APPENDIX TO THE BASIC ASSESSMENT REPORT

Retrofitting of the Duvha Unit 4 ESP with an FFP

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Proponent: Eskom Duvha Power Station

DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME

Project 12725

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Appendix A Applicable Procedures

GLOSSARY OF TERMINOLOGY

Bi-monthly	means every second month. Similarly "*two-monthly*" is assumed to have the equivalent meaning to "*bi-monthly*"
Contractor	means the **main contractor** as engaged by the Eskom for the construction of the subject infrastructure, including all Sub-contractors and service provides appointed by the main contractor of his own volition for the execution of parts of the Works. "*Contractor*" also includes any other contractor engaged by Eskom directly in connection with any part of the construction, which is not a nominated sub-contractor to the main contractor
Environment[1]	(i) the land, water and atmosphere of the earth; (ii) micro organisms, plant and animal life; (iii) any part or combination of (i) and (ii) and the interrelationships among and between them; and (iv) the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and wellbeing
Environmental Control Officer	means a person who is responsible for the monitoring of the implementation of the requirements of an EMProg on behalf of the applicant (could also be a member of the Duvha Environmental department)
Environmental Officer	means a person who is responsible for the implementation of the requirements of an EMProg on behalf of the contractor
Environmental Impact Assessment	means a study of the environmental consequences of a

[1] As defined in terms of the National Environmental Management Act No. 107 of 1998 (NEMA).

(EIA)	proposed course of action
Environmental impact	means an environmental change caused by some human act
Method Statement	means setting out in detail how the management actions contained in an EMProg will be implemented, in order to ensure that the environmental objectives are achieved
Public Participation Process	means a process of involving the public in order to identify needs, address concerns, in order to contribute to more informed decision making relating to a proposed project, programme or development

LIST OF ABBREVIATIONS

BA ..... Basic Assessme

CH_4 ..... Methar

DWA ..... Department of Water Affai

EA..... Environmental Authorisatic

EIA ..... Environmental Impact Assessme

EMProg ..... Environmental Management Programm

ECO.....

EO ..... Environmental Offi

DEA..... Department of Environmental Affai

GNR..... Government Notice Regulatic

I&AP ..... Interested and Affected Par

NEMA ..... National Environmental Management Act (No. 107 of 199

NEM: AQA..... National Environmental Management Air Quality Act (No 39 of 200

NEM:WA..... National Environmental Management Waste Act (No. 59 of 200

PM10 ..... Particulate Matter smaller than 10 micror

PART A: INTRODUCTION

1. Details of the person who prepared the EMProg and his expertise

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2. Background Information

New legislation (National Environmental Management – Air Quality Act, 2004 [Act 39/2004], Notice 248; 31 March 2010: Minimum Emission Standards) implies that all existing power stations should conform to a standard of 100mg/Nm_3 (N = Normalized cubic meter, 101,325 kPa, 0°C, normalised to 6% reference O_2, on a dry basis) by 2015 and further conform to the standard for new power stations of 50mg/Nm_3 by 2020. The current design of the Electrostatic Precipitators will not be able to meet the more stringent particulate emission limits and the need exists to replace the installed particulate capturing technology. The purpose of this project is to consistently meet the particulate emission licence limit as set out by the Department of Environmental Affairs (DEA) of South Africa at Duvha Power Station Unit 4 by retrofitting the existing Electrostatic Precipitators (ESP) with a Fabric Filter Plant (FFP) utilizing pulse jet cleaning technology that will fit into the existing casings occupied by the ESP's.

Duvha Power Station suffered a failure on unit 4 during the month of February 2011. Due to the extended outage duration to complete the recovery work on the centerline, an opportunity was created to retrofit unit 4 with a fabric filter plant (FFP). Eskom has completed several retrofits of the same nature in the past and experience has shown that the unit would require an estimated 120 day outage to complete the work. Due to current capacity constraints on the national grid, it is questionable whether Duvha Unit 4 will receive the outage required to perform this retrofit work in the foreseeable future to comply with the emission limits.

Project development started early in March 2011 with two contractors completing detailed designs for the proposed retrofit. The current schedule requires that construction contract placement, site mobilization, procurement and certain execution activities start as soon as August 2011 to have the project completed at the set returned to service date of 30 March 2012.

3. Structure of this Document

This document has been divided into four parts, each addressing a different aspect of the EMProg.

- **Part A** provides a brief introduction, details of the person who prepared the EMProg and his expertise;and overview of the purpose and structure of this guideline document;
- **Part B** sets the context for the EMProg by providing an overview of the project, summarising the objectives of the EMProg, highlighting the scope of the EMProg and briefly emphasising the Duvha Power Station's environmental commitments;
- **Part C** provides an introduction to the specification, an overview of the structure and application of the specification and highlights the environmental considerations that should inform the tender adjudication process; and
- **Part D** provides guidance in terms of the on-site implementation of the EMProg, highlighting the organisation structure and various roles and responsibilities, emphasising the importance of awareness training, summarising the requisite approach to monitoring and auditing and addressing the requirement for review and amendment of the environmental specifications.

PART B: SETTING THE CONTEXT

4. Overview of the proposed project

The project comprises the retrofit and operation of the proposed FFP. Due to the fact that there are existing FFP's operational on site, Duvha has an existing operational procedure attached in the Basic Assessment Report.

5. Objectives of the Environmental Management Programme

Environmental management does not end with obtaining the required Environmental Authorisations. Rather there is a need to ensure that the remedial requirements identified during the environmental process are effectively realised during project implementation, and this is where EMProgs have a key role to play.

An EMProg is defined as "an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the upgrade(construction) phase of a project are prevented and that the positive benefits of the projects are enhanced". Impacts range from those incurred during start up (site clearing, erection of the construction camp), and to those incurred during operation. Specifically, the objectives of this EMProg can be articulated as follows:

- To give effect to the retrofit (construction)-related requirements;
- To give effect to the environmental commitments to the various role players;
- To ensure that these requirements / commitments are expressed in a manner that is accessible to all parties and is binding upon those responsible for project implementation;
- To ensure that sufficient resources are allocated to the project budget in order to give effect to the environmental requirements / commitments, and to ensure that the scale of EMProg-related interventions is consistent with the significance of identified impacts;
- To provide a coherent and pragmatic framework for the implementation of the requirements, ranging from the roles and responsibilities of the key project participants to the auditing and reporting of compliance;
- To facilitate appropriate and proactive response to unforeseen events or changes in project implementation that were not considered in the BA process; and
- To ensure that the upgrade (construction) phase of the project does not result in undue or reasonably avoidable adverse environmental impacts, and that any potential environmental benefits are enhanced.

6. Scope of the Environmental Management Programme

The scope of the EMProg must ensure that the objectives outlined in Section 5 will be addressed, and is principally determined by the key documentation related to the BA process, notably the BAR, the Environmental Authorisation and the amended Emission License (once received). A brief overview of the key issues raised in each of these documents is provided below.

7.1 Environmental Management Programme

Adherence to the requirements as set out in Section 9 of this EMProg.

7.2 Environmental Authorisation

Once Environmental Authorisation has been received from the DEA, any additional conditions stipulated in the authorisation will be included into this dynamic EMProg (refer to Appendix A).

7.3 Existing Duvha Power Station Procedures

As part of the existing operations at Duvha Power Station several procedures have already been developed for the existing FFPs on site. All there procedures are to be adhered to as per the EMP and are attached in Appendix A.

PART C: ENVIRONMENTAL SPECIFICATIONS

7. Integration of the Environmental Management Programme into the contract

As alluded in Section 2, this EMProg has been written in a form and language that is consistent with the tender / contract documentation used for engineering contracts i.e. the EMProg takes the form of a set of environmental specifications that can integrate in the civil, mechanical and electrical tender / contract documentation. There are various advantages to this approach:

- The Contractor is made aware of the EMProg at the tender stage;
- The Contractor is able to cost for compliance with the EMProg;
- The EMProg is presented to the Contractor in the language and terminology with which he/she is familiar, and unnecessary duplication and contradiction is eliminated;
- Inclusion of the EMProg within the contract ensures that the EMProg becomes a legally binding document within a well-developed legal framework; and
- The standardised form and structure of the environmental specifications ensures that with time and each new contract, the Contractor becomes increasingly familiar with, and thus more accepting of, the EMProg and implements it with the same diligence as any other set of specifications contained within the contract.

Ultimately, by measuring compliance against an explicit set of environmental controls that are well located within a robust legal framework, the approach has been proven to enhance success in the implementation and enforcement of the EMProg significantly.

8. Specification Structure and Application

These specifications are not exclusive and could, within reason, be expanded on or amended at any time during the contract by the ECO.

9.3 Method statements

Environmental practitioners are not specialists with regard to upgrade (construction) techniques. Therefore, so as not to hinder construction activities by stipulating elaborate, costly and/ or ineffective mitigation measures, the environmental specification is underpinned by a series of Method Statements, within which the Contractor is required to outline how they propose to mitigate any identified environmental risks. For example, if the specification states that “cement contaminated water shall not be allowed to contaminate the soil or adjacent watercourse”, the Method Statement compiled by the Contractor would be required to outline how he or she intends to achieve this requirement.

In terms of the environmental specifications for the proposed FFP retrofit project, the Contractors must submit various written Method Statements to the Engineer and ECO as requested in the Specification.

For the purposes of the environmental specifications, a Method Statement is defined as *"a written submission by the Contractor to the Engineer in response to the Specification or a request by the Engineer, setting out the materials, labour and method the Contractor proposes using to carry out an activity, identified by the relevant specification or the Engineer when requesting the Method Statement, in such detail that the Engineer is enabled to assess whether the Contractor's proposal is in accordance with the Specifications and/or will produce results in accordance with the Specifications"*.

The Method Statement must cover applicable details with regard to:

- Retrofit (Construction) procedures,
- Materials and equipment to be used,
- Getting the equipment to and from site,
- How the equipment/ material will be moved while on site (including crane operation),
- How and where material will be stored,
- Removal of construction related waste,
- The containment (or action to be taken if containment is not possible) of leaks or spills of any liquid or material that may occur,
- Timing and location of activities,
- Compliance/ non-compliance with the Specifications, and
- Any other information deemed necessary by the Engineer.

The environmental specifications set very stringent requirements in terms of the provision of Method Statements and the commencement of the activities they cover:

- Any Method Statement required by the Engineer/ECO or the specification must be produced within the timeframes specified by the Engineer or the specification (typically two weeks);
- The Contractor may not commence the activity covered by the Method Statement until it has been approved, except in the case of emergency activities and then only with the consent of the Engineer;

- The Engineer may require changes to a Method Statement if the proposal does not comply with the specification or if the proposed methodology carries an unreasonable risk of excessive damage to the environment;
- Approved Method Statements must be readily available on the site and must be communicated to all relevant personnel;
- The Contractor is required to carry out the activities covered by the Method Statement in accordance with the proposed approach; and
- Approval of the Method Statement does not absolve the Contractor from their obligations or responsibilities in terms of the Contract.

9.3 Provisions for addressing non-conformance

Ultimately, the key to construction phase is ensuring that the requirements of the EMProg are adequately and appropriately implemented on site. Accordingly, monitoring performance and addressing non-compliance are key attributes of any environmental interventions. Part D addresses the actual process for identifying and addressing non-compliance, whilst this section provides an overview of the provision made for this in the environmental specification.

Broadly, the mechanisms for addressing non-compliance that are provided for in the environmental specifications and associated contract documentation can be divided into the following categories:

- Controlling performance via the certification of payments;
- Requiring the Contractor to "*make good*", at their own cost, any unjustifiable environmental degradation;
- Implementing a system of penalties to dissuade environmentally risky behaviours; and
- Removing environmentally non-compliant staff/ plant from site, or suspending part or all of the activities on site.

9.3 Environmental considerations in adjudication of tender

In terms of this EMProg, Eskom has an obligation to ensure compliance by various parties with a suite of environmental requirements related to the constrcution phase. The compilation of the EMProg and its integration into the Tender Document, as a suite of environmental specifications form part of meeting the obligation. However, to ensure that these obligations continue to be fulfilling during the actual construction processes, it requires the Eskom team to ensure that the appointed Contractors possess the requisite environmental management experience and expertise. Accordingly, it would be prudent for the Eskom team to ensure that environmental considerations form part of the tender adjudication process. Key considerations in this regard would be as follows:

- To request as part of the tender process that the Contractor provide his environmental policy and indicate how this will influence the way the construction process is approached and managed on site. At the tender stage the Contractor would merely be asked to provide the overarching environmental policy for the Company or Joint Venture;
- To request as part of the tender process a list of the Contractor's previous experience in terms of the onsite implementation and management of environmental requirements;
- To request as part of the tender process an indication of the proposed organisational structure for the Contract, and specifically for the Contractor to indicate which staff would be acting in the capacity of Environmental Officer (EO) and which senior staff member would have overall responsibility for ensuring compliance by the Contractor with the specified environmental requirements; and
- To confirm, upon receipt of the Tender, that the Contractor has made sufficient allowance in his Tender Price for meeting the various environmental requirements.

During the tender adjudication process for each Contract, each Contractor should be scored in terms of the aforementioned considerations and allocated an environmental competency score. This score should form a key consideration in the final decision-making regarding the award of the various contracts.

9. Environmental Management Measures for the project

The management measures documented in each of the sub-sections below have been compiled using the following information:

- Impact Assessment and mitigation measures documented in the BAR for the proposed retrofit; and
- The standard operations utilised by Eskom for the site preparation and operation of the proposed FFP.

In addition to the abovementioned information sources, the EMProg will be updated to include the conditions documented in the Environmental Authorisation (EA) to be received upon approval of the Basic Assessment (BA).

10.1 Planning Phase

To mitigate the negative environmental impacts, a number of measures would have to be addressed in the design of the salvage during the planning phase. An inspection must be carried out on the design before commencement of the upgrade in order to ensure that the mitigation measures have been incorporated in the design.

Table 1: Impacts, Management/ Mitigation Measures during the Planning Phase

Planning Phase		
Environmental Consideration	**Mitigation Measures**	**Responsible Party(ies)**
Training and Health and Safety	• Eskom is to appoint an ECO (can be the Duvha Environmental department.	Project Manager
	• Introduce the ECO to the Project Team.	Project Manager
	• Training of the Contractor's employees on the EMProg and EA. • Elucidation of environmental monitoring protocol to the Project Team by the ECO.	ECO
	• All correspondence from ECO must be filed and kept on site.	Project Manager and ECO
	• Staff responsible for retrofit should be issued with the appropriate PPE and trained in safe working procedures concerning the various retrofit and processing actions at the FFP.	Project Manager
Construction Camp/laydown area	• In consultation with the ECO, demarcate the suitable site identified for the laydown area. The site office as well as parking areas for construction vehicles should be confined to disturbed areas, away from drainage lines.	Contractor and the ECO
	• Utilise Power Station ablution facilities.	Project Manager, Contractor
Waste	• Identify suitable hazardous/general Waste Disposal Site which will accept waste material to be generated.	Project Manager, Contractor
Social	• Local suppliers must be used, as far as possible; and • Local labour should be employed.	Eskom and Contractor
Designs	• Ensure that the retrofit is designed to fit inside the existing casing.	Eskom
Vehicles	• Ensure that all machinery on site is in a good working order.	Contractor

10.2 Construction Phase

Once planning has been completed, the proposed construction of the FFP is to be constructed according to the standard specification sections, which are included in SANS 1200 (standardised specification for civil engineering construction). These standards should be referred to and included in the tender document for the construction contractor.

The Responsible Party from Eskom as well as the Environmental Control Officer (ECO) will monitor the activities of the construction team on site to ensure all mitigatory measures are implemented and to prevent any additional impacts from occurring.

A tender for construction of the FFP will be compiled, and subsequent to that, an evaluation of the tenders will be undertaken and the preferred tenderer will be appointed.

Once adequate planning and construction have been undertaken, site structure utilised during construction should be removed.

A monthly Project Compliance Audit should be undertaken, which should focus on waste handling, water etc.and management issues that would need to be addressed and audited have been listed in Table 2 below.

Table 2: Impacts, Management/ Mitigation Measures during Construction (Retrofit)

Construction (Upgrade) Phase		
Environmental Consideration	**Mitigation Measures**	**Responsible Party(ies)**
Soil	• Limit all activities to the Duvha Power Station property; • Ensure that adequate storm water control measures are in place to prevent erosion where activities do not take place on a concreted surface; • Spread absorbent sand or adequate drip trays on areas where oil spills are likely to occur; • Any spill-contaminants are to be removed to a contained storage area and bio-remediated or disposed of at a licensed facility; • No vehicles to be serviced on site;	Contractor and ECO.
Surface Water	• Ensure that storm water control measures are incorporated into the FFP construction designs prior to the start of construction. These measures should tie into the existing operations at Duvha; • Ensure that all machinery on site is in a good working order and does not have leaks; • Hydro-carbons, paints and chemicals should be stored in a bunded storage area or in designated facilities at the FFP; • No refuelling shall take place on site; • No maintenance of machinery to be done on site, but to be done at the site's demarcated area for this; • Limit all activities to the FFP.	Contractor
Groundwater	• Waste to be managed in accordance with station's waste management procedures. Suitable waste receptacles (e.g. bins, skips) to be provided at the construction camp as well as on site to receive material. • Refuel vehicles off-site. • Clean up any spills immediately. • No vehicles to be parked on open ground.	Contractor
Air Quality	• Vehicles to be properly maintained to avoid unnecessary emissions. • The proposed FFP operator should control on-site dust emissions by effective management and mitigation according to the existing procedures for the FFP. • Construction vehicles must travel at low speeds to reduce the effect of dust. • Dust mask to be worn in areas of concrete break-up work (Jack-hammers etc).	Contractor

Construction (Upgrade) Phase		
Environmental Consideration	**Mitigation Measures**	**Responsible Party(ies)**
Fauna and Flora	• Use existing roads; • All construction/laydown areas should be demarcated prior to construction to ensure that the footprint of the impacts are limited (including areas where vehicles may traverse); • Workers and machinery to remain inside construction footprint. • All labourers to be informed of disciplinary actions for the willful damage to plants or animals on Duvha property. • No vegetation must be removed. • Waste to be managed in accordance with station's waste management procedures. Suitable waste receptacles (e.g. bins, skips) to be provided at the construction camp.	Contractor
Aesthetics	• Sound housekeeping and waste management measures to be employed. • Location of construction camp to be determined by ECO to minimise visual intrusion. • Construction material to be stored in a neat and safe manner, in designated areas. • Waste should be restricted to storage in specifically designated areas, and removed daily. • Any complaints regarding the appearance of the construction site must be recorded and addressed promptly. • Ensure that all litter and pollution is cleared from the site (including remaining building rubble).	Contractor;
Noise	• All machinery to be maintained and fitted with equipment to reduce noise levels. • Labourers to be provided with hearing protection (PPE). • No loud music allowed from the construction camp or anywhere else within the work footprint.	Contractor and Eskom
Heritage Resources	• None required	Contractor, Eskom and ECO.

