

Methodology for Merit Order Dispatch

Version 1.0

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Chapter I

Introduction

1. OBJECTIVES

The Electricity Transmission and Bulk Supply Licensee, in relation to its Operations Business (The System Operator) has the responsibility for system operations, including operation planning, and identification of the expected generation resources required to supply the forecast demand. Planning and operations shall be done considering limitations such as generation unavailability, transmission system constraints, and in accordance with the performance standards established in the Grid Code.

The objective of the Operational Rules is to establish the rules and procedures that the System Operator should follow in order to optimize the system operation, the role of other Licensees and the role of Electricity Transmission and Bulk Supply Licensees (in relation to both the Transmission Business and the Bulk Supply) in this optimization, the mechanisms to coordinate the real time operation of the system and the reporting requirements.

In Chapter II the Operational Rules are described. They essentially cover three main topics:

- Operations Planning, aimed at establishing plans, in different horizons to ensure long and medium term optimization and check security of supply
- Daily operation scheduling and real time operation, aimed at producing a short term schedule (day ahead), real time operation and re-scheduling in case of large dispatch deviations
- Reporting, aimed at documenting all relevant aspects related to the operation of the system and dispatch

These Operational Rules assume that the generation business in Sri Lanka is and will continue to be a Power Purchase Agreement (PPA) based market, in which the PPAs have a take or pay capacity component, and an energy component which is essentially a fuel cost pass-through. Therefore, the main objectives of the Operational Rules are focused on minimizing the energy purchasing costs subject to performance standards as established in the Grid Code, by optimizing the available water allocation in such a way that in the medium and long run, the required thermal generation purchases are minimized. Along with this objective, the Operational Rules are set out to guarantee transparency and predictability in the way generation is dispatched, with its immediate result being that the generation costs are also transparently set.

The Operational Rules need to keep total consistency with the Grid Code and it is therefore needed that all required provisions are included either in the Operational Rules and/or the Grid Code, to ensure potential contradictions or overlaps.

2. ROADMAP FOR IMPLEMENTATION

The proposed Operational Rules imply a deep change in the way the operation is being carried out today in Sri Lanka. Thus, implementation will require a significant amount of effort and time, thus together with the proposed Operational Procedures, a roadmap is proposed for their implementation, considering that some of their outputs are essential inputs for the extraordinary tariff filing and review process that will take place by mid of 2011.

While many of the aspects related to how operations planning and system operation are done today, are adequately done mostly from the technical point of view, there are some other aspects that still need to be improved, essentially related to:

- Allocation of roles according to the Electricity Act and licenses
- Hydrothermal generation and transmission optimization function

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- Transparency and access to information
 - Connection with other regulations

In order to accomplish the objectives and take benefit of improvements, it is necessary to implement a number of tools, such as dispatch models for optimization, communication procedures, such as web based information systems, and capacity building to train the System Control staff in the new procedure and in the use of the tools and communication procedures.

This proposal considers too the new full scale SCADA system and an Energy Management System (EMS) for the Sri Lankan Power Sector, currently (December 2010) at an early stage in the tender document preparation. While this new system will be able to provide proper solutions for all the objectives and improvements aforementioned, its implementation will still demand a fairly long time, longer than what the new regulatory regime requires at present.

The proposed Operational Procedures and how to implement them already consider this future system in such a way that what is implemented now, is fully compatible with the future system and ensure that at the proper time, all tools implemented now provide the necessary features for a smooth transition towards the full scale SCADA and EMS systems.

In consideration of all the above mentioned, the Roadmap for Implementation presented in Chapter III special provisions towards their gradual implementation, considering the needs for developing the tools, communication procedures and capacity building, required for a quick response to the actual needs while taking into account the future integration with the full scale SCADA and EMS systems.

