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Table of Contents

1 ABBREVIATIONS

Abbreviation	Meaning
AHEF	*Ad-hoc* Expert Facility
CCGT	Combined Cycle Gas Turbine
ENA	Electricity Network of Armenia
EPSO	Electric Power System Operator
HVEN	High Voltage Electricity Networks Power Transmission Company
Hz	Herz (cycle/second)
MW	MegaWatt
nps	Negative phase sequence
pps	Positive phase sequence
SVC	Static Var Compensator

Tables

2 EXECUTIVE SUMMARY

Article 37 of the Armenian law on Energy, which was enacted in 1997 and revised by the National Assembly in 2001, requires that:

> *"2. Electric energy System Operator Licensee, based on the requirements of the Technical Rules and Procedures and cooperating with Operational Licensees prepares safety and reliability standards of the system, which shall be approved by the Commission and the authorized body of the Government of Armenia.*
>
> *3. Electric energy System Operator Licensee must ensure compliance with the safety and reliability standards contained in the Market Rules, while implementing the process of planning, coordination and dispatching".*

In 2012 the "RA Scientific Research Institute CJSC" produced a Report "Development of Armenian New Reliability and Security Indicators". This Report is a detailed technical consideration of the subject, but does not cover the issues associated with interconnected operation with Iran or other neighbouring countries. Because of its technical nature it is not suitable for use as a Standard.

In 2013 the Armenian Electricity System Operator asked for assistance under the Inogate Program in applying this section of the Law, to implement the results of the Research Report. It was agreed that Toby Manning would undertake this assignment on behalf of Inogate.

The Consultant made 3 visits to Armenia. The first was a fact-finding and orientation mission: the second was to present the draft results. During the third mission he ran a Workshop to discuss how the proposals should be implemented.

Details of the three Missions, and the meetings held, are given in Appendix 1.

The Consultant examined the position, and concluded that four documents should be introduced or amended. These are as follows:-

a) The Law. Although a change is not considered essential, changes are desirable.

b) "Safety and Reliability Standard", required by the existing Law.

c) A Quality of Supply Standard.

d) An annual Performance Report

Of these four documents, the second and third are Standards. The Safety and Reliability Standard is as described in the Law; the Quality of Supply Standard describes the service quality that Users connected to the electricity system may expect to experience.

The final document describes the performance of both the System Operator and Users connected to the system, and helps the Ministry, the Regulator and the public assess the performance of the electricity industry.

These four documents enable the technical principles included in the RA Research Report to be implemented on the Transmission System of Armenia.

In parallel with the work described in this Report, a Grid Code was being developed. Although it was produced independently of this Report, the two documents are broadly compatible.

However, the Grid Code is seriously deficient in two areas. Firstly, it does not adequately consider the effect of interconnected operation (particularly with Iran), and secondly it makes unreasonable assumption concerning the Scheduling and Dispatch process.

2.1 Next Steps

In order to move forward the following steps need to be taken:-

- Identify the full contractual relationship with Iran, particularly as it applies to frequency control, and make the appropriate amendments to the Grid Code and the Standards outlined in this document.
- Take the three new documents described in this Report (Safety and Relaibility Standard, Quality of Supply Standard and Performance Report), put them into standard Armenian format and submit to the Regulator and the Ministry for approval
- Review the Grid Code with respect to the Scheduling and Dispatch process and make the necessary amendments
- Produce three additional standards referred to by the Grid Code (Technical Standards, Ancillary Srvices and Emergency Operation).

3 INTRODUCTION

Every transmission system needs a set of rules to indicate to the System Operator if the transmission system is satisfactory. These rules are required for all timescales: in planning timescales they determine if investment is required, while in operational planning timescales they are used to assess if the proposed maintenance plan is acceptable. In real-tine they are used to determine if the Dispatch Schedule is acceptable.

These rules are referred to as the "Safety and Reliability Standards[1]".

The Armenian system inherited Safety and Reliability Standards from Russia, and these date from when Armenia was part of the USSR. However, Armenia is no longer part of the Russian electricity system, instead being normally interconnected with Iran, so it is necessary to review the Standard to ensure they are appropriate for the 21st century.

