NTNU

DEPARTMENT FOR INDUSTRIAL ECONOMICS
AND TECHNOLOGY MANAGEMENT

OPTIMAL REVISION AND UPGRADING OF HYDROPOWER PLANTS UNDER UNCERTAINTY

A CASE STUDY OF HYDROPOWER PLANTS IN STAVROPOL RUSSIA

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THOR ANDRE LUNDER

Preface

This is the master thesis written during spring 2005 at NTNU, department of Industrial Economics and Industrial Management.

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stud.tech. Thor Andre Lunder

Summary

In this thesis I have discussed various issues concerning investments in upgrading of a power plant in the Stavropol region in Russia, owned by Stavropol Energo. The power plant is currently being upgraded with assistance from Norplan and Rosnor Energo, which I have cooperated with during the thesis. The profitability of the business is first of all dependent on future prices for electricity. Russia is currently undergoing a deregulation of their power markets, and this will have huge influence on the future prices for electricity. The first part gives an overview about the deregulation process as well as demand and supply side for electricity in Russia. This also includes some macroeconomics about Russia. I have further described the uncertainty an investor have to cope with when investing in hydropower generation facilities.

During the writing of the thesis, I observed that the maintenance routines were based on old methods, and not on the profit maximizing maintenance routines we know from deregulated markets. I chose therefore to suggest some changes on this area, with special emphasis on the turbines. The different wear on turbines and routines for maintenance on them are described in an own chapter.

The main analysis is carried out with VTG Revision, a program developed at SINTEF. The program does a net present value analysis of hydropower plants with technical as well as market details as input. I have focused on two of the stations located at the Kuban river.

To deal with the uncertainty for future prices for electricity, I used a real option approach. The future prices are modeled as a Geometric Brownian Motion (GBM). The problem is solved with Stochastic Dynamic Programming in a decision tree, where I have done backwards calculation presuming always optimal decision making in the future. The model underlines the value of waiting for information and the "cost" for uncertainty. The input in the model is the results from VTG. At the end of the thesis are some sensitivity analysis which indicates the significance for the value to wait.

Contents

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11 References

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