Construction (Upgrade) Phase		
Environmental Consideration	**Mitigation Measures**	**Responsible Party(ies)**
Fuel Materials (if fuel stored on site)	• Area where decanting takes place also to have impermeable flooring. • The outflow of the bunded area to be supplied with an oil trap. The bund wall to be of sufficient height to allow for the containment of 110% of the tank(s) volume. Provide area with relevant warning signage (e.g. no smoking and open fires, fire extinguisher). • Prevent spillage from elevated fuel tanks during decanting. • In the event of a fuel spill in excess of 25ℓ, the spill must be confined and mopped up using oil absorbent fibres. Specialist, Professional clean-up staff should perform cleaning of large spills. The clean-up operation will initially involve aeration of the soil. This activates bacteria in the soil which then partially digest the spilt fuel. • Contaminated soil should then be removed to a depth of 0.5m below the saturated oil spill level. This soil must be disposed of at a hazardous registered Waste Disposal Site. The efficacy of the clean up should be monitored to ensure that all of the spilt fuel is removed from the soil.	Contractor and ECO.
Construction Materials	• Proper storage facilities should be provided for the storage of oils, grease, fuels, chemicals and hazardous materials. • Construction material must be stored under a roof or inside a suitable container. • The construction material must be mixed in designated areas, on impermeable surfaces. The batching plant must be bonded to prevent storm water entry, and to contain dirty water. • Material must be stored in a safe and neat manner. • Site offices, parking areas for construction vehicles should be confined to disturbed areas.	Contractor and ECO

Construction (Upgrade) Phase		
Environmental Consideration	**Mitigation Measures**	**Responsible Party(ies)**
Occupational Health and Safety	• All projects must be conducted in accordance with the Occupational Health and Safety Act (Act 85 of 1993). • The contact details of the Safety Officer/Representative should be provided to the ECO. • Safety induction must be expanded to include environmental risks and mitigation measures. **Fire prevention:** • The Contractor must take all the necessary precautions to protect the materials on site and to avoid fires. • All waste bins must be kept away from fuel tank installations. • No waste material may be burnt. • Designated areas must be provided, where smoking can occur in a controlled environment. • A firebreak must be put around the construction camp. • Provide area with relevant warning signage (e.g. no smoking and open fires, fire extinguisher).	Contractor
Waste	• Building rubble and recyclable waste must be handled in line with the Duvha Waste Management Plan and any relevant procedures. • Littering on site and the surrounding areas is prohibited. • Clearly marked litterbins must be provided on site. • All bins must be cleaned of litter regularly. • All general waste will be removed and disposed of at a registered Waste Disposal Site. • The contractor must install and maintain mobile chemical toilets at work sites if existing facilities are not available.	Contractor
Sanitation	• Under no conditions may the surrounding areas be used for ablution purposes. Sufficient chemical toilets to be provided (if no existing facilities are available). Chemical toilets to be placed at strategic points (with minimal visual impact).	Contractor
Infrastructure, Vehicles and Plant Equipment	• The equipment and plant to be used at the FFP must be suitable for the application and prevailing site conditions, of adequate rated capacity, in good working condition, and shall be so designed and constructed as to cause minimum environmental pollution. • The plant at the FFP shall be operated by properly qualified and experienced operators. • The plant, vehicles and equipment necessary for the operation shall be properly maintained and the vehicles serviced at the required service intervals to ensure road worthiness.	Contractor

Construction (Upgrade) Phase		
Environmental Consideration	**Mitigation Measures**	**Responsible Party(ies)**
	• All vehicles are inspected on a daily basis for roadworthiness.	

10.3 Operational Phase

Once construction (retrofit) has been completed, the proposed operation of the FFP is to be undertaken according to the existing operating procedure and associated procedures for the FFP's at Duvha.

The Responsible Party from Eskom will monitor the activities of the operational team on site to ensure all mitigatory measures are implemented and to prevent any additional impacts from occurring.

A annual Project Compliance Audit should be undertaken, which should focus on the adhereance to the procedures.

The procedures referred to above is attached as Appendix A.

PART D: ON-SITE IMPLEMENTATION

10. Organisational Structure

The organisational structure identifies and defines the responsibilities and authority of the various role-players (individuals and organisations) involved in the project. All instructions and official communications regarding environmental matters shall follow the organisational structure shown in figure 1 below.

The organisational structure reflected in Figure 1 has been developed to ensure that;

- There are clear channels of communication;
- There is an explicit organisational hierarchy for the FFP project; and
- Potential conflicting or contradictory instructions are avoided.

In terms of the defined organisational structure reflected in the figure, all instructions that relate to environmental matters will be communicated to the Contractor via the Site supervisor. The only exception to this rule would be in an emergency (defined as a situation requiring immediate action and where failure to intervene timeously would, in the reasonable opinion of the ECO, result in unacceptable environmental degradation), where instructions may be given directly to the Contractor .The detailed roles and responsibilities of the various role-players identified in the organisational structure are outlined in Section 11.

11. Environmental Roles and Responsibilities

As is evident from figure 1, the key-role-players for the FFP project are the DEA, Eskom Duvha Power Station (including the Environmental Control Officer) and the Contractor. The detailed roles and responsibilities of each of these organisations are outlined below.

12.1 Department of Enviromental Affairs

As the competent environmental authority, the DEA has the responsibility to ensure that the proponent, *viz. the Eskom*, complies with the conditions of the Environmental Authorisation for the FFP project (once received) as well as the requirements of the broader environmental legislation, specifically the NEMA - National Environmental Management Act (No. 107 of 1998). Compliance would be confirmed via the following mechanisms:

- Receipt and review of the environmental reporting required in terms of the EA; and
- *Ad hoc* and planned site inspection by the DEA Compliance and Enforcement Directorate.

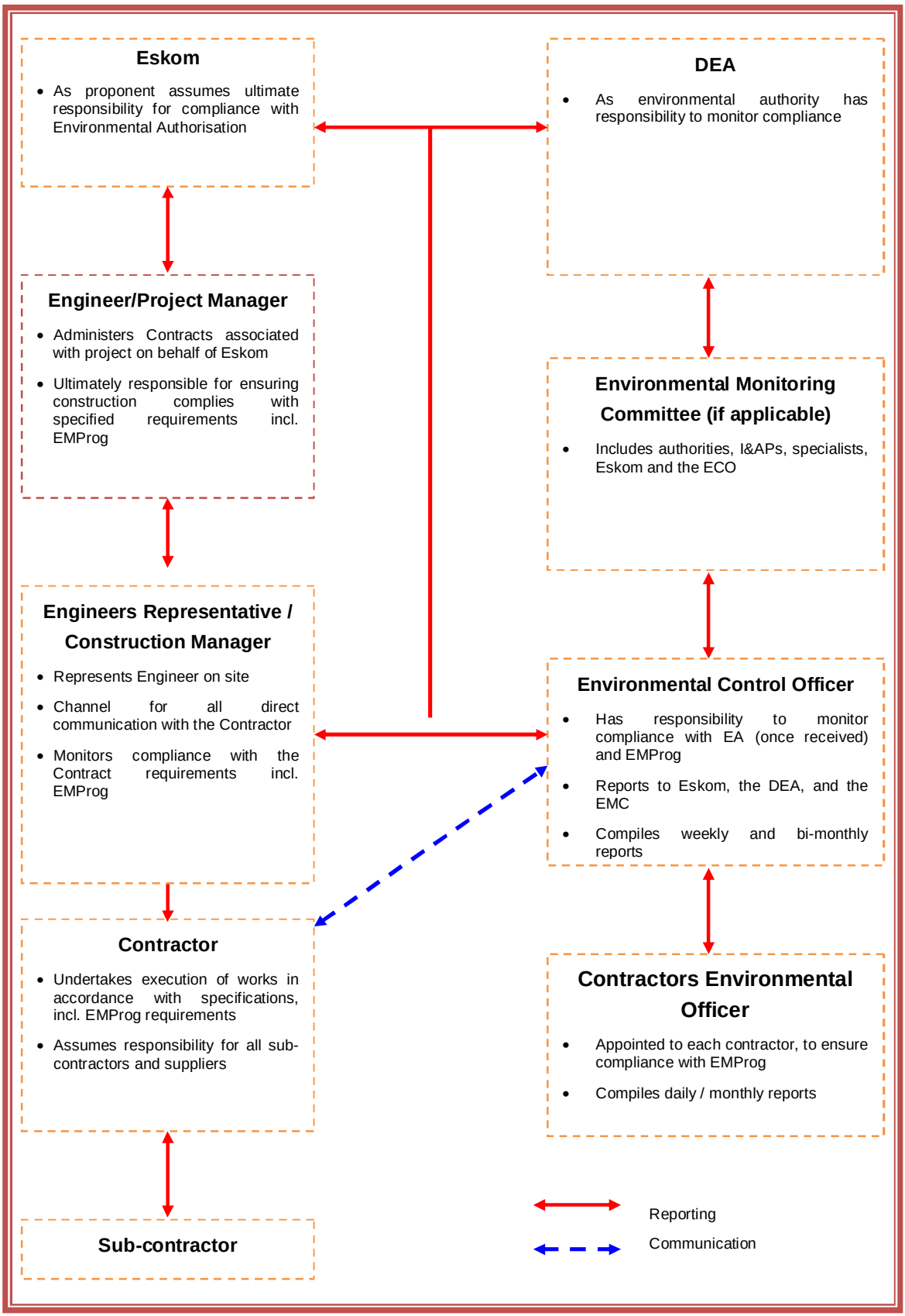

Figure 1: Organisational Structure: FFP project.

12.2 Eskom

As the Proponent, the Eskom must ensure that the implementation of FFP project complies with the requirements of the DEA Environmental Authorisation (once received), this EMProg, as well as any obligations emanating from other relevant environmental legislation. Although part of this obligation is being met by the development of the EMProg, and its integration into the contract documentation, and the appointment of the ECO, the Eskom cannot delegate out of this responsibility. Accordingly, the Eskom retains various key roles and responsibilities during the decommissioning of the FFP and associated infrastructure. These are outlined below.

The Eskom, as an organisation must ensure that adequate funding is made available for the implementation and monitoring of the environmental controls emanating out of the Basic Assessment, Environmental Authorisation (once received), EMProg and applicable environmental legislation. This would include the appointment of the ECO as this is an explicit requirement of the EMProg. It should be noted that the ECO can be an existing environmental employee at the station, for example the Environmental Manager.

The Eskom Project Manager must:

- Be fully conversant with the EIA reporting for the project, the conditions of the Environmental Authorisation (once received), the EMProg and all relevant environmental legislation.
- Ensure that all the specifications and, legal constraints pertaining to the project, specifically with regards to environment management, are highlighted to the Eskom and its Contractor(s) so that they are aware of these; and
- Ensure that the environmental specifications are correctly implemented throughout the project by means of site inspections and meetings. This will be documented as part of the site meeting minutes.

The Eskom's Representative (≈ Eskom's Construction Manager) must:

- Be fully knowledgeable with the contents of the EIA Reporting;
- Be fully knowledgeable with the contents and conditions of the Environmental Authorisation;
- Be fully knowledgeable with the contents of the EMProg, specifically as articulated into the environmental specifications attached to each Contract;
- Be fully knowledgeable with the contents of all relevant environmental legislation and ensure compliance with these;

- Have overall responsibility of the environmental specifications and their proper implementation;
- Ensure that regular audits are conducted to confirm compliance with the environmental specifications;
- Ensure there is communication with the Eskom Project Manager or his delegate, the ECO and the relevant Site Engineers on matters concerning the environment;
- Ensure that no actions are taken which will harm or may indirectly cause harm to the environment, and take steps to prevent pollution on the site.

12.3 Environmental Control Officer

The Eskom must appoint a suitable qualified ECO to monitor compliance with this EMProg, environmental legislation and the Environmental Authorisation (once received). To fulfil these requirements, the ECO would need to have relevant on site experience. It should be noted, unless otherwise stated in the Environmental Authorisation, the ECO could be a Eskom employee, as long as they have the requisite environmental training and experience.

The ECO will be responsible for monitoring, reviewing and verifying compliance by the Contractor with the environmental specification. Accordingly, the ECO would be required to:

- Be fully knowledgeable with the contents of the EIA Reporting;
- Be fully knowledgeable with the contents and conditions of the Environmental Authorisation;
- Be fully knowledgeable with the contents of the EMProg, specifically as articulated into the environmental specifications attached to each Contract;
- Be fully knowledgeable with the contents of all relevant environmental legislation and ensure compliance with these;
- Ensure that compliance with the conditions of the Environmental Authorisation and environmental specification are monitored and verified through regular and comprehensive inspections of the site and surrounding areas, and that the results of these inspections are reduced to writing;
- Ensure that if the environmental specifications are not followed then appropriate measures are undertaken to address this; and
- Report to the DEA every three months regarding compliance with the requirements of the EMProg, environmental legislation and the Environmental Authorisation (once received);

In meeting the aforementioned obligations, the ECO's specific duties would include the following:

- Assisting the Eskom Project Manager in ensuring necessary environmental authorizations and permits have been obtained;
- Confirming that activities on site comply with legislation;
- Monitoring and verifying that the conditions of the Environmental Authorisation and environmental specifications are adhered to at all times and requiring the Contractor to take action if these are not followed;
- Monitoring and verifying that environmental impacts are kept to a minimum;
- Giving a report back on the environmental issues at the monthly site meetings and other meetings that may be called regarding environmental matters;
- Inspecting the site and surrounding areas regularly with regard to compliance with the environmental specifications;
- Ensuring that a register of complaints is kept by the Contractor and that all complaints are appropriately recorded and addressed;
- Assisting the Engineer in certifying payment for items related to the environmental specification;
- Approving any method statement required by the contractor;
- Recommending the issuing of penalties for contraventions of the environmental specifications;
- Advising on the removal of person(s) and/or equipment, not complying with the specifications, from site;
- Completing the requisite environmental reporting, which should include a daily site diary entry, weekly audit checklists, a bi-monthly (*viz.* every second month) environmental compliance report;
- Keeping a photographic record of progress on Site from an environmental perspective; and
- Undertaking project and contractors audits.

As outlined previously, all instruction issued by the ECO would go through the Engineer's Representative, who will then convey these to the Contractor.

12.4 Contractors

By virtue of the environmental obligations delegate to the Contractor through the Contract Document, all contractors (including subcontractors and staff) and service providers appointed for FFP project would be responsible for:

- Ensuring adherence to the environmental specifications;
- Ensuring that any instructions issued by the Engineer, on the advice of the ECO, are adhered to;
- Ensuring that there must be communication tabled in the form of a report at each site meeting, which will document all incidents (refer to Appendix B for the incident register) that have occurred during the period before the site meeting;
- Ensuring that a register is kept in the site office, which lists all the transgressions issued by the ECO; and
- Undertaking subcontractor's audits.

Ensure that all employees, including those of sub-contractors receive training before the commencement of construction in order that they can constructively contribute towards the successful implementation of the environmental requirements of the Contract.

The most important actions by the Contractor to ensure compliance with the environmental requirements, relates to the establishment of an adequate and appropriate organisational structure for ensuring the implementation and monitoring of the requisite environmental controls.

The EO's specific duties relate to the implementation of the environmental controls contained within the EMProg, and which are audited by the ECO. Accordingly, the EO's duties include:

- Ensuring that activities on site comply with legislation;
- Monitoring and verifying that the environmental specifications are adhered to at all times and taking action if the specifications are not followed;
- In consultation with the engineers, develop any method statements required in this EMP;
- Monitoring and verifying that environmental impacts are kept to a minimum and taking action to address any environmental degradation;
- Proactively developing environmentally responsible solutions to problems, in consultation with the EO where necessary;

- Giving a report back on the environmental issues at the monthly site meetings and other meetings that may be called regarding environmental matters;
- Keeping records of all activities / incidents concerning the environment on site;
- Inspecting the Site and surrounding areas regularly with regard to compliance with the environmental specifications;
- Maintaining a register of complaints, ensuring that all complaints are appropriately recorded and addressed and notifying the ECO of each complaint and how it was resolved;
- Completing the requisite environmental reporting, namely a daily compliance checklist, a record of staff induction and incidence reports, for submission to the ECO;
- Keeping a photographic record of progress on Site from an environmental perspective; and
- Undertaking subcontractor audits.

12. Training

- The ECO shall be appropriately trained in environmental management and shall possess the skills necessary to impart environmental management skills to all personnel involved in the construction, of the proposed construction of the FFP;
- Eskom, together with the Environmental and Safety Manager and the ECO, shall ensure that the employees (including construction workers, engineers, and long-term employees) are adequately trained on the EMProg; and
- All employees shall have an induction presentation on environmental awareness. The cost, venue and logistics shall be for the Eskom's account.

Where possible, training must be conducted in the language of the employees. The induction and training shall, as a minimum, include the following:

- The importance of conformance with the EMProg, other environmental policies and procedures;
- The significant environmental impacts, actual or potential, related to their work activities;
- The environmental benefits of improved personal performance;
- Their roles and responsibilities in achieving conformance with the EMProg and other environmental policies and procedures;
- The potential consequences of departure from specified operating procedures; and

- The mitigation measures required to be implemented when carrying out their work activities.

13. Project compliance reporting

Regular monitoring of all the environmental management measures and components shall be carried out by the Eskom and ECO to ensure that the provisions of this plan are adhered to. Ongoing and regular reporting of the progress of implementation of this Programme should be done. Various points of compliance will be identified with regard to the various impacts that the construction will have on the environment.

Inspections and monitoring shall be carried out the implementation of the plan. Visual inspections on erosion and physical pollution shall be carried out on a regular basis.

14. Reporting procedures and documentation

Record keeping and monitoring of documentation is a vital part of compliance with the environmental management system, record-keeping procedures for the FFP upgrade has to be in order.

Accurate records must be kept of all waste exiting the FFP. Waste must be categorised by the number of loads, defined by mass, type and origin. Records must be kept on both a daily and a cumulative basis. One or a combination of the following systems could be used for record keeping:

- An electronic, totally computerised, mass measuring device providing detailed records of daily, weekly and monthly transactions. This system should be used with the proposed weighbridge and computer system.
- A mass measuring unit with hand capturing of data for manual or computerised collation. This would also be used as backup when the computer is out of action.

Details of waste category, quantities and origin will be obtained and recorded for all wastes accepted by the Contractor's access controller. A daily summary of the wastes accepted must be recorded by the Contractor in the Daily Diary in the Contractor's site office.

