ensure that no person works under overhanging	Construction Regulations-2014
Procedure for execution of the works	5.7.1.2		The Contractor shall specify in advance the procedures for execution of the works and the supervisors responsible for dismantling work, taking into account the conditions for construction and other relevant factors.				
Protective gear	5.7.1.3		Workers shall wear safety helmets and protective gear to protect their legs, feet and hands when undertaking work. Workers shall wear goggles when there is a need to protect their faces against flying objects or when undertaking the particular type of work. Workers shall wear dust masks when undertaking work that generates dust. Workers shall use safety belts when working in areas where they may fall.				
At the time of demolition work	5.7.2	(1)	Ensure that demolition works are undertaken strictly in accordance with the instructions of the responsible supervisor.				

(2)	Take measures to restrict unauthorised access of workers to the demolition area where they are not related to the work.		
(3)	Surround areas of a structure where third parties are exposed to danger associated with demolition by the fence or the equivalent and clearly indicate the area as a dangerous work area.		
(4)	Construct scaffolds or makeshift passages to ensure the safety of workers during dismantling. The Contractor shall take measures to prevent falls where there is a risk of falling, and instruct workers to use safety belts and other protective gear.		
(5)	Not undertake work simultaneously at any places right above or below the level where demolition work is to be undertaken.		
(6)	Ensure that no structure being demolished is left in a state where it may collapse due to strong wind or other factors.		
(7)	Sprinkle water and take any other necessary action as necessary to prevent the generation of dust when a structure is to be demolished.		
(8)	Take measures to prevent unauthorised access to areas where construction machinery is to be operated.		material or a structure which has not been adequately supported, shored or braced; (c) ensure that any support, shoring or bracing contemplated in paragraph (b), is designed and constructed so that it is strong enough to support the overhanging material; (d) where the stability of an adjoining building, structure or road is likely to be affected by demolition work on a structure, take steps to ensure the stability of such structure or road and the safety of persons; (e) ascertain as far as is reasonably practicable the location and nature of electricity, water, gas or other similar services which may in any way be affected by the work to be performed, and must before the commencement of demolition work that may affect any such service, take the steps that are necessary to render circumstances safe for all persons involved; (f) cause every stairwell used and every floor where work is being performed in a building being demolished, to be adequately illuminated by either natural or artificial means; (g) cause convenient and safe means of access to be provided to every part of the demolition site in which persons are required to work; and (h) erect a catch platform or net above an entrance or passageway or above a place where persons work or pass under, or fence off the danger area if work is being performed above such entrance, passageway, or place so as to ensure that all persons are kept safe where there is a danger or possibility of persons being struck by falling objects. (5) A contractor must ensure that no material is dropped to any point, which falls outside the exterior walls of the structure, unless the area is effectively protected. (6) No person may dispose of waste and debris from a high place by a chute unless the chute-

		(9)	Suspend work during stormy weather such as heavy rainfall or strong winds.		(a) is adequately constructed and rigidly fastened; (b) if inclined at an angle of more than 45 degrees to the horizontal, is enclosed on its four sides; (c) if of the open type, is inclined at an angle of less than 45 degrees to the horizontal; (d) where necessary, is fitted with a gate at the bottom end to control the flow of material; and (e) discharges into a container or an enclosed area surrounded by barriers. (7) A contractor must ensure that every chute used to dispose of rubble is designed in such a manner that rubble does not free-fall and that the chute is strong enough to withstand the force of the debris travelling along the chute. (8) A contractor must ensure that no equipment is used on floors or working surfaces, unless such floors or surfaces are of sufficient strength to support the imposed loads. (9) Where a risk assessment indicates the presence of asbestos, a contractor must ensure that all asbestos related work is conducted in accordance with the Asbestos Regulations, 2001, promulgated by Government Notice No. R. 155 of 10 February 2002. (10) Where a risk assessment indicates the presence of lead, a contractor must ensure that all lead related work is conducted in accordance with the Lead Regulations, 2001, promulgated by Government Notice No. R.236 of 28 February 2002. (11) Where the demolition work involves the use of explosives, a method statement must be developed in accordance with the applicable explosives legislation, by an appointed person who is competent in the use of explosives for demolition work and all persons involved in the demolition works must adhere to demolition procedures issued by the appointed person. (12) A contractor must ensure that all waste and debris are as soon as reasonably practicable removed and disposed of from the site in accordance with the applicable legislation.
Work where there is danger of oxygen deficiency					

Key points for the preparation stage	5.8.1.1	1) Wells, open caissons, shafts, tunnels, pneumatic caissons and other similar places that have not been used for a long period of time 2) The insides of those places listed in 1) above, that are in contact with or either lead to the following layers: a) Sand gravel layers that have impermeable layers located right above, which have little or no water content or running water b) Strata containing ferrous salts or first manganese salts c) Strata containing methane, ethane or butane d) Strata gushing out or likely to gush out with carbonated water e) Sludge layers 3) Cisterns, conduits, manholes and pits 4) The insides of cisterns, conduits, manholes and pits where rainwater, river water, or seepage water stagnates or previously stagnated at some point in time. 5) The insides of tanks, holds, cisterns, pipes, conduits, manholes, ditches, pits in which human waste, sapropel, sludge, pulp liquid, or other corroded or easily decomposable substances are contained or were once contained. 6) An excavation work site, a pile foundation work site or surroundings, where construction by a pneumatic method is or once was carried out . 7) Places where work is undertaken with internal combustion	Work in confined spaces	-	Work in confined spaces 5. (1) An employer or a user of machinery shall take steps to ensure that a confined space is entered by an employee or other person only after the air therein has been tested and evaluated by a person who is competent to pronounce on the safety thereof, and who has certified in writing that the confined space is safe and will remain safe while any person is in the confined space, taking into account the nature and duration of the work to be performed therein. (2) Where the provisions of subregulation (1) cannot be complied with the employer or user of machinery, as the case may be, shall take steps to ensure that any confined space in which there exists or is likely to exist a hazardous gas, vapour, dust or fumes, or which has or is likely to have, an oxygen content of less than 20 per cent by volume, is entered by an employee or other person only when-- (a) subject to the provisions of subregulation (3), the confined space is purged and ventilated to provide a safe atmosphere therein and measures necessary to maintain a safe atmosphere therein have been taken; and (b) the confined space has been isolated from all pipes, ducts and other communicating openings by means of effective blanking other than the shutting or locking of a valve or a cock, or, if this is not practicable, only when all valves and cocks which are a potential source of danger have been locked and securely fastened by means of chains and padlocks. (3) Where the provisions of subregulation (2)(a) cannot be complied with, the employer or user of machinery shall take steps to ensure that the confined space in question is entered only when the employee or person entering is using breathing apparatus of a type approved by the chief inspector and, further, that-- (a) the provisions of subregulation (2) (b) are complied with; (b) any employee or person entering the confined space is using a safety harness or other similar equipment, to which a rope is securely attached which reaches beyond the access to the confined space, and	1031 - OHS - General Safety Regulations, 1986
Procedure for execution of the works	5.8.1.2	The Contractor shall specify in advance the procedure for execution of the works and the supervisors responsible for work to be undertaken where there is a danger of oxygen deficiency, taking into account the relevant conditions for construction and other relevant factors.				
Measurement of the working environment	5.8.1.3	The Contractor shall specify in advance the timing and method for measuring oxygen concentration, and the procedure when the management concentrations in various working environments is to be applied.				
Advance training to workers	5.8.1.4	1) The influence of oxygen deficiency on the human body and the related symptoms 2) Usage of protective gear including a respirator 3) Evacuation in the event of accident and methods of emergency treatment				

Protective gear	5.8.1.5		Workers shall wear safety helmets and protective gear to protect their feet when undertaking work. Where toxic gas exists, they shall wear gas masks or respirators. They shall use safety belts when working at places where they may fall.						the free end of which is attended to by a person referred to in paragraph (c); (c) at least one other person trained in resuscitation is and remains in attendance immediately outside the entrance of the confined space in order to assist or remove any or persons from the confined space, if necessary; and (d) effective apparatus for breathing and resuscitation of a type approved by the chief inspector is available immediately outside the confined space. (4) An employer or user of machinery shall take steps to ensure that all persons vacate a confined space on completion of any work therein. (5) Where the hazardous gas, vapour, dust or fumes contemplated in subregulation (2) are of an explosive or flammable nature, an employer or user of machinery shall further take steps to ensure that such a confined space is entered only if -- (a) the concentration of the gas, vapour, dust or fumes does not exceed 25 per cent of the lower explosive limit of the gas, vapour, dust or fumes concerned where the work to be performed is of such a nature that it does not create a source of ignition; or (b) such concentration does not exceed 10 per cent of the lower explosive limit of the gas, vapour, dust or fumes where other work is performed. (6) The provisions of this regulation shall mutatis mutandis also apply, in so far as they can be so applied, to any work which is performed in any place or space on the outside of and bordering on or in the immediate vicinity of, any confined space, and in which place or space, owing to its proximity to the confined space, any hazardous article, oxygen-deficient atmosphere or dangerous concentration of gas, vapour, dust or fumes may occur or be present.	
Key points for working in places where there is a risk of oxygen deficiency	5.8.2	(1)	Install and maintain measurement equipment necessary to measure gas concentration in the working environment, when working in places where there is a risk of oxygen deficiency.							
		(2)	Undertake measurements of the working environment when undertaking work in places where there is a risk of oxygen deficiency, prior to the start of each and every work shift. If the measurement result exceeds the management standard, the Contractor shall immediately take necessary measures and ensure that no work is undertaken until the measurement reading shows a value below the standard value.							
		(3)	Comply with the following requirements when measuring the working environment: 1) When entering the measuring area, protective gear such as respirators shall be worn so as not to directly breathe in the air in the measuring area. 2) Measurements shall not be made by a single worker only; they shall be made always with the appropriate watch-personnel stationed.							
		(4)	Always maintain ventilation when work is undertaken at a place where there is a risk of oxygen deficiency.							
		(5)	Provide protective gear including respirators, evacuation tools including ladders and ropes, and other appliances necessary for rescue, when work is undertaken at a place where there is a risk of oxygen deficiency.							
		(6)	Take measures to prevent unauthorised access in areas where there is a risk of oxygen deficiency, and post relevant signs.							
		(7)	Ensure that the supervisor responsible immediately suspends the work whenever there is the potential for oxygen deficiency and evacuates workers to a safe place.							
		(8)	Ensure that rescue crew use protecting gear (such as respirators) when rescuing victims of oxygen deficiency and take measures to prevent secondary accidents.							
		(9)	Ensure that work is always undertaken with constant ventilation, when working in a closed space where an internal combustion engine of a construction machine is being operated.							

Slinging Work							
Key points for slinging work	5.9.1	(1)	Ensure that slinging work is undertaken by personnel who have a license certified in accordance with the relevant laws and regulations of the recipient country or who have the equivalent knowledge, capability and experience.			No discription regaring slinging work in Safety Regulation,2014	
		(2)	Use slinging equipment appropriate for the shape and weight of the cargo to be hoisted.				
		(3)	Always check slinging equipment before use and specify checkpoints, inspection methods, and the responsible inspectors in advance. Any inappropriate or defective slinging equipment shall be discarded immediately.				
		(4)	Store slinging equipment in an orderly manner at a place free of rainfall, soot and dust.				
		(5)	Hoist pipes and other slippery cargo only after measures to prevent falls are taken.				
		(6)	Not hoist long and short materials together.				
		(7)	Use hoisting boxes and other appropriate methods when hoisting small materials.				
		(8)	Prevent unauthorised access to work areas where workers are undertaking slinging work.				
		(9)	Ensure that no workers are present under hoisted cargo.				
		(10)	Comply with the guidance specified in Clause 6.4.2.3.” Measures for operation of mobile cranes”				
Technical Guidance for Safe Execution (by the Type of Accident)							
Measures for Prevention of Fall Accidents							

General rules	6.1.1	-	When undertaking work at a place more than two meters above ground level, the Contractor shall construct scaffolding prior to the execution of the works and ensure that workers wear safety helmets when conducting the works. Where it is impossible to construct scaffolding, workers shall use protective gear such as safety belts, fall arrestors and other anti-fall gear. The Contractor shall affix handrails, main ropes and other equipment as appropriate where the use of anti-fall protective gear is contemplated.	Personal safety equipment and facilities	-	Personal safety equipment and facilities 2. (1) Subject to the provisions of paragraphs (f), (g), (h) and (i) of regulation 5 of the General Administrative Regulations published under Government Notice R. 2206 of 5 October 1984, every employer and every user of machinery shall make an evaluation of the risk attached to any condition or situation which may arise from the activities of such employer or user, as the case may be, and to which persons at a workplace or in the course of their employment or in connection with the use of machinery are exposed, and he shall take such steps as may under the circumstances be necessary to make such condition or situation safe. (Replaced by GAR, 1994 by Government Notice R. 17403 of 6 September, 1996.) (2) Where it is not practicable to safeguard the condition or situation contemplated in subregulation (1), the employer or user of machinery, as the case may be, shall take steps to reduce the risk as much as is practicable, and shall provide free of charge and maintain in a good and clean condition such safety equipment and facilities as may be necessary to ensure	1031 - OHS - General Safety Regulations, 1986
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					that any person exposed to any such condition or situation at a workplace or in the course of his employment or on premises where machinery is used is rendered safe. (3) Taking into account the nature of the hazard that is to be countered, and without derogating from the general duties imposed on employers and users of machinery by subregulations (1) and (2), the safety equipment and facilities contemplated in subregulation (2) shall include, as may be necessary -- (a) suitable goggles, spectacles, face shields, welding shields, visors, hard hats, protective helmets, caps, gloves, gauntlets, aprons, jackets, capes, sleeves, leggings, spats, gaiters, protective footwear, protective overalls, or any similar safety equipment or facility of a type that will effectively prevent bodily injury; (b) waterproof clothing, high-visibility clothing, chemical-resistant clothing, low temperature clothing, chain mail garments, waders, fire retardant or flame-proof clothing, ice-jackets, or any similar safety equipment of a type that will effectively protect the wearer thereof against harm; (c) belts, harnesses, nets, fall arresters, life lines, safety hooks, or any similar equipment of a type that will effectively protect persons against falls; (d) mats, barriers, locking-out devices, safety signs, or any similar facility that will effectively prevent slipping, unsafe entry or unsafe conditions; (e) protective ointments, ear-muffs, ear-plugs, respirators, breathing apparatus, masks; air lines, hoods, helmets, or any similar safety equipment or facility of a type that will effectively protect against harm; (f) suitable insulating material underfoot where persons work on a floor made of metal stone, concrete or other similar material; and (g) generally, such safety equipment or facilities as may be necessary to render the persons concerned safe. (4) An employer or a user of machinery, as the case may be, shall take steps to ensure that no safety equipment or facility provided as required by this or any other regulation is removed from a workplace or from premises where machinery is used, except for purposes of cleaning, repair, maintenance, modification, mending or replacement, and no person	
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						shall remove any such safety equipment or facility from a workplace or premises where machinery is used, except for the aforesaid purposes. (5) An employer shall instruct his employees in the proper use, maintenance and limitations of the safety equipment and facilities provided. (6) An employer shall not require or permit any employee to work unless such an employee uses the required safety equipment or facility provided in terms of this or any other regulation. (7) The provisions of this regulation shall not be construed as derogating from the provisions of any specific regulation prescribing specific safety equipment or facilities.	
Scaffolding Structure and materials of scaffolding	6.1.2.1	(1)	Analyze the structural strength required for scaffolding based on the loads to be applied in the working areas and the expected service loads, and determine the appropriate structure for scaffolding.	16:Scaffolding	-	(1) A contractor must appoint a competent person in writing who must ensure that all scaffolding work operations are carried out under his or her supervision and that all scaffold erectors, team leaders and inspectors are competent to carry out their work. (2) A contractor using access scaffolding must ensure that such scaffolding, when in use, complies with the safety standards incorporated for this purpose into these Regulations under section 44 of the Act.	Construction Regulations
		(2)	Design the scaffolding structure to sustain expected loads for the relevant works after adequate review of the risk of any overturning or collapse of the structure.	Demolition and excavation 13D.Scaffold framework	-	Scaffold framework 13D.(1) An employer shall ensure that - (a) Scaffold standards are properly propped against displacement and are secured vertically on firm foundations: Provided that putlog scaffolds shall incline slightly towards the structure; (b) (i) steel scaffold standards with 'heavy', 'medium', 'light', or 'very light', platform loadings which shall not exceed 320, 240, 160 and 80 kg/m² respectively, are spaced not more than 1.8 m, 2 m, 2.5 m and 3 m apart, respectively; and	1031 - OHS - General Safety Regulations, 1986
		(3)	Use materials for scaffolding that can be reasonably procured within the country in which the project is located. More specifically, the Contractor shall select reliable, durable and appropriate materials that are free of defects in terms of strength, damage or corrosion.				
		(4)	Construct scaffolding on a firm and flat foundation to prevent sliding or collapse and use additional supports as				

			appropriate where any part(s) of the foundation is on soft ground.		
		(5)	Provide supporting measures such as braces to prevent the collapse of the scaffolding structure.		
Scaffolding Measures for assembly and dismantle of scaffolding	6.1.2.2	(1)	Prevent unauthorised access to the area where scaffolding is assembled or dismantled.		(ii) wooden scaffold standards are spaced not more than 3 m apart;
		(2)	Specify the details of the responsible supervisor(s), the location of the work area, the scope, and procedure for the works, and the required protective gear.		(c) ladders are spaced vertically not more than 2.1 m apart;
		(3)	Ensure that workers use appropriate protective gear such as safety belts when assembling or dismantling scaffolding if there is any risk of falling.		(d) putlogs or transoms --
		(4)	Install handrails along the entire length of the working floor to prevent accidents. Handrails shall be installed also at places other than working floors, where there is risk of falling. The height or structure of the handrails shall be adequately reviewed to prevent any accidents.		(i) which do not support a platform, are spaced at the same distances as the distances prescribed in paragraph (b) in respect of scaffold standards.
		(5)	Install baseboards, mesh sheets, protection nets and other appropriate measures for handrails as required, so as to prevent the fall of objects from the working floor.		(ii) which support a platform, are spaced not more than 1.25 m apart if the platform is constructed of solid timber boards; and
		(6)	Provide appropriate means for workers to move between higher and lower level working areas.		(e) every part of a wooden scaffold frame has a diameter of at least 75 mm or a section of similar strength.
		(7)	Apply floorboards to the floor of the working platform at appropriate intervals to prevent workers tripping over any openings between the floorboards. Floorboards shall be firmly fastened.		(2) No employer shall use a scaffold, or permit it to be used unless it -
		(8)	Where there are openings on the working area, install adequate handrails or fencing around the opening with sufficient signs and notifications at or near the opening. On non-working days, those openings shall be closed or covered up to prevent any falls.		(a) is securely and effectively braced to ensure stability in all directions;
		(9)	Cancel work when workers are likely to be exposed to danger while undertaking work during bad weather such as strong wind or rainstorms. The procedure and requirement for cancellation of the works shall be predetermined based on the working conditions.		(b) is secured at suitable vertical and horizontal distances to the structure to which work is being done, unless it is designed to be completely free-standing;
Scaffolding Measures on	6.1.2.3				(c) is so constructed that it has a throughout factor of safety of at least two; and
		(1)	Specify and notify all workers of the maximum live load for scaffolding, and install signs showing such information at locations easily visible to workers.		(d) is inspected at least once a week and every time after bad weather by a person who has adequate experience in the erection and maintenance of scaffolds, and all findings are recorded in a register or report book.
					(3) No employer shall require or permit that -
					(a) a scaffold with a supporting wooden framework exceeds a height of 10 m; and
					(b) a scaffold is erected, altered or dismantled by or under the supervision of a person other than a person who has had the necessary training and experience of such work and who has been appointed by the employer in writing for this purpose.
					Scaffold platforms
					13E.(1) An employer shall ensure that -
					(a) every plank of a solid wooden scaffold platform is at least 275 mm wide and 38 mm thick;
					(b) every plank which forms part of a scaffold platform is supported at distances not exceeding 1.25 m, and its ends are projected not less than 70 mm and

the use of scaffolding	(2)	Not place materials exceeding the predetermined upper limit of live loads in the working area.			
	(3)	Draw sufficient attention to where materials are placed in working areas, so as to ensure uniform placement and prevent destabilization of the scaffolding.			
	(4)	Not use the working platform to store materials other than those for immediate use. No materials or equipment shall be placed at access to the scaffolding.			
	(5)	Not remove or modify handrails installed at the working area or other parts of the scaffolding without prior approval. When handrails must be removed, the Contractor shall undertake the removal works after ensuring that there is no unauthorised access to the scaffolding and taking all preventive measures to avoid the occurrence of any accidents.			
	(6)	Inspect scaffolding daily before the commencement of work to ensure there are no problems with the scaffolding structure and the safety handrails. Any defective scaffolding shall be removed and/or repaired immediately.			
	(7)	In the case of inappropriate weather conditions such as strong wind or heavy rains, or natural disasters such as earthquakes, temporarily suspend works and inspect the scaffolding prior to the resumption of the works.			
	(8)	Take measures, so as to ensure that there is no unauthorized access into working areas where scaffolding is in place.			
				not more than 200 mm beyond the last prop; (c) every plank of a scaffold platform is firmly secured to prevent its displacement; and (d) every platform is so constructed as to prevent materials and tools from falling through. (2) An employer shall ensure that every scaffold platform- (a) with 'heavy' 'medium', 'light' or 'very light' platform loadings as referred to in regulation 13D (1) (b) (i) is not less than 1 125 mm and not more than 1 380 mm, not less than 1 125 mm and not more than 1 150 mm, not less than 900 mm and not more than 1 150 mm, and not less than 675 mm and not more than 1 150 mm, respectively, wide: Provided that where a platform is used only as a gangway, a platform width of 450 mm shall be sufficient; (b) which is more than 2 m above the ground is on all sides, except the side facing the structure, provided with- (i) substantial guard rails of at least 900 mm and not exceeding 1 000 mm in height; and (ii) toe-boards which are at least 150 mm high from the level of the scaffold platform and so affixed that no open space exists between the toe-boards and the scaffold platform: Provided that if the toe-boards are constructed of timber, they shall be at least 25 mm thick; (c) is not more than 75 mm from the structure: Provided that where workmen must sit to work, this distance may be increased to not more than 300 mm; and (d) is kept free of waste, projecting nails or any other obstructions, and is kept in a non-slip state. (3) No employer shall require or permit that a working platform which is higher than 600 mm be supported on a scaffold platform, and shall provide an additional guard rail of at least 900 mm and not exceeding 1000 mm in height above every such working platform. (4) An employer shall ensure that convenient and safe access is provided to every scaffold platform, and where the access is a ladder, the ladder shall project at least 900 mm beyond the top of the platform. Suspended scaffolds	

				13F. (1) An employer shall ensure that the outriggers of each suspended scaffold - (a) are constructed of steel or any other material of similar strength and have a factor of safety of at least four with respect to the load it is to carry; (b) have an overhang of not more than 1.8 m beyond the edge of the structure and are of such length that the counteracting length can be anchored securely; (c) are, otherwise than by means of weights at the inner-ends, properly propped, suitably spaced and firmly anchored: Provided that an inspector may grant permission that outriggers may be anchored by means of weights; and (d) are provided with stop or other effective devices at the outer-ends to prevent the displacement of ropes. (2) An employer shall ensure that the working platform of every suspended scaffold is suspended by: (a) pulley-blocks, sheaves, winches or hoists of the correct size for the ropes being used; (b) at least two independent steel wire ropes in the case of a working platform which is not wider than 912 mm, and at least four independent steel wire ropes in the case of a working platform which is 912 mm and wider; and (c) steel wire ropes of which the factor of safety is at least ten with respect to the maximum load which each rope is to carry. (3) An employer shall ensure that - (a) the hand or power-driven machinery used for the lifting or lowering of the working platform of a suspended scaffold is so constructed and maintained that an uncontrolled movement of the working platform cannot occur; (b) the machinery referred to in paragraph (a) is so situated that it is easily accessible for inspection; (c) the rope connections to the outriggers are vertically above the connections to the working platform; and (d) in the case of a working platform suspended by two ropes only, the connections of the ropes to the working platform are of such height above the level of the working platform as to ensure the stability of the working platform. (4) An employer shall ensure that the working platform of every suspended scaffold -	
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					(a) is at least 456 mm and not exceeding 1.8 m in width; (b) is suspended as near as possible to the structure to which work is being done and, except when light work is being done, is secured at every working position to prevent horizontal movement between the working platform and the structure; (c) is on all sides, except the side facing the structure, provided with substantial guard rails of at least 900 mm and not exceeding 1000 mm in height above the level of the working platform: Provided that in the case of a working platform suspended by two ropes only, the guard rails shall be on all sides; and (d) is on an sides provided with toe-boards which are at least 150 mm high from the level of the working platform and so affixed that no open space exists between the toe-boards and the working platform: Provided that if the toe-boards are constructed of timber, they shall be at least 25 mm thick. Trestle scaffolds 13G.(1) No employer shall use a trestle scaffold, or permit it to be used, unless - (a) it is soundly constructed of solid material, and (b) all reasonable precautionary measures have been taken to prevent the unexpected spreading of its supporting legs when it is in use. (2) No employer shall use a trestle scaffold or permit it to be used, if it - (a) is higher than 3 m; or (b) consists of more than two tiers.	
Measures for Prevention of Accidents Involving Flying or Falling Objects						
General rules	6.2.1	-	When undertaking work involving a risk of flying or falling objects, the Contractor shall take the following measures into account for the particular work conditions. The workers shall also wear safety helmets.	10:Fall Protection	10.CR 10: Fall protection 10. (1) A contractor must- (a) designate a competent person to be responsible for the preparation of a fall protection plan; (b) ensure that the fall protection plan contemplated in paragraph (a) is implemented, amended where and when necessary and maintained as required; and (c) take steps to ensure continued adherence to the fall protection plan. (2) A fall protection plan contemplated in subregulation (1), must include-	Construction Regulations-2014
		(1)	Measures for the installation of safety nets			
		(2)	Measures for work areas with height differences or openings			
		(3)	Measures for work conducted at different heights			
		(4)	Measures for work with rotating machines			

Measures for the installation of safety nets	6.2.2	(1)	Install safety nets to prevent workers from being injured by objects falling from higher places.		
		(2)	Declare an area protected by a safety net to be off-limits, when the safety net is removed due to particular work requirements. After removal, the said area shall be immediately restored to its original condition.		
		(3)	Use safety mesh nets that fit the intended purpose and use.		
Protection against flying or falling objects at work areas with heights or openings	6.2.3	(1)	Use only appropriate lifting equipment such as rope or cranes when objects are to be transferred from a higher to a lower working area.		
		(2)	Keep clear all work areas where objects may easily fall such as on scaffolding in excavated or access areas. No materials or equipment shall be placed at or near such locations. In case materials or equipment have to be temporarily placed at these locations, appropriate measures shall be taken, such as fastening with ropes or packing in boxes or bags, so as to prevent scattering or fall of those objects or to prevent workers from tumbling or falling by tripping over them.		
		(3)	Take preventive measures involving the use of baseboards at the edges of working floors, openings, or the top of slopes, so as to prevent the fall of materials or equipment.		
					(a) a risk assessment of all work carried out from a fall risk position and the procedures and methods used to address all the risks identified per location; (b) the processes for the evaluation of the employees' medical fitness necessary to work at a fall risk position and the records thereof; (c) a programme for the training of employees working from a fall risk position and the records thereof; (d) the procedure addressing the inspection, testing and maintenance of all fall protection equipment; and (e) a rescue plan detailing the necessary procedure, personnel and suitable equipment required to affect a rescue of a person in the event of a fall incident to ensure that the rescue procedure is implemented immediately following the incident. (3) A contractor must ensure that a construction manager appointed under regulation 8(1) is in possession of the most recently updated version of the fall protection plan. (4) A contractor must ensure that- (a) all unprotected openings in floors, edges, slabs, hatchways and stairways are adequately guarded, fenced or barricaded or that similar means are used to safeguard any person from falling through such openings; (b) no person is required to work in a fall risk position, unless such work is performed safely as contemplated in subregulation (2); (c) fall prevention and fall arrest equipment are- (i) approved as suitable and of sufficient strength for the purpose for which they are being used, having regard to the work being carried out and the load, including any person, they are intended to bear; and (ii) securely attached to a structure or plant, and the structure or plant and the means of attachment thereto are suitable and of sufficient strength and stability for the purpose of safely supporting the equipment and any person who could fall; and (d) fall arrest equipment is used only where it is not reasonably practicable to use fall prevention equipment. (5) Where roof work is being performed on a construction site, the contractor must ensure that, in addition to the requirements set out in subregulations

						(2) and (4), it is indicated in the fall protection plan that- (a) the roof work has been properly planned; (b) the roof erectors are competent to carry out the work; (c) no employee is permitted to work on roofs during inclement weather conditions or if any conditions are hazardous to the health and safety of the employee; (d) all covers to openings and fragile material are of sufficient strength to withstand any imposed loads; (e) suitable and sufficient platforms, coverings or other similar means of support have been provided to be used in such a way that the weight of any person passing across or working on or from fragile material is supported; and (t) suitable and sufficient guard-rails, barriers and toe-boards or other similar means of protection prevent, as far as is reasonably practicable, the fall of any person, material or equipment.	
Measures for work conducted at different heights	6.2.4	(1)	Coordinate works that are to be executed at varying heights, so as to avoid work being undertaken simultaneously right above or below at different heights.			There are some descriptions regarding fall protection in Safety Regulation, 2014. However, no description complying with requirement of JICA safety guideline.	
		(2)	Where work must be undertaken simultaneously at different heights, determine in advance the relevant supervisor for such works, the relevant work area, working time, and method and procedure of the works. Workers at different heights shall maintain constant communication with each other while undertaking the work.				
		(3)	Where work must be undertaken simultaneously at different heights, put up sufficient signage around that area and ensure in advance that workers communicate and coordinate the works to be executed at different heights . Sufficient signalmen and watch-personnel shall be stationed near those working areas, so as to ensure that the works are conducted in a safe and secure manner.				
Measures for rotating machines	6.2.5	-	Machines that produce any flying material or cut waste shall be covered or protected by protective fences. In case it is difficult to use a cover or fencing due to the nature of work, workers shall use protective gear when conducting work. Any area subject to risk of falling or flying objects shall be declared off-limits for unauthorized workers.				
Measures for Prevention of Accidents Involving Collapse of Structures							

General rules	6.3.1	-	Depending on the work conditions, the Contractor shall consider the following measures when undertaking work where there is a risk of accidents involving the collapse of structures. In addition to the measures set out below, workers shall wear safety helmets when conducting the work.			There are some descriptions regarding scaffolding and excavation in Safety Regulation, 2014. However no description regarding collapse.	
		(1)	Measures to prevent the collapse of the natural ground				
		(2)	Measures to prevent the collapse of cargo				
		(3)	Measures to prevent the collapse of temporary structures (timbering, forms, form shoring system, scaffolding, etc.)				
		(4)	Measures to prevent the collapse of structures				
Measures to prevent the collapse of natural ground	6.3.2	-	The Contractor shall comply with the following guidances :				
		(1)	The guidance specified in Clause 5.1.1.2. "Cofferdam walls and timbering"				
		(2)	The guidance specified in Clause 5.1.1.3. "Excavation slope for open cutting"				
		(3)	The guidance specified in Clause 5.1.2.1. "Prevention of ground collapse"				
Measures to prevent collapse of cargos	6.3.3	(1)	When loading materials on cargo handling machines, the Contractor shall undertake the loading work, so as to avoid uneven loading. In addition, the materials shall be fastened or covered with ropes or sheets to prevent any collapse or fall.				
		(2)	When unloading cargos, the Contractor shall not pull out materials in the middle of the piling.				
		(3)	The Contractor shall appoint a supervisor for the loading and unloading work, which shall be undertaken under his instructions and control.				
Measures to prevent the collapse of temporary structures (timbering, forms, form shoring system,	6.3.4	(1)	When assembling forms and form shoring system, prepare the assembling diagrams in advance, and assemble in accordance with the plans and drawings. The Contractor shall assign the responsible supervisor for this work and the work shall be undertaken strictly in accordance with his instructions and control.				
		(2)	Inspect in advance the materials for use in temporary structures and, in particular, those that would be used repeatedly, and shall not use those that are damaged, deformed or corroded.				

scaffolding, etc.)		(3)	Shall prevent unauthorised personnel from accessing work areas when assembling or dismantling temporary structures, and postpone such work in the case of bad weather conditions such as strong wind or rainstorms.				
		(4)	Follow the guidance specified in Clause 5.1.1.2. "Cofferdam walls and timbering"				
		(5)	Follow the guidance specified in Clause 5.1.3. "Key points for cofferdam and timbering"				
		(6)	Follow the guidance specified in Clause 5.3.3. "Key points for the form shoring system work"				
		(7)	Follow the guidance specified in Clause 6.1.2. "Scaffolding"				
Measures to prevent collapse of structures	6.3.5	(1)	The Contractor shall follow the guidance specified in Clause 5.7. "Demolition Work"				
Measures for Prevention of Accidents Involving Construction Machinery							
General rules	6.4.1	-	The Contractor shall consider the following particulars when undertaking work using construction machinery.	23: Construction vehicles and mobile plant	-	23.CR 23: Construction vehicles and mobile plant 23. (1) A contractor must ensure that all construction vehicles and mobile plant- (a) are of an acceptable design and construction; (b) are maintained in a good working order; (c) are used in accordance with their design and the intention for which they were designed, having due regard to safety and health; (d) are operated by a person who- (i) has received appropriate training, is certified competent and in possession of proof of competency and is authorised in writing to operate those construction vehicles and mobile plant; (ii) has a medical certificate of fitness to operate those construction vehicles and mobile plant, issued by an occupational health practitioner in the form of Annexure 3.; (e) have safe and suitable means of access and egress; (f) are properly organized and controlled in any work situation by providing adequate signalling or other control arrangements to guard against the dangers relating to the movement of vehicles and plant, in order to ensure their continued safe operation;	Construction Regulations-2014
		(1)	The Operator				
		(2)	Inspection and maintenance of the machines				
		(3)	Safety devices on the machines				
		(4)	Stationing of flagmen				
		(5)	Measures to prevent unauthorized access				
		(6)	Measures for the suspension and completion of work				
		(7)	Provision of training on safety issues				
Operator	6.4.1.1	(1)	The Contractor shall appoint and permit only trained, qualified and certified operators of construction machinery to operate the machines. The names of the regular operators shall be inscribed on their respective machines and only those appointed operators shall operate the machines.				

		(2)	The Contractor shall take steps to ensure the good physical and health condition of the operators. The operators shall be trained to have sufficient rest and shall not be subject to excessive work.		
		(3)	The Contractor shall not permit any operator to operate construction machinery if he is seen to be under the influence of any of the following conditions: 1) Intoxicated from consumption of alcohol 2) Suffering from the effects of excessive consumption of alcohol 3) Extremely exhausted 4) Suffering from any other condition that makes him unfit for any works for the operation of construction equipment or machinery.		
Inspection and maintenance	6.4.1.2	-	The Contractor's personnel with requisite knowledge and skill shall undertake inspection and maintenance of construction machinery in accordance with the relevant laws and regulations of the recipient country, prior to the start of work and at the predetermined times. The Contractor shall undertake such inspection and maintenance taking into account the following requirements.		(g) are prevented from falling into excavations, water or any other area lower than the working surface by installing adequate edge protection, which may include guardrails and crash barriers; (h) are fitted with structures designed to protect the operator from falling material or from being crushed should the vehicle or mobile plant overturn; (i) are equipped with an acoustic warning device which can be activated by the operator; (j) are equipped with an automatic acoustic reversing alarm; and (k) are inspected by the authorised operator or driver on a daily basis using a relevant checklist prior to use and that the findings of such inspection are recorded in a register kept in the construction vehicle or mobile plant. (2) A contractor must ensure that- (a) no person rides or is required or permitted to ride on a construction vehicle or mobile plant otherwise than in a safe place provided thereon for that purpose; (b) every construction site is organized in such a way that, as far as is reasonably practicable, pedestrians and vehicles can move safely and without risks to health; (c) the traffic routes are suitable for the persons, construction vehicles or mobile plant using them, are sufficient in number, in suitable positions and of sufficient size; (d) every traffic route is, where necessary, indicated by suitable signs; (e) all construction vehicles and mobile plant left unattended at night, adjacent to a public road in normal use or adjacent to construction areas where work is in progress, have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, in order to identify the location of the vehicles or plant; (f) all construction vehicles or mobile plant when not in use, have buckets, booms or similar appendages, fully lowered or blocked, controls in a neutral position, motors stopped, wheels chocked, brakes set and
		(1)	In principle, undertake inspection and maintenance only after ensuring the machine has ceased to operate and the power is turned off.		
		(2)	Take appropriate measures to prevent falling or overturning machines.		
		(3)	Take appropriate measures to prevent any unauthorised access to the work area where inspection or maintenance is undertaken.		
		(4)	Undertake inspection and maintenance on a flat and secure surface when the machine is not in operation. If for some unavoidable reason it has to be undertaken on a slope, stoppers shall be applied for the undercarriage of the machine to prevent slippage or movement.		
		(5)	Shut down the engine of the construction machinery, engage the brake and lock all rotating parts.		

		(6)	Lower all attachments onto the ground. If for some unavoidable reason inspection or maintenance has to be undertaken under a raised blade or bucket, the Contractor shall take appropriate measures to prevent the attachment from dropping, for example, by using supports such as struts or blocks.				
		(7)	Take appropriate measures when a machine is being repaired, including the complete shutdown of the machine's functions and preventing any operation or movement of the machine during repair.				
Safety devices	6.4.1.3	(1)	The Contractor shall check the safety devices fitted to construction machinery confirm the operation of the device, and shall not operate any construction machinery if the safety device has been removed or modified.				
		(2)	For construction machines capable of moving backwards, the Contractor shall use only such machines fitted with safety devices that give a warning when the machine moves backwards.				
Stationing of flagmen	6.4.1.4	(1)	Station flagmen when work is undertaken at the road shoulder, on the edge of a slope, and at other locations where there is a risk of vehicles overturning.				
		(2)	Station flagmen where workers and construction machinery are required, for unavoidable reasons, to work in the same vicinity.				
		(3)	Establish standardized signs and controlling procedures where flagmen are stationed.				
Prevention of unauthorized access	6.4.1.5	(1)	The Contractor shall declare danger zones to be off-limits to unauthorised personnel in order to prevent the occurrence of accidents, such as injury caused by collision with construction machinery. Where it is impossible to restrict access for unavoidable reasons, the Contractor shall station flagmen or other appropriate personnel.				
Measures for suspension and completion of work	6.4.1.6	-	When suspending or completing work using construction machinery, the Contractor shall:				
		(1)	Station construction machinery on flat and secure ground and lower buckets onto ground level.				
		(2)	Apply stoppers around the undercarriage of construction machinery to immobilize them when they must be positioned on a slope.				
		(3)	Turn off the engine, engage the brakes and remove the key from the vehicle.				
						ignition secured; (g) whenever visibility conditions warrant additional lighting, all mobile plant are equipped with at least two headlights and two taillights when in operation; (h) tools, material and equipment are secured and separated by means of a physical barrier in order to prevent movement when transported in the same compartment with employees; (i) vehicles used to transport employees have seats firmly secured and adequate for the number of employees to be carried; and (j) all construction vehicles or mobile plant traveling, working or operating on public roads comply with the requirements of the National Road Traffic Act, 1996.	

Provision of education on safety	6.4.1.7	(1)	The Contractor shall provide operators and workers engaging in work using construction machines with necessary training, including training on the deployment of construction machines, the work area, the scope of work, the method of work, and the work procedures to be undertaken prior to the commencement of work.				
		(2)	Whenever any major changes are made to the deployment of construction machinery, the work area, the scope of work, the method of work, and the work procedures, the Contractor shall provide further training to the relevant operators and workers.				
Measures for mobile crane work							
Guiding and signaling for mobile cranes	6.4.2.1	(1)	The Contractor shall appoint only one signalman, who shall use the predetermined signals and provide signals in a clear manner.	22: Cranes		22. A contractor must, in addition to compliance with the Driven Machinery Regulations, 1988 ensure that where tower cranes are used- (a) they are designed and erected under the supervision of a competent person; (b) a relevant risk assessment and method statement are developed and applied; (c) the effects of wind forces on the crane are taken into consideration and that a wind speed device is fitted that provides the operator with an audible warning when the wind speed exceeds the design engineer’s specification; (d) the bases for the tower cranes and tracks for rail-mounted tower cranes are firm, level and secured; (e) the tower crane operators are competent to carry out the work safely; and the tower crane operators have a medical certificate of fitness to work in such an environment, issued by an occupational health practitioner in the form of Annexure 3.	
		(2)	The signalman shall give signals from a position outside the work range that holds a good view of the hoisted cargo and is reasonably visible by the crane operator.				
		(3)	In case the signalman has no choice but to give signals at a position not visible to the operator, he shall use radio or other means to allow the operator to receive the signals.				
Measures for the arrangement and installation of mobile cranes	6.4.2.2	(1)	Ensure that there are no obstacles in the work range of the mobile crane.				Construction Regulations- 2014
		(2)	Establish a procedure that considers any obstacles in the work area and alerts all relevant workers and operators as to their existence in advance.				
		(3)	Check the ground conditions on which to position or transport the mobile crane.				
		(4)	Apply steel plates or conduct ground improvement works when the load-bearing capacity of the ground is insufficient, so as to prevent the crane from overturning.				
		(5)	Set the body of the mobile crane horizontally and extend the outriggers to their fullest depending on the load.				
		(6)	Conduct pre-operation inspection of the mobile crane to check safety devices or warning equipment. Safety devices or warning equipment shall not be turned off during work.				
		(7)	Check the condition of the outriggers or the condition of the ground on which the crane is positioned during operation. Any anomaly, if found, shall immediately be corrected or removed.				

