Contents

1. Introduction 1
2. Grid Development Plan: Short-term, Medium and Long-term 5
   2.1. Nordic Conditions - Nordic Grid Planning Code 5
      2.1.1. Purpose and target groups 6
      2.1.2. The work of planning 6
      2.1.3. Transmission capacity 8
      2.1.4. Grid planning for interconnections between the Nordel area and other areas 9
   2.2. Croatian conditions 17
      2.2.1. Introduction 17
      2.2.2. Legal responsibility for grid planning in Croatia 17
      2.2.3. Electricity market opening – influence on transmission network planning 18
      2.2.4. Transmission network planning methodology 18
      2.2.5. Transmission network investments valuation – Croatian experience 26
      2.2.6. Conclusion 27
   2.3. Lessons learned 27
3. Local, Regional and European Context 29
   3.1. The Nordic power system – Regional/European context 29
      3.1.1. Western Denmark's joint operation with the UCTE system 30
      3.1.2. The synchronous system's joint operation with Germany via Kontek 32
      3.1.3. The synchronous system's joint operation with Poland 33
      3.1.4. The synchronous system's joint operation with Russia 33
   3.2. Croatian conditions 34
      3.2.1. European level 34
      3.2.2. Regional level 38
      3.2.3. National level – the case of Croatia 39
   3.3. Lessons learned 42
4. Production investments 43
   4.1. Norwegian conditions 43
      4.1.1. The legal framework for hydropower development in Norway 43
      4.1.2. Distribution of responsibility 46
      4.1.3. Work organization and work processes 46
      4.1.4. Principles and methods used 47
   4.2. Production Investment planning - Croatian conditions 52
      4.2.1. Introduction 52
      4.2.2. Necessity of continuous power planning 52
      4.2.3. Initiating mechanisms 55
      4.2.4. Planning procedures (minimum cost vs maximum profit) 63
      4.2.5. Conclusion 67

4.3. Lessons learned 68

5. Reserve planning 71

5.1. Norwegian Conditions 71

5.1.1. Purpose and definition 71

5.1.2. Classification 72

5.1.3. A simple model for pricing of reserves 77

5.1.4. Consumer side reserves 83

5.1.5. Practical experiences 87

5.2. Croatian Conditions 94

5.2.1. Introduction 94

5.2.2. WASP program model 95

5.2.3. Reserve capacity in Croatia 97

5.3. Lessons learned 100

6. Power system security 101

6.1. Norwegian and Nordic countries conditions 101

6.1.1. Definitions 102

6.1.2. Actual regulation and cooperation 103

6.1.3. Distribution of responsibility 105

6.1.4. Harmonisation of operational rules and practices in Nordic Countries 108

6.1.5. Harmonisation of grid investments in the Nordic area 112

6.1.6. Principles and methods used 113

6.1.7. Available software 117

6.2. Croatian conditions 117

6.2.1. (n-1) security 117

6.2.2. Technical analyses in Croatia 118

6.2.3. Monitoring of the (n-1) criterion 120

6.2.4. Procedures 121

6.3. Lessons learned 122

7. Authority monopoly regulations 123

7.1. Norwegian conditions 123

7.1.1. Regulatory and controlling institutions and bodies 123

7.1.2. Monopoly regulation regime 127

7.2. Croatian conditions 132

7.2.1. Mandate and the organization of the Regulatory Council 132

7.2.2. The Croatian Energy Regulatory Council (CERA) activities and responsibilities 134

7.2.3. Issuing the approvals 137

7.2.4. Regulation of prices of energy and energy services 138

7.2.5. Settlement of disputes 141

7.3. Lessons learned 142

8. Development Curricula 143

9. References 145

9.1. Croatian References 145

9.2. References in chapter 4 (Norway) 146
9.3. References in chapter 5 (Norway) 147
9.4. References in chapter 6 (Norway) 148

10. Appendices 149

10.1. Appendix 1 - Method, models and tools for system engineering studies (NORDEL) 149
10.1.1. Methodology for system engineering studies 149
10.1.2. Electrical engineering electric power system models 152
10.2. Appendix 2 - Norwegian Regulations relating to power system operation 157
10.3. Appendix 3 – Agreement regarding operations of the interconnected Nordic power system (The System Operation Agreement) 165
10.4. Appendix 4 – Reliability/security (Croatia) 174
10.5. Appendix 5 - Nordic Grid Connection Code 176
10.5.1. Introduction 176
10.5.2. Connection to the grid 176
10.5.3. Production 180
10.6. Appendix 6 - Comparison of Nordic benchmarking methods 193
10.6.1. Summary 193
10.6.2. Benchmarking 193
10.6.3. Benchmarking methods 195
10.6.4. Evaluation of the methods 197
10.6.5. Comments to the different benchmarking models 198
10.6.6. References 200

11. List of abbreviations 201