15. Environmental Contact Persons

- ***To Be Confirmed***

16. Emergency Numbers

- Police: 10111

Appendix 1: Procedures

	Title	Document Number
1.	BOILER PLANT FLUE GAS CLEANING SYSTEM FFP FOR UNIT 1-3	HBI1213
2.	FFP DUST HOPPER ARGITATING EQUIPMENT - INSPECT AND REPAIR	HBI1133
3.	FFP COMPRESSOR - GEARBOX INSPECTION	HAI1506
4.	FFP JOY TA-18/28 COMPRESSOR - ALIGN COMPRESSOR	HAI1503
5.	FFP OIL COOLER - CLEANING	HAI1510
6.	FFP CELL INLET DUCTING BETWEEN FLUE GAS DAMPER AND CELL INLET - INSPECT AND REPAIR	HBI1126
7.	FFP - JOY TA-18/28 COMPRESSOR - DAILY CHECK AND CLEANING	HAI1498
8.	FFP CHANGING FABRIC FILTER BAGS - INSPECT AND REPLACE	HBI1134
9.	FFP HOPPER DUSTING - UNITS 1 TO 3	BP018
10.	FFP BAG FILTER PRE-COATING PROCEDURE	BP012
11.	FFP COMPRESSOR - INTERCOOLER INSPECTION AND CLEANING	HAI1508
12.	FFP JOY TA-18/28 COMPRESSOR - INSPECT AND REPAIR LUB OIL SYSTEM	HAI1501
13.	FFP JOY TA-18/28 COMPRESSOR - REPLACE MAIN DRIVE COUPLING	HAI1500
14.	FFP JOY TA-18/28 COMPRESSOR - REPLACE AIR INLET PRIMARY FILTER	HAI1502
15.	FFP COMPRESSOR - IMPELLER INSPECTION AND CLEANING	HAI1507
16.	FFP PLC - Y2K COMPLIANCY TEST	LCI3264
17.	UNIT 3 380V FFP. BRD. "3B"	EIP088
18.	UNIT 3 380V FFP. BRD. "3A"	EIP087
19.	UNIT 3 11KV/400V FFP. TRFR. "3B"	EIP080
20.	UNIT 3 11KV/400V FFP. TRFR. "3A"	EIP079
21.	UNIT 2 11KV/400V FFP. BRD. "2B"	EIP056
22.	UNIT 2 11KV/400V FFP. BRD. "2A"	EIP055
23.	UNIT 2 11KV/400V FFP. TRFR. "2B"	EIP048
24.	UNIT 2 11KV/400V FFP. TRFR. "2A"	EIP047
25.	UNIT 1 380V FFP BRD. "1B"	EIP024
26.	UNIT 1 380V FFP BRD. "1A"	EIP023
27.	UNIT 1 11KV/400V FFP. TRFR. "1B"	EIP016
28.	UNIT 1 11KV/400V FFP. TRFR. "1A"	EIP015
29.	FFP FILTER PLANT STANDBY COMPRESSOR TEST RUN	BW032
30.	FABRIC FILTER PLANT (FFP) SYSTEM STRATEGY	ENS0032
31.	FFP - JOY TA-18/28 COMPRESSOR - 500 HOURS SERVICE	HAI1505
32.	FABRIC FILTER PLANT (FFP) SYSTEM STRATEGY	ENS0032
33.		ENS0032
34.	FFP FILTER PLANT STANDBY COMPRESSOR TEST RUN	BW032

	Title	Document Number

1.	DUSTING ON THE FLOOR : FABRIC FILTER PLANT	BP026
2.	UNITS 1-3 FABRIC FILTER PLANT PULSE TANKS - INSPECTION	HBI1093
3.	U1-3 FABRIC FILTER MAINTENANCE PULSE TANKS SAFETY VALVES	HBI1082
4.	FABRIC FILTER PLANT TEMPERATURE TRANSMITTERS (K) MODULE 221L: CALIBRATION	LCI3071
5.	FABRIC FILTER PLANT FUJI PRESSURE TRANSMITTERS 0 - 500KPA (U1-3): CALIBRATE	LCI3074
6.	FABRIC FILTER PLANT VACUUM SWITCHES - 4,5KPA : CALIBRATE	LCI3077
7.	FABRIC FILTER PLANT FUJI FLOW TRANSMITTERS 0 - 300KPA (U1-3): CALIBRATE	LCI3075
8.	FABRIC FILTER PLANT FUJI DP TRANSMITTERS 0 - 5KPA (U1-3): CALIBRATE	LCI3076
9.	FABRIC FILTER PLANT TEMPERATURE TRANSMITTER (PT100) MODEL 223L: CALIBRATE	LCI3070
10.	FFP CHANGING FABRIC FILTER BAGS - INSPECT AND REPLACE	HBI1134
11.	U1 - 3 FABRIC FILTER PLANT PULSE TANKS INSPECTION	HBI1083
12.	UNITS 1-3 FABRIC FILTER PLANT HOPPER HEATERS	LEI1501
13.	FABRIC FILTER PLANT FUJI TRANSMITTER 0 - 10KPA: CALIBRATE	LCI3073
14.	FABRIC FILTER TEMP AIR DAMPER POSITION TRANSDUCER: SETTING THE LOWER AND UPPER RANGE VALVE	LCI3072
15.	FABRIC FILTER PLANT CROSS OVER DAMPER TEST	BW008
16.	FABRIC FILTER PLANT FIRE	BE005
17.	RETURN TO SERVICE OF A DRAUGHT GROUP AND FABRIC FILTER PLANT AFTER A TOTAL POWER FAILURE	BI061
18.	FABRIC FILTER PLANT PILOT PLANT PULSE TARIT INSPECTION	HBI1085
19.	FABRIC FILTER PLANT CELL ISOLATIONS	BI054
20.	TESTING OF CARBON MONOXIDE GAS IN BOILERS, MILL FOUNDATION SUMPS, AIR HEATERS, PRECIPS AND FABRIC FILTER PLANTS	BI008
21.	FABRIC FILTER PLANT DUST HOPPER CAPACITIES - UNITS 1 TO 3	BI046
22.	FABRIC FILTER PLANT (FFP) SYSTEM STRATEGY	ENS0032
23.		ENS0032
24.		ENS0032
25.	UNITS 1 TO 3 FABRIC FILTER PLANT MANUAL PULSING ON FAILURE OF THE MAIN PLC	BI056
26.	FABRIC FILTER PLANT COMPRESSORS	BC037C
27.	UNIT 1 FABRIC FILTER PLANT COMPRESSOR "B" ISOLATION	BIP010
28.	UNIT 1 FABRIC FILTER PLANT COMPRESSOR "A" ISOLATION	BIP009
29.	UNIT 1 FABRIC FILTER PLANT CELL A-D (OUTAGE) ISOLATION	BIP008
30.	UNIT 1 FABRIC FILTER PLANT CELL "D" ISOLATION	BIP007
31.	UNIT 1 FABRIC FILTER PLANT CELL "C" ISOLATION	BIP006
32.	UNIT 1 FABRIC FILTER PLANT CELL "B" ISOLATION	BIP005
33.	UNIT 1 FABRIC FILTER PLANT CELL "A" ISOLATION	BIP004

Eskom Generation	**PROCEDURE**	

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Introduction

This procedure is to ensure the safe management, operation and maintenance of fabric filter plants (FFP)

1 Scope

1.1 Purpose

The purpose of this procedure is to provide maintenance, operational and safety related information and guidance when working on or operating fabric filter plants and includes the minimum precautions to be taken to reduce the risk of injury or fire during maintenance or storage of filter bags. It also includes actions to be taken in the event of fire in order to protect the fabric filter plant and the safety of personnel.

1.2 Applicability

This activity applies to all Eskom sites which operate and intend to operate fabric filter plants.

2 References

The following standards contain provisions that, through reference in the text, constitute provisions of this procedure. All procedures are subject to revision and parties to agreements based on this procedure are encouraged to investigate the possibility of applying the most recent revisions of the standards listed below. Information on currently valid national and international standards may be obtained from the Information Centre at Megawatt Park and S&I, Polymers and Filtration section.

FC Sauer, *Report on Occupational Hazards and other risks associated with the use of bag filters.*

BHA Group, Inc. 1997, *Products Reference and trouble shooting guide.*

Duvha Fabric Filter Operating and Maintenance procedures.

RS Hansen, *Duvha Product Specification.*

The Mc Ilvaine Company, *Fabric Filter Manual.*

3 Definitions and Abbreviations

3.1 **SABS:** South African Bureau of Standards.

3.2 **CI:** Chief Inspector of Department of Manpower.

3.3 **FFP**: Fabric filter plant

3.4 **PAN**: Polyacrylonitrile

3.5 **PPS**: Polyphenylene sulphide

3.6 **BA**: Breathing Apparatus

3.7 **GBE:** Generation Business Engineering

3.8 **EED:** Enterprise Engineering Department

3.9 **GM:** General Manager

3.10 **GST&A:** Generation Strategy, Technology and Assurance

3.11 **S&I:** Sustainability and Innovation Department

4 Plant safety

In terms of plant and people safety, it is essential that each power station shall have procedures in place that cover the following aspects of fabric filter plant management:

4.1 Operating procedures

4.1.1 Optimization of boiler to limit acid dew point temperatures in the FFP.

4.1.2 Optimization of boiler to prevent/limit fuel oil carried over to the FFP.

4.1.3 Operating procedure in the event of a fire in the FFP (On load and off load condition).

4.1.4 FFP high inlet gas temperature protection philosophy.

4.1.5 How to return a draught group after a draught group trip to ensure that high temperatures are not carried over to the fabric filter plant.

4.1.6 FFP cell isolation. It is important to note that after the cell is isolated, dirty gases should be purged immediately by pulling clean air through the cell compartment/s. Purging is achieved via the attemperating system (where applicable), ventilation systems and/or by the opening of hopper doors or clean gas chamber access doors. Purging removes corrosive gases and rapidly cools the bag house through the dew point zone, minimizing the damage caused by condensation and corrosive salts formed in the shut down procedure. It should be noted that normal boiler purge is sufficient during a boiler outage.

4.1.7 FFP **c**ell de-isolation.

4.1.8 Dust removal from dust collection hoppers, including dust level management.

4.1.9 An emissions management procedure.

4.1.10 Implosion damper operation (with unit on load) - Operator response procedure.

4.1.11 Inlet and Outlet cross over damper operations (with unit on load) – Operating procedure.

4.2 Maintenance procedures

4.2.1 Prevention of fire during on load as well as off load maintenance, including fire fighting if a fire occurs.

4.2.2 Storage of filter bags, filter cages and FFP related equipment.

4.2.3 Working in a heat stressed environment (where applicable).

4.2.4 Hot work Procedure (Adapted for hot work inside a FFP)

4.2.5 General work in FFP (covering safety, processes, equipment required, risk assessments and minimum requirements).

4.3 Emergencies

4.3.1 High dust hopper level management procedure.

4.3.2 Pre-fire incident, planning and evacuation procedures.

4.3.3 Fire fighting and evacuation procedures in the event of a fire.

Although each power station will have to develop procedures to suit their own design requirements, the following specific guidelines can be used:

4.4 Fire prevention

On line or off line maintenance can be done on the plant and during these activities the following shall be adhered to. It must be noted that a fire risk is much higher with new bags than with bags covered and impregnated with ash.

4.4.1 Cutting, grinding and welding within the bag house is prohibited unless special precautions are taken. Precautions taken shall include covering the bag openings with a fire proof covering. If welding or cutting inside the bagged cell is required, a hot work permit shall be taken and a trained fire fighter shall be present to ensure that no hazardous conditions occur.

4.4.2 All entrance doors shall be marked clearly with no smoking; no grinding and no cutting or open flames sign boards.

4.4.3 No smoking shall be allowed inside the cell during cell outages.

4.4.4 Fire extinguishers/hoses shall be installed at points where they are easily accessible and can reach up to the clean gas chamber level.

4.4.5 Portable gas detection analysers must be operational during the maintenance activity.

4.5 In the event of a fire

In the event of a small localized fire during maintenance, the trained fire fighter shall take the necessary action. The person doing this shall have the correct protective equipment such as Breathing Apparatus (BA).

In the event of a larger fire, the following shall apply:

4.5.1 The interior of the cell should be inspected to ensure no personnel are trapped inside, and then the access doors, vacuum breakers, inlet and outlet isolating dampers must be closed. In other words the cell must be boxed up to reduce the oxygen content and should be left to burn out. Actions to protect exposure to the fire and fumes/gases shall be taken by the fire team.

4.5.2 Should a fire occur while the plant is on load, it shall be shut down and the cells boxed up, left to burn out and actions to protect exposures to the fire and fumes/gases shall be taken by the fire team.

4.5.3 If the fire occurs while the unit is off-line, evacuate total boiler gas passes and close all doors, i.e. air heater, ducts, boiler and fans.

4.5.4 In any event the fire should be left to burn out.

4.5.5 Areas downwind should be evacuated and cordoned off.

4.5.6 Any personnel entering the area shall be equipped with chemical suits and a self contained breathing apparatus, or in case of a fire fighter, full bunker gear shall be worn.

5 General

5.1 Gas tests

Gas tests shall be done in the FFP by an authorized person before a permit to work will be issued. Gases tested are:

	GAS	Threshold limit (THL)
a)	CO	0 %
b)	O_2	min 20 %
c)	Hydrogen Cyanide (HCN)	0 %

The temperature in the cell/compartment/duct shall be less than 40 ^{o}C (wet bulb).

5.2 Safety equipment

The following safety equipment shall be used before a cell is entered:

a) SABS and CI approved ear muffs.

b) SABS and CI approved, Uvex anti scratch, anti fog eye protection.

c) SABS and CI approved 3M 8822 dust masks. (Each worker must be supplied with 5 masks per 12 hour shift).

d) SABS and CI approved hard hats.

e) SABS and CI approved safety shoes.

5.3 Bag routine monitoring and inspection program

Due to the fact bag replacement costs represent one of the largest cost components for a power station over the life of the station, it is therefore crucial to understand and manage the performance of the bags to ensure least life cycle expenditure.

This is achieved by installing trial bags that vary in material selection, composition and manufacturing technique. The benefits of increasing bag life with optimum fabric selection can only be understood with the routine monitoring and inspection of the bags over the life of the set of bags.

In order to do so, it is a requirements that S&I's, Polymers and Filtration section be given access to the plant every 3 000 hours for routine testing of representative samples of the bags from the units. It remains the stations responsibility to ensure that this is done.

The station should also keep records of the following on a monthly basis:
- Actual operating hours per month,
- Number of bags failed per month (include reason for failure, date and bag location),
- A record of abnormal events (eg. unit start-ups, shut-downs and trips, temperature excursions, fuel oil carry-over occurrences, over-filled hopper incidents etc).

5.4 Bag disposal

A registered contractor such as Roshcon or Waste-tech shall remove the old bags from the Eskom site and dispose of them at an approved, Class 1 (H:H), hazardous disposal site. In the case of a bag change the old bags shall be dumped directly into suitable containers supplied by the removal contractor. The containers shall be removed from site as soon as they are filled with bags. The registered contractor shall provide Eskom with a disposal certificate as proof of compliance to the hazardous waste regulations.

All disposal certificates are to be stored safely for the life of the station. This is due to the fact that while the bags are disposed of safely, they still remains the property and responsibility of Eskom.

5.5 Storage

All bag storage areas must be clearly marked as such and, **"No smoking, No grinding and No cutting or open flames"** notice boards shall be installed above the entrance to the storage area. Maximum quantity of bags in the storage place shall be specified. Bags shall be stored in a manner which recognizes their flammability or which minimises the risk or effect of fire. Suitable fire fighting equipment shall be available in the close vicinity of the storage area. The bags shall be stored in such a way that they are not damaged in the process and special consideration should be given so as to ensure that the snap bands and cuffs are not deformed.

5.6 Packaging and marking

When bags are purchased the bag specification shall require that the bag supplier mark the bags with a shape coded tag showing the batch number sewn into the top cuff so that it may be linked to all relevant information including the name of any manufacturing sub-*Supplier.* The tag must be clearly visible after extended operation in the fabric filter plant.

When bags are stored, the bags must be enclosed in waterproof plastic bags or plastic wrapping. The containers must be clearly marked with the fabric type, supplier and order number. Any other relevant information pertaining to that particular shipment shall also be marked. Quantity per bale/container shall be clearly indicated.

6 Records

Actual bag operating hours per month and cumulative per set.

Actual bag failure records per month and cumulative per set.

A record of abnormal events as stated in section 5.3 above.

Bag disposal certificates.

7 Annexes

A Risks Associated with the Use of Polyacrylonitrile (PAN) Bag Filters.

B Risks Associated with the Use of Polyphenylene Sulfide (PPS) Bag Filters.

8 Revision Information

Date	Rev	Remarks
February 2008	0	Document review and update. Converted the specification into the Eskom document template, using the Eskom numbering system. This specification was previously known as GGP0768, Revision 0.
February 2010	1	Document reviewed and updated. Sections 3, 4.1, 5.3 and 6 expanded on.

Annex A
(Informative)

Risks Associated With The Use of Polyacrylonitrile (PAN) Bag Filters

A.1 Introduction

Polyacrylonitrile (PAN) fabric is used for filters throughout the world, with special emphasis on combustion equipment. It has a maximum recommended operating temperature of 125ºC, which normally means that a temperature control system such as an attemperating system is installed on the plant.

A.2 Characteristics

Low temperature fabric filter plants normally utilize bags manufactured from polyacrylonitrile (PAN). Although these bags are cheaper than PPS bag they are not as resistant to chemical degradation as PPS bags. Filtration efficiency is good and provided that the maximum operating temperature of 125ºC is not exceeded they should provide good service.

A.3 Risks associated with the use of polyacrylonitrile (PAN) bag filters

PAN fibres, also called acrylic fibres, are synthetic fibres made of linear high molecular weight polymers produced by polymerization of vinyl products. When installed into a fabric filter plant in the form of filter bags, the fabric is soon covered with ash and direct exposure to the PAN is limited.

A.3.1 Combustion gas products (mg/g polymer)

The following gases would be produced should degradation, flaming or combustion of filter bag material occur. The gas would be liberated by the degraded and burning material into the bag house section and penetrate some material.

a) Carbon dioxide (CO_2) 630 (mg/g polymer),

b) Carbon monoxide (CO) 132 (mg/g polymer),

c) Hydrogen cyanide (HCN) 59 (mg/g polymer), and

d) Methane (CH_4) 8 (mg/g polymer),

NOTE — Hydrogen cyanide is an extremely toxic gas, carbon monoxide is a chemical asphyxiate.

A.3.2 Health hazards

Acrylonitrile is an ingredient of polyacrylonitrile. It is listed as a suspected human carcinogen (group 2) by the American Conference of Governmental Industrial Hygienists (ACGIH)

A.3.3 Occupational exposure limits

Occupational Safety and Health Act permissible exposure limit (PEL) for the skin is 8 hour time weighted average (TWA): 2 PPM. 15 min ceiling value: 10 PPM.

ACGIH threshold limit value (TLV) 1992 TLW - TWA: 2 PPM, 4,5 mg/m^3.

Toxicity human inhalation limit (TC_{LD}):16 PPM (20 min).

Annex A
(continued)

A.3.4 Fire and explosion data

Polyacrylonitrile (PAN) fabric is flammable, and has in common with all plastic products a highly noxious combustion. In the case of acrylic the most noxious of these are hydrogen chlorides and hydrogen cyanide. When installed in a fabric filter there is very little chance of a fire while the boiler is on load, as there is generally insufficient oxygen in the boiler flue gas to support combustion.