Measures for operation of mobile cranes	6.4.2.3	(1)	Immediately suspend work if anomaly is found during the work, investigate the causes, and take all necessary measures prior to resuming work.			
		(2)	Confirm that the entire weight, including the cargo to hoist, hooks, slinging equipment and other hoisting attachments, is less than the rated hoisting load.			
		(3)	Provide indications or other means that allow operators and slinging workers to always be aware of the rated load of the mobile crane.			
		(4)	Use anti-release appliances when hoisting cargo, so as to prevent slinging equipment from releasing from the hooks.			
		(5)	When slinging cargo, temporarily stop the cargo when it is afloat only slightly from ground level, and check the machine for stability, the centre of gravity of the cargo and the condition of sling.			
		(6)	When hoisting cargo, position the hook right above the cargo to hoist.			
		(7)	When turning cargo, confirm that there are no workers or obstacles inside the turning range, and the operators shall slowly turn the cargo.			
		(8)	Slowly and silently lower cargo.			
		(9)	Not use mobile cranes to transport or hoist workers unless, because of the nature of the work or the need to complete the work, it is necessary to undertake such crane operation, in which case the Contractor shall take the following measures: 1) Provide means to prevent overturning or falling off of the hoisting basket. 2) Have workers use protective equipment such as safety belts. 3) Use the power-driven lowering when the hoisting basket is lowered down.			
		(10)	Ensure that no operators leave the operator's cabin with the cargo hoisted up.			
		(11)	Ensure that no workers are present under the hoisted cargo.			
	(12)	Take appropriate measures to restrict unauthorised access during the mobile crane work, so as to prevent workers from entering areas where cargo may fall.				
Measures for Prevention of Explosion Accidents						

General rules	6.5.1	(1)	When handling explosives in construction work, the Contractor shall: 1) Comply with all relevant requirements prescribed in the relevant laws and regulations of the recipient country. 2) Ensure that all necessary arrangements are made by qualified personnel prescribed by the relevant laws and regulations of the recipient country, and that workers are not exposed to any danger related to use of explosives.			Vide Regulation - 109 - OHS - Explosives Regulation	Regulation - 109 - OHS - Explosives Regulation
		(2)	Ensure that work contents, work methods and procedures, and other detailed work plans are prepared by the qualified personnel and made known to all relevant workers.				
		(3)	Appoint the responsible supervisors among the qualified personnel to supervise the work.				
		(4)	Ensure that workers to be assigned to blasting work are clearly identifiable from other workers by the use of signs or labels on their safety helmets.				
		(5)	Provide workers to be assigned to blasting work with sufficient training on the dangers of blasting work and the important particulars about safety and security.				
		(6)	Conduct blasting work on the ground in the daytime in principle. If blasting work has to be conducted after nightfall for unavoidable reasons, the Contractor shall provide sufficient lighting.				
		(7)	Secure the safety of workers engaged in other works by taking into consideration the following requirements: 1) Blasting times shall be determined with the consent of the relevant supervisors in other works. 2) An advance warning shall be given to the supervisors in other works, and blasting work shall be conducted after making sure those supervisors thoroughly understand when the blasting work is to be conducted.				
		(8)	Declare an area a "danger zone" where it is considered to be dangerous for workers as a result of blasting work, and declare an area a "safety zone" where workers can stand by there in safety during blasting work.				
		(9)	Take measures to ensure that worker's access to the danger zone is restricted by: 1) Setting up a watch-station. 2) Installing a warning signboard. 3) Installing a blasting warning sign at an easily visible location around the danger zone.				

Measures for storage of explosives	6.5.2		The Contractor shall:				
		(1)	Prepare a balance sheet of explosives recording the amount of explosives received, used, and remaining for each implementation of blasting work.				
		(2)	Strictly manage explosives balance sheets.				
		(3)	Take adequate care in relation to loss and theft of explosives.				
		(4)	Store explosives in a place: 1) Where access is restricted for unauthorized personnel, there is sufficient ventilation, clean and dry atmosphere is always maintained, and there is no direct exposure to sunlight. 2) Where there is no fire or risk of falling stones. 3) With a lockable facility to prevent entry from outside. 4) Resistant to fire.				
		(5)	Not store flammable materials such as dried grass, tree leaves or shrubs around the explosives storage.				
		(6)	Not open the storage door during thunderstorms or when a thunderstorm is expected.				
Measures for transport of explosives	6.5.3		The Contractor shall:				
		(1)	Put detonation devices and explosives in separate containers and transported individually.				
		(2)	Not put explosives of different kinds in the same container.				
		(3)	Identify the containers in which the explosives are stored up, as such by attaching explosives signs on their exteriors.				
		(4)	Ensure that vehicles transporting explosives satisfy the following requirements: 1) They run smoothly and are in good condition. 2) They have a structure that does not cause the explosives to fall from their cargo rack. 3) They are equipped with fire extinguishers.				
		(5)	Ensure that explosives are not transported by being tucked in workers' pockets or by being carried by workers.				
	6.5.4		The Contractor shall:				

Measures for handling of explosives		(1)	Establish the work procedures for safe and efficient charging of explosives and make these procedures known to all relevant workers.				
		(2)	Ensure that explosives and detonators are handled carefully and are not beaten, thrown, or dropped.				
		(3)	Cancel any blasting work when lightning is likely.				
		(4)	Ignite explosives when conducting blasting, only after it has first evacuated workers in the danger zones, stationed watch-personnel to prevent access to the danger zones, and notified relevant parties of the blasting operation.				
		(5)	Drill boreholes after ensuring there are no slick holes or remaining powder from the previous blasting.				
		(6)	Handle and treat any misfired dynamites found after blasting, using appropriate methods.				
		(7)	Return powder planned to be used but not actually used, to the same explosives storage after completion of work.				
Measures for Fire Prevention							
General rules	6.6.1		The Contractor shall:	29: Fire precautions on construction sites		29. A contractor must, in addition to compliance with the Environmental Regulations for Workplaces, 1987, ensure that- (a) all appropriate measures are taken to avoid the risk of fire; (b) sufficient and suitable storage is provided for flammable liquids, solids and gases; (c) smoking is prohibited and notices in this regard are prominently displayed in all places containing readily combustible or flammable materials; (d) in confined spaces and other places in which flammable gases, vapours or dust can cause danger (i) only suitably protected electrical installations and equipment, including portable lights, are used; (ii) there are no flames or similar means of ignition; (iii) there are conspicuous notices prohibiting smoking; (iv) oily rags, waste and other substances liable to ignite are without delay removed to a safe place; and (v) adequate ventilation is provided; (e) combustible materials do not accumulate on the construction site; (f) welding, flame cutting and other hot work are done only after appropriate precautions have been taken to	Construction Regulations-2014
		(1)	Appoint a fire control manager, and establish an emergency communication network and fire prevention management system.				
		(2)	Install fire-extinguishing facilities appropriate for the type of work conducted at all locations where a fire is handled, and clearly indicate the whereabouts of those facilities.				
		(3)	Replace fire extinguishers with new ones before expired.				
		(4)	Establish signals to warn of the outbreak of fire.				
		(5)	Review and undertake evacuation drills and fire-fighting drills.				
		(6)	Ensure that qualified personnel take precautionary measures when welding or cutting using fire.				
		(7)	Store waste contaminated with oil or solvent in metal containers, or dispose of it in the appropriate manner.				
		(8)	Ensure that no flammable materials are at or around a fire-handling site.				
		(9)	Immediately give a fire-warning signal following the outbreak of a fire.				

		(10)	Install warning signals throughout the entire construction site.		reduce the risk of fire; (g) suitable and sufficient fire-extinguishing equipment is placed at strategic locations or as may be recommended by the Fire Chief or local authority concerned, and that such equipment is maintained in a good working order; (h) the fire equipment contemplated in paragraph (g) is inspected by a competent person, who has been appointed in writing for that purpose, in the manner indicated by the manufacturer thereof; (i) a sufficient number of workers are trained in the use of fire- extinguishing equipment; (j) where appropriate, suitable visual signs are provided to clearly indicate the escape routes in the case of a fire; (k) the means of escape is kept clear at all times; (/) there is an effective evacuation plan providing for all- (i) persons to be evacuated speedily without panic; (ii) persons to be accounted for; and (iii) plant and processes to be shut down; and (m) a siren is installed and sounded in the event of a fire	
Measures for Prevention of Public Accidents						
General rules for prevention of third-party accidents	6.7.1		When undertaking work with a risk of third-party accidents, the Contractor shall review following measures taking into account the particular work conditions: 1) Installation of temporary enclosures and gates and related measures 2) Measures relating to the area around gates to construction sites 3) Installation of temporary pedestrian passages 4) Communication with local residents in the vicinity of the construction sites 5) Decluttering and cleanliness 6) Measures relating to work on public roads 7) Prevention of flying or falling object accidents to third parties 8) Prevention of dust generation 9) Provision of sufficient lighting 10) Prevention of noise and vibration 11) Site patrol		Medupi FGD retrofit project does not have risk of public accident.	

Installation of temporary enclosures and gates	6.7.1.1		The Contractor shall construct temporary hoarding and gates on the perimeter of the construction site, so as to prevent access by third parties and the occurrence of public accidents.				
Measures relating to temporary enclosures and gates	6.7.1.2	(1)	The Contractor shall construct temporary enclosures on the perimeter of the construction site to prevent third parties accessing the site at any given time. The Contractor shall review the structural measures designed to prevent children accessing the work area, taking into account the following requirements: 1) Temporary enclosures shall be of a height that is difficult for children to climb over. 2) The mesh-size used for the temporary enclosure shall be sufficiently small to prevent children from putting their limbs or heads through. 3) Temporary enclosures shall have no open underside, so that children cannot slip through.				
		(2)	Temporary enclosures shall be made of materials that would withstand strong wind or external forces and be durable enough to persist during the planned installation period.				
		(3)	When installing temporary enclosures, the work shall be undertaken taking third parties into consideration.				
		(4)	Temporary enclosures shall be regularly inspected and maintained to ensure they prevent intrusions.				
		(5)	Gates shall be constructed on the temporary enclosures. The locations of the gates shall not disturb traffic of general vehicles and pedestrians.				
		(6)	Gates shall be lockable. When the gates are open, the Contractor shall take appropriate measures including the stationing of watch-personnel or flagmen for work vehicles.				
		(7)	Gates of temporary enclosures shall be indicated as such, and warning signs prohibiting entry of unauthorized personnel into the site shall be put up.				
		(8)	No third parties or general vehicles shall be allowed to enter the construction area without prior permission, regardless of whether or not work is being conducted.				
Measures relating to the area around gates to	6.7.1.3	(1)	The Contractor shall provide entry and exit areas for work vehicles at the construction site and install appropriate guidance signboards or other similar measures to inform third parties including pedestrians of the entry and exit of work vehicles.				

construction sites		(2)	The Contractor shall ensure that the traffic of third parties is a top priority at the gates, and extend efforts to prevent public accidents associated with entry and exit of work vehicles. Traffic-control personnel or flagmen shall be stationed as needed taking into account the frequency of work vehicles accessing the gate and the general volume of traffic.				
Measures relating to temporary pedestrian passages	6.7.1.4		When allowing third parties to use passages temporarily constructed for work, the Contractor shall create temporary pedestrian passage in accordance with the following requirements: 1) Fences or panels shall be set up on the border between the temporary passage and the construction area. 2) Temporary passages shall be wide and high enough for pedestrians to pass. 3) The floor of the temporary passage shall be designed, so as to prevent stumbling, slipping and other injuries. 4) Temporary passages shall be identified by the use of signs, and guidance signboards or other similar measures shall be provided to prevent accidental entry into the construction site. 5) Appropriate lighting shall be installed and activated on nightfall. 6) When work is undertaken above or near a temporary passage, measures shall be taken to prevent accidents caused by flying or falling objects.				
Communication with local residents around the construction sites	6.7.1.5	(1)	The Contractor shall, jointly with the Employer and Engineer in accordance with the contract documents, notify the local residents of the outline of the construction work, and promote communication and cooperation with them on the work.				
		(2)	The Employer and Engineer shall enable communication to be convenient with local residents.				
Decluttering and cleanliness	6.7.1.6		The Contractor shall always keep the inside and surrounding of the construction site decluttered and clean, so as to avoid causing nuisance to local residents.				
Measures relating to work on public roads	6.7.1.7		When undertaking work on public roads, the Contractor shall take measures to allow the safe passage of general vehicles and third parties, and prohibit the entry of third parties into the work area.				

Measures for prevention of accidents to third parties caused by flying or falling objects	6.7.1.8		The Contractor shall take measures to prevent objects flying or falling when undertaking work near the border of the construction site or in high places and there is a risk that third parties will be injured by those objects				
Measures for prevention of dust generation	6.7.1.9		When dust is generated by implementing the construction work and can cause damage to the surrounding area, the Contractor shall take measures to prevent spreading of dust to the surrounding area taking the following requirements into consideration. When allowing third parties to use temporarily constructed passages, temporary pedestrian paths shall be set up by: 1) Stopping or reducing the amount of work that generates dust. 2) Reducing the amount of dust generation. 3) Sprinkling water and using any other appropriate methods as necessary to reduce the spread of dust generated by the work. 4) Preventing dust from being scattered close to its source.				
Provision of sufficient lighting	6.7.1.10		The Contractor shall provide another appropriate lighting where the construction work requires removal or relocation of existing public lighting facilities, causing any trouble to traffic of third parties.				
Prevention of noise and vibration	6.7.1.11		The Contractor shall take measures to mitigate noise and vibration, which is generated when undertaking construction work and can cause damage to the surrounding area, by: 1) Stopping or reducing the amount of work that generates noise or vibration. 2) Taking measures to mitigate the source of the noise or vibration.				
Site patrol	6.7.1.12		The Contractor shall patrol both the construction site and its vicinity to check and find any conditions that may affect third parties.				

General rules on preventing accidents relating to underground utilities or facilities	6.7.2	(1)	When the presence of underground utilities or facilities is foreseen at a construction site, the Contractor shall conduct a survey on such buried utilities or facilities based on the design documents and preliminary survey information, taking into account safe work methods and procedures for the protection of buried utilities or facilities.				
		(2)	When the presence of underground materials or facilities is foreseen at a work site, the Contractor shall consult with the relevant organisations in charge of such buried utilities or facilities, and after obtaining all appropriate permissions, shall undertake the necessary work in accordance with the relevant laws and regulations of the recipient country.				
		(3)	The Contractor shall check the kind and type, location (plan and depth), relevant standard, structure, and other details of the underground utilities or facilities in advance, so as to accurately understand the area of impact associated with excavation of those buried utilities or facilities.				
		(4)	The Contractor shall notify and ensure the relevant workers understand the information on the underground utilities or facilities, the method and procedure of excavation, the method of protection, emergency response and other necessary data relating to those utilities or facilities.				
General rules on preventing accidents relating to aerial utilities including aerial lines	6.7.3	(1)	The Contractor shall survey aerial lines or other aerial utilities existing in the construction area and identify the type, location (position, height, etc.) and the relevant organisations of any such aerial utilities in advance.				
		(2)	The Contractor shall consult with the relevant organisations owning the identified aerial utilities, and after obtaining all appropriate permissions undertake the required work in accordance with the relevant laws and regulations of the recipient country.				
		(3)	Where construction work is likely to be in contact with or to cut aerial lines or other utilities during the work, the Contractor shall take protective measures by: 1) Protecting aerial utilities such as aerial lines 2) Installing height control facilities at the gate to the construction site 3) Installing signage indicating the location of aerial utilities 4) Restricting access of construction machinery and				

			imposing restrictions on the turning movement range of the machines				
		(4)	Maintaining sufficient space when conducting work in the vicinity of aerial utilities.				
		(5)	Providing information to the relevant workers on aerial utilities, including the type and location, the work method and procedure, restricted access areas, and restricted turning movement ranges.				
Measures for Prevention of Traffic Accidents							
General rules on construction sites	6.8.1		When there is a risk of traffic accidents within the construction site, the Contractor shall adopt the following measures taking into account the work conditions: 1) Installing safety paths and related measures 2) Installing travelling routes for work vehicles and related measures				
Installation of safety paths	6.8.1.1		The Contractor shall install and maintain safety pedestrian paths to ensure the safe passage of workers within the construction site.				
Measures relating to safety paths	6.8.1.2		The Contractor shall:				
		(1)	Clearly separate safety paths from vehicle routes avoiding complicated crossings between them.				
		(2)	Ensure safety paths are wide enough to allow safe passage of workers taking into account the number of workers working in each site.				
		(3)	Take measures that prioritize pedestrians where safety paths cross vehicle routes.				
		(4)	Ensure safety paths have level floors, so as to prevent stumbling, slipping or other injuries.				
		(5)	Identify safety paths by signage.				

		(6)	Ensure no obstacles such as materials or equipment are placed on safety paths.			
Installation of safety paths	6.8.1.3		The Contractor shall specify and maintain travelling routes for safe passage of vehicles and construction machines within the construction site.			
Measures relating to the travel routes of work vehicles	6.8.1.4		The Contractor shall:			
		(1)	Clearly separate work vehicle travel routes from safety paths.			
		(2)	Ensure that work vehicle travel routes are wide enough to allow the passage of work vehicles in terms of the number, size and type of vehicles and machinery, and taking into account the scale of the relevant construction work.			
		(3)	Determine the alignment, profile and cross-sections for the travelling routes in consideration of the durability of the road surface, drainage systems and other factors in order to ensure safe passage of vehicles.			
		(4)	Avoid work vehicle travel routes with alignments that represent steep slopes or sharp curves.			
		(5)	Minimise the number of intersections between vehicle travel routes or crossings with safety pedestrian paths.			
		(6)	Ensure that no obstacles are placed on vehicle travel routes that would cause disruption.			
		(7)	Identify work vehicle travel routes using signs.			
		(8)	Determine and clearly indicate the applicable speed limits for the travel routes, and any weight limits that are imposed.			
		(9)	Station flagmen as needed at borders between work vehicle travel routes and public roads in order to prevent collisions with pedestrians or public vehicles.			
		(10)	Indicate height restrictions where aerial lines or other aerial utilities exist above the work vehicle travel routes, and prohibit the use of those routes by vehicles exceeding the restriction.			
General rules on public roads	6.8.2		When there is a risk of traffic accidents on public roads in connection with the construction work, the Contractor adopt the following measures as appropriate for the particular work conditions: 1) Measures relating to commuting with cars 2) Measures relating to work on public roads			

Measures relating to commuting with cars	6.8.2.1		The Contractor shall:				
		(1)	Determine commuting routes in advance and ensure that workers commute to work using the predetermined routes. If traffic conditions require a detour away from the predetermined commuting routes, the Contractor shall ensure workers drive in a safe manner, so as to prevent road accidents.				
		(2)	Ensure that drivers have a good understanding of the traffic conditions of the commuting routes.				
		(3)	Ensure that drivers shall consider the road conditions and shall not drive in haste.				
		(4)	Check the health conditions of drivers prior to driving, and shall prohibit from driving those who are likely to be unable to drive in a safe manner, because of, for example, fatigue, sickness or influence of alcohol.				
		(5)	Install and use appropriate lighting when driving is necessary after night has fallen.				
		(6)	Periodically inspect and maintain vehicles used for commuting, so as to prevent traffic accidents due to breakdown or defects.				
Measures relating to work on public roads	6.8.2.2		The Contractor shall:				
		(1)	Obtain the relevant permission when it is necessary to conduct work on public roads, through the relevant procedures in accordance with the provisions of the relevant laws and regulations of the recipient country prior to the commencement of work.				
		(2)	Clearly indicate work areas on public roads and take measures to prevent unauthorised access by third parties to the area. Relevant watch-personnel shall be stationed as needed.				
		(3)	Maintain the travelling areas for pedestrians and public vehicles so as to prevent road traffic issues, and station flagmen at appropriate spots to guide public vehicles.				
		(4)	Maintain safe pedestrian passages for the smooth passage of children and the elderly.				

		(5)	Take measures to allow drivers of public vehicles to be able to identify the work area from a distance and drive in a safe and secure manner by: 1) Installing road signs at work areas. 2) Installing notice boards to give advance notice of work on public roads. 3) Providing lighting that increases the visibility of road signs and notice boards, when working after nightfall. 4) Firmly affix road signs and notice boards, so as to ensure they do not overturn owing to strong wind or rainfalls.				
		(6)	Provide appropriate lighting when undertaking work after nightfall, and take care to prevent the dazzling light of the installed lighting fixture from disturbing drivers of public vehicles.				
		(7)	Install a detour information board to inform public vehicles and pedestrians of the need for diversions of public vehicles, and deploy flagmen as appropriate.				
		(8)	Notify local residents of the plan to work on public roads, so as to obtain their understanding and cooperation.				
Protective Gear							
General rules	6.9.1		The Contractor shall:				
		(1)	Ensure that workers use personal protective gear appropriate for the type of work and working environment where they may be exposed to danger during construction work.				
		(2)	Use personal protective gear that is properly certified by the relevant laws and regulations of the recipient country.				
		(3)	Provide workers with training on how to use and manage protective gear, and instruct them to use it appropriately.				
		(4)	Ensure that workers use appropriate protective gear depending on the work, and undertake work in a safe and secure manner.				
Safety helmet	6.9.2	(1)	The Contractor shall ensure that safety helmets are used to reduce the impact to the head in the event of a fall, and protect the head from flying or falling objects.				
		(2)	The Contractor shall inform workers of the type and location of work that requires safety helmets to be worn, and provide them with education on how to use the				

			helmets. They shall also be instructed to use them whenever necessary.				
		(3)	The safety helmet shall be designed or conditioned to fit the head of a wearer, and the chinstrap shall always be tightened when the wearer conducts work with a risk of falling.				
		(4)	The Contractor shall ensure that damaged safety helmets are never used.				
Safety belts	6.9.3		The Contractor shall ensure that:				
		(1)	Safety belts are used to prevent falls when work is undertaken at a high level, on the edge of a working floor, and near an opening where workers may fall.				
		(2)	Safety belts are used that are appropriate to the location or contents of work.				
		(3)	Workers are notified of the type and location of work that requires use of safety belts, and trained to correctly use them. They shall also be instructed to use them whenever necessary.				
		(4)	Damaged safety belts (even if damaged from a single event) are not used.				
		(5)	Safety belt hooks that have a latch are used.				
		(6)	Safety belt hooks are attached at a position higher than the waist.				
		(7)	A safety belt attaching system is installed whenever using a safety belt. The attaching system is strong enough to support a fall, and shall be checked for any anomalies before use.				
Protective gear for the eyes and face	6.9.4	(1)	The Contractor shall ensure that protective gear is used to protect the eyes and face against sparks or minute powder dust generated from grinders, splashes of chemicals from solvents, or sparks or light beams from welding or cutting work.				
		(2)	When using protective gear for the face such as goggles, the right type of goggles shall be used taking into account the type of work.				
		(3)	Workers shall be notified of the type and location of work requiring face protective gear, trained to correctly use them and given detailed instructions to use them whenever necessary.				

Protective gear for ears	6.9.5	(1)	The Contractor shall ensure that protective gear is used to protect the ears where strong noise is generated.				
		(2)	When ear protective gear such as ear plugs or earmuffs are used, the right type of gear shall be used taking into account the type of work.				
		(3)	Workers shall be notified of the type and location of work requiring ear protective gear, trained to correctly use them and given detailed instructions to use them whenever necessary.				
Protective gear for hands	6.9.6	(1)	The Contractor shall ensure that protective gear is used to protect hands against substances that may damage the skin, and during welding or cutting work.				
		(2)	When protective gear such as gloves is used, the right type of gear shall be used taking into account the type of work.				
		(3)	Workers shall be notified of the type and location of work requiring hand protective gear, trained to correctly use them and given detailed instructions to use them whenever necessary.				
Protective gear for feet	6.9.7	(1)	The Contractor shall ensure that protective gear is used to protect feet against injuries from falling objects, being caught between objects, electric shocks and skin-damaging substances.				
		(2)	When protective gear for feet such as safety boots or high boots are used, the right type of gear shall be used taking into account the type of work.				
		(3)	Workers shall be notified of the type and location of work requiring feet protective gear, trained to correctly use them and given detailed instructions to use them whenever necessary.				
Lifebuoy	6.9.8	(1)	The Contractor shall ensure that lifebuoys are used to prevent drowning accidents, when workers undertake work where they may fall into water.				
		(2)	When lifebuoys are used, the right type of gear shall be used taking into account the type of work.				
		(3)	Workers shall be notified of the type and location of work requiring lifebuoys, trained to correctly use them and given detailed instructions to use them whenever necessary.				
Respirators	6.9.9	(1)	The Contractor shall ensure that respirators are used to maintain breathing when workers undertake work where there may be explosions, fire, oxygen deficiency, or the				

			handling of toxic gas, and also when such accidents have occurred.				
		(2)	When respirators are used, the right type of gear shall be used taking into account the type of work.				
		(3)	Workers shall be notified of the type and location of work requiring respirators, trained to correctly use them, and given detailed instructions to use them whenever necessary.				
		(4)	Respirators shall be periodically inspected and always be maintained in good condition.				
Dust and gas masks	6.9.10	(1)	The Contractor shall ensure that dust and gas masks are used to protect workers against harmful conditions, when undertaking work that generates powder dust, gas or steam, or has other health hazards.				
		(2)	When dust and gas masks are used, the right type of gear shall be used taking into account the type of work.				
		(3)	Workers shall be notified of the type and location of work requiring dust and gas masks, trained to correctly use them and given detailed instructions to use them whenever necessary.				
		(4)	When dust and gas masks are used, the working parts of those masks shall be checked prior to use.				
		(5)	Dust masks shall not be used in a place, where there is a low oxygen concentration, or when filled with toxic gas.				
		(6)	When dust masks are used, spare dust masks or filters shall readily be made available.				
		(7)	When workers find it difficult to breathe with dust masks on, they shall immediately change the filters prior to re-use.				
		(8)	Gas masks shall not be used at a place with low oxygen concentration.				
		(9)	When gas masks are used, spare gas masks and canisters shall readily be made available.				
		(10)	The expected expiry of a gas mask shall be determined prior to use.				
		(11)	Whenever workers sense any abnormal odour during use of gas masks, they shall immediately check the status of the filter and change canisters in a safe place as required.				

Appendix 8.1

Inflow Discharge into Mokolo, Klipvoor, Vaalkop, and Roodekopjes Dams

Table App. 8.1-1 Inflow Record into Reservoirs (1/4)

Mokolo Dam												Unit : m ³ /sec	
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	0.00	1.73	9.85	19.65	39.53	22.43	7.53	5.35	3.80	3.27	3.00	2.42	9.88
1981 /82	1.33	1.40	1.13	2.58	0.96	1.41	0.75	0.47	0.35	0.53	0.35	0.23	0.96
1982 /83	0.00	0.00	0.00	0.00	0.00	0.61	0.26	0.36	0.32	0.07	0.19	0.00	0.15
1983 /84	0.00	0.03	0.57	1.92	0.15	0.00	0.08	0.01	0.00	0.00	0.06	0.06	0.24
1984 /85	0.07	0.10	2.07	2.91	6.08	6.43	1.63	0.51	0.15	0.11	0.00	0.08	1.68
1985 /86	0.03	0.11	0.02	0.05	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.02
1986 /87	0.00	0.00	6.69	5.64	1.41	0.53	0.45	0.12	0.00	0.00	0.00	0.00	1.24
1987 /88	0.00	0.17	10.99	3.21	3.70	0.00	5.33	3.02	1.11	1.04	0.41	0.22	2.43
1988 /89	0.12	0.54	0.42	1.02	5.55	7.42	3.17	2.40	1.55	0.80	0.44	0.09	1.96
1989 /90	0.05	0.05	1.93	1.09	4.53	2.64	3.10	2.33	0.84	0.61	0.33	0.13	1.47
1990 /91	0.01	0.16	0.05	0.30	8.29	21.02	10.25	3.20	1.82	1.04	0.44	0.05	3.89
1991 /92	0.05	0.00	0.00	0.01	0.23	0.10	0.00	0.00	0.00	0.00	0.02	0.14	0.05
1992 /93	0.15	0.00	0.14	0.07	0.00	0.00	0.04	0.00	0.00	0.04	0.06	0.09	0.05
1993 /94	0.06	0.02	2.50	8.51	30.72	5.77	3.05	1.03	0.52	0.46	0.21	0.00	4.40
1994 /95	0.00	0.04	0.00	0.00	0.00	0.41	0.95	0.64	0.23	0.10	0.09	0.12	0.22
1995 /96	0.06	0.23	19.85	31.48	0.00	37.01	11.41	7.23	4.96	3.97	2.81	1.13	10.01
1996 /97	0.53	2.28	5.90	8.31	7.76	24.93	8.92	6.10	4.85	0.00	0.00	0.00	5.80
1997 /98	0.00	1.26	0.00	6.11	1.62	1.06	0.41	0.07	0.17	0.39	0.30	0.13	0.96
1998 /99	-	-	-	-	7.04	2.27	1.23	0.71	2.15	0.00	0.56	0.00	1.75
1999 /00	0.03	0.12	0.89	34.16	73.75	32.84	39.16	16.05	11.67	7.41	4.92	2.42	18.62
2000 /01	1.74	1.23	2.32	0.84	1.31	16.69	5.67	4.23	2.42	1.79	1.18	0.38	3.32
2001 /02	0.28	19.91	34.61	7.11	3.70	1.91	1.44	0.91	1.94	0.94	0.58	0.30	6.14
2002 /03	0.07	0.24	0.00	0.76	0.29	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.13
2003 /04	0.05	0.21	0.07	0.55	3.25	43.72	27.03	7.56	4.09	2.84	1.58	0.47	7.62
2004 /05	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
2005 /06	0.00	0.03	0.00	3.73	25.04	51.25	12.02	5.50	3.69	2.45	1.54	0.56	8.82
2006 /07	0.40	0.30	0.34	0.47	0.11	0.02	0.26	0.00	0.01	0.00	0.32	0.00	0.19
2007 /08	0.20	4.34	25.00	52.88	17.67	9.09	6.71	3.74	2.06	1.43	0.87	0.10	10.34
2008 /09	0.73	4.66	8.72	32.30	40.16	24.22	8.02	6.81	4.86	3.30	2.05	1.27	11.42
2009 /10	2.50	1.52	3.84	8.99	11.25	3.72	37.29	29.13	11.00	6.44	5.17	3.31	10.35
2010 /11	1.34	2.08	7.50	45.81	15.91	8.03	11.06	5.35	4.11	3.16	1.91	0.36	8.89
2011 /12	0.59	0.00	9.22	31.80	13.53	4.14	0.00	1.71	1.53	1.26	0.65	0.85	5.44
2012 /13	0.75	1.04	8.51	10.62	11.82	2.86	2.76	1.50	0.80	0.74	0.05	0.00	3.45
2013 /14	0.00	0.00	0.34	6.62	4.96	136.45	26.07	10.17	5.74	4.08	2.51	1.45	16.53
2014 /15	0.60	2.86	10.42	9.99	11.98	2.68	3.74	1.62	0.67	0.97	0.30	1.02	3.90
2015 /16	0.00	0.03	0.34	0.01	0.08	4.07	1.34	0.59	0.45	0.23	0.14	1.00	0.69
2016 /17	0.00	0.18	2.41	5.69	11.28	0.00	0.00	0.00	0.00	-	-	-	2.17
Average	0.33	1.30	4.91	9.59	9.83	12.86	6.52	3.47	2.10	1.37	0.92	0.51	4.48

Source: DWS

Table App. 8.1-2 Inflow Record into Reservoirs (2/4)

Klipvoor Dam												Unit : m ³ /sec	
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	0.67	3.07	10.59	3.97	7.04	5.21	1.46	1.62	1.52	1.51	1.31	1.32	3.27
1981 /82	1.22	1.16	2.36	4.84	2.47	2.13	0.92	1.02	1.00	1.36	1.14	0.74	1.70
1982 /83	1.18	1.29	0.99	4.36	1.17	1.25	1.33	0.86	1.12	1.05	0.98	0.48	1.34
1983 /84	0.50	3.86	3.46	1.97	0.00	1.53	1.08	0.45	0.71	1.08	0.62	0.25	1.29
1984 /85	2.01	0.68	1.44	2.62	0.71	2.39	0.44	0.70	0.65	0.66	0.42	0.29	1.08
1985 /86	0.08	1.86	2.03	1.42	0.65	0.22	0.46	0.42	0.57	0.57	0.45	0.24	0.75
1986 /87	8.83	4.19	14.03	4.78	0.78	2.54	1.23	0.60	0.68	0.73	0.75	1.12	3.35
1987 /88	1.25	2.40	4.64	1.70	0.61	3.19	1.71	0.97	0.89	0.99	0.93	1.03	1.69
1988 /89	1.31	0.89	1.13	1.92	15.46	5.66	1.35	1.76	2.33	1.29	1.23	0.92	2.94
1989 /90	0.80	2.96	6.16	1.72	1.96	3.83	1.55	2.79	1.31	1.42	1.32	1.04	2.24
1990 /91	1.58	0.55	1.41	3.04	7.15	14.87	3.17	1.14	1.38	1.17	1.15	0.91	3.13
1991 /92	0.48	0.82	1.88	0.83	0.74	0.35	0.29	0.46	0.72	0.73	0.69	0.42	0.70
1992 /93	0.22	1.13	1.81	1.60	3.68	2.16	1.13	0.61	0.87	0.83	0.78	0.34	1.26
1993 /94	2.74	1.88	2.74	3.40	9.71	1.71	1.64	1.10	0.76	0.99	1.02	0.38	2.34
1994 /95	0.36	1.34	2.03	1.98	2.06	2.12	3.86	5.29	1.37	1.26	0.94	0.41	1.92
1995 /96	0.62	3.44	8.59	13.21	85.01	22.12	5.16	3.47	2.67	2.43	2.10	1.03	12.49
1996 /97	0.91	3.30	6.91	4.57	1.19	19.41	10.85	5.03	8.36	3.71	2.79	3.33	5.86
1997 /98	2.01	3.68	4.44	6.22	3.11	2.59	1.79	1.15	1.38	1.55	1.36	1.14	2.53
1998 /99	2.59	5.40	8.35	7.06	2.02	1.53	2.27	2.52	2.10	1.84	1.37	1.00	3.17
1999 /00	0.84	0.89	3.94	18.08	57.83	20.57	19.76	6.25	0.00	3.59	2.98	2.28	11.42
2000 /01	4.99	6.96	8.93	1.95	3.56	4.26	2.03	3.39	1.99	2.02	1.70	1.43	3.60
2001 /02	1.32	0.00	0.00	2.40	2.56	1.35	0.00	1.22	1.87	1.38	1.32	1.39	1.23
2002 /03	1.04	1.35	2.02	4.24	3.26	2.49	1.24	0.88	1.31	1.16	1.12	0.78	1.74
2003 /04	0.96	1.40	1.28	2.70	5.93	0.00	5.84	2.84	1.88	2.02	1.64	1.04	2.29
2004 /05	0.66	1.28	3.90	8.89	2.93	3.05	4.30	1.58	1.31	1.26	1.23	0.61	2.58
2005 /06	0.29	1.07	1.51	14.96	21.19	28.55	4.12	2.42	2.15	2.08	2.24	1.40	6.83
2006 /07	0.90	2.74	1.54	2.54	1.23	0.50	0.64	0.85	1.64	1.45	1.19	0.72	1.33
2007 /08	5.45	2.40	7.66	53.11	8.89	17.50	6.61	4.48	3.33	2.53	1.95	0.92	9.57
2008 /09	0.86	4.83	2.79	7.15	15.10	14.68	3.41	3.14	3.53	2.98	2.78	1.47	5.23
2009 /10	3.40	5.81	8.81	9.23	6.48	3.15	21.08	13.77	4.91	3.65	2.60	1.26	7.01
2010 /11	0.87	2.03	11.55	31.22	11.04	8.87	12.94	6.24	4.36	3.41	3.00	1.85	8.11
2011 /12	2.05	3.08	5.18	5.06	4.04	1.73	2.34	1.68	1.74	1.91	1.68	2.69	2.77
2012 /13	5.14	6.21	8.22	3.86	3.36	2.21	4.46	2.85	2.24	2.56	2.15	1.21	3.71
2013 /14	1.92	3.06	9.66	4.10	7.85	35.13	7.01	3.59	3.18	2.93	2.57	0.00	6.75
2014 /15	1.31	3.30	8.80	8.41	3.88	2.95	3.28	2.11	2.55	2.33	1.90	2.49	3.61
2015 /16	0.78	1.79	1.20	5.30	2.00	10.80	2.51	3.46	2.85	2.28	1.97	1.10	3.00
2016 /17	1.79	3.95	2.78	10.47	16.02	8.16	4.93	3.60	0.00	0.00	0.00	-	4.70
Average	1.73	2.60	4.72	7.16	8.72	7.05	4.01	2.60	1.92	1.75	1.50	1.08	3.74

Source: DWS

Table App. 8.1-3 Inflow Record into Reservoirs (3/4)

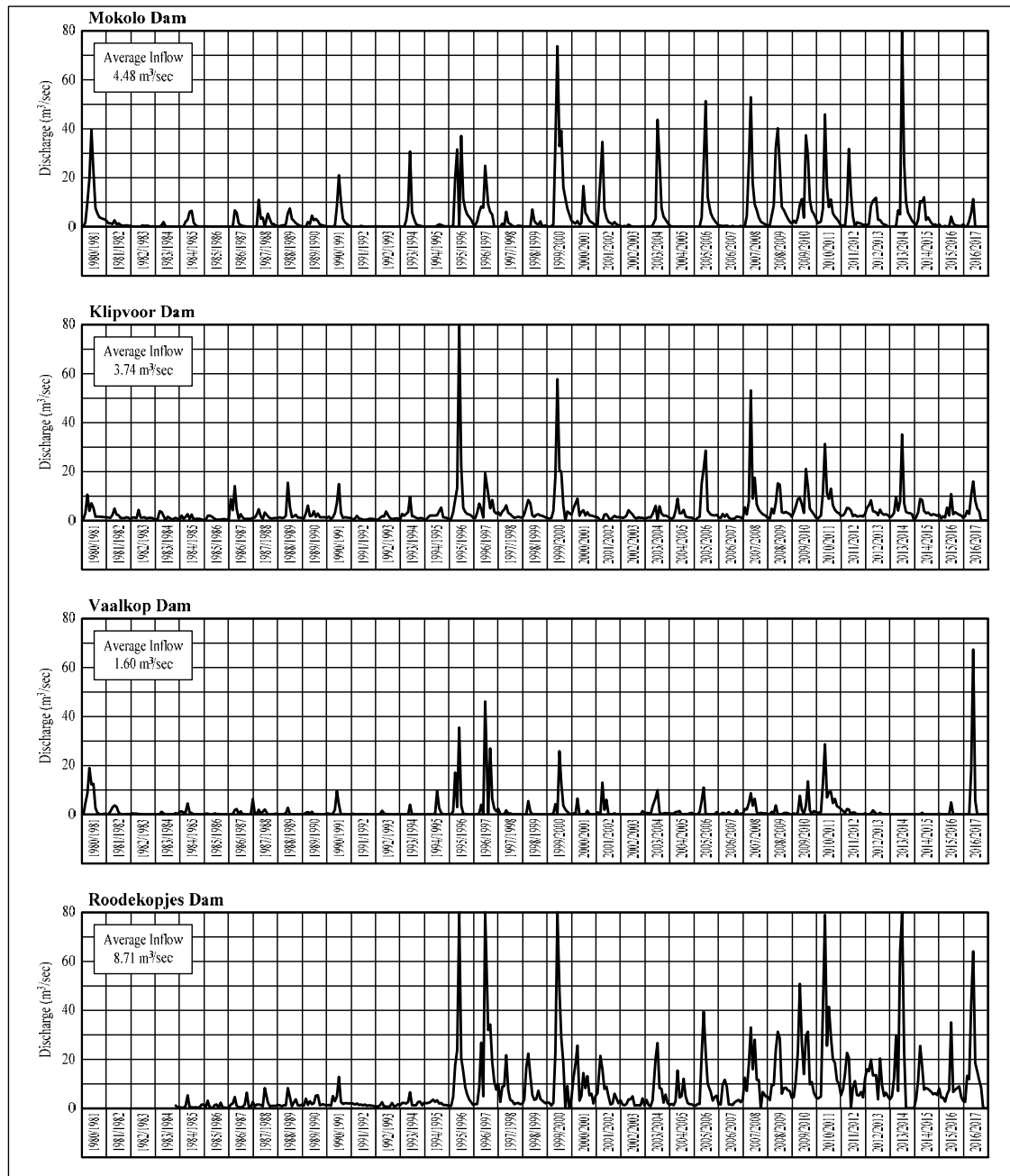
Vaalkop Dam													Unit : m ³ /sec
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	0.00	4.65	8.56	18.99	12.15	12.39	2.57	0.48	0.18	0.00	0.32	0.09	5.03
1981 /82	0.00	1.17	2.89	3.71	3.17	0.84	0.10	0.00	0.05	0.13	0.15	0.13	1.03
1982 /83	0.42	0.26	0.22	0.20	0.13	0.03	0.00	0.00	0.00	0.01	0.02	0.02	0.11
1983 /84	0.02	0.10	1.05	0.42	0.03	0.03	0.00	0.14	0.00	0.58	0.00	1.06	0.29
1984 /85	1.19	0.65	0.82	4.50	0.76	0.54	0.00	0.01	0.02	0.02	0.03	0.04	0.72
1985 /86	0.30	0.26	0.00	0.01	0.48	0.10	0.20	0.00	0.00	0.00	0.00	0.00	0.11
1986 /87	0.03	0.17	1.79	2.21	0.13	1.19	0.02	0.00	0.01	0.00	0.01	6.22	0.98
1987 /88	0.09	0.10	1.87	0.31	1.09	2.04	0.00	0.00	0.00	0.15	0.23	0.08	0.50
1988 /89	0.05	0.02	0.10	0.37	2.73	0.11	0.00	0.01	0.00	0.00	0.00	0.00	0.28
1989 /90	0.13	0.63	0.97	0.36	1.15	0.03	0.17	0.00	0.00	0.00	0.00	0.35	0.32
1990 /91	0.33	0.00	0.29	1.84	9.51	3.94	0.00	0.00	0.00	0.04	0.00	0.00	1.33
1991 /92	0.33	0.00	0.02	0.00	0.05	0.18	0.08	0.02	0.00	0.00	0.00	0.00	0.06
1992 /93	0.00	0.10	1.44	0.35	0.00	0.21	0.04	0.05	0.00	0.05	0.01	0.00	0.19
1993 /94	0.07	0.00	0.04	0.05	3.99	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.35
1994 /95	0.00	0.00	0.04	0.00	0.27	9.62	2.52	0.70	0.00	0.00	0.00	0.09	1.10
1995 /96	0.12	1.25	17.10	3.05	35.43	3.63	0.31	0.10	0.04	0.00	0.00	0.00	5.09
1996 /97	0.00	0.00	0.41	3.93	0.00	46.13	0.00	26.92	6.34	2.50	1.17	2.35	7.48
1997 /98	0.07	0.06	0.07	1.67	0.22	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.20
1998 /99	0.02	0.00	5.46	1.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56
1999 /00	0.00	0.00	0.44	4.23	0.00	25.83	12.52	3.49	2.04	1.15	0.31	0.00	4.17
2000 /01	0.42	0.00	6.44	0.00	0.00	0.00	0.00	1.48	0.00	0.00	0.00	0.06	0.70
2001 /02	0.80	0.00	12.93	1.92	5.92	0.00	0.03	0.12	0.42	0.00	0.00	0.00	1.84
2002 /03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	0.66	0.16
2003 /04	0.55	0.58	0.00	3.21	6.71	9.82	0.96	0.00	0.43	0.48	0.40	0.35	1.96
2004 /05	0.27	0.27	0.93	1.04	1.37	0.00	0.00	0.13	0.18	0.44	0.63	0.00	0.44
2005 /06	0.00	0.00	0.96	5.49	10.95	0.00	0.00	0.00	0.00	0.00	0.94	0.00	1.53
2006 /07	0.14	0.71	0.41	0.06	0.97	0.00	0.05	0.17	1.62	0.00	0.32	0.12	0.38
2007 /08	2.12	2.02	4.64	8.66	3.55	6.37	1.12	0.00	0.74	0.46	0.44	0.20	2.53
2008 /09	0.09	1.06	0.25	3.65	0.00	0.00	0.00	0.59	0.74	0.49	0.00	0.00	0.57
2009 /10	0.41	0.07	0.85	7.63	1.75	0.22	3.59	13.53	1.76	0.00	1.33	0.94	2.67
2010 /11	0.62	0.87	12.68	28.66	6.94	9.08	9.24	4.65	6.35	3.37	2.89	2.24	7.30
2011 /12	1.31	0.65	2.21	2.08	0.00	0.84	0.62	0.01	0.13	0.00	0.00	0.37	0.69
2012 /13	0.00	0.00	0.46	1.59	0.34	0.00	0.68	0.08	0.00	0.13	0.00	0.00	0.27
2013 /14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2014 /15	0.00	0.00	0.00	0.74	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.22	0.08
2015 /16	0.00	0.00	0.00	0.00	0.00	4.89	0.00	0.00	0.00	0.00	0.00	0.00	0.41
2016 /17	0.00	0.00	0.00	18.02	67.38	5.64	0.00	0.00	0.00	0.00	0.00	-	8.28
Average	0.27	0.42	2.33	3.52	4.79	3.89	0.94	1.42	0.57	0.27	0.28	0.43	1.60

