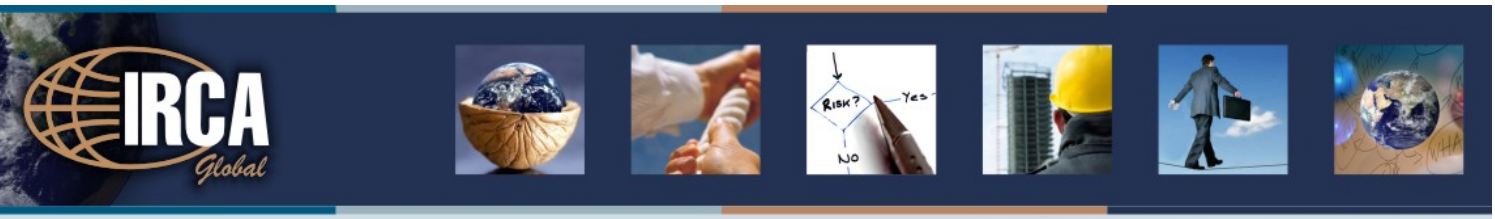

WHEN YOU'RE SERIOUS ABOUT MANAGING RISK

IRCA (Pty) Ltd.
Reg No 1986/004379/07

HEAD OFFICE:
Ground Floor
279 Kent Avenue
Randburg 2194

PO Box 2582
Randburg 2125
South Africa
solutions@ircaza.com
www.ircaza.com

Tel: +27 (11) 285-4200
Fax: +27 (11) 285-4229
Direct: Tel: +27 (11) 285-4285
Cell: +27 (83) 276-2994
Email:DHaasbroek@IRCAZA.com

Mr S Ingle
Consultant
Marsh Environmental Services
Private Bag X14
Benmore
2010

14 July 2009

Dear Steven,

Eskom Maningi Station – Sandton.

Attached, please find the report on the aspects referred to in the public's concerns regarding fire and lightning risk. I trust that the information meets your requirements.

I will be forwarding the information on the health issues on Friday this week.

Kind regards

_____

Dirk C Haasbroek
Operations Executive: Risk Management Services.





Risk Management Services

Eskom Maningi Substation – Sandton
Marsh Environmental Services

PREPARED BY: **Colin Edwards**

REPORT: 01

DATE: 14 July 2009

APPROVED BY: Dirk C Haasbroek

CONTACT: +27 (0)11 285 4285

DHaasbroek@IRCAZA.com

IRCA Global

WHEN YOU'RE SERIOUS ABOUT MANAGING RISK

TABLE OF CONTENTS

Document Version Control

Rev No	Issue Date	Reason for Issue	Prepared By	Reviewed By
0	14/07/2009	Report	CE	DCH

1.0 Introduction

Based on the reviewed of the Eskom Standard for Passive Fire Protection in Distribution Substation Yards (DISASAAAO – REV 3 dated April 2007), the following comments in respect of this document are presented.

2.0 Comments on Eskom Standard for Passive Fire Protection in Distribution Substation Yards

Section 1 – Scope of Work

1.5 This should be amended to read :
"To provide a cost effective passive fire protection system:.

Note:
The document makes no provision for any "active" fire protection systems other than portable fire fighting equipment.

Section 2 – Normative References

No comment

Section 3 – Definitions and Abbreviations

No comment

Section 4

4.1 General

No provision has been made for oil filled transformers which are fitted with automatic high velocity water spray systems as a means of fire extinguishment of an outbreak of fire involving one or more of the transformer units.

The combined volume of water/oil will determine the need for an oil catchment and holding area. Additional capacity for containment of the oil and fire water will be required if an automatic high velocity water spray system has been installed..

4.2 Oil Catchment and Holding Area

The transformer bund area should have a capacity of 110% of the total liquid content of the oil filled equipment plus, in the event of the installation of an automatic high velocity water spray fire extinguishing systems, an additional volumetric volume for the fire water system discharged for a period of 20 minutes.

