



ERS-007

# ERS-007 Participant Rolling Outage Plan

## Guideline

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## II. ROLES AND RESPONSIBILITIES

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Name	Position	Content Provided	Page #

### IV. RELATED DOCUMENTS

Internal Document No.	Document Title (Title & Description)
ERP-SD-001	Emergency Response Plan for Electricity and Gas Distribution
EOS-019-019	Vector Emergency Load Shedding Strategy

External Document No.	Document Title (Title & Description)
	Auckland Engineering Lifelines Technical Publication Priority Routes and Critical Sites
	System Operator Rolling Outage Plan (SOROP)



## 1. INTRODUCTION

### 1.1 Purpose

New Zealand's electricity system depends on the availability of sufficient supply of electricity to meet demand at all times in all areas of the country. Certain events could lead to a lack of electricity supply, either nationally or in certain areas. These events include very low rainfall leading to low hydro lake levels, the failure of a major generation plant or a fault on a critical transmission circuit. These events occur infrequently. However, given the widespread disruption they could cause, it is prudent to plan for them.

The EA has therefore introduced the Code to manage the supply and use of electricity at times of severe energy and/or supply shortage. This management would take the form of enforced Rolling Outages implemented across New Zealand to reduce demand in order to meet the reduced supply of electricity.

Under the Code various electricity participants, including Vector, are required to develop Participant Rolling Outage Plans (PROP) to specify the actions that would be taken to:

- Reduce electricity consumption when requested by the System Operator
- Comply with requirements of the System Operator Rolling Outage Plan (SOROP)
- Comply with the Electricity Industry Participation Code
- Supplement the SOROP

Rolling outages would be a last resort after all other options including voluntary savings have been exhausted. Vector will always endeavour to keep supply on to customers. Customers will be kept informed of events.

While this plan outlines Vector's planned response, a change in circumstances or network conditions may require Vector to adjust this plan to the operating conditions at the time.

### 1.2 Definitions

Term	Description
<b>AUFLS</b>	Automatic Under Frequency Load Shedding
<b>The Authority (EA)</b>	Electricity Authority
<b>Code</b>	Electricity Industry Participation Code 2010
<b>Feeder</b>	A high voltage supply line typically supplying between 100 and 2000 customers.
<b>GEN</b>	Grid Emergency Notice
<b>GXP</b>	Transpower Grid Exit Point
<b>PROP</b>	Participant Rolling Outage Plan (this plan)
<b>Act</b>	Electricity Industry Act 2010
<b>Rolling Outages or Rolling Cuts</b>	Planned electricity disconnections spread over different parts of the network at differing times to avoid prolonged outages at any one location.



Term	Description
<b>SCADA</b>	Supervisory Control and Data Acquisition
<b>SOROP</b>	System Operator Rolling Outage Plan
<b>Supply Shortage Declaration</b>	Declaration made by the System Operator under clause 9.14 <i>Supply shortage declaration</i> of the Code
<b>System Operator (SO)</b>	Operator of the national electricity transmission grid

## 2. BACKGROUND

### 2.1 Electricity Authority

The Electricity Authority is an independent Crown entity set up under the Electricity Industry Act 2010 to oversee New Zealand's electricity industry and markets.

In accordance with the Code, the Electricity Authority must approve the SOROP submitted by the System Operator.

### 2.2 Transpower

Transpower is a State Owned Enterprise, tasked with owning and operating New Zealand's National Grid - the network of high voltage transmission lines and substations that transports bulk electricity from the points of generation to distribution line companies such as Vector.

As the System Operator, Transpower manages the real-time operation of New Zealand's electricity transmission system. It keeps the right amount of energy flowing to match supply with demand, and publishes information and forecasts relating to security of supply in accordance with its obligations under the Security of Supply Forecasting & Information Policy (SoSFIP).

### 2.3 Vector

Vector Limited is the electricity network company that owns and maintains the electricity lines and cables that deliver electricity to the Auckland region between Wellsford and Papakura.

### 2.4 Supply and demand

Transpower, as the system operator, controls the transmission network to match generation with customer demand. Constraints on the ability to manage this may arise from:

- Insufficient or excessive generation
- Insufficient transmission capacity

which can, for example, be caused by:

- Low lake levels reducing hydro generation
- Failure of a large generator/generating plant
- Fault on a critical transmission circuit

The first two causes above could lead to an energy supply shortage while the third could lead to a shortage of transmission capacity.