History has shown that although dirty bags burn with difficulty and that fire is most likely with new bags, and with the plant off line. The singeing of bags makes them more difficult to ignite with a naked flame, but welding splatter/slag can readily ignite the material. It is therefore important that the necessary safety precautions are taken during off load periods.

Flash point	N/A
Auto ignition temperature	481 ^{o}C
Flammable range	3 % to 7 % (volume in air)

Severe fire and explosion hazard if exposed to ignition sources.

A.3.5 Hazardous products

Combustion products:

a) Hydrogen cyanide gas (HCN);

b) Nitrogen oxides (No_x);

c) Carbon monoxide (CO).

A.4 Carcinogenity

First proved in polymerization workers in USA (Incidence and mortality due to neoplasms). Targeted organs affected are the lungs and colon.

A.5 Transport

International maritime code on dangerous goods (IMDG Code)

Acrylonitrile (UN No 1093) is rated as a class 3.2 flammable product.

Transport of the material on ships whose passenger numbers exceed 25 is prohibited. Storage on or under deck is necessary in smaller ships.

A.6 Typical polyacrylonitrile specification

The following is a typical PAN fabric specification. The specification will differ from plant to plant to cater for the different operating conditions.

Fabric construction: Scrim supported needlefelt

Fibre chemical name: Polyacrylonitrile (PAN)

Annex A
(continued)

Scrim

Construction:	The scrim will be woven from PAN spun staple or multifilament yarns
Material:	Polyacrylonitrile (PAN)
Yarn type:	Spun staple yarn or multifilament
Weight:	180 g/m^2

Batt

Inner Support Batt

Material:	Polyacrylonitrile (PAN)
Fibre dimensions:	2.2 dtex Ricem or equivalent
Weight:	200

Surface layer

Construction:	The surface layer will be the following:
Polyacrylonitrile	(PAN) Ricem or equivalent with/out Poyimide (P84)
Fibre dimension:	1.7 dtex maximum
Weight:	200 g/m^2
Total batt weight:	490 - 510 g/m^2
Average weight:	500 g/m^2

Cloth Construction

Fabric Construction:	Scrim supported needlefelt
Weight:	570 - 590 g/m^2
Average weight:	580 g/m^2 average
Sides needled:	Both sides
Singeing:	Very light or no singeing

Calendaring

To be advised by the fabric supplier

Annex A
(concluded)

Fabric Properties

Air permeability: 7.6 - 10 m^3/m^2/minute @ 125 Pa

Elongation

warp: max. 4 % @ 50 N/cm

weft: max. 4 % @ 50 N/cm

Bursting strength: min. 2800 kPa

Dimensional stability

(free shrinkage at 150 °C dry heat for 24 hrs)

warp: max. 1.5 %

weft: max. 1.5 %

Tensile strength

warp: min. 800 N/50mm

weft: min. 900 N/50mm

NOTE: The values indicated in the above fabric specifications are for illustrative purposes only. The detailed and most recent specifications must be obtained from GBE and S&I.

Annex B

(Informative)

Risks associated with Polyphenylene Sulfide (PPS)

B.1 Introduction

Polyphenylene sulfide (PPS) fabric is used for filters throughout the world, with special emphasis on combustion equipment. It has a maximum recommended operating temperature of 180ºC, allowing higher temperature exposures without risk to fabric, than is the case with polyacrylonitrile.

B.2 Specification

Of importance is the high material melting temperature of 285 ºC. PPS performs well at high temperature. A test report quotes 4 years of operation at temperatures 182 ºC - 190 ºC, without material failure. Maximum recommended operational temperature is:

a) Continuous operation: 160 ºC; and

b) Period on surges: 190 ºC.

B.3 Chemical resistance

Resistance to acids and alkalis is good.

B.4 Flame retardancy

PPS was ranked as having the highest degree of fire safety in a NASA study, as a material for aircraft interiors. PPS Fibre Limiting Oxygen Index (LOI) is 34 – 35, which means that PPS requires 13% to 15% more oxygen than is readily available in the atmosphere (21%).

It is classified as non-flammable. The auto-ignition temperature of the material is 590ºC and it has an excellent electrical insulating property.

B.5 Occupational risks

Should the material be ignited, which is most unlikely (LOI = 34 - 35, maximum operating temperature: 180ºC), only carbon monoxide and sulphur dioxide gas would be liberated. **The material does not contain cyanides or emit hydrogen cyanide gas when ignited**. Due to the superior quality of the material, bag filter damage would be less and entry to the bag house area would, therefore be limited.

B.6 Typical polyphenylene sulfide specification

Please note that the scrim and batt can change depending on system requirements.

Annex B
(Continued)

Needle Felt Specification

The following is a typical PPS fabric specification. The specification will differ from plant to plant to cater for the different operating conditions.

Fabric construction: Scrim supported needlefelt

Fibre chemical name: Polyphenylene sulphide (PPS)

Scrim

Construction: The scrim will be woven from PPS spun staple or multifilament yarns

Material: Polyphenylene sulphide (PPS))

Yarn type: Spun staple yarn or multifilament

Weight: 180 g/m^2

Batt

Inner Support Batt

Material: Polyphenylene sulphide (PPS)

Fibre dimensions: 2.2 dtex, Procon or equivalent

Weight: 200 g/m^2

Surface layer

Construction: The surface layer will be the following:

Polyphenylene sulphide (PPS),

Fibre dimension: 1.7 dtex trilobal

Total batt weight: 490 - 510 g/m^2

Average weight: 500 g/m^2

Cloth Construction

Fabric Construction: Scrim supported needlefelt

Weight: 570 - 590 g/m^2

Average weight: 580 g/m^2 average

Sides needled: Both sides

Annex B
(Concluded)

Singeing: Very light or no singeing

Calendaring

Calendar contact time: 40 seconds

Calendar surface temperature: 210°C

Longitudinal extension: No

Calendar force: 260 N

Fabric Properties

Air permeability: 7.6 - 10 m^3/m^2/minute @ 125 Pa

Elongation

warp: max. 4 % @ 50 N/cm

weft: max. 4 % @ 50 N/cm

Bursting strength: min. 2800 kPa

Dimensional stability

(Free shrinkage at 190 °C dry heat for 24 hrs)

warp: max. 2.5 %

weft: max. 2.0 %

Tensile strength

warp: min. 900 N/50mm

weft: min. 1100 N/50mm

NOTE: The values indicated in the above fabric specifications are for illustrative purposes only. The detailed and most recent specifications must be obtained from GBE and S&I.

Eskom Generation	**Procedure**	**Alloc. Centre: 03E Duvha** **Doc ID: BP018** **Rev. 2**

RESPONSIBLE FUNCTIONAL AREA

OPERATING GROUP

TITLE:

ASH PLANT: F.F.P HOPPERS DUSTING (UNIT 1 – 3)

ACCEPTED BY	**ACCEPTED BY**	**ACCEPTED BY**	**COMPILED BY**
			L Y MBATHA **SNR TECHNICIAN**
ACCEPTED BY	**ACCEPTED BY**	**ACCEPTED BY**	**AUTHORISED BY**
	SHIFT SUPERVISOR	**SHIFT MANAGER**	**OPS MANAGER**

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7.8 RECORDS
8.0 APPENDICES

REV	DESCRIPTION OF REVISION	DATE
0	ORIGINAL	07/02
1	REVIEW	03/07
2	REVIEW	03/10

KEYWORDS:		
DOCUMENT CLASS:	CONTROLLED DISCLOSURE	
DATE OF LAST REVIEW:	MARCH 2010	
DATE OF NEXT REVIEW:	MARCH 2013	

OPERATING GROUP	ALLOCATION CENTRE		DOC ID
	03E		BP018
ASH PLANT: F.F.P HOPPERS DUSTING (UNIT 1 – 3)	**REV**	**PAGE**	**OF**
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1.0 PURPOSE

This procedure describes the correct method of dusting the F.F.P hoppers

2.0 SCOPE

This procedure is applicable the dusting of F.F.P hoppers units 1 - 3.

3.0 REFERENCES

BI046 Units 1 – 3 FFP dust hopper capacities

BI086 Precipitator dust hopper level indicator and alarms

4.0 DEFINITIONS

P.O Plant Operator

U.C Unit Controller

A.W.R Ash Water Return

C.W Cooling Water

F.F.P Fabric Filter Plant

5.0 RESPONSIBILITIES

The Plant Operator (Ash Plant) is responsible for:

- ❖ Ensuring that the dusting is carried out in accordance with this instruction.
- ❖ Defecting any defective equipment on the ash plant.
- ❖ Logging the plant status
- ❖ Co-ordinating of ash sump level with the Ash Sump Operator during dusting.
- ❖ Safety at the precipitator hoppers

The Ash Sump Utilityman is responsible for:

- ❖ Acting on receiving the ash sump alarm
- ❖ Controlling the level of water in the ash sump
- ❖ Preventing the ash sump from flooding
- ❖ Flushing the ash line and ash sump for 60 minutes after dusting has been completed.
- ❖ Operation of the ash crushers, ash pump and sluice pump.
- ❖ Alternating the use of A and B ash pump and A and B sluice pump.
- ❖ Co-ordinating with the Ash P.O during dusting.
- ❖ Safety of ash sump area
- ❖ Preventing the ash sump from blocking and flooding.

6.0 ACTIONS

NB: Overall, hard hat, dust goggle, safety gloves, dust musk, ear protection and safety shoes are to be worn when operating the precipitator dust hoppers dusting units. While dusting never stand behind hydrovac, hydrovac vacuum release or in front of the hydrovac.

1. Inform U.C that dusting is started
2. Ensure the ash and sluice pumps are standby (suction and discharge valves are open.
3. Open the sluice pump suction manifold supply hand isolating valve (AWR or CW depending on which source of water is used)
4. Fill the ash sump to the correct level via either of AWR or CW ash sump make-up valves (depending on which source of water is used) till the “ASH PUMP START ENABLE” signal is activated on the ash plant alarm panel.
5. Start the ash pump make sure it takes proper suction (70A to 80A motor current).
6. Open the sluice pump discharge manifold hand isolating valve, supply water to the F.F.P dust hoppers.
7. Ensure the ash sump agitation nozzle supply valves are open.
8. Start the sluice pump when the ash sump level is low enough to prevent the ash pump from tripping (ensure to control ash sump level on normal working level).
9. Inspect and clean blocked hydrovac nozzles.
10. Open hydrovac water supply isolating valve.
11. Slowly open dust hopper slide gate and close vacuum release valve and check dust water mixture.
12. When dust stop flowing, move mechanical actuating handle (Agitator) to ensure hopper is empty.
13. Close slide gate, open hydrovac vacuum valve and close hydrovac water supply valve.
14. Continue with the above procedure until all dust hoppers are empty. The maximum hoppers that can be dusted at the same time are six (3LHS F.F.P dust hoppers and 3RHS F.F.P dust hoppers)
15. The ash pump and sluice pump stay in-service for 60 minutes to flush the system (ash sump and ash line)
16. After flushing is completed the pumps can be shut down and make-up valve can be closed
17. Inform the U.C that dusting is completed.

	NOTE: F.F.P hoppers dusting normally takes place after ashing every shift. In case where the hopper levels rises, steps must be taken to drop the level to a safe level.
7.0	**RECORDS** Nil.
8.0	**APPENDICES** Nil.

Eskom Generation	**Work Instruction**	**Alloc. Centre: 03B Duvha** **Doc ID: HBI1134** **Rev. 3**

RESPONSIBLE FUNCTIONAL AREA

BOILER PLANT – FABRIC FILTER PLANT SYSTEM

TITLE: FFP CHANGING FABRIC FILTER BAGS

ACTIVITY: INSPECTION AND REPLACE

AUTHORISED BY	ACCEPTED BY	ACCEPTED BY	COMPILED BY
HEAD OF DEPARTMENT	SYSTEM ENGINEER	HEAD OF SECTION	PLANT SPECIALIST

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SAP PM MASTER DATA

MAINTENANCE PLAN	MAINTENANCE ITEM	OPERATION ACTIVITY NO	STRATEGY	PACKAGE
				ON REQUEST

REV	DESCRIPTION OF REVISION	DATE
0	ORIGINAL	11/94
1	GENERAL REVIEW	11/98
2	GENERAL REVIEW	07/03
3	GENERAL REVIEW	06/09

KEYWORDS:	INSPECT, REPLACE
DOCUMENT CLASS:	CONTROL DISCLOSURE
DATE OF LAST REVIEW:	JUNE 2009
DATE OF NEXT REVIEW:	JUNE 2012

W O R K S I N S T R U C T I O N

BOILER PLANT – FABRIC FILTER PLANT SYSTEM	ALLOCATION CENTRE **03B**	DOC ID **HBI1134**

TITLE: FFP CHANGING FABRIC FILTER BAGS

ACTIVITY: INSPECT AND REPLACE	REV	PAGE	OF
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1. PURPOSE

This work instruction is drawn up to inspect and replace Fabric filter bags.

2. SCOPE

This work instruction applies to the following departments:

Lead discipline : HMD – Boiler section
Support : OPS for isolations

This work instruction is applicable to the following plant components:

FUNCTIONAL LOCATION CODE	DESCRIPTION	PHYSICAL LOCATION
0NQ14-25G101	Fabric Filter Bags	In FFP Cells

3. REFERENCES

System P&ID	:	0.57/44438
Eskom Standard	:	OPS 6101 012
Eskom Standard	:	OPS 8047 013
Manual	:	HMG0001
Procedure	:	MGP0003
Generation FFP Procedure	:	GGP0768 Rev 0

4. FREQUENCY - DURATION AND SCHEDULE TIME LIMITS

4.1 Frequency on request.
4.2 Duration of work 4 to 8 hours on running unit.
4.3 Total man-hours 56 hours.

Manning:	Skill Code			
	04	05	18	or Contractor staff
Quantity	01	02	04	

4.4 Schedule time limit

This work instruction shall be carried out on request.

5. ACTIONS

5.1 Risk assessment
5.2 Special tools / equipment
5.3 Bill of material
5.4 Permits & Isolations
5.5 Service actions
5.6 History requirements

5.1 RISK ASSESSMENT, HEALTH AND SAFETY PRECAUTIONS & HAZARDS

1. RISK ASSESSMENT

NOTE: Smoking, open flames, grinding, cutting and welding in and around bag house filter area is prohibited and can only be performed if precautions were taken to prevent bags from burning.

5.1 RISK ASSESSMENT, HEALTH AND SAFETY PRECAUTIONS & HAZARDS

1. RISK ASSESSMENT

HAZARDS	PRECAUTIONS
Slip and fall	Clean area (House keeping)
Caught between	Know your danger points
Open up points	Covers in place and demarcation
Moving parts	Trained staff in safety awareness
Dust hazard	To wear dust mask
Water	To wear gumboots

2. PERSONAL PROTECTIVE EQUIPMENT TO BE USED

Gloves
Ear protection
Safety shoes & Gum Boots
Hard hat
Overalls (No loose clothing)
Eye Protection safety (goggles)
Dust Mask

3. GENERAL

(a) Only competent persons to be utilised to carry out the required work and inspections.
(b) Personal protective equipment to be used at all times.
(c) For any hot work precautions to take to prevent bags from burning;

- To work with welding or grinding, bags in direct vicinity must be removed and area to be covered with a flame proof blanket to prevent any sparks to come in contact with bags.
- Use argon arc welding to reduce splattering.
- Plug holes before welding to prevent sparks dropping to bag chamber.
- Keep fire extinguisher at work place.
- A Second person to observe while work is performed.
- If any signs of burning are observed evacuate and seal off area. Then call fire services to extinguish fire.

4. TESTS

GAS TESTS

An authorised chemist shall do gas tests before a permit to work will be issued.

Gases tested are:

	GAS	THRESHOLD LIMIT (THL)
a.	CO	0 %
b.	0_2	min 20 %
c.	Hydrogen Cyanide (HCN)	0 %

5. EMERGENCIES.

Pre-fire incident, planning and evacuation procedures. Personal protective equipment shall be available for emergency response teams.

6. FIRE PREVENTION

On line or off line maintenance can be done on the plant and shall adhere to the following safety regulations:

6.1 Cutting, grinding and welding within the bag house is prohibited unless special precautions are taken. If welding or cutting inside the bagged cell is required, a trained fire fighter has to be present to ensure that no hazardous conditions occur. A further precaution is to cover the bags with a fire blanket.

6.2 All entrance doors shall be marked clearly with no smoking, no grinding and no cutting or open flames sign boards.

6.3 No smoking shall be allowed inside the cell during cell outages.

6.4 Pre-determined positioning or placement of fire extinguishers and water hoses shall be installed on the plant.

7. SAFETY EQUIPMENT

The following safety equipment shall be used before a cell is entered:

a. SABS and CI approved earmuffs.

b. SABS and CI approved, Uvex anti scratch, anti fog eye protection.

c. SABS and CI approved 3M 8822 dust masks. (Each worker must be supplied with 5 masks per 12 hour shift).

d. SABS and CI approved hard hats.

e. SABS and CI approved safety shoes

8. BAG REMOVAL

Replaced or old used bags shall be removed to the Class 1 dumping site as soon as possible.

The bags will be sorted in a clearly demarcated area on a specially prepared ash- base and covered by compacted ash. Disposal area will be surveyed and recorded on controlled drawings for future recovery, if necessary. Old bags are classified as strategic disposable waste and shall be removed by a registered Contractor such as Roshcon.

9. STORAGE

All bag storage areas must be clearly marked and**, "No smoking, No grinding and No cutting or open flame"** notice boards shall be installed above the entrance to the storage area. Quantity of bags in the storage place shall be specified. Bags shall be stored in a manner which recognised their flammability or which minimised the risk or effect of fire.

10. PACKAGING

The potential bag supplier labels/identifies each bag with a colour or shape coded tag showing the batch number sewn into the top cuff so that it may be linked to all relevant information including the name of any manufacturing sub-Supplier. The tag colour or shape will be advised post contract award and the tag must be clearly visible after extended operation in the bag filter.

The potential bag supplier clearly marks the packaging box with the fabric type and order number. Any other relevant information pertaining to that particular shipment shall also be marked. Quantity per box shall be clearly specified.

1. HAZARDS

(a) Hot ash may be trapped in the system.
(b) Gas may be evident in confined spaces. (Use continuos monitor).
(c) Debris is a safety hazard therefore the work area must be left in a safe & clean condition.
(d) A fire can occur.

2. IN THE EVENT OF A FIRE.

In the event of a small-localised fire during maintenance, the trained fire fighter shall take the necessary action. The person doing this shall have the correct protective equipment such a Breathing Apparatus (BA).