Chapter II

Operational Rules

3. DEFINITIONS

System Operator	Transmission Licensee in relation to the its Operations Business
Single Buyer	Transmission Licensee in relation to the its Bulk Supply Business
Transmission Licensee	Transmission Licensee in relation to its Wire Business
Generator	Generation Licensee
Water Authority	Mahaweli Authority of Sri Lanka or other authority such as the Department of Irrigation
Must run generation	Generation that is not necessarily required due to economic optimum but due to performance standards or contractual requirements or resource constraints
Performance Standards	Operational criteria as established in the Grid Code
Distributor	Distribution Licensee
PUCSL	Public Utilities Commission of Sri Lanka

4. OPERATIONS PLANNING

4.1. GENERAL CONSIDERATIONS

The System Operator has the responsibility of system operation planning, including planning of reservoir operations¹, forecast of energy balance and identification of generation resources expected to be available to supply the forecast demand with adequate reserve and considering system constraints and meeting the required performance standards.

The optimization function shall be to minimize overall generation and transmission costs while complying with the required performance standards and security of supply for the different Planning Horizons.

The plans should be based on the long term load forecast produced by the Single Buyer², short term load forecasts produced by the System Operator, expected transmission constraints informed by the Transmission Licensee and generation availability and reserve informed by the Generators.

These plans will be indicative and have the purpose of providing each Licensee and the PUCSL with adequate information to evaluate the expected demand and supply balance, and the impact of system constraints and unavailability.

The plans will represent, with the available data and the best knowledge of the System Operator, indicative expected results of system operation including, among others:

- Load forecasts
- Generation and availability

¹ Subject to decisions by the Water Management Secretariat

² Load forecast responsibility should be a matter of another regulation establishing roles and responsibilities of different licensees in the elaboration and provision of information for building up nation-wide demand forecasts for each planning horizon under the Single Buyer's and System Operator's purview.

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- Reservoir levels and water availability for power generation (in conjunction with the Water Management Secretariat, as indicated in chapter)
 - Transmission constraints
 - must run generation
 - Risk of shortages or surpluses, including the risk of spilling.

The System Operator will not be responsible for any deviation between these projections, the actual generation and energy balance, since actual conditions may differ from the projections owing to uncertainties in hydrological conditions, load forecasts and forced outages.

4.2. PLANNING HORIZONS

The System Operator will produce plans of expected system operation for the following horizons:

- **Year Ahead.** The purpose of the Year Ahead Plan is to define the optimal allocation of hydro resources along the year to minimize the total generation and transmission costs, to coordinate the maintenance plans for generation and transmission to minimize the risks of non-supply and to forecast the generation costs to be transferred to the end user tariffs.

This plan will be prepared once in six months for the year ahead³, at least two months before the commencement of the planning period⁴. When a Tariff Filing is due (such as in June 2011 for the period 2012-2015), this plan will be prepared by the Filing Date as informed by PUCSL, and updated on the scheduled date, two months ahead of the planning period.

- **Monthly update.** The purpose of each Month Ahead Plan is to revise and eventually re-define the reservoir operations based on actual conditions that happened until the end of the previous month, and co-ordinate with other water users with the generation requirements.
- **Week ahead.** The purpose of the Week Ahead Plan is to coordinate maintenance outages, plan hydro generation and assist Licensees to anticipate possible conditions and constraints in order to make efficient decisions on matters that affect system operations, fuel requirements and other system conditions during the following week.

The System Operator will define the data required to execute these plans, and the Licensees will be obliged to supply it. The System Operator should draft procedures indicating the data that each Licensees will provide, and the associated time-schedules and formats.

³ Such as Jul-Dec 2011, Jan-Jun 2012.

⁴ eg: Jul-Dec 2011 plan to be provided by end May 2011.

4.3. WATER MANAGEMENT AND RESERVOIR PLANNING

The System Operator will be responsible for coordinating with the Water Management Secretariat the use of the water to be made available for being administered by the power sector for hydro power generation.

This coordination will be made consistently with the planning horizons, and the results of each coordination meeting, will be inputs for the operation planning associated to each one of them.

