

	<p style="text-align: center;"><b>SOW</b></p>	<p style="text-align: center;"><b>Camden Power Station</b></p>
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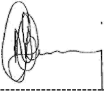

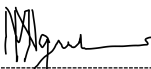

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<p><b>N. Shoji</b> System Engineer Auxiliary</p>	<p><b>O. Tilodi</b> Auxiliary Engineering Line Manager</p>	<p><b>M. Ngubeni</b> Auxiliary Maintenance Line Manager</p>	<p><b>M. Mathabatha</b> Engineering Manager</p>
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## **1. Introduction**

A structural inspection was carried out on the Water Treatment Plant at Camden Power Station. The inspection report recommends that the aforementioned structure must undergo both external and internal structural rehabilitation. The WTP clarifiers consists of a structural steel frame and reinforced concrete structure. The Clarifiers are supported over a grid of reinforced columns and beams, with a shell of reinforced concrete walls and steel handrailing at the top. The function of the clarifier tanks is to remove sediment from the raw water.

## **2. Supporting Clauses**

- [1] 240-112234362: Camden Power Station Critical Civil Structures Monitoring
- [2] UNI EN 1504-2:2005: Surface protection systems for concrete
- [3] UNI EN 1504-3:2006: Structural and non-structural repair
- [4] UNI EN 1504-4:2005: Structural bonding
- [5] UNI EN 1504-5:2005: Concrete injection
- [6] UNI EN 1504-6:2007: Anchoring of reinforcing steel bar
- [7] UNI EN 1504-7:2007: Reinforcement corrosion protection
- [8] UNI EN 1504-8:2005: Quality control and certification of conformity
- [9] UNI EN 1504-9:2008: General principles for the use of products and systems
- [10] UNI EN 1504-10:2005: Site application of products and quality control of the works

### **2.1 Scope**

#### **2.1.1 Purpose**

The purpose of this scope of work is to give detailed instructions regarding the repairs that need to be done on the internal and external structure of the water treatment plant clarifiers.

#### **2.1.2 Applicability**

This document shall be applicable at Camden Power station.

#### **2.1.3 Effective date**

This document will be effective after it has been signed for Authorisation.

## **2.2 Normative/Informative References**

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

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### 2.2.1 Normative

[11]ISO 9001 Quality Management Systems

[12]OHSACT

### 2.2.2 Informative

[13]SANS 1200 A - General

[14]SANS 1200 G - Construction Works

[15]SANS 2001-EM1:2007 Construction works Part EM1: Cement plaster

### 2.3 Definitions

Definition	Description
Concrete Spalling	Hardened concrete falling off due to tension forces arising from expansion.
Carbonation	Rebar corrosion due to the penetration of CO <sub>2</sub> from the atmosphere into the concrete and react with calcium hydroxide to form calcium carbonates.
Honeycombing	Void formation on the surface of the concrete structure.
Meridional cracks	Stress induced cracks on the structure: i.e. temperature gradient, differential settlement.
Rebar	Steel Reinforcing bars in a concrete structure.

#### 2.3.1 Document:

N/A

### 2.4 Abbreviations

Abbreviation	Explanation
ISO	International Organization for Standardization
OHSACT	Occupational Health and Safety Act
SARTSM	South African Roads Traffic Signs Manual
SANS	South African National Standards
CT	Cooling Tower
FFP	Fabric Filter Plant

### 2.5 Roles and Responsibilities

- Auxiliary engineering
- Auxiliary maintenance

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## **2.6 Process for Monitoring**

The process for monitoring the work activity for rehabilitating of the water treatment plant clarifiers shall be done by an Eskom representative.

