Eskom	STANDARD	Document Classification: PUBLIC

Title:	PASSIVE FIRE PROTECTION FOR OIL-FILLED EQUIPMENT	Unique Identifier:	TST41-224
		Alternative Reference Number:	
		Area of Applicability:	T
		Documentation Type:	ST
		Revision:	1
		Total Pages:	16
		Next Review Date:	February 2016
		Disclosure Classification:	CONTROLLED DISCLOSURE

Compiled by	Functional Responsibility	Authorized by
Andrew Haynes	S Matlala	N Kleynhans
Senior Advisor Safety Risk	Senior Manager Safety Risk Manager	BIPM Senior Manager
Date: 12/2/2013	Date: 04/03/2013	Date: 04/03/2013

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Introduction

The history of this document, now at revision 5, captures the current fire protection criteria and philosophy applicable to Eskom's high voltage transmission stations. The experience and observations flowing from a number of incidents have been consolidated and incorporated into this document. As indicated by the title, Passive Fire Protection has been developed into the preferred method of preventing and / or reducing damage to Eskom plant and surrounding environments.

Due to the remoteness of the transmission sites and limitations relating to the provision of fire fighting water supplies and the logistics / availability of local fire fighting infrastructures, passive protection measures and objectives are seen as the best option.

In achieving the passive objectives serious consideration must be given to active fire fighting undertaken at sites where these passive arrangements are in place. Because the introduction of large quantities of water or fire fighting foams into drainage, bunding and oil holding configurations could have a detrimental impact on those arrangements the balance between appropriate fire fighting and passive protection measures must be weighted very carefully.

1. Scope

1.1 Objective

This standard identifies the passive fire protection objectives to be achieved for oil-filled equipment in high voltage yards.

It is not the intention to prescribe how these objectives should be met. It is, however, recommended that reference is made to the annex to this standard which gives basic guidelines which may be of some assistance in achieving the passive fire protection objectives.

The objectives of this standard are:

* to confine a major fire to the particular unit of equipment,

* to reduce fire damage,

* to minimize disruption of substation operation and customer supplies,

* to prevent / control oil pollution,

* to provide a cost effective fire protection system

1.2 Applicability

This standard is applicable to new transmission substations (i.e. 132 kV and above):

Note: The provision of passive fire protection at existing transmission sub-stations will be treated on merit.

2. Normative references

Not applicable

3. Definitions

3.1 Oil-filled Equipment

Major equipment (in terms of oil capacity) situated in high voltage yards, for example, transformers, shunt reactors and neutral earth resistors.

3.2 Passive Fire Protection

This consists of construction features such as bund walls, oil catchment areas and drainage. In the case of high voltage yards, the purpose of passive fire protection is, inter alia, to contain a major fire to the particular unit of equipment. Unlike an automatic fire suppression system, passive fire protection will not extinguish a fire. Damage to the unit of equipment involved in fire is unavoidable and is accepted.

3.3 Substation

A transmission or switching station.

3.4 Unit of equipment

Major oil-filled equipment and adjacent auxiliary equipment.

4. Requirements

4.1 Passive fire protection objectives

The following objectives shall be achieved:

Objective 1:

To prevent an oil spillage from a unit of equipment spreading to adjacent units of equipment, buildings and switchgear.

Objective 2:

To minimize exposure to the main oil-filled equipment during a fire, involving an oil spillage from the auxiliary equipment.

Objective 3:

To minimize the severity and duration of fire in an oil catchment area.

Objective 4:

To prevent oil drained from an oil catchment area from polluting the environment.

Objective 5:

To prevent or minimize the spread of fire from a unit of equipment to adjacent units, buildings and switchgear.

Annex A
(informative)

Guidelines on how to achieve the passive fire protection objectives

Contents

A1. INTRODUCTION

This guideline cannot cover every situation that will be encountered in a high voltage yard. The recommendations in this guideline should therefore be used with judgement and awareness of the rationale for passive fire protection and the objectives to be achieved.

A2. PASSIVE FIRE PROTECTION

A2.1 Oil Catchment Area: (Objective 1)

A2.1.1 An oil catchment area shall be provided for oil-filled equipment. The provision of an oil catchment area for auxiliary equipment shall, however, be subject to the guidelines under *A2.2* of this annex.