Source: DWS

Table App. 8.1-4 Inflow Record into Reservoirs (4/4)

Roodekopjes Dam													Unit : m ³ /sec
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	-	-	-	-	-	-	-	-	-	-	-	-	-
1981 /82	-	-	-	-	-	-	-	-	-	-	-	-	-
1982 /83	-	-	-	-	-	-	-	-	-	-	-	-	-
1983 /84	-	-	-	-	-	-	-	-	-	1.15	0.23	0.44	0.60
1984 /85	0.25	0.19	1.01	5.24	0.38	0.48	0.25	0.40	0.32	0.35	1.52	1.53	0.99
1985 /86	0.33	3.14	0.42	0.19	1.30	1.50	0.18	2.30	0.30	0.22	0.15	0.20	0.85
1986 /87	1.54	1.91	4.63	1.01	0.35	0.47	0.53	1.47	6.38	0.63	0.59	2.58	1.84
1987 /88	0.85	1.46	1.46	1.32	0.85	8.28	2.44	0.86	0.93	1.01	0.99	1.42	1.82
1988 /89	1.29	0.82	1.24	1.29	8.23	4.65	0.86	2.33	3.69	1.25	1.14	1.52	2.36
1989 /90	1.15	3.97	1.37	2.82	1.63	2.09	5.11	5.34	1.29	1.62	1.37	1.20	2.42
1990 /91	1.36	0.95	4.99	2.81	4.93	12.79	2.53	1.83	2.00	2.01	1.94	2.00	3.35
1991 /92	1.88	1.53	1.94	1.30	1.51	1.24	1.45	1.00	1.22	1.10	0.93	0.88	1.33
1992 /93	0.62	1.26	2.46	0.71	0.74	0.61	0.83	2.11	0.85	1.02	1.59	1.22	1.17
1993 /94	2.12	2.13	1.88	2.52	6.47	1.20	1.20	1.25	2.63	2.75	1.20	2.36	2.31
1994 /95	1.99	2.22	2.47	3.58	2.59	3.22	1.88	2.21	1.35	1.37	1.17	0.97	2.08
1995 /96	1.01	4.60	17.56	23.68	124.18	20.62	15.00	8.57	5.68	3.63	2.43	1.32	19.02
1996 /97	1.61	1.81	8.73	26.81	4.90	100.55	31.92	34.28	18.75	10.96	7.59	9.82	21.48
1997 /98	2.63	8.77	9.07	21.65	7.48	3.37	2.97	1.57	1.98	2.23	1.65	1.75	5.43
1998 /99	3.55	16.51	22.28	13.36	5.40	3.39	3.82	7.18	3.78	3.15	2.07	2.35	7.24
1999 /00	2.31	1.09	2.15	23.18	183.25	48.12	28.75	18.40	0.00	9.09	0.00	3.93	26.69
2000 /01	12.37	17.96	25.53	3.13	5.06	14.31	8.29	13.10	5.25	5.91	1.93	4.95	9.82
2001 /02	6.06	21.45	15.96	7.80	8.78	4.82	1.56	1.84	5.90	3.99	2.05	3.26	6.96
2002 /03	1.50	1.24	1.77	3.71	3.62	4.90	1.06	1.20	1.24	1.07	4.02	1.08	2.20
2003 /04	3.33	1.34	0.75	3.26	20.50	26.72	8.27	7.82	2.27	5.59	2.18	1.33	6.95
2004 /05	1.72	1.28	2.79	15.36	4.27	5.01	11.99	4.82	2.12	1.65	1.58	1.04	4.47
2005 /06	0.94	1.81	1.81	21.58	39.55	22.89	9.97	6.60	3.15	4.61	5.09	1.57	9.96
2006 /07	1.53	9.68	11.69	8.97	1.51	1.48	1.38	2.47	2.98	3.40	2.40	3.64	4.26
2007 /08	12.50	6.98	17.87	33.00	15.99	27.96	11.71	11.49	0.00	6.65	4.81	4.58	12.80
2008 /09	3.31	9.58	9.49	23.86	31.23	28.58	5.91	8.25	8.40	7.26	7.05	4.17	12.26
2009 /10	4.56	11.43	22.93	50.92	26.72	13.90	29.64	31.20	9.76	10.75	6.41	4.67	18.57
2010 /11	3.93	4.71	41.17	78.95	25.59	41.41	29.51	20.00	18.54	11.38	9.84	5.25	24.19
2011 /12	7.73	14.06	22.60	20.63	0.00	8.56	11.16	5.42	5.14	6.67	4.48	12.24	9.89
2012 /13	16.00	15.11	19.89	13.43	13.59	3.61	20.26	9.35	4.95	6.37	4.77	3.71	10.92
2013 /14	4.97	12.21	29.73	7.07	63.83	108.56	23.27	0.00	0.00	0.00	0.00	0.00	20.80
2014 /15	3.81	11.36	25.38	17.09	7.59	8.28	7.87	6.76	5.73	6.16	5.40	8.11	9.46
2015 /16	4.32	4.31	2.67	5.66	7.57	35.03	6.65	7.59	8.23	8.95	4.58	2.96	8.21
2016 /17	2.57	13.31	11.86	42.89	64.06	18.35	14.96	11.37	8.46	0.00	0.00	-	17.08
Average	3.50	6.37	10.53	14.81	21.02	17.79	9.19	7.28	4.34	3.94	2.74	2.97	8.71

Source: DWS



Source: DWS

Figure App. 8.1-1 Inflow Record into Reservoirs

Appendix 8.2

Reservoir Water Level at Mokolo, Klipvoor, Vaalcap, and Roodekopjes Dams

Table APP. 8.2-1 Reservoir Water Level at 4 Dams (1/4)

Mokolo Dam													Unit : Elm
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	908.27	907.72	907.84	910.42	912.42	912.36	912.23	912.18	912.09	912.09	912.07	912.08	910.98
1981 /82	912.03	911.93	911.86	911.78	911.90	911.86	911.89	911.83	911.66	911.49	911.34	910.64	911.68
1982 /83	910.35	909.44	909.02	908.72	908.41	907.27	906.22	905.91	905.54	905.21	904.85	904.55	907.12
1983 /84	902.04	901.57	901.21	901.04	900.64	900.12	899.57	899.13	898.51	898.05	897.60	897.00	899.71
1984 /85	896.45	895.87	895.25	895.92	897.16	899.84	902.58	902.72	902.39	901.51	900.58	898.67	899.08
1985 /86	897.94	897.22	896.31	895.52	894.58	893.76	892.95	892.77	892.48	892.14	891.84	891.54	894.09
1986 /87	891.17	890.90	890.63	895.53	896.97	897.39	896.97	896.09	895.80	895.46	895.18	894.90	894.75
1987 /88	894.69	892.15	891.87	899.05	899.39	900.82	907.30	908.99	909.90	909.40	909.36	909.25	902.68
1988 /89	908.89	908.14	907.91	907.52	907.19	908.78	911.18	911.96	912.03	912.03	911.97	911.28	909.91
1989 /90	910.82	910.30	909.64	909.84	909.64	910.52	910.89	911.41	911.97	911.97	911.72	911.31	910.84
1990 /91	910.70	910.13	909.36	908.72	908.36	910.62	912.39	912.11	912.05	912.03	912.00	911.67	910.84
1991 /92	911.10	910.36	909.49	908.93	908.49	907.72	907.47	907.20	906.91	906.68	905.25	904.59	907.85
1992 /93	903.93	903.44	903.20	902.41	902.11	901.92	901.67	901.40	901.11	900.84	900.57	898.89	901.79
1993 /94	898.15	896.85	896.60	897.86	902.07	912.21	912.13	912.07	912.01	911.92	911.59	911.36	906.23
1994 /95	910.80	909.08	908.10	907.77	907.31	906.62	906.58	906.76	906.19	906.07	905.42	905.18	907.16
1995 /96	904.51	903.73	902.92	910.55	912.57	912.62	912.29	912.18	912.15	912.11	912.10	912.05	909.98
1996 /97	911.81	911.54	911.69	912.07	912.15	912.12	912.34	912.14	912.24	912.09	912.07	912.02	912.02
1997 /98	912.00	911.87	911.79	911.15	912.13	912.03	911.63	911.09	910.73	910.16	910.05	909.45	911.17
1998 /99	908.79	-	908.09	-	912.22	912.10	912.09	912.00	911.70	911.84	911.45	911.12	911.14
1999 /00	910.38	909.68	909.07	909.16	912.38	912.53	912.46	912.41	912.25	912.24	912.14	912.09	911.40
2000 /01	912.04	912.00	911.82	912.04	911.53	911.29	912.16	912.09	912.06	911.89	912.02	911.99	911.91
2001 /02	911.40	910.80	912.67	912.30	912.08	912.03	911.99	911.93	911.70	911.81	911.69	911.37	911.81
2002 /03	910.93	910.31	909.68	909.21	909.03	908.71	908.40	908.12	907.81	906.91	906.23	905.98	908.44
2003 /04	905.16	903.99	903.73	903.37	903.36	904.48	911.98	912.22	912.09	912.08	912.05	912.01	908.04
2004 /05	911.52	910.96	910.32	910.69	910.85	910.44	910.13	910.02	909.93	909.73	908.91	908.44	910.16
2005 /06	907.62	906.83	906.59	905.84	907.12	912.76	912.39	912.17	912.11	912.10	912.03	911.98	909.96
2006 /07	911.32	910.68	910.30	909.74	909.50	908.91	908.61	908.44	908.18	907.97	906.51	905.81	908.83
2007 /08	905.19	904.98	906.49	912.21	912.45	912.19	912.10	912.02	912.05	911.97	912.02	911.86	910.46
2008 /09	911.39	910.79	911.34	912.15	912.79	912.16	911.87	911.74	912.07	912.08	912.06	912.02	911.87
2009 /10	912.04	912.05	912.04	912.08	912.27	912.15	912.07	912.55	912.29	912.20	912.15	912.10	912.17
2010 /11	912.03	911.50	911.40	911.64	912.29	912.15	912.06	912.58	912.04	912.03	912.05	912.05	911.99
2011 /12	911.66	911.44	911.30	912.47	912.38	912.11	912.10	912.04	912.01	911.84	911.70	911.38	911.87
2012 /13	911.16	911.02	910.71	911.85	912.20	912.08	912.01	912.05	912.00	911.73	911.63	911.19	911.64
2013 /14	910.75	909.73	909.06	908.86	911.05	912.12	912.27	912.14	912.17	912.14	912.11	912.06	911.21
2014 /15	911.78	911.40	911.62	912.18	912.14	912.08	912.04	912.10	912.01	911.84	911.68	911.19	911.84
2015 /16	910.87	910.12	909.30	908.67	908.03	907.71	908.71	908.80	908.30	908.16	907.09	906.84	908.55
2016 /17	905.77	905.28	904.81	905.21	907.26	910.64	912.05	912.03	912.02	-	-	-	908.34
Average	907.77	907.11	906.89	907.62	908.23	908.84	909.35	909.33	909.20	908.94	908.64	908.27	908.35

Source: DWS

Table APP. 8.2-2 Reservoir Water Level at 4 Dams (2/4)

Klipoor Dam													Unit : ELM
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	986.99	985.63	986.71	989.11	989.22	989.19	989.12	989.14	989.12	989.13	988.85	988.23	988.37
1981 /82	987.42	986.18	985.80	986.62	988.46	988.51	988.44	988.55	988.66	988.40	987.82	986.67	987.63
1982 /83	984.28	983.12	983.35	982.36	983.97	980.99	980.15	981.45	982.12	983.00	983.72	984.16	982.72
1983 /84	981.06	980.25	983.65	985.30	983.23	978.99	981.07	982.03	982.33	982.86	983.73	983.94	982.37
1984 /85	979.57	981.98	981.14	981.16	981.90	980.27	982.50	982.67	983.22	983.51	983.95	982.54	982.03
1985 /86	978.82	978.24	979.01	981.71	982.81	979.05	979.29	979.77	980.16	980.84	981.45	981.82	980.25
1986 /87	981.90	987.65	987.85	989.37	988.98	988.04	987.56	987.61	987.69	987.82	987.99	987.01	987.46
1987 /88	985.88	984.46	984.67	986.49	985.90	984.42	986.01	986.82	987.16	987.28	987.39	987.19	986.14
1988 /89	986.45	985.99	985.43	985.11	984.41	989.34	989.15	989.12	989.10	989.11	988.99	988.60	987.57
1989 /90	987.71	986.93	987.82	989.13	988.53	988.52	989.11	989.15	989.11	989.05	989.11	988.87	988.59
1990 /91	988.01	987.50	986.56	986.00	986.53	988.92	989.23	989.11	989.10	989.10	989.09	988.92	988.17
1991 /92	988.13	987.17	986.84	987.21	986.14	984.39	983.61	983.48	983.59	983.86	984.14	983.98	985.21
1992 /93	982.80	981.91	982.67	983.90	983.00	984.05	984.02	984.34	984.52	984.88	985.17	984.72	983.83
1993 /94	981.36	982.55	982.87	983.67	984.51	988.69	988.41	988.53	988.67	988.22	987.79	987.12	986.03
1994 /95	985.14	982.96	983.25	983.28	983.16	981.24	981.41	984.66	987.47	987.61	987.30	986.58	984.50
1995 /96	984.43	982.81	985.08	988.81	989.43	989.44	989.16	989.14	989.14	989.13	989.14	989.00	987.89
1996 /97	988.28	987.52	988.25	989.08	989.11	988.20	989.20	989.15	989.30	989.15	989.15	989.13	988.79
1997 /98	989.12	988.68	989.08	988.94	989.06	988.80	988.46	988.62	988.80	988.86	988.87	988.59	988.83
1998 /99	987.79	987.84	989.17	989.22	989.03	988.27	987.73	988.22	989.01	989.12	989.11	988.93	988.62
1999 /00	988.00	987.10	986.93	988.26	989.21	989.26	989.30	989.17	989.15	989.15	989.14	989.11	988.65
2000 /01	989.07	989.26	989.16	989.11	988.69	988.62	989.12	989.07	989.10	989.10	989.10	988.89	989.02
2001 /02	988.25	987.81	989.21	989.12	988.86	988.66	988.47	988.62	988.88	989.08	989.09	988.90	988.75
2002 /03	988.39	987.59	987.21	987.09	987.57	987.60	987.20	987.47	987.65	987.07	986.83	985.81	987.29
2003 /04	984.17	982.78	983.77	982.22	984.23	986.03	989.17	989.13	989.10	989.11	989.10	988.79	986.46
2004 /05	987.79	986.29	986.19	987.04	989.18	988.67	988.64	989.11	989.09	989.05	988.75	987.91	988.14
2005 /06	985.85	983.84	983.72	983.67	989.27	989.39	989.14	989.11	989.10	989.09	989.09	988.87	987.51
2006 /07	988.05	987.03	987.78	987.34	987.74	987.17	986.06	986.09	986.33	986.31	986.60	985.91	986.87
2007 /08	984.55	987.25	987.44	988.97	989.40	989.05	989.19	989.08	989.10	989.07	989.10	988.86	988.42
2008 /09	987.96	987.23	988.90	989.03	989.14	989.23	989.16	989.08	989.11	989.11	989.13	989.04	988.84
2009 /10	988.60	988.87	989.11	989.13	989.20	989.03	989.00	989.32	989.12	989.12	989.11	988.96	989.05
2010 /11	988.13	987.12	987.49	989.15	989.33	989.11	989.28	989.19	989.10	989.12	989.09	989.06	988.76
2011 /12	988.60	988.23	988.75	989.16	989.12	989.09	988.78	989.10	989.10	989.11	989.10	988.96	988.93
2012 /13	988.74	989.15	989.23	989.17	989.07	988.96	988.87	989.14	989.12	989.12	989.11	988.83	989.04
2013 /14	987.81	987.13	987.38	989.17	989.04	989.17	989.18	989.09	989.10	989.10	989.10	989.04	988.69
2014 /15	988.28	987.41	987.83	989.20	989.13	989.01	989.12	989.11	989.09	989.11	989.06	988.80	988.76
2015 /16	988.48	987.34	986.95	985.62	986.90	985.97	989.09	989.10	989.14	989.14	989.12	988.91	987.98
2016 /17	988.00	987.58	987.78	987.57	987.26	987.40	989.12	989.11	989.10	989.12	989.11	-	988.65
Average	986.32	985.90	986.32	986.93	987.34	989.10	987.34	987.59	987.78	987.84	987.88	987.52	987.15

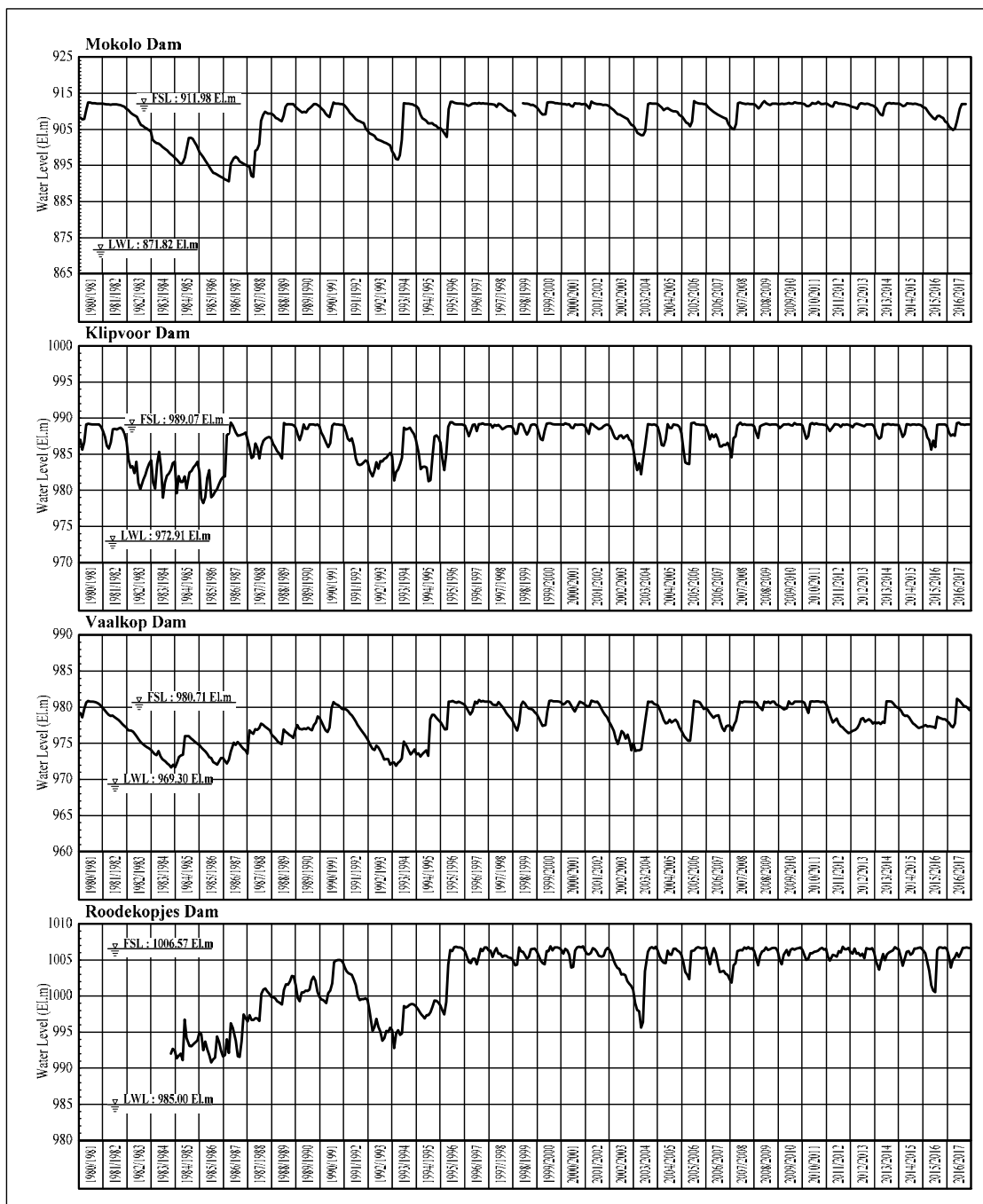
Table APP. 8.2-3 Reservoir Water Level at 4 Dams (3/4)

Vaalkop Dam													Unit : El.m
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	979.17	978.56	979.73	980.64	980.85	980.78	980.76	980.72	980.61	980.46	980.23	979.91	980.20
1981 /82	979.55	979.22	978.93	978.77	978.82	978.64	978.43	978.24	977.98	977.66	977.44	977.17	978.40
1982 /83	976.84	976.74	976.59	976.27	975.93	975.51	975.16	974.91	974.68	974.50	974.32	974.11	975.46
1983 /84	973.83	973.53	973.35	973.93	973.21	972.80	972.53	972.21	972.02	971.66	972.05	971.69	972.73
1984 /85	972.37	973.13	973.32	973.44	976.03	976.02	976.02	975.72	975.48	975.26	975.03	974.71	974.71
1985 /86	974.37	974.14	973.86	973.50	973.08	972.96	972.42	972.27	972.04	972.49	972.96	972.98	973.09
1986 /87	972.57	972.21	972.71	973.85	975.10	974.78	975.18	974.87	974.54	974.22	974.01	973.58	973.97
1987 /88	976.84	976.52	976.32	976.97	976.86	977.10	977.73	977.56	977.31	977.04	976.84	976.17	976.94
1988 /89	975.89	975.60	975.26	975.03	974.87	976.90	976.63	976.40	976.16	976.00	975.74	976.76	975.94
1989 /90	977.54	977.04	976.89	977.05	976.95	977.18	976.94	976.81	977.50	977.89	978.74	978.49	977.42
1990 /91	977.95	977.32	976.83	976.58	977.15	979.85	980.73	980.48	980.24	980.02	979.77	979.75	978.89
1991 /92	979.71	979.44	979.10	978.82	978.42	977.96	977.48	977.09	976.70	976.35	975.97	975.55	977.72
1992 /93	974.94	974.23	974.05	974.69	974.43	973.94	973.37	972.76	972.79	972.80	972.05	972.28	973.53
1993 /94	972.37	971.90	972.32	972.52	972.92	975.23	974.58	974.02	973.49	973.78	974.16	973.46	973.40
1994 /95	973.61	973.17	973.53	973.80	974.03	973.29	978.35	978.96	978.95	978.61	978.28	977.90	976.04
1995 /96	977.41	976.90	976.95	980.75	980.76	980.86	980.69	980.60	980.76	980.65	980.53	980.38	979.77
1996 /97	979.95	979.45	978.99	979.38	980.74	980.52	981.02	980.77	980.87	980.77	980.77	980.76	980.33
1997 /98	980.69	980.34	980.33	980.24	980.74	980.37	980.04	979.65	979.22	978.84	978.40	977.86	979.73
1998 /99	977.26	976.74	977.84	980.31	980.76	980.49	980.04	979.82	979.75	979.63	979.31	979.02	979.25
1999 /00	978.54	977.97	977.43	977.51	979.46	980.86	980.90	980.80	980.82	980.79	980.79	980.64	979.71
2000 /01	980.38	980.51	980.82	980.75	980.30	979.80	979.37	979.95	980.78	980.67	980.50	980.26	980.34
2001 /02	980.12	980.08	980.94	980.82	980.73	980.75	980.43	979.86	979.32	978.97	978.63	978.05	979.89
2002 /03	977.53	976.73	975.60	974.87	975.80	976.73	976.42	975.63	976.21	975.32	974.04	974.99	975.82
2003 /04	973.93	974.02	974.02	974.16	976.10	978.07	980.76	980.70	980.75	980.47	980.36	980.24	977.80
2004 /05	979.66	979.00	978.22	977.79	977.82	978.30	977.89	978.07	978.30	977.92	977.22	976.52	978.06
2005 /06	975.94	975.63	975.34	975.34	977.99	980.92	980.78	980.75	980.68	980.23	979.76	979.86	978.60
2006 /07	979.66	979.18	978.83	978.54	978.77	978.88	977.91	977.10	976.69	977.36	977.46	977.35	978.14
2007 /08	976.78	977.58	978.14	979.45	980.78	980.62	980.78	980.77	980.70	980.77	980.73	980.73	979.82
2008 /09	980.60	980.07	979.90	979.59	980.79	980.62	980.76	980.54	980.75	980.75	980.34	980.25	980.41
2009 /10	980.12	979.89	979.68	979.86	980.82	980.45	980.48	980.79	980.78	980.78	980.77	980.77	980.43
2010 /11	980.62	979.86	979.19	980.75	980.83	980.77	980.81	980.83	980.72	980.75	980.68	980.15	980.50
2011 /12	979.42	978.61	977.86	978.19	978.44	977.80	977.37	977.21	976.91	976.68	976.41	976.50	977.62
2012 /13	976.73	976.85	977.10	977.64	978.40	978.50	977.98	978.18	978.31	978.11	977.72	977.91	977.79
2013 /14	977.78	977.85	977.67	977.99	977.81	980.83	980.83	980.77	980.50	980.15	979.97	979.81	979.33
2014 /15	979.48	979.00	978.80	978.86	978.61	978.18	977.78	977.57	977.33	977.13	977.22	977.31	978.10
2015 /16	977.53	977.34	977.38	977.34	977.29	977.14	978.67	978.53	978.42	978.31	978.35	978.10	977.87
2016 /17	977.83	977.42	977.22	977.75	981.18	980.89	980.53	980.17	980.10	979.91	979.62	-	979.33
Average	977.45	977.13	977.05	977.40	977.93	978.25	978.34	978.16	978.08	977.94	977.76	977.55	977.75

Source: DWS

Table APP. 8.2-4 Reservoir Water Level at 4 Dams (4/4)

Roodekopjes Dam													Unit : El.m
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	-	-	-	-	-	-	-	-	-	-	-	-	-
1981 /82	-	-	-	-	-	-	-	-	-	-	-	-	-
1982 /83	-	-	-	-	-	-	-	-	-	-	-	-	-
1983 /84	-	-	-	-	-	-	-	-	-	992.00	992.70	992.45	992.38
1984 /85	991.39	991.75	992.01	991.09	996.74	994.19	993.08	993.02	993.36	993.58	993.85	994.96	993.25
1985 /86	994.70	992.50	993.69	992.64	991.84	990.83	991.19	991.45	994.41	993.63	992.45	991.64	992.58
1986 /87	991.81	994.01	992.12	996.22	995.57	993.79	991.67	991.55	993.74	997.44	996.96	996.49	994.28
1987 /88	997.34	996.69	996.67	996.95	996.90	996.57	1000.32	1000.93	1001.04	1000.66	1000.34	999.88	998.69
1988 /89	999.84	999.68	999.30	999.15	998.82	1000.85	1001.63	1001.57	1002.02	1002.79	1002.75	1001.50	1000.82
1989 /90	999.73	999.26	1000.49	1000.51	1000.75	1000.72	1000.93	1002.17	1002.68	1002.14	1000.60	999.88	1000.82
1990 /91	999.51	999.46	999.05	1000.40	1000.77	1001.77	1004.69	1004.90	1004.96	1005.00	1004.80	1004.26	1002.46
1991 /92	1003.62	1003.26	1003.10	1002.92	1002.29	1001.52	999.98	999.46	999.57	999.61	999.68	999.43	1001.20
1992 /93	997.90	995.15	995.67	996.83	995.74	995.09	993.82	994.18	995.18	995.03	995.65	995.25	995.46
1993 /94	992.79	994.83	995.26	994.63	994.84	998.61	998.43	998.58	998.82	998.88	998.84	998.61	996.93
1994 /95	998.02	997.57	997.23	996.89	997.34	997.34	997.75	998.54	999.40	999.35	999.10	998.67	998.10
1995 /96	998.03	997.46	999.17	1004.35	1006.39	1006.25	1006.78	1006.86	1006.73	1006.75	1006.62	1006.18	1004.30
1996 /97	1005.41	1004.72	1004.56	1005.15	1005.15	1004.39	1005.47	1006.56	1006.23	1006.76	1006.72	1006.33	1005.62
1997 /98	1006.28	1005.40	1006.20	1006.62	1005.86	1005.86	1005.41	1005.61	1005.55	1005.36	1005.25	1004.85	1005.69
1998 /99	1004.26	1004.38	1006.74	1006.19	1006.14	1005.69	1005.17	1005.48	1006.49	1006.55	1006.60	1006.20	1005.82
1999 /00	1005.61	1004.91	1004.56	1004.40	1006.22	1006.22	1006.90	1006.34	1006.74	1006.75	1006.62	1006.41	1005.97
2000 /01	1005.89	1006.53	1006.32	1005.70	1003.95	1004.05	1006.28	1006.74	1006.83	1006.75	1006.87	1006.26	1006.01
2001 /02	1005.81	1005.77	1005.99	1006.63	1006.49	1006.14	1005.56	1005.46	1005.59	1006.38	1006.69	1006.37	1006.07
2002 /03	1005.80	1004.95	1004.37	1003.89	1003.73	1003.00	1003.02	1002.87	1002.07	1001.71	1001.41	1000.87	1003.14
2003 /04	999.04	998.05	997.89	995.62	996.38	1003.44	1006.12	1006.62	1006.78	1006.59	1006.82	1006.30	1002.47
2004 /05	1005.48	1004.91	1004.58	1004.58	1006.30	1005.77	1005.74	1006.55	1006.57	1006.28	1006.13	1005.69	1005.72
2005 /06	1004.70	1003.34	1002.93	1002.30	1006.23	1006.35	1006.64	1006.79	1006.66	1006.57	1006.69	1006.74	1005.49
2006 /07	1005.58	1004.38	1005.73	1006.65	1005.92	1004.49	1003.32	1003.38	1003.47	1003.08	1002.96	1002.35	1004.28
2007 /08	1001.87	1004.24	1004.58	1006.25	1006.39	1006.35	1006.73	1006.54	1006.81	1006.53	1006.62	1006.21	1005.76
2008 /09	1005.27	1004.27	1005.63	1006.16	1006.26	1006.72	1006.40	1006.49	1006.66	1006.67	1006.64	1006.19	1006.11
2009 /10	1005.01	1004.40	1005.72	1006.36	1005.61	1006.37	1006.57	1006.44	1006.57	1006.63	1006.73	1006.37	1006.06
2010 /11	1005.73	1005.04	1005.16	1005.94	1005.91	1006.11	1006.19	1006.28	1006.54	1006.68	1006.41	1006.55	1006.04
2011 /12	1005.40	1004.91	1005.73	1005.62	1005.45	1006.22	1006.04	1006.83	1006.50	1006.47	1006.68	1006.06	1005.99
2012 /13	1005.90	1006.60	1005.87	1005.96	1005.56	1005.87	1005.20	1006.66	1006.53	1006.47	1006.61	1006.01	1006.10
2013 /14	1004.75	1003.62	1004.84	1005.82	1004.96	1005.76	1006.04	1006.20	1006.34	1006.77	1006.57	1006.48	1005.68
2014 /15	1005.43	1004.20	1005.16	1006.13	1006.22	1005.73	1005.92	1006.58	1006.60	1006.69	1006.71	1006.28	1005.97
2015 /16	1005.92	1004.69	1003.47	1001.49	1000.76	1000.53	1006.37	1006.72	1006.72	1006.66	1006.75	1006.46	1004.71
2016 /17	1005.45	1003.97	1004.99	1005.37	1005.99	1005.41	1005.97	1006.67	1006.67	1006.76	1006.61	-	1005.81
Average	1002.10	1001.66	1001.96	1002.28	1002.53	1002.67	1003.07	1003.36	1003.66	1003.41	1003.34	1002.85	1002.74



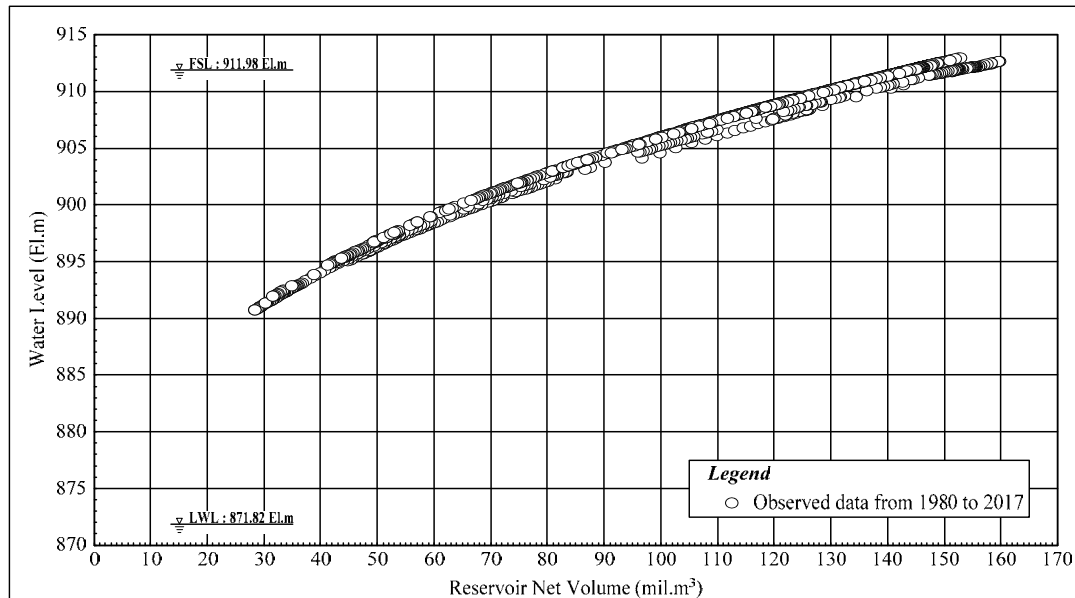
Source: DWS

Figure App. 8.2-1 Reservoir Water Level Record at 4 Dams

Appendix 8.3 Reservoir Height – Volume (H-V) Curves

1) Mokolo Dam

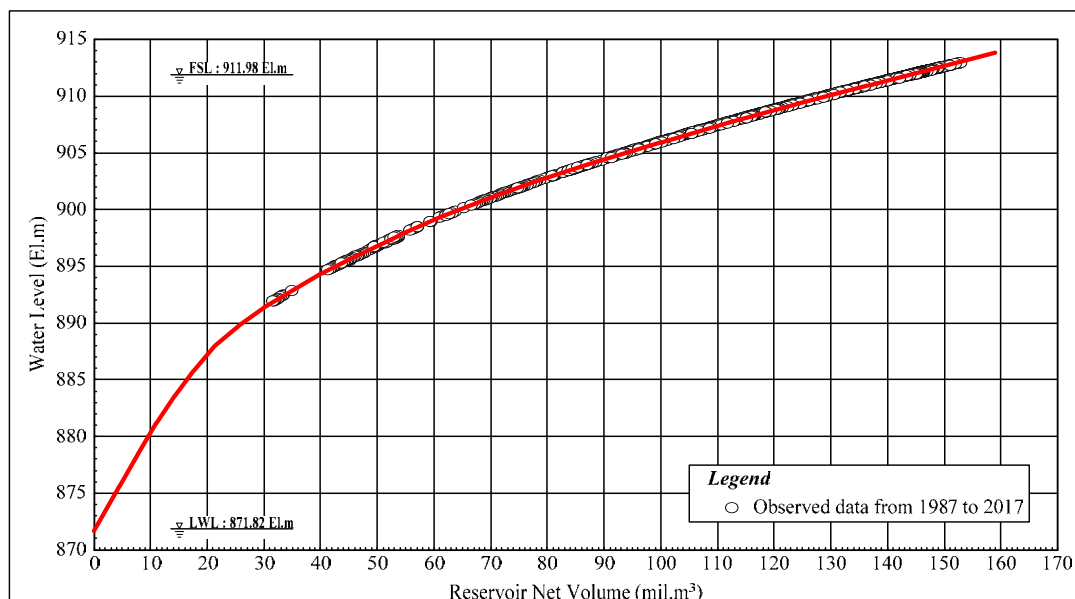
Observation reservoir water level and reservoir volume data of Mokolo dam was observed from April 1980 to September 2017 at weekly interval. Figure App. 8.3-1 shows all data of observed reservoir water level and reservoir volume.



Source: DWS

Figure App. 8.3-1 Relationship between Water Level vs Net Volume of Mokolo Reservoir
(Data Period: 1980 to 2017)

Reservoir storage volume was decreases year by year due to sediment inflow into reservoir. Figure App. 8.3-1 shows 2 trends in reservoir water level and reservoir storage volume. Figure App. 8.3-2 shows plot of the data after 1987, when the tendency of reservoir water level and reservoir storage volume becomes one.



Source: JST

Figure App. 8.3-2 H-V Curve of Mokolo Reservoir

Relationship between reservoir water level and reservoir volume is compatible, H-V curve of Mokolo

reservoir adopts Figure App. 8.3-2 and Table App. 8.3-1.

Table App. 8.3-1 H-V Curve of Mokolo Reservoir

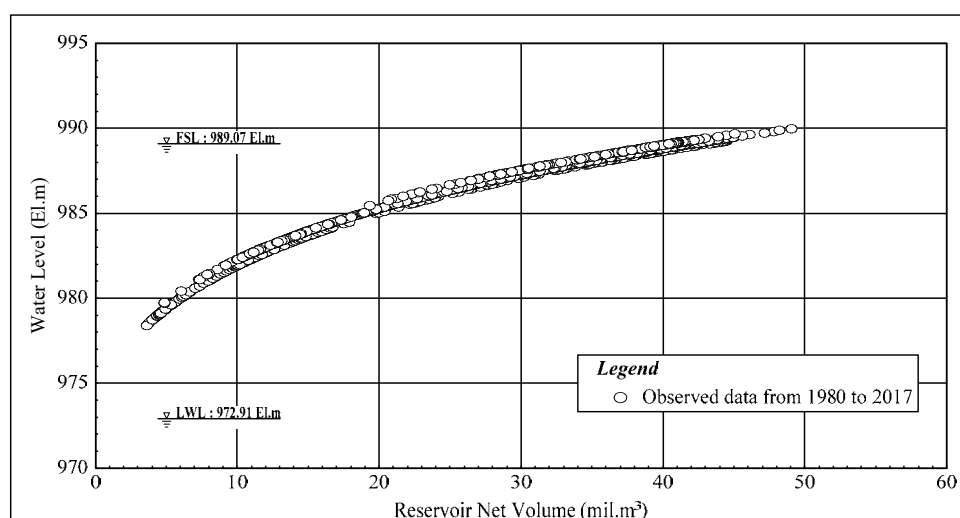
Water Level (El.m)	Net Reservoir Volume (mil.m ³)	Note
871.82	0.0	Low Water Level
875.00	4.0	
880.00	9.5	
885.00	16.5	
890.00	26.0	
895.00	42.5	
900.00	65.0	
905.00	94.0	
910.00	129.5	
911.98	145.8	Full Supply Level

Source: JST

Note: Net Reservoir Volume; reservoir volume between FSL and LWL.