The first phase of this review was undertaken by RA Scientific Research Institute CJSC in 2012, with a project financed by the International Finance Corporation. They produced a Report[2] which reviewed the existing (Russian) standards, and identified how they should be amended to bring them up-to-date.

Although this report identified the changes that should be made, it was of a technical nature and not suitable for implementation as a Standard. The Armenian System Operator therefore asked the Inogate project for assistance from its Ad-Hoc Expert Facility (AHEF) in 2013, and Inogate asked the author to undertake the assignment.

3.1 This Report

This Report is in 8 sections, of which this is section 1.

Section 2 contains a brief summary of the Armenian Electricity System.

Section 3 contains proposed changes to the Law.

Section 4 contains the proposed text of the *S*afety and Reliability Standard.

Section 5 contains the text of the proposed Quality of Supply Standard.

Section 6 describes the contents of the proposed Annual Performance Report.

Section 7 gives the Conclusions, and identifies the next steps required

Section 8 contains the Appendices.

It should be noted that this suite of documents assumes that a Grid Code is in place.

[1] An early translation of the Law into English used the term "Safety and Reliability Standards". A more appropriate English term would be "Transmission Security Standard", but in this document "Safety and Reliability Standard" is used for consistency. It is understood that this confusion does not exist in Armenian, where the same word is used for "safety" and "security".

[2] Development of Armenian EPS New Reliability and Security Indicators. Report by RA Scientific Research Institute CJSC, Yerevan 2012.

The original Application Form suggested that the Project would require 3 items of Legislation and 5 standards. However, following the discussions during the first mission, when it became clear that this was only a preliminary estimate, it was decided that the requirement was:-

- 1 item of legislation (a revision to the Law)
- 2 New Standards
- 1 Annual Performance Report.

Throughout this document a number of numerical values are suggested for limiting conditions. These are generally shown in square brackets []. These represent the Consultant's initial proposals, and are subject to change following detailed discussions with the System Operator and other stakeholders.

3.2 Non Compliance

During the Consultant's first mission, the System Operator asked for advice concerning how it ensures that other parties comply with the various laws, rules and regulations covering the electricity system.

An important component in ensuring compliance with rules, standards and procedures is to maximize **transparency** for all parties. This means that everyone can see what is happening, and there is no possibility of hiding what is happening. The publication of the proposed Annual Performance Report (see Section 6) is an integral part of this process.

The law states that the System Operator must "ensure compliance with the Safety and Reliability Standards of the system".

While the EPSO is clearly responsible for ensuring that it complies itself with the Security and Reliability Standards, it cannot be responsible for ensuring that other parties comply: the EPSO does not have the power or authority to make other parties comply. If parties other than the EPSO are non-compliant then this must be the responsibility of the Regulator (the Commission) or the Government.

However the SO does have a responsibility to its best to ensure compliance by other parties, and this should be done by:-

- Ensuring that all other parties are aware of their obligations
- Informing (initially) other parties if it believes that they are non-compliant
- Reporting any resulting non-compliance to the Commission and the Government.

There are two areas where non-compliance may occur: these are in the area of Long-term Planning, and Dispatch. These are considered separately below.

3.3 Long-Term Planning Compliance

Currently the Armenian Transmission System complies with the Transmission Security Standard. However, in the future it is likely that additional investment will be required, as a result of power station closure, new power station construction or demand growth, but it may be that this investment is not forthcoming.

If there is a projected shortage of generation, it is possible that neither the government nor the private sector will come forward with the necessary investment. If a significant transmission investment is required, it is possible that the Transmission Company is unable to finance it, or that the necessary environmental permits cannot be obtained.

As a result, it is possible that the system will not comply with the Transmission Safety and Reliability Standard.

In such cases it is clear that any such shortfall is not the System Operator's responsibility, although it may be that the System Operator will be blamed.

This is a recognised issue world-wide. There are four significant steps that the System Operator can take to reduce the risk that it is considered to be responsible for any non-compliance:-

a) Communicate with other Users (Generators, Distribution Companies, the Transmission Company) to ensure that the facts are known and understood
b) Lobby government to ensure that the necessary investment is undertaken
c) Publish predictions
d) Plan closely with utilities in neighbouring countries

It is normal practice throughout Europe for the System Operator to publish data showing the likely future direction of the electricity system. This usually takes the form of a "planning document" looking forward for up to 10 years. This prediction covers issues such as:-

- Demand predictions
- Details of existing generation
- Predictions pf geeration openings and closures
- System adequacy forecast
- Import/export predictions
- New transmsision investment required

The European Network of System Operators (ENTSO-e) requires all its members to provide such a prediction every 2 years; these are then combined into a document which covers the whole of Europe[3].

