National Code of Practice

Emergency Demand Reduction

NRS048-9 Implementation

Rev 1
Presentation: Delegation
Date: 5 Sept 2014

Powering your world

1923-2013

Contents

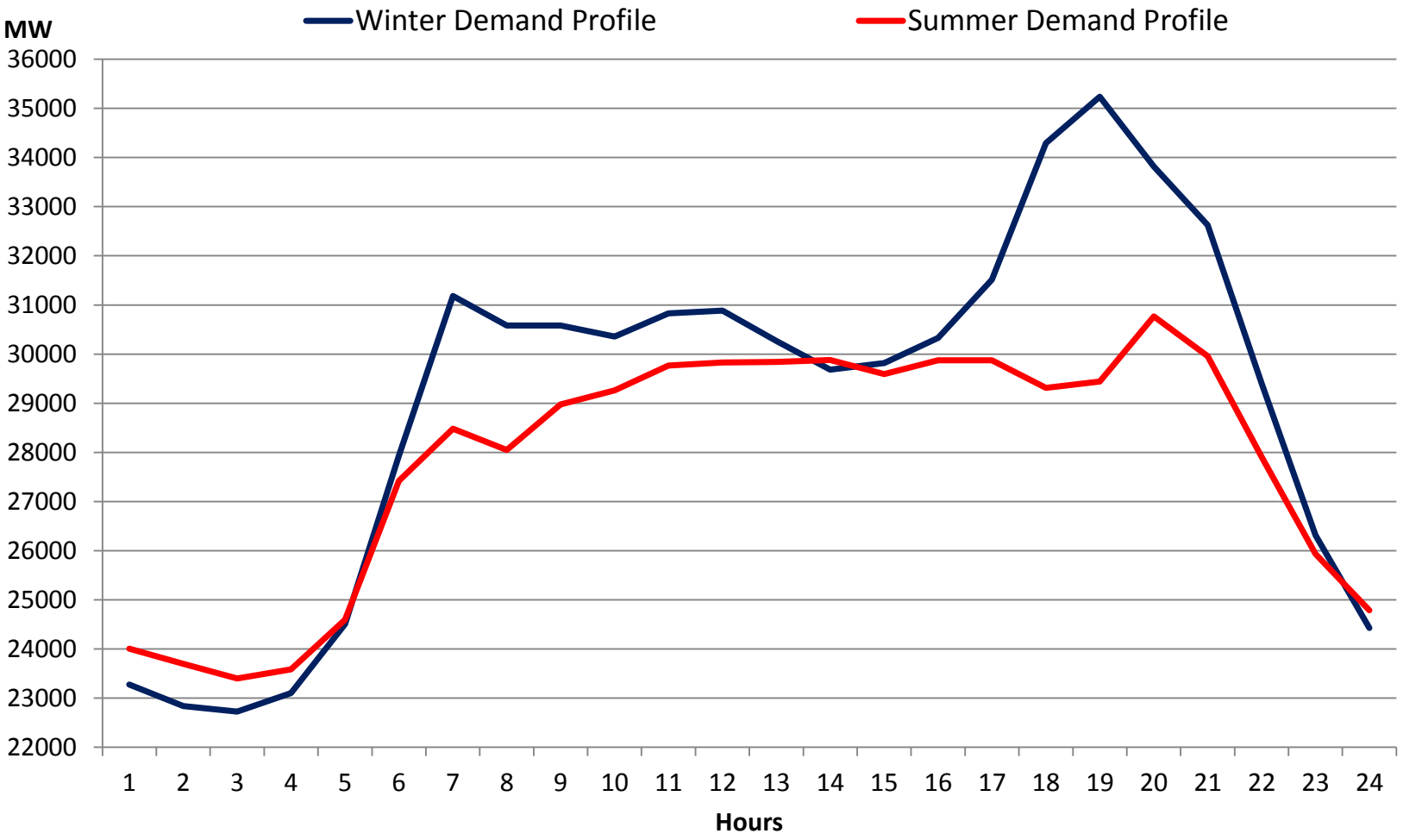
NRS 048-9 Ed.1: 2010

National Code of Practice: Emergency Load Reduction and System Restoration Practices

(*prepared on behalf of the NRS 048 Working Group*)

Published in 2010 by SANS
Approved as a Regulatory Standard & License Condition by NERSA
All NERSA Licensees required to implement by April 2011
(or provide reasons why they cannot)

Summer and Winter Profile



Contents

National Code of Practice (NRS 048-9)

Demand reduction under system critical constraints & emergencies

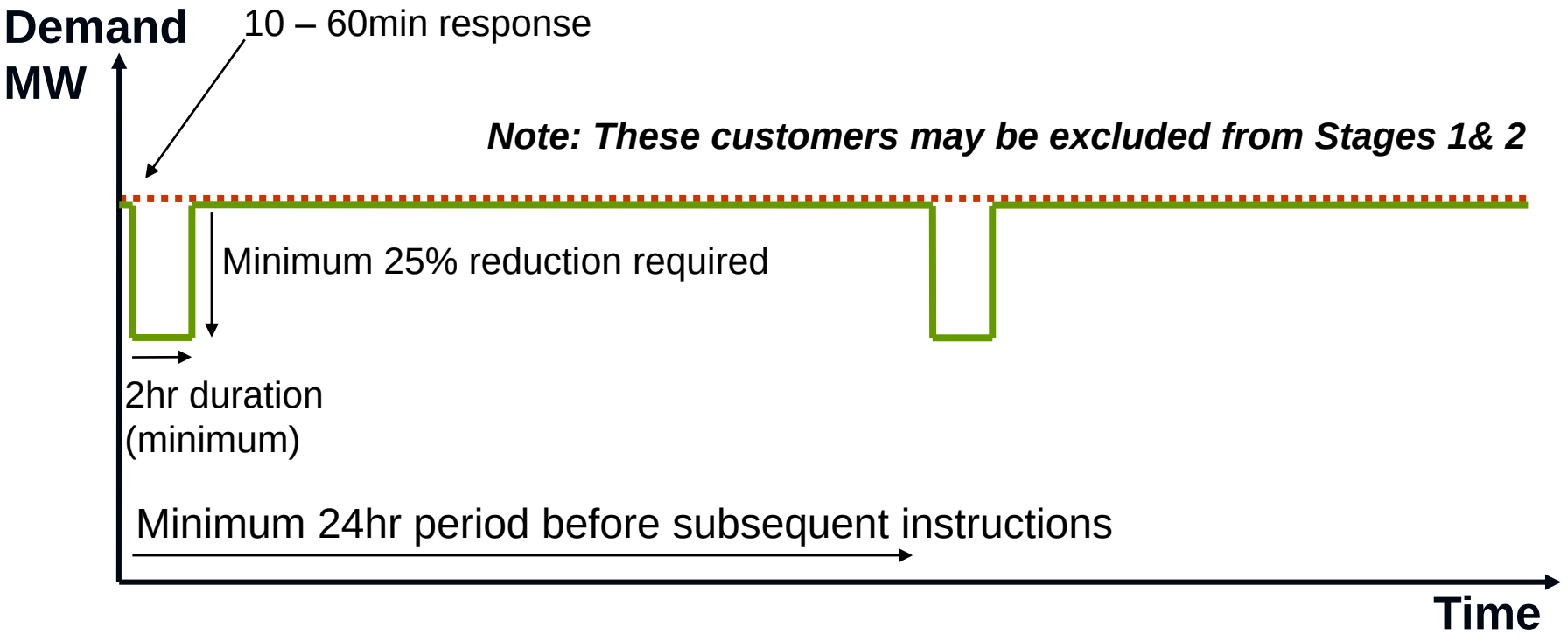
- **Mandatory demand reduction – shedding vs. curtailment**

system emergency

Stage	Type	Reduction obtained by interrupting supply - *load shedding*	Reduction obtained by instructing reduction - *curtailment (pre-agreed)*
Stage 0 70-100 MW	Unscheduled (pre-agreed)	Ad hoc	Load offered by customers under the *immediate* curtailment option (min 25% for 2 hrs)
Stage 1 800-1300 MW	Scheduled / Notified	Shed 5% of national non-curtailment load at peak	Curtail 10% of normal demand within 2h of *notification*
Stage 2 1600-2100 MW	Scheduled / Notified	Shed 10% of national non-curtailment load at peak	
Stage 3 3200-4400 MW	Scheduled / Notified	Shed 20% of national non-curtailment load at peak	Curtail 20% of normal demand within 2hrs of *notification*
Stage 4	Unscheduled (instructed)	Shed >20% of national non-curtailment load at peak	As *instructed* by the National System Operator at the time.