2) Klipvoor Dam

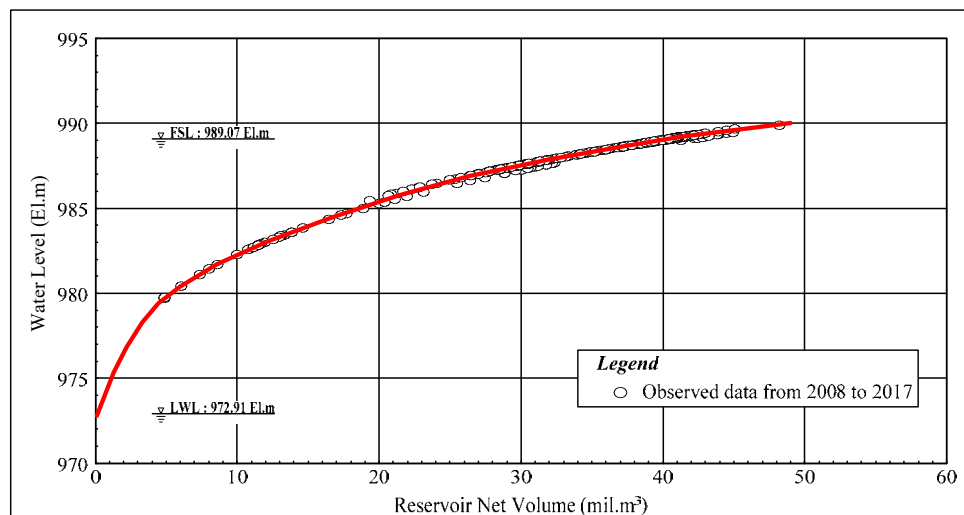
Observation reservoir water level and reservoir volume data of Klipvoor dam was observed from January 1980 to September 2017 at weekly interval. Figure App. 8.3-3 shows all data of observed reservoir water level and reservoir volume.



Source: DWS

Figure App. 8.3-3 Relationship between Water Level vs Net Volume of Klipvoor Reservoir (Data Period: 1980 to 2017)

The relationship between reservoir water level and reservoir volume is different in the past and recent years due to sedimentation as well as Mokolo dam. Figure App. 8.3-4 shows plot of the data after 2008, when the tendency of reservoir water level and reservoir storage volume becomes one.



Source: JST

Figure App. 8.3-4 H-V Curve of Klipvoor Reservoir

Relationship between reservoir water level and reservoir volume is compatible, H-V curve of Klipvoor reservoir adopts Figure App. 8.3-4 and Table App. 8.3-2.

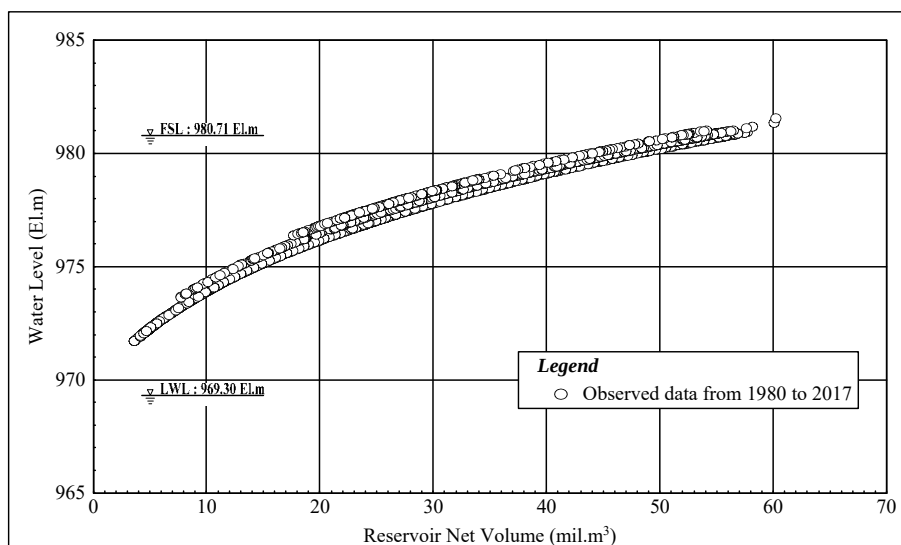
Table App. 8.3-2 H-V Curve of Klipvoor Reservoir

Water Level (El.m)	Net Reservoir Volume (mil.m ³)	Note
972.91	0.0	Low Water Level
975.00	1.1	
977.50	2.7	
980.00	5.3	
982.50	10.7	
985.00	18.4	
987.50	29.8	
989.07	40.7	Full Supply Level

Source: JST

3) Vaalkop Dam

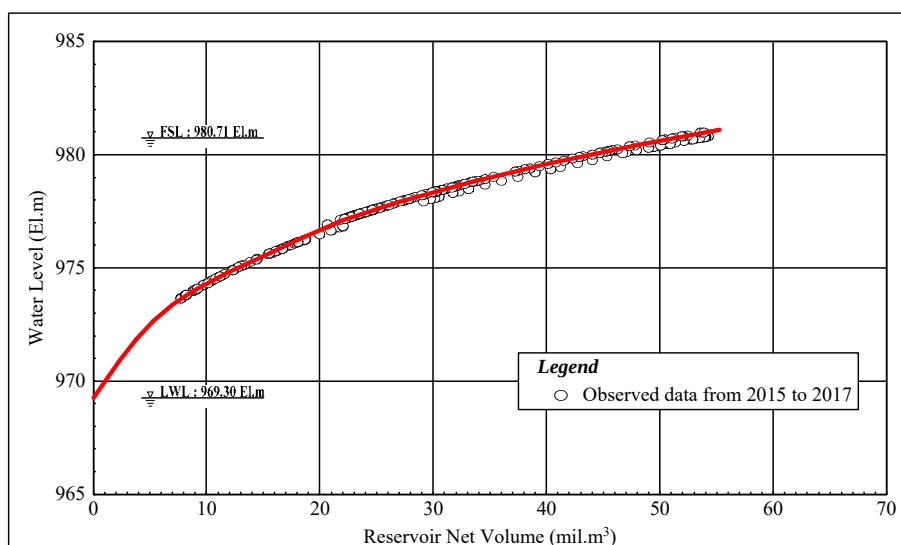
Observation reservoir water level and reservoir volume data of Vaalkop dam was observed from January 1980 to September 2017 at weekly interval. Figure App. 8.3-5 shows all data of observed reservoir water level and reservoir volume.



Source: DWS

Figure App. 8.3-5 Relationship between Water Level vs Net Volume of Vaalkop Reservoir (Data Period: 1980 to 2017)

The relationship between reservoir water level and reservoir volume is different in the past and recent years due to sedimentation as well as Mokolo and Klipvoor dams. Figure App. 8.3-6 shows plot of the data after 2015, when the tendency of reservoir water level and reservoir storage volume becomes one.



Source: JST

Figure App. 8.3-6 H-V Curve of Vaalkop Reservoir

Relationship between reservoir water level and reservoir volume is compatible, H-V curve of Vaalkop reservoir adopts Figure App. 8.3-6 and Table App. 8.3-3.

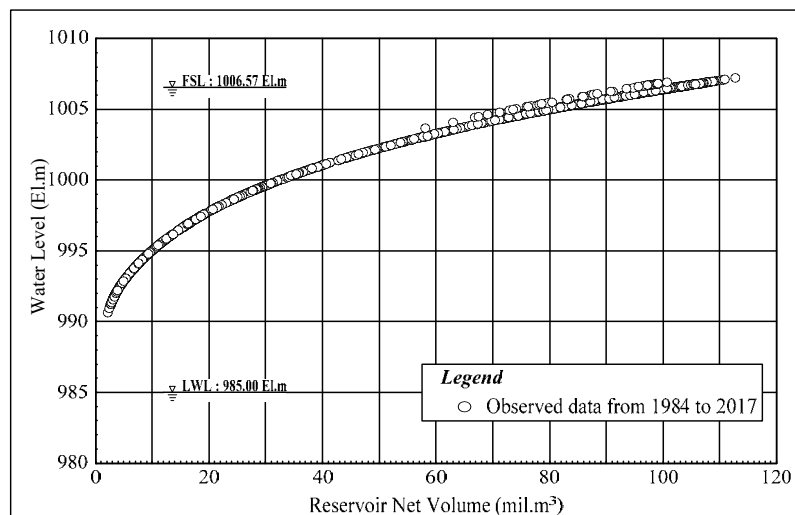
Table App. 8.3-3 H-V Curve of Vaalkop Reservoir

Water Level (El.m)	Net Reservoir Volume (mil.m ³)	Note
969.30	0.0	Low Water Level
970.00	1.0	
972.50	5.0	
975.00	12.7	
977.50	24.2	
980.00	44.0	
980.71	51.3	Full Supply Level

Source: JST

4) Roodekopjes Dam

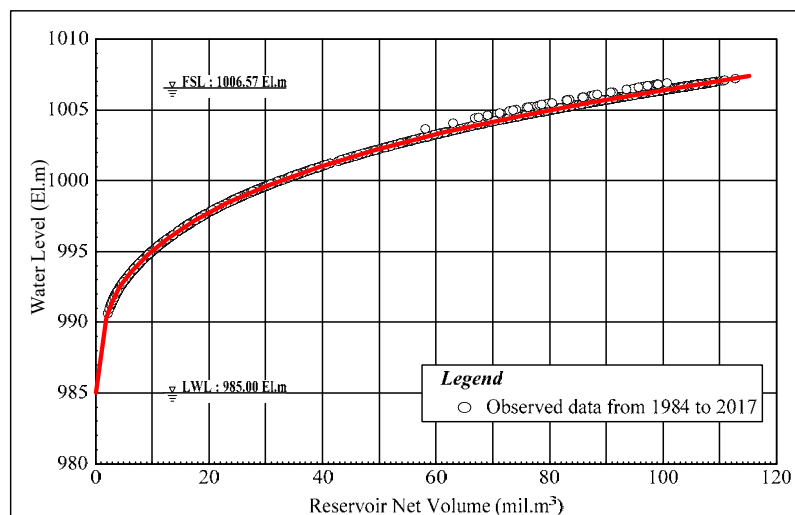
Observation reservoir water level and reservoir volume data of Roodekopjes dam was observed from June 1984 to September 2017 at weekly interval. Figure App. 8.3-7 shows all data of observed reservoir water level and reservoir volume.



Source: DWS

Figure App. 8.3-7 Relationship between Water Level vs Net Volume of Roodekopjes Reservoir (Data Period: 1984 to 2017)

The observation data of Roodekopjes dam is different from other dams, and the relationship between reservoir water level and reservoir volume is compatible. Therefore, H-V curve of Roodekopjes reservoir adopts Figure App. 8.3-8 and Table App. 8.3-4 without rejecting data.



Source: JST

Figure App. 8.3-8 H-V Curve of Roodekopjes Reservoir

Table App. 8.3-4 H-V Curve of Roodekopjes Reservoir

Water Level (El.m)	Net Reservoir Volume (mil.m ³)	Note
985.00	0.0	Low Water Level
987.50	1.0	
990.00	2.0	
992.50	4.2	
995.00	10.0	
997.50	19.0	
1000.00	33.0	
1002.50	52.2	
1005.00	80.2	
1006.57	96.4	Full Supply Level

Source: JST

Appendix 8.4

Discharge of Remain Basin

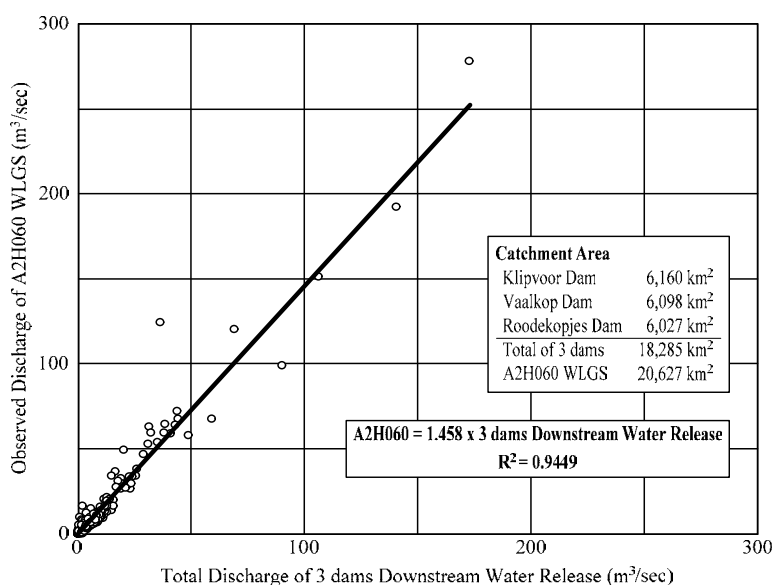
The discharge of remain basin is calculated from the relation between the downstream water release record of Klipvoor, Vaalkop, Roodekopjes dams and discharge of downstream water level gauging station (WLGS), and catchment area ratio. A2H060 WLGS managed by DWS is located downstream of 3 dams, which is close to intake site of MCWAP Phase 2 in Thabazimbi. The catchment area of above key points as shown in Table App. 8.4-1.

Table App. 8.4-1 Catchment Area of Key Points for Discharge of Remain Basin

No.	Location	Catchment Area (km ²)
1	Klipvoor Dam	6,160
2	Vaalkop Dam	6,098
3	Roodekopjes Dam	6,027
	Total of 3 dams	18,285
4	A2H060 WLGS	20,627
5	Thabazimbi (proposed MCWAP Phase 2 intake site)	23,762

Source: JST

The total of downstream water release records of 3 dams and the discharge record of A2H060 WLGS are correlated as shown in Figure App. 8.4-1 ($R^2=0.9449$).



Source: JST

Figure App. 8.4-1 Correlation of 3 dams Downstream Water Release and Discharge of A2H060 WLGS

The missing discharge data of A2H060 is interpolated by the correlation formula with downstream water release records of 3 dams as follows.

$$\text{Discharge of A2H060 (m}^3\text{/sec)} = 1.458 \times \text{Downstream Water Release Record of 3 Dams (m}^3\text{/sec)}$$

Table App. 8.4-2 shows the estimated monthly mean discharge of A2H060 WLGS after interpolation of missing data.

Table App. 8.4-2 Estimated Monthly Mean Discharge at A2H060 WLGS

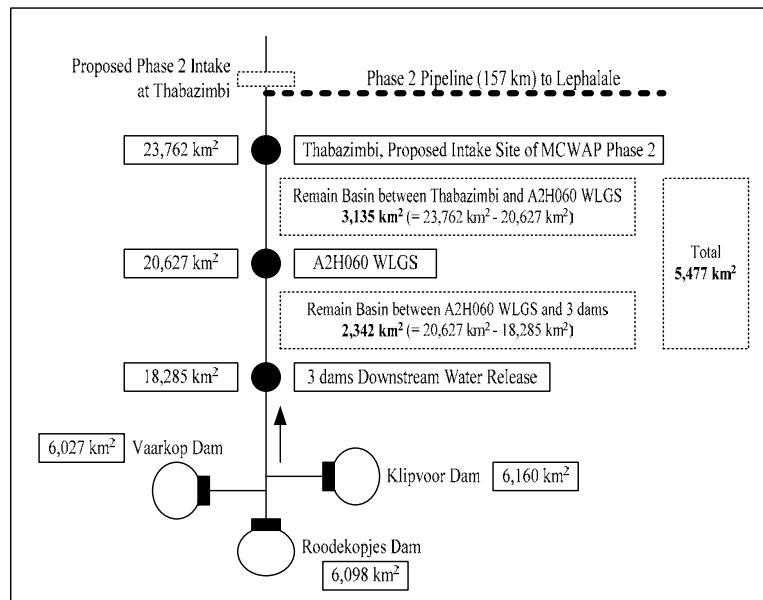
Year	Unit : m ³ /sec												Mean
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
1984 /85	1.32	1.02	2.00	2.09	2.88	1.30	0.00	0.00	0.00	0.00	1.00	3.41	1.25
1985 /86	0.29	1.79	0.49	0.01	3.87	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.56
1986 /87	0.34	4.49	9.55	7.69	4.25	4.19	0.71	0.46	0.07	0.02	2.66	3.39	3.15
1987 /88	3.26	3.07	3.83	3.36	3.27	1.98	0.30	0.05	1.25	1.28	2.01	2.69	2.19
1988 /89	2.62	1.84	2.29	3.30	4.88	7.34	1.46	1.78	2.77	1.78	2.21	4.68	3.08
1989 /90	3.23	2.20	3.84	4.09	2.63	2.87	1.77	3.28	1.59	2.62	2.99	3.41	2.88
1990 /91	3.70	3.02	3.70	3.65	3.34	15.79	4.93	1.54	1.97	3.03	3.04	4.19	4.32
1991 /92	4.44	2.54	3.03	3.96	4.76	4.29	1.48	0.30	0.13	0.33	0.40	3.65	2.44
1992 /93	3.17	2.21	1.62	2.83	3.27	2.60	0.84	0.13	0.05	0.01	0.74	4.01	1.79
1993 /94	2.24	1.83	1.84	3.58	4.89	2.31	0.86	0.52	1.74	2.18	2.32	3.78	2.34
1994 /95	3.57	1.28	2.42	2.69	3.89	3.32	0.84	1.34	1.24	2.40	2.64	3.91	2.46
1995 /96	2.95	1.55	8.89	36.14	233.42	49.22	19.29	11.22	7.31	5.61	5.26	6.01	32.24
1996 /97	5.71	4.11	7.14	33.91	9.45	192.27	58.43	90.90	31.11	19.00	14.72	17.22	40.33
1997 /98	11.21	5.32	9.15	36.11	11.60	7.67	3.01	1.41	2.64	2.86	3.76	5.15	8.32
1998 /99	4.74	6.21	33.89	20.21	9.72	7.22	2.67	1.32	2.98	3.12	3.65	6.24	8.50
1999 /00	5.82	3.00	3.61	17.72	24.22	119.85	67.32	26.94	18.53	13.23	9.13	6.43	26.32
2000 /01	12.72	25.01	51.32	11.89	6.62	5.63	4.67	14.79	7.60	6.68	7.21	10.30	13.70
2001 /02	10.24	44.17	36.67	14.44	23.62	29.22	4.98	3.40	4.00	4.70	7.43	9.75	16.05
2002 /03	9.89	4.30	4.05	5.16	5.96	3.93	0.45	0.01	0.64	0.54	3.54	5.25	3.64
2003 /04	4.20	0.23	2.60	0.54	1.01	33.65	14.48	7.89	4.24	4.05	4.38	6.04	6.94
2004 /05	5.75	2.47	4.17	8.33	8.28	7.73	8.75	4.87	6.53	3.18	4.96	6.84	5.99
2005 /06	5.54	5.30	3.19	12.08	64.37	67.70	16.83	8.82	5.11	5.40	5.28	6.59	17.18
2006 /07	6.99	3.54	5.94	9.06	6.19	5.64	1.15	0.35	2.68	1.39	2.87	4.85	4.22
2007 /08	3.30	4.72	12.25	124.19	32.26	62.78	20.92	13.43	11.71	6.95	6.66	7.44	25.55
2008 /09	7.31	4.69	6.53	30.60	52.68	53.54	9.63	6.99	9.77	9.71	9.66	8.90	17.50
2009 /10	8.12	8.35	29.29	67.21	33.32	13.86	59.00	63.95	15.52	12.67	8.47	7.48	27.27
2010 /11	8.28	5.66	71.87	150.81	46.30	57.58	59.34	33.30	28.67	19.45	13.50	13.27	42.34
2011 /12	12.20	11.08	26.35	28.35	16.20	9.50	6.77	7.07	4.49	5.18	6.04	13.07	12.19
2012 /13	14.78	26.34	30.82	19.82	10.31	7.07	15.20	11.79	5.64	6.83	6.29	8.80	13.64
2013 /14	12.50	5.78	28.96	12.05	98.78	277.53	37.78	19.07	13.63	16.03	10.11	9.79	45.17
2014 /15	9.09	7.26	26.79	27.12	15.48	6.66	4.71	5.46	4.45	4.23	5.38	9.11	10.48
2015 /16	8.32	12.27	6.41	11.53	6.53	15.85	3.88	11.15	10.25	7.71	6.51	7.84	9.02
Mean	6.18	6.77	13.89	22.33	23.69	33.76	13.51	11.05	6.51	5.38	5.15	6.67	12.91

Source: JST

The remain basin of 2,342 km² (= 20,627 km² - 18,285 km²) from the downstream of 3 dams to A2H060 WLGS subtracts the downstream water release of 3 dams from the discharge record of A2H060 WLGS. If the estimated discharge of remain basin is a negative value, it is set to 0.0 m³/sec.

The discharge of remain basin (3,135 km² = 23,762 km² - 20,627 km²) from A2H060 WLGS to Thabazimbi is calculated with the estimated catchment area ratio of remain basin by 1.34 (= 3,135 km² / 2,342 km²).

Figure App. 8.4-2 shows a schematic diagram of remain basin between 3 dams and Thabazimbi in Crocodile river.



Source: JST

Figure App. 8.4-2 Schematic Diagram of Remain Basin between 3 dams and Thabazimbi

The estimated discharge of remain basin from 3 dams to Thabazimbi is shown in Table App. 8.4-3. The area of the remain basin between 3 dams and Thabazimbi is $5,477 \text{ km}^2 (= 2,342 \text{ km}^2 + 3,135 \text{ km}^2)$.

Table App. 8.4-3 Estimated Discharge of Remain Basin between 3 dams and Thabazimbi

Year	Unit : m ³ /sec												Ave
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
1984 /85	2.37	1.74	0.56	3.85	0.00	0.00	0.00	0.00	0.00	0.00	0.72	3.26	1.04
1985 /86	0.00	0.00	0.00	0.00	4.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34
1986 /87	0.07	4.14	19.76	13.44	4.02	4.99	0.00	0.34	0.00	0.00	2.60	4.25	4.47
1987 /88	2.96	2.94	6.18	4.19	4.06	2.27	0.00	0.00	0.00	0.00	0.00	1.97	2.05
1988 /89	1.63	0.19	1.32	2.74	8.60	11.82	0.82	2.16	3.67	0.85	0.00	3.44	3.10
1989 /90	0.88	1.53	4.76	4.09	1.66	2.39	1.07	5.68	0.14	0.00	0.00	0.41	1.88
1990 /91	2.23	2.15	3.71	3.33	3.08	32.09	8.31	0.06	0.09	0.00	0.00	0.33	4.62
1991 /92	1.96	0.40	0.55	0.40	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31
1992 /93	0.00	3.30	0.92	0.99	3.26	0.37	0.00	0.00	0.00	0.00	0.00	2.13	0.91
1993 /94	3.04	1.80	0.00	3.91	9.63	1.02	0.00	0.00	0.00	0.61	0.53	2.67	1.94
1994 /95	2.12	0.00	0.34	1.61	1.20	2.75	0.38	1.51	0.00	0.16	0.42	2.25	1.06
1995 /96	0.75	0.00	6.54	45.32	171.57	67.28	12.13	8.34	4.78	3.62	1.72	0.60	26.89
1996 /97	0.53	1.51	8.40	19.03	2.90	120.12	40.16	66.81	22.87	13.96	10.82	12.65	26.65
1997 /98	8.24	3.91	6.73	26.54	8.52	3.08	2.34	0.00	0.00	0.00	0.00	0.32	4.97
1998 /99	2.63	4.56	24.91	19.99	4.70	2.09	0.00	1.21	2.16	1.85	0.00	2.22	5.53
1999 /00	0.63	0.58	0.89	13.03	16.46	118.04	53.64	20.77	13.60	8.52	4.74	0.00	20.91
2000 /01	9.35	18.38	37.73	0.96	4.48	6.42	6.28	10.87	5.58	4.91	5.30	7.57	9.82
2001 /02	7.53	32.47	26.96	10.61	17.37	18.21	3.66	2.50	2.94	3.45	5.46	7.17	11.53
2002 /03	7.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61
2003 /04	0.00	0.00	0.00	0.00	0.00	43.82	19.79	5.84	0.00	0.00	0.00	0.00	5.79
2004 /05	0.05	0.00	0.01	2.60	3.28	5.69	5.25	3.58	4.80	0.00	0.00	1.02	2.19
2005 /06	0.00	3.90	0.00	18.91	60.32	108.24	17.64	5.84	0.00	1.58	1.33	0.00	18.15
2006 /07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007 /08	0.00	0.00	7.92	204.92	30.14	72.44	18.44	6.88	1.93	1.77	0.00	0.00	28.70
2008 /09	0.00	0.02	0.00	17.73	50.61	42.27	9.10	2.86	3.74	2.17	0.11	0.00	10.72
2009 /10	1.23	8.55	22.44	18.63	21.59	4.60	61.78	48.13	12.32	18.57	0.44	0.00	18.19
2010 /11	0.00	0.00	64.75	104.17	40.39	19.64	49.50	24.73	12.49	8.33	0.95	0.00	27.08
2011 /12	0.00	0.00	6.81	15.01	0.60	0.00	0.00	0.41	0.00	0.00	0.00	2.30	2.09
2012 /13	6.28	17.16	29.76	13.23	0.00	0.00	6.98	5.89	0.33	1.19	0.00	0.00	6.73
2013 /14	9.19	0.28	12.19	3.97	19.81	244.33	27.28	13.76	7.40	6.61	1.67	0.00	28.87
2014 /15	0.00	0.23	12.77	23.06	11.38	0.00	2.33	0.00	0.00	0.00	0.00	0.15	4.16
2015 /16	0.00	9.02	0.00	10.10	0.00	8.69	0.26	3.20	3.89	0.00	0.81	0.00	3.00
Average	2.22	3.71	9.59	18.95	15.75	29.46	10.85	7.54	3.21	2.44	1.18	1.71	8.88

Source: JST

Appendix 8.5

Actual Water Use of Mokolo, Klipvoor, Vaalcap, and Roodekopjes Dams

(1) Mokolo Dam

Water of Mokolo dam is classified into 1) water use for industry and town and 2) downstream river release. Industry and town also includes Medupi TPP, which is supplied through pipeline of MCWAP Phase 1. Table App.8.5-1 shows water supply records from Mokolo dam to industry and town, and Table App.8.5-2 shows downstream river release discharge records from Mokolo dam.

Table App.8.5-1 Record of Water Use for Industry and Town from Mokolo Dam through MCWAP
Phase 1 Pipeline

Year	Unit : m ³ /sec												Ave
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
1980 /81	-	-	-	0.19	0.20	0.23	0.21	0.08	0.16	0.16	0.14	0.15	0.17
1981 /82	0.14	0.15	0.13	0.17	0.25	0.19	0.15	0.16	0.15	0.21	0.18	0.18	0.17
1982 /83	0.15	-	0.15	0.14	0.17	0.20	0.16	0.15	0.15	0.16	0.19	0.22	0.17
1983 /84	0.18	0.19	0.18	0.22	0.23	0.18	0.18	0.21	0.17	0.15	0.17	0.19	0.19
1984 /85	0.24	0.25	0.22	0.25	0.25	0.26	0.26	0.23	0.23	0.23	0.26	0.32	0.25
1985 /86	0.35	0.31	0.35	0.33	0.31	0.30	0.26	0.22	0.29	0.25	0.24	0.31	0.29
1986 /87	0.28	0.23	0.22	0.33	0.32	0.29	0.29	0.39	0.29	0.22	0.23	0.18	0.27
1987 /88	0.40	0.36	0.26	0.33	0.33	0.18	0.32	0.17	0.31	0.30	0.27	0.25	0.29
1988 /89	0.32	0.39	0.28	0.29	0.28	0.29	0.33	0.31	0.27	0.40	0.31	0.48	0.33
1989 /90	0.44	0.38	0.31	0.39	0.36	0.39	0.35	0.34	0.36	0.34	0.36	0.38	0.37
1990 /91	0.38	0.51	0.38	0.33	0.31	0.35	0.43	0.39	0.40	0.44	0.42	0.39	0.39
1991 /92	0.43	0.31	0.30	0.34	0.69	0.46	0.31	0.34	0.29	0.33	0.33	0.38	0.38
1992 /93	0.37	0.32	0.38	0.35	0.29	0.34	0.37	0.32	0.30	0.40	0.28	0.33	0.34
1993 /94	0.36	0.25	0.31	0.36	0.35	0.37	0.30	0.32	0.30	0.36	0.38	0.38	0.34
1994 /95	0.42	0.39	0.36	0.36	0.38	0.38	0.37	0.35	0.33	0.38	0.37	0.39	0.37
1995 /96	0.43	0.45	0.31	0.40	-	0.36	0.41	0.44	0.40	0.34	0.29	0.39	0.38
1996 /97	0.41	0.39	0.29	0.35	0.50	0.30	0.24	0.37	0.40	0.38	0.37	0.37	0.36
1997 /98	0.42	0.43	0.45	0.43	0.46	0.47	0.40	0.48	0.44	0.42	0.49	0.42	0.44
1998 /99	0.39	0.44	0.29	0.41	0.47	0.44	0.42	0.39	0.38	0.43	0.40	0.44	0.41
1999 /00	0.46	0.43	0.46	0.34	0.36	0.37	0.31	0.33	0.36	0.37	0.44	0.33	0.38
2000 /01	0.36	0.37	0.35	0.41	0.41	0.32	0.32	0.34	0.36	0.35	0.35	0.37	0.36
2001 /02	0.39	0.30	0.40	0.37	0.38	0.34	0.31	0.35	0.23	0.26	0.27	0.31	0.33
2002 /03	0.36	0.48	0.37	0.34	0.37	0.26	0.26	0.23	0.25	0.28	0.34	0.35	0.32
2003 /04	0.39	0.35	0.45	0.30	0.28	0.35	0.26	0.26	0.25	0.23	0.26	0.32	0.31
2004 /05	0.35	0.34	0.28	0.31	0.28	0.32	0.32	0.29	0.33	0.28	0.26	0.24	0.30
2005 /06	0.23	0.23	0.28	0.35	0.24	0.25	0.22	0.25	0.29	0.35	0.35	0.30	0.28
2006 /07	0.28	0.31	0.32	0.34	0.27	0.26	0.36	0.26	0.33	0.40	0.32	0.32	0.31
2007 /08	0.34	0.25	0.26	0.32	0.40	0.37	0.42	0.40	0.39	0.38	0.34	0.38	0.35
2008 /09	0.45	0.48	0.57	0.48	0.34	0.36	0.39	0.34	0.29	0.31	0.36	0.38	0.40
2009 /10	0.41	0.42	0.51	0.64	0.67	0.78	0.64	0.65	0.71	0.67	0.70	0.73	0.63
2010 /11	0.71	0.70	0.69	0.71	0.70	0.85	0.67	0.60	0.66	0.62	0.05	0.07	0.59
2011 /12	0.06	0.67	0.64	0.66	0.70	0.68	-	0.60	0.70	0.57	0.37	0.41	0.55
2012 /13	0.48	0.47	0.37	0.40	0.41	0.37	0.45	0.46	0.44	0.49	0.10	0.09	0.38
2013 /14	0.05	0.05	0.05	0.09	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.45	0.08
2014 /15	0.53	0.52	0.48	0.53	0.56	0.44	0.49	0.54	0.18	0.41	0.53	0.54	0.48
2015 /16	0.58	0.56	0.52	0.52	0.50	1.13	0.54	0.55	0.50	0.54	0.47	0.52	0.58
2016 /17	0.52	0.49	0.50	0.49	0.46	0.50	0.50	0.61	0.54	-	-	-	0.51
Average	0.36	0.38	0.35	0.37	0.38	0.38	0.34	0.35	0.34	0.35	0.31	0.34	0.35

Source: DWS

Pipeline discharge is supplied about 0.35 m³/sec without monthly fluctuation. Medupi TPP is currently running 3 units (Unit No. 4, 5, 6), and the amount of water used is 0.09 m³/sec (= 0.03 m³/sec x 3 units). 0.26 m³/sec obtained by subtracting 0.03 m³/sec from 0.35 m³/sec is the amount of currently water used by industry and town other than Medupi TPP.

Table App.8.5-2 Record of Downstream Water Release from Mokolo Dam

Year	Unit : m3/sec												Ave
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
1980 /81	0.87	1.43	1.96	13.29	39.39	22.27	7.23	5.28	3.43	2.92	2.60	2.03	8.56
1981 /82	1.02	1.22	0.80	1.75	0.71	0.66	0.52	0.55	0.53	0.53	1.99	0.51	0.90
1982 /83	2.33	0.93	-	-	2.21	2.84	0.71	0.50	0.54	0.49	0.52	-	1.23
1983 /84	0.47	0.46	0.56	2.25	0.69	0.75	0.51	0.75	0.60	0.58	0.73	0.58	0.74
1984 /85	0.67	0.69	0.67	0.63	0.41	0.39	0.76	0.84	1.76	1.66	-	0.88	0.85
1985 /86	0.71	1.03	0.88	0.89	0.80	0.61	0.01	0.00	0.00	0.00	0.00	0.00	0.41
1986 /87	0.00	-	0.00	2.98	0.17	0.75	1.42	0.01	0.01	0.02	0.02	0.02	0.49
1987 /88	2.74	0.03	0.02	1.98	0.28	-	0.05	0.03	2.09	0.59	0.15	0.66	0.78
1988 /89	1.73	0.40	1.01	1.45	0.57	0.13	0.24	1.65	1.15	0.31	1.98	0.57	0.93
1989 /90	0.71	1.43	0.81	0.90	1.24	0.98	0.90	0.03	0.22	0.82	0.89	1.20	0.84
1990 /91	0.84	1.42	1.15	0.90	0.65	15.29	10.34	2.75	1.27	0.47	0.71	1.15	3.08
1991 /92	1.35	1.85	1.00	0.67	1.42	0.02	0.02	0.02	0.02	2.93	1.00	0.99	0.94
1992 /93	0.51	0.02	1.36	0.01	-	0.08	0.04	0.04	0.03	0.03	2.72	0.84	0.52
1993 /94	1.66	0.03	0.07	0.04	0.84	5.28	2.57	0.57	0.27	0.87	0.22	0.79	1.10
1994 /95	3.82	2.06	-	0.66	-	0.03	0.02	1.62	0.03	1.14	0.02	1.01	1.04
1995 /96	1.16	1.40	0.04	25.21	139.01	37.25	10.97	6.78	4.41	3.42	2.35	1.02	19.42
1996 /97	0.49	1.33	4.00	7.64	7.03	23.95	8.98	5.22	4.68	-	-	-	7.04
1997 /98	-	0.80	1.44	2.32	0.89	1.51	1.22	0.27	1.15	0.01	1.21	1.25	1.10
1998 /99	-	-	-	-	6.40	1.52	0.64	1.09	1.07	0.49	0.75	0.89	1.61
1999 /00	1.10	1.41	0.05	24.31	73.03	32.55	39.08	15.99	11.27	7.12	4.30	1.80	17.67
2000 /01	0.98	1.00	1.03	1.31	1.67	13.29	5.28	3.71	2.43	0.76	0.58	1.39	2.79
2001 /02	1.37	13.86	35.08	6.92	2.98	1.15	1.08	1.10	1.12	0.78	0.95	0.96	5.61
2002 /03	1.42	1.07	-	0.59	0.50	0.03	0.03	0.02	2.02	1.12	0.02	1.39	0.75
2003 /04	2.06	0.03	0.03	0.03	0.08	23.07	25.99	7.41	3.62	2.40	1.09	1.14	5.58
2004 /05	1.01	1.29	0.90	0.10	1.18	0.71	0.83	0.05	0.06	0.05	0.91	1.51	0.72
2005 /06	0.07	0.07	0.06	0.05	7.04	52.51	12.14	5.15	3.15	2.02	0.99	1.83	7.09
2006 /07	1.45	0.97	1.32	0.24	1.05	0.03	0.02	0.01	0.00	3.06	1.44	0.95	0.88
2007 /08	0.21	0.13	8.25	52.16	17.47	8.86	6.23	2.94	1.65	0.64	0.64	0.71	8.32
2008 /09	1.56	2.21	5.45	30.03	41.73	24.55	7.68	5.18	4.37	2.83	1.49	0.49	10.63
2009 /10	1.82	0.97	3.02	7.67	10.56	2.92	37.48	29.17	10.39	5.65	4.29	2.30	9.69
2010 /11	1.77	1.31	5.81	43.34	15.46	7.03	8.48	6.14	3.23	2.22	1.57	1.05	8.12
2011 /12	0.90	0.91	13.74	31.45	13.16	3.16	3.64	0.87	1.08	0.85	0.91	0.69	5.95
2012 /13	0.39	1.44	4.45	9.09	11.35	2.35	2.10	0.91	0.95	0.30	0.95	0.65	2.91
2013 /14	2.16	0.98	0.77	0.13	0.79	136.57	26.14	9.74	5.40	3.82	2.21	1.35	15.84
2014 /15	0.63	1.40	8.30	9.16	11.30	1.98	2.57	0.96	0.71	0.79	0.94	1.08	3.32
2015 /16	0.94	1.53	1.06	0.84	0.06	0.06	0.06	1.13	0.13	2.30	0.03	2.87	0.92
2016 /17	0.31	0.65	0.80	0.31	0.31	-	-	-	-	-	-	-	0.47
Average	1.18	1.36	3.21	8.04	11.78	12.15	6.28	3.29	2.08	1.54	1.21	1.07	4.43

Source: DWS

Downstream water release from Mokolo dam has abounded in discharge during the rainy season from December to May.

(2) Klipvoor Dam

The main purpose of Klipvoor dam is water supply for irrigation. The intake of irrigation water is located downstream of Klipvoor dam. Record of downstream water release from Klipvoor dam is shown in Table App.8.5-3.

Table App.8.5-3 Record of Downstream Water Release from Klipvoor Dam

Year	Unit : m ³ /sec											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Ave
1980 /81	2.89	1.10	4.71	3.98	7.19	5.51	1.10	1.41	1.30	2.07	2.74	3.03
1981 /82	3.50	1.69	0.74	0.50	1.84	2.08	0.44	0.41	1.47	2.61	3.38	4.56
1982 /83	2.52	0.88	1.91	2.28	4.37	1.77	0.22	0.17	0.11	0.13	0.30	3.68
1983 /84	1.02	0.51	1.05	4.58	3.65	0.10	0.11	0.06	0.07	0.01	0.22	4.24
1984 /85	0.16	1.33	1.33	1.87	2.09	0.43	0.10	0.00	0.20	0.01	1.93	3.09
1985 /86	0.30	1.35	0.09	0.16	3.85	0.04	0.12	0.10	0.01	0.01	0.03	0.03
1986 /87	0.04	3.57	9.92	5.58	3.60	3.29	0.72	0.12	0.12	0.10	2.74	3.18
1987 /88	3.22	2.03	1.47	2.57	2.96	0.52	0.02	0.03	0.47	0.54	1.11	2.32
1988 /89	1.99	1.56	1.55	2.69	4.13	5.74	1.17	1.50	2.13	1.37	1.94	2.71
1989 /90	2.18	0.80	2.58	2.92	1.79	2.08	1.19	2.62	1.20	0.99	1.63	2.88
1990 /91	2.38	2.12	2.18	2.00	0.74	13.99	3.08	0.83	1.18	0.91	1.29	2.65
1991 /92	2.43	1.25	0.91	2.60	3.45	1.15	0.26	0.18	0.26	0.24	0.75	1.62
1992 /93	0.92	0.32	0.25	2.45	2.15	2.07	0.52	0.20	0.17	0.23	1.27	3.98
1993 /94	1.62	1.47	1.67	2.23	0.40	1.97	0.90	0.37	1.68	1.82	2.24	3.82
1994 /95	3.02	0.85	1.85	1.93	3.87	1.90	0.04	0.01	0.83	1.77	2.15	3.83
1995 /96	2.40	0.33	0.73	11.53	85.09	22.59	4.87	3.27	2.48	2.18	2.19	2.55
1996 /97	2.41	1.31	4.36	4.28	3.48	17.01	10.72	4.53	8.57	3.47	2.51	3.09
1997 /98	2.79	2.22	4.43	5.79	3.53	3.13	0.94	0.30	0.96	1.28	1.77	2.88
1998 /99	2.20	1.84	8.07	7.19	3.80	2.53	0.70	0.24	1.53	1.61	1.53	3.07
1999 /00	2.48	0.99	0.85	15.31	57.78	20.63	19.87	6.07	-	3.39	2.70	1.99
2000 /01	4.28	7.03	8.74	2.65	3.66	2.49	1.94	3.09	1.75	1.78	1.92	2.74
2001 /02	2.25	-	-	2.70	2.87	1.37	-	0.20	1.04	1.10	1.59	2.34
2002 /03	2.62	1.79	2.14	2.87	2.78	2.97	0.22	0.15	2.45	1.47	2.79	3.10
2003 /04	2.42	0.13	2.75	0.37	2.73	-	5.70	2.68	1.64	1.80	2.19	3.16
2004 /05	3.48	1.22	2.08	3.30	4.13	2.79	2.80	1.38	1.16	1.85	3.05	4.64
2005 /06	3.00	1.09	1.42	4.22	21.22	29.15	3.93	2.15	1.93	1.81	2.55	3.16
2006 /07	2.79	0.80	2.18	1.09	2.05	2.28	0.36	0.16	1.53	0.65	2.23	2.76
2007 /08	0.59	1.81	3.60	51.97	9.65	17.58	6.62	4.18	3.22	2.24	2.33	2.95
2008 /09	2.21	0.33	2.21	6.75	14.61	14.65	3.38	2.79	3.33	2.73	2.71	2.40
2009 /10	2.41	4.76	8.55	8.84	6.66	2.86	19.95	14.15	4.70	3.41	2.70	3.15
2010 /11	2.86	0.95	7.44	30.50	11.19	8.27	12.94	6.21	4.09	3.30	2.80	2.74
2011 /12	2.73	1.37	3.91	4.91	3.79	2.13	1.11	1.37	1.47	1.67	1.77	2.90
2012 /13	3.97	5.52	8.09	3.89	3.21	2.10	3.53	2.53	2.01	2.33	2.58	3.47
2013 /14	3.16	2.16	5.00	4.11	7.28	34.85	6.98	3.22	2.92	2.72	2.43	-
2014 /15	3.01	2.04	5.06	8.20	3.72	2.34	2.89	1.87	2.18	2.16	2.28	3.10
2015 /16	3.11	2.36	3.34	2.79	3.65	3.49	2.08	3.02	2.67	2.10	2.27	3.14
2016 /17	2.49	3.33	3.16	6.08	15.72	8.54	4.81	3.39	2.67	-	-	-
Average	2.37	1.78	3.34	6.15	8.61	6.84	3.51	2.03	1.82	1.61	2.02	3.00

Source: DWS

(3) Vaalkop Dam

Water of Vaalkop dam is classified into 1) water use for industry and town and 2) downstream river release. Table App.8.5-4 shows water supply records from Vaalkop dam to industry and town, and Table App.8.5-5 shows downstream river release discharge records from Vaalkop dam.