[3] See https://www.entsoe.eu/major-projects/ten-year-network-development-plan/

3.4 Compliance with Dispatch Instructions

Another way in which a party other than the System Operator can be non-compliant, is by failing to follow Dispatch Instructions. Dispatch Instructions are the instruction given by the System Operator to operate the system: the procedures for issuing Dispatch Instructions will be included within the Grid Code (Scheduling and Dispatch Code section).

The Scheduling and Dispatch Code is expected to contain the following concepts:-

Scheduling

"On each working day, each Generating Company will provide an **availability declaration** and will provide any change to the **Scheduling and Dispatch Parameters** for each Generating Unit before [10:00].

The **availability declaration** will state, for each half-hour of the following day, the expected available generation from each generating unit. The **Scheduling and Dispatch parameters** will give the limitations on generation dispatch. These will include notice to synchronise, generation ramp rate limitations, and the MW/MVAr envelope (as given by the Performance or Capability Chart).

If at any time from issuing the **Availability Declaration**[4], the Generating Company becomes aware that either the generator availability or the **Scheduling and Dispatch Parameters** have changed, then it shall immediately notify the System Operator. Not later than [15:00] on each working day the System Operator will issue the Generation Schedule for the next day.

The Generation Schedule will show, for each half-hour of the succeeding day, the expected output required from each Generating Unit.

On Fridays, and other days prior to public holidays, the **availability declaration** and generation schedule will cover the period of time up to and including the next working day..

Dispatch

Real–time operation will be governed by the issue of Dispatch Instructions. These will be issued by the System Operator to Power Stations and other Users[5].

All Dispatch Instructions to Power Stations must comply with the **Scheduling and Dispatch Parameters** of their generating units**.** It will be assumed that the Power Station will have a period of [2] minutes before it needs to comply with the Instruction.

For example, if the **Scheduling and Dispatch parameters** specify a maximum ramp rate of 5 MW/min, and a 400 MW generating unit is currently operating at 300 MW, then an instruction given at 10:00 to "increase output to 350 MW by 10:12" is a valid Dispatch Instruction, but specifying 10:11 would be invalid. Similarly specifying a MW/MVAr combination which lies outside the envelope of the Performance (Capability) Chart would be invalid.

[4] Items in bold are expected to be terms which are defined in the Grid Code

[5] A term to encompass Generators, the Transmission Owner and Distribution Companies.

The System Operator may also issue Dispatch Instructions to the transmission owner to:-

- Open or close a circuit breaker or other switch
- Alter the tap position on a transmission grid transformer

In cases of emergency, the System Operator may also issue Dispatch Instructions to the Distribution Company to reduce demand.

All Dispatch Instructions will be numbered by the System Operator. They will be issued by telephone, and shall be recorded by the System Operator. Power Stations may also record them if they wish.

In the event that a User is unable to comply with a Dispatch Instruction, or the User considers the Dispatch Instruction to be invalid, the User shall immediately inform the System Operator.

All Users must comply with valid Dispatch Instructions. A failure to comply with a valid Dispatch Instruction shall be considered to be a Dispatch Instruction Failure.

The System Operator will keep a record of Dispatch Instructions, and shall report to the Regulator the number of Dispatch Instruction Failures for each Generating Company.

Emergency Dispatch Instruction

If necessary, the System Operator may issue an "Emergency Dispatch Instruction". This may not be a valid Dispatch Instruction (e.g. it may not comply with the Scheduling and Dispatch parameters). All Generators are to comply as far as possible with such Emergency Dispatch Instructions, but there is no penalty for not complying.

Dispatch Instruction Failures

A Section is to be added here describing appropriate error limitations, for example MW dispatched must be within +/-[5]% or [5] MW, whichever is greater.

It is the responsibility of all Users to report Dispatch Instruction Failures to the System Operator as soon as possible.