## **2.7 Related/Supporting Documents**

**Water Treatment Plant Clarifier Tanks structural assessment – E-square Engineering**

## **3. Scope of Work**

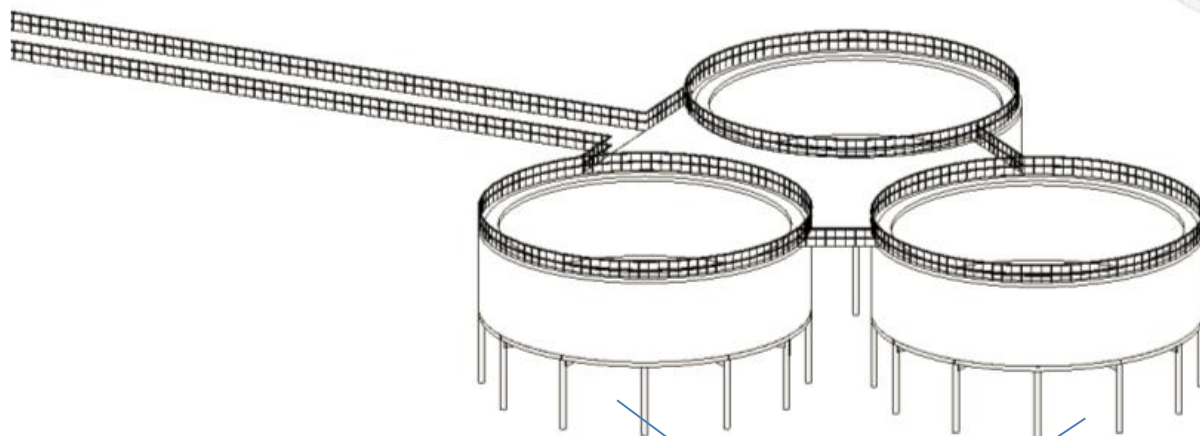
### **3.1.1 Current condition of cooling tower**

A structural inspection was carried out on the clarifiers at Camden Power Station and the condition of these structures

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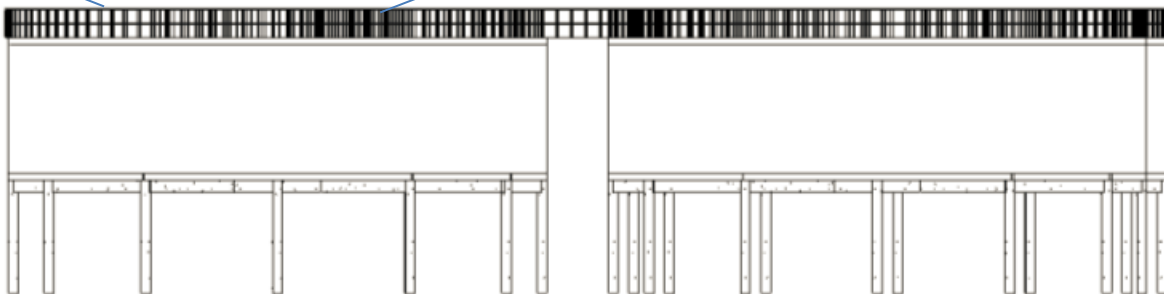
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Reinforced concrete Columns

Steel frame

IBR Cladding



**Figure 1: Structural arrangement of the clarifiers**

The structural inspection report specifies the damages that the structure of the clarifiers has incurred. These damages include;

- Structural & non-structural cracks (Shrinkage, diff. settlement, mechanical damage and meridional cracks).
- Corrosion of reinforcing bars and bracing steel.
- Concrete spalling on the cooling tower structure.

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The damages are located on the **columns, structural steel and cladding** of the clarifiers. The cause of these damages is mostly due to lack of concrete cover, corrosion & moisture protection measures and lack of maintenance on the aging clarifiers situated in an aggressive environment. These damages require immediate repairs to avoid compromising the durability and subsequently the ultimate strength of the clarifiers.

#### Current condition of the Clarifiers

The WTP as shown in the figures above consists of a structural steel frame and reinforced concrete structure. The Clarifiers are supported over a grid of reinforced columns and beams, with a shell of reinforced concrete walls and steel handrailing at the top. The function of the clarifier tanks is to remove sediment from the raw water.



**Figure 2: Internal structure for clarifiers**

**Figure 2 shows corrosion on the Clarifier tanks cladding, handrail and minor concrete cracks**

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**Figure 3: Circular columns for clarifiers**

**Figure 3 above shows the thermal cracks that are evident on the columns of the clarifiers structure.**

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## **3.2 Structural repair procedures**

This section of the document contains detailed steps that need to be followed for the repairs to be done on the structure of the clarifiers. Each type of damage has its own set of instructions to be implemented for effective rehabilitation. The rehabilitation shall be applicable in all affected areas of the clarifiers.