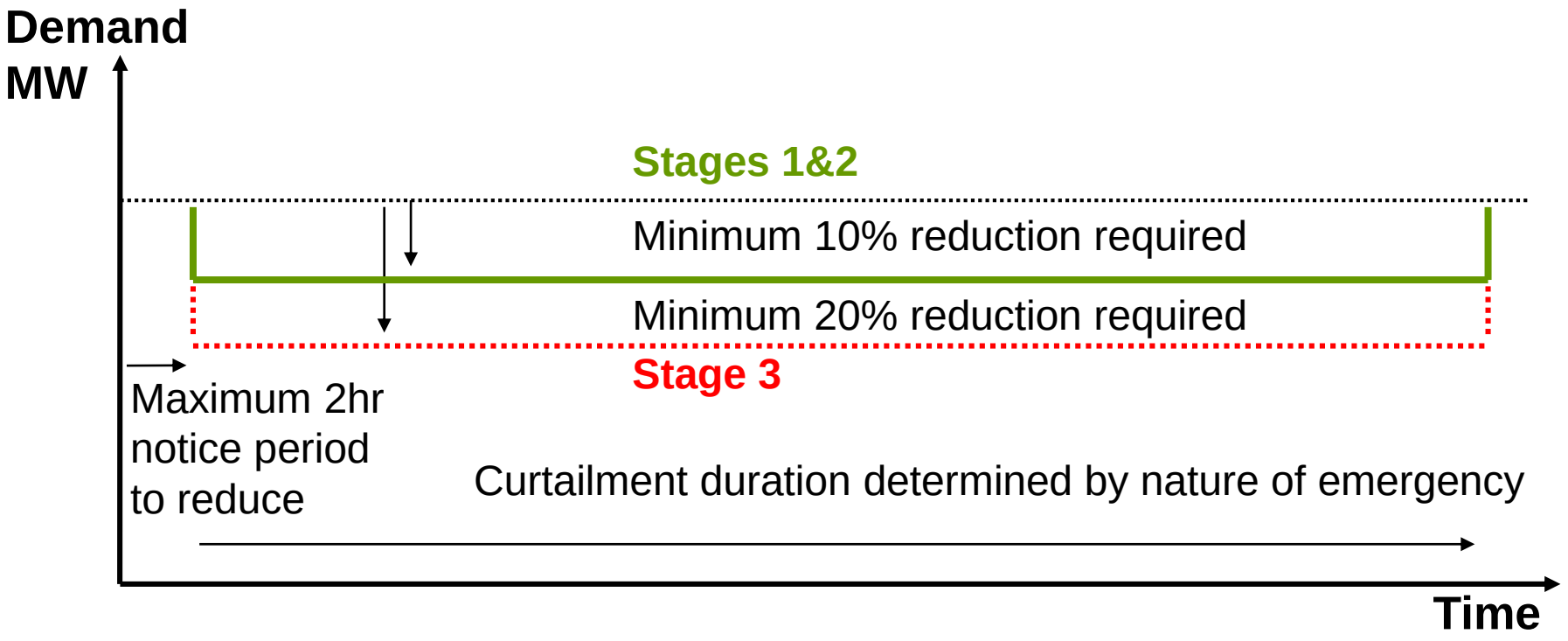
National Code of Practice
Overview – Stage 0 curtailment

- **Customers who meet requirements may elect to reduce their own load (curtail) on instruction**



National Code of Practice
Overview – Stages 1,2,3 curtailment

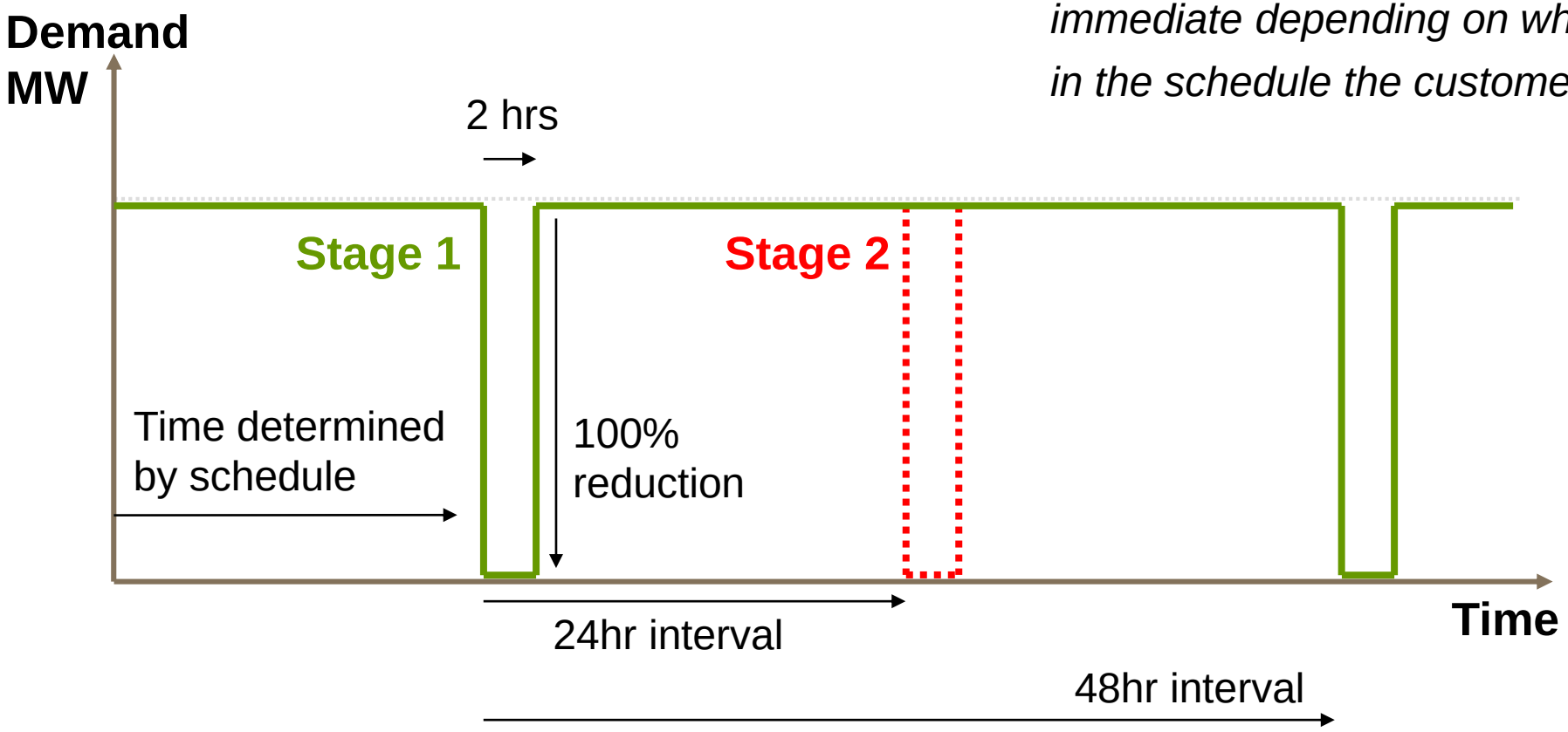
- **Customers who meet requirements may elect to curtail their own load within 2 hrs after notification – for the duration of the emergency**



National Code of Practice
Overview – Stages 1&2 shedding

- **Customers are by default on the shedding schedules**

Note: shedding could be immediate depending on where in the schedule the customer is

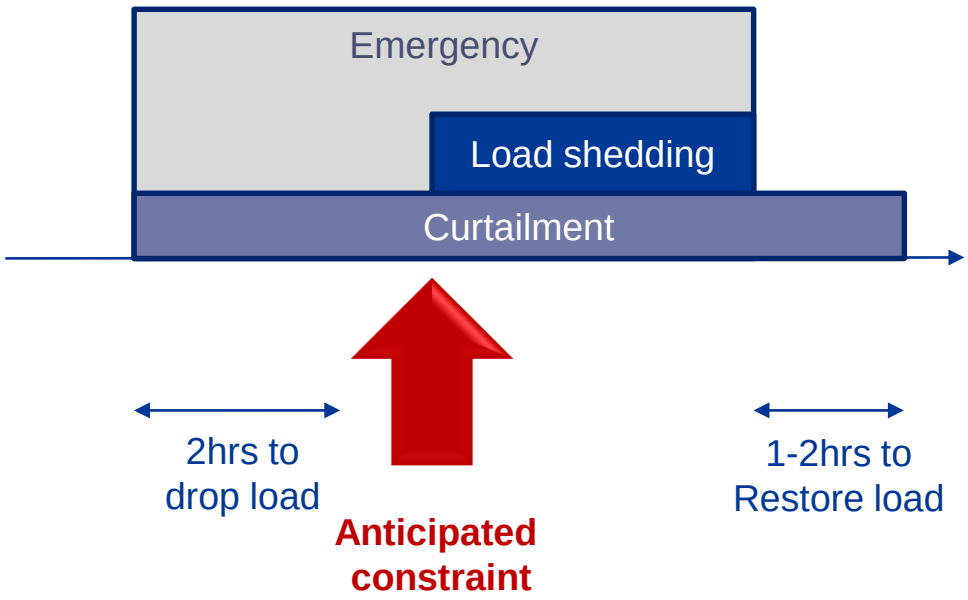


Contents

Mandatory Reduction Options
Declaration of a System Emergency - NRS 048-9

emergency
system emergency
situation that arises on the system as a result of significant loss of generation, transmission, or distribution plant, and where all due precautions and interventions fail to prevent the integrated power system or a localized part of the system from approaching or entering a state of collapse

Load shedding load has a 15-30 min response time
Curtailment has a 1-2hr response time



Mandatory Manual Reduction Options

NRS: Curtailment is instructed with 2hrs notice under a declared system emergency.

