



NUCLEAR POWER PLANTS FOR SRI LANKA BY YEAR2020

A dissertation submitted to the
Department of Electrical Engineering, University of Moratuwa
in partial fulfillment of the requirements for the
Degree of Master of Science

By
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2010

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Abstract

Ever increasing demand for electricity, due to increased consumption, industrial development and electrification, will have to be met by the Sri Lankan electricity industry. Ceylon Electricity Board has a long term generation plan, which mainly focuses on coal power. Despite the massive environmental pollution, it is not wise to depend only on coal power since coal resource is also a limited conventional resource. Therefore a country like Sri Lanka should have a good mixture of energy options for electricity generation rather than adhering to one conventional energy source as coal.

Aim of this study is to investigate the possibility of adopting Nuclear Power option to Sri Lanka. Due to the limited capacity of the current electricity network to absorb an economic scale nuclear power plant, the consideration was made for the year 2020, by which time the electricity network capacity will be large enough. An interesting fact is that some countries smaller in size than Sri Lanka successfully adopted nuclear power plants for their electricity generation. Hence this study could be considered as timely.

The study focuses on following facts;

1. Future demand and generation of Sri Lanka up to year 2020
2. World status of the Nuclear Power Plants and Technology
3. Pre-feasibility study - Technology
4. Pre-feasibility study - Economics
5. Pre-feasibility study - Site Survey
6. Pre-feasibility study - Environmental Impact Assessment

The technological pre-feasibility study addresses suitable type and size of a nuclear power plant for Sri Lanka. Thereby the CANDU technology is discussed which is adopted mainly in India and Canada.



In economic pre-feasibility study, the Levelized Unit Electricity Costs were calculated for the nuclear power plant as well as for the coal power option. As per the calculation unit electricity cost for the nuclear option seems to be slightly higher than from the coal option at current market conditions. Also a sensitivity analysis was done considering the changes in fuel cost and it shows that nuclear power unit cost dependency on fuel price is very much less than that of coal option. Under the economics, the possible initial financing methods for a country like Sri Lanka are also discussed.

For the site survey, author proposes 9 locations for initial consideration. Screening to select final sites, should be done by the authority that is responsible for feasibility study. The main criteria for selecting these sites were population density, cooling water availability, and land availability. The selected sites should also have minimum impact on the environment.

Existing local regulations and international obligations as well as required local regulations for setting up a nuclear power plant are also discussed in this document. Especially the adaptation of International Atomic Energy Agency (IAEA) safeguard system is elaborated.

The worst nuclear power plant accident in the world history is analyzed to have a clear picture on the possible maximum damage in case of a major accident, even though the probability of occurrence of such a disaster is extremely low. India, the closest neighbor country of Sri Lanka, is increasing nuclear power share drastically and some nuclear power plants are being built near to Sri Lanka. A complete information regarding the locations of Indian nuclear power plants are also discussed.

For the formidable question, "In case of a nuclear accident, can Sri Lanka bear it?", the most common answer will be "NO!". It is not possible to rule out accidents. On the other hand, as the conventional fuels deplete and their prices escalate, the only long term sustainable and dependable energy source is nuclear. Renewable sources



such as solar, wind, hydro etc are either limited in availability or economically unviable as a standalone supply source. Unless there is an economically competitive supply of energy, any country will not be able to provide its services at an acceptable price and thereby will become economically bankrupt. Thus the recommendation conceived from this project is "Study the subject of nuclear power at national level and be cautiously ready to implement nuclear power projects at an appropriate stage in the future to come"

DECLARATION

The work submitted in this dissertation is the result of my own investigation, unless otherwise stated.

It has not already been accepted for any degree, and is also not being concurrently submitted for any other degree.

UOM Verified Signature

B.M.A.T. Priyadarshana

Date: 30-03-2019

I endorse the declaration by the candidate.