4.3 Oil Holding Dam

No comment

4.3.1 Oil Catchment Area

No comment (see 4.2 above)

4.3.2 Oil Drainage Systems

No comment

4.3.3 Oil Holding Dam

All oil drainage pipes which discharge oil into the Holding Dam shall be fitted with flame traps to minimise fire spread between the Catchment Area and the Holding Dam.

Drain pipe diameters shall make due allowance for the automatic fire protection system water which will be discharged into the Catchment Area.

4.4 Fire Walls and Barriers

In view of the intensity of a fire involving oil filled transformers where temperatures of the burning oil is in the region of 1000^{o}C, it is essential to provide a two hour rated fire barrier between adjacent sets of transformers.

These barriers should be of 210mm thick brick or 150mm thick reinforced concrete.

The barriers should **not** be constructed of a steel frame with IBR metal sheet cladding. An intense transformer oil fire would destroy this inferior steel structure within a few minutes. This could allow fire spread to the adjacent transformer unit(s).

Sections 4.5 through to 4.11

No comments.

Annex "A"

In the event of a serious outbreak of fire involving an oil filled transformer, there will be major heat and smoke generation.

This could lead to :

- The loss of the plant/transformer units;
- Environmental impact;
- Smoke damage to adjacent property;
- Spread of fire to adjacent transformer unit;
- Loss of revenue;
- Legal claims from adjacent property owners;
- Loss of trust in Eskom as a top utility.

Fire barriers/walls having a two-hour fire rating must be erected between all transformer units irrespective of the electrical load or the criteria in respect of the effect on availability of the network etc. The fire breakout could result in the loss of a single or multiple transformer unit(s) with the resulting effect to the Eskom business as indicated above.

In view of the location of the Maningi Sub Station, this is sited in an area where there are high value properties and buildings located in the immediate vicinity of the proposed sub station site.

If an outbreak of fire results in a major conflagration involving oil filled transformer units, the smoke generated could cause property damage and environmental impact which may result in legal claims being made by the public/property owners.

Lightning protection

The document referred to above makes no reference to lightning protection and earthing of structures, etc.

In view of the fact that Johannesburg is listed by the National Fire Protection Association of America (NFPA) as one of the highest incidence localities for lightning strikes in the world, we feel it imperative that the provision of lightning arrestors and earthing requirements should be included for within the document.

Lightning can strike indiscriminately for all structures, including sub stations. A lightning strike on an oil filled transformer can cause rupturing of the core box, radiators, conservator etc., which, due to the high energy discharge, can cause an outbreak of fire at the affected transformer.

3.0 HPR (Highly Protected Risk) Status
(As referred to by Insurers / Underwriters).

In view of the public reaction regarding the construction of the Maningi sub station, the siting of the sub stations within the Sandton area, the importance of the sub station to the Sandton business community and, in particular, its impact on the road and rail infrastructures etc., we would suggest that you consider the Maningi sub station as a risk which requires to be treated as a **highly protected risk** (HPR) with due attention to the provision of superior active and/or passive fire protection systems for the transformers and switchgear equipment etc., installed at Maningi.

MANINGI SUB STATION SANDTON (LAYOUT 1)

Recommended Standards for Active and Passive Fire Protection Systems to HPR Requirements

1. SUB STATION BUILDINGS AND TRANSFORMER BAYS
(Recommendations)

1.1 All buildings shall be constructed from brick with concrete roof. The walls shall have a minimum fire rating of two hours.

1.2 All entrance doors leading into plant rooms, control rooms shall not face onto the oil filled transformer bays.

1.3 All division walls between plant rooms and control rooms shall have a minimum fire rating of two hours.

1.4 Oil filled transformer bund areas should be fire separated from plant rooms by a minimum distance of 10 metres where transformers are provided with automatic fire protection high velocity water spray systems.

1.5 Fire walls having a two hour rating shall be built between each of the four oil filled transformers. These walls shall protrude at least one metre above the level of the highest conservator tank and shall be constructed from 210 mm thick brick or 150mm thick reinforced concrete.

