BEFORE THE BOARD OF INQUIRY

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of applications for resource consent and notices of requirement by Transpower New Zealand Limited for the North Island Grid Upgrade Project

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STATEMENT OF EVIDENCE OF ROY JOHN CLEMENT NOBLE FOR TRANSPOWER NEW ZEALAND LIMITED
(Overview: transmission line engineering)

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INTRODUCTION

Qualifications and role

1. **MY** name is Roy John Clement Noble. I hold the role of Team Leader (Transmission Lines) with Transpower New Zealand Limited (**Transpower**). I have undertaken the role of Transmission Line Engineering Manager for the North Island Grid Upgrade Project (**Upgrade Project**) since May 2004.

2. I hold a New Zealand Certificate of Engineering (Civil).

3. I have 22 years experience in the design, construction and maintenance of high voltage transmission lines. I have worked on line construction projects, including the Huntly to Stratford line, Haywards Substation line deviations, and Churton Park deviation projects. I have undertaken management roles on a number of reconductoring and refurbishment projects.

4. I have worked for two years as a Land Survey Technician in Saskatchewan, Canada. This work included transmission line surveying and mine, dam and legal surveys.

5. **MY** experience includes 5 years as South Island Transmission Line Maintenance Manager for a contractor to Transpower, followed by 3 years working in a transmission line design and project management consultancy.

6. I have worked for Transpower directly for 9 years, initially in an engineering support role for maintenance works, however over the last 4 years I have transitioned back into engineering design and management roles for transmission line development and enhancement projects.

7. **MY** responsibilities relating to the Upgrade Project include management of all engineering aspects of the overhead transmission line. This includes providing engineering input to all phases of the ACRE process, design and costing of options for the Grid Upgrade Plan, attendance at open days, engineering representation on the indicative alignment selection group, management of field engineering activities, engineering inputs to Notice of

Requirement (**NOR**) documentation, and management of the overhead line design.

8. I confirm that I have read and am familiar with the Code of Conduct for Expert Witnesses in the Environment Court Consolidated Practice Note (2006). I have approached the preparation of this evidence in the same way that I would for the Environment Court.

Scope of evidence

9. **IN** this brief of evidence, I provide an overview of transmission line engineering. I discuss:

    (a) the basic components of an overhead transmission line;

    (b) the development of the overhead line design;

    (c) the principles of alignment selection and tower positioning;

    (d) an overview of the proposed line design;

    (e) the consideration of alternative tower heights;

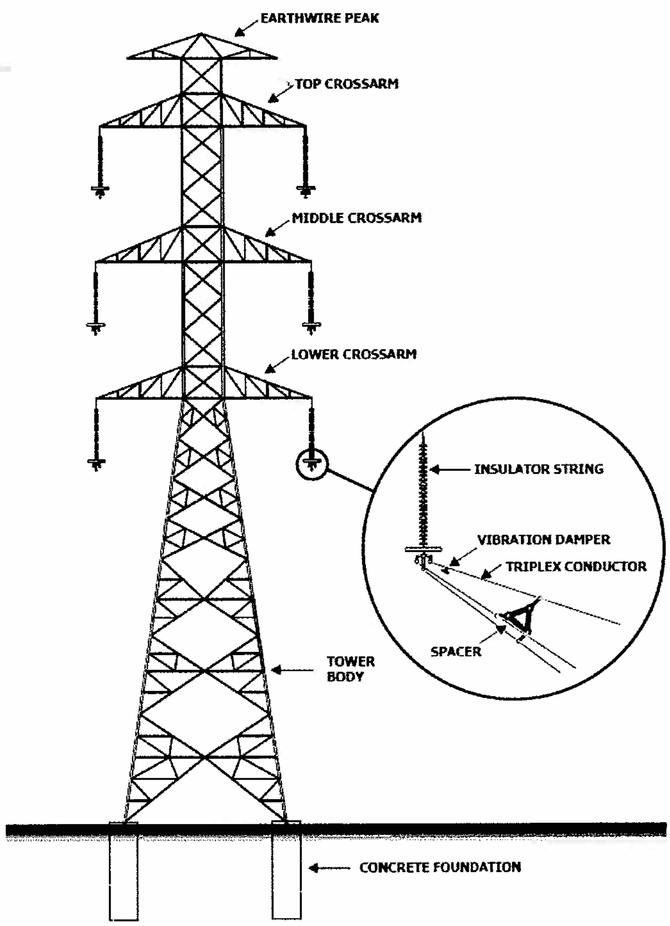
    (f) tower design status; and

    (g) limitation on the design flexibility.

10. I provide an overview of the overhead line design from a civil, structural and electrical perspective. Mr Khot will provide detailed evidence on the electrical aspects of the transmission line design, including line rating, conductor selection, clearances, lightning performance, insulation design, audible noise, radio frequency interference, and electric and magnetic interference (**EMF**). Mr Lake will provide detailed evidence about the use of PLS-CADD in transmission line design, line behaviour, basic design parameters for the line, preliminary tower design, and foundation design.

BASIC COMPONENTS OF AN OVERHEAD TRANSMISSION LINE

11. **OVERHEAD** transmission lines consist of four major components. These are the conductors, structures (including foundations), insulator sets, and earthwires. These are shown on the diagram below:



12. I discuss each of these components further below.

Conductors

13. **THE** purpose of the conductors is to span from structure to structure to carry the electricity. The conductors consist of conductive wires bundled together.