Based on the coordination results, the System Operator will centrally administer a planning process for optimizing the use of the water made available for being administered by the power sector for hydro power generation, including how to use the reservoirs with a storage capacity that allow yearly, seasonal or monthly regulation of outflows. Generators with hydro generation, have the right to participate in this reservoir planning process.

In cases where due to specific features of the hydraulic systems special measures are required, the System Operator may delegate to the involved Generators the coordination with the relevant water authorities and any other water users of the detailed constraints management on reservoir inflows or outflows.

The System Operator will determine the reservoir operation using the proper dispatch models as described for each planning horizon.

With the available data, trends and forecasts, the System Operator will elaborate scenarios for hydrology, thermal availability, load forecast and all other matters that may affect the relationship between consumption and the cost of supply, in order to determine the optimal use of reservoirs and hydro generation associated.

4.4. YEAR AHEAD PLAN

The System Operator shall develop the Year Ahead Plan using a medium and long term operation planning optimization model to define the economic allocation of hydro resources made available for power generation and conduct a hydro thermal optimal dispatch subject to the performance criteria as established in the Grid Code.

4.4.1. REQUIRED INFORMATION

Before the end of each year, the System Operator will request the following Licensees the indicated information

Single Buyer	Demand: Year-ahead load forecast, total and discriminated by delivery points to each Distribution Licensee, including monthly energy demand, peak capacity and typical load curves
	Generation: Generator's Contract Prices
	Embedded generation: Load forecast shall be net of this generation. However for the sake of improving system costs optimization, Distribution Licensees should be required to provide the Single Buyer with discriminated information about each embedded power plant located in their territories, for the Single Buyer to inform it to the System Operator.
Generators	Annual Maintenance Plan and other foreseen restrictions Fuel availability and fuel prices (if so considered in the PPA)
Transmission Licensee	Annual Maintenance Plan, transmission restrictions, Ancillary Service requirements, new transmission capacity to be commissioned during the year, decommissioning, etc.
Generators with hydro generation	reservoir security constraints and restrictions due to other water users or environmental reasons reservoir operation and dispatch restrictions due to hydro downstream obligations; rainfall forecasts if any (specially in the case of small hydro plants);

	upstream and downstream water restrictions due to other users or environmental restrictions.
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Note: Year means the 12-month period covered in each Year-ahead plan, as described in section 0

4.4.2. RESULTS

The System Operator shall compile the expected energy balance and system operation for the 12 months of the Year Ahead Plan, which shall include, at the minimum, the following results for each month:

- Load forecasts;
- Expected energy balance;
- Indicative generation plan and fuel requirements;
- Indicative maintenance plans for generation and transmission assets
- Expected reservoir operations;
- Expected shortages (or, in the future, risk of shortages) with an estimation of the energy not served;
- Expected risks of spilling.

The System Operator shall be responsible for the coordination of the generation and transmission system maintenance. The System Operator must analyze the Generators and the Transmission Licensee maintenance requests, and evaluate their effects on the planned operation, mainly operating costs and the risk of failure. With the aim of optimizing the operation and minimizing the risk of supply restrictions, the System Operator shall define the maintenance schedule, coordinating with the Licensee(s) the changes necessary to their respective maintenance requests.

4.4.3. YEAR AHEAD OPERATION PLANNING OPTIMIZATION MODEL

The Year Ahead Operation Planning Optimization Model shall be a security constrained economic dispatch model in which objective function is to optimize the total generation and transmission costs, while considering the security and performance standard constraints established by the Grid Code.

The model must be approved by PUCSL and its characteristics be known to all Licensees. The System Operator cannot make changes to the model without prior authorization from the PUCSL.

The System Operator shall model the transmission system and its restrictions on the basis of existing equipment and the data supplied and reported by the Transmission Licensee in terms of expansions under construction with informed scheduled date of commissioning, and the additions foreseen in the Long-term Transmission Development Plan.

The model shall meet the following minimum requirements.

