DEVELOPMENT OF A TRANSMISSION PRICING METHODOLOGY FOR SRI LANKA POWER SYSTEM

R.M.I.K.K. Rajapaksha

118687H

Degree of Master of Science

Department of Electrical Engineering

University of Moratuwa

Sri Lanka

April 2016

DEVELOPMENT OF A TRANSMISSION PRICING METHODOLOGY FOR SRI LANKA POWER SYSTEM

R.M.I.K.K. Rajapaksha

118687H

Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree of Master of Science in Electrical Engineering

Department of Electrical Engineering

University of Moratuwa
Sri Lanka

March 2016

DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Also, I hereby grant to University of Moratuwa the non-exclusive right to reproduce and distribute my thesis/dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature of the Author: Date:
R.M.I.K.K. Rajapaksha

The above candidate has carried out research for the Masters Dissertation under my supervision.

Signature of the supervisor: Date:
Dr.Asanka Rodrigo
Senior Lecturer
Department of Electrical Engineering
University of Moratuwa

ABSTRACT

The electricity sector in Sri Lanka is governed by the Sri Lanka Electricity Act, No. 20 of 2009 (as amended), and the Public Utilities Commission of Sri Lanka (PUCSL) is empowered by the Electricity Act to regulate the electricity industry. Ceylon Electricity Board has license of Generation, Transmission and Distribution, while the Transmission Licensee is the Transmission System Operator and the Single Buyer. Five Distribution Licensees (DLs) buy electricity from the Transmission Licensee (TL). Tariffs and charges levied from the Distribution Licensees for purchasing of electricity from the Transmission Licensee are determined in pursuant to the Tariff Methodology approved by PUCSL. In addition to the five DLs there are a few customers directly served by the TL at 220kV and 132kV voltage level, but charged under the tariff imposed by DLs, since the presently approved tariff methodology is not properly address tariff calculation for the bulk customers connected at 132kV/220kV.

In this research, different power market models, transmission pricing principles and methodologies in different power markets were studied first, followed by transmission pricing methodologies in different countries. The study evaluated three main methodologies which can be implemented in Sri Lanka: (i) embedded cost based, (ii) marginal cost based and (iii) composite cost based methodologies. By analyzing data in each proposed model, the best suited methodology for Sri Lanka is recommended to be the embedded cost based method.

The new tariff scheme which is to be implemented should recover the cost of utility, simple, stable and easy to implement in existing framework. With this background it was proposed the embedded cost based tariff calculation model, as the most appropriate option for calculation the transmission tariff in Sri Lanka.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my sincere gratitude to my supervisor Dr. Asanka Rodrigo for his continuous guidance, constructive feedback and support extended throughout this research. Despite his busy schedule, he always remained accessible and his guidance and advice, expertise and insights were by all means truly invaluable.

It's with immense pleasure that I thank Mrs. Amali Seneviratne, Deputy General Manager (Energy Marketing), Ceylon Electricity Board for her help, guidance, and encouraging me throughout this study. Without her support, this research would not have been successful. Further my gratitude goes to Ms. H.K.N.W.Kodithuwakku, and Ms.D.P Liyanage, Electrical Engineers (Energy marketing Branch) of the Ceylon Electricity Board for their kind help during my study.

I am grateful to my parents for all the sacrifices they have made along the way and for all the support given to me during various endeavors in my life.

R.M.I.K.K. Rajapaksha

March 2016

TABLE OF CONTENT

List of Figures

List of Tables

List of Abbreviations

AARR	Aggregate Annual Revenue Requirement
AFCR	Annual Fixed Charged Rate
ASRR	Annual Service Revenue Requirement
BST	Bulk Supply Tariff
CEB	Ceylon Electricity Board
Disco	Distribution Company
DNSP	Distribution Network Service Provider
ECOWAS	Economic Community of West African States
ERERA	ECOWAS Regional Electricity Regulatory Authority
ESI	Electricity Supply Industry
Genco	Generation Company
IMO	Independent Market operator
IPP	Independent Power Producer
ISO	Independent System operator
LRIP	Long Run Incremental Pricing
LRMCP	Long Run Marginal Cost Pricing
MC	Marginal Cost
NCRE	Non-Conventional Renewable Energy
NEM	National Energy Market
NEMMCO	National Electricity Market Management Company
O&M	Operation and Maintenance
OPF	Optimal Power Flow
ORC	Optimized Replacement Cost
PPA	Power Purchase Agreement
PSA	Power Sales Agreement
PUCSL	Public Utilities Commission Sri Lanka
SMO	System and Market Operator
SPP	Small Power Producer
SRIC	Short run Incremental Cost
SRMCP	Short run Marginal Cost Pricing
TNSP	Transmission Network Service Provider
TransCo	Transmission Company
TSO	Transmission System Operator
VIU	Vertically Integrated Unit
VSPP	Very Small Power Producer
WAPP	West African Power Pool
WACC	Weighted Average Cost of Capital