NRS: Shedding is instructed immediately under a declared system emergency.

In the event that NRS cannot be initiated in time, NC will open breakers.

In the event that there is no time to open breakers, system security relies on automatic under-frequency load shedding protection scheme, which has to be restored in 10 min

load curtailment
load reduction obtained from customers who are able to reduce demand on instruction

load shedding
load reduction obtained by disconnecting load at selected points on the transmission or distribution system

Meeting demand under a constrained system
Declaration of a System Emergency - NRS 048-9

emergency
system emergency
situation that arises on the system as a result of significant loss of generation, transmission, or distribution plant, and where all due precautions and interventions fail to prevent the integrated power system or a localized part of the system from approaching or entering a state of collapse

Emergency demand reduction (Stage 4)
- Unscheduled load shedding
- Large customer & international load curtailment

Emergency demand reduction (Stages 1-3)
- Scheduled load shedding
- Large customer & international load curtailment

System Emergency declared in terms of the National Code of Practice (NRS048-9)

Voluntary demand reduction
- Country response to calls to reduce load
- Emergency demand market

Contracted demand reduction
- Interruptible loads (Aluminium smelters)
- Demand market participation

Peaking & mid-merit power stations
- Open cycle gas turbines
- Water

Base load power stations
- Nuclear (Koeberg)
- Coal
- IPP's

load curtailment
load reduction obtained from customers who are able to reduce demand on instruction

load shedding
load reduction obtained by disconnecting load at selected points on the transmission or distribution system

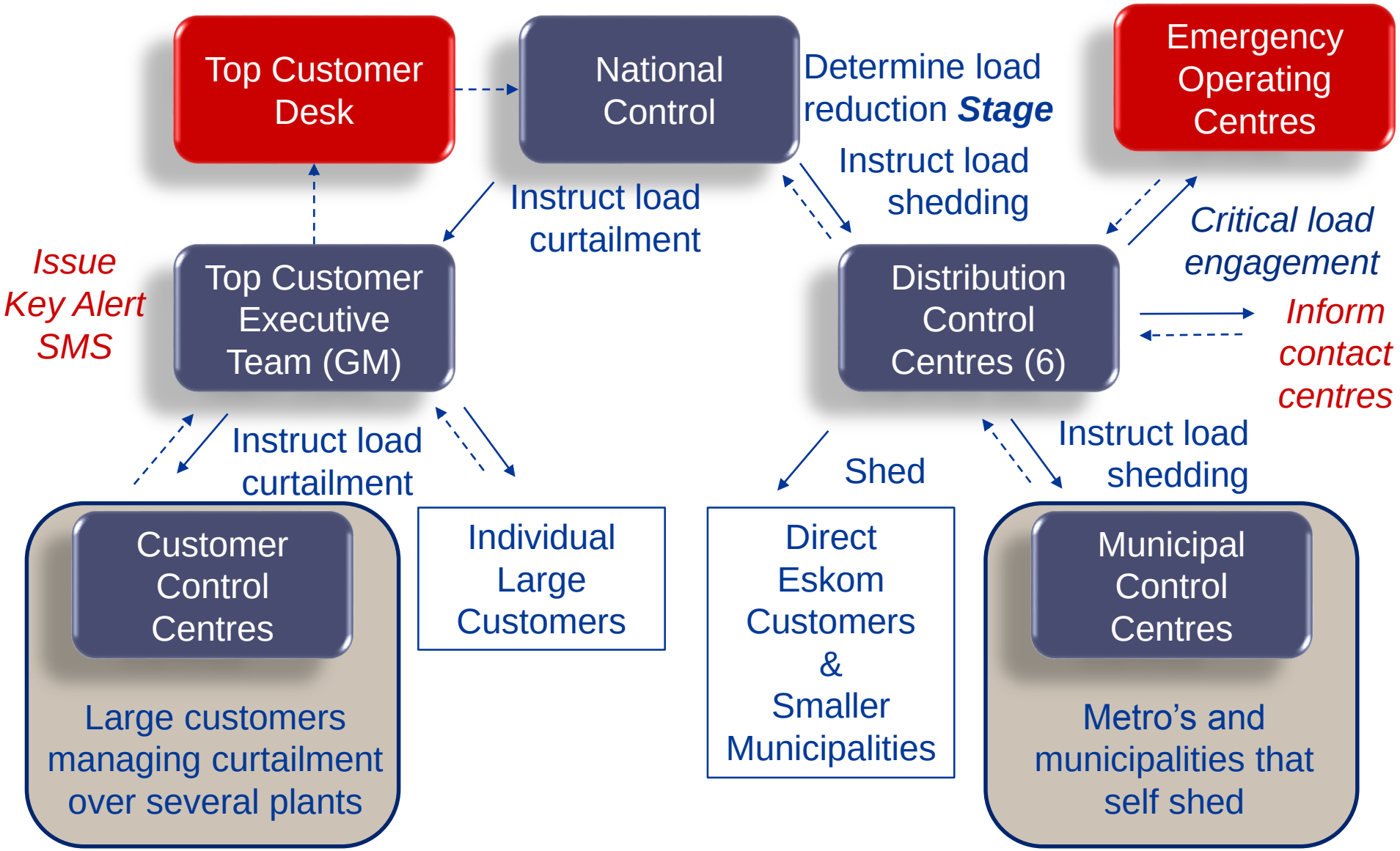
Contents

Protocols

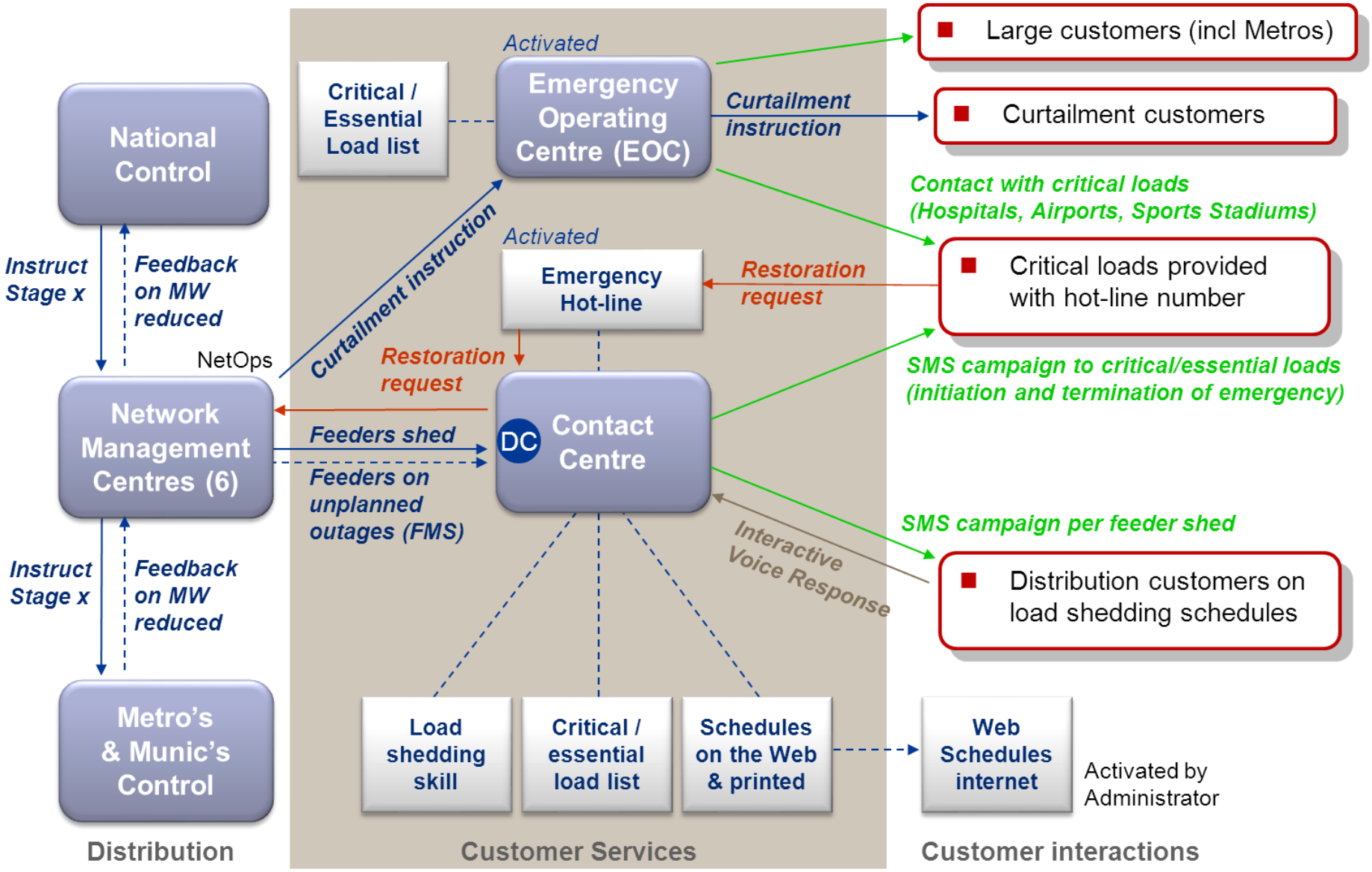
State	Notification	Criteria (example)
Early warning	Internal	2 units (1200MW), and limited Emergency Reserves available
Power System Alert	All control rooms ready for shedding, key stakeholders, general media	1 unit (600MW) and limited Emergency Reserves available
Power System Emergency Declared	All control rooms, key stakeholders, general media statement	Only limited Emergency Reserves available
Power System Emergency Lifted	All control rooms, key stakeholders, all media	System prognosis positive