- Allow adequate modeling of demand and its random variations, in terms of both energy and load curve shapes.
- Allow adequate representation of the transmission network and the restrictions that may significantly affect the operation and generation demand balance for the period under study.
- Allow adequate modeling capacity for:
 - hydro generation and its characteristics and constraints
 - thermal generation of different technologies and burning different type of fuels
 - non-conventional renewable energy-based generation
- Allow adequate modeling of the restrictions resulting from the minimum performance standard criteria, including must run generation, and meet the requirements for ancillary services on the network.

The model, as well as its manuals will be available for the Licensees. In case there is any software license costs, the same shall be borne by the requesting Licensee.

4.4.4. TIMING AND PUBLICATION

No later than 30th day of April and 31st October each year, or any other date specifically stated by PUCSL in years when Tariff Filings occur, the System Operator shall have the Year Ahead Plan provisional version. This version will be sent to PUCSL for approval.

The Year Ahead Plan shall be accompanied by the input information provided by the Water Management Secretariat and the Licensees. In case the System Operator had used different information, this decision needs to be justified and reflected in the Plan.

PUCSL may request clarifications within 15 days of submission of the Year Ahead Plan, or request the System Operator to introduce changes or amendments.

In the event PUCSL requests clarifications, changes or amendments, the System Operator shall respond to them within a maximum period of 7 days.

Once PUCSL approves the Year Ahead Plan, the System Operator shall post the Plan in its website for public access⁵.

4.5. MONTHLY UPDATED PLAN

The System Operator shall issue a monthly update of the remaining months of the Year Ahead Plan for the current year, aimed at adjusting the economic positioning of hydro resources made available for power generation and to obtain an updated hydro thermal optimal dispatch plan subject to the performance criteria as established in the Grid Code.

Monthly Updated Plan shall be carried out using the same Year Ahead Operation Planning Optimization Model.

4.5.1. REQUIRED INFORMATION

Before the end of each month, the System Operator will require the Licensees to update the information supplied for the Year Ahead Plan.

Based on this information, the System Operator will analyze and update the expected energy balance and system operation plan for the rest of the year, and prepare an update of the Year Ahead Plan.

The System Operator will prepare the Monthly Update Plan based on the same criteria used to prepare the Year Ahead Plan, but using more accurate information regarding water flows, generator outages, fuel prices and load forecast.

The report with the Monthly Update Plan shall also include a summary of the results and conditions in the previous month and during the current year, including an analysis of the deviations occurred from the Year Ahead Plan, as well as their causes.

4.5.2. TIMING AND PUBLICATION

No later than 15 days before end of the month, the System Operator shall submit to PUCSL, the updated Year Ahead Plan for the remaining months till the completion of the current year.

The updated Year Ahead Plan shall be accompanied by the input information provided by the Water Management Secretariat and the Licensees. In case the System Operator has used different information, this decision need to be justified and reflected in the Plan.

By the same date, the System Operator shall post the updated Plan in its website for public access⁶.

⁵ Posting for public information shall be only after the initial preparations are completed, according to the Roadmap for Implementation

4.6. WEEK AHEAD PLANS

The System Operator shall carry out the Week Ahead Plan using a medium term operation planning optimization model to define the economic location of hydro resources available for the week within each day of it, considering the maintenance requests for the week consistent with the approved annual maintenance plan, and the balance between the available energy resources and the demand for the week, with the aim of minimizing the non-supply risk and satisfy the performance standards established by the Grid Code.

The Week Ahead Plan is aimed at determining the production for each hydro plant unit in the week and type of day, based on expected demand, transmission restrictions, performance standard requirements, the operating restrictions, forecasts and constraints in rivers and reservoirs.

4.6.1. REQUIRED INFORMATION

Before the end of each week, the System Operator will require the Licensees to update the information supplied for the Month Ahead Plan.

Additionally each Generator shall submit to the System Operator:

- Requests for modifications to the maintenance outage plan, if any
- Fuel availability and any related constraints
- Updated information on generator availability

For the Week Ahead Plan preparation the System Operator will take into consideration:

- The results and data of the Monthly Update Plan;
- Updated load forecasts
- Generator availability
- Upstream and downstream hydro restrictions, if the generator is aware of any transmission and operational constraints
- Security and quality of service standards

4.6.2. RESULTS

Based on this information and using a hydro optimization and dispatch model, the System Operator shall prepare a Week Ahead Plan which should minimize the total operation cost of the week to supply the forecast load.