### 3. GENERAL PRINCIPLES

#### 3.1 Range of events

Events that could lead the System Operator to make a supply shortage declaration can be generally categorized as:

- Developing Event – An event that evolves over time, e.g. low hydro lake levels.
- Immediate Event – An event that occurs with little or no warning, usually as a result of a transmission line or major generation failure.

#### 3.2 Major incident

A Developing Event or an Immediate Event will be treated by Vector as a major incident in accordance with Vector's Emergency Response Plan, ERP-SD-001. The Emergency Response Team comprises senior Vector operational managers, electricity specialists and specific experts as required.

Communication with retailers, Civil Defence and other stakeholders will be as defined in the Emergency Response Plan (refer to *Section 3.2 Roles and Responsibilities*).

#### 3.3 Load reduction by Vector

Vector has the ability to reduce load by turning off domestic water heaters. Water heating load reduction is only useful to reduce peak demand. It is of almost no value for energy saving because users simply transfer their energy usage to later in the day. Additional load reductions for response to immediate events, or effective load reductions for energy savings, would require disconnecting customers.

#### 3.4 Automatic reduction

##### 3.4.1 Reserve market

Generators with reserve capacity and users with interruptible load such as distribution networks offer reserve capacity to the Instantaneous Reserves Market to cover the risk of the largest generating unit or a critical transmission line tripping. Vector offers its water heating load into the Reserve Market. Tripping of water heaters in this case is automatic in response to grid events.

Generally, the water heaters are only turned off for a short duration. Due to the inherent storage capacity of water heaters there is little or no effect to customers. Once spinning-reserve generators take up the load lost by the disconnected generator, the water heaters are gradually switched back on.

### 3.4.2 Automatic Under Frequency Load Shedding (AUFLS)<sup>1</sup>

If the load shed by the Reserve Market tripping is insufficient to stabilise the network or if the frequency falls below the reserve market threshold, further automatic load reduction may be required.

Every distribution company is required, unless exempted, to have available, at all times, two blocks of load (each comprising 16% of its total instantaneous load) to be shed by AUFLS relays should an AUFLS event occur.

#### AUFLS Block 1

This will automatically disconnect a minimum of 16% of Vector's load by disconnecting customers' supply.

#### AUFLS Block 2

This will automatically disconnect a further 16% of Vector's load.

Note: a large drop in frequency may cause an AUFLS trip before the reserve market operates.

## 3.5 Manual shedding

Under certain circumstances the System Operator may request Vector to manually shed load. Under the Code, Vector must comply with this request.

## 3.6 Criteria for rolling outages

During a shortage of energy supply or transmission capacity, it may be necessary for the System Operator to request Vector to coordinate and manage rolling outages in order to meet the energy savings target.

To ensure public health and safety is preserved and costs to economy are minimised, the following table shows the desired criteria for selecting feeders to be included in rolling outages.

Table 1: Priority for rolling outages

Priority	Priority concern	Maintain supply to:
1	Public health and safety	Major hospitals, air traffic control centres, and emergency operation centres.
2	Important public services	Energy control centres, communication networks, water and sewage pumping, fuel delivery systems, major ports, public passenger transport and major supermarkets.
3	Public health and safety	Rest homes, prisons, medical centres, schools, and street lighting.
4	Animal health and food production/storage	Dairy farms, milk production facilities, chicken sheds and cool stores.

<sup>1</sup> The AUFLS regime is currently being reviewed. The outcomes will impact on the threshold values and final feeder selection for rolling outages.

Priority	Priority concern	Maintain supply to:
5	Domestic production	Central business districts, commercial and industrial premises.
6	Disruption to households	Residential premises.

These priorities as recommended by the System Operator are intended as guidelines, and because rolling outages will be implemented on a feeder by feeder basis, it is not possible to discriminate between individual customers on the same feeder. For example, a predominantly residential feeder may also have a small number of commercial or industrial customers.

