



GREATER MEKONG SYSTEM REGIONAL GRID CODE

Operational Training Code (draft)


7 of 8 C7de Documents

Version 0.3

December2018

Enquiries: The Secretariat,
RPCC
Telephone:
Email

Version control

		
Document #	Title: GMS Regional Grid Code Market Code	Print Date: [Date]
Revision # 0.2 Draft	Prepared By: Dr Graeme Chown – Ricardo Energy & Environment	Date Prepared: September 2018
Effective Date: [Date]	Reviewed By: Jonathan Hedgecock – Ricardo Energy & Environment Michel CAUBET	Date Reviewed: September 2018 December 2018
Standard: Code	Approved By: [Approver's Name]	Date Approved: [Date]

Note: A section titled "ANNEX: Code – History of Comments" is attached to each Code. It provides a log of every comment and subsequent consideration taken on the Code.

Table of Contents

1. Introduction	4
2. Training Programs	4
2.1 Initial Training Program	5
2.2 Continuous Training Program.....	7
3. Inter-<i>TSO</i> Training.....	8
4. Training Organization and <i>Dispatchers</i> Accreditation	9
5. Basic requirements for Dispatcher Training Simulator	10
ANNEX: Operational Training Code – History of Comments.....	12

List of Figures

No table of figures entries found.

List of Tables

No table of figures entries found.

1. Introduction

- (1) This code contains a set of operational training requirements for the operation for the *GMS interconnected system*. The code defines a standard framework for operational training in order to provide reasonable assurance that the *dispatchers* have and maintain the knowledge and skills to operate the power system in a safe and reliable manner under all conditions and at all times.
- (2) A *dispatcher* is a person with all necessary technical and non-technical skills, qualifications and technical expertise to safely operate the whole system in a regional or a national control centre and to take decisions about switching in the transmission system. A person in charge of only switching execution is not a *dispatcher*.
- (3) The common framework for training of operating and supervisory personnel shall enable the building up of operational know-how in normal and insecure system conditions.
- (4) Each *TSO* shall ensure the appropriate qualification of the personnel to cope with any kind of events within its system. The training is based on the *TSO* operating procedures. The training also gives feedback about the quality of these procedures and the skills of the *dispatchers*, especially in case of procedures in real time operation that are applied rarely.
- (5) A training program is a planned, organized sequence of activities designed to prepare individuals and teams to perform their jobs and to maintain or improve their performance on the job. It describes the training process on the basis of the qualifications to be awarded (selection, activities, training requirements, etc.) and consists of an initial program and a continuous program.
- (6) The initial program is determined as an important stage of the general structured basic training of operating personnel with respect to the critical contribution of their role to the safe and reliable operation of electric power system. The aim of the initial program is to prepare personnel to take the *dispatcher* position. It provides an adequate necessary level of professional knowledge in order to obtain the required qualifications.
- (7) The main aim of the continuous program is to keep and extend the *dispatchers'* knowledge and competences.
- (8) On-the-job training is the integration of previously acquired knowledge related to routines and skills in practice under the supervision of a qualified On-the-Job instructor in a live system situation.
- (9) This code was based on ENTSO-e Policy 8 Operator Training, accessed November 2017, and adapted for the *GMS Interconnected Network*.

2. Training Programs

- (1) Each *TSO* shall provide *dispatchers* with a structured training program that is designed to develop and improve their skills. This program includes initial and continuous parts. The training has to be permanently adapted to the evolution of system operational conditions. All the issues addressed by the training have to be regularly checked and updated.

- (2) The initial and continuous programs have to consider the relevant parts of the *Regional GMS Grid Code* and mutual agreements between *TSOs*. Each *TSO* defines its specific requirements for the initial program and the continuous program and their duration.
- (3) *Dispatchers* in contact with neighbouring *Control Areas* shall have sufficient knowledge of English and operational terms to carry out their tasks, ensuring the safe and smooth flow of information in an international environment using clear expressions in order to ease an immediate understanding. These shall provide the *dispatcher* with the ability to produce clear messages in unusual situations including:
 - (a) the ability to communicate in plain language even under stress;
 - (b) understanding of and appropriate answering to foreign dispatchers;
 - (c) the resolving of misunderstanding in communication.
- (4) Each *TSO* shall make available a reference list of technical terms in English with translation to the mother language of *dispatchers* for operation and for training based on the existing *GMS Grid Code* definitions and terms.