The Week Ahead Plan shall contain, at least:

- best estimation on load forecast (with probable hourly load profiles)
- expected energy balance
- maintenance outages planned for the week
- Indicative weekly and daily generation of each power plant
- expected reservoir levels and risk of spilling (if any)
- identification of expected conditions with shortages or inadequate reserve margins

4.6.3. MEDIUM TERM OPERATION PLANNING OPTIMIZATION MODEL

The Medium Term Operation Planning Optimization Model shall be a security constrained economic dispatch model and shall perform sequential optimization of hydro resources with the objective function to minimize the production cost subject to the performance standards criteria as established in the Grid Code, and must meet the following minimal requirements:

- allow to represent hourly load curves.

⁶ Posting for public information shall be only after the initial preparations are completed, according to the Roadmap for Implementation

- allow a detailed representation of the transmission network and its restrictions.
- allow detailed modeling of the hydroelectric resource availability and its restrictions, and of the thermal resources, conventional and non-conventional (renewable) availability, and its restrictions.
- allow detailed modeling of restrictions imposed by safety and quality of service standards, including must-run generation or forced machines, and requirements arising from frequency regulation and voltage control

The Week Ahead Economic Dispatch Model must be approved by PUCSL and its characteristics be provided for the information of all the Licensees. The System Operator cannot introduce modifications in the model without previous authorization of the PUCSL.

The model, as well as its manuals will be available for review and study the Licensees. In case there is any software license costs, the same shall be borne by the requesting Licensee.

4.6.4. WEEK AHEAD NOTIFICATION AND PUBLICATION

At 15 hrs of the last working day of a week, the System Operator shall notify the Licensees the results of the Week Ahead Plan.

The Week Ahead Plan shall be accompanied by the input information provided by the Water Authority and the Licensees. In case the System Operator had used different information, this decision need to be justified and reflected in the Plan.

By the same date, the System Operator shall post the updated Plan in its website for public access⁷.

5. ECONOMIC DISPATCH AND SCHEDULING

This section establishes the rules the System Operator shall follow to dispatch the system and schedule generation, either the day ahead or in real time.

5.1. DISPATCH PROCEDURES

The dispatch procedures shall be based on the following principles:

- Licensees to submit the information required for day ahead dispatch and real time dispatch, according to the System Operator requirements
- The System Operator to validate data, confirm or reject data, to communicate (notify) the Day Ahead Schedule and Ancillary Services schedule and other results of the dispatch process; and
- The System Operator to issue the Dispatch Instructions, including request for load disconnection, during real time operation.

5.2. DAY AHEAD ECONOMIC DISPATCH

Each day the System Operator shall produce a day-ahead security constrained economic dispatch based on the results of the Week Ahead Plan, with the aim of supplying the demand at the optimum total production cost within the specified performance standards, to:

- Plan and schedule sufficient generation and transmission capacity to meet expected load and reserve requirements, within the performance standards criteria established by the Grid Code;

⁷ Posting for public information shall be only after the initial preparations are completed, according to the Roadmap for Implementation.

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- Coordinate maintenance requested by the Licensees
 - Plan, when necessary, load shedding; and
 - Inform the results to each Licensee about their expected operation for the next day, for them to take all required measures to be able to comply with it.

In case of holidays and weekends, the System Operator shall produce the Economic Dispatch on the last working day.

The System Operator shall perform an economic dispatch to determine the optimal use of available generation resources and transmission capacity to supply the forecast load, within the required security and quality of service requirements and taking into account operational constraints (including spinning and load following reserves).