A2.1.2 Oil catchment areas shall have a positive slope (minimum 1:50) towards the drainage as indicated in Sketch 1.

A2.1.3 The maximum depth of an oil catchment area shall preferably be not more than 500 mm and the volumetric capacity shall be 100 % of the total liquid content of oil-filled equipment within the catchment area

NOTE: Where any auxiliary oil catchment area is connected to the catchment area for the main transformer, the separating bund wall shall be one brick course lower than the perimeter bund walls. This will allow oil from a main transformer incident to fill the total catchment area, but will prevent oil from the auxiliary equipment flowing around the main transformer.

A2.1.4 Crushed stone shall not be used in oil catchment areas.

A2.1.5 Oil catchment areas shall have liquid-tight bund walls with a fire resistance rating of not less than two hours consisting of selected clay facebrick class "FBS" (semi facebrick) built in class 11 mortar.

A2.1.6 Bund walls shall be a minimum height of two courses of bricks (approximately 150 mm) above the concrete runway and located at a minimum distance of 1, 5 m from the oil-filled equipment.

NOTE: Since the total convective and radiative heat release rates are proportional to the burning surface area, the area formed by bund walls surrounding oil-filled equipment shall be kept to a minimum.

A2.1.7 Bund walls shall extend over concrete runways, with vertical joints on either side so that the bund wall can be removed when installing a new transformer.

A2.1.8 Openings in bund walls of oil catchment areas shall be sealed with a material having a fire resistance rating of not less than two hours.

A2.1.9 Cable trenches shall be filled with sand to a distance 10 m from oil catchment areas and, if within the oil catchment area, such trenches shall be capped with a weak mortar mix.

A2.2 Auxiliary Equipment (Objective 2)

A2.2.1 An auxiliary transformer, or any other oil-filled equipment presenting a potential fire threat to the main equipment, shall be located a minimum distance of 3m from the main equipment, and accommodated in a separate oil catchment area (refer to "*Substation Layout Design Guide*", SLDG Series - Standard Transformer Bay Layouts).

A2.2.2 If such auxiliary equipment is located 8m or more from the main equipment, no oil catchment area will be necessary; however oil catchment is required for pollution control for the auxiliary equipment, provided that there is no potential for burning oil spreading to/or endangering the main equipment, adjacent units of equipment, buildings or switchgear.

A2.2.3 Where the oil cooler bank is separate from the main transformer, a bund wall shall be erected between the oil cooler bank and the main transformer within any single oil catchment area. This wall shall be lower than the exterior bund walls (refer to sketch 1).

A2.3 Oil Drainage System (Objective 3)

A2.3.1 All oil catchment areas, including catchment areas around auxiliary equipment, shall be provided with an oil drainage system.

A2.3.2 The oil drainage system from catchment areas shall be separate from the storm water drainage for the high voltage yard. The drainage pipes shall have a minimum diameter of 300 mm and a gradient of not less than 1:200 (depending on the site terrain).

A2.3.3 The oil drainage system shall be designed to prevent the conveyance of oil from the fire origin, to oil catchment areas of adjacent units of equipment (refer to Sketch 2).

A2.3.4 The pipe layout shall be such that no 90 degree bends are at manholes. If this is unavoidable, the manhole cover is to be 1m above the terrace level, and the pipe between the last manhole and the oil dam one size bigger e.g. 400mm.

A2.4 Off-Terrace Oil Containment (Objective 4)

A2.4.1 Off-terrace oil containment shall be provided at the termination point of drainage pipes from oil catchment areas.

A2.4.2 The oil containment shall be designed to prevent pollution of the environment by oil, if the total oil content of the largest unit of equipment on site is released.

A2.4.3 The oil containment shall be located so as not to expose other equipment or buildings to an increased fire hazard e.g. outside any HV yards at the lower contour area.

A2.4.4 The type of off-terrace oil containment selected shall suit the particular site. The oil containment could be an open holding dam (refer to sketch 3 - 0.54 /3754 Rev 6) or a closed oil trap (refer to 0.54/2229, Eskom Standard Oil Trap)

A2.4.5 Where an open holding dam is provided, precautions shall be taken to prevent wildlife and unauthorized persons gaining access to the dam. Arrangements shall be provided to facilitate maintenance of the dam (steps or ladder).