NOTE: Emergency declaration and operational intervention only – public informed that mandatory demand reduction is implemented.
NOTE: In order to minimize the impact on customers, the emergency is a condition under which reduction is instructed (i.e. Shedding and curtailment can be lifted and reinstated rather than re-declaring an emergency at short intervals).

Load reduction protocols
Operational command – execution of demand reduction

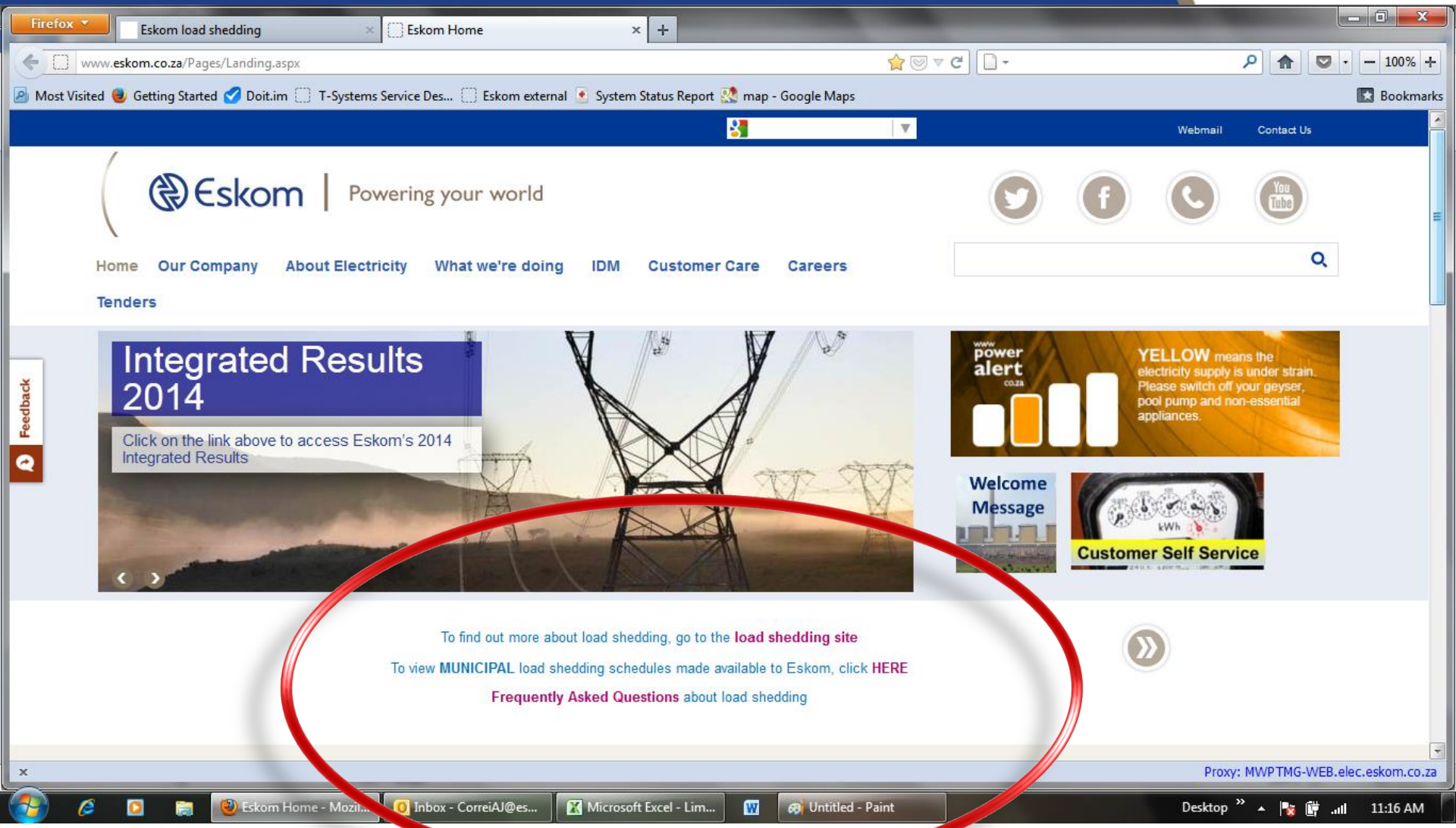


Load reduction protocols
Operational command – engagement

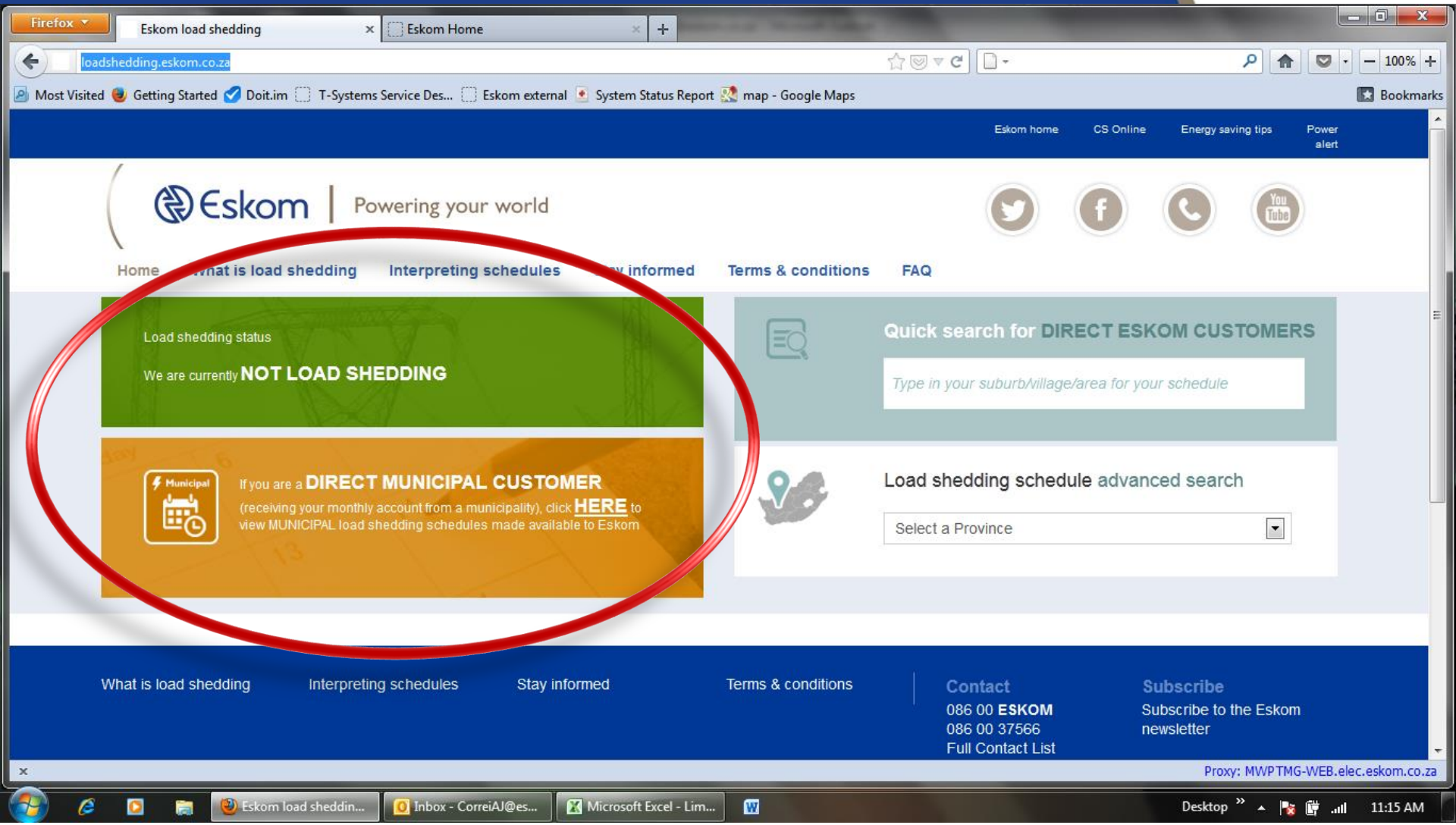


Contents

Website: eskom.co.za



Website: loadshedding.eskom.co.za



Schedule search result

Province: Gauteng

City: City of Johannesburg

Suburb: Sandton-WEST

Month: 15-07-2014 to 11-08-2014

1

◉ Stage 1

Up to 1000 MW to be shed
From 06:00-22:30 Monday to Saturday

2

○ Stage 2

Up to 2000 MW to be shed
From 06:00-22:30 Monday to Saturday

3

○ Stage 3

Up to 4000 MW to be shed
24hrs from Monday to Sunday

If you are an Eskom customer and cannot find, or do not understand, your schedule, please log onto CS Online or contact us on **0860037566**, to verify your load shedding schedule.

Tue, 15 Jul	Wed, 16 Jul	Thu, 17 Jul	Fri, 18 Jul	Sat, 19 Jul	Sun, 20 Jul	Mon, 21 Jul
-	-	-	09:00 - 13:30	-	-	-
Tue, 22 Jul	**Wed, 23 Jul**	**Thu, 24 Jul**	**Fri, 25 Jul**	**Sat, 26 Jul**	**Sun, 27 Jul**	**Mon, 28 Jul**
-	13:00 - 17:30	-	-	-	-	17:00 - 21:30