To produce such a day ahead dispatch, the System Operator shall use a security constrained dispatch model which minimizes the total operational cost, able to consider:

- Load forecast at each connection node;
- Generation availability and or operating restrictions
- Generation Prices (energy prices), reflected in the Contracts registered by the Single Buyer, for thermal generators;
- Fuel and environmental constraints;
- Daily water requirements as coordinated with the Water management Secretariat and/or other water users;
- Required reserve margins and voltage control resources as required to meet the minimum performance standards established in the Grid Code;
- The characteristics, losses and constraints of the transmission system.

All generators must be dispatched with the spinning reserve required to meet the performance standards established in the Grid Code, except in conditions of supply deficit or operational restrictions. In such emergencies, the System Operator may choose to operate with a lower reserve margin. This situation needs to be immediately informed to PUCSL and the Licensees in the most practicable manner.

5.2.1. RESULTS

The Day Ahead Economic Dispatch shall produce the following results:

- For each Generation Licensee, per plant and/or machine, generation schedule and participation in the spinning reserve, frequency regulation and voltage and reactive power control;
- Transmission restrictions that may result in the system;
- For each Distribution Licensee, supply restrictions (if any);
- The hourly cost of energy; if needed, by time intervals as PUCSL may instruct the System Operator (consistently with the Time of Use tariff system)
- Total transmission losses
- Must run generators forced by performance standard requirements or other requirements in the system (such as tests), accompanied by an estimation of the cost differential compared with an optional dispatch without must run generation.

5.2.2. DAY AHEAD SECURITY CONSTRAINED ECONOMIC DISPATCH MODEL

The Day Ahead Economic Dispatch Model shall be a security constrained dispatch model that must meet the following minimal conditions:

- allow to represent hourly load curves in all nodes of the transmission network.
- represent the configuration of the network to the level of detail necessary to take into account the constraints that affect the daily dispatch, ensuring that the schedule is feasible with the potentially existing transmission restrictions and within the performance standards;
- represent hourly load flows in the network and determination of losses;
- represent thermal plants in detail, indicating availability by type of fuels, energy costs, the specific fuel consumption per MWh, restrictions on the maximum hourly load variation and the possibilities of contributing to primary and secondary frequency regulation
- represent the minimum time that must elapse between a stop and the following start up, and the start up and stop costs;
- represent the power reserve requirements for regulation;
- represent the spinning reserve requirements to maintain the system operation within the performance and the required response times during contingencies
- allow detailed modeling of non-conventional renewable energy-based generation and their restrictions.
- allow detailed modeling of restrictions imposed by safety and quality of service standards, including must run generation of forced machines, and requirements arising from frequency regulation and voltage control

For the particular case of hydro power plants, the model has to be able to represent:

- different types of basins and hydro power (run of river, storage capacity, cascades and links between components of it, compensating or regulating dams, pumped-storage stations, etc.), and downstream restrictions affecting the hourly dispatch of hydro power;
- restrictions on weekly and daily peaking ability of power plants, including maximum allowable ramp;
- forced generation due to base or minimum downstream flow volume requirements;
- limitations to their daily maximum generation and/or weekly, not to exceed the maximum allowable downstream flows or other water management requirements;
- any restrictions or rules of operation, represented as its effects on energy and capacity delivery.
- maximum zero-generation time without need of operating spillway gates
- maximum hourly admissible generation variation due to water flow control requirements

The Day Ahead Economic Dispatch Model must be approved by PUCSL and its characteristics be of knowledge for all the Licensees. The System Operator cannot introduce modifications in the model without previous authorization previous of the PUCSL.

The model, as well as its manuals will be available for the Licensees upon request. In case there is any software license costs, the same shall be borne by the requesting Licensee.

5.2.3. DAY AHEAD NOTIFICATION AND PUBLICATION

Before the 15 hours of each day, the System Operator shall notify each Generator for the next day:

- Transmission restrictions in the system
- Hourly generating schedule (by fuel type if applies) for each unit
- Hourly spinning reserve, frequency regulation and reactive power control commitments for each plant;

Before the 15 hours of each day, the System Operator notifies each Distributor:

- Transmission restrictions in the System;
- Hourly discriminated foreseen supply restrictions (if any) for each Distribution Licensee

The Day Ahead Plan shall be accompanied by the input information provided by the Water Authority and the Licensees. In case the System Operator had used different information, this decision need to be justified and reflected in the Plan.