2.1 Initial Training Program

- (1) The initial program shall last at least 6 months for trainees without any experience of power system operation, either in real time or in operational planning, including a minimum of three months for on-the-job and simulator training.
- (2) The initial program shall include at least knowledge of components of the power system, the operation of the power system, the tools for operation and relevant on-the-job-practice
- (3) The initial program consists of a theoretical part and an on-the-job part complemented by simulator sessions.
- (4) A prerequisite to the initial training program shall be the successful completion of relevant *TSO's* Safety Code
- (5) The structure of the theoretical part of the initial program shall provide a first level of competencies on the following main topic categories of power system components, operation of the power system and knowledge of operational tools:
 - (a) Power system components shall include a general description and analysis of all network components including national and international technical specifications, as follows:
 - (i) Types of overhead lines, underground and submarine cables with their components;
 - (ii) Different types of HV and EHV substations, HV DC converters, with their entire components as types of breakers, isolator-ground switches, power transformers, measurement-protection transformers, tap changers, reactors, capacitors, phase shifter transformers, other electronic regulators (SVCs, FACTS, etc.), telecommunication systems, protection relays, other auxiliaries etc.;

- (iii) Types of power plants (fossil fuel, nuclear, oil, gas turbine, combined cycle gas turbine - CCGT, hydro, wind, renewable sources etc.) and their components like turbines, generators, etc. with respect to their operational characteristics e.g. response times.
- (b) Operation of the power system shall include all relevant domestic and international regulations and market rules as well as the knowledge and analysis of the necessary conditions for safe and reliable operation. (e.g. under *Normal*, *Alert*, *Emergency*, *Blackout* and *Restoration* conditions, as they are determined by *GMS Regional Grid Code*). This category might include courses on the following aspects:
- (i) Network behaviour and network operation (power flows and system frequency);
 - (ii) Basics of network protection;
 - (iii) Voltage and reactive power control;
 - (iv) *Balancing* (primary, secondary and tertiary control), *Automatic Generation Control*, organization and operation;
 - (v) Other internal rules (e.g. relevant market rules, organizational and technical) described by each *TSO*;
 - (vi) Introduction to *GMS* and other *TSO* organizations;
 - (vii) *GMS Grid Code* and other international regulations;
 - (viii) Crisis management;
 - (ix) Manual or automatic remedial actions in *Alert* or *Emergency* situations (e.g. load shedding)
 - (x) Restoration actions after black-out;
 - (xi) Basic methods in network calculation (on-off line), state estimation, load flows, etc;
 - (xii) Limiting short-circuit levels to the maximum capacity of the network components;
 - (xiii) Special phenomena such as frequency oscillations (slow = sub synchronous, higher-order harmonics = over synchronous) in the national and *GMS networks*;
 - (xiv) Special phenomena such as local (in the national networks) and global (in the *GMS network*) collapses (voltage, frequency, angular), etc.
- (c) *Dispatchers* shall be trained in the knowledge of operational tools including:
- (i) Collecting, transferring data signals, computers configuration, SCADA systems etc.;
 - (ii) Remote control technology;

- (iii) Implemented models for state estimation, for network topology, for contingency analysis, for offer-demand balancing, for automatic generation control, for load forecast, etc.
 - (iv) Interpretation of calculation results;
 - (v) Operator's MMI (Man Machine Interface), etc.;
 - (vi) Other internal operational tools (e.g. scheduling system).
- (6) The theoretical part of the initial program shall be supported by practical experience, which plays crucial role in the education procedure. For this purpose respective on-the-job sessions as well as additional simulator sessions shall be provided.
- (a) On-the-job training shall consider the future position and responsibilities of the candidate and should cover all relevant operational aspects related to this position.
 - (i) The on-the-job training shall put into practice all the professional actions required in real time operation, using appropriate tools.
 - (ii) The trainees shall be guided by personnel experienced in the respective position(s) for which they are being trained.
 - (iii) On-the-job education shall take into account the theoretical aspects of all the relevant topics.
 - (b) On-simulator sessions shall be provided during which the trainees experience normal and insecure system situations.