If the System Operator identifies a Dispatch Instruction Failure, whether reported to it or not, then he shall immediately contact the User by telephone, to:-

- Inform the User that, in the System Operator's opinion, there has been a Dispatch Instruction Failure
- To ascertain the reason for the failure
- To issue a further dispatch instruction that the User agrees can be met.

The System Operator may also issue Dispatch Instructions to other Users, depending on the state of the system.

If the User wishes to dispute the Dispatch Instruction Failure, then it shall do so within [2] working days.

In the event of a Dispatch Instruction Failure, the System Operator shall determine whether the failure is major or minor. Minor failures shall be reported to the Regulator, but no further action shall be taken.

Major failures shall be investigated[6].

The determination of whether a Dispatch Instruction Failure is major or minor shall be at the System Operator's absolute discretion.

For example if a failure has only minor consequences to the system operation it may be classified as a minor failure. However, if a Power Station persistently has Dispatch Instruction Failures then the System Operator might declare a major failure to initiate a detailed investigation into the cause of the failure.

3.5 Consequences of Failure

It should be stressed that the System Operator has no powers to punish any other party for a failure to comply with the Grid Code (including Dispatch Instructions) or any other standard. It is the System Operator's responsibility to report all such events to the Commission.

All non-compliances, both major and minor, will be reported in the Annual Performance Report as described in Section 6. This will ensure transparency.

If the non-compliance is major then a senior management representative from the System Operator must immediately contact his/her opposite number in the non-compliant organisation, to seek to resolve the issue. The System Operator shall also inform the Commission.

3.6 Relationship with RA Research Report

In 2012 the RA Scientific Research Institute" CJSC published a Report entitled "Development of Armenian EPS New Reliability and Security Indicators".

This Report comprehensively examined the old (Russian) indicators, and recommended some minor changes to bring them up to international standards. It is a detailed technical report which covers the issues in detail. However, it does not cover the issues associates with interconnected operation (with Iran or other neighbouring countries), and its technical nature makes it not suitable for direct implementation as a Standard.

The major conclusions were reported in Tables S1, S2 and S3 of the Report.

Table S1 deals with the contingencies[7] which are to be considered. These contingencies have been included in the proposed "Transmission Security Standard" - see Column 4 of Tables 1, 2 and 3 in section 4.

Table S2 deals with "Security Indicators". These are the numerical values of certain parameters which must be met. These parameters can be split into three types:-

[6] It is assumed that Armenia has standard methods of making such investigations, and these will be used here.

[7] Contingencies are faults, and other events, which should not cause adverse events on the transmission system (see section 13.1).

- There are limiting values (of, for example, frequency and voltage) which must be met, and are included in the "Quality of Supply Standard" in Section 5
- There are consequencies of the contingencies included in Table S1, which are included in the proposed "Transmission Security Standard" - see Column 5 of Tables 2, 3 and 4 in section 4.
- There are Indicators covering reserve and response. These Indicators are not relevant to the documentation proposed within this Report, for two reasons: firstly, the values do not take into account the interconnected nature of the transmission system, and in particular that frequency control is undertaken by Iran, and secondly these issues are internal issues for the System Operator: ensuring adequate reserve and response is the way in which the System Operator meets the frequency requirement included in the "Quality of Supply Standard" (see Section 5).

Table S3 of the RA Research Report is a set of proposed implementations, and is outside the scope of this document.

SECTION 2: THE ARMENIAN ELECTRICITY SYSTEM

4 INTRODUCTION

Armenia is a small landlocked country in the Caucasus, bordering Georgia, Azerbaijan, Iran and Turkey. Until 1991 it was part of the USSR.

5 ELECTRICITY SYSTEM STRUCTURE

The Armenian electricity system has been partially unbundled. Generation is subject to competition, with 6 major companies running power stations: however, the remaining parts of the electricity system consist of monopolies. There is a single company owning (but not operating) the Transmission System, and a company which owns the distribution system and is also the single supplier.

System Operation is undertaken by a separate company, the Transmission System Operator. This organisation has 220 staff, of whom 80 work at their Headquarters. The System Operator is a state-owned company, with a Board of Directors appointed by the Government.

6 GENERATION

Generation is from nuclear, hydro and gas (both steam turbine and combined–cycle plants). There is a small amount of wind and photovoltaic generation.