By the same date, the System Operator shall post the updated Plan in its website for public access⁸.

5.3. ADMINISTRATION OF SHORTAGES

The System Operator may plan and instruct a Licensee to shed load if the Day Ahead Dispatch or Real Time Dispatch show shortage of energy in the system as a whole or in one or more specific regions in the system, due to insufficient generation or insufficient transmission capacity. All Licensees are obliged to comply with the curtailment schedules, load shedding plans and instructions of the System Operator.

In case of expected prolonged shortages, the criteria to be applied to determine the load shedding each Licensees has to execute will be determined by PUCSL. The System Operator will be responsible for implementing such criteria, determining the amount and timing of load shedding to be produced by Licensees.

During real time operations, the System Operator may instruct curtailments that were not planned for the day ahead, to solve emergencies or unanticipated conditions in order to maintain the security and integrity of the system. These curtailments may be instructed without previous request for authorization from PUCSL if the circumstances do not allow to do it. In such cases, the System Operator must inform PUCSL at the earliest possible moment of such events.

5.4. REAL TIME OPERATION AND DISPATCH INSTRUCTIONS

The System Operator has the responsibility of monitoring and coordinating in real time, the operation of the system, reliability, security and quality of service. To be able to fulfil these functions, each Licensee is obliged to inform immediately any modification to the day ahead expected conditions that may affect generation schedules, loads, reserve, ancillary services, reliability or security in the system (procedures to communicate such incidences to be included either in the Grid Code).

Each Licensee is obliged to follow dispatch and operation instructions received from the System Operator, unless when by doing so it could endanger the security of its equipment or its staff. Penalties may be imposed on a Licensee if this Licensee fails to use its best endeavour to act in accordance with dispatch instructions issued by the System Operator.

⁸ Posting for public information shall be only after the initial preparations are completed, according to the Roadmap for Implementation.

The System Operator shall follow the generation and reserve scheduled on the Day Ahead Economic Dispatch, except when conditions require an update of the economic dispatch and re scheduling of generation and/or reserves. Normal deviations of the load will be covered using spinning reserve Ancillary Services.

During the operation of the system, the System Operator shall:

- Review forecasted and actual system conditions, including load, generation availability and constraints, and update the expected conditions for the rest of the day;
- Modify the schedule of generation when a Generation Licensee informs a modification in the availability

In case of significant deviations between expected day-ahead conditions and updated conditions for the rest of the day, the System Operator shall re-schedule generation to restore the economic dispatch of generation resources and ensure the balance between actual load and actual generation. This rescheduling will be done using the same model used for the day-ahead dispatch adjusting the relevant input data. The System Operator shall issue the required dispatch instructions based on the re-scheduling results for the rest of the day and, when necessary, the foreseen load curtailments.

In case of emergencies or unexpected conditions that endanger the security of the system, the System Operator has the right to issue generation instructions that differ from the generation schedules informed with the Day Ahead Economic Dispatch, to maintain the security of the system and the quality of service within the standards.

In case of emergencies or any other unexpected condition that endangers the security of the system, the System Operator shall give priority to system reliability over economic operation. In these conditions, the System Operator shall give the instructions and follow the emergency procedures to restore the system to normal operation as soon as possible, independent of economic dispatch. Once the emergency or disturbance or unexpected condition has been solved or, if it not solved, the system has been adjusted to the new conditions within security and reliability standards, the System Operator shall give priority to economic efficiency.

5.4.1. OBLIGATIONS OF GENERATION AND DISTRIBUTION LICENSEES

Generators must meet operating schedules as directed by the System Operator within a tolerance band defined by PUCSL in regard to power generation, spinning reserve, participation in the regulation of frequency, and other requirements to maintain the operation of the electrical system within the established performance standards. Deviations from the programmed values beyond the defined tolerance is considered a breach of the Generator's obligations and subject to penalties as decided by the PUCSL.