In the event of a larger fire, the following shall apply:

2.1 If possible, the interior of the cell should be inspected to ensure no personnel are trapped inside, and then the access doors, vacuum breakers, inlet and outlet isolating dampers must be closed. In other words the cell must be boxed up to reduce the oxygen content and should be left to burn out. Actions to protect exposure shall be taken by the fire team.
2.2 Should a fire occur while the plant is on load, it shall be shut down and the cells boxed up? left to burn out and actions to protect exposures shall be taken by the fire team.
2.3 If the fire occurs while the unit is off-line, evacuate total boiler gas passes and close all doors, i.e. air heater, ducts, boiler and fans.
2.4 In any event the fire should be left to burn out.
2.5 Areas downwind should be evacuated and cordoned off.
2.6 Any personnel entering the area shall be equipped with chemical suits and a self contained breathing apparatus, or in case of a fire-fighter, full bunker gear shall be worn.

5.2 SPECIAL TOOLS / EQUIPMENT

1. Adequate lighting is essential.
2. Bag lifting tool (2 off required).

5.3 BILL OF MATERIALS

STOCK NUMBER:	DESCRIPTION	QTY
0160359	FABRIC FILTER PLANT BAGS	6724 CELL
0053205	CAGE (TOP HALF)	EACH
0053196	CAGE (BOTTOM HALF)	EACH
0053197	BOTTOM SUPPORT STEEL CAP	EACH
011 3259	CUFF RING (BAG CAGE SUPPORT RING)	EACH

5.4 PERMITS & ISOLATIONS

1. Fabric filter plant permit.
2. Dampers closed. (FFP Inlet and outlet dampers. Flue gas damper included).
3. Remote operation isolated.
4. Compartment ventilated.
5. Dust hoppers to be empty.
6. Lab test for harmful gasses.

NOTE: ONLY OPERATING STAFF TO DO ISOLATIONS!

5.5 SERVICE ACTIONS

NOTE: Ensure that you are familiar with the risk assessment, health and safety precautions and hazards as well as the isolations pertaining to this instruction before attempting any of the following:

Inspect the bag plates of the cell in question and observe the gas flowing into the cell outlet damper through the inspection window to locate the failed bag(s).

W O R K S I N S T R U C T I O N

BOILER PLANT – FABRIC FILTER PLANT SYSTEM	ALLOCATION CENTRE **03B**	DOC ID **HBI1134**

TITLE: FFP CHANGING FABRIC FILTER BAGS

ACTIVITY: INSPECT AND REPLACE	REV	PAGE	OF
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WITNESS POINT: CALL THE MAINTENANCE SPECIALIST TO CONFIRM THE FAILURE OF THE BAG(S).

REF / ACCEPTANCE CRITERIA	SIGNATURES: MAINTENANCE SPECIALIST	ACCEPT / REJECT / NOT INSPECTED	REMARKS
Bag(s) failed and need to be replaced			

Arrange for a permit to work on the specific cell, sign the Workers Register and proceed as follows:

1. Remove the pin from the end of each nozzle pulse pipe.
2. Slide the tank at the end of the nozzle pipe sideways, lift the tank off the keeper plate and slide the nozzle off from pulse pipe.
3. Lift the nozzle pipe away and place it clear from the bags to be changed.

4. Pull up the bag cages vertically, separating the sections as the joint comes out of the bag and place the cage carefully aside to avoid damage that may later puncture new bags.
5. Squeeze the bag snap ring cuff into a kidney shape and release the cuff from the bag plate.
6. Pull the bag out through the bag plate and place immediately into a suitable dust proof container or bag.
7. When all the damaged bags have been removed, the area must be vacuum cleaned.
8. Install the new bags in the reverse order of the removal procedure. Ensure that when the cage is inserted into the bag that the cage sits squarely on top of the support ring on the bag plate.

WITNESS POINT: CALL THE MAINTENANCE SPECIALIST TO CHECK THE FOLLOWING:

REF / ACCEPTANCE CRITERIA	SIGNATURES: MAINTENANCE SPECIALIST	ACCEPT / REJECT / NOT INSPECTED	REMARKS
1. New bag(s) installed correctly and recorded on the attachment sheet.			
2 Outage time & duration			
3. Work carried out by:	**Artisan: .....**		

USE THE FOLLOWING SYMBOLS:

X - BAGS PLUGGED
• - BAGS CHANGED

UNIT NO: .....

CELL NO: .....

DATE: .....

5.6 HISTORY REQUIREMENTS

Service actions and recording sheet to be kept for

history requirements.

SPARES USED

STOCK NUMBER DESCRIPTION USED

……. …… ……..

Eskom Generation	**P r o c e d u r e**	**Alloc. Centre: 03E Duvha** **Doc ID: BP012** **Rev. 2**

RESPONSIBLE FUNCTIONAL AREA

OPERATING GROUP

TITLE:

FABRIC FILTER PLANT FILTER BAG PRE-COATING PROCEDURE (UNIT ON OUTAGE)

ACCEPTED BY	**ACCEPTED BY**	**ACCEPTED BY**	**COMPILED BY**
			M.DREYER **SNR TECHNICIAN.**
ACCEPTED BY	**ACCEPTED BY**	**ACCEPTED BY**	**AUTHORISED BY**
	SHIFT SUPERVISOR.	**SHIFT MANAGER**	**OPERATING MANAGER**

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ACTIONS

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6.2 PRE-COATING PROCEDURE

REV	**DESCRIPTION OF REVISION**	**DATE**
0	ORIGINAL	10/00
1	REVIEW	03/07
2	REVIEW	03/10

KEYWORDS:	
DOCUMENT CLASS:	CONTROLLED DISCLOSURE
DATE OF LAST REVIEW:	MARCH 2010
DATE OF NEXT REVIEW:	MARCH 2013

OPERATING GROUP	ALLOCATION CENTRE	DOC ID
	03E	BP012

FABRIC FILTER PLANT FILTER BAG PRE-COATING PROCEDURE	REV	PAGE	OF
	2	1	2

1.0 PURPOSE

To prevent a build-up of unburnt fuel oil on filter bags in order to increase bag life.

2.0 SCOPE

This procedure applies to units 1 - 3 FFP.

3.0 REFERENCES

Nil.

4.0 DEFINITIONS

FFP	-	Fabric Filter Plant
DP	-	Differential Pressure
RVC	-	Radial Vane Control
ID	-	Induced Draught
SGC	-	Sub Group Control
RH	-	Right Hand
LH	-	Left Hand

5.0 RESPONSIBILITIES

5.1 Outage Management's Controller is to ensure that the contractor carries out this operation according to this procedure.

5.2 Operating Re-commissioning and Shift staff is to facilitate the process according to this procedure.

6.0 ACTIONS

6.1 Requirements

6.1.1 Compressed air supply valves to the pulse cleaning system are isolated. (The system must stay isolated until the unit is on load and a DP of 1.4 kPa is reached on all four cells before it is de-isolated. De-isolation of the pulsing system before this value is reached, will cause major damage to the filter bags).

6.1.2 All dust hoppers are empty and clean.

6.1.3 All hopper slide gates are open.

6.1.4 Sluice pump supply valves to hydro vacs are isolated (under no circumstances must the sluice pumps be started.

6.2 Pre-Coating Procedure

The pre-coating can now be done on all four cells simultaneously, therefore requiring that both draught groups to be on load. The following steps must be adhered to:

6.2.1 Start both LH and RH draught groups as per SGC until ID fans are on load.

6.2.2 Open the attemperating air dampers fully (100%).

6.2.3 Open and secure the following hopper doors: Hopper No's 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21 and 23 on LH and RH sides.

6.2.4 Open ID fan RVC's until cell outlet flows are as close to 350 cubic meter per second as possible. The cell vacuum should be plus minus 2.0 kPa.

6.2.5 Inject the lime from the tanker via the pre-coating pipeline to the inspection holes (situated next to the attempering air system) into the cell. In total at least 16 tonnes of lime should be injected per cell. Cells A an C to be done first and then cells B and D. Coating is to be done over a time period of at least 2 hours per cell. While pre-coating is in progress, the DHP over the cell must be monitored on the DEMACS computer and should at least be 700 Pa or higher, (minimum 600 Pa).

6.2.6 Close RVS's.

6.2.7 Close hopper doors.

6.2.8 Close attemperating air dampers.

6.2.9 Isolate FFP for cell inspection after completion of pre-coating activity.

6.2.10 Remove sample bags to confirm effectiveness of pre-coating.

6.2.11 Clear permits and hand over plant.

Eskom Generation	**Emergency Procedure**	**Alloc. Centre: 03E Duvha** **Doc ID: BE005** **Rev. 3**

RESPONSIBLE FUNCTIONAL AREA

OPERATING GROUP

TITLE:

FABRIC FILTER PLANT FIRE ALARM

ACCEPTED BY	**ACCEPTED BY**	**ACCEPTED BY**	**COMPILED BY**
			M DREYER **SNR TECHNICIAN**
ACCEPTED BY	**ACCEPTED BY**	**ACCEPTED BY**	**AUTHORISED BY**
	SHIFT MANAGER	**SHIFT SUPERVISOR**	**OPS MANAGER**

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0	ORIGINAL	05/00
1	TITLE CHANGED	05/00
2	REVIEW AND NEW FORMAT	05/05
3	CHANGE OF REVIEW DATE	10/10

KEYWORDS:		
DOCUMENT CLASS:	CONTROLLED DISCLOSURE	
DATE OF LAST REVIEW:	OCTOBER 2010	
DATE OF NEXT REVIEW:	OCTOBER 2013	

OPERATING GROUP	ALLOCATION CENTRE	DOC ID
	03E	BE005

FABRIC FILTER PLANT FIRE ALARM	REV	PAGE	OF
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1.0 PURPOSE

To provide an action plan should a fire occur in one of the FFP cells.

2.0 SCOPE

This instruction is applicable to the FFP's on units 1 to 3.

3.0 REFERENCES

GGR0568 – Pulverised Fuel Firing Regulations – Rev 2, September 2002
GI002 – Pulverised Fuel Firing Regulations – Rev 0

4.0 DEFINITIONS

Nil.

5.0 RESPONSIBILITIES

The USS, Unit Controller and Boiler PO shall be responsible for ensuring compliance with this procedure.

6.0 ACTIONS

6.1 If a fire occurs in any of the FF. cells during a FFP cell outage the following actions must be taken:

6.1.1 EOD to be notified and emergency alarm to be sounded.

6.1.2 If possible the interior of the cell should be checked to ensure no persons are trapped inside.

NOTE: Prior to entry into the cell a breathing apparatus is required.

6.1.3 Evacuate the area.

6.1.4 All access doors and vacuum breakers should be closed and the fire should be left to burn out. All dampers (inlet and outlet ISO dampers) should be closed.

6.2 Development of a fire while the unit is on load.

6.2.1 EOD to be notified and emergency alarm to be sounded.

6.2.2 Box-up the cell or cells by making use of the cell isolation procedure. See BI054. It might be necessary to switch off the draught group.

6.2.3 The area should be barricaded.

6.2.4 Continuous gas testing should be carried out on the plant (breathing apparatus sets to be used while testing) until the area is confirmed safe.

Eskom Generation	SYSTEM PROCEDURE	Alloc. Centre: 03A Duvha Doc ID: ENS0032 Rev.0

RESPONSIBLE FUNCTIONAL AREA ENGINEERING			
TITLE:	DUVHA POWER STATION FABRIC FILTER PLANT (FFP) STRATEGY		
ACCEPTED BY	ACCEPTED BY Operating Manager	ACCEPTED BY Maintenance Manager	COMPILED BY: Msizi Ngcoya System Engineer
ACCEPTED BY	ACCEPTED BY	ACCEPTED BY	AUTHORISED BY Engineering Manager

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Eskom	**Procedure**	Alloc. Centre: 03E Duvha Doc ID: BP026 Rev. 1

RESPONSIBLE FUNCTIONAL AREA

OPERATING GROUP

TITLE:

DUSTING ON THE FLOOR : FABRIC FILTER PLANT

ACCEPTED BY	ACCEPTED BY	ACCEPTED BY	COMPILED BY
		ENGINEERING MNGR	RK NCONGWANE PEA RECOMMISSIONING
ACCEPTED BY	**ACCEPTED BY**	**ACCEPTED BY**	**AUTHORISED BY**
MAINTENANCE MNGR	SHIFT MANAGER	SHIFT SUPERVISOR	OPS MANAGER

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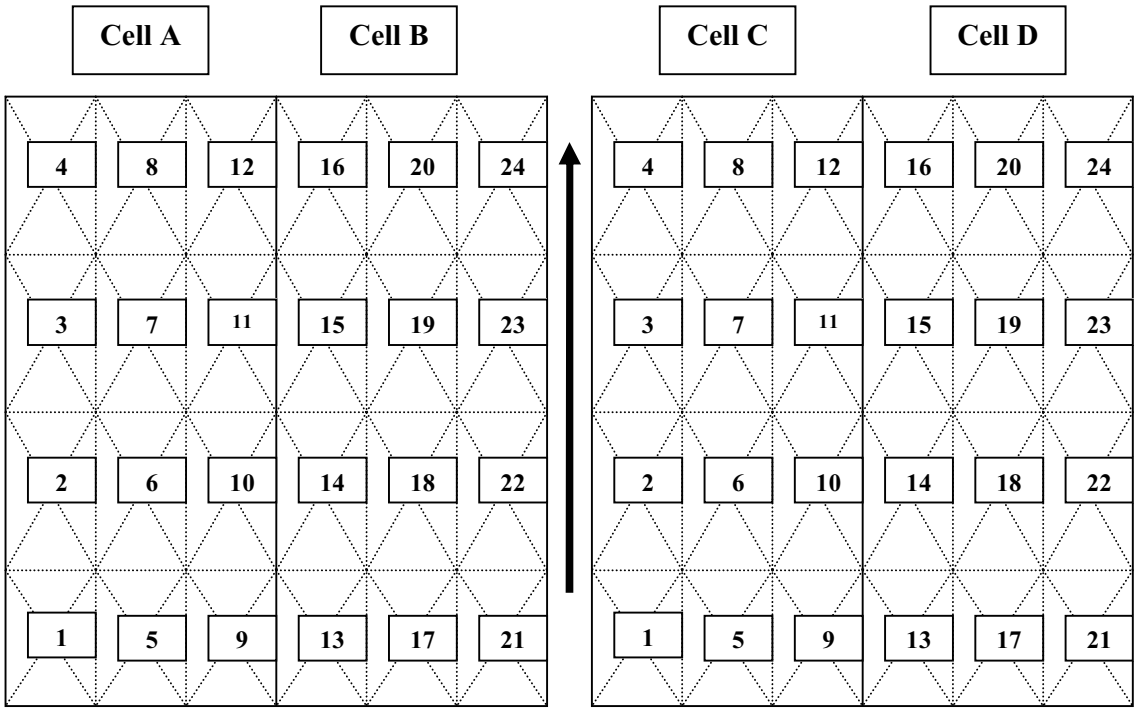
OPERATING GROUP	ALLOCATION CENTRE		DOC ID
	03E		BP026
DUSTING ON THE FLOOR : FABRIC FILTER PLANT	**REV**	**PAGE**	**OF**
	1	1	4

1.0	**PURPOSE** The purpose of this procedure is to ensure safe working practices when it becomes necessary to dust on the floor when the fabric filter plant dust hoppers blocked while the unit is on-load
2.0	**SCOPE** Dusting on the floor when the fabric filter plant dust hoppers are blocked while the unit is on-load
3.0	**REFERENCES** GGR 0568 Pulverised fuel firing regulations. GGR 0992 Plant safety regulations. Fabric filter plant isolating procedures.
4.0	**DEFINITIONS** FFP – Fabric Filter Plant GMR-2– General Machinery Regulation section 2 (Refers to the appointed Certified Engineer on Site, which is Andre King) DMT – Duvha Management Team HMD – Heavy Maintenance Department RH – Right Hand LH – Left Hand
5.0	**RESPONSIBILITIES** **Appointed person** will be responsible to do the isolations. **Responsible person** will be responsible for ensuring that the work on the plant covered by a permit to work can be carried out with safety and health of personnel. He will also inform the power station manager and the GMR-2 of the activity. **HMD fitter** will be responsible to open and close the inspection doors. **System engineer** will be responsible to determine the risk of the work that will be carried out. **Operating support** to clean the dust away after it has been dumped on the floor. **The proto team and medical station** to be on standby while the activity is carried out. They will be informed by the RP.
6.0	**ACTIONS** **Plant Safety Regulations determines that:** 1. Special pre-cautions must be taken to allow hot work on or in any flue gas conditioning fabric filter plant. (16.6f,) 2. Safe access to be provided, training of personnel, testing and monitoring of gas levels, availability of breathing apparatus, adequate lighting, control of material flow.(16.4f) **Operational explanation of filling of FFP dust hoppers while the unit is on load.**

Plan Layout of the FFP



Notes

1. The FFP's are equipped with 4 Cell, Cell A, Cell B, Cell C and Cell D.
2. Each cell discharges the dust into 12 hoppers. In other words in total There are 48 hoppers per unit.
3. Different to ESP's, the dust are equally spread and discarded into the hoppers.
4. The front row of hoppers is smaller than the rest of the hoppers on the plant. The total capacity of hoppers 1, 5, 9, 13, 17 and 21 on the LH and RH side can accumulate about 82m³ of dust per hopper. The total capacity of the bigger hoppers can accumulate about 96m³ per hopper

Time to fill the FFP Hoppers

Calculations show the Following:

Time to fill the small hoppers is about 35 hours

Time to fill the big hoppers is about 40 hours

Full hoppers on the FFP are predominantly caused when the hoppers are not dusted timeously and properly. Hopper blockages are also sometimes caused due to sluice pump water valves that are passing. This must be reported immediately to avoid hopper bridging at the mouth above the slide gates.

Should a dust hopper be severely blocked then the dust will have to be emptied on the floor via the hopper door in order to prevent severe damage to the internals of the FFP. Needless to say, that this is a very dangerous activity. The fine dust in the FFP hoppers can reach temperatures of up to 130^{o}C.

The following pre-cautions should therefore be taken before this activity is carried out.

1. Call the System Engineer to assess the situation and determine more or less how full the hopper is. This will give an indication of the risk of the activity and if necessary a full risk assessment must be done.
2. Inform the GMR2, s/by DMT member and environmentalist of the activity.
3. Inform the Proto Team and the Medical Station of the activity.
4. Ensure that the area around the hopper that needs emptying is barricaded off at least 3 meters away from the effected hopper on each side.
5. Apply for a FFP Cell outage permit. The permit must clearly stipulate the intended work to be performed.
6. Determine wind direction and evacuate any people working down stream of the wind direction.
7. With this design the risk of opening the door is low. Use the portable platform to stand on when removing the mounting bolts on the door. Once the four mounting bolts have been removed, the fitter should stand clear while the door is opened to release the dust onto the floor. This activity can even be done in a more save way by tying a rope onto the inspection door handle before it is opened slowly. This will allow the person opening the door to stand further away from the dust that will be released onto the floor. The door must be locked open and a confined space sign should be attached to it. Please note that for this activity to dump the dust onto the floor it will not be necessary to enter the inside of the hopper at all. Should it be necessary to enter the hopper then the normal isolation procedure on the cell permit must be followed to ensure that the temperature as well as gas tests are done and that it is within the specified limits before a permit is issued.
8. An alternative method to release the dust on the floor is to remove the hydrovac. The dust in the hopper is controlled with the slide gate. Sluice pumps must be isolated and a permit to work must be taken.