Table App.8.5-4 Water Use Record for Industry and Town from Vaalkop Dam

Year	Unit : m ³ /sec												Ave
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
1980 /81	0.29	0.29	0.24	0.29	0.30	0.27	0.34	0.32	0.30	0.31	0.31	0.33	0.30
1981 /82	0.33	0.31	0.29	0.30	0.31	0.27	0.25	0.29	0.25	0.23	0.28	0.30	0.28
1982 /83	0.27	0.27	0.29	0.29	0.29	0.22	0.19	0.19	0.18	0.17	0.17	0.19	0.23
1983 /84	0.19	0.23	0.17	0.21	0.27	0.21	0.21	0.22	0.23	0.20	0.24	0.25	0.22
1984 /85	0.26	0.27	0.24	0.26	0.26	0.12	0.12	0.29	0.29	0.28	0.30	0.30	0.25
1985 /86	0.34	0.32	0.29	0.30	0.32	0.31	0.29	0.30	0.25	0.28	0.29	0.32	0.30
1986 /87	0.31	0.30	0.27	0.29	0.34	0.31	0.31	0.32	0.31	0.29	0.29	0.31	0.30
1987 /88	0.35	0.33	0.31	0.33	0.35	0.32	0.29	0.30	0.30	0.31	0.34	0.35	0.32
1988 /89	0.35	0.38	0.35	0.34	0.31	0.29	0.33	0.31	0.31	0.32	0.37	0.41	0.34
1989 /90	0.46	0.31	0.31	0.39	0.34	0.36	0.34	0.32	0.33	0.30	0.41	0.45	0.36
1990 /91	0.47	0.41	0.41	0.29	0.41	0.42	0.45	0.45	0.43	0.44	0.42	0.46	0.42
1991 /92	0.46	0.47	0.47	0.49	0.60	0.57	0.55	0.56	0.49	0.17	0.17	0.34	0.45
1992 /93	0.36	0.26	0.33	0.31	0.27	0.63	0.61	0.67	0.63	0.62	0.67	0.71	0.51
1993 /94	0.59	0.65	0.66	0.60	0.57	0.55	0.67	0.63	0.64	0.54	0.54	0.55	0.60
1994 /95	0.61	0.48	0.59	0.46	0.84	0.64	0.50	0.51	0.62	0.57	0.55	0.77	0.60
1995 /96	0.82	0.83	0.68	0.46	0.41	0.36	0.31	0.55	0.61	0.56	0.56	0.53	0.56
1996 /97	0.58	0.50	0.56	0.57	0.61	0.59	0.59	0.57	0.56	0.55	0.54	0.58	0.57
1997 /98	0.57	0.58	0.59	0.55	0.60	0.55	0.57	0.57	0.55	0.53	0.59	0.58	0.57
1998 /99	0.61	0.58	0.57	0.55	0.59	0.74	-	-	-	-	-	-	0.61
1999 /00	-	-	-	-	-	-	-	-	-	-	-	-	-
2000 /01	-	-	-	-	-	-	-	-	-	-	-	-	-
2001 /02	1.31	1.13	1.11	1.38	1.44	1.54	1.56	1.49	1.32	1.42	1.43	1.50	1.39
2002 /03	1.71	1.72	1.51	1.74	1.67	1.74	1.88	1.85	1.70	1.63	1.71	1.80	1.72
2003 /04	1.76	1.62	1.76	1.70	1.73	1.64	1.60	1.46	1.54	1.44	1.55	1.76	1.63
2004 /05	1.78	1.96	1.69	1.78	1.81	1.69	1.64	1.74	1.74	1.74	1.78	1.86	1.77
2005 /06	2.02	1.91	1.83	1.77	1.76	1.73	1.71	1.71	1.60	1.58	1.54	1.75	1.74
2006 /07	1.94	1.85	1.84	1.95	1.82	1.89	1.66	1.75	1.68	1.67	1.74	1.81	1.80
2007 /08	1.64	1.83	1.84	1.79	1.99	1.79	1.83	1.73	1.60	1.74	1.82	1.94	1.80
2008 /09	2.08	1.86	1.81	1.72	1.83	1.79	1.70	1.83	1.77	1.82	1.70	1.82	1.81
2009 /10	1.90	1.95	2.04	1.93	2.01	2.04	2.04	1.93	1.86	1.94	1.97	1.90	1.96
2010 /11	1.99	2.01	1.94	1.86	2.01	2.07	2.04	1.94	1.95	1.86	1.89	2.04	1.97
2011 /12	1.99	1.98	1.92	2.01	2.16	2.10	2.00	1.90	1.90	1.85	1.81	1.85	1.96
2012 /13	1.92	1.99	2.04	2.12	2.14	2.12	2.06	2.10	2.13	2.09	2.07	2.04	2.07
2013 /14	1.96	1.94	1.87	1.94	1.99	1.92	1.98	1.97	1.95	2.04	2.06	2.08	1.98
2014 /15	2.12	2.06	2.08	2.11	2.15	2.18	2.17	1.99	2.18	1.98	2.14	2.23	2.12
2015 /16	2.20	2.23	2.15	2.19	2.30	2.26	2.15	2.01	1.99	1.97	2.00	2.13	2.13
2016 /17	1.89	1.85	1.94	1.59	1.95	2.23	2.37	-	-	-	-	-	1.98
Average	1.10	1.08	1.06	1.05	1.11	1.10	1.10	1.05	1.04	1.01	1.04	1.10	1.07

Source: DWS

The average water supply of industry and town is 1.07 m³/sec. In recent years since 2010, the average water supply has risen to 2.20 m³/sec.

Table App.8.5-5 Record of Downstream Water Release from Vaalkop Dam

Year	Unit : m ³ /sec												Ave
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
1980 /81	-	0.89	4.80	18.09	12.41	12.04	2.37	0.54	0.50	-	1.18	0.90	5.37
1981 /82	0.45	1.79	3.11	3.36	3.41	1.27	0.49	0.47	0.68	0.49	0.56	0.57	1.39
1982 /83	0.47	0.39	0.53	0.62	0.62	0.44	0.20	0.19	0.18	0.17	0.17	0.19	0.35
1983 /84	0.19	0.23	0.24	1.06	0.32	0.21	0.21	0.22	0.23	0.20	0.24	0.25	0.30
1984 /85	0.26	0.27	1.23	0.26	0.50	0.27	0.13	0.29	0.29	0.28	0.35	0.36	0.37
1985 /86	0.46	0.39	0.34	0.38	0.47	0.52	0.30	0.30	0.25	0.28	0.29	0.32	0.36
1986 /87	0.31	0.41	0.34	0.29	0.40	0.36	0.31	0.32	0.37	0.35	0.45	0.37	0.36
1987 /88	0.43	0.38	0.31	0.33	0.35	0.32	0.29	0.30	0.42	0.39	1.42	0.51	0.45
1988 /89	0.45	0.40	0.39	0.42	0.39	0.36	0.33	0.31	0.33	0.35	0.56	0.60	0.41
1989 /90	1.30	0.86	0.53	0.50	0.39	0.44	0.34	0.32	0.45	0.42	0.63	1.50	0.64
1990 /91	1.57	0.63	0.56	0.54	0.60	0.66	0.48	0.45	0.54	0.62	0.65	0.72	0.67
1991 /92	0.78	0.70	0.62	0.77	0.88	0.91	0.60	0.59	0.57	0.26	0.26	0.55	0.63
1992 /93	0.49	0.26	0.39	0.50	0.39	0.76	0.61	0.70	0.64	0.72	0.78	0.92	0.60
1993 /94	0.63	0.65	0.80	0.70	0.57	0.66	0.67	0.67	0.77	0.61	0.69	0.79	0.68
1994 /95	0.82	0.57	0.72	0.58	1.10	0.88	0.50	0.53	0.76	0.66	0.68	1.03	0.74
1995 /96	0.94	0.93	5.33	3.60	35.12	3.74	0.32	1.26	1.17	0.84	0.82	0.96	4.59
1996 /97	1.07	0.99	1.04	1.29	1.45	45.10	16.12	26.61	6.74	2.54	1.77	2.56	8.94
1997 /98	0.96	0.96	0.97	1.57	1.21	1.16	0.84	0.81	0.80	1.00	1.06	1.03	1.03
1998 /99	1.05	0.83	0.82	1.20	1.14	1.05	-	0.11	0.10	0.19	0.26	0.28	0.64
1999 /00	0.29	0.30	0.30	0.32	-	26.65	12.70	5.34	4.55	3.24	0.65	0.39	4.97
2000 /01	0.36	0.90	7.80	0.63	0.49	0.44	0.10	0.90	1.11	0.31	0.24	1.28	1.21
2001 /02	1.52	13.12	15.31	3.27	5.82	-	1.84	1.65	1.52	1.59	1.78	1.88	4.48
2002 /03	2.01	1.98	1.73	1.96	1.89	1.96	2.01	1.89	-	-	1.95	2.03	1.94
2003 /04	1.90	1.67	2.00	1.83	1.73	2.71	1.75	2.13	1.69	1.59	1.71	1.94	1.89
2004 /05	1.94	2.16	1.83	1.93	2.11	1.83	1.67	1.75	1.92	2.02	1.99	2.11	1.94
2005 /06	2.24	2.00	1.91	1.86	1.86	-	-	1.78	-	-	1.71	1.94	1.91
2006 /07	2.16	2.04	2.01	2.14	2.00	2.14	1.80	1.76	1.68	1.67	1.74	1.81	1.91
2007 /08	1.65	1.83	1.84	6.08	5.05	7.16	2.99	2.49	1.76	2.04	2.19	2.18	3.10
2008 /09	2.49	2.24	2.15	2.11	5.11	6.50	2.41	2.06	2.69	2.06	2.40	2.53	2.89
2009 /10	2.24	2.15	2.13	5.48	2.90	2.21	4.14	14.63	2.83	-	2.29	2.28	3.93
2010 /11	2.66	2.80	7.87	29.41	7.36	9.42	10.85	4.93	5.98	4.67	4.56	4.35	7.91
2011 /12	3.44	2.82	2.44	2.54	2.76	2.67	2.27	2.14	2.09	2.12	2.03	2.06	2.45
2012 /13	2.15	2.23	2.25	2.31	2.35	2.33	2.27	2.30	2.31	2.22	2.20	2.20	2.26
2013 /14	2.11	2.12	2.05	2.14	31.42	66.16	4.35	2.17	2.15	2.39	2.35	2.44	10.15
2014 /15	2.49	2.42	2.41	2.41	2.46	2.46	2.43	2.24	2.39	2.16	2.29	2.39	2.38
2015 /16	2.36	2.36	2.30	2.36	2.46	2.40	2.30	2.18	2.17	2.13	2.15	2.28	2.29
2016 /17	2.05	-	2.06	9.36	70.00	6.88	2.58	-	-	-	-	-	15.49
Average	1.35	1.60	2.26	3.09	5.82	6.15	2.39	2.43	1.55	1.27	1.31	1.40	2.55

Source: DWS

(4) Roodekopjes Dam

Water of Roodekopjes dam is classified into 1) water use for irrigation and 2) downstream river release. Table App.8.5-6 shows water supply records from Roodekopjes dam to irrigation, and Table App.8.5-7 shows downstream river release discharge records from Roodekopjes dam.

Table App.8.5-6 Water Use Record for Irrigation from Roodekopjes Dam

Year	Unit : m ³ /sec												Ave
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
1980 /81	-	-	-	-	-	-	-	-	-	-	-	-	-
1981 /82	-	-	-	-	-	-	-	-	-	-	-	-	-
1982 /83	-	-	-	-	-	-	-	-	-	-	-	-	-
1983 /84	-	-	-	-	-	-	-	-	-	-	0.02	0.86	0.44
1984 /85	0.02	0.02	0.84	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.09
1985 /86	0.02	0.46	0.06	0.07	0.02	0.06	0.04	0.20	0.95	1.00	0.52	0.04	0.29
1986 /87	0.02	0.90	0.02	0.04	0.04	0.04	0.01	0.01	0.03	0.23	0.03	0.03	0.12
1987 /88	0.03	0.03	0.03	0.03	0.03	0.02	0.01	0.02	0.02	0.03	0.03	0.03	0.03
1988 /89	0.03	0.03	0.03	0.03	2.05	0.03	0.04	0.03	0.03	0.03	3.08	3.46	0.74
1989 /90	0.38	0.03	0.03	0.03	0.03	0.03	0.03	2.72	1.84	3.61	0.29	0.04	0.76
1990 /91	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	1.02	1.02	0.20
1991 /92	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03
1992 /93	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.83	0.71	0.06	1.13	1.17	0.34
1993 /94	0.05	1.13	1.00	1.05	0.08	0.06	0.06	0.23	1.27	1.33	0.06	1.41	0.64
1994 /95	0.68	1.52	1.28	1.40	0.05	1.26	0.06	0.07	0.06	0.07	0.07	0.07	0.55
1995 /96	0.06	0.07	0.07	0.07	0.09	0.08	0.09	2.33	1.03	0.74	0.73	0.10	0.46
1996 /97	0.10	0.10	2.78	2.69	1.31	0.08	0.09	0.11	0.48	0.34	1.01	0.38	0.79
1997 /98	0.11	1.25	1.04	2.26	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.46
1998 /99	0.11	0.38	3.19	2.50	0.94	0.11	0.11	0.39	0.84	0.21	0.29	0.06	0.76
1999 /00	0.07	0.05	0.04	2.02	3.27	1.18	0.03	2.66	-	2.83	-	0.04	1.22
2000 /01	0.48	2.83	1.31	0.06	0.07	0.07	2.93	3.02	1.37	0.50	0.34	1.20	1.18
2001 /02	0.74	3.44	2.30	1.45	0.61	0.05	0.05	0.07	0.07	0.17	0.06	0.84	0.82
2002 /03	0.37	0.07	0.07	0.06	2.33	1.78	0.79	3.48	0.18	0.03	2.28	0.04	0.96
2003 /04	1.62	1.20	2.09	1.90	0.05	1.84	0.80	3.08	0.41	1.09	1.26	0.04	1.28
2004 /05	0.03	0.05	0.05	1.14	2.30	1.11	2.37	2.63	0.83	0.03	0.03	1.17	0.98
2005 /06	2.05	1.59	1.30	2.30	1.84	1.76	2.63	2.35	0.05	0.22	1.38	1.67	1.59
2006 /07	0.84	0.64	1.03	2.96	1.56	0.04	0.04	1.40	2.32	2.31	1.96	0.63	1.31
2007 /08	1.51	1.55	1.70	1.99	1.22	1.26	2.20	1.66	-	1.58	2.08	1.99	1.70
2008 /09	0.84	0.39	1.33	2.60	1.82	1.48	1.40	3.08	2.57	0.30	1.81	2.21	1.65
2009 /10	1.55	1.85	2.22	1.45	0.09	2.55	2.14	1.51	1.57	2.07	1.99	1.50	1.71
2010 /11	0.00	0.00	0.84	1.65	1.55	0.82	1.69	0.23	0.00	1.30	0.00	0.00	0.67
2011 /12	0.00	0.42	1.67	1.67	0.63	1.30	1.59	2.06	1.76	1.67	2.48	2.50	1.48
2012 /13	1.75	2.01	3.42	3.21	2.92	1.13	2.06	2.65	1.73	1.19	3.25	2.77	2.34
2013 /14	3.07	2.48	2.42	2.25	0.76	0.00	0.00	0.00	0.00	1.11	1.59	1.53	1.27
2014 /15	1.54	1.62	1.29	1.19	1.44	1.58	2.18	2.23	2.22	3.07	2.92	3.14	2.04
2015 /16	2.64	3.06	3.03	2.73	2.63	1.38	2.38	2.29	2.02	2.43	1.67	2.11	2.36
2016 /17	1.64	1.72	1.82	2.19	1.15	0.01	0.62	2.17	2.00	-	-	-	1.48
Average	0.68	0.94	1.16	1.31	0.94	0.65	0.81	1.32	0.86	0.93	1.05	0.98	0.97

Source: DWS

Table App.8.5-7 Record of Downstream Water Release from Roodekopjes Dam

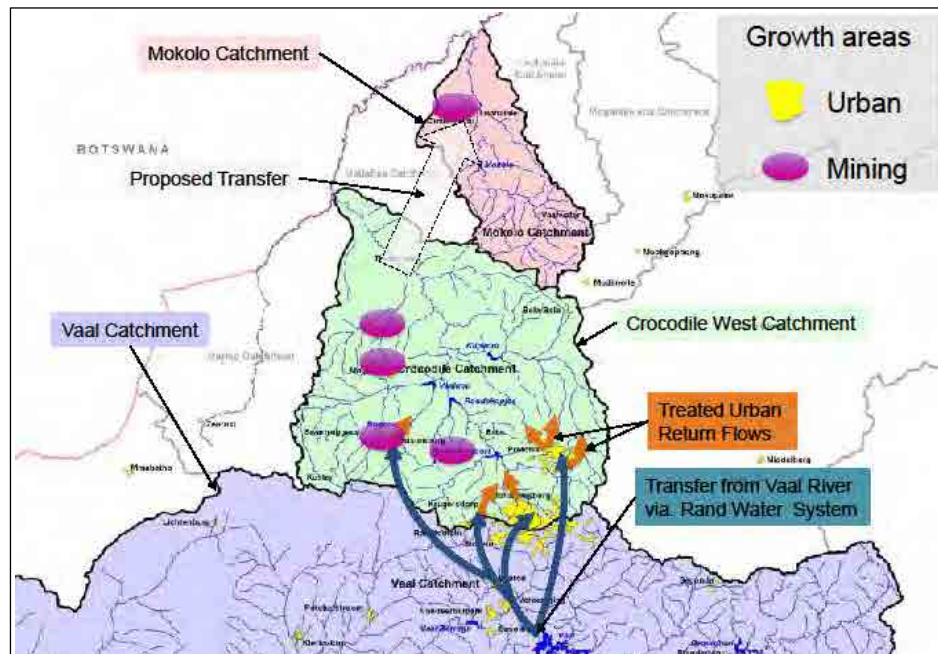
Year	Unit : m ³ /sec												Ave
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
1980 /81	-	-	-	-	-	-	-	-	-	-	-	-	-
1981 /82	-	-	-	-	-	-	-	-	-	-	-	-	-
1982 /83	-	-	-	-	-	-	-	-	-	-	-	-	-
1983 /84	-	-	-	-	-	-	-	-	-	0.01	0.30	0.04	0.12
1984 /85	0.05	0.01	0.53	0.19	3.55	1.32	0.19	0.07	0.06	0.04	0.35	1.66	0.67
1985 /86	2.02	1.62	1.10	0.49	1.65	1.24	0.01	0.00	0.00	0.00	0.00	0.02	0.68
1986 /87	0.00	2.32	0.76	1.65	2.13	1.69	0.50	0.00	1.64	0.99	1.10	1.21	1.17
1987 /88	1.56	1.43	0.88	1.23	1.18	0.68	0.54	0.25	1.80	1.63	1.84	1.33	1.20
1988 /89	1.47	1.36	1.34	1.71	0.81	1.93	0.78	0.54	0.87	1.06	1.90	2.61	1.37
1989 /90	1.56	0.69	1.28	1.85	1.53	1.41	0.97	0.53	1.08	2.48	2.67	1.74	1.48
1990 /91	1.17	1.47	1.56	1.69	1.42	1.41	0.90	1.06	1.39	2.56	2.96	3.32	1.74
1991 /92	2.81	1.67	2.17	3.02	3.73	5.01	2.35	0.42	0.85	0.67	1.20	3.73	2.30
1992 /93	4.17	0.54	0.83	1.91	1.49	1.68	0.35	0.16	0.20	0.14	0.80	2.18	1.20
1993 /94	0.31	0.41	1.41	1.21	0.20	1.21	0.57	0.30	1.06	1.31	1.40	1.84	0.94
1994 /95	1.85	0.99	1.55	1.42	2.28	1.26	0.17	0.16	1.19	1.68	1.78	1.92	1.35
1995 /96	1.69	1.09	0.77	13.17	124.97	16.73	13.79	6.40	4.10	3.22	3.70	4.80	16.20
1996 /97	4.41	2.48	2.51	24.49	6.75	95.84	25.15	35.74	14.60	10.49	8.32	9.25	20.00
1997 /98	6.73	2.69	5.31	23.20	6.74	5.19	1.16	1.16	2.42	2.18	3.04	3.98	5.32
1998 /99	2.56	3.43	22.43	10.47	6.57	5.28	1.55	0.69	1.96	2.13	3.39	5.01	5.46
1999 /00	5.27	2.46	2.93	11.84	181.10	42.76	31.70	12.72	8.17	6.35	6.45	6.33	26.51
2000 /01	8.36	16.25	27.41	10.85	4.21	2.44	1.89	9.25	4.10	4.27	4.70	5.78	8.29
2001 /02	5.50	17.17	9.85	6.63	10.38	7.23	1.57	0.68	1.22	1.64	3.32	4.81	5.83
2002 /03	4.77	3.21	3.29	4.21	4.20	2.46	0.32	0.19	2.03	1.70	2.97	5.39	2.89
2003 /04	3.45	0.27	1.72	0.27	0.85	12.21	4.27	3.27	2.68	2.70	3.33	5.12	3.34
2004 /05	3.79	2.06	2.33	5.30	4.77	3.48	4.83	1.59	2.56	2.05	3.47	4.29	3.38
2005 /06	3.94	1.64	2.37	2.14	36.73	19.48	6.05	4.55	3.29	3.26	3.00	5.94	7.70
2006 /07	5.97	1.82	5.25	9.28	6.87	5.53	0.63	0.25	2.11	1.24	2.29	4.27	3.79
2007 /08	1.86	3.54	7.02	30.54	14.33	24.66	10.05	8.00	9.13	4.16	4.49	7.03	10.40
2008 /09	6.65	2.44	4.70	20.91	25.95	28.97	3.33	3.71	5.48	6.72	7.21	7.72	10.32
2009 /10	5.35	2.55	17.56	53.77	21.20	9.69	28.46	28.74	7.43	7.71	5.99	6.09	16.21
2010 /11	6.39	3.49	36.32	76.88	21.68	39.77	27.33	17.80	17.35	11.22	8.53	10.92	23.14
2011 /12	9.53	8.78	21.00	19.40	13.18	7.62	4.63	4.76	3.13	3.37	4.98	10.03	9.20
2012 /13	9.95	16.78	15.85	11.86	8.16	5.56	9.95	6.98	3.19	4.10	4.37	6.93	8.64
2013 /14	6.47	3.54	21.70	8.21	58.90	106.95	21.78	11.03	8.31	10.81	7.06	8.01	22.73
2014 /15	7.45	4.74	18.92	14.85	8.16	5.16	1.29	3.85	2.55	2.58	4.47	6.65	6.72
2015 /16	7.06	6.05	5.93	4.85	5.33	9.74	1.47	7.60	6.42	5.62	4.01	5.63	5.81
2016 /17	7.17	6.40	7.91	38.15	66.43	15.18	10.29	8.89	5.58	-	-	-	18.44
Average	4.28	3.80	7.77	12.65	19.92	14.87	6.63	5.49	3.88	3.34	3.50	4.71	7.57

Source: DWS

Appendix 8.6

Return Flow of Waste Water Treatment Works

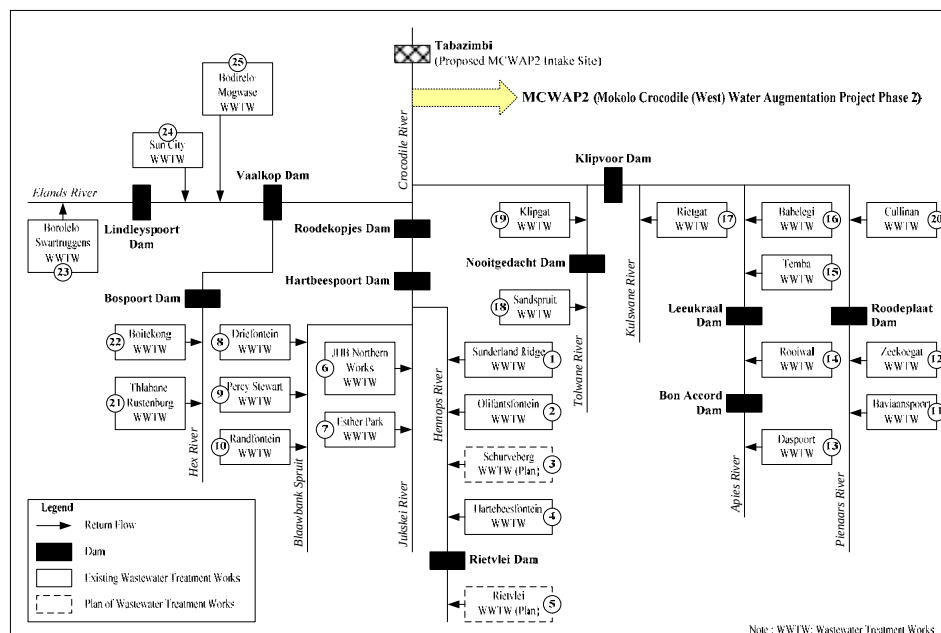
The Crocodile River catchment is supplied water for domestic water in Johannesburg and Pretoria, and mining water by the Land Water System from the Vaal River catchment. The Land Water System is Project of water transfer from Vaal River catchment to Crocodile River catchment. The supplied water is used for domestic water, mining water, etc., and treatment water through waste water treatment works (WWTW) is return to Crocodile River catchment. Figure App. 8.6-1 shows the Land Water System provided by DWS.



Source: DWS

Figure App. 8.6-1 Land Water System

There are 23 existing waste water treatment plants supplied from Land Water System in the Crocodile River catchment. Other 2 WWTWs are also planned. Figure App. 8.6-2 shows a schematic diagram of the existing and planned WWTWs in the Crocodile River catchment.



Source: JST

Figure App. 8.6-2 Schematic Diagram of Existing and Planned Waste Water Treatment Works

In Johannesburg and Pretoria, water demand will increase from future population growth forecasts. Expansion of existing WWTWs and construction of new WWTWs are planned, and increases return flow to the Crocodile River catchment. Table App. 8.6-1 shows the WWTW capacities in 2016 and 2030, collected from the report of “ Crocodile (West) River Reconciliation Strategy 2015, DWS”. The WWTW where the plan for 2030 is unknown shall apply the capacity of 2016.

Table App. 8.6-1 Capacity of Waste Water Treatment Works in 2016 and 2030

No.	Name of WWTW	Capacity (mil.litter/day)		Capacity (mil.m ³ /year)	
		2016	2030	2016	2030
1	Sunderland Ridge	95.00	209.00	34.68	76.29
2	Olifantsfontein	105.00	157.00	38.33	57.31
3	Schurveberg (Plan)	0.00	55.00	0.00	20.08
4	Hartebeesfontein	45.00	45.00	16.43	16.43
5	Rietvlei	0.00	193.00	0.00	70.45
6	JHB Northern Works	450.0	450.0	164.25	164.25
7	Esther Park	0.40	0.40	0.15	0.15
8	Driefontein	35.00	50.00	12.78	18.25
9	Percy Stewart	17.00	17.00	6.21	6.21
10	Randfontein	19.50	19.50	7.12	7.12
11	Baviaanspoort	66.00	305.00	24.09	111.33
12	Zeekoegat	70.00	161.00	25.55	58.77
13	Daspoort	58.00	58.00	21.17	21.17
14	Rooiwal	205.00	492.00	74.83	179.58
15	Temba	33.00	120.00	12.05	43.80
16	Babelegi	4.70	4.70	1.72	1.72
17	Rietgat	28.00	119.00	10.22	43.44
18	Sandspruit	20.00	60.00	7.30	21.90
19	Klipgat	55.00	91.00	20.08	33.22
20	Cullinan	2.00	0.00	0.73	0.00
21	Thlabane/Rustenburg	42.00	42.00	15.33	15.33
22	Boitekong	8.00	8.00	2.92	2.92
23	Borolelo/Swartruggens	2.50	2.50	0.91	0.91
24	Sun City	5.14	5.14	1.88	1.88
25	Bodirelo/Mogwase	4.00	4.00	1.46	1.46
Total		1,370.24	2,668.24	500.14	970.57

Source: Crocodile (West) River Reconciliation Strategy 2015, DWS

Among the 25 WWTWs in the above table, the return flow are recorded until 2005 of 18 WWTWs. The monthly mean return flow is shown in Table App. 8.6-2.

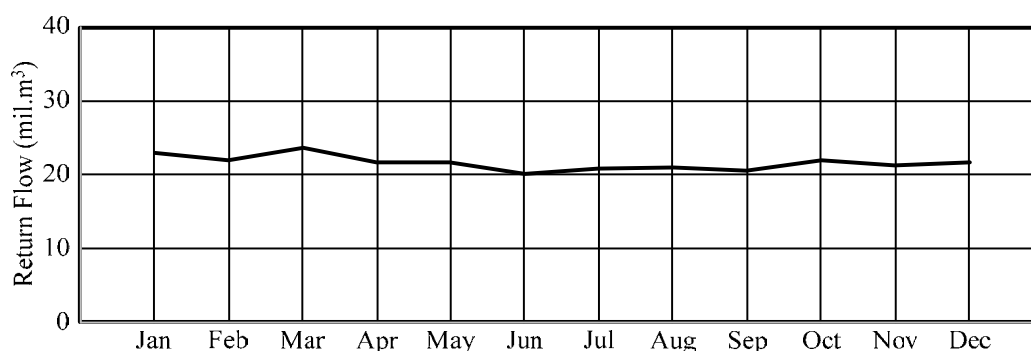
Table App. 8.6-2 Monthly Mean Return Flow Record

Unit : mil.m³

No.	Name of WWTW	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	1. Sunderland Ridge	1.28	1.27	1.35	1.19	1.21	1.16	1.15	1.13	1.08	1.18	1.18	1.14	14.34
2	2. Olifantsfontein	2.05	1.91	2.01	1.85	1.93	1.65	1.64	1.66	1.93	2.19	1.66	1.82	22.31
3	4. Hartebeesfontein	1.14	1.11	1.23	1.20	1.02	0.99	1.14	1.13	1.09	1.00	1.04	1.07	13.16
4	6. JHB Northern	7.60	7.01	7.72	7.45	7.58	7.28	7.50	7.50	7.20	7.55	7.46	7.37	89.22
5	7. Esther Park	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.12
6	8. Driefontein	0.47	0.46	0.49	0.46	0.48	0.46	0.48	0.47	0.46	0.48	0.47	0.47	5.64
7	9. Percy Stewart	0.44	0.47	0.48	0.45	0.45	0.47	0.48	0.48	0.47	0.50	0.50	0.47	5.66
8	11. Baviaanspoort	1.24	1.14	1.18	1.07	0.96	0.90	0.94	0.89	0.90	1.02	1.03	1.19	12.48
9	12. Zeekoegat	1.19	1.06	1.16	1.04	1.05	0.98	1.04	1.05	1.01	1.09	1.07	1.12	12.86
10	13. Daspoort	1.36	1.26	1.36	1.30	1.35	1.25	1.27	1.29	1.25	1.33	1.30	1.34	15.66
11	14. Rooiwal	4.28	4.46	4.75	3.85	3.91	3.46	3.58	3.73	3.52	3.95	3.84	3.86	47.20
12	15. Temba	0.21	0.21	0.22	0.23	0.18	0.17	0.17	0.17	0.17	0.17	0.19	0.20	2.29
13	16. Babelegi	0.06	0.07	0.07	0.07	0.08	0.07	0.06	0.07	0.07	0.06	0.06	0.06	0.79
14	17. Rietgat	0.34	0.29	0.38	0.30	0.28	0.24	0.23	0.24	0.24	0.23	0.23	0.27	3.28
15	18. Sandspruit	0.12	0.11	0.13	0.12	0.11	0.10	0.10	0.10	0.09	0.09	0.10	0.12	1.31
16	19. Klipgat	0.91	0.88	1.01	0.96	0.86	0.81	0.81	0.83	0.87	0.90	0.88	1.03	10.73
17	21. Thlabane/Rustenburg	0.14	0.13	0.03	0.05	0.08	0.05	0.08	0.10	0.06	0.07	0.08	0.05	0.93
18	22. Boitekong	0.11	0.10	0.09	0.10	0.10	0.09	0.10	0.10	0.11	0.10	0.11	0.12	1.22
Total		22.96	21.93	23.68	21.70	21.65	20.15	20.80	20.95	20.53	21.93	21.21	21.71	259.19

Source: The assessment of water availability in the Crocodile (West) River catchment by means of water resource related models in support of the planned future licensing process 2008, Department of Water Affairs and Forestry

Figure App. 8.6-3 shows the variation of the monthly mean return flow. The monthly fluctuation of return flow is almost constant throughout the year.



Source: JST

Figure App. 8.6-3 Monthly Fluctuation of Return Flow

Also, the average return flow is about 50% (= total return flow [259.19 mil.m³] / WWTW capacity in 2016 [500.14 mil.m³]) of WWTW capacity. Assumed future return flow forecasts are as follows:

Waste water treatment works with return flow record

$$\text{Future Return Flow (mil.m}^3\text{/year)} = (\text{Return Flow Record} / \text{Present WWTW Capacity}) \times \text{Future WWTW Capacity}$$

Waste water treatment works without return flow record

$$\text{Future Return Flow (mil.m}^3\text{/year)} = 50\% \times \text{Future WWTW Capacity}$$

The return flow in 2023 when MCWAP 2 is completed is estimated by linear interpolation between return flow of 2016 and 2030. The assumed return flow in 2023 is shown in Table App. 8.6-3.

Table App. 8.6-3 Assumed Return Flow in 2023

No.	Name of WWTW	WWTW Capacity (mil.m ³ /year)			Return Flow Ratio	Return Flow (mil.m ³ /year)		
		2016	2023	2030		2016	2023	2030
1	Sunderland Ridge	34.68	55.48	76.29	0.41	14.34	22.94	31.55
2	Olifantsfontein	38.33	47.82	57.31	0.58	22.31	27.83	33.36
3	Schurveberg	0.00	10.04	20.08	0.50	0.00	5.02	10.04
4	Hartebeesfontein	16.43	16.43	16.43	0.80	13.16	13.16	13.16
5	ERWAT Rietvlei	0.00	35.22	70.45	0.50	0.00	17.61	35.22
6	JHB Northern Works	164.25	173.38	182.50	0.54	89.22	94.18	99.13
7	Esther Park	0.15	0.15	0.15	0.82	0.12	0.12	0.12
8	Driefontein	12.78	15.51	18.25	0.44	5.64	6.85	8.06
9	Percy Stewart	6.21	6.21	6.21	0.91	5.66	5.66	5.66
10	Randfontein	7.12	7.12	7.12	0.50	3.56	3.56	3.56
11	Baviaanspoort	24.09	67.71	111.33	0.52	12.48	35.08	57.67
12	Zeekoegat	25.55	42.16	58.77	0.50	12.86	21.22	29.58
13	Daspoort	21.17	21.17	21.17	0.74	15.66	15.66	15.66
14	Rooiwal	74.83	127.20	179.58	0.63	47.20	80.24	113.28
15	Temba	12.05	27.92	43.80	0.19	2.29	5.31	8.33
16	Babelegi	1.72	1.72	1.72	0.46	0.79	0.79	0.79
17	Rietgat	10.22	26.83	43.44	0.32	3.28	8.61	13.94
18	Sandspruit	7.30	14.60	21.90	0.18	1.31	2.62	3.93
19	Klipgat	20.08	26.65	33.22	0.53	10.73	14.24	17.75
20	Cullinan	0.73	0.37	0.00	0.00	0.00	0.00	0.00
21	Thlabane/Rustenburg	15.33	15.33	15.33	0.50	7.67	7.67	7.67
22	Boitekong	2.92	2.92	2.92	0.50	1.46	1.46	1.46
23	Borolelo/Swartruggens	0.91	0.91	0.91	0.50	0.46	0.46	0.46
24	Sun City	1.88	1.88	1.88	0.50	0.94	0.94	0.94
25	Bodirelo/Mogwase	1.46	1.46	1.46	0.50	0.73	0.73	0.73
Total		500.14	746.15	992.16		271.86	391.95	512.04

Source: JST

The assumed value of return flow in 2023 is 391.95 mil.m³/year. Return flow in 2023 is increases by 120.09 mil.m³/year compared to return flow in 2016 (= 391.95 mil.m³/year - 271.86 mil.m³/year).

Return flow of WWTW No.1 to No.10 flows into Hartbeespoort Dam located upstream of Roodekopjes Dam, WWTW No.11 to No.17 and No.20 flows into Klipvoor Dam, and WWTW No.21 to No.25 flows into Vaalkop Dam. Return flow of WWTW No.18 and No.19 flows directly to the Crocodile River located downstream of Klipvoor Dam. Return flow in 2016 has already flowed into each dam in the Crocodile River catchment, and it will be return flow with increased differential return flow in 2023 and 2016. Table App. 8.6-4 shows the distribution of return flow to each dams and the Crocodile River.

Table App. 8.6-4 Distribution of Return Flow to Each Dams and Crocodile River

No.	Place of Return Flow	2016 Return Flow		2023 Return Flow		2023-2016 Return Flow	
		mil.m ³ /year	m ³ /sec	mil.m ³ /year	m ³ /sec	mil.m ³ /year	m ³ /sec
1	Roodekopjes Dam	154.01	4.88	196.93	6.24	42.92	1.36
2	Klipvoor Dam	94.56	3.00	166.90	5.29	72.34	2.29
3	Vaalkop Dam	11.25	0.36	11.25	0.36	0.00	0.00
4	Crocodile River	12.04	0.38	16.86	0.53	4.82	0.15
Total		271.86	8.62	391.95	12.43	120.09	3.81

Source: JST

The increase of return flow from 2016 to 2023 is 120.09 mil.m³/year (=3.81 m³/sec).

1) Return Flow into Existing Dams

The future return flow is predicted as described in above, but the return flow from the existing WWTW is already reflected of the dam inflow in the Crocodile River basin. Although it possesses WWTW construction status and return flow records as of 2016, there is no information up to the construction year of WWTW. As for the current inflow record of dams, there are mixed periods of with return flow and without return flow

from WWTW.

Therefore, in order to ensure consistency of the dam inflow data, the transition of return flow is examined for each dam. The verification of the transition of return flow is carried out by the runoff coefficient (coefficient of rainfall and dam inflow).

Table App. 8.6-5 shows the runoff coefficient of 3 dams in the Crocodile River basin. Since there is fluctuation in the runoff coefficient of each year, the 5-year average runoff coefficient is calculated.