Eng. W.D.A.S. Wijayapala

CONTENTS

| | Page No. |
|---|------------|
| Declaration | i |
| Contents | ii-v |
| List of Tables | vi |
| List of Figures | vii – viii |
| Acronyms | ix-x |
| Abstract | xi-xiii |
| Acknowledgement | xiv |
| | |
| 1. Introduction | 1 |
| 1.1 Background | 1 |
| 1.2 Present Situation of Electricity Generation in Sri Lanka | 1 |
| 1.2.1 Present Generation | 1 |
| 1.2.2 Future Plans | 2 |
| 1.3 Motivation | 3 |
| 2. Problem statement | 6 |
| 2.1 Identification of the Problem | 6 |
| 2.2 Objectives of the Study | 6 |
| 2.3 Importance of the Study | 7 |
| 3. Basics of Nuclear Power Technologies | 8 |
| 3.1 Basics of Nuclear Power | 8 |
| 3.1.1 Nuclear Fission | 8 |
| 3.1.2 Nuclear Fusion | 8 |
| 3.1.3 Chain Reaction | 9 |
| 3.2 Basic Components of a Conventional Nuclear Power Plant | 9 |
| 3.2.1 Nuclear Reactor | 9 |
| 3.2.2 Reactor Coolant System | 10 |
| 3.2.3 Steam Generator | 10 |
| 3.2.4 Steam Turbine and Electric Generator | 10 |
| 3.2.5 Reactor Control System and Safety Shutdown System | 11 |
| 3.2.6 Containment Building | 11 |
| 3.2.7 Spent Fuel Storage | 11 |
| 4. Nuclear Power Plant Pre-feasibility Study: Technology | 12 |
| 4.1 System Capacity | 12 |

| | | |
|-----------|---|-----------|
| 4.2 | Technology | 13 |
| 4.2.1 | CANDU Power Plant | 13 |
| 4.2.2 | Suitable Size of the Nuclear Power Plant | 17 |
| 4.2.3 | Fuel Requirement of CANDU 6 Unit | 18 |
| 4.2.4 | Cooling Water Requirement of Nuclear Power Station | 19 |
| 4.2.5 | Waste Disposal | 19 |
| 4.2.5.1 | Managing HLW from used fuel | 21 |
| 4.2.6 | Spent Fuel Reprocessing | 22 |
| 4.2.7 | SSTAR (Small, Sealed, Transportable, Autonomous Reactor) | 22 |
| 5. | Nuclear Power Plant Pre-feasibility Study: Economy | 24 |
| 5.1 | Economics of Coal Power | 24 |
| 5.2 | Economics of Nuclear Power | 25 |
| 5.3 | Comparison and Sensitivity Analysis of Unit Cost | 26 |
| 5.4 | Possible International Financing Sources and Contractors | 27 |
| 5.4.1 | Export Credit | 27 |
| 5.4.2 | Multilateral Development Institutions | 28 |
| 5.4.3 | International Markets | 28 |
| 5.4.4 | Alternative Method – BOO/BOT Approach | 28 |
| 5.4.5 | Possible Contractors and Equipment Suppliers | 29 |
| 5.5 | Nuclear Fuel Market and Availability | 29 |
| 5.5.1 | Uranium Market | 29 |
| 5.5.2 | Thorium Market | 32 |
| 5.5.3 | Availability and Sustainability to the Future (Uranium) | 32 |
| 5.5.3.1 | Uranium Availability | 33 |
| 5.5.3.2 | Availability at the Current Consumption Rate (Uranium) | 34 |
| 5.5.3.3 | Thorium Availability | 34 |
| 5.5.3.4 | Thorium Fuel Availability in Sri Lanka | 35 |
| 6. | Nuclear Power Plant Pre-feasibility Study: Site Survey | 36 |
| 6.1 | Regional Analysis and Identification of Potential Sites | 36 |
| 6.1.1 | Ease of Integration into the Electric System | 37 |
| 6.1.2 | Geology and Tectonic | 38 |
| 6.1.3 | Seismology | 40 |
| 6.1.4 | Heat Removal Capability | 41 |
| 6.1.5 | Hydrology | 41 |