A2.5 Spatial Separation (Objective 5)

A2.5.1 Units of oil-filled equipment shall be separated from each other; adjacent buildings and switchgear by a minimum separation distance of 23m (refer to Sketch 4).

A2.5.2 Where a distance of 23m cannot be achieved, a heat radiation barrier shall be provided between the relevant hazards

A2.5.3 Heat radiation barriers between units of oil-filled equipment shall be constructed to a minimum height of 0,5m above the main transformer tank. Safe electrical clearances shall be maintained at all times.

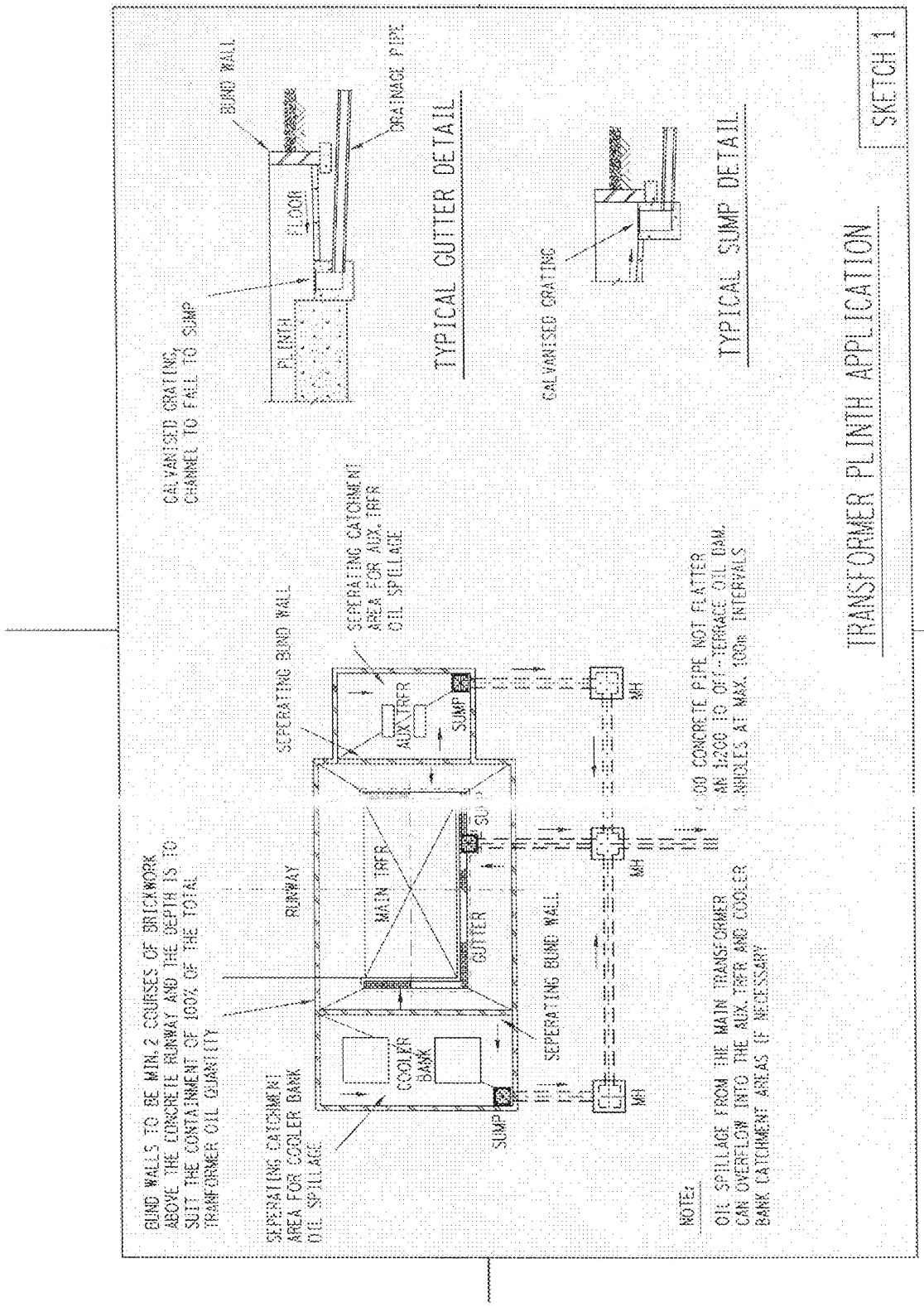
A2.5.4 Heat radiation barriers shall be at least to the width of the oil catchment area.