The Armenian system has a surplus of generation, some of which is exported to Iran with which it is interconnected. There is also some energy interchange with Georgia and Artsakh (Nagorno-Karabakh).

7 DEMAND

The table below gives some typical Demand values for 2013.

Table 1 Demand on the Armenia Electricity System[8]

Month	January	July
Typical Maximum (MW)	1245	900
Typical Minimum (MW)	695	513

8 TRANSMISSION SYSTEM

The Transmission system consists of a network operating at 220 kV and 110 kV. A 400 kV interconnection with Iran is under construction.

The primary distribution voltage is 38 kV.

[8] Information provided by System Operator

8.1 Ownership Boundary

The following are the ownership principles adopted in Armenia:-

- Generators will own all Generating Equipment, the Generating Unit step-up Transformer and the associated high voltage substation
- Distribution Companies will own the Distribution Supply transformers (typical voltage ratio 110/38 kV), and the associated 110 kV substation
- All other equipment operating at 110 kV or above will be owned by the Transmsision Owner.

9 INTERNATIONAL CONNECTIONS

Armenia is normally linked synchronously to Iran; it is only under exceptional circumstances (normally associated with maintenance of the interconnecting circuits) that this link is broken. It was estimated by the System Operator that this would be the case for approximately 1 week/year (i.e. 2% of the time)[9], and this value would significantly reduce to close to zero once the 400 kV reinforcement to Iran was commissioned.

Georgia is normally linked synchronously to Russia, but occasionally this link is broken or taken out of service, in which case Georgia is linked synchronously to Armenia. The same is true of Artsakh (Nagorno-Karabakh).

The capacity of the link with Iran is limited to about 350 MW (if the export is any larger then the contingency outage of circuit Eghegnadzor – Lichk will cause overloading of circuit Eghegnadzor – Aravat, or *vice versa*). This limitation will be increased to 1000 MW when a 400 kV reinforcement is completed, probably in 2015.

It appears that the trading with Iran is relatively informal: Iran treats Armenia as a "tolling plant" (where they supply the fuel, and take the electricity in return[10]).

10 FREQUENCY CONTROL

The Iranian electricity system, with a peak demand of over 40 GW, is about 30 times greater in size than the Armenian one (peak demand around 1.25 GW). This means that, when the two systems are being run interconnected, that Iran is responsible for frequency control: although Armenia will make a contribution, it will be swamped by that of Iran. Hence frequency control will depend largely upon the governor settings of generation in Iran, and how the Iranian generation is operated[11].

This means that the stated objectives[12] of having the frequency being

- within 50 +/- 0.05 Hz for 60% of the time

[9] Discussions held in January 2014

[10] While this arrangement would cover the "tolling plant's" variable costs, it would not cover the fixed costs, It was suggested that these are covered by the provision of additional natural gas. However, it is not clear if Armenia gains or loses from this arrangement.

[11] Iran may also be interconnected to other countries: a recent press report said "Iranian Energy Minister Majid Namjou said Iran's electricity network has integrated into power grids of seven neighbouring countries including Afghanistan, Pakistan, Iraq, Turkey, Armenia, Azerbaijan and Turkmenistan". In this case Armenia has even less effect on system frequency.

[12] See Paragraph F2 of the RA Research Report

- within 50 +/- 0.1 Hz for 97% of the time
- within 50 +/- 0.2 Hz for 99.99% of the time

while laudable, are not within Armenia's control. Accordingly they should not be used as targets unless the Armenian system is being run in islanded mode.

However, Armenia should use disconnection from Iran as a final resort in the event that the frequency deviates significantly from 50.0 Hz. This can only be used if:-

- Armenia is exporting and the frequency is low
- Armenia is importing and the frequency is high.

10.1 Tie-line control

An alternative to frequency control is "tie-line control". In this case the output of the generation in Armenia is adjusted so as to keep the export (or import) to Iran constant.

Tie-line control is generally used where it is important to control the amount of import/export, for example where there are contractual reasons or where excessive power flows would lead to equipment overloading.

It is understood that tie-line control is not used between Armenia and Iran.