| | |
|--|-----------|
| 6.1.6 Demography | 42 |
| 6.1.7 Meteorology | 42 |
| 6.1.8 Risks from Man-made Events | 44 |
| 6.1.9 Availability of Local Infrastructure | 44 |
| 6.1.10 Public Acceptance | 45 |
| 6.2 Population Distribution and Zoning Criteria | 45 |
| 6.3 Identification of Potential Sites | 46 |
| 7. Nuclear Power Plant Pre-feasibility Study: Environmental Impact Assessment | 48 |
| 7.1 Impact on land use | 48 |
| 7.2 Impact on water systems and the fishing industry | 49 |
| 7.3 Impact of radioactive and other emissions | 49 |
| 7.4 Impact on flora, fauna and protected sites | 50 |
| 7.5 Impact on the soil, bedrock and groundwater | 51 |
| 7.6 Impact on the landscape and cultural environment | 52 |
| 7.7 Noise impacts | 52 |
| 7.8 Impact on people and society | 52 |
| 7.9 Impact on waste management and final disposal | 53 |
| 7.10 Impact of decommissioning the power plant | 54 |
| 8. Local Regulations & International Obligation | 55 |
| 8.1 Existing Local Regulations and Laws on Nuclear Technologies | 55 |
| 8.2 Local Legal Framework Required | 56 |
| 8.3 International Obligation | 57 |
| 8.3.1 Safeguards | 57 |
| 8.4 IAEA Assistance | 58 |
| 9. Analysis of Past Nuclear Accidents | 59 |
| 9.1 Effect to Human | 59 |
| 9.1.1 Deaths | 59 |
| 9.1.2 Long Term Radiation Effects | 61 |
| 9.1.3 Other Effects | 61 |
| 9.2 Affected Areas | 61 |
| 9.3 Reasons for the Chernobyl Accident | 63 |
| 10. Analysis of NPP Status of the India | 65 |
| 10.1 Government Bodies and Institutions | 65 |

| | |
|--|-----|
| 10.2 General Picture of Nuclear Energy (Electricity) Production | 66 |
| 10.3 India's Nuclear Power Stations Nearest to Sri Lanka | 68 |
| 10.3.1 Koodankulam Atomic Power Station | 68 |
| 10.3.2 Madras Atomic Power Station | 70 |
| References | 71 |
| | |
| Appendix I: Nuclear Power Plant Classification | 74 |
| Appendix 2: Capital Cost of Unit Energy | 80 |
| Appendix 3: Nuclear Fuel | 82 |
| Appendix 4: Radiation and Radiation Measurement. | 85 |
| Appendix 5: Proposed NPP Sites | 91 |
| Appendix 6: International Nuclear Event Scale (INES)/ Record of Past Accidents | 100 |



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List of tables

| Table number | Description |
|--------------|--|
| Table 1.1 | Electricity Generation Statistics |
| Table 1.2 | Load Forecast |
| Table 1.3 | Implementation Program |
| Table 1.4 | Pollutants Emission |
| Table 1.5 | Pollutants Emission Estimate: Sri Lanka |
| Table 1.6 | World Nuclear Status: Statistical Data, 2006 |
| Table 4.1 | World CANDU Plants as at Year 2003 |
| Table 4.2 | 700 MWe class CANDU 6 NPP Data |
| Table 4.3 | Cooling Water Requirement |
| Table 5.1 | Sensitivity Analysis |
| Table 5.2 | World Uranium Production |
| Table 5.3 | Uranium Availability |
| Table 5.4 | Uranium Availability: No. of Years |
| Table 10.1 | Nuclear Plants in Operation - India |
| Table 10.2 | Nuclear Plants Under Construction - India |
| Table 10.3 | Planned Nuclear Power Plants - India |
| Table 10.4 | Firmly Proposed Projects - India |
| Table 10.5 | Koodankulam Atomic Power Station |
| Table 10.6 | Madras Atomic Power Station |
| Table A2.1 | Discounted Project Cost & Energy |
| Table A2.2 | Loan Schedule |
| Table A6.1 | General Description of INES Levels |