A2.5.5 Direct flame impingement on heat radiation barriers shall be prevented, by allowing a minimum clearance of 1,5m between the bund walls and the barrier.

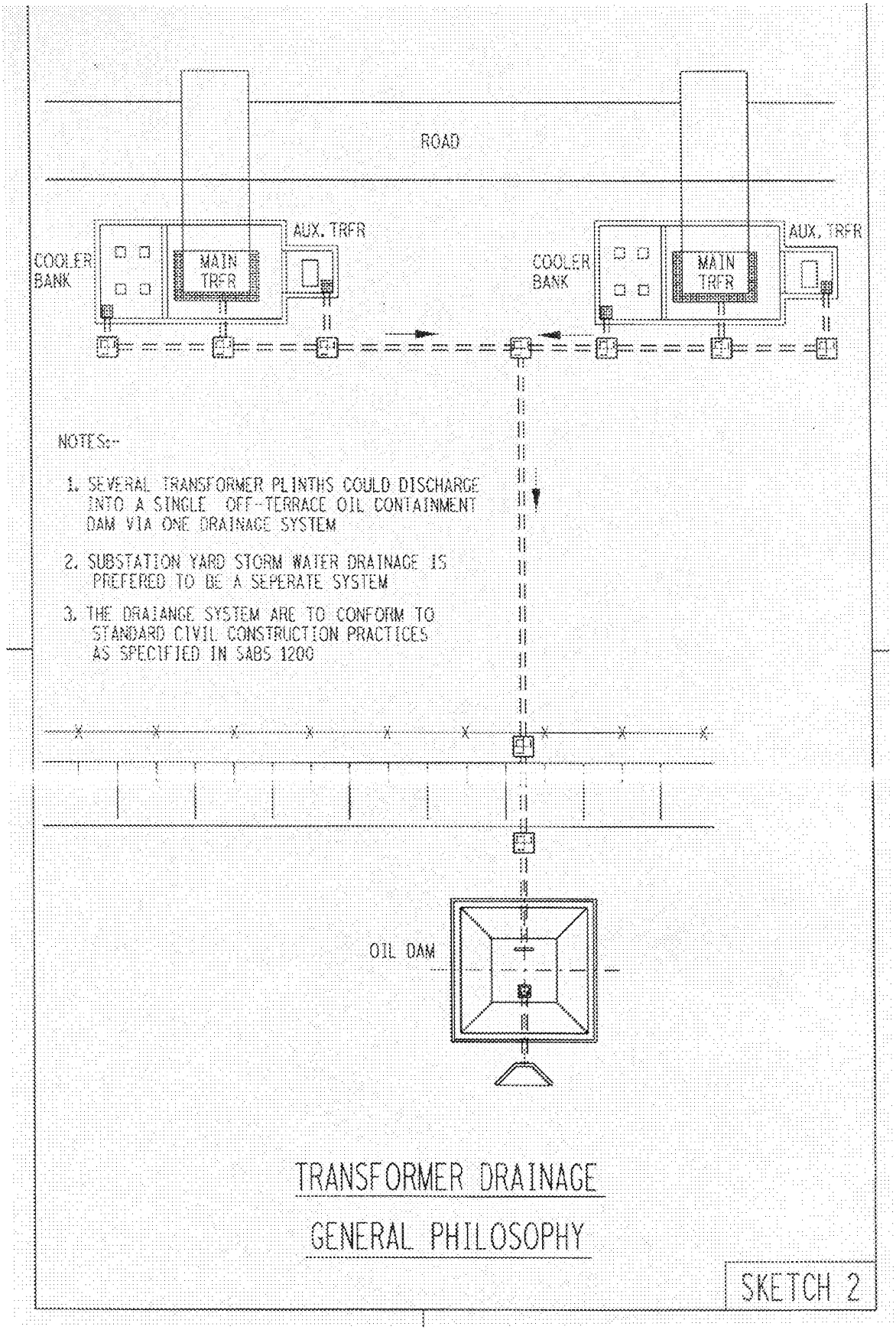
A3. GENERAL

Where necessary, precautions shall be taken to ensure the safety of personnel who may come into contact with, or work within, oil catchment areas.