1.6 Reduce the proposed oil filled transformer bund areas to approximate dimensions of 9 metre wide x 10 metres long. All entrance gates into each of the transformer bays shall be installed adjacent to the access roadways.

2. LIGHTNING AND EARTHING
(Recommendations)

2.1 All buildings and steel structures shall be provided with lightning arrestors and earthing probes in keeping with an acceptable standard.

All electrical equipment shall be earthed in keeping with an acceptable standard.

3. FIRE PROTECTION – TRANSFORMERS
(Recommendations)

3.1 Provide two hour rated fire walls between each of the oil filled transformers and bund walls around each unit. The bund volumetric capacity shall contain 110% of oil contents of the transformer, plus additional volume for the containment of the fire water which will be discharged during fire fighting operations.

3.2 Provide a suitable underground concrete dump tank which shall receive the oil and fire water from the largest transformer unit as indicated in 3.1 above. The drain pipes shall be taken from each of the four transformer bund areas and discharged into the underground concrete dump tank. Each drain pipe shall be fitted with a suitable flame trap to prevent any fire at the transformer being transported into the dump tank.

3.3 An automatic deluge type high velocity water spray system shall be installed around each of the oil filled transformer units. This system shall be controlled via a 100mm diameter deluge valve and a 20mm diameter hydraulic detector line.

There shall be a minimum of six floor projectors, 8 core box projectors and 2 conservator projectors installed around each of the transformer units.

The four sets of deluge valves required for the control of each of the 4-high velocity water spray systems shall be installed behind an exposure wall next to the 132 kV indoor GIS building.

3.4 The automatic deluge type high velocity water spray and hydrant systems shall be connected to an adequate and suitable source of water such as the municipal water main providing that this has sufficient water flow and pressure. The total water requirement for the high velocity water spray systems and hydrant system will be somewhere in the order of 3000 dm^3/min at a running pressure of 450kPa. If this amount of water cannot be guaranteed by the municipality then it will be necessary to install a single galvanised mild steel reservoir and a single diesel driven fire pump which will achieve the flow/pressure requirements for the risk. The reservoir capacity required for the high velocity water spray systems and hydrants will be of the order of 268 cu.m.

The design of the deluge type high velocity water spray systems shall be undertaken by a specialist fire protection consultant and shall be in keeping with the NFPA Standard No 15 and the protection equipment manufacturers' recommendations.

If the design is correct and there is sufficient water for the high velocity deluge system installed around the oil filled transformer units, an outbreak of fire

should be extinguished within 10-15 seconds of activation of the system. This short duration of the fire will minimise :

- Smoke generation – reducing smoke contamination and damage to surrounding properties;
- Heat generation – minimising damage to adjacent transformer units;
- Heat generation – preventing total non repairable damage to the affected transformer;
- Prolonged fire fighting operations which could endanger the lives of fire fighting crews;
- Reduction of damage to trees, bird life, and this will minimise the environmental impact;
- Minimise claims arising from owners of adjacent properties;
- Minimise loss of revenue;
- Retain the Eskom image as a top utility provider.

3.5 The buildings which contain switchgear and associated electrical equipment shall be provided with an early warning smoke detection system which shall comply with the SANS 10139.

There shall be a central multi-zone fire alarm panel with backup 24 volt d.c. electrical supply, local audio and visual alarm (strobe light unit) mounted in a prominent position outside of the entrance door to the affected building. Smoke detectors shall be installed at roof level in each building and within cable floor ducts where these are provided.

3.6 Consideration should be given to the installation of “approved” in-cabinet aerosol fire extinguishing units in each main item of switchgear, within cable ducts and within the control room. These units shall be activated by means of a ‘Thermocord’ heat activation device in each instance and the generator units connected to a monitoring panel which shall indicate which unit has been activated. The monitoring panel shall be connected to the detection system alarm panel which shall indicate via the audible and visual (strobe light) system that a fire condition exists.