### 3.7 AUFLS criteria

The criteria shown in Table 1 are also used to select feeders for AUFLS tripping. As AUFLS load blocks are predominantly taken from category 6 priority in the table, there is little load left in this priority for rolling outages unless an AUFLS modification notice (Section 3.8) is received from the System Operator. Without such a modification, category 5 and higher groups must be included in rolling outages. However as total load decreases during rolling outages, the amount of load required for AUFLS will also decrease and some feeders reserved for AUFLS blocks may be included in rolling outages.

### 3.8 AUFLS modification

The System Operator may, under clause 7 of Technical Code B of Schedule 8.3 of the Code, specify modifications to the AUFLS rules. This may enable Vector to select feeders normally reserved for AUFLS to be used in rolling outages. However, if network conditions change, the System Operator may revoke the modification at any time. Due to the commitment to customer notification prior to rolling outages, any modified AUFLS groups are unlikely to be included in planned outages because of the uncertainty of their availability. While this plan assumes that no AUFLS modification exists, some AUFLS feeders may be included as indicated in Section 3.7. The PROP will be adjusted as and when required to accommodate any future changes to AUFLS block allocations.

### 3.9 Savings calculations

Savings calculations have been based on the daily average energy consumption at the time rolling outages would take place (08:00 to 18:00). The shutdown duration and the number of feeders selected for rolling outages will depend upon the savings required.

Savings calculations have been based upon the 2016 recorded feeder loads. For simplicity, average energy use has been used during the expected rolling outage period.

### 3.10 Feeder selection

Feeders to be disconnected are set out in the schedule of feeders for rolling outages (ERS-007-1). Because of AUFLS obligations and changes in network configuration, this schedule will

change from time to time. The number of feeders chosen for any one day and week, will depend upon the savings required to meet target. Given that the actual selection of feeders during any outage will most likely diverge from this plan due to operational considerations the schedule of feeders is not made publicly available in order to avoid any confusion regarding which feeders are to be disconnected. In the event of pending rolling outages Vector will advise customers at the time – see Section 7.

### 3.10.1 Auckland region feeders

The number of AUFLS feeders is 286 with 376<sup>2</sup> feeders remaining available for rolling outages. Sixteen feeders supplying essential services will not be included, leaving 360 feeders available for rolling outages.

Table 2: Auckland region average energy consumption based on 2016 data

Auckland region	Average energy consumption
Average daily energy consumption	15265 MWh
Average energy consumption per hour	636 MWh
AUFLS Block 1 substations daily energy consumption	3011 MWh
AUFLS Block 1 substations energy consumption per hour	125 MWh
AUFLS Block 2 substations daily energy consumption	2972 MWh
AUFLS Block 2 substations energy consumption per hour	124 MWh
AUFLS Block 1 total average consumption	19.7%
AUFLS Block 2 total average consumption	19.5%
Remaining average consumption (available for rolling outages)	61%

### 3.10.2 Northern region feeders

The number of AUFLS feeders is 171, with 181 feeders remaining available for rolling outages. Three feeders supplying essential services will not be included, leaving 178 feeders available for rolling outages.

Table 3: Northern region average energy consumption based on 2016 data

Auckland region	Average energy consumption
Average daily energy consumption	7504 MWh
Average energy consumption per hour	313 MWh
AUFLS Block 1 substations daily energy consumption	1974 MWh
AUFLS Block 1 substations energy consumption per hour	82 MWh
AUFLS Block 2 substations daily energy consumption	1790 MWh

<sup>2</sup> The AUFLS regime is currently being reviewed. The outcomes will impact on the threshold values and final feeder selection for rolling outages.

AUFLS Block 2 substations energy consumption per hour	75 MWh
AUFLS Block 1 total average consumption	26.3%
AUFLS Block 2 total average consumption	23.9%
Remaining average consumption (available for rolling outages)	49.8%

### 3.10.3 Number of feeders included

Generally, feeders will be selected from the schedule of feeders for rolling outages<sup>3</sup>. The number of feeders selected will depend upon savings required. Table 4 shows the duration of outages for the percentage savings required.

Table 4: Shed times required to meet savings targets

Savings required	No of days per week	Average time off per feeder each day (Auckland)	Total number of customers affected (Auckland)	Average time off per feeder each day (Northern)	Total number of customers affected (Northern)
5%	5	4 hours	57631	4 hours	41915
10%	6	6 hours	64353	6 hours	47108
15%	7	6 hours	72883	6 hours	52949
20%	7	8 hours	72883	8 hours	52949
25%	7	10 hours	72883	10 hours	52949

The detailed list of feeders associated with percentage savings required are listed in schedule of feeders (ERS-007-01).