Table App. 8.6-5 Runoff Coefficient of 3 Dams in the Crocodile River Basin

Year	Dam Inflow (m ³ /sec)			Rainfall (mm) at Mokolo.D	Dam Inflow (mm)			Runoff Coefficient (%)			Runoff Coefficient (%), 5-year Average		
	Klipvool	Vaalkop	Roodekopjes		Klipvool	Vaalkop	Roodekopjes	Klipvool	Vaalkop	Roodekopjes	Klipvool	Vaalkop	Roodekopjes
1984/85	1.08	0.72	0.99	667	5.6	3.7	5.2	0.83	0.55	0.78	1.74	0.46	1.44
1985/86	0.75	0.11	0.85	410	3.8	0.6	4.5	0.93	0.14	1.09	1.74	0.46	1.44
1986/87	3.35	0.98	1.84	549	17.2	5.1	9.6	3.13	0.93	1.76	1.74	0.46	1.44
1987/88	1.69	0.50	1.82	540	8.7	2.6	9.5	1.60	0.48	1.77	1.74	0.46	1.44
1988/89	2.94	0.28	2.36	676	15.0	1.5	12.3	2.22	0.22	1.83	1.74	0.46	1.44
1989/90	2.24	0.32	2.42	485	11.5	1.6	12.6	2.36	0.34	2.61	1.94	0.44	2.18
1990/91	3.13	1.33	3.35	546	16.0	6.9	17.5	2.93	1.26	3.20	1.94	0.44	2.18
1991/92	0.70	0.06	1.33	442	3.6	0.3	7.0	0.81	0.07	1.58	1.94	0.44	2.18
1992/93	1.26	0.19	1.17	445	6.5	1.0	6.1	1.45	0.22	1.37	1.94	0.44	2.18
1993/94	2.34	0.35	2.31	559	12.0	1.8	12.1	2.14	0.32	2.16	1.94	0.44	2.18
1994/95	1.92	1.10	2.08	597	9.8	5.7	10.9	1.65	0.96	1.83	4.14	2.21	9.18
1995/96	12.49	5.09	19.02	779	63.9	26.3	99.5	8.21	3.38	12.78	4.14	2.21	9.18
1996/97	5.86	7.48	21.48	650	30.0	38.7	112.4	4.62	5.95	17.30	4.14	2.21	9.18
1997/98	2.53	0.20	5.43	364	13.0	1.1	28.4	3.56	0.29	7.80	4.14	2.21	9.18
1998/99	3.17	0.56	7.24	612	16.2	2.9	37.9	2.65	0.48	6.19	4.14	2.21	9.18
1999/00	12.45	4.17	26.69	874	63.8	21.6	139.6	7.29	2.47	15.97	3.45	1.38	8.66
2000/01	3.60	0.70	9.82	419	18.4	3.6	51.4	4.40	0.86	12.27	3.45	1.38	8.66
2001/02	1.64	1.84	6.96	546	8.4	9.5	36.4	1.54	1.75	6.67	3.45	1.38	8.66
2002/03	1.74	0.16	2.20	452	8.9	0.8	11.5	1.97	0.19	2.55	3.45	1.38	8.66
2003/04	2.50	1.96	6.95	622	12.8	10.1	36.4	2.06	1.63	5.84	3.45	1.38	8.66
2004/05	2.58	0.44	4.47	-	13.2	2.3	23.4	-	-	-	4.15	0.93	8.20
2005/06	6.83	1.53	9.96	-	35.0	7.9	52.1	-	-	-	4.15	0.93	8.20
2006/07	1.33	0.38	4.26	346	6.8	2.0	22.3	1.96	0.57	6.44	4.15	0.93	8.20
2007/08	9.57	2.53	12.80	718	49.0	13.1	67.0	6.82	1.82	9.32	4.15	0.93	8.20
2008/09	5.23	0.57	12.26	726	26.8	3.0	64.1	3.68	0.41	8.83	4.15	0.93	8.20
2009/10	7.01	2.67	18.57	1441	35.9	13.8	97.2	2.49	0.96	6.74	4.44	1.94	13.09
2010/11	8.11	7.30	24.19	572	41.5	37.8	126.6	7.26	6.60	22.14	4.44	1.94	13.09
2011/12	2.77	0.69	9.89	-	14.2	3.5	51.7	-	-	-	4.44	1.94	13.09
2012/13	3.71	0.27	10.92	662	19.0	1.4	57.1	2.87	0.21	8.64	4.44	1.94	13.09
2013/14	7.36	0.00	20.80	733	37.7	0.0	108.9	5.15	0.00	14.86	4.44	1.94	13.09
2014/15	3.61	0.08	9.46	533	18.5	0.4	49.5	3.47	0.08	9.29	-	-	-
2015/16	3.00	0.41	8.21	-	15.4	2.1	43.0	-	-	-	-	-	-
2016/17	4.70	8.28	17.08	-	24.1	42.8	89.3	-	-	-	-	-	-

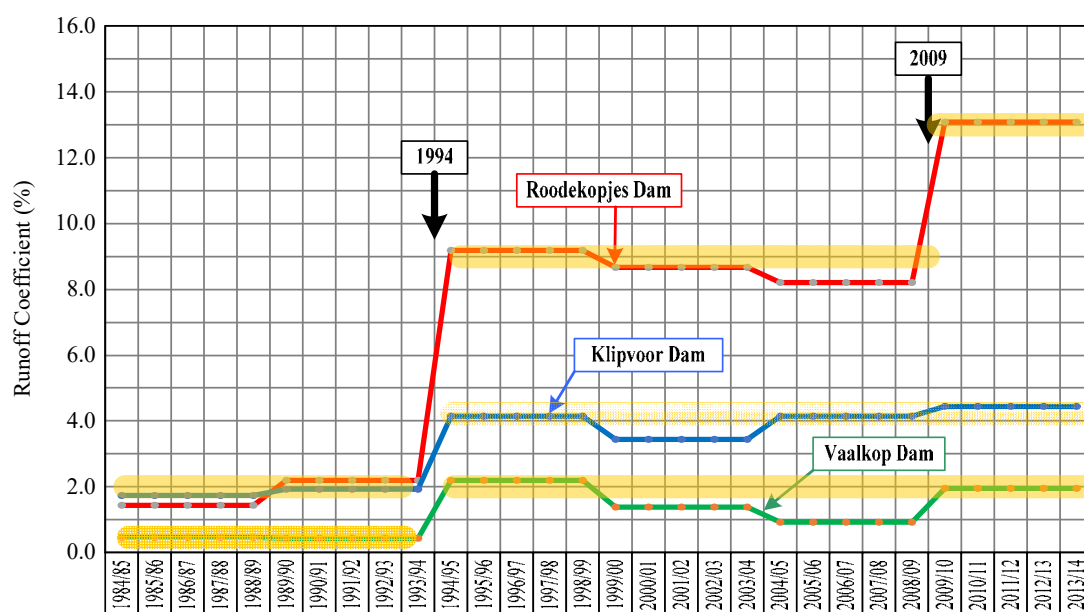
Dam Inflow (m³/sec) : Annual mean dam inflow (m³/sec) record from DWS

Rainfall (mm) : Rainfall at Mokolo dam (mm) record from DWS

Runoff Coefficient (%) : = Dam Inflow (mm) / Rainfall (mm)

Source: JST

Figure App. 8.6-4 shows the 5-year average runoff coefficient.



Source: JST

Figure App. 8.6-4 5-year Average Runoff Coefficient of 3 Dams in the Crocodile River Basin

Runoff coefficient is nearly constant, and it does not change year by year. The change in the runoff coefficient in Figure App. 8.6-4 is judged to be due to return flow. Roodekopjes dam has changed runoff coefficient in 1994 and 2009, Klipvoor and Vaalkop dams have a change runoff coefficient in 1994.

Return Flow of Roodekopjes Dam

The return flow of Roodekopjes dam in 2016 is 4.88 m³/sec (see Table App. 8.6-4). The runoff coefficient from 2010 to 2014 is 13% (see Figure App. 8.6-4). Estimate the return flow of Roodekopjes Dam before 2009, uses return flow of 4.88 m³/sec and runoff coefficient of 13%. The 5-year average runoff coefficient in Figure App. 8.6-4 is 2% from 1984 to 1994, and 9% from 1995 to 2009. Estimated return flow before 2009 at this coefficient is as shown in Table App. 8.6-6.

Table App. 8.6-6 Estimated Return Flow before 2009 in the Crocodile River Basin

Period	Return Flow (m ³ /sec)	Runoff Coefficient (%)	Compare with 2016 (%)
1984-1994	0.75	2	15 (=2%/13%)
1995-2009	3.38	9	69 (=9%/13%)
2010-2016	4.88	13	100 (=13%/13%)

Source: JST

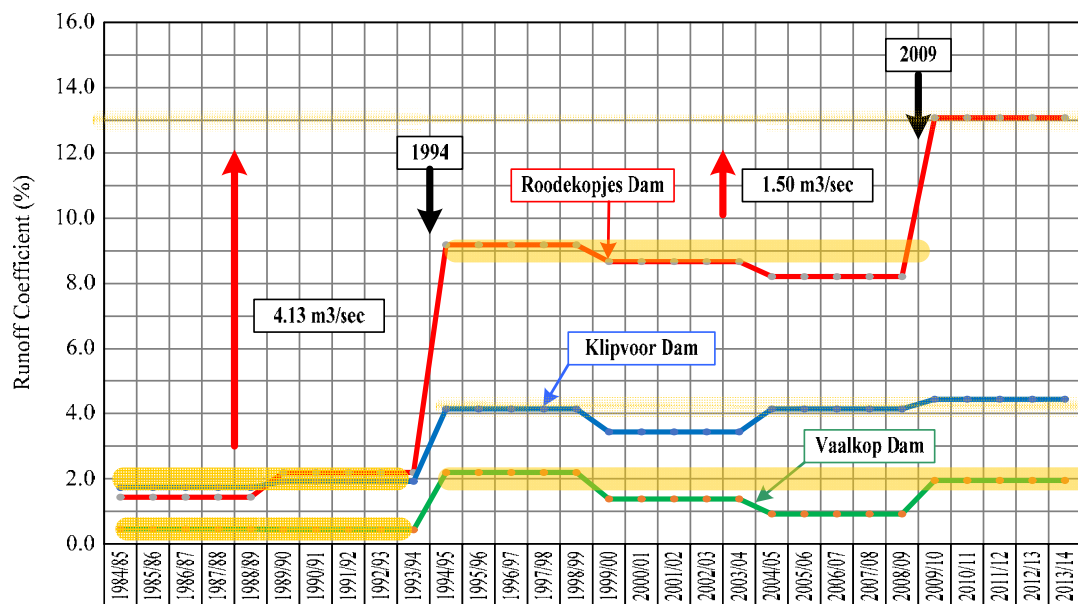
Add the difference return flow to the inflow of Roodekopjes dam under the condition that the current WWTW is constructed in past return flow. The added difference return flow is shown below.

1984 - 1994 : + 4.13 m³/sec (= 4.88–0.75)

1995 - 2009 : + 1.50 m³/sec (= 4.88–3.38)

2010 - 2016 : + 0.00 m³/sec (= 4.88–4.88)

Figure App. 8.6-5 shows difference return flow mentioned above.



Source: JST

Figure App. 8.6-5 Difference Return Flow in the Crocodile River Basin

Return Flow of Klipvoor Dam, Vaalkop Dam and Downstream of Crocodile River

Return flow of Klipvoor, Vaalkop dams and downstream of the Crocodile River was considered as well as Roodekopjes dam. Return flow was added from 1984 to 1994 (There is no change of runoff coefficient in 2009 for this 2 dams). Downstream dams of Crocodile River has no data, therefore, return flow of downstream

of Crocodile River is similar to Klipvoor and Vaalkop dams.

Klipvoor Dam : 1984 - 1994 ; + 1.50 m³/sec (= 3.00–1.50)
 Vaalkop Dam : 1984 - 1994 ; + 0.27 m³/sec (= 0.36–0.09)
 Crocodile River : 1984 - 1994 ; + 0.28 m³/sec (= 0.38–0.10)

Past Return Flow Consider to Water Balance Calculation

Table App. 8.6-7 summarizes the difference return flow of Roodekopjes Dam, Klipvoor Dam, Vaalkop Dam and downstream dams of Crocodile River. This difference return flow is added to the inflow of 3 dams and downstream dams of Crocodile River for water balance calculation.

Table App. 8.6-7 Difference Return Flow in the Crocodile River Basin

Location	Return Flow (m ³ /sec)		
	1984-1994	1995-2009	2010-2016
Roodekopjes Dam	4.13	1.50	-
Klipvoor Dam	1.50	-	-
Vaalkop Dam	0.27	-	-
Crocodile River	0.28	-	-
Total	5.98	1.50	0.00

Source: JST

Appendix 9.1 South African Codes and Eskom Specific Codes

(1) South African codes

South African codes regarding engineering, procurement and supply of FGD is shown in Table App9.1-1

Table App9.1-1 South African codes regarding engineering, procurement and supply of FGD

Number	Revision	Title
SANS 10100		The structural use of concrete
SANS 10108		The Classification of Hazardous Locations and the Selection of Apparatus for Use in such Locations
SANS 60079-10		Electrical apparatus for explosive gas atmospheres Part 10: Classification of hazardous areas
SANS 101003-2004		Noise Level
SANS 10142-1		The Wiring of Premises, Part 1: Low-voltage installations
SANS 10160		Basis of structural design and actions for buildings and industrial structures
SANS 10162		The structural use of steel
SANS 10164		The structural use of masonry
SANS 10164-2		The structural use of masonry, Part 2: structural design and requirements for reinforced and prestressed masonry
SANS 1200 HC		Corrosion protection of structural steelwork
SANS 1411-1		Materials of Insulated Electric Cables and Flexible Cords, Part 1: Conductors
SANS 1411-7		Materials of Insulated Electric Cables and Flexible Cords, Part 7: Polyethylene (PE)
SANS 1574		Electric cables - Flexible Cords and Cables
SANS 1632-1		Batteries, Part 1 - General information - Definitions, abbreviations and symbols
SANS 1632-2		Batteries, Part 2 - Vented-type stationary lead-acid cells and batteries
SANS 1632-3		Batteries, Part 3 - Vented-type prismatic nickel-cadmium cells and batteries
SANS 1632-4		Batteries, Part 4 - Valve regulated type stationary lead-acid cells and batteries
SANS 1652		Battery Chargers - Industrial Type
SANS 10109		Concrete floors
SANS 10400		The application of the National Building Regulations
SANS 1200		set Standardized specification for civil engineering construction
SANS 60034-1		Rotating Electrical machines Part 1 - Rating and performance
SANS 60079-14		Explosive atmospheres Part 14: Electrical installations design, selection and erection
SANS 60794-1-1		Optical fiber cables Part 1-1: Generic specification - General
SANS 60794-1-2		Optical fiber cables Part 1-2: Generic specification - Basic optical cable test procedures
SANS 61312		Protection against lightning electromagnetic impulse
SANS 61312-1		Protection against lightning electromagnetic impulse Part 1: General Principles
SANS 61312-2		Protection against lightning electromagnetic impulse Part 2: Shielding of structures, bonding inside structures and earthing
SANS 61312-3		Protection against lightning electromagnetic impulse Part 3: Requirements of surge protective devices (SPDs)
SANS 61312-4		Protection against lightning electromagnetic impulse Part 4: Protection of equipment in existing structure
SANS 1085:2004		Wall outlet boxes for the enclosure of electrical accessories
SANS 1433-1-2:2008		Electrical terminals and connectors
SANS 10198-1-5:2004		The selection, handling and installation of electric power cables of rating not exceeding 33 Kv
SANS 60034-1-34:2010		Rotating electrical machines
SANS 60044-1-8:2003		Instrument transformers
SANS 60050-441:1984		International electrotechnical vocabulary Chapter 441: Switchgear, controlgear and fuses
SANS 60072-1-3:1991		Dimensions and output series for rotating electrical machines
SANS 60076-1-21:2011		Power transformers

SANS 60086-1-5:2011		Primary batteries
SANS 60099-1-8		Surge arresters
SANS 60204-1-32:2009		Safety of machinery
SANS 60227-1-5:2006		Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V
SANS 60269-1-6:2010		Low-voltage fuses
SANS 60282-1-2:2010		High-voltage fuses
SANS 60287-1-3:2010		Electric cables - Calculation of the current rating
SANS 60309-1-4:2012		Plugs, socket-outlets and couplers for industrial purposes
SANS 60439-1-5:2004		Low-voltage switchgear and controlgear assemblies
SANS 60502-4:2006		Power cables with extruded insulation and their accessories for rated voltages from 1 Kv (Um = 1,2 Kv) up to 30 Kv (Um = 36 Kv) Part 4
SANS 60614-2-3-14:1990		Specification for conduits for electrical installations
SANS 60909-0-4: 2010		Short-circuit currents in three-phase a.c. systems
SANS 60947-1-8:2012		Low-voltage switchgear and controlgear
SANS 61800-1-8		Adjustable speed electrical power drive systems
SANS 61869-1-5:2013		Instrument transformers
SANS 61936-1		Power installations exceeding 1 Kv a.c
SANS 62262:2004		Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
SANS 60529:2001 / IEC 60529:2001		Degrees of protection provided by enclosures (IP Code)
SANS 10329:2004		The design and construction of sectional steel tanks for storage of liquids at or above ground level
SANS 10252-1		Water supply and drainage for buildings Part 1: Water supply installations for buildings
SANS 966-1		Components of pressure pipe systems Part 1 : Unplasticized poly(vinyl chloride) (PVC-U) pressure pipe systems

➤ Eskom specific codes

Eskom specific codes regarding engineering, procurement and supply of FGD is shown in Table App9.1-2

Table App9.1-2 Eskom Specific codes regarding engineering, procurement and supply of FGD

Number	Revision	Title
0.00/1310		Standard Power & Control Cable Code
36-721		Generation MV And LV Protection Philosophy For Eskom Power Stations
240-56176852		Essential Power Supplies For Power Stations Standard
240-56247004	1	Thermal Insulation Standard
0.54/393		Earthing Standard
ANSI/ISA-77 20-1993		Fossil Fuel Power Plant Simulators
EED_GTD_C&I_007		EED/GTD Technical Guideline: Modes of Operation - Local & Remote
240-56355808		Guideline for Ergonomic Design of Power Station Control Suites
GGSS 0462		Quality Requirements For Engineering And Construction Works In Generation
240-56227443	5	Requirements for Power and Control Cables for Power Stations
240-56357518		Power Station electric Motors Procurement Standard
240-56356530		Environmental Conditions For Process Control Electronic Equipment Used at Power Stations
240-56227516	4	Specification for LV Switchgear and Control Gear Assemblies and Associated Equipment for Voltages up to and including 1000 V AC and 1500 V DC
240-53114214	1	Station cabling and racking standard
240-56356396	1	Earthing and lighting standard
GGSS 0690	0	Medium Pressure Pipelines
GGSS 0839		Eskom specification for self contained battery and charger
240-53114256		Eskom specification for battery stands
GGSS 1427		Instrument Piping
N.PSZ 45-698		Engineering Drawing Office and Engineering Documentation Standard
NRS 042		Guide For the Protection of Electronic Equipment against Damaging Transients

NWP 3058, VOL 6		Battery Test Procedure For Acceptance and Type Testing of Lead Acid Vented Stationery Cells and Valve Regulated Sealed Lead Acid Cells
NWS 1582	1	Labels on Control Relay Panels and other Indoor and Outdoor Equipment
240-49230111		Hazard and Operability (HAZOP) Study Guideline
240-49230046	0	Failure Mode Effects (And Criticality) Analysis (FMECA) Guideline
240-56242363		Emission Monitoring and Reporting Standard
240-56242850		Continuous Emission Monitoring System Selection Standard
IEEE 1050 -2004		IEEE Guide for Instrumentation and Control Equipment Grounding in Generating Stations
IEEE Green Book 142 -2007		IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
ISO 898-1		Mechanical Properties of fasteners made of carbon steel and alloy steel - Part 1: Bolts, screws and studs
ISO 898-5		Mechanical Properties of fasteners made of carbon steel and alloy steel - Part 5: Set screws & similar under tensile stresses threaded fasteners not
ISO 9000: 2005		Quality Management System - Fundamentals and Vocabulary
ISO 9001: 2008		Quality Management Systems - Requirements
ISO 10006:2003		Quality Management System - Guideline for Quality Management in Projects
ISO 10005: 2005		Quality Management Systems - Guidelines for Quality Plans Standard
NERSA GRID CODE		NERSA - South African Grid Code
NRS 013:2007		Medium-voltage cables
32-9		Definition of Eskom Documents
32-85		Eskom Information Security Policy
32-188		Procurement and Supply Chain Management Procedure
32-391		Integrated Risk Management Framework and Standard
32-894		Server Rooms and Data Centres Standard
36-193		The Management of Plant Simulations
240-56355910		The Management of Plant Software
36-776		Environmental conditions of Process Control Equipment used in Power Stations
240-56355541		Control System Computer Equipment Habitat Requirements
39-59		Project/Process Quality plan
39-60		Contract Quality Requirements Standard
240-53114190		Internal Audit Standard
240-53114186		Document and Record Management Procedure
249-53114194		Control of Non-conforming Product
39-65		Quality Management System Policy
39-66		Quality Management System Manual
240-53114192		Corrective and Preventive Action Standard
39-71		Quality Control Plan Standard
240-55896482	5	Design of Vertical Flat Base and Horizontal Steel Storage Tanks Guidelines
QM-1		Supplier Audit Standard
240-53113685		Design Review Procedure
240-53114002		Engineering Change Procedure
240-53114026		Project Engineering Change Management Procedure
32-1155		Eskom Standard Project Life Cycle Model Policy
240-55864784		Guideline for the preparation of a specification for an Expert Chemistry System (ECS)
240-5584789		Analytical Chemistry Laboratory Method Validation Guideline
240-55864833		Chemistry Manual for Auxiliary and Ancillary Cooling Water Systems
240-55864830		Design Guideline for Bulk Liquid Chemical Offloading/ Unloading Systems
240-55864855		Design Guideline for Semi Bulk Liquid Chemical Handling
240-55864827		Specification for Flexible Hose Suitable for Use with Aggressive Fluids (Ammonia, Sodium Hydroxide and Sulphuric Acid)
ISO 8573.1		Guide to Compressed air systems ASME VIII Pressure Vessels
GG5 0529		Compressed Air Testing
TBD GGR 0992		Plant Safety Regulations
240-52843902		Engineering Terms and Abbreviation Standard
240-56356376		Procedure for On-site Commissioning of Low Pressure Systems
GGSS 0317		Specification for storage Tanks
ESKSCAAC6		Pipeline Identification Specification
240-56227902		Dry Type Transformers Used In Power Stations Specification
240-56176953		Acde Board Installation And Commissioning Manual
240-56177006		Acde Board Maintenance Manual
240-56177100		Acde Systems User Guideline

240-56177186		Design Guide For Power Station Battery Rooms Guideline
240-56177396		Battery Capacity Test Manual
240-56178099		Battery Charger Installation And Commissioning Manual
240-56176078		Battery Commissioning Manual
240-56176082		Battery Installation Manual
240-56176097		Cable Schedule Template
240-55714363		Coal Fired Power Stations Lighting And Small Power Installation Standard
TBD 369		Dc And Ups Settings Document
240-56356396		Earthing And Lightning Protection Standard
240-56355574		Earthing Standards
240-56227648		Maintenance Of L M H Range Nickel Cadmiu Batteries Work Instruction
240-56227711		Maintenance Of Vantage Nickel Cadmium Cells Standard
TBD 406		Mv Load Motor Parameters
240-56227773		Switchgear Schedule Template
240-56227778		Fault Current Calculations Rating Switch Gear Standard
240-56356445		Earthing And Lightning Protection Of Equipment Moving On Rails Coal Stackers Reclaimers And Ash Stackers Guideline
240-56227780		Installation Of Cables And Cable Racks At Power Stations Specification
240-56227929		Power Station Standby Diesel Generators Specification Standard
240-56239133		High Pressure Pipework Supports Standard
240-56356455		Rectifier Specification
240-56227788		Safe Disposal Of Redundant Batteries Work Instruction
240-53114248		Battery Chargers Specification
240-53114294		Flat Plate Lead Acid Cells Specification
240-56227809		Specification For Lv Power And Control Cable Rated Voltage 600 1000V Specification
240-53113666		Specification For Medium Power Transformers Used In Power Stations Schedule A B
240-56227823		Medium Voltage Impregnated Paper And Xlpe Insulated Cables Specification
240-56356460		Perimeter Security Lighting At Eskom Installations Standard
240-56356465		Switchboard List Template
240-56227830		The Safe Handling Of Batteries And Electrolyte Work Instruction
240-56228095		Transportation Of Electrolyte And Battery Cells Standard
TBD 439		Ups And Dc Schedule
240-56227573D		Ac Metal Enclosed Metal Clad Swithgear And Control Gear For Voltages Above 1Kv Up To And Including 52Kv Specification
240-56227881		Arc Flash Protective Clothing And Personal Protective Equipment Against The Thermal Hazard Of Electrical Arc Specification
240-56227883		Battery Test And Type Testing Of Lead Acid Vented Stationary Cells And Valve Regulated Sealed Lead Acid Cells Work Instruction
240-56356472		Clean Conditions For Power Transformer Outage Standard
240-56356486		Conveyor Belt Interface To Ac Metal Enclosed Switchgear And Control gear For 1Kv to 52 Kv Specification
240-56356491		Dc Earth Fault Detection Manual
240-56356510		Definitions Of Terms Applicable To Dc Emergency Supplies Standard
240-56356523		Section 1 Mv And Lv Distribution System Earthing Standard
240-56535950		Electrical Plant Information Files Standard
240-56356530		Environmental Conditions For Process Control Electronic Equipment And Components Used At Power Stations Manual
240-56227426		Management Of Power Station Mv And Lv Protection And Settings Standard
240-56227430		Eskom' s Undervoltage Philosophy For Large Fossil Fuel Power Stations Guideline
240-56356411		Fire Barrier Seals For Electrical Cable Installations At Power Plants Standard
240-56227515		Eskom Under Voltage Philosophy For Large Fossil Fuel Power Stations Guideline
240-56227520		Large Power Generator Transformers In Power Stations Specification
240-56227923		Quality Requirements For Stationary Vented Nickel Cadmium And Lead Acid Batteries For Power Stations Standard
240-57859177		Control Of Clean Conditions When Working On Generators And Large Motors Standard
240-56536488		Control Of Works Performed On Large Power Transformers Standard
TBD 486		Insulation Testing Of Mv Metal Clad Switchgear
240-56357314		Interlocking On Ac Metal Enclosed Switchgear And Control gear For Voltages 1Kv To 52 Kv Specification
240-56357332		Licensing Generating Facilities Work Instruction
240-56357346		List Of Approved Relays For Use On Power Stations Standard
240-56357366		Long Term Plant Health Indicators Manual

240-56535959		Management Of Emergency Ac And Dc Supplies At Power Stations Standard
240-56535964		Management Of Power Station Mv And Lv Protection Standard
240-56356630		Management Of Generation Protection Standard
240-56536505		Management Of Hazardous Locations Standard
240-56535978		Management Of Large Generators During Outages And Works Standard
240-56357421		Measurements And Metering Standard
240-56357424		Mv And Lv Switchgear Protection Standard
TBD 504		Medium Voltage Switchboard Maintenance
TBD 505		Management Of Safety Risks Of Mv Switchboard
240-56357438		Mv Motor Heater Interface To Ac Metal Enclosed Switchgear And Control gear For Voltages 1Kv To 52Kv Specification
240-60238757		On Site Dry Out Of Power Transformers Within Generation
240-56357462		Guideline On Shaft Voltage And Current Monitoring Manual
240-56357489		Plant Related Abbreviations For Inter System Use Standard
240-56535985		Power Station Medium Voltage Switchgear Management Standard
240-56357579		Precommissioning Of Large Power Transformers Standard
240-56357641		Electricity Impurity Tests For Lead Acid Batteries At Power Stations Work Instruction
240-56357725		Water Impurity Tests For Lead Acid Batteries And Nickel Cadmium Batteries Standard
240-56356630D		Management Of Generator Protection Standard
240-56356668		Maintenance Of Power Station Earthing And Earth Mats Guideline
240-56356675		Partial Discharge Testing Guideline
240-56356687		Transformer Long Term Plant Health Indicator Guideline
240-56356696		Monitoring Generator By Gas Analysis Guideline
240-56357019		Replacement Of Above Ground Copper Earthing Networks With Aluminum Guideline
240-56357281		Lay Up Mothballing Of Generation Electrical And Process Control Equipment In Power Stations Manual
240-56227292		Specification For Corrosion Protection Of Plant And Equipment With Coatings Specification
240-56227389		Specification For Loose Starters For Power Stations For Voltages Up To 1000V Ac And 1200V Dc Specification
240-56227394		Portable Earthing Equipment Specification
240-56227409		Refurbishment Of Battery Chargers At Power Stations Specification
240-56227419		Actions And Precautions To Be Followed When Receiving A Buccholtz Alarm Standard
240-56227424		Commissioning And Recommissioning Of Power Transformers Standard
240-56358929		Electronic Protection And Fault Monitoring Equipment For Power Systems Standard
240-56358993		Maintenance Of Power Transformers Standard
240-56359013		Maintenance Of Substation Isolators Standard
240-56359053		Transformer Hand Condition Monitoring Standard
240-56359083		Requirements For Measurement And Metering Systems For All Eskom Power Stations In Generation Standard
240-56359118		Low Voltage Variable Speed Drive Control Equipment Standard
240-56359660		Specification For Medium Voltage Motor Switching Devices Standard
240-56360031		Static Uninterruptible Power Supplies Specification
240-56360034		Stationary Vented Lead Acid Batteries Standard
240-56360086		Stationary Vented Nickel Cadmium Batteries Standard
240-56360387		Storage Of Power Station Electric Motors Standard
240-56361164		Sweep Frequency Response Analysis Testing Guideline
240-56361242		Non Phase Segregated Gas Insulated Ac Metal Enclosed Switchgear And Control gear for 1Kv To 52Kv Specification
240-56361296		Circuit Breakers To Independent Supplies In Ac Metal Enclosed Switchgear And Control gear For 1Kv And Up Specification
240-56361382		Transformer Hand Condition Monitoring Guideline
240-56361422		Transformer Insulation Moisture Measurement Guideline
240-56361435		Transport Of Power Station Electric Motors Standard
240-56361454		Undervoltage Protection Standard
240-56357751		Protection Of Electronic Equipment Against Damage By The Discharge Of Static Electricity Work Instruction
240-56357765		Radio Station Earthing And Bonding Standard
240-56357787		Diesel Alternator Sets For Fixed Installations Specification
240-56358788		Refurbishment Of Generator Stators For Steam Or Gas Turbines Standard
240-56178825		Requirements For Transportation And Movement Of Large Electrical Equipment Standard
TBD 591		Responsibilities For The Management Of Transformer

TBD 592		Rotary Current Asynchronous Motors Technical Requirements
240-56179027		Safety Measures Personal Protective Equipment for Thermal Hazard Of Electrical Arc For Metal Clad Switchgear Up To 11Kv Standard
240-56358900		Sampling And Testing Of Mineral Insulating Oil For Power Transformers Within Generation Division Standard
240-57859036		Lv Motor Deviation Schedule Template
240-57859043		Lv Motor Document Submittal Schedule Vdss Template
240-57859046		Lv Motor Technical Schedule Template
240-57617998		Typical General Arrangement Template
240-57617975		Procurement Of Power Station Low Voltage Electric Motors Specification Standard
240-64430501		Low Voltage Speed Drive Control Equipment Standard
BS 8007		Code of practice for design of concrete structures for retaining aqueous liquids
ESK PB AAQ 3	2	Interior specifications for Eskom
32-402		Energized perimeter fence
200-6166		Backfill specification
200-26680		Architectural technical specification
200-37830		Medupi User Requirement Specification
200-42385		Master Document List
84CIVL007		Conceptual architectural design specifications for Structures and other Buildings
84CIVL036		Stormwater design criteria
84CIVL037		Sewer network
84CIVL053		Concrete specification
240-56364537		Design of steel structures standard
240-56364542		Standard for reinforced concrete foundations and structures
240-56364545		Structural design and engineering standard
240-53458817		Design bulk material handling plant
ISO 5048:1989		Continuous mechanical handling equipment. Belt conveyors with carrying idlers -Calculation of operating power and tensile forces.
240-55864434		Storage and Handling of Conveyor Belting in Eskom Guideline
240-55864498		Operation and Selection of Fluid and Mechanical Couplings Specification
240-55864499		Specification for Belt Conveying Systems (Rev 1) Standard
240-55864504		Belt Conveyor Structural Steelwork and Welding Specification
240-55864505		Erection of belt Conveyor Mechanicals Specification
240-55864509		Ceramic Lagging for Pulleys Specification
240-55864544		Quality Requirements for the Purchasing of Conveyor Belting Guideline
240-55864546		Ceramic Lagging for Pulleys Guideline
240-55864551		Ash Stacker and Tripper Equipment Standard
240-55864562		Steelcord Reinforced Conveyor Belting Specification
240-55864564		Conveyor Belt Rolls Standard
240-55864521		Transfer Houses Cladding Guideline Manual
240-55864479		Belt Conveyor Chute Design Manual
240-55864503		Belt Conveyor Mechanical Components Standard
240-55864574		On-site Hot Repairs on Steel Cord Reinforced Conveyor Belt Standard
240-55864585		Textile Ply Belt Splicing Quality Control Standard
240-55864586		Steel Cord Belt Splicing Quality Control Standard
240-55864587		Conveyor Belt Manufacturing Repairs Standard
240-55864550		Mass Meters for Coal Measurement in Power Stations Design Specification
240-55864553		Magnetic Separators and Metal Detectors Specification
240-55864558		General Purpose Textile Reinforced Conveyor Belting Standard
240-56737448		Fire Detection and Life Safety Design Standard
240-56737654		Inspection Testing and Maintenance of Fire Detection Systems Standard
240-54937450		Fire Protection and Life Safety Design Standard
240-54937454		Inspection Testing and Maintenance of Fire Protection Systems Standard
240-54937439		Fire Protection - Detection Assessment Standard
ESKAMAAA1		Corporate Identity Document
N.PSZ 45-45		Kraftwerk Kennzeichen System (KKS) Key Part - Fossil Power Station
N.SSZ 45-629		KKS Plant Labeling Specification
200-4190		The Application of KKS Plant Coding
200-5343		Medupi Power Station Project - Standard Abbreviations
200-41103		Medupi Diesel Generator Operating, Control and Protection Philosophy
200-35586		Medupi MV switchgear Interlocking philosophy
200-50085		Medupi PS Project - Chop-over Philosophy
200-19408		Medupi Power Station, Auxiliary power system description
200-72508		Low voltage switchgear protection and control philosophy for Medupi Power Station,

240-53573084		Design Structures and Buildings
240-53573086		Design Roads and Railways
240-53573079		Perform Geotechnical Engineering
240-53573085		Design Dams, Waterways and Hydro



environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Private Bag X 447 · PRETORIA · 0001 · Environment House · 473 Steve Biko Road, Arcadia · PRETORIA

DEA Reference: 14/12/16/3/3/2/1060

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E-mail: HerbstDL@eskom.co.za

PER E-MAIL / MAIL

Dear Ms Herbst

APPLICATION FOR ENVIRONMENTAL AUTHORISATION IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998), AS AMENDED (NEMA); GOVERNMENT NOTICES. R982, R983 AND R984, AS AMENDED: PROPOSED RETROFITTING OF A FLUE GAS DESULPHURISATION (FGD) SYSTEM AT THE MEDUPI POWER STATION WITHIN LEPHALALE LOCAL MUNICIPALITY, LIMPOPO PROVINCE

With reference to the above application, please be advised that the Department has decided to grant an environmental authorisation to you. The Environmental Authorisation (EA) and reasons for the decision are attached herewith.

In terms of Regulation 4(2) of the National Environmental Management Act: the Environmental Impact Assessment Regulations, 2014, as amended (the EIA Regulations), you are instructed to notify all registered interested and affected parties, in writing within 14 (fourteen) days of the date of this EA, of the Department's decision as well as the provisions regarding the submission of appeals that are contained in the Regulations.

In terms of the Promotion of Administrative Justice Act, 2000 (Act No 3 of 2000), you are entitled to the right to fair, lawful and reasonable administrative action; and to written reasons for administrative action that affects you negatively. Further your attention is drawn to the provisions of the Protection of Personal Information Act, 2013 (Act no. 4 of 2013) which stipulates that the Department should conduct itself in a responsible manner when collecting, processing, storing and sharing an individual or another entity's personal information by holding the Department accountable should the Department abuses or compromises your personal information in any way.

Your attention is drawn to Chapter 2 of National Environmental Management Act, 1998 (Act No. 107 of 1998) National Appeal Regulations published under Government Notice R993 in Government Gazette No. 38303 dated 08 December 2014 (National Appeal Regulations, 2014), which prescribe the appeal procedure to be followed. Kindly include a copy of this document (National Appeal Regulations, 2014) with the letter of notification to interested and affected parties in this matter.

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Should any person wish to lodge an appeal against this decision, he/she must submit the appeal to the appeal administrator, and a copy of the appeal to the applicant, any registered interested and affected party, and any organ of state with interest in the matter within 20 days from the date that the notification of the decision was sent to the registered interested and affected parties by the applicant; or the date that the notification of the decision was sent to the applicant by the Department, whichever is applicable.

Appeals must be submitted in writing in the prescribed form to:

Director: Appeals and Legal Review of this Department at the below mentioned addresses.

By email: appealsdirector@environment.gov.za

By hand: Environment House
473 Steve Biko Street
Arcadia
Pretoria
0083; or

By post: Private Bag X447
Pretoria
0001

Please note that in terms of Section 43(7) of the NEMA, the lodging of an appeal will suspend the environmental authorisation or any provision or condition attached thereto. In the instance where an appeal is lodged, you may not commence with any activity authorised in the EA until such time that the appeal is finalised.

To obtain the prescribed appeal form and for guidance on the submission of appeals, please visit the Department's website at https://www.environment.gov.za/documents/forms#legal_authorisations or request a copy of the documents at appealsdirector@environment.gov.za.

Yours faithfully



Mr Sabelo Malaza
Chief Director: Integrated Environmental Authorisations
Department of Environmental Affairs
Date: 06/09/2018

CC:	Dr Mathys Vosloo	Zitholele Consulting Pty Ltd	Tel: 011 270 2079	Email: mathysv@zitholele.co.za
	Mr Tsholedi Joel	Limpopo Economic Development,	Tel: 015 290 7134	Email: NgoashengTJ@ledet.gov.za
	Ngoasheng	Environment and Tourism		





environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Environmental Authorisation

In terms of regulation 25 of the Environmental Impact Assessment Regulations, 2014

Medupi Power Station Flue Gas Desulphurisation (FGD) Retrofit Project

Waterberg District Municipality

Authorisation register number:	<i>14/12/16/3/3/2/1060</i>
Last amended:	<i>First issue</i>
Holder of authorisation:	<i>ESKOM HOLDINGS SOC LIMITED</i>
Location of activity:	<i>LIMPOPO PROVINCE: Within Ward 3 of Lephalale Local Municipality</i>

This environmental authorisation does not negate the holder of the authorisation's responsibility to comply with any other statutory requirements that may be applicable to the undertaking of the activity.

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Decision

The Department is satisfied, on the basis of information available to it and subject to compliance with the conditions of this environmental authorisation, that the applicant should be authorised to undertake the activities specified below.

Non-compliance with a condition of this environmental authorisation may result in criminal prosecution or other actions provided for in the National Environmental Management Act, 1998 and the EIA regulations.

Details regarding the basis on which the Department reached this decision are set out in Annexure 1.

Activities authorised

By virtue of the powers conferred on it by the National Environmental Management Act, 1998 (Act No.107 of 1998) and the Environmental Impact Assessment Regulations, 2014 the Department hereby authorises –

ESKOM HOLDINGS SOC LIMITED

(hereafter referred to as the **holder of the authorisation**)

with the following contact details –

Ms Diedre Herbst

Eskom Holdings SOC Limited

PO Box 1091

JOHANNESBURG

2157

Tel: (011) 800 3501

Cell: (083) 660 1147

E-mail: HerbstDL@eskom.co.za.

to undertake the following activities (hereafter referred to as "the activity") indicated in Listing Notice 1 and Listing Notice 2 of 2014 EIA Regulations as amended:

Listed activities	Activity/Project description
<u>GN R. 327 Activity 9:</u> <i>The development of infrastructure exceeding 1000 metres in length for the bulk transportation of water or storm water - (i) with an internal diameter of 0,36 metres or more.</i>	Construction of clean and dirty water infrastructure associated with the rail yard and FGD infrastructure will be greater than 360mm and 1km in length.
<u>GN R.327 Activity 12</u> <i>The development of (ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs- (a) within a watercourse; or c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse.</i>	Construction of the proposed rail yard or rail siding take-of point from the existing Thabazimbi – Lephalale mainline will occur within 32 m of the wetlands identified bordering the existing railway line, while construction of the rail yard infrastructure, gypsum and limestone handling facilities and proposed pollution control dam will occur within 32 m of an existing pan located on the western border of the rail yard development area.
<u>GN R.327. Activity 19</u> <i>The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells,</i>	Infilling or excavation of more than 10m³ within a watercourse will occur during construction of the

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Listed activities	Activity/Project description
<i>shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.</i>	rail yard and associated infrastructure.
<u>GN R.327, Activity 25</u> The development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput capacity of more than 2 000 cubic metres but less than 15 000 cubic metres.	The proposed (Waste Water Treatment Plant) WWTP, which will be operated as a Zero Liquid Effluent Discharge (ZLED) plant to treat wastewater originating from the FGD infrastructure, will have a daily throughput capacity of more than 2 000 m3 but less than 15 000 m3.
<u>GN R.325, Activity 4</u> The development and related operation of facilities or infrastructure, for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres.	The construction of facilities or infrastructure for the handling, storage, and transportation (conveyance) of gypsum,(Waste Water Treatment Plant) WWTP salts and sludge (~1420m3), diesel and chemical substances that will be stored and used in the rail yard workshops within the FGD footprint and rail yard will cumulatively be more than 500m3
<u>GN R.325, Activity 6</u> <i>The development of facilities or infrastructure for any process or activity which requires a permit or licence or an amended permit or licence in</i>	A new Water Use Licence will be required to support the project (as part of the

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Listed activities	Activity/Project description
<i>terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent.</i>	station); an amendment or variation of the station's Atmospheric Emission Licence will be required; and the Waste Management Licence for the Ash Disposal Facility will be required. All these permits are affected by the proposed FGD development.
<u>GN R.325, Activity 7</u> The development and related operation of facilities or infrastructure for the bulk transportation of dangerous goods – (iii) in solid form, outside an industrial complex, using funiculars or conveyors with a throughput capacity of more than 50 tons per day.	The operation and transportation (conveyance) of gypsum, Waste Water Treatment Plant (WWTP) salts and sludge, diesel and chemical substances that will be stored and used in the rail yard workshops within the FGD footprint and rail yard will be more than 50 tons per day.
<u>GN R.325, Activity 12</u> <i>The development of railway lines, stations or shunting yards.</i>	The construction of a railway tie-in line and yard for purposes of transport of products to the Power Station and waste products from the Power Station.