Tue, 29 Jul	**Wed, 30 Jul**	**Thu, 31 Jul**	**Fri, 01 Aug**	**Sat, 02 Aug**	**Sun, 03 Aug**	**Mon, 04 Aug**
-	-	-	05:00 - 09:30	-	-	-
Tue, 05 Aug	**Wed, 06 Aug**	**Thu, 07 Aug**	**Fri, 08 Aug**	**Sat, 09 Aug**	**Sun, 10 Aug**	**Mon, 11 Aug**
-	09:00 - 13:30	-	-	-	-	13:00 - 17:30
Tue, 12 Aug						
-						

4hr schedules

City: Kouga

Suburb: Redfi

Website

Month: 15-07-2014 to 11-08-2014

1

Stage 1

Up to 1000 MW to be shed
From 06:00-22:30 Monday to Saturday

2

Stage 2

Up to 2000 MW to be shed
From 06:00-22:30 Monday to Saturday

3

Stage 3

Up to 4000 MW to be shed
24hrs from Monday to Sunday

or do not understand, your schedule, please log onto CS Online or contact us on **0860037566**, to verify your load shedding schedule.

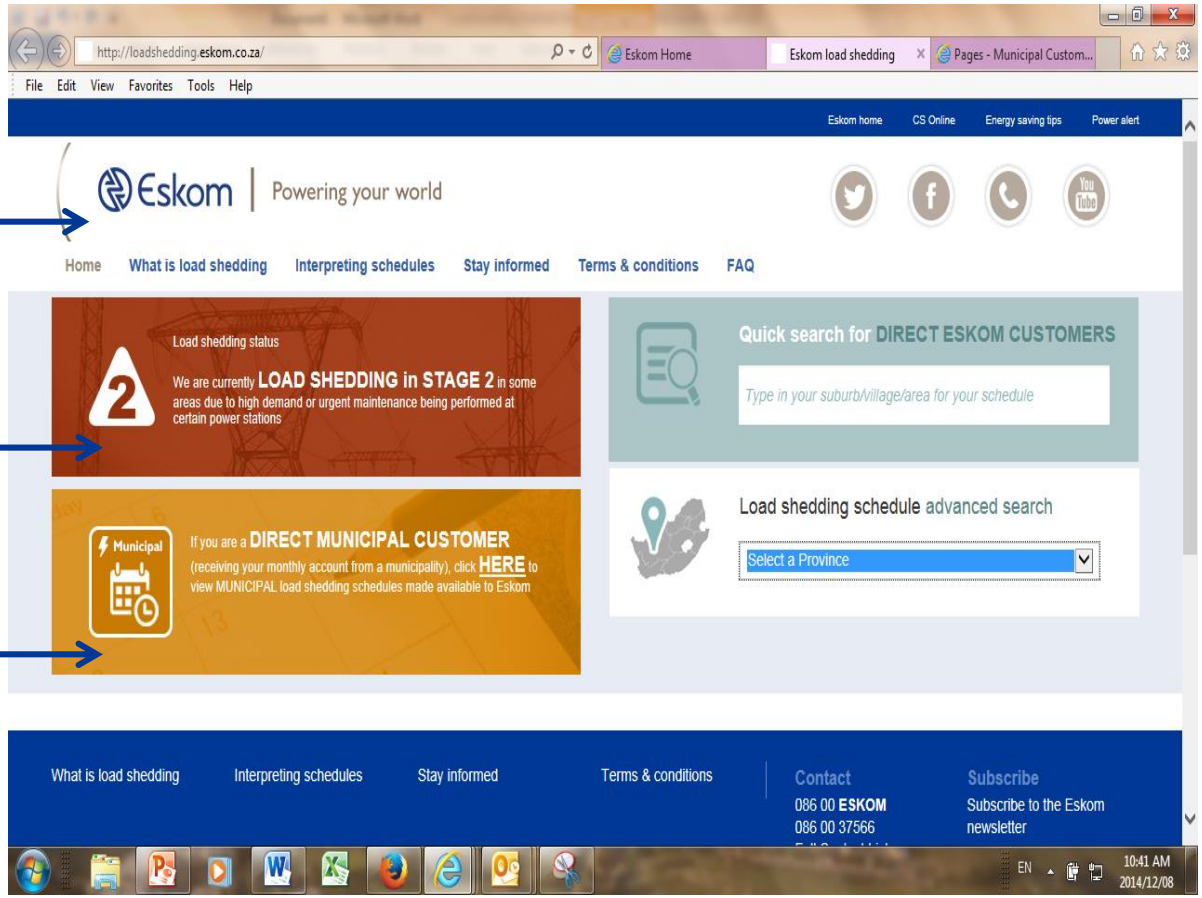
Tue, 15 Jul	Wed, 16 Jul	Thu, 17 Jul	Fri, 18 Jul	Sat, 19 Jul	Sun, 20 Jul	Mon, 21 Jul
13:00 - 15:30	-	19:00 - 21:30	-	09:00 - 11:30	-	-
Tue, 22 Jul	**Wed, 23 Jul**	**Thu, 24 Jul**	**Fri, 25 Jul**	**Sat, 26 Jul**	**Sun, 27 Jul**	**Mon, 28 Jul**
13:00 - 15:30	-	19:00 - 21:30	-	09:00 - 11:30	-	-
Tue, 29 Jul	**Wed, 30 Jul**	**Thu, 31 Jul**	**Fri, 01 Aug**	**Sat, 02 Aug**	**Sun, 03 Aug**	**Mon, 04 Aug**
13:00 - 15:30	-	19:00 - 21:30	-	09:00 - 11:30	-	-
Tue, 05 Aug	**Wed, 06 Aug**	**Thu, 07 Aug**	**Fri, 08 Aug**	**Sat, 09 Aug**	**Sun, 10 Aug**	**Mon, 11 Aug**
13:00 - 15:30	-	19:00 - 21:30	-	09:00 - 11:30	-	-
Tue, 12 Aug						
13:00 - 15:30						