### 3.11 Medically dependent customers and priority sites

Vector will endeavour to give retailers as much advanced notice as possible of pending rolling outages to enable them to notify medically dependant customers.

Priority sites listed in Auckland Engineering Lifelines Technical Publication Priority Routes and Critical Sites will be taken into consideration when scheduling rolling outages.

### 3.12 Load variation

To ensure the national transmission network remains stable during rolling outages, the System Operator has requested that Vector's system load should not vary by more than 25 MW in any 5-minute period. This applies both when shedding and restoring load.

<sup>3</sup> The feeder selection for rolling outages will be reviewed, pending outcome of the AUFLS feeder selection process

### 3.13 Grid emergency during Developing Event

If the System Operator declares a grid emergency during a Developing Event, the grid emergency will take priority. As water heating load generally would not be used to reduce load in a Developing Event, Vector would have the water heating load available to respond to the grid emergency. If water heating load is insufficient, the rolling outage feeders may have to be rearranged to comply with the grid emergency. After the grid emergency is over, the programmed rolling outages pattern will continue.

## 4. ROLES AND RESPONSIBILITIES

### 4.1 Vector staff responsibilities

Table 5: Vector staff roles and responsibilities

Role	Vector role responsibility
Receive communication from System Operator	Electricity Operations Centre
Implement this plan	Manager Electricity Operations
Weekly savings reporting	Manager Analytics
Customer notification	Head of Customer Excellence
Revoking rolling outages	Manager Electricity Operations
Reporting to System Operator	Manager Analytics
Reporting to media	Group Manager External Relations
Reporting to public agencies	Government Relations Manager
Reporting to civil defence and Lifelines	Government Relations Manager

If the listed Vector staff member is unavailable, the staff member must appoint an appropriate replacement.

### 4.2 Authority to commence rolling outages

#### 4.2.1 Developing Events

Upon receipt of direction from the System Operator to prepare for rolling outages, Vector's Manager Electricity Operations will inform Vector's management and commence specific rolling outage plan preparations to meet the requirements of the instructions issued by the System Operator. Final authorisation to commence a programme of rolling outages will be made by Vector's Group Chief Executive Officer.

#### 4.2.2 Immediate Events

On receipt of a GEN from the System Operator, Vector's Electricity Operations Controllers are authorised to take all necessary operational steps including the shedding of high voltage feeders

where necessary to comply with the requirements of the GEN. The duty Electricity Operations Controller will initiate a priority notification.

#### 4.2.3 *Operations Planners and Network Support Services*

The Operations Planners together with the Network Support Services team will notify retailers of the extent of outages and where possible ICP numbers of customers affected.

## 5. IMPLEMENTATION AND MANAGEMENT OF ROLLING OUTAGES

### 5.1 **Developing Events**

Rolling outages will be the key mechanism for managing Developing Events. If the Authority uses its authority under the Act to require, through the System Operator, a load reduction for a planned event, Vector must reduce demand to meet the targets. The targets may be a weekly energy savings target that is reviewed each week. To reduce energy usage, Vector would disconnect feeders (rolling outages) in a controlled manner to enable targets to be reached. There are financial penalties on distributors for not meeting targets set by the System Operator. Water heating load shedding is generally not considered to be an effective option for energy savings because it does not result in a significant reduction in overall energy usage – it simply shifts the usage to a different time.


### 5.2 **Rolling Outages**

When instructed by the System Operator to reduce demand, rolling outages will be instigated by Vector's Manager Electricity Operations following authorisation from Vector's Group Chief Executive Officer, as per this plan and outage strategy. The Manager Electricity Operations will ensure advance load shedding schedule is prepared and load is controlled and monitored to meet desired targets. Where possible Vector will endeavour to comply with priorities in Table 1 to select feeders for rolling outages. Vector will endeavour to keep rolling outages to any customer no longer than 4 hours in one day. For savings targets greater than 5%, longer and more frequent outages will be necessary as shown in Table 4.

Outages would be scheduled between 0800 and 1800 Monday to Friday and on Saturday and Sunday for larger savings targets.