2.2 **Continuous Training Program**

- (1) The continuous program has to focus on theoretical and practical aspects of national system operation as well as on boundary conditions at the borders with neighbouring systems. The inter-TSO training as defined in Chapter 3 is part of the continuous training.
- (2) The continuous program shall be applied to all *dispatchers* as soon as they are certified and nominated to a *dispatcher* position. The main aim of the continuous program is to keep and extend the *dispatchers'* knowledge and competences. The continuous program is established to complement the initial program with:
 - (a) advanced theoretical parts;
 - (b) learning of new rules and procedures;
 - (c) additional simulator sessions.
- (3) Each TSO shall define a continuous program designed to cover theoretical knowledge, simulator sessions and stress management techniques:
 - (a) The theoretical part of the continuous program shall provide advanced knowledge on the following main topics:
 - (i) Analysis of disturbances and "almost" disturbances;

- (ii) Technical knowledge (recapitulation of important aspects of network operation in *Normal*, *Alert*, *Emergency* and *Black-out* conditions);
 - (iii) Information about new conditions affecting network operation (e.g. new network elements, new power units);
 - (iv) Information about new rules and procedures following changes in general framework;
 - (v) Human behaviour aspects (analysis of human factors).
- (b) The simulator session shall be provided on a *Dispatcher Training Simulator (DTS)*. The *DTS* shall simulate situations with insecure and emergency scenarios, complemented by the restoration of the network after disturbances / black-outs. It shall also include inter-*TSO* disturbances.
- (c) *Dispatchers* shall be informed on methods to manage the stress associated with the *dispatcher's* tasks.

3. Inter-*TSO* Training

- (1) *TSOs* can sign bilateral/multilateral agreements of cooperation for common training, these issues can be included in general operational agreements;
- (2) The content of inter-*TSO* training program shall include:
- (a) a necessary knowledge of the neighbouring *TSOs'* networks;
 - (b) awareness of coordinated actions in normal operational conditions in order to ensure the best operational conditions of the common network area;
 - (c) awareness of coordinated remedial actions in case of security violations, in order to avoid the deterioration of the operational conditions towards emergency;
 - (d) awareness of remedial actions in case of emergency and restoration after black-out conditions
- (3) Each *TSO* shall implement at least one of the following four actions to improve communication and coordinated measures between neighbouring *TSO dispatchers*. The actions taken have to be chosen depending on the mutual level of risks for secure system operation with the first (or further) neighbouring *TSO(s)*.
- (a) Cross visits between neighbouring *TSOs'* *dispatchers* in which the characteristics of the network and operational constraints of a *TSO* organization are presented. A cross visit intends to give the opportunity to operators, who have frequent contacts, to get to know each other on a personal level and introduce a more collaborative atmosphere between the *dispatchers*, and to provide a global overview of the neighbouring *TSO* network to *TSO* dispatchers;
 - (b) Common training workshops where participants are informed about the specific items, problems, evolutions, etc. in the different networks and they can exchange experience on system operation at boundaries. These workshops aim at providing the same set of information (common knowledge) to all involved *dispatchers*, with a view to better understanding the problems of the neighbouring systems and the

content of existing procedures in normal and abnormal system states. During the workshops, exercises can be carried out (e.g. tests of communication procedures on borders, where detailed arrangements between TSOs exist).

- (c) On-shift cross periods, meaning visits by neighbouring *dispatchers* for spending full real-time shifts at the hosting TSO. During on-shift cross periods in the respective control rooms, the *dispatchers* will enhance their mutual knowledge of the neighbouring operational environment. The on-shift cross periods aim at improving in-depth understanding and interpersonal communication between neighbouring TSOs' *dispatchers* and at reinforcing the knowledge level of the neighbouring TSOs' systems.
- (d) Common DTS training sessions, to ensure better coordination of neighbouring *dispatchers'* actions in normal and abnormal conditions. They can be organized on a bilateral or multilateral level. The main focus of the sessions for the TSO *dispatchers* should be the training of inter-TSO disturbances with the goal that the TSO *dispatchers* act in a coordinated way in stressful conditions (e.g. to exchange efficient information, to apply relevant rules and procedures, to order cross-border actions after mutual evaluation or to take any remedial actions).

4. Training Organization and *Dispatchers* Accreditation

- (1) All *dispatchers* shall be accredited. Accreditation means a written endorsement of the proved qualifications of a person for the position of a *dispatcher*. The accreditation validity shall be subject to the *dispatcher* successfully completing continuous training required in Chapter 2.
- (2) Each TSO shall appoint a training coordination manager responsible for the organization of training, including designing, following-up and updating the full training process.
- (3) The training coordination manager shall determine appropriate procedures for the organization of training. These procedures shall cover:
 - (a) a description of the *dispatchers'* required qualifications (knowledge and skills);
 - (b) a reference list of topics for training programs linked to the *dispatchers'* required qualifications;
 - (c) the processes for the initial and continuous programs including scripts/documents for the theoretical sessions, time-schedules, supervision, tools, support for trainees, evaluation/validation and continuous improvement of the programs and the process of *dispatchers* accreditation;
 - (d) selection and training of trainers.
- (4) TSOs have to determine the profile of trainers with regards to their respective tasks and responsibilities in the training programs. Trainers may be selected internally (experienced *dispatchers*) or from external bodies.
- (5) Training of trainers shall be provided depending on their education and previous experience, and an individual training program shall be defined for each trainer; it can be provided by internal sessions or by outsourced training sessions.