List of Figures

| Figure number | Description |
|---------------|---|
| Figure 3.1 | Components of NPP |
| Figure 4.1 | Average Daily Demand Curve |
| Figure 4.2 | CANDU Fuel Bundle (37 element, 50 cm long & 10 cm diameter) |
| Figure 4.3 | CANDU Fuel cycle options |
| Figure 4.4 | Schematic Diagram of a CANDU reactor |
| Figure 4.5 | Graphical Conception of Underground Disposal of HLW |
| Figure 5.1 | World Uranium Production |
| Figure 5.2 | Uranium Spot Prices – Cameco (Canada) |
| Figure 5.3 | Australian Thermal Coal Prices (Low Sulphur) |
| Figure 6.1 | Sri Lankan Electrical Transmission System |
| Figure 6.2 | Geological Layers of Earth |
| Figure 6.3 | Geology of Sri Lanka |
| Figure 6.4 | Indian Plate |
| Figure 6.5 | Seismic Hazard Map of Sri Lanka |
| Figure 6.6 | Population Distribution of Sri Lanka |
| Figure 6.7 | Proposed Locations for NPP |
| Figure 7.1 | National Parks and Sanctuaries |
| Figure 9.1 | Chernobyl Site after the Disaster |
| Figure 9.2 | Continental Scale of the Chernobyl Accident |
| Figure 9.3 | Continental Scale of the Chernobyl Accident |
| Figure 10.1 | Atomic Power Stations in India |
| Figure 10.2 | Koodankulam Atomic Power Station, India |
| Figure 10.3 | Koodankulam Atomic Power Station, India |
| Figure 10.4 | Madras Atomic Power Station, India |
| Figure A4.1 | Radiation |
| Figure A5.1 | Delft Island |
| Figure A5.2 | Manar Island |
| Figure A5.3 | Near Palavi Nawaladi |

| Figure number | Description |
|----------------------|--|
| Figure A5.4 | Near Kudramalei Point |
| Figure A5.5 | Near Alampil Mulaitivu |
| Figure A5.6 | Near Periyakarachchi Tank, Trincomalee North |
| Figure A5.7 | Near Valaichchenai |
| Figure A5.8 | Sangaman Kanda Tuduwa |
| Figure A5.9 | Near Yala |



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Acronyms

| | |
|--------|---|
| ABWR | Advanced Boiling Water Reactor |
| AEA | Atomic Energy Authority |
| AGR | Advanced Gas Cooled Reactor |
| BOO | Build Own and Operate |
| BOT | Build Own and Transfer |
| BWR | Boiling Water Reactor |
| CANDU | CANada Deuterium Uranium |
| CAESAR | Clean And Environmentally Safe Advanced Reactor |
| CEB | Ceylon Electricity Board |
| ECA | Export Credit Agencies |
| ECCS | Emergency Core Cooling System |
| EPZ | Emergency Planning Zone |
| ESBWR | Economic Simplified Boiling Water Reactor |
| GCR | Gas Cooled Reactor |
| HLW | High-Level Waste |
| HWR | Heavy Water Moderated Reactor |
| HTGCR | High Temperature Gas Cooled Reactor |
| IAEA | International Atomic Energy Authority |
| ILW | Intermediate-Level Waste |
| INES | International Nuclear Event Scale |
| JVC | Joint Venture Company |
| LLW | Low Level Waste |
| LMFBR | Liquid Metal Fast Breeder Reactor |
| LUEC | Levelized Unit Energy Cost |
| LWR | Light Water Moderated Reactor |
| MSR | Molten Salt Reactor |
| NPP | Nuclear Power Plant |
| OMR | Organically Moderated Reactor |
| PHWR | Pressurized Heavy Water Reactor |
| PWR | Pressurized Water Reactor |
| RBMK | Reaktor Bolshoy Moshchnosti Kanalniy (High Power Channel Reactor) |

SSTAR Small Sealed Transportable Autonomous Reactor
VLLW Very Low Level Waste
4S Super-Safe, Small, and Simple



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ACKNOWLEDGEMENT

First of all, I am very much grateful to Eng. W.D.A.S. Wijayapala, who encouraged and guided me in all the areas in this investigation and on perpetration of final dissertation.

I also thank academic staff members of Department of Electrical Engineering who gave valuable comments and instructions during the progress reviews and valuable advices for perpetration of final dissertation. I sincerely mention all the teachers who gave me lot of knowledge during my first year of the M.Sc. program.

I would like to take this opportunity to extend my sincere thanks to Mr.U.K.W. Silva, Deputy General Manager (PHM-R4), Mr.M.M.M. Sabry, Chief Engineer (Procurement) and Mr. M. Weeratunga, Electrical Engineer (Substation – D4) of Ceylon Electricity Board who gave their co-operation to conduct my investigation work successfully.



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It is a pleasure to remember the co-operation offered by the colleagues in the post graduate programme, friends and specially my wife who encouraged me to continue the studies from start to end.