9. The following safety equipment shall be used by the people involved in this activity:
   - ✓ Safety Hat
   - ✓ Face Mask/shield
   - ✓ Safety Shoes
   - ✓ Leather Apron
   - ✓ Ear Protection
   - ✓ Dust Masks
   - ✓ Overall
   - ✓ Gloves
   - ✓ Fire Resistant Clothes
10. After the dust is dumped on the floor it must be washed away into the sluice ways as soon as possible.
11. Once the hopper is empty and the area is clear from dust, the door can be un-locked, replaced and secured.

FFP cell outage permit must be cleared as per plant safety regulations.

7.0 RECORDS

8.0 APPENDICES

Eskom Generation	**SYSTEM PROCEDURE**	**Alloc. Centre: 03A Duvha** **Doc ID: ENS0032** **Rev.0**

RESPONSIBLE FUNCTIONAL AREA

ENGINEERING

TITLE: **DUVHA POWER STATION**

FABRIC FILTER PLANT (FFP) STRATEGY

ACCEPTED BY	**ACCEPTED BY**	**ACCEPTED BY**	**COMPILED BY:**
	Operating Manager	**Maintenance Manager**	**Msizi Ngcoya** **System Engineer**
ACCEPTED BY	**ACCEPTED BY**	**ACCEPTED BY**	**AUTHORISED BY**
			Engineering Manager

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1. PURPOSE

This document serves to officially create an optimised maintenance strategy, based on the analysis of the Fabric Filter Plant equipment by the relevant plant personnel, in order to improve the reliability of the entirely Flue gas cleaning plant. In order to achieve this purpose, this document prescribes “What to be done and when to be done”.

The distinct strategy and plans shall include all testing and inspection requirements to obtain reliable information for accurate assessment of the plant conditions, to determine the remainder of the life of plant (LOP) strategy.

2. SCOPE

The scope for the FFP maintenance strategy is limited to the following equipment:

- Inlet perforated screens,
- Flue gas Isolating dampers
- FFP inlet isolating dampers
- Cells
- Bag plates
- Filters
- Hoppers
- Piping windows
- FFP outlet dampers

3. REFERENCES

a) **GGS 0462 -** Eskom Quality Requirement

b) **OHS ACT -** Occupational Health and Safety Act, Number 85 of 1993

c) **OPS 0002 (rev 2) -** Operating and Maintenance Manuals

d) **OPR 3305 (rev 3) -** Eskom Plant Safety Regulation

4. ABBREVIATIONS AND DEFINITIONS

4.1 Abbreviations

FFP	_	Fabric Filter Plant
BOM	_	Bill Of Materials
C & I	_	Control and Instrumentation
DE	_	Drive End
Diff	_	Differential
Pr	_	Pressure
EPRI	_	Electric Power Research Institute
ESP	_	Electrostatic Precipitator
FLOC	_	Functional Location Code (AKZ)
FMECA	_	Failure Modes and Effects Criticality Analysis
GGCS	_	Generation Generic Component Strategy
GO	_	General Overhaul (Every 6 Years)
IRT	_	Infra Red Thermography
ISO	_	International Organisation for Standardisation
kPa	_	Kilopascal
Kw	_	Kilowatts
l/s	_	Litre per second
LH	_	Left Hand
Lub	_	Lubrication
Lvl	_	Level
Max	_	Maximum
m^3/hr	_	Metres cubed per hour
mbar	_	Millibar
Min	_	Minimum
mm	_	Millimetre
MMS	_	Machine Monitoring Services [Rotek Contractor]
MPI	_	Magnetic Particle Inspection
MTR	_	Motor
MWH	_	Mega Watt Hour
NB	_	Nominal bore
NDE	_	Non Drive End
NDT	_	Non-Destructive Testing
NRV	_	Non Return Valve
OC	_	Outer Circumference
OD	_	Outer Diameter
oC	_	Degree Celsius
PdM	_	Predictive Maintenance
PFA	_	Pulverised Fly Ash

4.2 Definitions

Condition Based Maintenance

Predictive maintenance carried out because of findings from analysis of parameters measured under a condition-monitoring regime, or from recommendations from reliability analysis.

Condition Monitoring

Non-intrusive monitoring carried out to determine the physical condition of plant and equipment.

Corrective Maintenance

The process of restoring plant and equipment which have failed or deteriorated to a state which renders it unable to meet the acceptance criteria required for its particular application.

In-service Inspection

All inspection and testing conducted on plant and equipment at regular intervals and prescribed by regulatory and statutory codes or other types of specification throughout its service life.

Inspection

Activities, which by means of examination, observation or measurement, determine the conformance of material, parts, components etc., to predetermined specifications and quality requirements.

Maintenance

A combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, a state in which it can perform the required function.

Maintenance Philosophy

The principle approach decided upon for performing maintenance, such as pro-active or reactive maintenance.

Maintenance Plan

A structured set of tasks, which include the activities and time scales required to carry out maintenance on equipment. This could be a combination of preventive or predictive maintenance tasks and forms the basis of all PM's found in SAP for that particular plant system.

Maintenance Strategy

Management method used in order to achieve the maintenance objectives. Furthermore it is the choice of routine maintenance tasks and the timing of those tasks, designed to ensure that an item of equipment continues to fulfil its intended functions.

Preventive Maintenance

Maintenance carried out at predetermined time intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item.

Note: The term PM's is also used in a general sense in Generation to describe the preventative activities located in SAP PM.

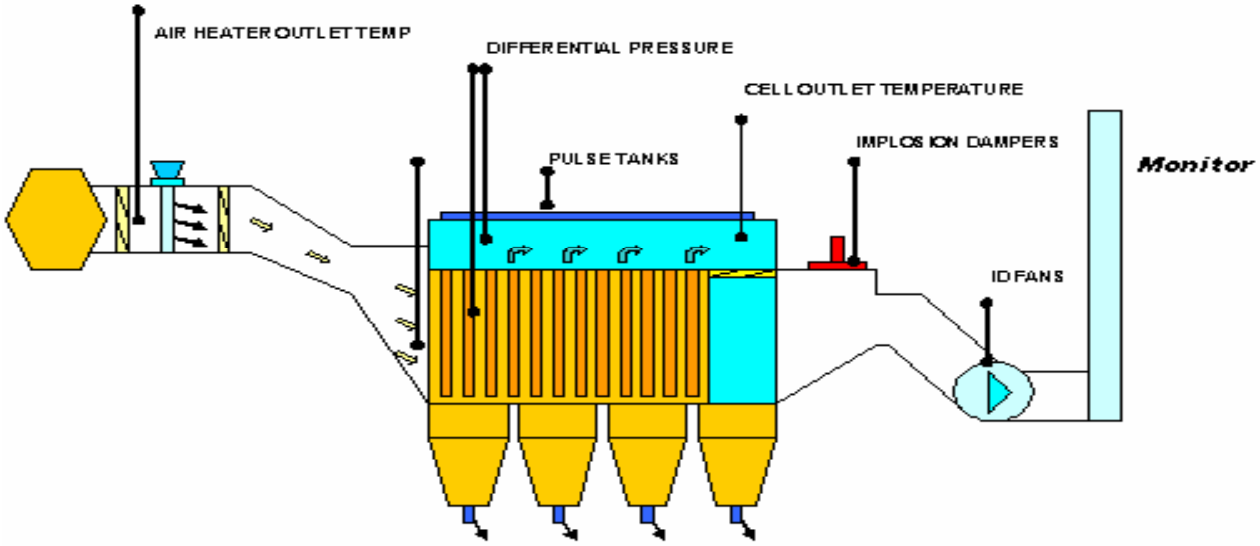
Reliability Centred Maintenance (RCM)

Reliability Centred Maintenance represents a disciplined decision logic approach that focuses on the consequences of failure to develop the most cost-effective lifetime maintenance programme. The decision logic question is sequenced to those parts of the plant that are maintenance significant. Significant components failure modes are evaluated to identify appropriate maintenance tasks and their costs.

Testing

All activities required to determine the actual performance or condition of an item.

5. FABRIC FILTER PLANT OVERVIEW



5.1 FFP System and Process Description

5.1.1 FFP General Description

Duvha Power Station unit 1, 2 and 3 have been retrofitted with ABB Pulse Jet Fabric Filter Plants into the casings of the original ESP's. The installation is designed to remove the particulate matter from the boiler plant exhaust gas before the gas is discharged to the atmosphere. The particulate matter discharged to atmosphere will not exceed 50 mg/Sm3. The fly ash is collected in the in the hoppers and removed using the hdrovac system. (FFP) consists of four casings per boiler. One casing can be isolated for maintenance with the unit on-load

5.1.2 Cross over ducts

Interconnecting crossover ducts and isolation dampers have been fitted at the air-heater outlet and between the Fabric Filter outlet ducts to allow on-line compartments to evenly share the gas flows from the boiler.

5.1.3 Cell inlet and Outlet dampers

Compartment inlet and outlet dampers are provided to allow on line filter bags inspection and maintenance.

5.1.4 Hoppers

The bottom of the casing is enclosed by ash hoppers, which are equipped with heaters to ensure the walls of the hoppers, are kept above the dew point temperature. Thermostatically controlled 3.3 and 4 kW heaters are installed below bags.

5.1.5 Compartment and Plenums

Each existing Precipitator casing is divided in two fabric filter compartment also referred as cells by longitudinal gas tight walls. Each cell contains twenty four nests of filter bags.

Each cell is divided horizontally by a gas tight bag plate located about 4.5 metres below the roof, The tubular filter bags, closed at the bottom and open on top are connected to and hang bellow the bag plate.

Gas flow through the bags is from outside to the inside, with fly ash being deposited on the outside of the bags within the lower dirty gas chamber below the bag plate, and the clean gas passing through the bags into the upper clean gas plenum.

5.1.6 Casing Implosion protection

All areas of the plant between the bags and induced draught (ID) fans has been designed to withstand the uprated fan suction. The plant between the air heater outlet and the bag plate is protected by implosion dampers located in the fabric filter plant outlet manifold. The suction pressure within the casing is continuously monitored and the implosion dampers will open if the suction levels rise above a preset level. This will have the effect of flooding the induced draught fans with ambient air, thereby reducing the suction levels in the casings to acceptable limits.

Operation of the implosion damper system will lead to the boiler trip. It should be noted, however, that under normal operation such event can not occur unless a cell isolating damper is closed prior to the outlet damper being closed. The operation of the isolation dampers is sequenced to prevent such an occurrence. Other events which may lead to high casing are closure of the air heater outlet dampers of inadvertent closure of the compartment inlet dampers.

The hydraulic system for the actuation of the implosion dampers consist of bed mounted units located on the main access gallery between the filter casings of the filter. Three hydraulic power units and accumulators are provided, one for each boiler unit. Each unit consist of one oil reseivoir, two 100% duty pumps arranged in a duty-standby configuration with automatic changeover on low oil pressure, and three hydraulic accumulators.

5.1.6.1 General Description

There are four implosion dampers located between the outlet duct and the ID fan inlet which provide the implosion protection for the Fabric Filter Plant cells and ducts.

The implosion protection system operates independently to the boiler implosion system, it guards against the possibility of an obstruction in the gas (e.g. a closed damper), fouling of the air heaters or the Fabric Filters, and prevents a high suction pressure (from the ID fans) developing within the Fabric Filter plant. In case of high casing suction pressure the implosion system will open and admit atmospheric air to the inlet of the ID fans.

5.1.6.2 Failure Modes

- Alarms

-3, 5 kPa FFP high vacuum

-4 kPa Load gradient 5 (No loading of the unit)

-4, 5 kPa Unit trip

The implosion dampers close again 30 seconds after a trip, allowing for natural purge, the 30 seconds being calculated to prevent surging in the cells, as the furnace will not be able to be purged whilst the implosion dampers are open.

To reduce the likelihood of the implosion dampers opening, the flue gas dampers, filter cell inlet and outlet dampers are interlocked so that the outlet dampers must be fully closed before the filter cell inlet dampers and flue gas dampers can be closed when taking a compartment off-line, and the reverse when the compartment is returned to service.

Furthermore, the flue gas damper control system is interlocked to prevent closure before the cell outlet dampers are fully closed.

The implosion dampers are actuated by hydraulic cylinders. Hydraulic pressure at 21 Mpa is supplied from the unit Implosion Protection Hydraulic System.

5.1.6.3 Failure Modes

- Loss of electric power to pump motors

  I. Implosion Damper remain in current position
  II. Group priority one alarm will be activated

- Loss of electric power to solenoids

  I. Implosion Damper remain in current position
  II. Group priority one alarm will be activated

Loss of hydraulic pressure

I. Implosion Damper remain in current position
II. Priority one alarm will be activated

5.1.6.4 Control Actions

At a cell inlet suction pressure above -4, 5 kPa, the implosion dampers open.
Only cells selected for service are monitored

5.1.6.5 IMPLOSION DAMPERS HYDRAULIC SYSTEM

As these units are an important part of the operation of the ID fans and designed as a safety feature, it is important that a clear understanding of its operation is imparted to the personnel assigned to operate the units.

The importance of maintaining the hydraulic units at peak performance, can not be over stressed, the consequences could be extremely serious.

GENERAL DESCRIPTION

The system is installed to prevent the implosion of the cells, should an excessive vacuum condition occur. The dampers are held in place by means of hydraulic cylinders and in case of emergency the cylinders will

outstroke, opening the damper and thus breaking the vacuum condition. As the opening time is very fast, an emergency power source in the form of an accumulator station is provided.

Make use of the quick coupler connection provided when oil is being topped up. Never pour oil into the reservoir as this will result in contamination. It is recommended that even new oil from a drum must be pumped into the reservoir via a 10µ filter.

The system is designed to pump oil to the accumulator station and maintain a preset load on the dampers.
As the accumulator station is critical to the operation of the damper cylinders, it is essential that strict attention must be paid to the condition of the nitrogen pre-charge in the accumulators.

VISUAL CHECKS

The pressure of the stored oil in the accumulators can be read from the gauge.

The reduced pressure acting on the annular area of the cylinders can be read from the gauge.

A level gauge on the side of the tank indicates the oil level in the reservoir.

A rotary thermometer shows the temperature of the reservoir oil.

MONITORING DEVICES

Level switches

Low level in the reservoir
Ultimate low level in the reservoir
Pressure switches
Maximum pressure in the accumulator, stop pump
Falling accumulator pressure, start pump
Low pressure in system
Ultimate low pressure in system
Ultimate high pressure in system.
Temperature switch
High oil temperature in the oil reservoir
Filter pressure switch
High differential pressure in the filter

All of the above are electrical signals relayed back to the control system warning of any alarm conditions.

DESCRIPTION OF OPERATION

It must be stressed that as this hydraulic system is a critical part of the overall filter system, and is primarily designed as a safety feature, utmost care must be taken to ensure that all instructions are carried out and that all alarms and trips are carefully monitored.

The hydraulic system is a basic open loop system consisting of four basic modules.

Oil reservoir and pump/motor assembly
Accumulator station
Control manifold block
Cylinders

The oil reservoir assembly consists of a 250 litre tank mounted on a frame with the pump/motor units sitting under the reservoir allowing for a flooded suction condition. There is one operational and one standby pump/motor. Pump flow is fed from the two pressure exits through non return valves to a combined pressure line entering the control manifold. Each pump is fitted with a separate pressure gauge.

The accumulator stand has three/five hydraulic storage accumulators mounted on it. These accumulators are designed to store enough oil to allow the damper cylinders to open and close in the specific time. They are each fitted with a blow down valve, high pressure shut off valve and throttle.

The function of the throttle valves is to control the oil flow from the accumulators and thus regulate the opening speed of the damper cylinders. The shut off valves are for maintenance purposes and isolate each accumulator from the system. The smaller blow down valves exhausts oil from the accumulator so that they can then be safely removed from the control circuit for maintenance.

The control manifold contains all valves for the control of both motion and pressure in the system. Some of these valves are critical to the operation of the system and will be sealed after commissioning. A description of the function of each valve is given below.

RELIEF VALVE

Pump safety relief valve to prohibit over pressurizing the pumps setting, 21.5 Mpa.

ACCUMULATOR RELIEF VALVE

Accumulator relief valve to cater for thermal expansion of the accumulator volume. Note that this valve is a requirement of law. Operating pressure is 12.5 MPa.

NON RETURN VALVE

The non return valve is to prevent pressurized oil from escaping the accumulator circuit when the pumps are not in service.

PUMP UNLOADING VALVE

Once the system pressure reaches 21 Mpa, a pressure switch gives a signal to de-energize this valve allowing the pump to circulate at zero pressure. If the pressure falls to 17.5 Mpa, this valve is energized and the pump brought back into service.

IMPLOSION DAMPER POWER PACK OPERATION

Normal operation:

The duty pump runs continuously, and is controlled via a solenoid, which when energized allows the pump to increase the accumulator pressure. The solenoid is energized when a falling pressure of 17.5 Mpa is detected. The solenoid is de energized when a rising pressure of 21 Mpa is detected. Should the pressure continue increasing, the High High 22.5 Mpa switch point will cause the motor to be stopped and give an alarm. A mechanical override button is provided on the solenoid. A mechanical safety blow off valve is provided.

Abnormal drop in pressure:

Should the pressure continue falling and reach the low, 16 Mpa switch point, the duty pump will be stopped. If an ID fan is running, the standby pump will be started. If the pressure continues falling at 13 Mpa, two priority one alarms and a secondary alarm will be initiated.

5.1.7 Fabric Filter Plant

The fabric filter plant is designed with 33% excess capacity, to allow cells on line isolations.

5.1.8 Bag cleaning Components

The optimise cleaning system consists of a pulse tank which act as the compressed air reservoir and pulse valves which control the flow of compressed air through a system of pulse pipes and nozzle pipes

which distribute the compressed air to the bags. The filter bags are cleaned by means of a compressed air pulse ejected vertically down inside the bag in the opposite direction to the normal filtering gas flow. The pulse cleaning takes place while the cell continues in operation.

Pulse tanks with the solenoid operated pulse valves integrally mounted, are located on the outside of the plenum roof and pulse air is distributed to each bag row through a distribution pipe which is an integrally welded part of the pulse tank assembly. The pulse tank is a certified pressure vessel fitted with the a pressure regulating valve, Isolating valve, non return valve, pressure relief valve, pulse valves, bleed off valve, pressure gauge and a drain valve. The tank is sized to contain sufficient air to pulse a row of 18 filter bags.

5.1.9 Bag Cleaning Control System

Three cleaning modes are provided, Differential Pressure (DP) initiated cleaning, Operator initiated fast cleaning and slow circle timer initiated cleaning. With DP initiated cleaning, the pressure drop across the bags is monitored and sequential cleaning of rows of bags is initiated when a pre-set DP set point is reached. Only sufficient rows of bags are cleaned to reduce the DP below the set point. With operator fast cleaning all the bags in the plant are cleaned at once when the fast cleaning button in the control room is depressed.

