



Procedure: Substation Lightning Protection Design

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0	01/10/2013	Initial Document Creation

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1 PURPOSE

This document provides a guide for the design of substation lightning protection systems.

2 APPLICATION

All Horizon Power staff and contractors that are involved in the design process of lightning protection systems.

3 NORMATIVE REFERENCES

The following normative documents contain provisions which, through reference in this text, constitute provisions of this procedure. All documents are subject to revision, and parties to agreements are encouraged to investigate the possibility of applying the most recent editions of the normative documents listed below.

3.1 Related/referenced documents

Document title	Document ID (DM #)
AS/NZS 1768:2007 Lightning Protection	
Lightning Protection System Design Report Template	DM #3247674
Engineering Design Standard C1.9 Lightning Protection of Substations	DM #3246170

3.2 Definitions

The definitions and abbreviations below apply:

LPS	Lightning Protection System
Policy	A brief, straightforward statement indicating intention and direction, and enabling the decision-making process.
Procedure	Prescribed means of accomplishing policy through a series of steps or processes
Site	All parts of the works that are the subject of the offer and acceptance between Horizon Power and the Customer for the provision of electrical services.
Substation	A collection of switchgear and/or a transformer/s on a single site (which may or may not be screened or enclosed).
Works	The electricity works associated with the provision of electrical supplies to the installation that is the subject of the offer

4 INTRODUCTION

The purpose of a substation lightning protection system is to ensure safe conditions for Horizon Power's equipment, personnel and buildings from lightning strikes. The design process is based on a process flow-chart from AS/NZS 1768:2007 and Horizon Power's Engineering Design Standard C1.9 (DM# 3246170) which provides more detail about the method of protection used (rolling sphere). The main and most effective measure for protection of structures against physical damage is considered to be the lightning protection system (LPS).

The LPS is intended to:

1. Intercept a lightning flash to the structure (with an air-termination system);
2. Conduct the lightning current safely towards earth (using a down-conductor system);
3. Disperse the lightning current into the earth (using an earth-termination system).

This document provides an overview of the subject, dealing mainly with the design limits and the general procedure followed to design a LPS.

Lightning design for the whole Terminal/Zone substation should be done to its ultimate design regardless of the nature of the project. The lightning design shall be reviewed for adherence to latest standards and equipment.

5 METHOD/PROCEDURE

5.1 Information Gathering

The design of a lightning protection system (LPS) is dependent on several aspects of the system and on the surrounding areas. The following information is required:

5.1.1 *Substation Layout and Elevations*

The substation layout drawings (electrical equipment and foundation) are required for initial placement of lightning masts (as proposed by design engineer). The elevation drawings are required to get the height of the equipment used.

5.1.2 *Ground Flash Density of Area*

Obtain the average annual lightning ground flash density (GFD) for the substation location from the Ground Flash Density Map. When substations are located in high lightning areas (i.e. high GFD) then increased protection is required – more lightning masts can be used in this situation.

5.1.3 Overhead Earth Wire Entries and Gantries

The location of overhead earth wires (OHEW) coming into the substation along with the gantries supporting these lines, provide significant protection from lightning. These OHEW's and gantries must be included in the LPS design.

5.1.4 Earthing System Information

No matter how proper and reliable the LPS is designed, it will always depend on the integrity of the substation earthing system. Therefore, it is important to know what state the earthing system is in and that an adequate level of safety should be provided throughout the lifetime of an asset.

Where a component of the lightning protection system (LPS) has a primary function, (e.g. a roof), it is not acceptable to incorporate it into the LPS if its primary function is adversely impacted by being bonded to the LPS. For instance, damage to the roof due to lightning.