11 VOLTAGE CONTROL

The Armenian transmission system is normally run with voltage limits of +/- 5% at 400 kV, and +/- 10% at 220 kV and 110 kV[13]. As in most transmission systems, voltage is controlled by the operation of excitation systems on large generators and transformer tap changers. There are no specific voltage control devices, (capacitors, reactors, SVC's etc.).

Some of the hydro generators can be run economically at low real power output, but delivering significant quantity of reactive power (ultimately operating as a synchronous compensator).

The system shows the usual characteristics of having potentially low voltages at high demand levels, and high voltages when the demand is low.

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[13] See Paragraph 6.2.5 of the RA Research Report

SECTION 3: PROPOSED CHANGES TO THE LAW

12 THE LAW

Article 37 of the Armenian law on Energy, which was enacted in 1997 and revised by the National Assembly in 2001, requires that:

> *"2. Electric energy System Operator Licensee, based on the requirements of the Technical Rules and Procedures and cooperating with Operational Licensees prepares safety and reliability standards of the system, which shall be approved by the Commission and the authorized body of the Government of Armenia.*
>
> *3. Electric energy System Operator Licensee must ensure compliance with the safety and reliability standards contained in the Market Rules, while implementing the process of planning, coordination and dispatching".*

This gives rise to the following issues:-

- Paragraph 2 refers to "*safety and reliability standards of the system",* while paragraph 3 refers *to "safety and reliability standards contained in the Market Rules"* although the two standards are the same[14]
- It may not be possible for the System Operator to "ensure compliance" as it does not have the necessary powers.

The requirement in paragraph 2 is covered by Section 4 of this report.

The requirement in paragraph 3 is considered to mean that the System Operator must plan, coordinate and dispatch the system in accordance with the Safety and Reliability standards. This assumes that all parties cooperate to ensure this happens. This process of co-operation will be laid down in the Grid Code. However, the wording does not cover the case where another party fails to cooperate (by, for example, not complying with the Grid Code).

12.1 Proposed Changes to the Law

The current Law only deals with the Safety and Reliability ("Transmission Security") Standard and does not mention any requirement to produce a Quality of Supply Standard or a Performance Report. These requirements could be introduced by amending the Law, or by administrative action by the Regulator.

No changes to section 2 of Article 37 of the Law are proposed, although it is not clear what is meant by the term "Technical Rules and Procedures".

It is suggested that Section 3 be re-worded as follows:

> *3. Electric energy System Operator Licensee must comply with the Safety and Reliability Standard, while implementing the process of planning, coordination and dispatching".*

[14] It is possible that this apparent confusion has come from the translation, and is not in the Armenian original.

The paragraph has been reworded to avoid the implication that the System Operator is responsible for ensuring compliance with the Grid Code (and other standards) by other parties.

> *4. Electric energy System Operator Licensee, based on the requirements of the Technical Rules and Procedures and cooperating with Operational Licensees prepares Quality of Supply Standard, which shall be approved by the Commission and the authorized body of the Government of Armenia*

This new paragraph requires the System Operator to prepare a Quality of Supply Standard.

> *5. Electric energy System Operator Licensee prepares an annual System Performance Report which shall be submitted to the Commission and the Government of Armenia, and published on its web-site. This Report shall include statistics to demonstrate the number of times that the System Operator Licensee has failed to comply with the Transmission Security Standard and will include data showing the number of times such non-compliance is due to the actions of participants other than the System Operator. The format of this Report is to be approved by the Commission.*

This new paragraph requires the System Operator to prepare, each year, a Report on System Performance. The **format** of the Report is to be approved by the Commission, but the contents are the responsibility of the System Operator. The Report is to be made publicly available.

12.2 Derogations / Dispensations

There will be occasions when an item of equipment is unable to comply with the Grid Code, for example a fault in the excitation system may restrict the reactive (MVAr) capability of a generating unit. There may also be some other standard which cannot be met (for example a long-term failure of an item of transmission equipment may mean that the System Operator cannot meet the Safety and Reliability Standard).

Such cases of non-compliance may be temporary, where repair is economic but will take some time, or permanent (where repair is uneconomic).

In all such cases the Commission may grant a Derogation. This grants permission for the non-compliance. The derogation may be permanent, or time-limited.

It is normal practice for the owner of the deficient equipment to apply for a Derogation. The Regulator will seek the advice of the System Operator before granting any Derogation.