### 5.3 Rolling Outages timeline

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Savings target received		Rolling outages commence 			
Feeders selected for rolling outages	Stakeholders notified of pending outages for following week	Stakeholders notified of pending outages for following week	Stakeholders notified of pending outages for following week	Stakeholders notified of pending outages for following week	Stakeholders notified of pending outages for following week
			Savings calculated. Adjustments made to schedule if required for week 6	Savings calculated. Adjustments made to schedule if required for week 7	Savings calculated. Adjustments made to schedule if required for week 8

### 5.4 Shutdown notification

When requested to reduce demand with rolling outages, Vector will endeavour to advise customers in advance, through media channels, of pending outages. Because demand varies from day to day the time and extent of advertised outages will be approximate.

### 5.5 Rolling outages actions

On receipt of the target savings required, the Manager Electricity Operations will:

- Review savings target received from the System Operator and decide whether rolling outages are required to meet the target and the extent of the outages required.
- Determine the number of feeders to be included in rolling outages from feeder list.
- Prepare rolling outages log sheets to list selected feeders and proposed shed times.
- Notify feeder shutdowns and times to:
  - Head of Operational Excellence;
  - Head of Contracted Services;
  - Head of Customer Excellence; and
  - Group Manager External Relations.
- Provide the System Operator with a daily week-ahead forecast of half-hourly system load at each GXP during any period in which rolling outages are scheduled.
- Consult with the System Operator prior to implementing rolling outages to establish a process for shedding and restoration.

- Appoint dedicated Electricity Operations Controllers to control tripping and restoration of feeders via SCADA. Depending upon level of savings required, more than one controller may be required.

## 5.6 Other planned outages

Unless urgent for safety reasons, all Vector planned outages for maintenance will be cancelled during the period of rolling outages.

## 5.7 Supply restoration

Load disconnected during rolling outages must be restored in consultation with the System Operator. This is to prevent overloading the transmission network and creating further instability. Vector will ensure that all feeders are returned to service in a controlled manner to maintain system stability.

## 5.8 Contingent events

If an unplanned event occurs that can alter the planned rolling outages, Vector's Major Incident Team will be responsible for all decisions and communication with stakeholders of any changes to advertised program. Where possible any changes to planned timetable will be published on Vector's Website.

# 6. IMMEDIATE EVENTS

## 6.1 System stability

Transpower, as the System Operator, is required to procure sufficient reserve generation to cover the risk of the largest connected generator tripping. They are also required to maintain the system frequency at 50Hz. If a large generator trips, it may cause a reduction in frequency which if not rectified can result in other generators tripping which could lead to complete failure of the electricity network.

Since reserve generation cannot immediately pick up the load of a disconnected generator, an immediate load reduction is required until additional generation can be brought on line. Automatic load shedding groups reduce load in stages until the frequency stabilises.

## 6.2 Transmission grid emergency

The System Operator may request Vector to reduce load under a GEN. Vector will commence with shedding water heating load and if necessary shed feeders in accordance with the priority list shown in schedule of feeders. If a Developing Event is in place, the grid emergency will take precedence.

### 6.3 Supply restoration

Load disconnected during a grid emergency may only be restored following advice from the System Operator. This is to prevent overloading the transmission network and creating further instability. Vector will ensure that all feeders are returned to service in a controlled manner to maintain system stability.

## 7. COMMUNICATIONS

### 7.1 Stakeholder communications

#### 7.1.1 Background

In a security of supply situation Vector will work with the System Operator and the wider electricity industry in communicating the objectives and targets of a voluntary savings campaign to help ensure customers are as well informed as possible regarding events and plans for any outages.

Generally, security of supply issues arise from generation/transmission constraints, rather than distribution problems. Vector as a network distribution company will therefore follow the lead of the System Operator in implementing measures to restore the integrity of the electricity supply chain.

Depending on the circumstances, whether there is advanced notice of a security supply situation, or an immediate event triggering a grid emergency, Vector may also instigate its crisis management process.

### 7.2 Communication objectives and strategy

Communication objectives will take into account the following two security of supply situations:

- Developing Event – the System Operator will provide up to 14 days notice of a security of supply situation, and up to 9 days notice of a savings target.
- Immediate Event – little or no notice. Vector will act under the instruction of the System Operator in managing the situation.