5.2 Lightning Protection System Design

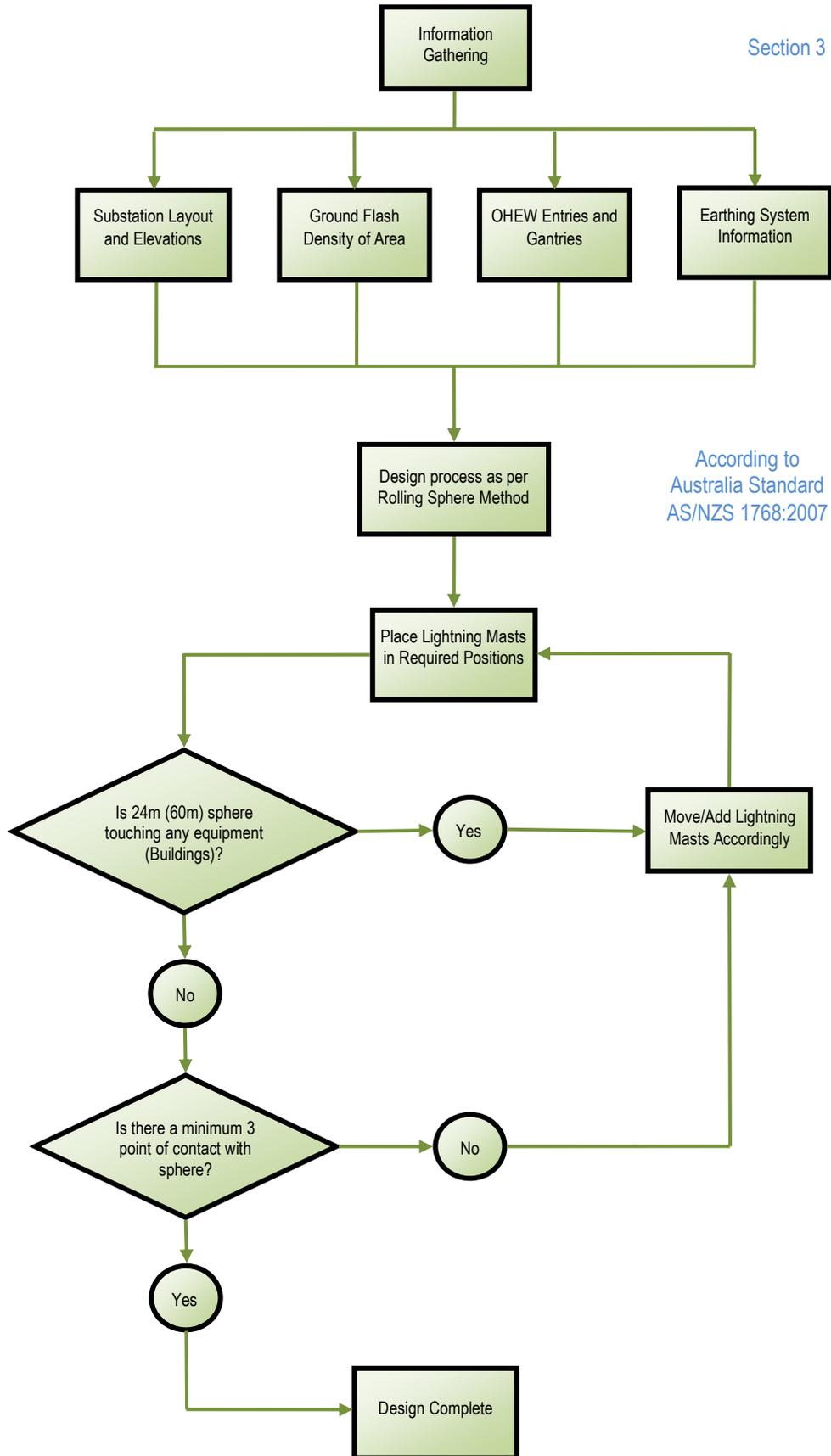
All substations should be adequately protected against lightning events. This is achieved through a combination of elements such as feeder overhead earth wires, surge diverters, lightning spires, lightning shield wires and the earthing system – these combine to form the lightning protection system. The substation earthing layout design shall identify lightning spire and lightning shield wire placement whilst maintaining the required access and safety clearances in accordance with the substation design.

5.3 Design Process

1. Engage with Stakeholders to determine/finalise the scope of work.
2. Determine if the lightning design system is for a Greenfield or Brownfield project.
3. Determine the soil resistivity by tests.
4. Lightning masts:
 - a. Design masts suited for the specific wind.
 - b. Determine the required height of masts.
 - c. Consider the sail effect on masts and mast foundations.
5. Basis of design
 - a. The designer shall undertake a lightning design using the rolling sphere method or alternative approved method. The rolling sphere size shall be 24 m unless otherwise specified in the design standard C 1.9 (DM #3246170).

- b. The earthing layout drawings shall show placement and height of lightning spires, and any lightning shield wires, and all connections to earth.
 - c. Verify the integrity of the substation earthing system.
 - d. The lightning layout report shall show the calculations that demonstrate compliance with the 24 m rolling sphere.
 - e. All substation buildings and equipment shall be protected unless designed to intercept lightning strikes, in which case the interception and strike conditions shall be specified.
6. Keep record of all calculations in the earthing layout report. The rolling sphere approach is documented in AS/NZS 1768.
 7. Have the Lightning Design verified by an independent reviewer and arrange for sign off.

6 DESIGN PROCEDURE FLOW-CHART



7 REVISION INFORMATION

(Informative) Horizon Power has endeavoured to provide standards of the highest quality and would appreciate notification if any errors are found or even any queries raised.

Each Standard makes use of its own comment sheet which is maintain throughout the life of the standard, which lists all comments made by stakeholders regarding the standard.

The following comment sheet **DM: 3725184** can be used to record any errors or queries found in or pertaining to this standard, which will then be addressed whenever the standard gets reviewed.

Date	Rev No.	Notes
01/10/2013	0	Original Issue