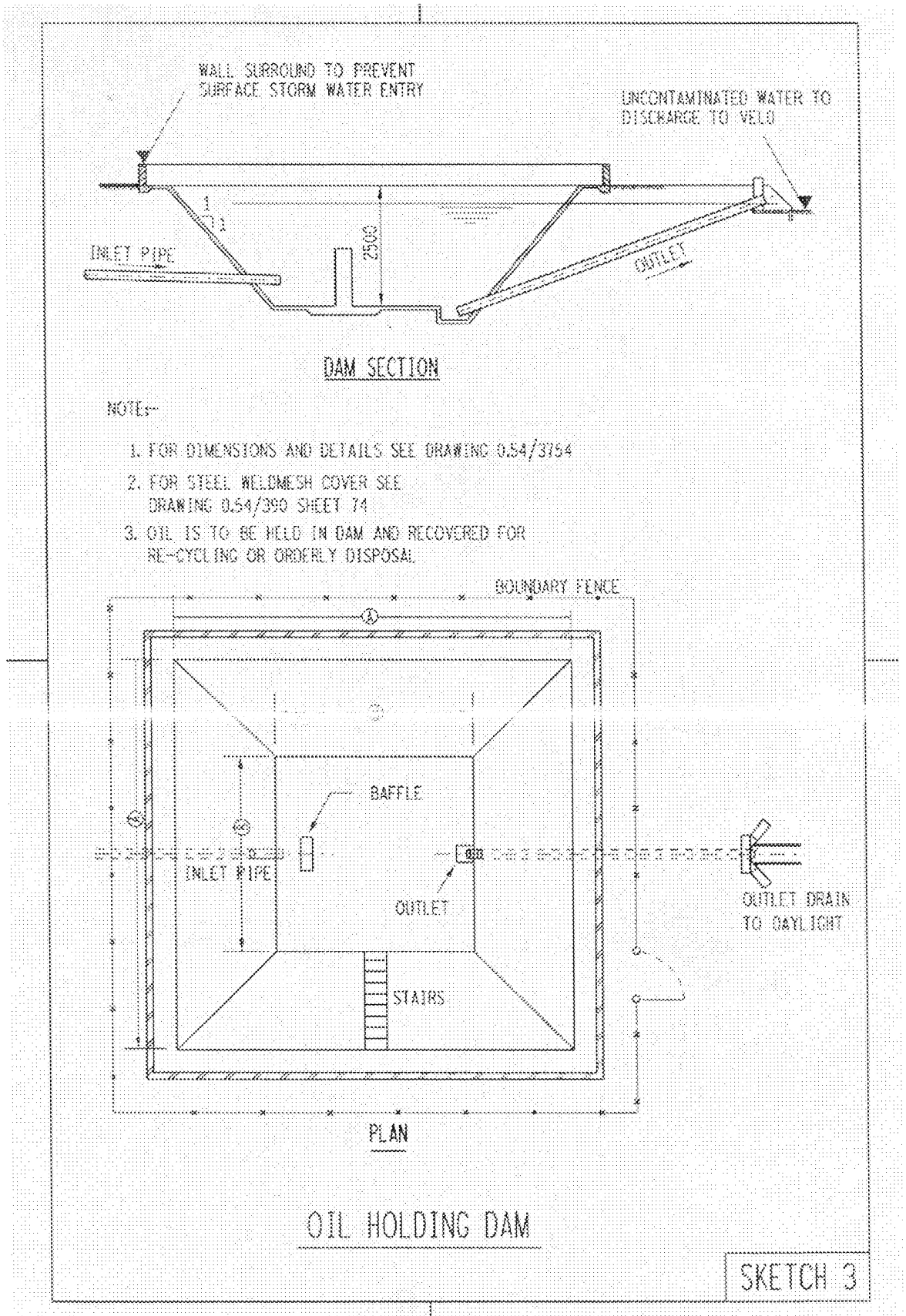
Transformer Plinth Application



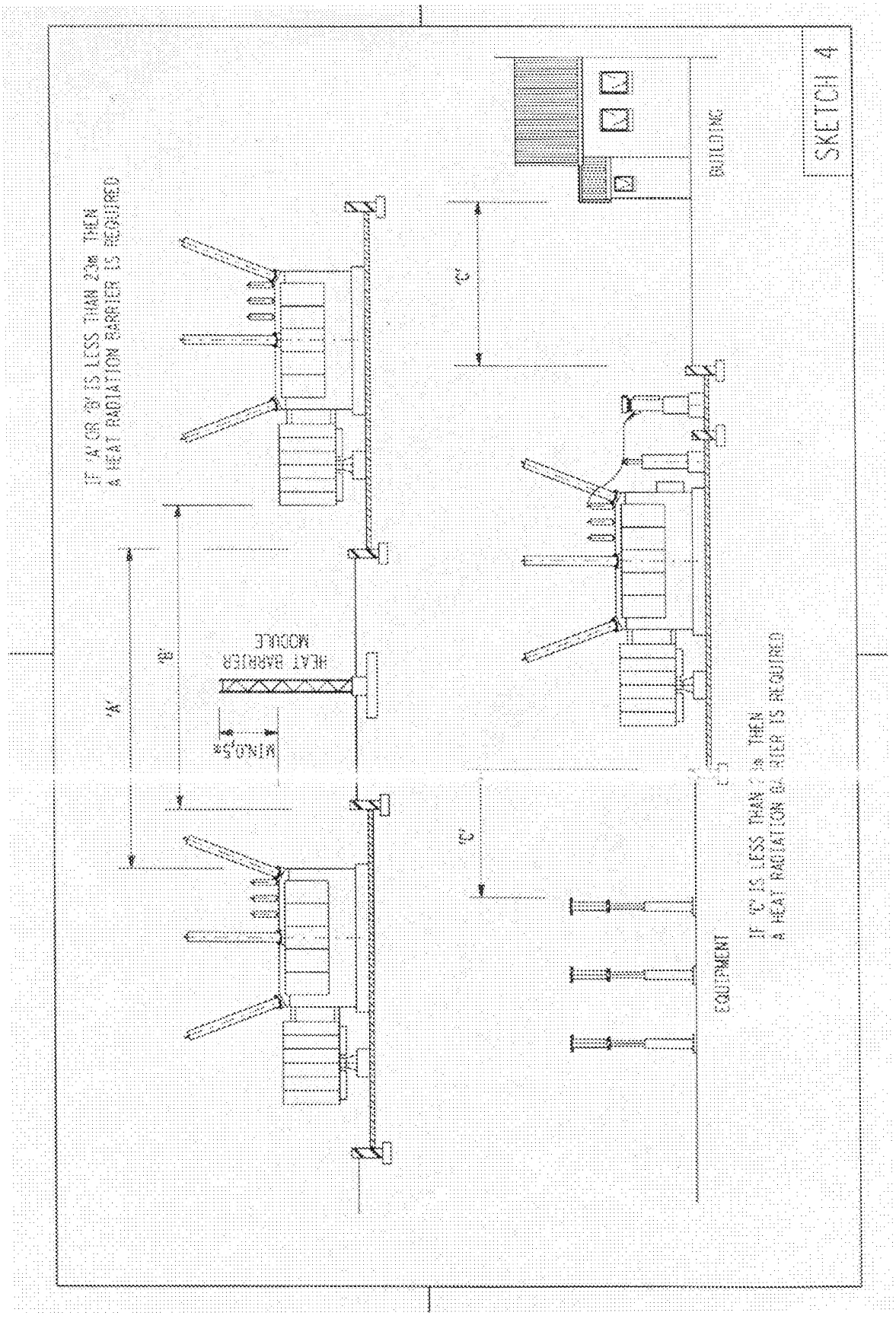
Transformer Drainage General Philosophy



Oil Holding Dam



Heat Radiation Barriers – General Arrangement



This document has been seen and accepted by:

REVISION INFORMATION

Rev	Notes	Date
0	Renumbering, old number TRMASAAQ8	Dec 2006
1	Extended the revision Date	February 2013