Listed activities	Activity/Project description
<u>GN R.325, Activity 15</u> <i>The clearance of an area of 20 hectares or more of indigenous vegetation.</i>	The total development footprint of the railway yard and associated infrastructure will be greater than 20ha, therefore the clearance of more than 20ha indigenous vegetation will be required.

as described in the Final Environmental Impact Report (FEIAR) dated 24 May 2018 at:

Farm Names:

- Portion 0 of Farm Naauw Ontkomen 509 LQ;
- Portion 0 of Farm Eenzaamheid 687 LQ and
- Portion 0 of Farm Kromdraai 690 LQ

21 Digit SG code:

T	0	L	Q	0	0	0	0	0	0	0	0	0	5	0	9	0	0	0	0	0
T	0	L	Q	0	0	0	0	0	0	0	0	0	6	8	7	0	0	0	0	0
T	0	L	Q	0	0	0	0	0	0	0	0	0	6	9	0	0	0	0	0	0

Development footprint point	Latitude (DMS)	Longitude (DMS)
Corner Point A	23°42'34.88"S	27°32'40.66"E
Corner Point B	23°42'35.73"S	27°33'11.34"E
Corner Point C	23°42'25.30"S	27°33'31.10"E
Corner Point D	23°42'15.17"S	27°33'24.72"E
Corner Point E	23°42'06.49"S	27°33'41.51"E
Corner Point F	23°42'35.56"S	27°33'59.42"E
Corner Point G	23°43'16.10"S	27°31'38.02"E
Corner Point H	23°43'14.84"S	27°31'39.86"E
Corner Point I	23°42'58.62"S	27°32'36.00"E
Shape Centre Point J (Centroid)	23°42'42.03"S	27°33'15.92"E

the location indicated in the locality plan, attached as Annexure 2 of this authorisation.

- for the retrofitting of a Flue Gas Desulphurisation (FGD) system at the Medupi Power Station within Lephalale Local Municipality in the Limpopo Province.

The infrastructure associated with this facility includes:

- The construction and operation of a railway yard or rail siding to receive Limestone and transport gypsum via rail,
- The installation of diesel storage facilities within the FGD and railway yard footprint,
- The construction and operation of the wet FGD system as well as associated infrastructure required for operation of the FGD system,
- The handling, treatment and conveyance of gypsum and effluent,
- The construction and operation of a Waste Water Treatment Plant (WWTP), and the management, handling, transport and storage of salts and sludge generated through the waste water treatment process at a temporary waste storage facility; and a complete water management system.
- The transportation of salts and sludge via trucks from the temporary waste storage facility to a final Waste Disposal Facility to be contracted by Eskom for the first 5 years of operation of the FGD system.

Conditions of this Environmental Authorisation

Scope of authorisation

1. The retrofitting of a Flue Gas Desulphurisation (FGD) system at the Medupi Power Station is approved as per the geographic coordinates cited at the table reflected in page 6 above.
2. Authorisation of the activity is subject to the conditions contained in this environmental authorisation, which form part of the environmental authorisation and are binding on the holder of the authorisation.
3. The holder of the authorisation is responsible for ensuring compliance with the conditions contained in this environmental authorisation. This includes any person acting on the holder's behalf, including but not limited to, an agent, servant, contractor, sub-contractor, employee, consultant or person rendering a service to the holder of the authorisation.

4. The activities authorised may only be carried out at the property as described above.
5. Any changes to, or deviations from, the project description set out in this environmental authorisation must be approved, in writing, by the Department before such changes or deviations may be effected. In assessing whether to grant such approval or not, the Department may request such information as it deems necessary to evaluate the significance and impacts of such changes or deviations and it may be necessary for the holder of the authorisation to apply for further environmental authorisation in terms of the regulations.
6. The holder of an environmental authorisation must apply for an amendment of the environmental authorisation with the competent authority for any alienation, transfer or change of ownership rights in the property on which the activity is to take place.
7. This activity must commence within a period of **five (05) years** from the date of issue of this environmental authorisation. If commencement of the activity does not occur within that period, the authorisation lapses and a new application for environmental authorisation must be made in order for the activity to be undertaken.
8. Commencement with one activity listed in terms of this environmental authorisation constitutes commencement of all authorised activities.

Notification of authorisation and right to appeal

9. The holder of the authorisation must notify every registered interested and affected party, in writing and within 14 (fourteen) calendar days of the date of this environmental authorisation, of the decision to authorise the activity.
10. The notification referred to must –
 - 10.1. specify the date on which the authorisation was issued;
 - 10.2. inform the interested and affected party of the appeal procedure provided for in the National Appeal Regulations, 2014;
 - 10.3. advise the interested and affected party that a copy of the authorisation will be furnished on request; and
 - 10.4. give the reasons of the competent authority for the decision.

Commencement of the activity

11. The authorised activity shall not commence until the period for the submission of appeals has lapsed as per the National Appeal Regulations, 2014 and no appeal has been lodged against the decision.
-

In terms of section 43(7), an appeal under section 43 of the National Environmental Management Act, 1998 will suspend the environmental authorisation or any provision or condition attached thereto. In the instance where an appeal is lodged you may not commence with the activity until such time that the appeal has been finalised.

Management of the activity

12. The Environmental Management Programme (EMPr) submitted as part of the Application for EA is hereby approved. This EMPr must be implemented and strictly adhered to.

Frequency and process of updating the EMPr

13. The EMPr must be updated where the findings of the environmental audit reports, contemplated in Condition 23 below, indicate insufficient mitigation of environmental impacts associated with the undertaking of the activity, or insufficient levels of compliance with the environmental authorisation or EMPr.
14. The updated EMPr must contain recommendations to rectify the shortcomings identified in the environmental audit report.
15. The updated EMPr must be submitted to the Department for approval together with the environmental audit report, as per Regulation 34 of GN R. 982. The updated EMPr must have been subjected to a public participation process, which process has been agreed to by the Department, prior to submission of the updated EMPr to the Department for approval.
16. In assessing whether to grant approval of an EMPr which has been updated as a result of an audit, the Department will consider the processes prescribed in Regulation 35 of GN R.982. Prior to approving an amended EMPr, the Department may request such amendments to the EMPr as it deems appropriate to ensure that the EMPr sufficiently provides for avoidance, management and mitigation of environmental impacts associated with the undertaking of the activity.
17. The holder of the authorisation may apply for an amendment of an EMPr, if such amendment is required before an audit is required. The holder must notify the Department of its intention to amend the EMPr at least 60 days prior to submitting such amendments to the EMPr to the Department for approval. In assessing whether to grant such approval or not, the Department will consider the processes and requirements prescribed in Regulation 37 of GN R. 982.

Monitoring

18. The holder of the authorisation must appoint an experienced independent Environmental Control Officer (ECO) for the construction phase of the development that will have the responsibility to ensure that the mitigation/rehabilitation measures and recommendations referred to in this environmental authorisation are implemented and to ensure compliance with the provisions of the approved EMPr.
- 18.1. The ECO must be appointed before commencement of any authorised activities.
- 18.2. Once appointed, the name and contact details of the ECO must be submitted to the *Director: Compliance Monitoring* of the Department at Directorcompliance@environment.gov.za.
- 18.3. The ECO must keep record of all activities on site, problems identified, transgressions noted and a task schedule of tasks undertaken by the ECO.
- 18.4. The ECO must remain employed until all rehabilitation measures, as required for implementation due to construction damage, are completed and the site is ready for operation.

Recording and reporting to the Department

19. All documentation e.g. audit/monitoring/compliance reports and notifications, required to be submitted to the Department in terms of this environmental authorisation, must be submitted to the *Director: Compliance Monitoring* of the Department at Directorcompliance@environment.gov.za.
20. The holder of the environmental authorisation must, for the period during which the environmental authorisation and EMPr remain valid, ensure that project compliance with the conditions of the environmental authorisation and the EMPr are audited, and that the audit reports are submitted to the *Director: Compliance Monitoring* of the Department at Directorcompliance@environment.gov.za.
21. The frequency of auditing and of submission of the environmental audit reports must be as per the frequency indicated in the EMPr, taking into account the processes for such auditing as prescribed in Regulation 34 of GN R. 982.
22. The holder of the authorisation must, in addition, submit an environmental audit reports to the Department within 30 days of completion of the construction phase (i.e. within 30 days of site handover) and a final environmental audit report within 30 days of completion of rehabilitation activities.
23. The environmental audit reports must be compiled in accordance with appendix 7 of the EIA Regulations, 2014 and must indicate the date of the audit, the name of the auditor and the outcome

of the audit in terms of compliance with the environmental authorisation conditions as well as the requirements of the approved EMPr.

24. Records relating to monitoring and auditing must be kept on site and made available for inspection to any relevant and competent authority in respect of this development.

Notification to authorities

25. A written notification of commencement must be given to the Department no later than fourteen (14) days prior to the commencement of the activity. Commencement for the purposes of this condition includes site preparation. The notice must include a date on which it is anticipated that the activity will commence, as well as a reference number.

Operation of the activity

26. A written notification of operation must be given to the Department no later than fourteen (14) days prior to the commencement of the activity operational phase.

Site closure and decommissioning

27. Should the activity ever cease or become redundant, the holder of the authorisation must undertake the required actions as prescribed by legislation at the time and comply with all relevant legal requirements administered by any relevant and competent authority at that time.

Specific conditions

28. The EA holder must ensure that the storage areas have firm, waterproof base and drainage system. It must be designed and managed such that there is no escape of contaminants to the environment. All runoff must be prevented from entering local watercourses including wetlands.
29. The holder of environmental authorisation must prevent spillages. Where the spillages occur, the holder of authorisation must ensure the effective and safe cleaning of such spillages.
30. The Waste Management Licence (WML) for the existing ash disposal facility must be amended to allow the co-disposal of ash and gypsum. The amendment of the WML must be obtained prior to any co-disposal to the current ash disposal facility.

31. The holder of environmental authorisation must prevent the occurrence of nuisance conditions or health hazards.
32. No effluent must be discharged into any storm water drain or furrow, whether by commission or by omission.

General

33. A copy of this environmental authorisation, the audit and compliance monitoring reports, and the approved EMP, must be made available for inspection and copying-
- 33.1. at the site of the authorised activity;
- 33.2. to anyone on request; and
- 33.3. where the holder of the environmental authorisation has a website, on such publicly accessible website.
34. National government, provincial government, local authorities or committees appointed in terms of the conditions of this authorisation or any other public authority shall not be held responsible for any damages or losses suffered by the holder of the authorisation or his/her successor in title in any instance where construction or operation subsequent to construction be temporarily or permanently stopped for reasons of non-compliance by the holder of the authorisation with the conditions of authorisation as set out in this document or any other subsequent document emanating from these conditions of authorisation.

Date of environmental authorisation: 06/09/2018



Mr Sabelo Malaza

Chief Director: Integrated Environmental Authorisations
Department of Environmental Affairs

Annexure 1: Reasons for Decision

1. Information considered in making the decision

In reaching its decision, the Department took, *inter alia*, the following into consideration -

- a) The information contained in the EIAr dated 24 May 2018;
- b) The comments received from the Limpopo Department of Economic Development, Environment and Tourism (LDEDET) and interested and affected parties as included in the EIAr dated 24 May 2018;
- c) Mitigation measures as proposed in the EIAr dated 24 May 2018 and the EMPr;
- d) The information contained in the specialist studies contained within Appendix D of the EIAr; and
- e) The objectives and requirements of relevant legislation, policies and guidelines, including section 2 of the National Environmental Management Act, 1998 (Act No.107 of 1998).

2. Key factors considered in making the decision

All information presented to the Department was taken into account in the Department's consideration of the application. A summary of the issues which, in the Department's view, were of the most significance is set out below.

- a) The findings of all the specialist studies conducted and their recommended mitigation measures.
- b) The need for the proposed retrofitting of Flue Gas Desulphurisation (FGD) technology to remove sulphur dioxide from the exhaust flue gases of the Medupi Power Station operations, Eskom Holdings SOC Limited, established a SO₂ emissions target of 400mg/Nm³ at 6% O₂ for power stations commissioned between 2002 and 2017. This target complies with the minimum emissions standards stipulated by the National Environmental Management: Air Quality Act (Act 39 of 2004), which requires a concentration of 500mg/Nm³ at 10% O₂. The Air Quality Strategy further recommended that the Medupi Power Station be fitted with a flue gas desulphurisation technology in order to comply with the emissions standards set. Therefore in response to the Eskom Air Quality Strategy and funder requirements, the Medupi Power Station units have been designed, and

constructed, with provisions incorporated into the space and equipment design to accommodate the installation of the wet limestone FGD system.

- c) The EIAr dated 24 May 2018 identified all legislation and guidelines that have been considered in the preparation of the EIAr dated 24 May 2018.
- d) The methodology used in assessing the potential impacts identified in the EIAr dated 24 May 2018 and the specialist studies have been adequately indicated.
- e) A sufficient public participation process was undertaken and the applicant has satisfied the minimum requirements as prescribed in the EIA Regulations, 2014 for public involvement.

3. Findings

After consideration of the information and factors listed above, the Department made the following findings -

- a) The identification and assessment of impacts are detailed in the EIAr dated 24 May 2018 and sufficient assessment of the key identified issues and impacts have been completed.
- b) The procedure followed for impact assessment is adequate for the decision-making process.
- c) The proposed mitigation of impacts identified and assessed adequately curtails the identified impacts.
- d) The information contained in the EIAr dated 24 May 2018 is accurate and credible.
- e) EMPr measures for the pre-construction, construction and rehabilitation phases of the development were proposed and included in the BAR and will be implemented to manage the identified environmental impacts during the construction phase.

In view of the above, the Department is satisfied that, subject to compliance with the conditions contained in the environmental authorisation, the authorised activities will not conflict with the general objectives of integrated environmental management laid down in Chapter 5 of the National Environmental Management Act, 1998 and that any potentially detrimental environmental impacts resulting from the authorised activities can be mitigated to acceptable levels. The environmental authorisation is accordingly granted.

Annexure 2: Locality Plan

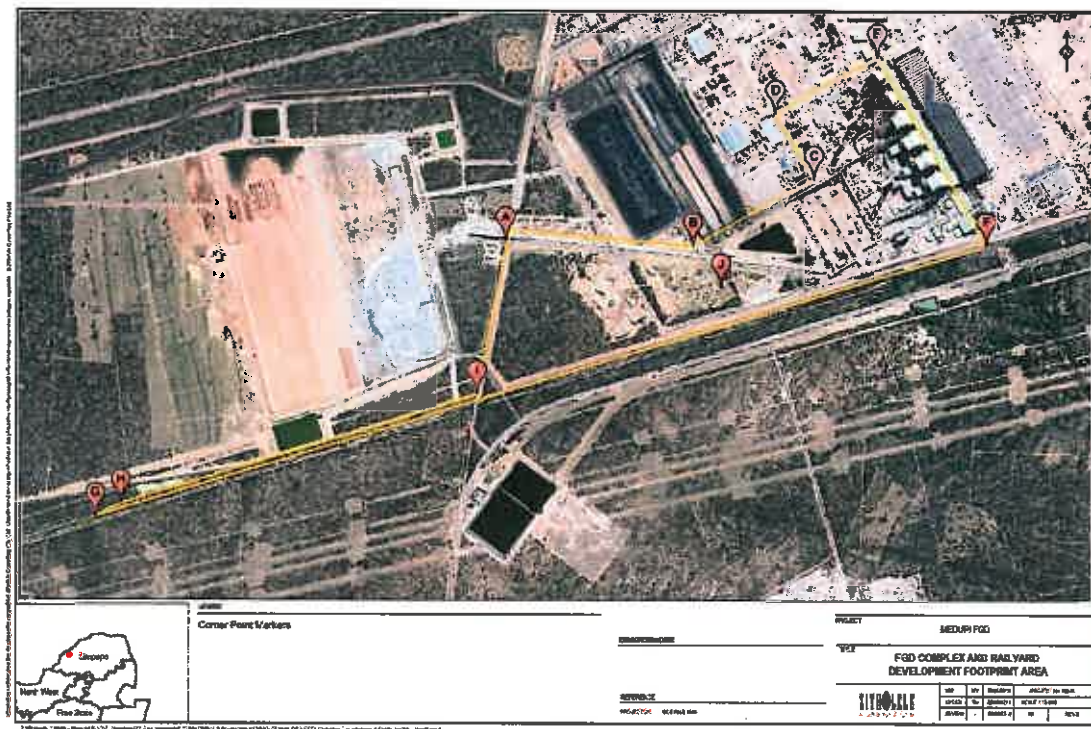


Figure 1: FGD complex and railyard development footprint area

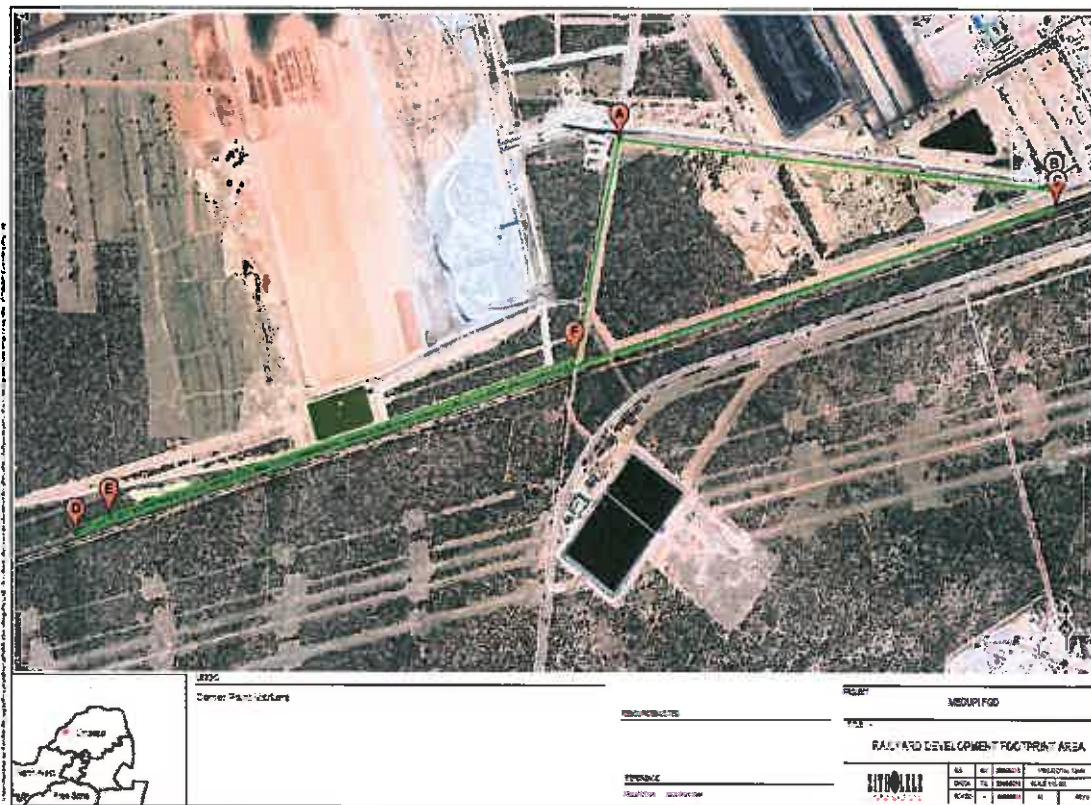


Figure 2 :Railyard development footprint area

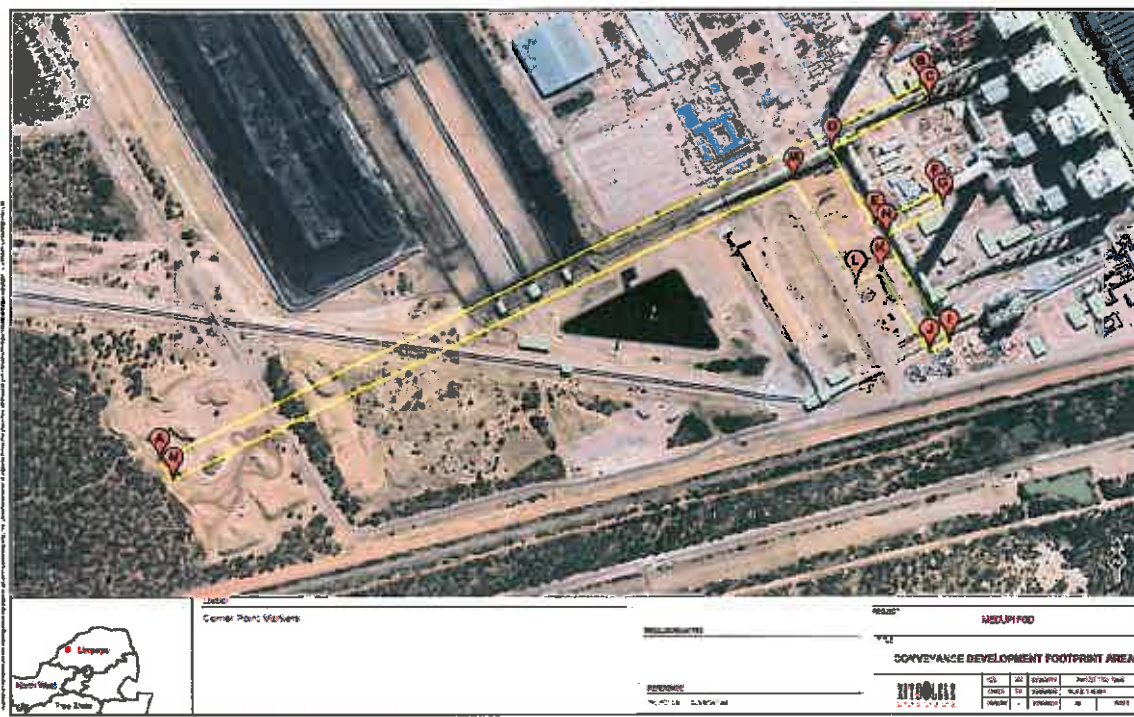


Figure 3: Conveyance development footprint area

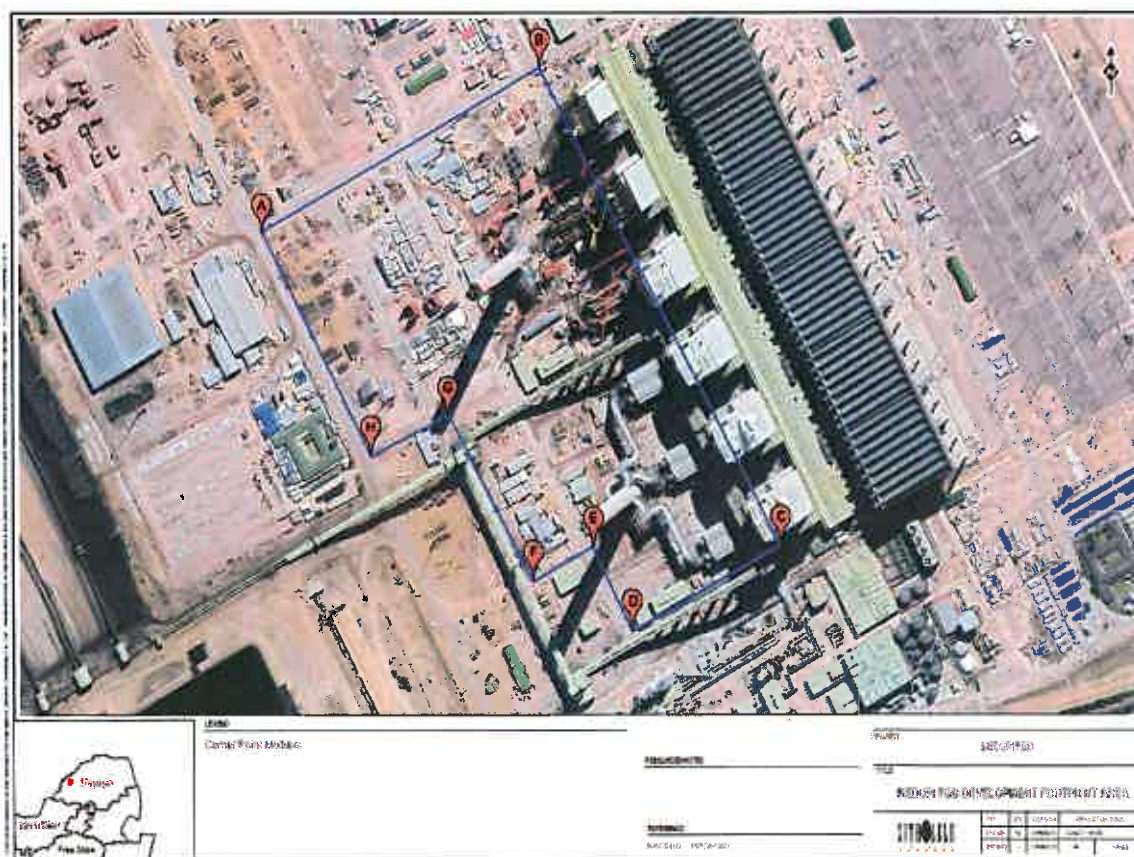


Figure 4: Medupi FGD development footprint area

MS



environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Private Bag X 447· PRETORIA · 0001· Environment House · 473 Steve Biko Road, Arcadia· PRETORIA
Tel (+ 27 12) 399 9372 ·

Reference: 14/12/16/3/3/2/1060/AM1

Enquiries: Ms Bongeka Ngcoliso

Telephone: 012-399 9376 E-mail: BNgcoliso@environment.gov.za

Ms Diedre Herbst
Eskom Holdings SOC Limited
PO Box 1091
JOHANNESBURG
2157
Tel: (011) 800 3501
Cell: (083) 660 1147
E-mail: HerbstDL@eskom.co.za

PER E-MAIL / MAIL

Dear Ms Herbst

AMENDMENT OF THE ENVIRONMENTAL AUTHORISATION ISSUED ON 06 SEPTEMBER 2018 FOR THE PROPOSED RETROFITTING OF A FLUE GAS DESULPHURISATION (FGD) SYSTEM AT MEDUPI POWER STATION WITHIN LEPHALALE LOCAL MUNICIPALITY, LIMPOPO PROVINCE.

The Environmental Authorisation (EA) (Reference number 14/12/16/3/3/2/1060) for the above project issued by the Department on 06 September 2018, and your amendment application received by the Department on 13 September 2018, refer.

Based on a review of the reason for requesting an amendment to the above EA, this Department, in terms of Chapter 5 of the Environmental Impact Assessment Regulations, 2014 as amended Regulation 27 (4) has decided to amend the EA dated 06 September 2018 as follows:

1. The listed notice authorised on page 3-7 of the EA is amended to add the following:

Listed activities	Activity/Project description
<u><i>GN R.327, Activity 24</i></u> <i>The development of a road-</i> <i>(ii) with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres</i>	The road infrastructure is associated with the railway yard, limestone stockpile and gypsum storage facility will be more than 8 m wide and 1km in length when considering the road surface area and shoulder of the road.
<u><i>GN R.327, Activity 34</i></u> <i>The expansion of existing facilities or infrastructure for any process or activity where such expansion will result in the need for a permit or licence or an</i>	Medupi Power Station's existing provisional AEL will require an amendment due to the storage and handling of

M.S

Listed activities	Activity/Project description
<i>amended permit or licence in terms of national or provincial legislation governing the release of emissions, effluent or pollution.</i>	limestone on site and the additional storage of fuel at the railway siding workshops and FGD development footprint. The additional storage of fuel is considered an expansion of the existing fuel storage capacity within the Medupi Power Station footprint.
<u>GN R.324, Activity 4</u> <i>The development of a road wider than 4 metres with a reserve less than 13,5 metres,</i> (e) Limpopo <i>(i) Outside urban areas,</i> <i>(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;</i>	The south western extent of the railway yard development area, which provides for the runoff railway line from the main railway line, is located within a critical biodiversity area as identified in Waterberg District Bioregional Plan, which was developed from the Limpopo Conservation Plan (C-Plan) version 2. Some of the service roads within this area will be wider than 4 metres with a reserve less than 13.5 metres.
<u>GN R.324, Activity 12</u> <i>The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.</i> (e) Limpopo <i>ii. Within critical biodiversity areas identified in bioregional plans</i>	The south western extent of the railway yard development area, which provides for the runoff railway line from the main railway line, is located within a critical biodiversity area as identified in Waterberg District Bioregional Plan, which was developed from the Limpopo Conservation Plan (C-Plan) version 2. The clearance of vegetation to allow construction of the runoff railway line and associated infrastructure, including a service road, will be more than 300m ² , while the vegetation is largely intact natural vegetation.
<u>GN R.324, Activity 14</u> <i>The development of-</i> <i>(ii) infrastructure or structures with a physical footprint of 10 square metres or more;</i> <i>where such development occurs—</i>	The south western extent of the railway yard development area, which provides for the runoff railway line from the main railway line, is located within

Listed activities	Activity/Project description
(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse; (e) Limpopo, (i) Outside urban areas: (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;	a critical biodiversity area as identified in Waterberg District Bioregional Plan, which was developed from the Limpopo Conservation Plan (C-Plan) version 2. The runoff railway line and associated infrastructure, including service road, will cover an area greater than 10m² and will be located within 32m of a wetland area as identified by the wetland specialist

2. To clarify wording on EAIR receipt date from:

The wording currently reads as follows ***“the Final Environmental Impact Assessment Report (FEIAR) dated 24 May 2018”*** on Page 6 under the table of listed activities, Page 13 under section 1 (a) to (c), Page 14 under section 2 (c) and (d), and Page 14 under section 3 (a) and (d).

Is hereby amended to:

The Final Environmental Impact Assessment Report (FEIAR) dated 23 May 2018” on Page 6 under the table of listed activities, Page 13 under section 1 (a) to (c), Page 14 under section 2 (c) and (d), and Page 14 under section 3 (a) and (d).

This proposed amendment letter must be read in conjunction with the EA dated 06 September 2018.

In terms of Regulation 4(2) of the Environmental Impact Assessment Regulations, 2014 (the Regulations), you are instructed to notify all registered interested and affected parties, in writing and within 14 (fourteen) days of the date of the EA, of the Department’s decision in respect of your application as well as the fact that an appeal may be lodged against the decision in terms of the National Appeals Regulations, and the provisions regarding the submission of appeals as contained in the Regulations.

Should any person wish to lodge an appeal against this decision, he/she must submit the appeal to the appeal administrator, and a copy of the appeal to the applicant, any registered interested and affected party, and any organ of state with interest in the matter within 20 days from the date that the notification of the decision was sent to the registered interested and affected parties by the applicant; or the date that the notification of the decision was sent to the applicant by the Department, whichever is applicable.

Appeals must be submitted in writing in the prescribed form to:

Director: Appeals and Legal Review of this Department at the below mentioned addresses.

By email: appealsdirector@environment.gov.za;

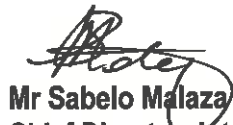
By hand: Environment House
473 Steve Biko,
Arcadia,
Pretoria,
0083; or

By post: Private Bag X447,
Pretoria,
0001

Please note that in terms of Section 43(7) of the National Environmental Management Act, 1998, the lodging of an appeal will suspend the environmental authorisation or any provision or condition attached thereto. In the instance where an appeal is lodged, you may not commence with the activity until such time that the appeal is finalised.

To obtain the prescribed appeal form and for guidance on the submission of appeals, please visit the Department's website at https://www.environment.gov.za/documents/forms#legal_authorisations or request a copy of the documents at appealsdirector@environment.gov.za.

Yours faithfully



Mr Sabelo Malaza
Chief Director: Integrated Environmental Authorisations
Department of Environmental Affairs

Date: 11/10/2018

CC:	Dr Mathys Vosloo	Zitholele Consulting Pty Ltd	Tel: 011 270 2079	Email: mathysv@zitholele.co.za
	Mr Tsholedi Joel Ngoasheng	Limpopo Economic Development, Environment and Tourism	Tel: 015 290 7134	Email: NgoashengTJ@ledet.gov.za

Appendix 11.2 Environmental Authorization for Medupi PS

Ref: 12/12/20/695
Tel: (012) 310 3031 Fax: (012) 320 7539 e-mail: mntene@deal.gov.za
Enquiries: Ms Maeli Ntane

Ms D Herbst
Eskom Holdings Limited: Generation Division
PO Box 1081
JOHANNESBURG
2000

Fax: (011) 800 3501

Dear Ms Herbst

**GRANTING OF CONDITIONAL AUTHORISATION FOR PROJECT REFERENCE 12/12/20/695:
CONSTRUCTION OF THE PROPOSED ESKOM HOLDINGS LIMITED: GENERATION DIVISION
4800MW COAL FIRED POWER STATION AND ASSOCIATED INFRASTRUCTURE NEAR
LEPHALALE**

Please find attached the record of decision in respect of your application for authorisation in terms of Regulations R1182 and R1183 (as amended) promulgated under sections 21, 22, 26 and 28 of the Environment Conservation Act (Act 73 of 1989).

Yours sincerely



Ms Pam Yeko
Director-General
Department of Environmental Affairs and Tourism

Date: 21/09/06 .

CC: Ms Ashlea Strong

Bahlwaki Environmental

Fax: (011) 466 3841

RECORD OF DECISION FOR PROJECT REFERENCE 12/12/20/695: CONSTRUCTION OF THE PROPOSED ESKOM GENERATION 4800MW COAL FIRED POWER STATION, NEAR LEPHALALE

By virtue of the power delegated by the Minister in terms of section 33(1) Environment Conservation Act, (Act 73 of 1989) ("the Act"), I hereby, in terms of section 22(3) of the Act, authorise Eskom Generation to undertake the activities specified/ detailed below subject to the indicated conditions.

1. DESCRIPTION, EXTENT AND LOCATION OF THE ACTIVITY:

As illustrated in the site layout Plan in Appendix A of the Final Environmental Impact Report dated 22 May 2006 the proposed development entails the following:

- The construction of a 4800MW coal fired power station near Lephalale, on approximately 700ha of the farm Naauwontkome 509 LQ
- The installation of ancillary infrastructure including the ashing facility on 500-1000ha of the farm Eenzaamheid 687 LQ
- The construction of a conveyor belt for coal supply on the eastern alignment
- The re-routing of the Steenbokpan Road to the northern alternative
- The construction of the overland ash conveyor belt

2. KEY FACTORS INFORMING THE DECISION:

2.1 In reaching its decision in respect of the application, the Department of Environmental Affairs and Tourism ("the Department") has taken, *inter alia*, the following into consideration:

a) The information contained in the:

- Final Scoping Report dated
- Final Environmental Impact Assessment Report dated 22 May 2006.
- Specialist Reports contained in the Final Environmental Impact Assessment Report.
- Addendum to the Final Environmental Impact Assessment Report dated June 2006.
- Comments on the Environmental Impact Assessment Report dated 18 July 2006 from the Department of Water Affairs and Forestry (DWAF).
- Minutes of the meeting held on 10 May 1982 in the office of the Chief Officer (Air Pollution Control) between Eskom and the Department of Health to discuss the Pollution Control conditions related to Eskom's power stations and related matters.

b) Compliance with applicable international and national legislation and departmental policies:

- The Act
- The principles set out in Section 2 of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA)
- Process 29 set out in the Scheduled processes under the Second Schedule to the Atmospheric Pollution Prevention Act, 1965 (Act No. 45 of 1965).
- The principles of sound management of toxic chemical set out in Chapter 19 of Agenda 21
- Minimum requirements for landfills by the Department of Water Affairs and Forestry (second edition, 1998)
- Stockholm Convention

- c) The findings of the site inspection undertaken by Mr Vincent Matabane and Mr Ndhivhuwo Netshilaphala on 6th April 2005
- d) The objections from MW De Jager Kinder Trust/Landelani Game Lodge & MW De Jager Safaris set out in the letter dated 2nd August 2006 from Ivan Pauw & Partners to Bohlweki Environmental Consultants in Midrand.

2.2 In reviewing this information, the Department made the following findings:

The existing Matimba Power Station is a dry cooled, coal fired pulverised fuel power station comprising six 665 MW units, representing a total nominal capacity of 3990 MW and a total net maximum generation capacity of 3690 MW

- The proposed power station is a dry cooled, coal fired pulverised fuel power station will have a generation capacity of 4800 MW
- Existing sources of atmospheric emission which occur in the vicinity of the proposed development sites include:
 - Existing Matimba Power Station and its associated ash dump
 - Grootgeluk coal mining operations
 - Brickworks operating at Hanglip
 - Household fuel combustion
 - Potential veld fires
 - Sewage works (Farm Nelsonkop)
 - Wind blown dust from areas and agricultural activities
 - Vehicle exhaust releases and road dust entertainment along paved and unpaved roads in the area
- The proposed power station is approximately 3 Km away from the existing Matimba Power Station and the Marapong Village
- The existing Matimba Power Station does not have SO₂ and NO₂ abatement measures in place
- The burning of coal in the proposed power station will potentially release significant amounts of air pollutants such as Sulphur Dioxide (SO₂), Nitrogen oxides (NO_x), Carbon Monoxide (CO), and trace amounts of mercury.

Ambient SO₂ levels resulting from the new power station are predicted to cause health effects in the Marapong residential area

The proposed power station will potentially release significant amounts of greenhouse gases, namely, Carbon Dioxide (CO₂) and Nitrous Oxide (N₂O).

Ambient SO₂ standards are already being exceeded in the area where the new power station is proposed.

- Ambient air quality standards in the Marapong residential area are already being exceeded
- The proposed development will result in a loss of approximately 1 500 hectares of vegetation due to the required pre construction site clearing.

Approximately 1000 ha of the above are intended for facility for disposal / storage of ash. A conventional ash dam has been proposed and assessed but mention is made of investigations into alternatives to this disposal option, including backfilling at the Grootegeluk open cast coal mine. The investigation of alternatives in this regard has not sufficiently progressed to allow for an informed decision with regard to ash disposal / storage at this stage. It is however acknowledged that an ashing facility will be required.

The proposed development is part of Eskom's new capacity installation programme and is intended to meet the future base load electricity demands of South Africa which is under severe pressure.

- The purpose of the proposed power station is to increase the Eskom Generation base load capacity to facilitate the forecast increase in demand by 2010 and to further supply this additional capacity in such a way that it improves security of supply to the national grid system and South Africa in its entirety.

Based on the information considered, the Department's conclusions are that:

- (a.) the proposed activities may lead to substantial detrimental impact on the environment;
- (b.) the need for the project have been adequately demonstrated;
- (c.) the activities will result in some socio-economic benefits, not only to the Lephalale area, but to the country as a whole;
- (d.) the implementation of the mitigation measures and conditions set out in this Record of Decision, are considered adequate to minimise detrimental impacts to acceptable levels;
- (e.) subject to successful implementation of conditions and mitigation measures, the proposed development is likely to be acceptable; and
- (f.) the principles of section 2 of NEMA can largely be upheld.

It is further the Department's conclusion that further information on alternatives for the disposal of ash produced by the facility is required before an informed decision can be made on this aspect of the application.

The Department has accordingly decided to grant Eskom Holdings Limited: Generation Division authorisation in terms of Regulations R 1182 and R 1183 (as amended), promulgated under section 21, 22 and 26 of the Environment Conservation Act (Act 73 of 1989) for the activities specified below, subject to the conditions and provisions listed below.

3. CONDITIONS

3.1 Description of the activity

The authorisation applies in respect of the following activities as listed in Schedule 1, regulation R. 1182 and described in the final environmental impact report dated 22 May 2006 and the addendum report to the final environmental impact report dated June 2006:

Item 1: The construction, erection or upgrading of-

- (a) facilities for commercial electricity generation with an output of at least 10 megawatts and infrastructure for bulk supply;
- (c) with regard to any substance which is dangerous or hazardous and is controlled by national legislation-
 - (i) infrastructure, excluding road and rails, for the transportation of any such substance; and
 - (ii) manufacturing, storage, handling, treatment or processing facilities for any such substance;
- (d) roads, railways, airfields and associated structures;
- (n) sewerage treatment plants and associated infrastructure;

Item 2: The change of land use from-

- (c): agricultural or zoned undetermined use or an equivalent zoning to any other land use.

Item 9: Scheduled processes listed in the Second Schedule to the Atmospheric Pollution Prevention Act, 1965 (Act No. 45 of 1965). (Process 29 (a) – Power Generation Processes in which fuel is burned for the generation of electricity for distribution to the public or for purposes of public transport).

The following activity applied for is not included in this authorisation and will be addressed in an amended or supplementary record of decision:

- o Item 8: The disposal of waste as defined in section 20 of the Act, excluding domestic waste, but including the establishment, expansion, upgrading or closure of facilities for all waste, ashes and building rubble

The decision contemplated above will be based on the review of the investigation and assessment of alternative ash disposal options to be submitted to the Department for consideration.

SPECIFIC CONDITIONS

Air quality management

- 3.2.1.1 Eskom must initiate a programme for the continuous monitoring of ambient concentrations of pollutants in the Marapong residential area as well as surrounding areas around the proposed power station and existing Matimba power station. This programme must be included in the construction EMP and the operational EMP to be submitted to the authorities for acceptance prior to construction, commissioning and operation of the power station. The programme must, among others, detail the installation of air quality monitoring equipment at an appropriate location within the Marapong residential area. The site for the air quality monitoring equipment should be such that the monitored ambient air represents a fair reflection of the ambient air the majority of Marapong residents are likely to breathe. The air quality monitoring equipment must be such as to provide continuous measurement of the following substances or mixtures of substances: Sulphur Dioxide (SO₂); Nitrogen Dioxide (NO₂); Carbon Monoxide (CO); Particulate Matter (PM10 and PM 2.5); Ozone (O₃); and Mercury (Hg).