2hr schedules

Eskom Load Shedding Website Look and Feel

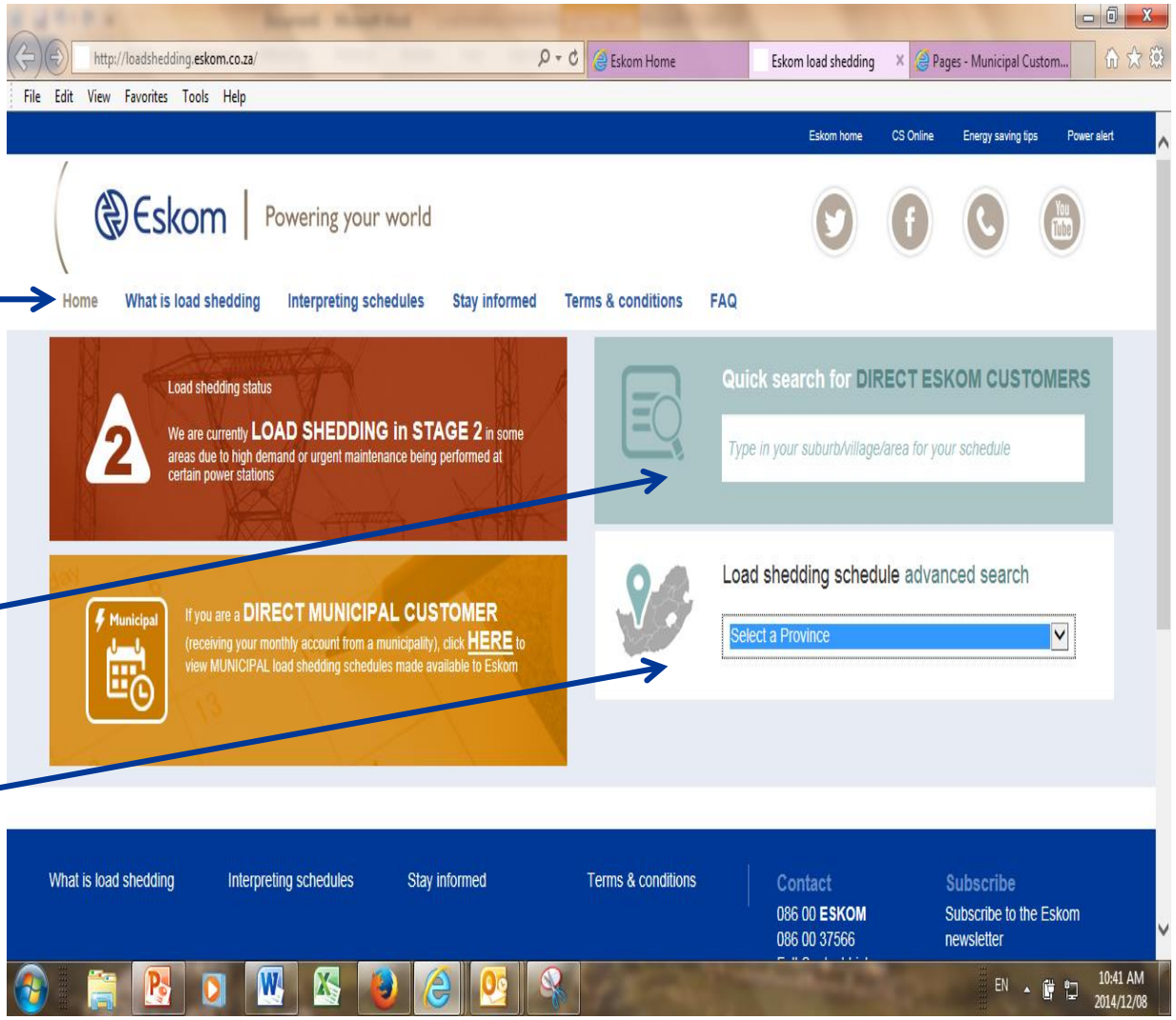
1. You will land on the Load Shedding page http://loadshedding.eskom.co.za/
2. This is what you will see
3. You will be informed here whether Load shedding has been implemented.

   If Load Shedding has been implemented, the Stage of Load Shedding is indicated.
4. You can also access the Municipal Schedules that has been provided to Eskom by the Municipalities here.



Eskom Load Shedding Website How to navigate

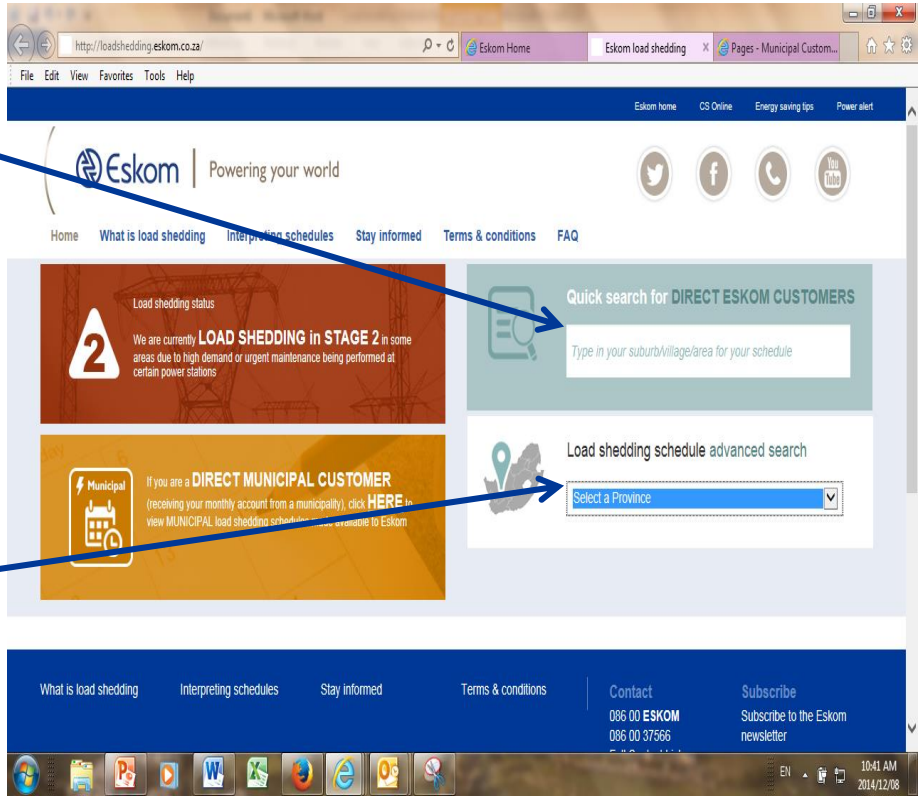
1. The menu bar can be used to navigate and find out:
   - What is Load Shedding
   - How to interpret the Schedule
   - The latest information
   - Answers to Frequently asked Questions
2. This is the search functionality where as a Customer you will be able to search for you suburb and view the schedule.
3. This is the advanced Search Functionality – allows the user to search by province and Municipality.



Eskom Supplied (Direct) Customers Searching for your Schedule

Quick Search Functionality

1. Enter your suburb here
2. A list of matching areas will become available.
3. Select the appropriate Area
4. A Schedule will reflect
5. Now select the Stage (1,2 or 3)
6. Your correct schedule will now reflect.



Advanced Search Functionality

1. Select your Province
2. Select the Municipality that you are serviced by
3. Select your suburb
4. A Schedule will reflect
5. Now select the Stage (1,2 or 3)
6. Your correct schedule will now reflect.

Example: Midland Schedule – Stage 1

Mon, 08 Dec	Tue, 09 Dec	Wed, 10 Dec	Thu, 11 Dec	Fri, 12 Dec	Sat, 13 Dec	Sun, 14 Dec
-	-	18:00 - 22:30	-	-	-	-
Mon, 15 Dec	**Tue, 16 Dec**	**Wed, 17 Dec**	**Thu, 18 Dec**	**Fri, 19 Dec**	**Sat, 20 Dec**	**Sun, 21 Dec**
06:00 - 10:30	-	-	-	10:00 - 14:30	-	-
Mon, 22 Dec	**Tue, 23 Dec**	**Wed, 24 Dec**	**Thu, 25 Dec**	**Fri, 26 Dec**	**Sat, 27 Dec**	**Sun, 28 Dec**
-	-	14:00 - 18:30	-	-	-	-
Mon, 29 Dec	**Tue, 30 Dec**	**Wed, 31 Dec**	**Thu, 01 Jan**	**Fri, 02 Jan**	**Sat, 03 Jan**	**Sun, 04 Jan**
18:00 - 22:30	-	-	-	06:00 - 10:30	-	-
Mon, 05 Jan						
-						

Eskom Supplied (Direct) Customers
Select your Schedule Stage

Selecting the correct stage

1. Once your schedule appears it will be defaulted to Stage 1
2. Scroll up until you see the menu below.

3. Select the appropriate Stage (for this exercise we have selected Stage 2)
4. The schedule should have changed accordingly.