The only ‘approved’ aerosol type fire extinguishing system available in South Africa at present is that provided by PYROGEN South Africa and is marketed via Alien Systems and Technologies (Proprietary) Limited.

These systems shall comply with SANS 331:2005 or Australian/New Zealand Standard AS/NZ 4487:1997.

3.7 The Maningi sub station alarm panel shall relay all fire alarms etc. to the engineer and/or the Eskom emergency back-up team that a problem requires immediate response by the relevant personnel.

3.8 Provide and install at least two double-outlet hydrant valves mounted on stand pipes spaced no more than 60 metres apart on an underground pipe system

of minimum diameter of 100mm. Each hydrant stand-pipe shall be provided with a hose box with hoses, couplings and an adjustable spray type branch pipe.

This pipe system shall be provided with sufficient water for fire fighting purposes, which shall not be less than 1200 dm^3/min at a minimum residual pressure of 300 kPa.

The system can be connected to the town main or, preferably, to the recommended fire pump and reservoir systems indicated in 3.4 above.

3.9 Connect the transformer bund areas to a suitable drainage pit by means of individual buried drain pipes and flame arrestors.

3.10 In view of the sensitivity surrounding the construction and operation of the Maningi Sub Station, we would strongly urge you to protect Eskom's interests and image. We strongly suggest that you follow the recommendations indicated in this report and that your Eskom standard for passive fire protection requirements be reviewed.

We would suggest that any future sub stations which are to be built in similar locations/environments and which have significant impact on local business and/or residential areas, should be given enhanced treatment measures as indicated in this report.

4.0 Changes in Lightning Strike Incidences

The question raised in respect of lightning strokes made by the public cannot be answered fully since the behaviour of lightning when discharged to earth is unpredictable.

We do know that tall building and structures, and especially steel structures will attract lightning and will dissipate the lightning strike to earth.

The Maningi sub station will probably have low steel structures for supporting cables etc., but these structures are normally provided with lightning protection systems which will allow any lightning strikes to be safely discharged to earth without appreciable damage to the installed equipment and to any adjacent property.

A lightning strike is more likely to be attracted to the adjacent properties where these structures are taller.

The Maningi sub station must be provided with the necessary lightning conductors as called for in our recommendations since the incidence of lightning on the Highveld region is very high.

ANNEXURE 1.
CV of Colin Edwards – Fire Engineer.

P O Box 951
RANDPARK RIDGE
Gauteng, 2156

27 Sherwell Manor
184 Sherwell Avenue
BOSKRUIN EXTN 46
Gauteng, 2154
Tel 791 0652
Fax 793 6981
Cell 072 927 3707

COLIN EDWARDS – Curriculum Vitae 2009

Personal Information

Nationality (dual)	Dual nationality - British / South African
Date of Birth	30 January 1939
Place of Birth	Chelmsford, Essex, United Kingdom

Education

Mid Essex Technical College, Chelmsford, Essex, UK
National Certificate in Mechanical Engineering.

Work experience

United Kingdom

1956 – 1961 **The Watkin Heating Company Limited**
Chelmsford, Essex, United Kingdom.
Student apprentice in heating and ventilation, mechanical services.

1961 – 1962 **Henry Potter Limited**
Chelmsford, Essex, United Kingdom.
Technical Manager, heating and ventilation, mechanical services.

1962 - 1964 **H A Sandford and Partner**
Consulting Engineers, London
Mechanical services, design engineer.

Work experience

South Africa

1965 - 1967 **Construction Engineering Company (Pty) Ltd, Johannesburg.**
Manager, heating and ventilation department, mechanical services.

In the above companies, between 1956 and 1967, the following aspects of business were undertaken during normal duties :

- Sales, estimating, design, hydraulic calculations, detailed working drawings, equipment ordering, site control, handling of site meetings and site personnel, final accounts. The following mechanical services were regularly handled as a matter of routine;
- Low pressure water heating systems (pumped and gravity circulation), pumps, boiler plant, oil storage and water storage systems.
- High pressure hot water heating systems, pumps, boiler plants.