- (6) Training for trainers shall be provided for trainers to be qualified to hold lectures for the trainees, to conduct oral examinations or provide personal coaching. The essential training is to be able to:
 - (a) lead a training session;
 - (b) lead a debriefing;
 - (c) evaluate of a training session; and
 - (d) teach management of *dispatchers'* stress.
- (7) The initial program has to be completed by an evaluation in which the knowledge and capabilities of a candidate to perform a *dispatcher* job are tested. This evaluation is performed by the trainers; a relevant document is forwarded to the manager of the candidate.
- (8) The *TSO* shall provide a first accreditation to the *dispatcher* candidate that authorizes them to perform their job in the control room. The first accreditation is attributed according to defined criteria for a duration decided by the *TSO* based on the following criteria:
 - (a) content of the evaluation document;
 - (b) on-the-job session reports;
 - (c) simulator session reports, where these exist;
 - (d) assessment of the *dispatcher's* capabilities through an interview at the end of the initial training program.
- (9) The renewal of accreditation shall be based on following criteria:
 - (a) confirmation of attendance at the theoretical part of the continuous program;
 - (b) simulator sessions reports;
 - (c) assessment of the *dispatcher* capabilities through an interview.
- (10) The validity duration of the *dispatcher's* accreditation is two years. Furthermore, any dispatcher not on active duty for more than 6 months shall be required to renew their accreditation.

5. Basic requirements for Dispatcher Training Simulator

- (1) An integrated *DTS* is required which is based on the *EMS* in the dispatching centre or on a dedicated modelling of the real time network.
- (2) An external *DTS* which is an independent simulator, which can be used for joint extended training including multi areas, is optional.
- (3) The *DTS* shall include a comprehensive database with respective data from neighbouring networks at a sufficient level and including a (n-1) security analysis. The *DTS* shall also provide an adequate realistic control room environment.

- (4) The *DTS* shall have the functionality to provide training to *dispatchers* to learn to solve situations that occur in the power system operation, including:
 - (a) operation during the normal state;
 - (b) defence of the system against a serious disturbance; and
 - (c) restoration of the system starting after a blackout.
- (5) The *DTS* should also be able to provide:
 - (a) training in SCADA and/or in other power applications of the dispatching tool (*EMS*);
 - (b) training in the MMI (Man Machine Interface) of the local dispatching tool (*EMS*) in case of integrated *DTS*;
 - (c) testing of the *EMS* sub-applications, e.g. SCADA and AGC (case of integrated *DTS*);
 - (d) training in local switching procedures for maintenance activities in the network;
 - (e) training in N-1 calculation software; and
 - (f) analyzing the past events through simulations.
- (6) The minimum functional requirements of *DTS* are:
 - (a) efficient data input, data accessibility and data handling;
 - (b) modelling of all the system components in the operational areas;
 - (c) including low/high voltages, over-current and multi-island-operation;
 - (d) optional modelling of (sub)transient behaviour of the system;
 - (e) monitoring and control options for the trainee and trainer to influence the process, through the MMI;
 - (f) MMI functions to prepare and apply base cases and training scenarios for the trainer;
 - (g) providing reports after a training session with the view of evaluation;
 - (h) restoration of the simulated system; and
 - (i) combining sets of data of the different control areas.

ANNEX: Operational Training Code – History of Comments

#	Country	Reference section in the document	Country Comment	Consultants Review and Recommendation	Country Acceptance
1.	China	Section 2 (4)	We suggest this reference list should be compatible with dictionary in Grid Code.	Agreed but paragraph already says the list should be 'based on the existing <i>GMS Grid Code</i> definitions and terms'.	
2.	China	Section 2 (1)	We suggest the following request should be added: an exam on safety code of electric power work on field is compellent before any other training process.	Agreed – paragraph to be added 'A prerequisite to the initial training program shall be the successful completion of relevant TSO's Safety Code'.	
3	China	Section 4 (10)	We suggest the following request should be added: a dispatcher must take exam again if he or she leaves power dispatcher occupation more than half a year.	Agreed – paragraph 4(10) to be enhanced with 'Furthermore, any dispatcher not on active duty for more than 6 months shall be required to renew their accreditation'.	