Example: Midland Schedule – Stage 1 (default)

Mon, 08 Dec	Tue, 09 Dec	Wed, 10 Dec	Thu, 11 Dec	Fri, 12 Dec
-	-	18:00 - 22:30	-	-
Sat, 13 Dec	**Sun, 14 Dec**	**Mon, 15 Dec**	**Tue, 16 Dec**	**Wed, 17 Dec**
-	-	06:00 - 10:30	-	-
Thu, 18 Dec	**Fri, 19 Dec**	**Sat, 20 Dec**	**Sun, 21 Dec**	**Mon, 22 Dec**
-	10:00 - 14:30	-	-	-
Tue, 23 Dec	**Wed, 24 Dec**	**Thu, 25 Dec**	**Fri, 26 Dec**	**Sat, 27 Dec**
-	14:00 - 18:30	-	-	-
Sun, 28 Dec	**Mon, 29 Dec**	**Tue, 30 Dec**	**Wed, 31 Dec**	**Thu, 01 Jan**
-	18:00 - 22:30	-	-	-
Fri, 02 Jan	**Sat, 03 Jan**	**Sun, 04 Jan**	**Mon, 05 Jan**	
06:00 - 10:30	-	-	-	

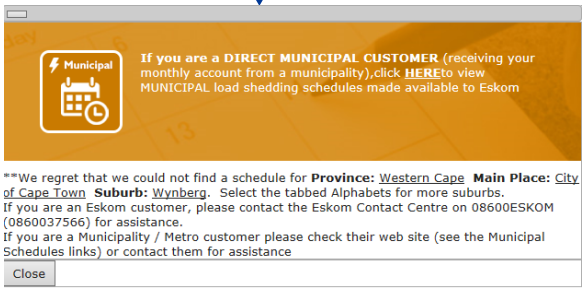
Example: Midland Schedule – Stage 2 Selected

Mon, 08 Dec	Tue, 09 Dec	Wed, 10 Dec	Thu, 11 Dec	Fri, 12 Dec
-	18:00 - 22:30	18:00 - 22:30	-	-
Sat, 13 Dec	**Sun, 14 Dec**	**Mon, 15 Dec**	**Tue, 16 Dec**	**Wed, 17 Dec**
06:00 - 10:30	06:00 - 10:30	06:00 - 10:30	-	-
Thu, 18 Dec	**Fri, 19 Dec**	**Sat, 20 Dec**	**Sun, 21 Dec**	**Mon, 22 Dec**
10:00 - 14:30	10:00 - 14:30	-	-	-
Tue, 23 Dec	**Wed, 24 Dec**	**Thu, 25 Dec**	**Fri, 26 Dec**	**Sat, 27 Dec**
14:00 - 18:30	14:00 - 18:30	-	-	18:00 - 22:30
Sun, 28 Dec	**Mon, 29 Dec**	**Tue, 30 Dec**	**Wed, 31 Dec**	**Thu, 01 Jan**
18:00 - 22:30	18:00 - 22:30	-	-	06:00 - 10:30
Fri, 02 Jan	**Sat, 03 Jan**	**Sun, 04 Jan**	**Mon, 05 Jan**	
06:00 - 10:30	-	-	-	

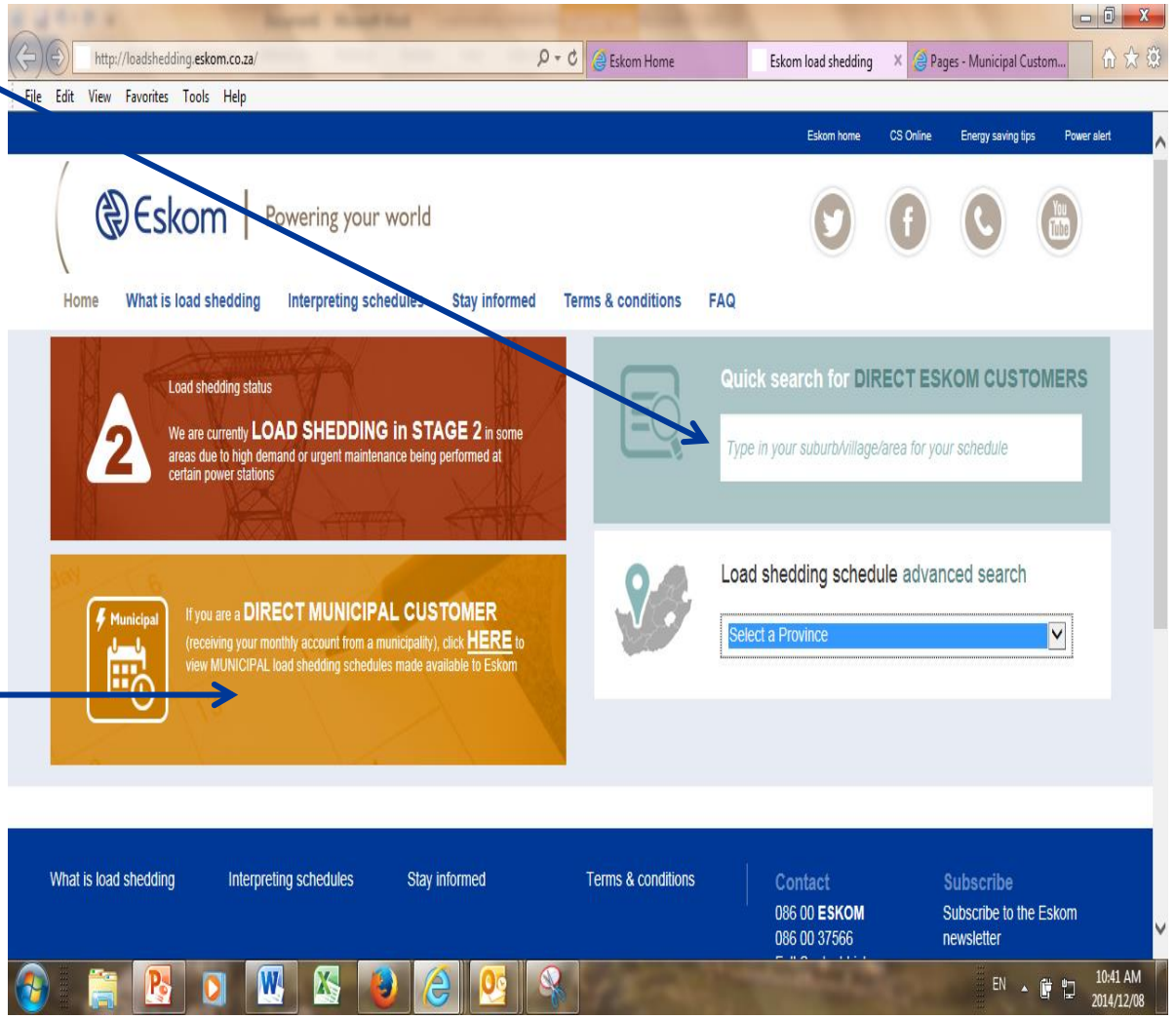
Municipal Supplied (Direct) Customers Searching for your Schedule