- Steam and condensate installations including steam boiler plant, steam reciprocating pumps etc;
- Hot water systems for schools, hospitals, military establishments, boiler plant, calorifiers, immersion heaters.
- Plenum heating systems and oil fired air heating plants.
- Ventilation systems and kitchen extract systems.
- Dust extraction systems.
- Gas systems for boiler plant and gas systems for hospital kitchen equipment.
- Installation of steam autoclaves for hospitals.
- Bulk oil handling and storage facilities;
- Electric control equipment including control panels.

Work experience continued

1967 - 1979 **Mather and Platt S.A. (Pty) Limited,**
Johannesburg Fire Protection and Mechanical Engineers
Positions held:

- Sales Engineer – 1 year;
- Natal Branch as Manager – 3 years;
- Johannesburg Head Office as Executive Manager/Director - 5 years;

Changing management structures to meet growth and to improve profitability

- Divisional Sales and Contracting Director – 2 years
  Profit responsible for the complete Fire Engineering division Profit responsible for the complete Fire Engineering division

During the latter years with Mather and Platt I was totally responsible for the Fire Engineering Division and controlled all branch managers, contract managers, contract engineers, workshop facilities, drawing offices, site personnel and credit control personnel. The annual turnover of the division was in the region of R8,5 million. A total of ±450 people were employed in the Fire Engineering Division.

The experience gained included the following :

- Design of all types of fixed fire protection and detection/alarm systems
- Negotiation of sales and preparation of tenders up to R1,5 million per contract.
- Procurement and stock control including indent and importation of overseas equipment.
- Programming and execution of all divisional contracts.
- Monitoring of all sales and contracts and the performance of all contracts.
- Profit forecasting.
- Budgeting - overheads, expenses, transport, capital equipment.
- Forecasting of turnover, invoicing and profit thereon on quarterly and annual basis and monitored monthly for the board of directors.
- Complete profit responsibility for the division with an annual turnover of R8,5 million in 1979 (R90 million at 1999 values).

1980 - 1984 **Security and Risk Management Consultants (Pty) Ltd,**
Johannesburg (a subsidiary of Willis Faber (S.A.) (Pty) Ltd)
Manager - Survey Department/Director

The scope of work included the preparation of confidential risk control

reports for major companies such as Coca Cola, 3M, Gillette, Johnson & Johnson, Van Leer S.A., Smiths Industries, Lucas, S.A. Reserve Bank. The reports were based on technical appraisals of Risk Management and Risk Control. Clients would request us to advise them concerning major risk improvement recommendations for expansion programmes and management techniques to upgrade their fire protection, safety, security and human element systems and to improve self- inspection of plant and premises.

A wide understanding of industry as a whole is required and the technical advice given must meet the highest professional standards. Contact with the client was normally at a high level, i.e. with the Managing Director, Chief Engineer or Financial Director.

1984 - 1986 **Belfa Fire Protection Services (Cape) (Pty) Ltd**
Director of Cape region.

All facets of running a small branch operation in all areas of fire protection work.

1987 - 1997 **Corporate Risk Management (Pty) Ltd**
(wholly owned subsidiary of Price Forbes)
Senior Consultant/Client executive, in the following capacities :
Rational Fire Design (Pty) Ltd
(wholly-owned subsidiary of Corporate Risk Management (Pty) Ltd),
Director.

Duties :

- Risk control surveys
- Preparation of EML/MPL reports
- Analysis of risk
- Quantification of risk exposures
- Risk profiling
- Risk improvement recommendations
- Engineering surveys - boiler plant, turbines and generators etc. Preparation of Fire Engineering Codes of Practice and detailed specifications
- New project design in conjunction with client's own professional team
- Design of fire protection systems, both active and passive, involving all types of systems, i.e. water/foam/gas based systems, early warning smoke detection and fire alarm systems
- Post loss surveys
- Underwriting reports
- Rational fire designs for various projects throughout South Africa
- Cost of risk exercises for various clients throughout Southern Africa
- Preparation of Code of Practice for Impala Platinum Limited
- Preparation of a Code of Practice for Richards Bay Minerals

1997 - 2007 **Colin Edwards & Associates (Pty) Ltd**
Risk Management & Fire Engineering Consultants

- Risk assessments for numerous platinum mines and coal collieries,

namely Impala Platinum, Amplats and Lonmin.