Distribution Licensees must meet the restrictions indicated by the System Operator within a tolerance defined by the PUCSL, and meet other requirements to maintain the operation of the electrical system within the established performance standards. Deviations from the programmed values beyond the defined tolerance is considered a breach of the Distribution Licensee's obligations and subject to penalties as decided by the PUCSL.

Embedded generation on standardised Power Purchase Agreements will have to be duly considered, when Distribution Licensee obligations are agreed between the System Operator and each Distribution Licensee.

6. OPERATIONS REPORT AND EX POST DISPATCH ANALYSIS

Every day, before 10 hours, the System Operator shall produce and post in the System Operator website, and simultaneously provide to PUCSL, an Operations Report containing an evaluation of deviations between actual conditions and conditions expected in the day ahead dispatch, and how such deviations affected generation scheduling, reserve and quality of service.

After holidays and weekends, the Operational Report shall contain the same information for each one of these days.

PUCSL may request the System Operator to include other data in the Operations Report.

Chapter III

Roadmap for Implementation

7. IMMEDIATE NEEDS

The following activities are required to be undertaken at the earliest possible, in order to facilitate the implementation of the Operational Procedures

- Dispatch model(s): procurement, implementation and training
- Templates for exchanging information between System Operator, Licensees and PUCSL
- Web based systems for exchange of information and posting information required to be made public
- Revise the System Operator's internal organization to carry out the functions assigned to it by the Operational Procedures

7.1. DISPATCH MODELS: PROCUREMENT, IMPLEMENTATION AND TRAINING

Based on the model specifications described in the Operational Rules in the foregoing chapters, the System Operator shall procure the required software. Software responding to those specs are commercially available in the market, thus no special programming needs are required.

Normally available models require implementation and fine tuning, in order to make them represent properly the power system electrical behaviour. Thus, implementation and fine tuning should be included in the procurement process to have assistance from the software provider in these regards.

Adequate participation of the System Operator's personnel in the implementation and fine tuning must be granted in order to ensure adequate knowledge transfer and develop the require capacity for running these tools and update them when needed. Training needs to be part of the scope of services required from the software provider.

7.1.1. TIMING

The dispatch models should be operational and ready to produce the required information for the upcoming tariff filing review, foreseen for June 2011. Therefore the models need to be fully implemented and the personnel properly trained, no later than 30th April 2011.

7.2. TEMPLATES FOR EXCHANGING INFORMATION BETWEEN SYSTEM OPERATOR, LICENSEES AND PUCSL

Information requirements to Licensees need to be systematized through standard templates to facilitate the initial data gathering and subsequent updates.

These templates normally can be developed in MS Excel spreadsheets. Existing forms used to receive information from licensees are a good basis for this, and based on the dispatch models selected, the supplier should advice on how to adapt them to the specific software requirements.

7.2.1. TIMING

The templates design and development should start simultaneously with the dispatch model implementation.

7.3. WEB BASED SYSTEMS FOR EXCHANGE OF INFORMATION AND PUBLICATION

Based on the existing facilities, the System Operator shall define what functions need to be additionally implemented.

7.3.1. TIMING

The publication requirements established in the Operational Procedures shall to be put in force not earlier than the moment when the dispatch models are fully operational and the output properly tested.

However the design of the required system needs to be started in advance in order to have them ready for the moment when publication can start. The start of the works should be no later than 1st February 2011.

7.4. SYSTEM OPERATOR INTERNAL ORGANIZATION

The adequacy of the System Operator's internal organization to carry out the functions assigned to it by the Operational Procedures needs to be revised and if considered necessary properly adjusted to have the human resources required for that.

7.4.1. TIMING

This activity has to be initiated as early as possible during 2011, mostly considering that the personnel deployed to carry out the required functions needs to be fully accomplished by the time the dispatch models and template design commence.