### **3.2.1 Concrete Spalling & Honeycombing**

#### **Base Preparation:**

- All weak and damaged concrete should be chipped away. Rebar must be exposed to at least 50mm beyond the visibly corroded area.
- If the re-bars are only partially exposed after all unsound concrete is removed, it may not be necessary to remove additional concrete to expose the full circumference of the reinforcement.
- When the exposed reinforcement steel has loose wrap, corrosion or is not well bonded to the surrounding concrete, the concrete removal should continue until a clear space of 15 to 25 mm is created behind the reinforcing steel and remove dust by air blowing and wash with clean water to achieve a clean dry surface.
- Clean steel reinforcement with mechanical wire-brushing or by sand blasting and in case the reinforcing bars are corroded and have lost more than 25% of their diameter, they must be cut and removed.
- In such event, removed steel bars should be replaced with new steel bars of the same diameter either by respecting the overlap length or by welding 100 mm length to the existing steel
- The exposed steel must be treated with a steel reinforcement primer similar to *Sika Armatec 110 Epocem*. This will protect the steel for further corrosion.
- A non-shrink grout similar to *Sika Monotop* must be hand applied to fill the voids formed after the cleaning process.

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Application of Remedy:

- A mineral turpentine primer must be applied to the cleaned surface to ensure better bond with the finishing coat. This primer must be given 2-3 hours to set.
- Two neat coats of Acrylic, silicone enhanced, epoxy or polyurethane anti-carbonation coating should be applied without any dilution. It should be ensured that over coating is done when the first coat is dry for 5-6 hrs.

**3.2.2 Structural and Non-structural Cracks**

Cracks on the structure of the clarifiers shall be repaired as mentioned below. All cracks shall be cleaned and all debris removed. For a proper fix, ream out the crack down to firm material. The dust and loose material shall be removed by vacuuming or flushing with water or other effective cleaning methods. The type of crack shall be considered when performing the repair.

**3.2.2.1 Major/ Structural cracks**

- Drill holes on both side of the crack and clean the holes.
- Stitch the crack with U shape metal with short legs.
- Anchor the legs of the stitching U shape metal in the holes with a non-shrink grout or an epoxy resin-based bonding system. Inject the crack with epoxy or crack filler.

**3.2.2.2 Minor & Moderate cracks**

- The minor & moderate cracks shall be injected with *Sikadur* structural epoxy or similar product using a hydraulic pump, paint pressure pots, or air-actuated caulking guns.
- For vertical/inclined cracks, inject the entry port at the lowest elevation until the epoxy level reaches the entry port above.
- For horizontal cracks, injection shall be from one end of the crack to the other end in a similar manner as in the vertical/inclined crack.
- Cut or grind the surface after the injected epoxy has cured.

**3.2.3 Structural Steel Frame**

- Clean all structural steel frame members and brush off minor corrosion with mechanical wire brushing or by sand blasting.
- Apply corrosion inhibitor on the steel members such as red oxide and there after apply corrosion resistant paint.
- Severely corroded vastrap plate must be replaced with hot dipped galvanized vastrap plate.

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#### 3.2.4 Steel Corrosion

#### 3.2.5 Base Preparation

- Clean all structural steel frame members and brush off the old paint with mechanical wire-brushing or by sand blasting and apply corrosion inhibitor on the all steel members such as red oxide and there after apply corrosion resistant paint.

#### 3.2.6 Damaged Hand Railing

- Damaged handrailing on walkways and stairs to be replaced with 316 stainless steel similar to MS 90.

#### 3.2.7 Corroded Grating on Walkway and Stairs

- Severely affected grating on the walkways and stairs must be replaced with galvanized grating stair treads.

#### 3.2.8 Corroded cladding over clarifier tanks

- The damaged iron cladding over clarifier tanks should be removed and replaced when replacing the corroded handrailing.

### **3.3 Damage Prevention Measures**

After completing the rehabilitation of the clarifiers, the following must be implemented to mitigate the re-occurrence of similar structural damage.

- Internally:** Spalling of concrete can be avoided by coating the interior of the clarifiers with products similar to *Sika icosit 2406 epoxy coating* or *Sikagard hydrophobic impregnation* which prevent moisture ingress and therefore the corrosion of reinforcing steel.
- Externally:** Two coats of *Sikagard 700 S hydrophobic impregnation* or similar must be applied on the exterior of the clarifiers followed by two coats of acrylic based *Sikagard 680 S Beton Color* or similar. For meridional cracks an additional coating of *Sikagard 550W* or similar on areas at risk of future cracking must be applied.

**NB!** All work shall be done in accordance with the safety regulations and the OHS act.

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#### **4. Acceptance**

N/A

#### **5. Revisions**

<b>Date</b>	<b>Rev.</b>	<b>Compiler</b>	<b>Remarks</b>
16/02/2021	0	N. Shozi	Original issue of the SoW for the water treatment plant clarifier tanks structural repairs

#### **6. Development Team**

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

- Nkanyiso Shozi

#### **7. Acknowledgements**

N/A

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