With the slow cycle timer cleaning, the next row of bags to be cleaned is cleaned if a pre-set time interval (nominally 9minutes) has elapsed since the last row of bags was cleaned, independent of DP. Pulsing will only take place if the compressed air pressure in the pulse tank reaches a pre-set level. Thus fast cleaning and DP cleaning rates are dependent on compressed air supply rate. As a consequence in an emergency, pulsing frequency can be doubled by simultaneous operation of both duty and standby air compressors.

5.1.10 Monitoring

There are two Differential Pressure (DP) transmitters to each cell or compartment:

Cell .A. NQ 14 P001/P002
Cell .B. NQ 15 P001/P002
Cell .C. NQ 24 P001/P002
Cell .D. NQ 25 P001/P002

The pressure drop across the bags is represented by the signal from these DP transmitters and the DP initiated cleaning programme is initiated by it, where by sequence cleaning of rows of bags is initiated when the pre set DP set point 1.3 kPa is reached. Only sufficient rows of bags are cleaned to reduce the DP below the set point. The unit controller in the desk should also de-load the unit manually to facilitate an acceptable DP level of 0.9 kPa across the cells.

Pressure switches are provided in the Fabric Filter Compartment to monitor the negative pressures in the casing below the bag plate and to initiate operation of the implosion dampers; these are set at **-4.5kPa** and for each cell work on a **2v3** voting circuit.

Cell .A. NQ 14 P301/P302/303
Cell .B. NQ 15 P301/P302/303
Cell .C. NQ 24 P301/P302/303
Cell .D. NQ 25 P301/P302/303

Annubars are provided in the outlet from gas the gas plenum to measure the outlet gas velocity

Cell .A. NQ 14 F001
Cell .B. NQ 15 F001
Cell .C. NQ 24 F001
Cell .D. NQ 25 F001

The outlet gas temperature, Tube plate DP and outlet gas velocity are to calculate the filter bag resistance.

Triboflow Filter bag leak dictators are located in the Fabric Filter plant outlet from the clean gas plenum to detect the dust emissions which indicates faulty filter bags.

Cell .A. NQ 14 A101/A102
Cell .B. NQ 15 A101/A102
Cell .C. NQ 24 A101/A102
Cell .D. NQ 25 A101/A102

Thermocouples are provided in the clean gas plenum to monitor cells outlet gas temperatures. Also a priority 1 alarm will be initiated in the control if this temperature exceeds the inlet temperature by more than 10 ^{o}C.

Cell .A. NQ 14 T030
Cell .B. NQ 15 T030
Cell .C. NQ 24 T030
Cell .D. NQ 25 T030

5.1.11 Emission monitors

FLOWSIC100 opacity monitor from Sick Sensor intelligence is installed on chimneys 250 m from the ground for all 6 units.

Every 4 years the Correlation Tests are carried out to establish all the settings that will be inputted into the monitor to give an indication to the various control rooms. Also two after the spot correlation checks are done.

5.2 FFP Information and Limitations

Duvha Power station is equipped with four compartments per boiler, when Isolating one cell the load need to be reduced by 100 MW or more depending on the boiler condition (A/H leakages, ID fan vanes, furnace pressure, Flue gas flow etc.)

±6500 of filter bags are installed on one cell, if one bag fail/leaking the whole cell need to be isolated in order to change that bag. One leaking/damage bag can increase emissions from the average of 20 mg/Sm^3 to 40 mg/Sm^3.

5.3 Plant Performance to date

The operating strategy at Duvha normally is determined by the plant performance and life span of bags. Emissions normally run in the average of 20 mg/Sm^3 when emissions increases to 35 mg/Sm^3 operating, production and maintenance department starts planning to isolate the cells and change bags. The cells are isolated one by one to check which cell is contributing to the increase of emissions, once the cell is determined that cell will be isolated and maintenance will apply for permit to work. Once the permit to work has been issued by the authorised person the responsible person will accept the permit after doing risk assessment and checking all the isolations.

The life span of the high temperature bags (PPSP) is now 32000 hours.

The unit is re-bagged with 23024 Polyphenelene Sulphide Polyimide (PPSPI) high temperature bags. The remaining bag plate holes (26 896 -23024 = 3872) is blanked off with specially designed blank-off bags.

5.4 Criticality of Plant

The FFP's are classified as non-critical plant, due to the redundancy of the number of bags inside the cells.

5.5 Environmental Impact

Bags are changed when the life span of the bags is reached, also during normal conditions the bags are inspected and changed as they fail.

During the Re-bagging or normal maintenance the procedure for disposing is followed to minimise any environmental impact.

5.6 Health and Safety Impacts

- Permit to work with gas pass permit, workers register, risk assessment need to be in place before anyone can get access to the FFP's compartments.
- The FFP's compartments internals are defined as a confined space. When any hot work is performed in the Precip a gas test must be done and a hot work PTW issued.
- The FFP's locations are in elevated areas. Caution should be exercised when making use of the stairways moving from the different landings. The landings may contain huge lumps of ash that may be slippery. The correct PPE must be worn at all times.
- Full PPE must be worn in the FFP compartment at all times.
- Good housekeeping must be exercised at all times.

5.7 Risk Assessment

Every time before going into the FFP's the Risk Assessment must be in place.

5.8 Assumptions

- Airheter and ducting outage takes place every 18 months
- Interim Repair (IR) takes place once after every 3 years.
- A General Overhaul (GO) takes place once every 6 years
- All 20 fields and SO3 plant available at all times.

5.9 Proposed Modifications (Planned and bases on the RBO Analysis)

- Nil

5.10 Life of Plant Plan

Project	Unit	Value	Period
Re-bagging	1	R50 m	2011-10-01
Re-bagging	2	R50 m	2012-06-01
Re-bagging	3	R50 m	2015-03-01

6 ORGANISATIONAL RESPONSIBILITIES

Refer to the Duvha Power Station Organisational Responsibilities Document QAS0004.

7 OPERATING STRATEGY

FFP Manuals and Operating training available on site

8 OUTAGE STRATEGY

Based on the new proposed outage strategy

- GO 6 years
- (1st year) Airheater and Ducting every 12 months yearly (10 days)
- (2nd year) Airheater and Ducting every 12 months yearly (10 days)
- (3rd year) Interim after 3 years
- (4th year) Airheater and Ducting every 12 months yearly (10 days)
- (5th year) Airheater and Ducting every 12 months yearly (10 days)
- (6th year) GO 6 years

Refer to **MAINTENANCE POLICY AND OUTAGE PHILOSOPHY** document **DUV0004.**

9 MAINTENANCE STRATEGY DETERMINATION PROCESS

Refer to Duvha Reliability Basis Optimization Procedure ENP0032.

10 MAINTENANCE STRATEGY

Generic system maintenance strategies can be used on G:\DATA\INFOBANK\Plant Maint\RBO\2009 06 16 - GGCS form SS

High level Maintenance philosophy:

- Preventive on critical components
- Predictive inspection on protections
- Condition monitoring
- Outage scope – items which cannot be access on load
- On -site workshop/supplier repairs
- Run to failure on non critical / non economic repairs

Maintenance of most components is outage-based. Most wear components, for example valves and ash sump are overhauled during unit outages once every three years. However, there are more regular preventative maintenance activities undertaken on components with short working lives, like pumps.

11 MAINTENANCE PLAN

See Specific Equipment and Component Maintenance Strategy on **Excel Workbook ENS0032-1**

12 SPARES STRATEGY

All spares are kept as stock Items

13 OTHER AREAS FOR RESEARCH, MODIFICATION OR INVESTIGATION.

None

14 MAINTENANCE STRATEGY AUDIT

Asset Management Department will perform an audit as per CTAD schedule.

15 REVIEW PERIOD

This document and strategy will be reviewed annually or based on modification requirements or plant performance trends.

16 DISTRIBUTION LIST

Nielen Toerin - Engineering Manager
Sophy Dipela - Boiler Engineering Manager
Piet Van Der Merwe - Maintenance Support Manager
Ebrahim Patel - Senior Consultant (GBE)
Msizi Ngcoya - Flue gas cleaning System Engineer
Thembeka Oliphant - Maintenance Support Technician

17 APPENDICES

Maintenance Strategy Excel Workbook ENS0032-1

18 LIST OF AVAILABLE DRAWINGS

The following drawings are available on Excalibur.

DRAWING NUMBER	DRAWING TITLE
057/ 51051	FFP COMPRESSOR SOLENOID VALVE CONTROL CIRCUIT
057/ 50303	UNIT 1 FFP COMPRESSOR HOUSE GENERAL ARRANGEMENT OF ACCESS PLATFORM
057/ 50303	UNIT 1 FFP COMPRESSOR HOUSE GENERAL ARRANGEMENT OF ACCESS PLATFORM
057/ 48621	DETAILS OF FFP PULSE SYSTEM NOZZLE PIPE

Plant	Equipment	Components	AKZX Code (Unit 1 only)	Functional Importance (C/NC/RTF)	Parts (that could fail)	Type	Functional failure (Loss of ...)	Failure Mode (... failure)	Strategy	Current Frequency	RBO Frequency (W/M/Y)	Dept	Power Unit Run or Outage	During Outage "Lock Plan"	Remarks	Change	Reason for change	Doc Requirements	Specific History Requirements	SPARES
FABRIC FILTER PLANT	Cells A-D	FFP MULTIPLEXER	03-01NQ00Uxxx	C	Electronic components	-	Loss of FFP control	Electronic component failure.	Function testing of inputs and outputs	Nil	2-Yearly (IR)	C&I	Outage	N/A	-	Yes	New strategy being developed to improve reliability.	Outage Task List to be developed.	Condition found and components replaced.	Spares are available from Stores. Check with C&I.
		CELL A-D OUT FLOW TX	03-01NQ14/15/24/25F001	C	Electronic components and impulse line leaks.	-	Loss of flow detection and control/protection.	Electronic components failure and impulse line leaks.	Comparison check via the Data acquisition/VA System.	Nil	Yearly (A/H duct outage)	C&I Unit Maint	Outage	N/A	Experience with failures has led to this frequency.	Yes	New strategy being developed to improve reliability.	LCI No. 3367 exists.	Condition found.	Spares available from Stores
		CELL A-D BROKEN BAG DETECTOR SENSOR A/B	03-01NQ14/15/24/25S101 03-01NQ14/15/24/25S102	RTF																
		FFP CELL A-D PEEPING WINDOWS	03-01NQ14/15/24/25F002-5	RTF																
		CELL A-D OUTLET DUCT	03-01NQ14/15/24/25G002	C	Vanes and duct	Mild steel	Loss of flow control.	Corrosion and wear.	Inspect condition of vanes and ducts.	18-Monthly	Yearly (A/H duct outage)	Outage	Outage	N/A	-	Yes	Change of outage cycle.	Outage Task List to be developed.	Condition found.	Material available locally.
		CELL A-D DIFF PRESS TX 1/2	03-01NQ14/15/24/25P001/2	C	Electronic components	-	Loss of high diff. pressure detection and control/protection.	Electronic components failure and impulse line leaks.	Comparison check via the Data acquisition/VA System.	Yearly (A/H duct outage)	Yearly (A/H duct outage)	C&I Unit Maint	Outage	N/A	Experience with failures has led to this frequency.	No	-	LCI No. 3007 exists.	Condition found.	Spares available from Stores
		CELL A-D INLET VACUUM TX	03-01NQ14/15/24/25P003	C	Electronic components and impulse line	Yokogawa	Loss of vacuum detection and control/protection.	Electronic component failure and impulse line leaks.	Calibration	18-Monthly	Yearly (A/H duct outage)	C&I Unit Maint	Outage	N/A	-	Yes	Change of outage cycle.	LCI to be developed for FFP.	Condition found.	Spares available from Stores
		CELL A-D INLET VACUUM PRESS SW A-D	03-01NQ14/15/24/25P301-304	C	Contacts and bellows.	Sauter/Darksdale	Loss of signal (for tripping, interlocks, etc)	Contacts and bellows failure.	Calibration	2-Yearly (IR)	2-Yearly (IR)	C&I Unit Maint	Outage	N/A	-	No	Compliance to GGCS	LCI to be developed.	Condition found.	Spares available from Stores
		CELL A-D INLET TEMP TC 1-12	03-01NQ14/15/24/25T010-21	C	Electronic components	Thermocouple	Loss of temperature indication.	Electronic component failure.	Verify functionality	3-Yearly	2-Yearly (IR)	C&I Unit Maint	Outage	N/A	See GGCS for thermocouples Rev 0 - Column 5.	Yes	Change of outage cycle.	Outage Task List to be developed.	Condition found.	Spares are available from Stores.
		CELL A-D INLET TEMP TC 1-12 TX	03-01NQ14/15/24/25T010-21XQ01	C	Electronic components	Wika, etc	Loss of temp detection and control/protection.	Electronic component failure	Calibration	RTF	2-Yearly (IR)	C&I Unit Maint	Outage	N/A	See GGCS for temp transmitters Rev 0	Yes	Compliance to GGCS	LCI's are to be developed.	Condition found.	Spares available from Stores
		CELL A-D OUTLET TEMP TC TX	03-01NQ14/15/24/25T030XQ01	C	Electronic components	Wika, etc	Loss of temp detection and control/protection.	Electronic component failure	Calibration	RTF	2-Yearly (IR)	C&I Unit Maint	Outage	N/A	See GGCS for temp transmitters Rev 0	Yes	Compliance to GGCS	LCI's are to be developed.	Condition found.	Spares available from Stores
		CELL A-D OUT TEMP TC	03-01NQ14/15/24/25T030	C	Electronic components	Thermocouple	Loss of temperature indication.	Electronic component failure.	Verify functionality	3-Yearly	2-Yearly (IR)	C&I Unit Maint	Outage	N/A	See GGCS for thermocouples Rev 0 - Column 5.	Yes	Change of outage cycle.	Outage Task List to be developed.	Condition found.	Spares are available from Stores.
	UNITS 1-3 FFP PULSING SYSTEM	LH/RH LINE MAIN HAND ISOL V/V	03-01NQ60S005-8	RTF	-	Butterfly														
		FFP CELLS A-D PULSE TANKS A-D 001-12	03-01NQ41-44G001-12	C, due to Statutory requirements	Tank	Steel @ 350 kPa	Loss of compressed air containment.	Corrosion and cracking	Internal and external visual inspection.	3-Yearly	3-Yearly	Outage	Outage	N/A	Statutory pressure vessels	No	-	PM No's U1-3: 6301/6303/6304		N/A
		CELL A-D PULSE TANKS A-D PRESS RELIEF V/V	03-01NQ41-44S011/21/31/41 03-01NQ41-44S011/21/31/41	C, due to Statutory requirements	Spring	PRV	Loss of tank overpressure protection.	Drift.	Remove and test setpoint.	3-Yearly	3-Yearly	Outage	Outage	N/A	Statutory relief valves	No	-	PM No's U1-3: 6301/6303/6305 to be updated to include the testing of the PRV's.	Record original and calibrated setpoint and attach Certificate for filling.	Spares are available from Stores.
		CELL A-D PULSE TANK A-D LOW AIR PRESS SWITCH	03-01NQ41-44P301-304	C	Micro-switch and diaphragm	Mecosa/Delta/ Square D/CCS/ Ashcroft.	Loss of signal (for tripping, interlocks, etc)	Micro-switch and diaphragm failure.	Calibration	2-Yearly (IR)	2-Yearly (IR)	C&I Unit Maint	Outage	N/A	See GGCS for pressure switches Rev 0	No	-	LCI to be developed.	Condition found.	Spares available from Stores.
		CELL A-D PULSE TNKS A-D AIR PRESS INDICATORS	03-01NQ41-44P501-504	C, due to Statutory requirements	See GGCS	Dial gauge	Loss of tank pressure indication and red-lining.	See GGCS.	Calibrate gauge and confirm red lining.	3-Yearly	3-Yearly	Outage	Outage	N/A	Statutory pressure indicators.	No	-	PM No's U1-3: 6301/6303/6305 to be updated to include the calibration of gauges.	Record original and calibrated values and attach Certificate for filling.	Spares are available from Stores.
		CELL A-D PULSE TANK A-D PRESS GUAGE/SWITCH ISOL V/V	03-01NQ41-44S012-15/18/20/22-25/28/30/32-35/38/40/42-45/48/100/200/300/900	RTF																
		CELL A-D PULSE TANK SOLENOID V/V's	03-01NQ41-44S101-195 03-01NQ41-44S201-295 03-01NQ41-44S301-395 03-01NQ41-44S401-495	C, due to Environmental Statutory requirements	Solenoid valve	Electrical pulsing solenoids	Loss of pulsing action.	Sticky and/or filter clogged.	Inspect operation of solenoids and replace if necessary.	Weekly	Weekly	HMD	Run	Yes	-	No	-	PM No's 03-12506 exists.	Solenoids replaced.	Spares are available from Stores.
		-	-	NC	Gum washer seal	Flat rubber	Loss of air sealing.	Distortion.	Inspect condition and replace if necessary (with the solenoids).	Weekly	Weekly	HMD	Run	Yes	-	No	-	PM No's 03-12506 exists.		Spares are available from Stores.
		CELLS A-D PULSE TANKS A-D PULSE V/V	03-01NQ41S101/102KA01 (new - create 46 additional AKZ)	NC	Diaphragm, spring and nylon disc.	Diaphragm pulse.	Loss of pulsing action.	Diaphragm torn or leaking, spring loss and nylon disc wear.	Inspect operation of pulse valves (with the solenoids) and replace if necessary.	Weekly	Weekly	HMD	Run	Yes	-	No	-	PM No's 03-12506 exists. Group in Cells or Units.	Valves failed.	Spares are available from Stores.
		CELL A-D PULSE TANKS A-D INLET FLEX PIPE	03-01NQ41-44G100/200/300/400	NC	Pipe.	Mild steel.	Loss of pulsing air.	Wear and holes.	Inspect piping for damage.	Yearly	Yearly	Outage	Outage	N/A	-	No	-	Outage Task List to be developed.		Spares are available from Stores.
		CELLS A-D PULSE TANKS A-D ISOL V/V	03-01NQ41-44S010/20/30/40	RTF																
		CELLS A-D PULSE TANK A-D DRAIN V/V A/B	03-01NQ41-44S016/17/26/27/36/37/46/47	RTF																
Implosion Damper System:	Hydraulic system	HYDRAULIC TANK/BREATHER	03-01NQ50G001-2	C	Tank walls	Steel	Loss of oil containment	Wear and leaks	Clean tank and breather, inspect condition and perform wall thickness tests.	3-Yearly	2-Yearly (IR)	Outage	Outage	N/A		Yes	Change of outage cycle.	Outage Task List to be developed.	Condition found.	N/A
		IMPLOSION DAMPER HYDR SYS ACCUMULATORS A-C	03-01NQ50G003-5	C	Cylinder	Steel	Loss of hydraulic pressure accumulation.	Cracks and corrosion.	Perform inspection & thickness measurements and replace if necessary.	3-Yearly	3-Yearly	Outage	Outage	N/A	-	No	-	Outage Task List to be developed.		Spares are available from Stores.
		HYDRAULIC ACCUMMULATORS A-C CHECK/ISOL V/V's	03-01NQ50S051-59	RTF	Small bore isol valves															
		IMPLOSION DAMPER HYDRAULIC P/P A/B	03-01NQ50D001/2KP01	NC, due to redundancy	Impellors	Centrifugal.	Loss of hydraulic pressure.	Loss of impellor clearance.	Open pump, inspect and perform clearance measurements.	3-Yearly	3-Yearly	Outage	Outage	N/A	-	No	-	Outage Task List to be developed.		Spares are available from Stores.
		IMPLOSION DAMPER HYDRAULIC P/P A/B MOTOR	03-01NQ50D001/2-M01	NC, due to redundancy	Bearings, windings and terminals.	380V ac induction.	Loss of pump rotation.	Bearings, windings and terminal failure.	Remove motor, run test and send away for refurbishment, if necessary.	3-Yearly	3-Yearly	Outage	Outage	N/A	-	No	-	Outage Task List to be developed.		Spares are available from Stores.