In both cases, through consistent industry messages and multiple mass communication channels, the objective is to ensure the public are informed of any security of supply issues, industry actions and responsibilities, energy savings measures consumers may need to take and the implications of failing to meet targets. As in existing communication materials Vector will continue to reiterate that it can never guarantee an uninterrupted supply and medically dependent and vulnerable customers do need to prepare contingency plans to be used in the event of an outage. Retailers will have the overall responsibility for communicating with medically dependent and vulnerable customers.

#### 7.2.1 Stakeholders

In order to guarantee consistency of messages and industry approach, Vector will look to the System Operator to establish an industry group to manage coordination of the communications campaign. Vector will coordinate messages with this group and the System Operator.

A component of communications in both situations will be to outline the rolling outage process and which customers will be affected first, with the priority to maintain essential services.

Scenario	Stakeholders	Responsibility
Developing event – up to 14 days notice of security of supply situation with 9 days notice of savings targets	<ul style="list-style-type: none"> <li>• General public (including medically dependant customers)</li> <li>• Central Government</li> <li>• Local Government</li> <li>• Vector executive and Board</li> <li>• Electricity retailers and generators</li> <li>• District health boards</li> <li>• Consumer and industry lobby groups</li> <li>• Media</li> <li>• Business associations</li> <li>• Customer services - Vector</li> </ul>	System Operator/Electricity Authority lead, with support from retailers, generators, and lines companies. Vector will advise on regional specifics.
Grid emergency	<ul style="list-style-type: none"> <li>• Central Government</li> <li>• Local Government</li> <li>• Electricity retailers</li> <li>• District health boards</li> <li>• General public (including vulnerable customers)</li> <li>• Consumer and industry lobby groups</li> <li>• Business associations</li> <li>• MPs</li> <li>• Customer services - Vector</li> </ul>	System Operator lead. Vector will advise on regional specifics.

Vector will keep media and customers informed of planned interruptions to supply before and during the outages. Media will be informed in line with Vector's standard Communications Plan. The Manager Network Support Services, together with the Manager Operations Planning will be responsible for customer notification.

Vector will notify all stakeholders when targets are received and rolling outages are imminent. It is expected that this notification should be at least a week in advance of any rolling outages for a Developing Event. Generally, Immediate Events occur as a result of equipment breakdowns and leave little or no time for advance notification. However, notification of the event would occur as the event proceeded.

### 7.3 Communication with System Operator

All communications with the System Operator will be between Vector’s Electricity Operations Centre and Regional Operating Centre using Transpower’s TSX telephone.

### 7.4 Coordinating with the System Operator

If Vector has to depart from forecast load profile during rolling outages, Vector will communicate direct with Security Coordinator at the System Operator rather than with Regional Operating Centre.

### 7.5 Communication with the Authority

Communication	Contact details
Vector	Manager Electricity Operations Vector Ltd PH: 09 978 7787 101 Carlton Gore Road, Newmarket PO Box 99882, Newmarket, Auckland
Electricity Authority	Electricity Authority PH: 04 460 8860 FAX: 04 460 8879 Level 7, ASB Bank Tower, 2 Hunter Street, PO Box 10041, Wellington

## 8. MEASURING AND REPORTING

### 8.1 Target monitoring

Actual energy savings will be measured by plotting the normal network load graph during period of planned rolling outages and plotting a savings curve for the same period. This way energy savings can be calculated and monitored.

For load shedding to meet a weekly target, Vector’s Manager Analytics, will monitor energy savings against target and together with Manager Electricity Operations, review future load shedding. They will adjust future feeder selection to compensate for any under or over achieving of targets. Vector’s Manager Analytics will be responsible for daily and weekly reporting of consumption relative to target levels. During the period of rolling outages, the Manager Analytics will report weekly by email to the System Operator the actual energy usage compared with the energy used in corresponding week of previous year. The Head of Operational Excellence will report any under or over achieving of targets to the Manager Electricity Operations to enable adjustments to be made in the following week’s feeder selection.

## 8.2 Log of rolling outages

Vector's Electricity Operations Centre will log times of disconnection and reconnection of all feeder interruptions. The Manager Analytics will calculate savings made and enter them into the log. The log sheet to be used by Electricity Operations Centre is in Appendix A.