The installation should also include gas-sampling systems as appropriate for the parameters being monitored, meteorological equipment and data management systems that will allow the effective and reliable transfer of data. The programme must also detail the compilation of a commissioning report produced by an independent party indicating that the installations are in place, calibrated and operating to internationally acceptable standards of operation. The programme must also detail reporting procedures including, among others, the submission of quarterly reports to the department detailing the monitoring results obtained from the installation detailed above and any other monitoring results from Eskom monitoring stations in the area. The monitoring reports must provide, but are not limited to the provision of, both a numeric and graphical representation of measured concentrations of the measured pollutants with a comparison against any applicable ambient air quality standards published in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004). This information should include detailed information for the 3 month period to which the report relates as well as a summary of historical trends from the commencement of monitoring activities.

- 3.2.1.2 Eskom shall install, commission and operate any required SO₂ abatement measures that may be necessary to ensure compliance with any applicable emission or ambient air quality standards published in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004).

- 3.2.1.3 Notwithstanding the measures referred to in 3.2.8.2, should the monitoring referred to in 3.2.8.1 indicate non-compliance with ambient SO₂ standards, Eskom shall install, commission and operate any required SO₂ abatement measures in respect of the existing Matimba Power Station as may be necessary to ensure compliance with any applicable emission or ambient air quality standards published in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004).
- 3.2.1.4 Eskom must initiate a programme of support for initiatives aimed at improving air quality in the Marapong residential area. This programme must be included in the construction EMP and carried through to the operational EMP.
- 3.2.1.5 The power station must be operated in compliance with any related Registration Certificate issued in terms of the Atmospheric Pollution Prevention Act, Act 45 of 1965, or any related Atmospheric Emission License issued in terms of the National Environment Management: Air Quality Act, Act 39 of 2004.
- 3.2.2 Environmental Monitoring Committee (EMC)**
- 3.2.2.1 This development is authorised on condition that the developer establishes an EMC with clear terms of reference as described in 3.2.2.6.
- 3.2.2.2 Amongst others the EMC shall consist of the following members:
- (a) A chairperson as described in 3.2.2.3,
 - (b) The ecologist that participated in the EIA process, or any other suitably qualified and experienced ecologist approved for this purpose by the department,
 - (c) Two representatives of the public, one community member from Marapong and one from Lephalele.
 - (d) Environmental Control Officer (ECO) (once appointed in terms of 3.2.4 below), and
 - (e) A senior site manager from the main contractor.
- 3.2.2.3 The EMC must appoint an independent chairperson who has appropriate people and project management skills.
- 3.2.2.4 The EMC must meet on a bi-monthly basis from the inception of the project.
- 3.2.2.5 The EMC must report to the Director-General of the Department of Environmental Affairs and Tourism on a bi-monthly basis and the report must include matters as described in 3.2.2.6 below.
- 3.2.2.6 The purpose of the EMC is to execute the following:
- (a) To monitor and audit project compliance to the conditions of this record of decision, environmental legislation and specific mitigation requirements as stipulated in the environmental impact report and the Environmental Management Plans.
 - (b) To make recommendations to the Director-General on issues related to the monitoring and auditing of the project.

- (c) The EMC shall decide on the frequency of meetings should a need arise to review the prescribed frequency. This change should be communicated to the department for acceptance.

3.2.2.7 All costs associated with the EMC shall be borne by the applicant. The terms of reference for the EMC must, in addition to the scope of work as detailed in 3.2.2.6, clearly set out roles and responsibilities related to logistical arrangements, administration and financial arrangements associated with the EMC.

3.2.2.8 Upon completion of construction, the role, responsibilities and constitution of the EMC shall be re-considered and re-established with new terms of reference for the operational phase of the development.

3.2.3 Environmental Management Plan (EMP)

3.2.3.1 Eskom must submit a site specific construction EMP to the relevant authorities for acceptance before commencement of any of the activities related to this authorisation. The EMP must include but not be limited to the following aspects:

- Rehabilitation of all areas disturbed during the construction phase of the project excluding those areas where permanent structures are erected.
- Siting and management of construction camps, sanitation, ablution and housing facilities as well as material storage areas used by the contractor. All work areas must be supplied with proper sanitation facilities.
Management and rehabilitation of access roads to individual construction areas that will not become permanent roads upon completion of construction. Any new road constructed for any purpose not authorised as part of this authorisation, must comply with the relevant SANS codes and permission for construction must be obtained from DEAT as required by Schedule 1, item 1 (d) of R. 1182.
- Waste avoidance, minimisation and disposal of waste at an appropriate facility.
- Protection of any heritage sites likely to be impacted by the development should such sites be found during any phase of the project to follow.
Provisions for harvesting of any medicinal plants that may occur on site prior to site clearance.
- Protection of indigenous vegetation where such is not affected by the physical footprint of the power station plant or ancillary infrastructure and associated construction works.
- Provision for plant search and rescue of protected and endangered species which should be done before commencement of any construction related activity.
- Management of traffic during the construction phase of the development where the site access roads and other transportation networks intersect.
- Measurement, monitoring and management of noise and dust pollution levels during the construction phase.
- A fire control management plan for implementation on site.
- Implementation of site specific erosion and sediment and dust control measures during the construction phase of the project.
- Insofar as it relates to the activities hereby approved, all recommendations and mitigation measures as proposed in the final environmental impact report dated 22 May 2006 and the

addendum report to the final environmental impact report dated June 2006 forms part of this record of decision and must be implemented as part of the EMP.

All relevant requirements emanating from 3.2.1 above.

3.2.3.2 Once accepted by DEAT, the revised construction EMP will be seen as a dynamic document. However, any changes to the EMP, must be submitted to DEAT for acceptance before such changes could be effected. Such a submission for consideration by DEAT must be accompanied by recommendations of the EMC.

3.2.3.3 Compliance with the accepted construction EMP must form part of all tender documentation for all contractors working on the project and must be endorsed contractually.

3.2.3.4 Eskom must submit an EMP for the operational phase of the development to DEAT and other relevant provincial and local authorities for acceptance prior to the completion of construction phase and the inception of the operational phase of the development. The revised operational EMP will be seen as a dynamic document. However, any substantial changes to the operational EMP, which is environmentally defensible, must be submitted to DEAT for acceptance before such changes could be effected.

3.2.4 Environmental Control Officer (ECO)

3.2.4.1 The EMC in conjunction with the developer must appoint a suitably qualified Environmental Control Officer (ECO) who would on behalf of the EMC, on a daily basis monitor the project compliance with conditions of the record of decision, environmental legislation and recommendations of the EMP. The cost of the ECO shall be borne by the applicant.

3.2.4.2 The ECO must be appointed one month before the start of construction and the authorities must be notified of such an appointment for communication purposes.

3.2.4.3 The ECO shall ensure that periodic environmental performance audits are undertaken on the project implementation.

3.2.4.4 The ECO shall submit an environmental compliance report on a two-monthly basis, in writing, to the Director-General of the Department of Environmental Affairs and Tourism (DEAT), copied to the Limpopo Department of Economic Development, Environment and Tourism.

3.2.4.5 The ECO shall maintain the following on site:

- A daily site diary
- A non-conformance register
- A public complaint register
- A register of audits

3.2.4.6 The ECO shall remain employed until all rehabilitation measures, as required for implementation due to construction damage, are completed and the site is handed over to Eskom by the contractor for operation.

3.2.4.7 The ECO shall report to and be accountable to the EMC.

Monitoring and auditing

3.2.5.1 Records relating to monitoring and auditing must be made available for inspection to any relevant authority in respect of this development.

3.2.5.2 This department reserves the right to monitor and audit the development throughout its full life cycle to ensure that it complies with the conditions stipulated in the record of decision as well as mitigation measures in the final environmental impact report dated 22 May 2006, the addendum report to the final environmental impact report and the construction and operational EMPs.

Transportation and handling of hazardous materials.

3.2.6.1 During the construction of the power station, an effective monitoring system must be put in place to ensure safety and to detect any leakage or spillage of coolants from all oil containing equipment during transportation, their handling and installation.

3.2.6.2 The transportation and handling of hazardous substances must comply with all the provisions of the Hazardous Substances Act, (Act No.15 of 1973), associated regulations as well as SABS 0228 and SABS 0229 codes.

Rehabilitation after construction

3.2.7.1 No exotic plant species may be used for rehabilitation purposes. Only indigenous plants may be utilised.

3.2.7.2 Measures aimed at controlling invasive plant species and weeds must be implemented and must form part of the relevant EMP.

3.2.7.3 No disturbance of the land at any stream or rivers edge is allowed unless such disturbance complies with legislation and conforms to strict design parameters.

Compliance with other legislation

3.2.8. Archaeological remains, artificial features and structures older than 60 years are protected by the National Heritage Resources Act, 1999 (Act No. 25 of 1999). Should any archaeological artefacts be exposed during excavation for the purpose of laying foundations, construction in the vicinity of the finding must be stopped. An archaeologist must be called to the site for inspection. Under no circumstances shall any artefacts be destroyed or removed from the site. The South African Heritage Resource Agency must be contacted to this effect. Their recommendations should be included in the construction EMP and be adhered to.

3.2.8.2 All provisions of the Occupational Health and Safety Act, 85 of 1993, and any other applicable legislation must be adhered to by the holder of this authorisation.

- 3.2.8.3 All provisions of the National Water Act, Act 36 of 1998, must be adhered to by the holder of this authorisation.
- 3.2.8.4 All provisions of the National Environment Management: Air Quality Act, Act 39 of 2004, must be adhered to by the holder of this authorisation.
- 3.2.8.5 All provisions of the Atmospheric Pollution Prevention Act, Act 45 of 1965, must be adhered to by the holder of this authorisation.
- 3.2.8.6 All provisions of the National Environment Management: Biodiversity Act, Act 10 of 2004, must be adhered to by the holder of this authorisation.
- 3.2.8.7 Should fill material be required for any purpose, the use of borrow pits must comply with the provisions of the Minerals and Petroleum Resources Development Act, 28 of 2002 administered by the Department of Minerals and Energy.
- 3.2.8.9 A permit shall be obtained from the provincial department of nature conservation for the removal of indigenous protected and endangered plant and animal species.

Water quality management

- 3.2.9.1 Eskom shall continuously monitor the ground water quality and implement measures to ensure that pollution of the resource does not occur. The monitoring programme for water quality and measures to control and prevent pollution of the resource shall be included in the operational EMP.

3.3 GENERAL CONDITIONS

This authorisation is granted only in terms of section 22 of the Environment Conservation Act, 1989 (Act No. 73 of 1989) and does not exempt the holder thereof from compliance with any other legislation.

This authorisation refers only to the activities as specified and described in the final environmental impact report dated 22 May 2006 and the addendum report to the final environmental impact report dated June 2006. Any other activity listed under section 21 of the Environment Conservation Act, 1989 (No. 73 of 1989) which is not specified above, is not covered by this authorisation, and must therefore comply with the requirements of the Environment Conservation Act, Government Notice R 1182 and R.1183 (as amended).

This authorisation is subject to the approval of the relevant local authorities in terms of any legislation administered by those authorities.

The applicant must, within 7 (seven) calendar days of receipt of this record of decision inform all interested and affected parties and at least include the following:

- (i) That an authorisation has been issued to the applicant to proceed with the construction and operation of the activity. If requested, provide copies of this ROD.

- (ii) That any appeals against the issuing of the authorisation must be lodged with the Minister of Environmental Affairs and Tourism within 30 (thirty) days from the date on which this ROD has been issued to the applicant at the address stipulated in this ROD.
- (iii) That an appeal questionnaire may be used in the lodging of an appeal. It is obtainable from the Department's offices at tel. (012) 310 3590 or e-mail: cveeden@deal.gov.za.
- (iv) The date on which the ROD was issued to the applicant in terms of regulation 10(1) and the date by which appeals must reach the Minister.

Failure to inform interested and affected parties within the stipulated time period may result in the Minister considering requests from such parties for permission to submit a late appeal favourably.

One week's written notice must be given to this Department before commencement of construction activities. Such notice shall make clear reference to the site location details and reference number given above.

One week's written notice must be given to this Department before commencement of operation activities. Such notice shall make clear reference to the site location details and reference number given above.

The applicant shall be responsible for ensuring compliance with the conditions contained in this ROD by any person acting on his behalf, including but not limited to, an agent, servant, or employee or any person rendering a service to the applicant in respect of the activity, including but not limited to, contractors and consultants.

The applicant must notify the Department in writing, within 24 (twenty four) hours if any condition of this authorisation cannot, or is not, adhered to. The notification must be supplemented with reasons for non-compliance.

A copy of the authorisation and ROD shall be available on site during construction and all staff, contractors and sub-contractors shall be familiar with or be made aware of the contents of this authorisation and ROD.

- 3.3.10 Compliance/non-compliance records must be kept and shall be made available on request from the authorities within five days of receipt of the request.
- 3.3.11 Any changes to, or deviations from, the project description set out in this letter must be approved, in writing, by the Department before such changes or deviations may be effected. In assessing whether to grant such approval or not, the Department may request such information as it deems necessary to evaluate the significance and impacts of such changes or deviations.
- 3.3.12 This Department may review the conditions contained in this letter from time to time and may, by notice in writing to the applicant, amend, add or remove a condition.

- 3.3.13 In the event that the predicted impacts exceed the significance as predicted by the independent consultant in the final environmental impact report and appendices dated 22 May 2006 and the addendum report to the final environmental impact report dated June 2006, the authorisation may be withdrawn after proper procedures have been followed.
- 3.3.14 In the event of any dispute concerning the significance of a particular impact, the opinion of the Department of Environmental Affairs and Tourism (DEAT) in respect of its significance will prevail.
- 3.3.15 The applicant must notify the Department, in writing, at least 10 (ten) days prior to the change of ownership, project developer or the alienation of any similar rights for the activity described in this letter. The applicant must furnish a copy of this document to the new owner, developer or person to whom the rights accrue and inform the new owner, developer or person to whom the rights accrue that the conditions contained herein are binding on them.
- 3.3.16 Where any of the applicant's contact details change, including the name of the responsible person, the physical or postal address and/or telephonic details, the applicant must notify the Department as soon as the new details become known to the applicant.
- 3.3.17 National government, provincial government, local authorities or committees appointed in terms of the conditions of this application or any other public authority or authorisation shall not be held responsible for any damages or losses suffered by the applicant or his successor in title in any instance where construction or operation subsequent to construction be temporarily or permanently stopped for reasons of non-compliance by the applicant with the conditions of approval as set out in this document or any other subsequent document emanating from these conditions of approval.
- 3.3.18 If any condition imposed in terms of this authorisation is not complied with, the authorisation may be withdrawn after 30 days written notice to the applicant in terms of section 22(4) of the Environment Conservation Act, 1989 (Act No. 73 of 1989).
- 3.3.19 Failure to comply with any of these conditions shall also be regarded as an offence and may be dealt with in terms of sections 29, 30 and 31 of the Environment Conservation Act, 1989 (Act No. 73 of 1989), as well as any other appropriate legal mechanisms.
- 3.3.20 The applicant shall be responsible for all costs necessary to comply with the above conditions unless otherwise specified.

Any complaint from the public during construction must be attended to as soon as possible to the satisfaction of the parties concerned. A complaints register must be kept up to date and shall be produced upon request.

- 3.3.22 Departmental officials shall be given access to the properties earmarked for construction activities for the purpose of assessing and/or monitoring compliance with the conditions contained in this document at all reasonable times.

All outdoor advertising associated with this activity, whether on or off the property concerned, must comply with the South African Manual for Outdoor Advertising Control (SAMOAC) available from this Department.

3.4 DURATION OF AUTHORISATION

If the activity authorised by this letter does not commence within 4 (four) years from the date of signature of this letter, the authorisation will lapse and the applicant will need to reapply for exemption or authorisation in terms of the above legislation or any amendments thereto or any subsequent new legislation.

4. CONSEQUENCES OF NON-COMPLIANCE

The applicant must comply with the conditions set out in this letter. Failure to comply with any of the above conditions may result in, *inter alia*, the Department withdrawing the authorisation, issuing directives to address the non-compliance – including an order to cease the activity – as well as instituting criminal and/or civil proceedings to enforce compliance.

5. APPEALS

Appeals in respect of this decision must be lodged with the Minister of Environmental Affairs and Tourism within 30 (thirty) days of the date of this decision. Appeals can be submitted utilising one of the following methods:

By facsimile: (012) 322 0082
By post: Private Bag X447, Pretoria 0001
By hand: 2nd Floor, Fedsure Forum Building, North Tower, cor. Van der Walt and Pretorius Streets, Pretoria.

Appeals must comply with the provisions of Regulation 11 of Government Notice No. R. 1183 which reads as follows:

"An appeal to the Minister or provincial authority under section 35(3) of the Act must be done in writing within 30 days from the date on which the ROD was issued to the applicant in terms of regulation 10(1);

An appeal must set out all the facts as well as the grounds of appeal, and must be accompanied by all relevant documents or copies of them which are certified as true by a commissioner of oaths."

An appeal questionnaire may be used in the lodging of an appeal. It is obtainable from the Department's offices at tel. (012) 310 3590 or e-mail: cveeden@deat.gov.za.

Should the applicant wish to appeal any aspect of this decision, the applicant must notify and furnish copies of the appeal which will be submitted to the Minister, to all registered interested and affected parties. Proof of such notification must be submitted to the Minister with the appeal. Failure to comply with this provision may result in the Minister refusing to consider the appeal.

6. APPLICANT:

Eskom Holdings Limited: Generation Division
P O Box 1091
JOHANNESBURG
2000

Contact person: Ms Deirdre Herbst

Tel: (011) 800 3501

Fax: (011) 800 5140

7. CONSULTANT:

Bohlweki Environmental (Pty) Ltd
P O Box 11784
VORNA VALLEY
1686

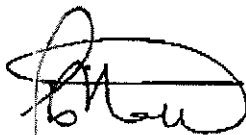
Contact person: Ms Ashlea Strong

Tel: (011) 466 3841

Fax: (011) 466 3849

8. SITE VISIT

A site visit was undertaken by Mr Vincent Matabane and Mr Ndhivhuwo Netshilaphala from the department, Eskom personnel and the consultant on 6th April 2005.



Ms Pam Yako
Director – General
Department of Environmental Affairs and Tourism

Date: 21/09/06

Appendix 11.3 Environmental Checklist of JICA Guidelines for Environmental and Social Considerations

Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1	1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process?	(a)Y	(a) Final EIA report on Medupi FGD project was submitted to DEA on 23 of May 2018.
2			(b) Have EIA reports been approved by authorities of the host country's government?	(b)Y	(b) DEA has granted Environmental Authorisation (EA) for the Medupi FGD project on September 2018 (Amendment of EA on October 2018).
3			(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	(c) N/Y	(c) EA includes general conditions and specific conditions. Conditions require the project proponent to ensure to pay attention to water and soil contamination, to prevent spillage, and to comply with the all relevant regulations. Conditions are not additional requirement of study.
4			(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(d)N	(d) The project is required to obtain the following Licenses and Environmental Authorizations: -Air Emissions License (AEL) in terms of the National Environmental Management: Air Quality Act, 2004 (39 of 2004) (NEMAQA); -Water Use Licensee (WUL) in terms of Section 21 of the National Water Act, 1998 (Act No 36 of 1998) (NWA) and; -Waste Management License (WML) as per the National Environmental Management Waste Act, 2008 (Act No. 59 of 2008) (NEM: WA). The application for AEL will be revised according to the expiration date (2020) of the AEL of the Medupi PS and reapplied. The application for WUL was submitted in June 2018. The application for WML was submitted in March 2018.
5		(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	(a)Y	(a) Brief description of the project and the potential impacts were explained to the local stakeholders through stakeholder consultation meetings at the scoping stage on November 2014. Two key stakeholder workshops and three public meetings were held in March 2018 at the Draft EIA stage.
6			(b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(b)Y	(b) Final EIA report was prepared based on the appropriate question-and-answers of the key stakeholder workshops and Public meetings consultations. All contents are summarized as "Correspondence with I&APs" and "Comment and Response Note" as Appendixes of the final EIA report.
7		(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a)Y	(a) Alternative assessment was conducted including no-project. The alternative analysis was conducted for technology to be applied for desulfuration, namely Wet FGD and FGD-CFB both technology and environment/social aspects. As a result, it was concluded that the installation of Wet FGD (WFGD) facilities is considered as the feasible technology after the evaluation. The optional locations for installation was not considered since the FGD is supposed to be installed to the

Appendix 11.3 Environmental Checklist of JICA Guidelines for Environmental and Social Considerations

Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
					existing Medupi PS and the available layout is limited.
8	2 Pollution Control	(1) Air Quality	(a) Do air pollutants, such as sulfur oxides (SO _x), nitrogen oxides (NO _x), and soot and dust emitted by the power plant operations comply with the country's emission standards? Is there a possibility that air pollutants emitted from the project will cause areas that do not comply with the country's ambient air quality standards? Are any mitigating measures taken?	(a)Y	(a) PM, SO₂, NO₂, and CO of emission gas from existing Medupi PS are continuously monitored in compliance with the existing AEL of the Medupi PS. The Medupi PS annual emissions report from April 2016 to March 2017 report that NO₂ is under the emission standards, but SO₂ and PM are not satisfied with the emission standards. High particulates emissions were noticed in September and October 2016, due to leaking bag from the Pulse Jet Fabric Filter Plant, which is the technology in place to reduce dust / particulates emissions. Action plan to address the issue (i.e. bag replacement) was developed and implemented. Emission exceedance for SO₂ were reported in September and October 2016, due to the presence of high Sulphur content in the coal. Coal blending at Medupi PS was completed in March 2017. Impacts on ambient air quality by operation of Medupi PS with/without FGD were assessed by calculation of the air concentrations with following three scenarios; i) 2014 Baseline: under operation of Matimba Power Station ii) 2020 Baseline: under operation of Matimba Power Station and Medupi Power Station without FGD iii) Proposed Project operations under operation of Matimba Power Station and Medupi Power Station with FGD As for SO₂, there are areas that have not satisfied with the environmental standard under the scenario i) that only existing Matimba PS operates. In scenario ii), the environmental standard unachieved area is expanded to the residential area. However, the area of non-compliance of SO₂ concentrations reduces significantly for scenario iii) and reduces the significance to the lower impact as no exceedances of the NAAQS are simulated at the closest sensitive receptors in the study area. No exceedances of the NAAQS for NO₂ and PM were simulated at sensitive receptors due to proposed project operations. The ambient air quality will be improved through reduction of SO₂ due to the operation of FGD system and reduction of PM due to have sprinkled water and covered topsoil.

Appendix 11.3 Environmental Checklist of JICA Guidelines for Environmental and Social Considerations

Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
9	2 Pollution Control	(2) Water Quality	(b) In the case of coal-fired power plants, is there a possibility that fugitive dust from the coal piles, coal handling facilities, and dust from the coal ash disposal sites will cause air pollution? Are adequate measures taken to prevent the air pollution?	(b)Y	(b) Gypsum generated from FGD is processed the existing Ash Disposal Facility (ADF). It was confirmed that dust does not exceed the standard to confirm with periodical monitoring results of the existing operating conditions of Medupi PS. To prevent dust generation, to be vegetated cleared areas, or to keep moist topsoil will be taken as the mitigation measurements.
10			(a) Do effluents including thermal effluents from the power plant comply with the country's effluent standards? Is there a possibility that the effluents from the project will cause areas that do not comply with the country's ambient water quality standards or cause any significant temperature rise in the receiving waters?	(a)N/A	(a) There is no thermal effluent from the FGD facilities.
11			(b) In the case of coal-fired power plants, do leachates from the coal piles and coal ash disposal sites comply with the country's effluent standards?	(b)Y	(b) There are no environmental issues on leachates from the existing coal piles and coal ash disposal sites in accordance with monitoring report prepared by Medupi PS.
12			(c) Are adequate measures taken to prevent contamination of surface water, soil, groundwater, and seawater by the effluents?	(c)Y	(c) The wastewater from FGD will be treated and the clean water will be re-used in the plant. There is no factor to polluted surface water due to discharge from FGD. Polluted water from Medupi PS is separated from surface water and discharged into the pollution control dam in Medupi PS site. Surface water and groundwater will be periodically monitored and confirm that the standard is not exceeded.
13		(3) Wastes	(a) Are wastes, (such as waste oils, and waste chemical agents), coal ash, and by-product gypsum from flue gas desulfurization generated by the power plant operations properly treated and disposed of in accordance with the country's regulations?	(a)Y	(a)Wastes are treated and managed in accordance with Waste Management License. Record and report the sorting situation and the amount of waste by type. The FGD Plant and the FGD Waste Water Treatment Plant operation will generate three waste streams, namely FGD Gypsum, FGD WWTP Sludge, and FGD WWTP Crystallizer Solids. These three waste streams required the assessment in terms of the "National Norms and Standards for the Assessment of Waste for Landfill Disposal" (National Norms and Standards) of DEA (DEA, 2013a).
14	2 Pollution Control	(4) Noise and Vibration	(a) Do noise and vibrations comply with the country's standards?	(a)Y	(a) Currently the noise standards are generally satisfied at the residence near the power station. The noise generated by the project operation including main steam boilers, steam turbine-generator units, vehicles/trucks for transporting limestone, and will not exceed the selected noise guidelines at Noise Sensitive Receptors (NSR) surrounding the Medupi PS with an increase above the baseline of less than 3 dBA at all of the

Appendix 11.3 Environmental Checklist of JICA Guidelines for Environmental and Social Considerations

Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
					identified NSR. As for Vibration, there is no receptor in the surrounding area, so there is no effect of vibration. FGD is planned in the site of the existing Medupi PS facility, there are no neighboring dwellings.
15		(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a)N	(a) There is no possibility of utilization of groundwater during construction phase and operation phase.
16		(6) Odor	(a) Are there any odor sources? Are adequate odor control measures taken?	(a)N	(a) There are no odor sources.
17	3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a)N	(a) The project site is in Medupi PS site. Medupi PS is already developed and is not protected area.
18		(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	(a)N	(a) The project site is planned in the Medupi PS. There are no primeval forests, tropical rain forests, ecologically valuable habitats.
19			(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	(b)N	(b) The project site is planned in the Medupi PS. There are no protected habitats of endangered species designated by the country's laws or international treaties and conventions.
20			(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	(c)Y	(c) When an animal is observed in the place, it is processing as relocation to the outside.
21			(d) Is there a possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(d)N	(d) Water will supply from MCWAP 1 and 2 by DWS. There is no possibility of water use from groundwater and surface water directly near project site.
22			(e) Is there a possibility that discharge of thermal effluents, intake of a large volume of cooling water or discharge of leachates will adversely affect the ecosystem of surrounding water areas?	(e)N	(e) There is no thermal effluent from the FGD facilities. The wastewater from FGD will be treated and the clean water will be re-used in the plant.
23	4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	(a)N/A	(a) There is no resettlement and land acquisition caused by project implementation. The grievance redress mechanism conforms to the current environmental communication procedure of the Medupi PS and is appropriately responded.
24			(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	(b) N/A	
25			(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic	(c) N/A	

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Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
			studies on resettlement?		
25			(d) Are the compensations going to be paid prior to the resettlement?	(d) N/A	
27			(e) Are the compensation policies prepared in document?	(e) N/A	
28			(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	(f) N/A	
29			(g) Are agreements with the affected people obtained prior to resettlement?	(g) N/A	
30			(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	(h) N/A	
31			(i) Are any plans developed to monitor the impacts of resettlement?	(i) N/A	
32			(j) Is the grievance redress mechanism established?	(j) N/A	
33	4 Social Environment	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	(a) Y	(a) Employment opportunity might be created due to the project implementation.
34			(b) Is sufficient infrastructure (e.g., hospitals, schools, and roads) available for the project implementation? If the existing infrastructure is insufficient, are any plans developed to construct new infrastructure or improve the existing infrastructure?	(b) N	(b) The project site is planned in the Medupi PS. There is no plan developed to construct new infrastructures.
35			(c) Is there a possibility that large vehicles traffic for transportation of materials, such as raw materials and products will have impacts on traffic in the surrounding areas, impede the movement of inhabitants, and any cause risks to pedestrians?	(c) Y	(c) The traffic volume will be increased to transport limestones to Medupi PS and transport salts and sludge to hazardous waste facilities. The project proponent will arrange the traffic control staff at intersection, if necessary.
35			(d) Is there a possibility that diseases, including infectious diseases, such as HIV, will be brought due to the immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	(d) Y	(d) There are integrated response strategies, which are education and awareness, prevention; check of employees' HIV status, treatment, care, and support for diseases and development of more HIV/Aids related campaigns by the developer educating its contractors.
36			(e) Is there a possibility that the amount of water used (e.g., surface water, groundwater) and discharge of thermal effluents by the project will adversely affect existing water uses and uses of water areas (especially fishery)?	(e) N/A	(e) Water will supply from MCWAP 1 and 2 by DWS. There is no possibility of water use from groundwater and surface water directly near project site. There is no thermal effluent from the FGD facilities. The wastewater from FGD will be treated and the clean water will be re-used in the plant.
37		(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) There is no the local archeological, historical, cultural, and religious heritage in the project site. There is an old tomb in the site of the power station, but there is no modification by the FGD and related facilities. A buffer area of 10 m surrounded by a fence is provided.

Appendix 11.3 Environmental Checklist of JICA Guidelines for Environmental and Social Considerations

Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
38		(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a)N	(a) Potential visual impacts associated with construction of the FGD infrastructure within the MPS or construction of the rail yard were deemed negligible due to the existing visual character of the Medupi Power Station infrastructure surrounding the proposed infrastructure.
39		(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	(a)N/A	(a) There is no ethnic minority and indigenous people in the project site.
40			(b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(b) N/A	(b)ditto
41		(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	(a)Y	(a) The project proponent complies with labor laws and ordinances associated with the working conditions of South Africa. In addition to this, the project proponent established the independent requirement and program as follows.
42			(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	(b)Y	(b) All Personal Protective Equipment (PPE) required to be used by contractors is supplied by the project proponent. In addition, there is a full-time emergency team on site with necessary medical facilities and paramedics operated 24/7 supplied by the project proponent.
43			(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	(c)Y	(c)Since the project proponent has already established and applied the comprehensive Safety Health Environment programs and implementation system in the Medupi PS project, the existing framework and implementation are reviewed as follows and considered to be applied to this project.
44			(d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(d)Y	(d) Regular joint meetings are held to ensure threats are identified and mitigation measures put in place prior to any violence erupting. The Medupi PS Project does have many mechanisms including the Environmental Monitoring Committee (EMC) and Project Information Offices in town as well as surrounding communities where residents are able to raise grievances with procedures in place to address any complaints.
45	5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	(a)Y	(a) There are no receptors around the project site, impacts during construction is limited. In addition, mitigation measures are planned for pollution (groundwater quality, waste, ecosystem, soil erosion, etc.) during construction.

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Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
46			(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce the impacts?	(b)Y	(b) Impact on the wetland would be expected to be minor since the FGD infrastructure is situated within the footprint of the existing Medupi PS.
47			(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce the impacts?	(c)Y	(c) It is predicted that the influence on traffic due to the increase in traffic volume and trucks and the possibility of infectious diseases increase due to increase in workers during construction. Appropriate mitigation measures for road traffic and prevention of infectious diseases are planned by the project proponent.
48		(2) Accident Prevention Measures	(a) In the case of coal-fired power plants, are adequate measures planned to prevent spontaneous combustion at the coal piles (e.g., sprinkler systems)?	(a)Y	(a) There are no new coal piles in FGD project. In addition, worker in power station educated with Medupi Emergency Preparedness Plan and accident prevention measures are planned.
49		(3) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	(a)Y	(a) The items for which any mitigation measures will be taken are supposed to be monitored. The project proponent will monitor groundwater quality, solid waste, ecosystem, soil erosion, existing social infrastructure and services, infectious diseases such as HIV/AIDS, working conditions, and accidents.
50			(b) What are the items, methods and frequencies of the monitoring program?	(b)Y	(b) Based on the existing framework for Medupi PS, conduct regularly based on the standards of South Africa and report each month.
51			(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	(c)Y	(c) The monitoring implementation system has already been established in existing framework for Medupi PS, and feasibility is secured.
52			(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(d)Y	(d) Monitoring report shall be prepared and submitted to the relevant authorities in line with license and permission.
53	6 Note	(1) Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	(a)N/A	(a)-
54			(b) Where necessary, pertinent items described in the Ports and Harbors checklist should also be checked (e.g., projects including construction of port and harbor facilities).	(b)N/A	(b)-
55		(2) Note on Using Environmental	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the	(a)N	(a) The quantity of greenhouse gas emission during the operation of FGD will not increase. Because the electricity for

Appendix 11.3 Environmental Checklist of JICA Guidelines for Environmental and Social Considerations

Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		Checklist	project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, and global warming).		FGD operation will be from Medupi PS and total amount of electricity generation by PS will not change.

- 1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are requested to be made.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience)
- 2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.

Appendix 11.4 Environmental Monitoring Form

Environment Monitoring Form (Construction Stage and Operation Stage)

1. Compliance Report

Check Item	Preparation/Submission Date	Status/ Summary / Issues / Note
Compliance Audit Report		
Safety Health and Environmental Specification		
Emergency Preparedness Plan		
Work Instruction		

2. Ambient Air Quality- monthly base data form-

2-1 Summary of Monthly Data

Pollutant	Unit	Highest hourly Mean	No. of Hourly National Limit Exceedance	Highest Daily mean	No. of Daily National Limit Exceedance	No. of 8 hrs moving Average Limit	Highest 10 min mean	No. of Daily National Limit Exceedance	National Ambient Air Quality Standard ^{*1}		
									Period	limit	Number of annual exceedance
PM2.5	µg/m ³								24hr	40	4
									1year	20	0
PM10	µg/m ³								24hr	75	4
									1year	40	0
NO ₂	ppb								1year	21	0
									1hr	106	88
SO ₂	ppb								1hr	134	88
									10min	191	526
									24hr	48	4
CO	ppm								1hr	26	88
									8hr	8.7	11
O ₃	ppb								8hr	61	11.

* Government Notice No.1210 (2009) of National Environmental Management: Air Quality Act (NEMAQA) (Act 39 of 2004)

2-2 Exceedances of National Ambient Air Quality Standards

hourly exceedances						
Pollutant	Limit* (ppb)	Year	Month	Day	Time	Concentration (ppb)
SO ₂	134					
10 minutes exceedances						
Pollutant	Limit	Year	Month	Day	Time	Concentration
SO ₂	191					

* Government Notice No.1210 (2009) of National Environmental Management: Air Quality Act (NEMAQA) (Act 39 of 2004)

2-3 Number of Exceedances of the National Ambient Air Quality Standards (Annual Check)

Parameter Measured	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Number of Exceedances	Allowed Number of Exceedances*
PM2.5 (Daily)														4
PM10 (Daily)														4
NO ₂ (Hourly)														0
SO ₂ (10 minutes)														526
SO ₂ (hourly)														88
SO ₂ (Daily)														4
O ₃ (8hours)														11

* Government Notice No.1210 (2009) of National Environmental Management: Air Quality Act (NEMAQA) (Act 39 of 2004)

2-4 Dust-fall

Month Site ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
01													
02													
Average													
Acceptable Dust Fall Rate*: 1200 mg/m ² /day, 30 days Average													

* National Dust Control Regulation (GNR 827 November 2013)

3. Emission Gas (During Operation)- monthly base data form-

Unit X	Days	PM (mg/Nm ³)	SO ₂ (mg/Nm ³)	NO ₂ (mg/Nm ³)	CO (mg/Nm ³)	CO ₂ (mg/Nm ³)	Temp (°C)	Press (kPa)	Velocity (m/s)	O ₂ (%)
	Day 1									
	Day 2									
	Day 3									
	Day 4									
	Day 5									
	Day 6									
	Day 7									
	Day 8									
	Day 9									
	Day 10									
	Day 11									
	Day 12									
	Day 13									
	Day 14									
	Day 15									
	Day 16									
	Day 17									
	Day 18									
	Day 19									
	Day 20									
	Day 21									
	Day 22									
	Day 23									
	Day 24									
	Day 25									
	Day 26									
	Day 27									
	Day 28									
	Day 29									
	Day 30									
Daily Limit	National Standard for New Plant* (for Existing plant)	50 (100)	500 (3,500)	750 (1100)	-	-	-	-	-	-

Source *: Government Notice No.248 (2010) of National Environmental Management: Air Quality Act (Act 39 of 2004), Atmospheric Emissions License by Limpopo Province Government, March 2015, under normal conditions of 10% O₂, 273 Kelvin and 101.3kPa.

4. Water quality (Ground water) and Ground Water Level

Table1

Monitoring Location	Groundwater level (m)	Physical Determinants		Chemical Determinants								
		pH	EC (mS/m)	Cd (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	p-Alk (mg/l)	m-Alk (mg/l)	Cl (mg/l)	SO ₄ (mg/l)	NO ₃ as N(mg/l)
01												
02												
SANS241: 2011 Max. Allowable Limit (*1)	-	9.7	<170	-	-	200	-	-	-	300	500	11
Class 0 Max. Allowable Limit (*2)	-	9.5	<70	-	<70	<100	<25	-	-	<100	<200	<6
Class 1 Max. Allowable Limit (*2)	-	10	150	-	100	200	50	-	-	200	400	10
Class 2 Max. Allowable Limit (*2)	-	10.5	370	-	200	400	100	-	-	600	600	20
Class 3 Max. Allowable Limit (*2)	-	11	520	-	400	1000	500	-	-	1200	1000	40
Class 4 Max. Allowable Limit (*2)	-	>11	>520	-	>400	>1000	>500	-	-	>1200	>1000	>40
South African Water Quality Guidelines (SAWQG), Volume 5 – Agricultural Use – Livestock Watering Target Range	-	-	154	0.01	500	2000	-	-	-	1500	100	1000
Minimum												
Maximum												
Average												

*1 : South Africa National Standard (SANS) 241 (2011)

*2 : Department of Water Affairs and Forestry : DWAF Guidelines 1998 Water category : Class0: Ideal water quality, Class1: Good water quality, Class2: Marginal water quality, water suitable for short-term use only, Class3: Poor water quality, and Class 4: Unacceptable water quality

Table2

Monitoring Location	Chemical Determinants									Others (if any)	Water Quality Class
	F (mg/l)	Al (mg/l)	Fe (mg/l)	Mn (mg/l)	Cr (III) (mg/l)	Cr (VI) (mg/l)	Cu (mg/l)	Co (mg/l)	COD (mg/l)		
01											
02											
SANS241: 2011 Max. Allowable Limit*	1.5	0.3	0.3	0.5	-	-	-	-	-		
Class 0 Max. Allowable Limit	<0.7	-	<0.01	<0.1	-	-	-	-	-		
Class 1 Max. Allowable Limit	0.7-1.0	-	0.01-0.2	0.1-0.4	-	-	-	-	-		
Class 2 Max. Allowable Limit	1.0-1.5	-	0.2-2.0	1.0-4.0	-	-	-	-	-		
Class 3 Max. Allowable Limit	1.5-3.5	-	2.0-10.0	4.0-10.0	-	-	-	-	-		
Class 4 Max. Allowable Limit	>3.5	-	>10.0	>10.0	-	-	-	-	-		
South African Water Quality **Guidelines (SAWQG), Volume 5 – Agricultural Use – Livestock Watering Target Range	2	5	10	10	-	2	0.5	2	-		
Minimum											
Maximum											
Average											

*1 : South Africa National Standard (SANS) 241 (2011)

*2 : Department of Water Affairs and Forestry : DWAF Guidelines 1998 Water category : Class0: Ideal water quality, Class1: Good water quality, Class2: Marginal water quality, water suitable for short-term use only, Class3: Poor water quality, and Class 4: Unacceptable water quality

5. Waste

Description of Waste Management

Report of condition of waste management (with pictures attached)

Amount of Waste

[illegible]

Note: Kinds of generated hazardous waste are not limited above.

6. Ecosystem (Flora and Fauna)

Area/Location \ Items	Date	Name of Species	Rare species, Common species or Foreign species	Description of Finding and Action

7. Soil Erosion (During Construction)

Check Point: To check the construction design and site condition through the site inspection

Area/Location \ Items	Date	Severity	Source Category	Description of Finding and Action (if any problems are found)

8. Existing Social Infrastructure and Services (Road Traffic)

Check Point: To check the traffic problem in and around the power station

Area/Location \ Items	Date	Severity	Source Category	Description of Finding and Action (if any problems are found)

9. Infectious diseases such as HIV/AIDS

Check Point: To Record of HIV/Aids workplaces programme

Name of Programme or topic	Date	Target/Area	Attendance	Summary / Achievement / Note
Education and awareness campaign				
Check the health check sheet				
Treatment, care, and support				
Monthly medical health services				
Others (if any)				

10. Working Condition

Check Point: To record the Safety Health and Environmental Program and training

Name of Programme or topic	Date	Target/Area	Attendance	Description
Safety Health and Environmental induction				
Trainings on OHSAS 18002				
First aid program				
Evacuation warden				
Occupational Health and Safety Act 85 of 1993 OHS Act				
Working at heights				
Fundamentals of firefighting				
Construction regulations				
Eskom Lifesaving Rules				
Behavior Safety awareness				

Check Point: To check the working condition through the site inspection

Items Area/Location	Date	Severity	Source Category	Description of Finding and Action (if any problems are found)
Construction Site				
Workers Camp				

11. Accidents

Check Point: To record accidents

Items Area/Location	Date	Severity	Source Category	Description of Finding and Action

12. Complaints from Residents

Check Point: To record complaints (if any)

Items Area/Location	Date	Severity	Source Category	Description of Finding and Action