14. **THE** proposed overhead line is a double circuit line, with each circuit consisting of three phases. Each phase will have a triplex sub-conductor arrangement, which means there are three conductors in a triangular configuration (two horizontally spaced at the top, and a single one positioned centrally below). Sub-conductor spacers are installed between the individual

conductors within the triplex bundle to ensure the conductors are held apart and do not clash. The details of the selection of the conductor size and bundle are discussed in Mr Khot's evidence.

Structures

15. **THE** purpose of the structure on an overhead transmission line is to support the conductors and earthwires above the ground or other obstacles to maintain safe electrical clearances. Internationally, the most common designs for 400 kV capable structures consist of self supporting lattice towers, guyed lattice structures and tubular poles. The proposed structure type for the Upgrade Project is self supporting lattice towers. The detailed reasons for this decision will be addressed later in my evidence and in Mr Lister's evidence.

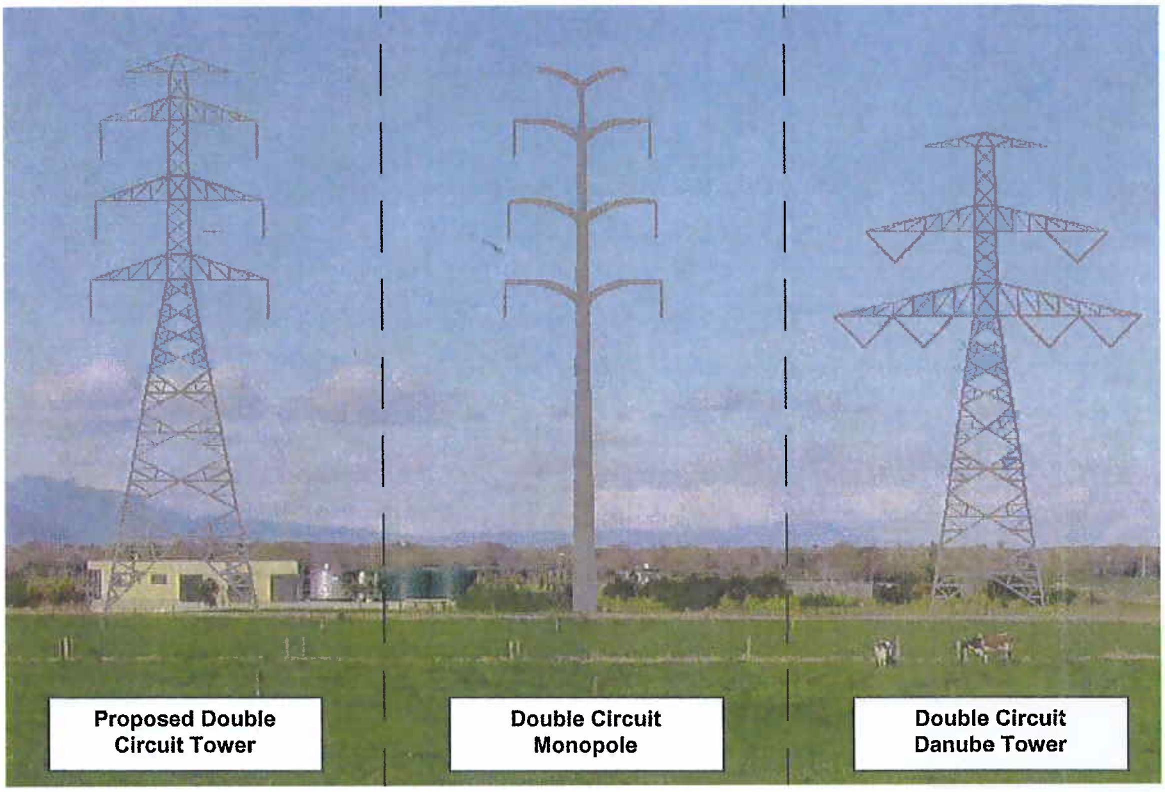
16. **SELF** supporting lattice towers consist of a number of tower types (towers with different strength characteristics) to make up a tower family. This concept is used to ensure that a similar design philosophy, and common structure dimensions and scales, are maintained. The use of tower families, incorporating different tower types, provides the ability to optimise tower weights and to ensure light towers are used where loads are the least. It also generally ensures a relatively consistent visual appearance. Tower families will be discussed in more detail by Mr Lake.

17. **HIGH** voltage alternating current (**AC**) transmission line structures are designed to carry one, two or more circuits and are commonly called "single circuit structures" or "double circuit structures", etc. A double circuit structure has provision for carrying two three-phase circuits, i.e. it has a total of six conductor set support positions, as shown in the picture above.

Double circuit structures

18. **THE** conventional configuration of double circuit structures in New Zealand has three phases of each circuit arranged spatially adjacent to each other and separate from the other circuit. These structures are traditionally configured so that the phases of each circuit are aligned vertically, with one circuit positioned on each side of the structure body. Alternative layouts such as the "Danube" style, shown below, are used in parts of Europe. The use of these alternative layouts would bring additional factors, such as wider easements,

increased working clearances and changes in EMF. The proposed design specifies the use of conventional double circuit structures.



Single circuit structures

19. **SINGLE** circuit structures carry one three-phase circuit only (i.e. a total of three conductor set support positions).