The procedure for issuing Derogations needs to be enshrined in the Law, and the following paragraph is proposed:-

> *6 Where any party considers that compliance with any regulation or standard is technically impossible, or uneconomic, they may apply to the Commission for a Derogation which would permit the non-compliance. The Commission shall consult with the Electric energy System Operator Licensee before issuing any Derogation*

SECTION 4: PROPOSED ARMENIAN TRANSMISSION SECURITY STANDARD

13 SAFETY AND RELIABILITY STANDARD FOR ARMENIA

This section describes the "safety and reliability standards of the system" as described in the Law (article 37, section 2).

The standard provides the rules and criteria to determine if the transmission system is fit for purpose. It covers both planning and operation. In planning timescales, the document identifies if additional reinforcement is required; in operational planning timescales it ensures that maintenance outages are co-ordinated between Users, while in real time it identifies if it is necessary to reschedule generation (non-economic dispatch) or to re-switch the system in order to ensure secure operation.

Although this document can be included in the Grid Code, it is normally considered to be separate[15].

13.1 Contingencies

Contingencies are the potential faults which might occur, and which shall not have an adverse effect on the transmission system or its customers.

The contingencies to be considered are as follows:-

- Any permanent fault on a transmission line, normally cleared within 150 ms
- Any permanent fault on a transmission line, cleared slowly (in 500 ms) by back-up protection
- The loss of any generating unit or CCGT module
- A double circuit fault (the simultaneous loss of both circuits on the same tower).

They are listed in Table S1 of the RA Research Report.

13.2 Background conditions for analysis

The principle behind the Safety and Reliability Standard is to ensure that the Transmission System can be operated so that it can continue to operate safely, supplying customers, even if subject to certain faults.

[15] In the UK the document is the "National Electricity Transmission System Security and Quality of Supply Standard", available at http://www.nationalgrid.com/NR/rdonlyres/0F3512E9-EFE9-4A3F-8F0F-57FBD67652DA/52977/NETSSQSSversion23changemarked1.pdf

In Germany it is the "German Transmission Code" which applies to all 4 separate transmission networks (see http://www.vde.com/de/fnn/dokumente/documents/transmissioncode%202007_engl.pdf

In Abu Dhabi it is "TRANSCO Electricity Transmission System Security Standard", available at http://www.transco.ae/media/pdf/Security%20Standard%20Issue%201%20Rev%200.pdf

In Oman it is "Transmission Security Standards", published under Licence Condition 26 and available at http://www.omangrid.com/OEC/UserFiles/File/TRANSMISSION%20SECURITY%20STANDARD%20July%202006%20%2022.pdf

In Kosovo it is "KOSTT Transmission System Security and Planning Standards", available at http://www.kostt.com/website/images/stories/dokumente/tjera/Transmission_System_Security_and_Planning_Standards.pdf

There is a very large number of possible combinations of demand level, generation dispatch patterns, system topology and possible contingencies, and it is not possible to analyse all of these combinations. Instead it is normal practice to identify a few critical (worse-case) combinations, on the basis that if the system can cope with these it will generally be able to cope with other cases.

Realistic assumptions therefore need to be made concerning the background conditions to be considered. These assumptions cover the demand, export to Iran, system topology and generation which is expected to be available.

13.3 Consequences of a Contingency

In general, the system shall be planned and operated so that no contingency shall result in:-

- Loss of suppply (although in some circumstances a limited loss of supply may be permitted)
- System instability
- Equipment overload
- A failure to meet the Quality of Supply Standard (see Section 5).

It will be noted that, during the maintenance period, a limited loss of supply is permitted. This covers cases, for example, where a load is supplied by only 2 circuits; while one circuit is being maintained: a fault on the other circuit will result in a loss of supply.

13.4 Planning Criteria

The Planning criteria are used to determine if system reinforcement is required.

As well as ensuing that the system can supply the demand, it must also be capable of being maintained. It is generally necessary to take each item of equipment out of service for a period of time in order to maintain it, and this is generally done during the summer when demand levels are reduced and the weather is better. Accordingly in planning timescales there are 2 criteria: intact conditions with winter peak conditions, and maintenance conditions with summer demands.

The detailed planning criteria are shown in Table 2. This Table shows the Background condition against which all contingencies are to be assessed.