Plant	Equipment	Components	AKZX Code (Unit 1 only)	Functional Importance (C/NC/RTF)	Parts (that could fail)	Type	Functional failure (Loss of ...)	Failure Mode (... failure)	Strategy	Current Frequency	RBO Frequency (W/M/Y)	Dept	Power Unit Run or Outage	During Outage "Lock Plan"	Remarks	Change	Reason for change	Doc Requirements	Specific History Requirements	SPARES
		IMPLOSION DAMPER HYD P/P A/B COUPLING	03-01NQ50D001/2MK01	NC, due to redundancy	Plastic	Plastic inserts	Loss of pump rotation.	Wear and holes.	Remove, inspect condition and replace if necessary.	3-Yearly	3-Yearly	Outage	Outage	N/A	-	No	-	Outage Task List to be developed.		Spares are available from Stores.
		FFP IMPL PROT SYSTEM PRESS RELIEF V/V	03-01NQ50S032/41	C	Spring	PRV	Loss of hydraulic overpressure protection.	Drift.	Remove and test setpoint.	3-Yearly	3-Yearly	Outage	Outage	N/A	-	No	-	Outage Task List to be developed.		Spares are available from Stores.
		IMPLOSION DAMPER A-D SOLENOID OPEN S5M	03-01NQ50S101/201/301/401	NC	-	-	Loss of hydraulic supply.	Sticky and/or filter clogged.	Inspect operation of solenoids and replace if necessary.	Weekly	Weekly	HMD	Run	Yes	-	No	-	Revise Doc No HAI 1419, include the solenoids inspection and re-instate.		Spares are available from Stores.
		HYDRAULIC TANK DUPLEX FILTERS	03-01NQ50G001KT01	NC	Filter elements.	Wiremesh	Loss of hydraulic pressure.	Clogged.	Change-over and clean filters.	Weekly	Weekly	HMD	Run	Yes	-	No	-	Revise Doc No HAI 1419 and re-instate.		Spares are available from Stores.
		IMPL DAMPER HYD P/P A/B INLET ISOL V/V	03-01NQ50S011/21	RTF																
		IMPL DAMPER HYD P/P A DISCHARGE ISOL V/V	03-01NQ50S014/24	RTF																
		IMPLOSION DAMPER HYD P/P A/B DISCHARGE NRV	03-01NQ50S012/22	RTF																
		FFP IMPLOSION DAMPER SYSTEM NRV	03-01NQ50S031	RTF																
		IMPLOSION DAMPER HYD P/P A/B PRESS GAUGE	03-01NQ50P501/2	RTF																
		IMPL DMP HYD P/P A/B PRESS GAUGE ISOL V/V	03-01NQ50S013/23	RTF																
		IMPLOSION DAMPER PRESS SWITCHES LOLO/LO/MED/HI/HIHI	03-01NQ50P302-306	C	Electronic components	-	Loss of hydraulic pressure protection.	Electronic component failure.	Verify functionality of pressure switch.	2-Yearly (IR)	2-Yearly (IR)	C&I	Outage	N/A	-	No	-	Outage Task List to be developed.	Functionality results obtained.	Spares are available from Stores.
		IMPL PROT SYSTEM OIL PRESS SW ISOL V/V	03-01NQ50S061-066	RTF																
		IMPLOSION DAMPER TANK LEVEL SW LO/LOLO	03-01NQ50L001-2	C	Electronic components	-	Loss of tank low level alarms.	Electronic component failure.	Verify functionality of level switch.	2-Yearly (IR)	2-Yearly (IR)	C&I	Outage	N/A	-	No	-	Outage Task List to be developed.	Functionality results obtained.	Spares are available from Stores.
		IMPLOSION DAMPER TANK LEVEL SWITCH A/B	03-01NQ50L301-2	C	Electronic components	-	Loss of tank low level alarms.	Electronic component failure.	Verify functionality of level switch.	2-Yearly (IR)	2-Yearly (IR)	C&I	Outage	N/A	-	No	-	Outage Task List to be developed.	Functionality results obtained.	Spares are available from Stores.
		IMPLOSION DAMPER TANK LEVEL INDICATION	03-01NQ50L501	C	Electronic components	-	Loss of tank local indication.	Electronic component failure.	Verify functionality of level switch.	2-Yearly (IR)	2-Yearly (IR)	C&I	Outage	N/A	-	No	-	Outage Task List to be developed.	Functionality results obtained.	Spares are available from Stores.
		IMPL DAMPER RTN LINE FLT DIFF PRESS HIGH	03-01NQ50P301	C	Electronic components	-	Loss of diff. pressure alarm.	Electronic component failure.	Verify functionality of level switch.	2-Yearly (IR)	2-Yearly (IR)	C&I	Outage	N/A	-	No	-	Outage Task List to be developed.	Functionality results obtained.	Spares are available from Stores.
		HYDRAULIC ACCUMMULATOR PRESS GAUGE	03-01NQ50P503	RTF	-	Local gauge														
		IMPL PROT SYSTEM PRESS GAUGE ISOL V/V	03-01NQ50S043	RTF	Small bore isol valves															
		CELL A IMPLOSION PROT SYSTEM PRESS GAUGE	03-01NQ50P504	RTF	-	Local gauge														
		FFP IMPLOSION DAMPER SYSTEM FLEX PIPES	03-01NQ50AA11	C	Electronic components	-	Loss of tank low level alarms.	Electronic component failure.	Verify functionality of level switch.	2-Yearly (IR)	2-Yearly (IR)	C&I	Outage	N/A	-	No	-	Outage Task List to be developed.	Functionality results obtained.	Spares are available from Stores.
		CELL A IMPLOSION DAMPER HYDRAULIC CYL	03-01NQ50S010MU01	C	Seals	-	Loss of damper movement.	Seal leaks.	Inspect, test and repair if necessary.	2-Yearly (IR)	2-Yearly (IR)	C&I	Outage	N/A	-	No	-	Outage Task List to be developed.	Functionality test results obtained.	Spares are available from Stores.
		IMPLOSION DAMPER A-D OPEN/CLOSED LIMIT SW	03-01NQ50S010XG01-06 03-01NQ50S020XG01-06 03-01NQ50S030XG01-06 03-01NQ50S040XG01-06	C	Switch	Proximity switch	Loss of cylinder position detection.	Component failure or open circuit.	Loop tests and function check.	3-Yearly	2-Yearly (IR)	C&I	Outage	N/A	-	Yes	Change of outage cycle.	Outage Task List to be developed.	Functionality results obtained.	Spares are available from Stores.
		CELL A-D IMPLOSION DAMPER DIR CONTROL V/V	03-01NQ50S011/21/31/41	C	Valve seats	Solenoid valve	Loss of directional flow control.	Leakage	Visual inspection covered by generic inspections.											
		CELL A-D IMPLOSION DAMPER CHECK V/V	03-01NQ50S012/22/32/42	C	Valve seats	Throttle check valve	Loss of throttling flow.	Leakage	Visual inspection covered by generic inspections.											
		CELL A-D IMPLOSION DAMPER BLADE/FRAME	03-01NQ50S010KA01/KZ01	C	Seals	Poppet	Loss of induced draught on boiler.	Seal leaks.	Visual inspection for seal leakage.	Weekly	Weekly	HMD	Run	Yes	-	No	-	Revise Doc No HAI 1419, include the implosion damper seal inspection and re-instate.		Spare damper to be purchased and made a stock item.
	Cells internal	Bags	03-01NQ50	RTF	-	-	-	-	Continuous monitoring of emissions to determine bag replacement.											
		Pulsing pipes	03-01NQ50	RTF																
		CELL A-D INL DUCT, GUIDE VANES & SPLITTER PLATES	03-01NQ14/15/24/25G001	C	Vanes and duct	Mild steel	Loss of flow control.	Corrosion and wear.	Inspect condition of vanes and ducts.	18-Monthly	Yearly (A/H duct outage)	Outage	Outage	N/A	-	Yes	Change of outage cycle.	Outage Task List to be developed.	Condition found.	Material available locally.
		Cell outlet isolation dampers	03-01NQ14/15/24/25S030/40MU01	C	Vanes and linkages	Damper	Loss of cell isolation and ID Fan running out of capacity.	Wear and holes.	Inspect and repair as required.	2-Yearly (IR)	2-Yearly (IR)	Outage	Outage	N/A	-	No	-	Outage Task List to be developed.	Condition found.	Spares are available from Stores.
		CELL A-D INLET/OUTLET ISOL DAMPER ROTORK ACTUATOR	03-01NQ14/15/24/25S030/40MU01	C	Motor, gearbox and limit switches.	Rotork	Loss of cell isolation and ID Fan running out of capacity.	Motor, gearbox and limit switches failure.	Perform stroke check of actuator.	2-Yearly (IR)	2-Yearly (IR)	Outage	Outage	N/A	-	No	-	Outage Task List to be developed.	Condition found.	Spares are available from Stores.
		Structure	03-01NQ50	C	-	-	-	-	See Civils and Structures Strategy.											
		Bagplates	03-01NQ50	C	Plates	Mild steel	Loss of dust containment.	Wear and heavy loading.	Inspect condition and perform repairs as required.	2-Yearly (IR)	2-Yearly (IR)	Outage	Outage	N/A	-	No	-	Outage Task List to be developed.		Material available locally.
		Blanks	03-01NQ50	RTF	-															
		Cages	03-01NQ50	RTF	-															
	Cells External	FFP CELL 1A-D VACUUM BREAKER 1-3	03-01NQ14/15/24/25S501-503	RTF	-															
		Inspection lights	03-01NQ14/15/24/25F001-5	RTF	-															
		FFP CELL A-D PEEPING WINDOW	03-01NQ14/15/24/25F001-5	NC	Window	Glass	Loss of internal visibility	Staining.	Clean and replace if necessary.	Ad hoc	Monthly	HMD	Run	Yes	-	Yes	To improve visibility inside the compartments.	PM to be developed.		Not required.
		FFP CELL A-D ENTRANCE DOOR 1-3	03-01NQ14/15/24/25I001-3	NC	Seals	Steel with fibre-wool seals.	Loss of sealing.	Seal wear.	Inspect condition of seals and replace if necessary.	Yearly	Yearly	Outage	Outage	N/A	-	No	-	Outage Task List to be developed.		Spares are available from Stores.

Plant	Equipment	Components	AKZX Code (Unit 1 only)	Functional Importance (C/NC/RTF)	Parts (that could fail)	Type	Functional failure (Loss of ...)	Failure Mode (... failure)	Strategy	Current Frequency	RBO Frequency (W/M/Y)	Dept	Power Unit Run or Outage	During Outage "Lock Plan"	Remarks	Change	Reason for change	Doc Requirements	Specific History Requirements	SPARES
	Hoppers	HOPPER HI LEVEL SWITCH	03-01NT11-14L100/200 03-01NT21-24L100/200 03-01NT31-34L100/200 03-01NT41-44L100/200	C	Switch	Vacuum switch	Loss of hi level alarm	Switch failure, blockages, etc.	Functional testing.	3-Yearly	2-Yearly (IR)	Outage	Outage	N/A	-	Yes	Change of outage cycle.	Outage Task List to be developed.	Functionality found.	Spares are available from Stores.
		Body and cladding/lagging	-	RTF	Structure	Mild steel.	Loss of dust containment.	Wear and corrosion.	RTF	-	-	-	-	-	-	-	-	-	-	-
		FFP HOPPER LH/RH NR 1-24 INSPECTION DOOR	03-01NT11-14KB01 03-01NT21-24KB01 03-01NT31-34KB01 03-01NT41-44KB01	NC	Seals	Steel with fibre-wool seals.	Loss of sealing.	Seal wear.	Inspect condition of seals and replace if necessary.	Yearly	Yearly	Outage	Outage	N/A	-	No	-	Outage Task List to be developed.		Spares are available from Stores.
	Agitator assembly	FFP HOPPER LH/RH NR 1-24 AGITATING HANDLE	03-01NT11-14D102/202/302KM01 03-01NT21-24D102KM01 03-01NT31-34D102KM01 03-01NT41-44D102KM01	NC	Rod, chains and handle	Manual	Loss of agitation capability.	Mechanical failure.	Inspect condition and repair as necessary.	Yearly	Yearly	Outage	Outage	N/A	-	No	-	Outage Task List to be developed.		Material available locally.
		HOPPER TEMP TC	03-01NT11-14T100/200 03-01NT21-24T100/200 03-01NT31-34T100/200 03-01NT41-44T100/200	NC	Electronic components	Thermocouple	Loss of temperature indication.	Electronic component failure.	Verify functionality	3-Yearly	2-Yearly (IR)	Outage	Outage	N/A	See GGCS for thermocouples Rev 0 - Column 5.	Yes	Change of outage cycle.	Outage Task List to be developed.	Functionality found.	Spares are available from Stores.
		FFP CELL A-D HOPPER 1-12 HEATER	03-01NT11-14W102/202/302 03-01NT21-24W102/202/302 03-01NT31-34W102/202/302 03-01NT41-44W102/202/302	RTF	Element	Electrical heaters	Loss of heating for start-up.													

Eskom Generation	**Instruction**	**Alloc. Centre: 03E Duvha** **Doc ID: BI090** **Rev. 4**

RESPONSIBLE FUNCTIONAL AREA

OPERATING GROUP

TITLE: BOILER PLANT

PARTICULATE EMISSION MONITORING & CONTROL (UNIT 1 – 3)

ACCEPTED BY	**ACCEPTED BY**	**ACCEPTED BY**	**COMPILED BY**
			M DREYER **SNR TECHNICIAN**
ACCEPTED BY	**ACCEPTED BY**	**ACCEPTED BY**	**AUTHORISED BY**
BOILER SYSTEM ENG.	**SHIFT MANAGER**	**SHIFT SUPERVISOR**	**OPS MANAGER**

INDEX **ACTIONS**

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REV	DESCRIPTION OF REVISION	DATE
0	ORIGINAL	06/00
1	TITLE CHANGED	06/02
2	REVIEW AND NEW FORMAT	06/04
3	REVIEW	03/07
4	REVIEW	03/10

KEYWORDS:	
DOCUMENT CLASS:	CONTROLLED DISCLOSURE
DATE OF LAST REVIEW:	MARCH 2010
DATE OF NEXT REVIEW:	MARCH 2013

1.0 PURPOSE

The purpose of this instruction is to enable operating staff to monitor particulate emissions and report abnormalities in the flue gas cleaning plants.

2.0 SCOPE

This document applies to the Fabric Filter Plant Units 1 – 3.

3.0 REFERENCES

Nil.

4.0 DEFINITIONS

UC - Unit Controller
USS - Unit Shift Supervisor
CAPCO - Chief Air Pollution Control Officer
CAP - This is an upper absolute limit never to be exceeded
TPM - Tonnes per month
mg/sm³ - Milligrams per standard cubic meter

5.0 RESPONSIBILITIES

U.C. and U.S.S. are responsible for adherence to this instruction.

6.0 LIMITS & TONNES PER MONTH

The Visible Emission Limit, CAP and Tonnes per month values as per Registration Certificate are legally binding and non-compliance is a contravention.

Unit	Visible Emission Limit	**CAP**
	mg/Sm³	
1 – 3	50	100
TPM		
Station	569	
Units	**Total**	**Per Unit**
Tonnes		
Units 1 – 3	229	76

7.0 CAPCO REGISTRATION CERTIFICATE CONDITIONS (CAPCO LICENSE)

1. Fabric Filter Plant – Units 1 - 3

Verbatim from CAPCO Registration Certificate

B Visible Emissions

If the stack monitor is greater than 50**mg/Sm³** (using the average stack exit opacity equivalent), for more than an hour, an immediate investigation must be launched to identify and rectify causes.

2. TONS per MONTH

The total particulate emission from the station will not be more than 569 tons over any consecutive 31 day period.

8.0 ACTIONS

Fabric Filter Plant (Units 1 – 3)

Stack Emission	Actions
< 29**mg/Sm³**	Normal. At ≥ 30**mg/Sm³** and sootblowing is initiated then the emissions turn at approximately 40**mg/Sm³**. After every sootblowing session the UC should note that this happens.
> 30**mg/Sm³**.	• Above 30**mg/Sm³** before soot-blowing the UC notifies the USS that the Stack Emissions are going abnormal. UC requests the Ash plant operator to check and report on any high dust hopper levels. UC raises a notification for Filter bags inspections by HMD. • On the visual display unit (Fabric Filter Plant display CELL A & CELL B) the UC must observe that all Pulse Tanks are alternately pulsing and that the Cell DP's are staying normal (below 1,5 kpa). UC must also request the Boiler plant operator to do physical plant inspections to observe if the cells are pulsing correctly. • UC and USS both continues to check cells DP's and compare them to the gas flows. Gas flows below 220m^3 and high DP's (above 1.5 kpa) will indicate high dust hopper levels. USS will also request C&I to check the stack monitor to see if it is giving a true indication.

8.0 ACTIONS Continue……

Fabric Filter Plant (Units 1 – 3)

> 40**mg/Sm³**	• At this point the USS reports the plant status to the Shift Manager and requests the production planner allocated to that unit to investigate the possibility of isolating cells and replacing bags in that unit (by referring to the notification raised by the UC). • The Shift Manager will request assistance from Boiler Engineering and report plant status to the Operating Manager, Production Management and Risk Manager (Environmental Manager). • The Shift Manager will then be responsible to oversee to the whole recovery actions and to ensure that both the Operating Manager and the Risk Manager are kept notified throughout the process to enable the Risk Manager to inform and negotiate with CAPCO should the need arise.
> 50**mg/Sm³**	• If the stack monitor is greater than 50mg/Sm^3, use average stack exit opacity equivalent, for more than 1 hour, Above limit count 2 on the VDU (Boiler Flue gas system) counts in increments of one for every hour. • If the hours accumulative per boiler per calendar month from Above limit count 2 on the VDU, exceeds or are equal to 30, the offending unit(s) will reduce load (even be shutdown – depending on the negotiations between CAPCO and Risk Manager) until the reading is less than 50mg/Sm^3.