- ❖ Design of fire protection for major cable void for the smelter at Richards Bay Minerals. Project value R260,000-00.
- ❖ Design of fire protection systems for Richards Bay Minerals. Project value R16 million.
- ❖ Preparation of Fire Protection Code of Practice for SAPPI Limited.
- ❖ Fire engineering risk assessments for SAPPI Paper Mills at Enstra, Ngodwana, Stanger, and Mandini.
- ❖ Investigation into standards of fire protection, Melrose Arch Project, Johannesburg.
- ❖ Design of major transformer – copper pipework system to FM Standards project – Value R350,000 at Richards Bay Minerals.
- ❖ Design of all automatic fire protection systems at Impala Platinum No 14 Shaft Project – value R1,0 million.
- ❖ Fire Engineer to various mining companies in Africa.

List of clients/Projects

Columbus Stainless Steel
Standard Bank H.Q. Johannesburg
Richards Bay Minerals - Rio Tinto
Reserve Bank, Johannesburg
Impala Platinum, Springs
Gencor H.Q. Johannesburg
Delta Motor Corporation, Port Elizabeth
KSM Milling Pietermaritzburg
Samancor S.A.
Toyota Prospecton Paint Shop
BMW Rosslyn
Federal Mogul - Warehouse
SAPPI Usutu Pulp
VW - Spray Booth protection
Cadbury's - Port Elizabeth & Swaziland
Illovo Sugar - Natal Mills – Fire pumps etc
Konkola Copper Mines, Zambia
Iscor, Vanderbijlpark – Coated Products Division
Ashanti Goldfields, Ghana, Guinee and Zimbabwe
Tiger Milling, Pietermaritzburg
Spitzkop Concentrator Project –
Full fire systems design and tender documentation
Spar Warehouse, Elandsfontein and Cape Town
Optimum Coal Mine Inclined Shaft Conveyor
Three Power Stations (Hydro Electric) - Kenya
SAPPI – Hanover, Germany
Anglian Windows, Norwich, England
Samancor - Transformer protection Meyerton
Ferralloys - Cato Ridge
Nampak Group - various premises
Victrex Peek Manufacturing (ICI) England
Carlton Paper Enstra Springs
Ticor Heavy Minerals, Empangeni – Fire systems investigation
SAPPI Paper Mills - Stanger, Springs, Ngodwana and Tugela
Barlow Rand South Africa
BHP – Billiton-Ingwe Coal – Conveyor Protection Systems.
Anglo Platinum Limited, Potgietersrust - Project for new fire

protection systems
Eskom - Hendrina Power Station
Rand Refineries - All fire protection systems design work and risk assessment
Eskom – Design of all fire protection systems for Braamhoek Pumped water scheme
XSTRATA Chrome Alloys, Boshoek Smelter Plant – Complete fire system, design and tender documentation.

Professional memberships

Member of the Institute of Risk Managers, South Africa

References

Mr Mike Roussow , Risk Manager, Impala Platinum Limited
Johannesburg Head Office - Tel : (011) 481 3900

Mr Gawie Mouton, Risk Manager,
SAPPI Head Office, Braamfontein - Tel (011) 407 8111

Mr Bill Temblett, Risk Manager
Nampak, Sandton - Tel : (011) 444-7418

Mr Joseph Roux – Engineering Manager BMR
Impala Platinum, Springs – Tel (011) 360 3427

Mr Andy Gasgoine – Engineering Manager PMR
Impala Platinum, Springs - Tel : (011) 360 3051

Mr Andries van Heerden, Engineering Manager
XSTRATA Chrome Division, Boshoek – Tel : (014) 573 1709