Quick Search Functionality

1. Enter your suburb here
2. If you are not an Eskom Customer, the following message will pop-up.

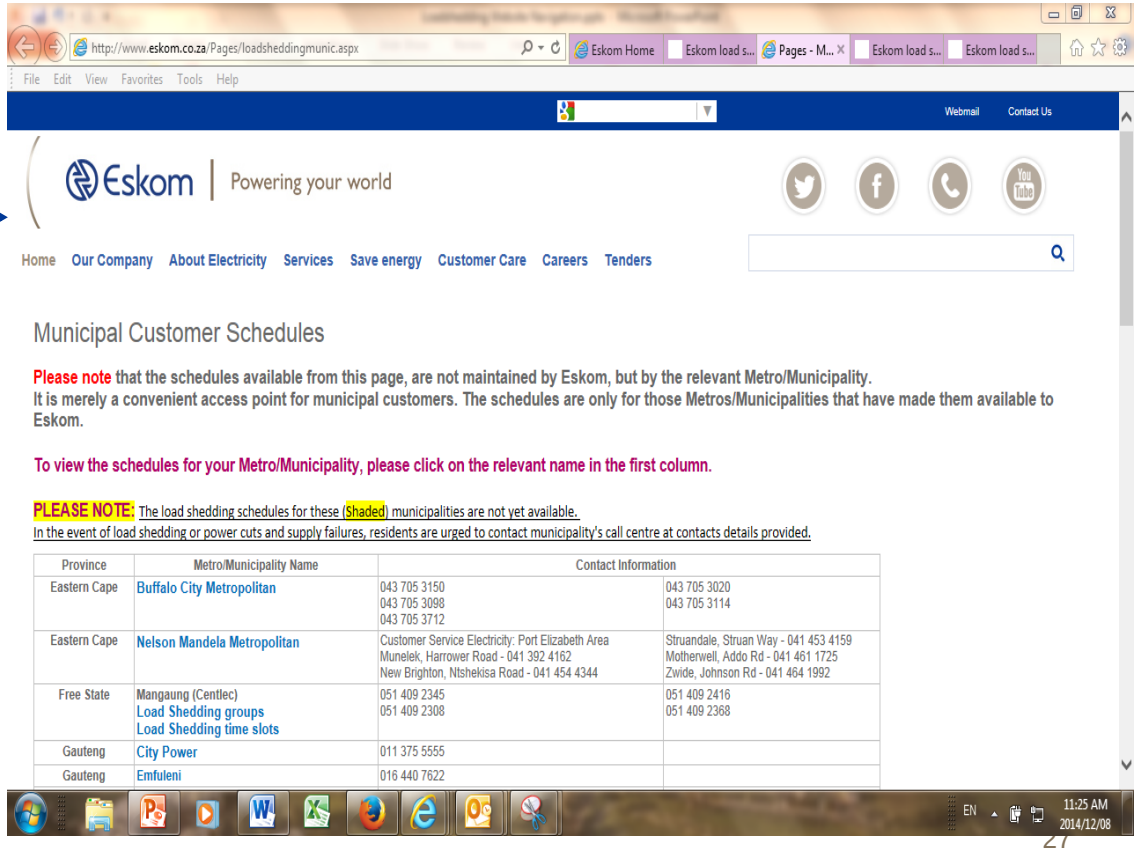


3. You can now either navigate to the Municipal Schedule using this link, or
4. You can log into the appropriate Municipal Website



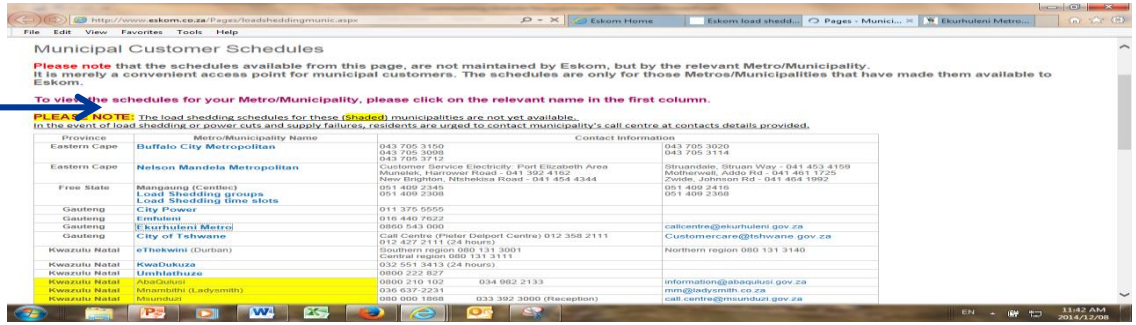
Municipal Schedules Link

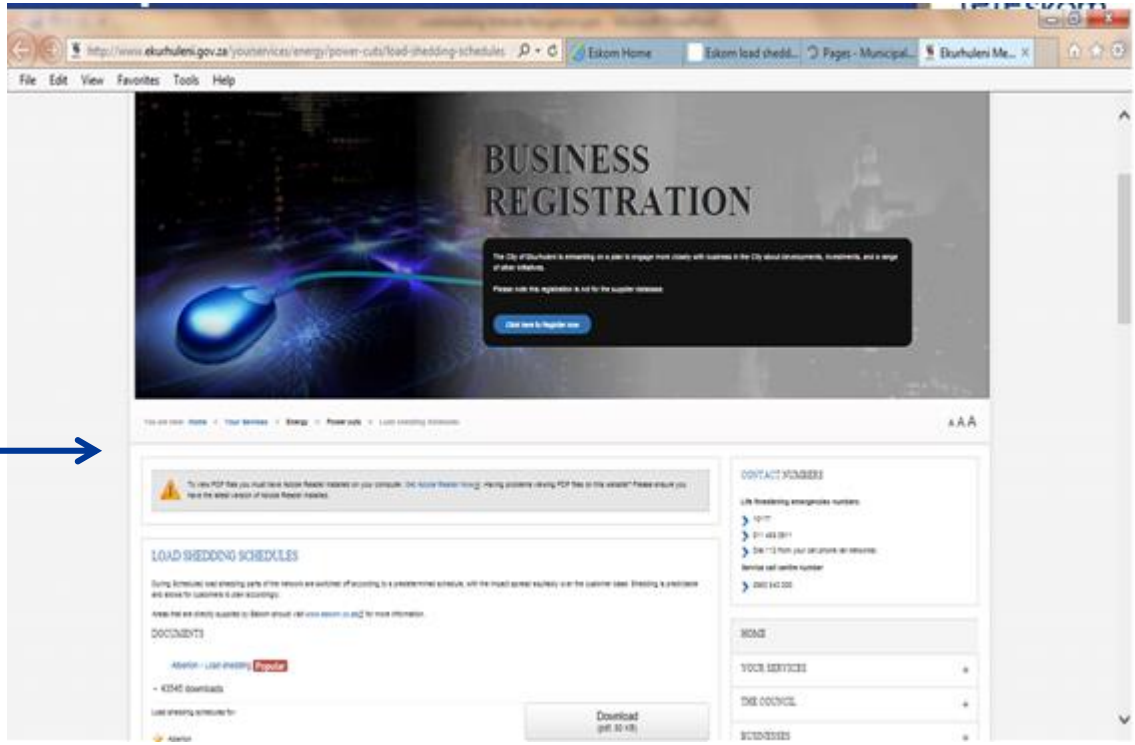
1. If you select this link on the Eskom website http://www.eskom.co.za or the Eskom Load Shedding Website http://loadshedding.eskom.co.za/ you will be directed to the following link http://www.eskom.co.za/Pages/loadsheddingmunic.aspx where you will be able to view the Municipal Schedules provided to Eskom by the Municipalities.
2. Select the Municipality that Services you
3. You will now be redirected to the appropriate Municipal Site or a download of the schedule will be available.



Example: Ekurhuleni Munic

1. Select the Municipality that Services you
2. You will now be redirected to the appropriate Municipal Site or a download of the schedule will be available.
3. Example: Ekurhuleni Munic
4. You will be redirected to the Municipality's Website http://www.ekurhuleni.gov.za/yourservices/energy/power-cuts/load-shedding-schedules .
5. Navigate down the page and select the Area you need.
6. The schedules are available to download in PDF format.





Example: Ekurhuleni Munic

1. Once you have selected you Area and downloaded your schedule, this is an example of what you will see (Area selected Alberton)

ALBERTON - Load Shedding Schedule

Times of the day	Days of the Month 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
06h00 - 09h00	1	9	17	7	15	5	13	3	11	1	9	17	7	15	5	13	3	11	1	9	17	7	15	5	13	3	11	1	9	17	7
09h00 - 12h00	2	10	18	8	16	6	14	4	12	2	10	18	8	16	6	14	4	12	2	10	18	8	16	6	14	4	12	2	10	18	8
12h00 - 15h00	3	11	1	9	17	7	15	5	13	3	11	1	9	17	7	15	5	13	3	11	1	9	17	7	15	5	13	3	11	1	9
15h00 - 18h00	4	12	2	10	18	8	16	6	14	4	12	2	10	18	8	16	6	14	4	12	2	10	18	8	16	6	14	4	12	2	10
18h00 - 21h00	5	13	3	11	1	9	17	7	15	5	13	3	11	1	9	17	7	15	5	13	3	11	1	9	17	7	15	5	13	3	11
21h00 - 24h00	6	14	4	12	2	10	18	8	16	6	14	4	12	2	10	18	8	16	6	14	4	12	2	10	18	8	16	6	14	4	12
24h00 - 03h00	7	15	5	13	3	11	1	9	17	7	15	5	13	3	11	1	9	17	7	15	5	13	3	11	1	9	17	7	15	5	13
03h00 - 06h00	8	16	6	14	4	12	2	10	18	8	16	6	14	4	12	2	10	18	8	16	6	14	4	12	2	10	18	8	16	6	14

AREA	
1-Brackenhurst north part of Ext 1	10- P&P, New Market, Raceview south,General Alberts park,Randhart north
2-Bracenhurst ext 1& Meyberrypark	11- Randhart & ext 1
3-Brackendowns,Brackenhurst Ext 2	12- Randhart Ext 2 & Alberante ext 1
4-Brackendowns Ext 2,3 &4	13- New Redruth west Florentia west ,CBD west & Alberante
5-Brackendowns 5,Albertsdal	14- Civic Centre Alberton CBD South Crest west
6-Thokoza South,Edenpark,Greenfields	15- Alberton North, South Crest East
7-MEYERSDAL North & Eco Estate	16- Apple tree Complex New Red Ruth east, Raceview north
8-Meyersdal South & Nature estate	17- Verwoerd park & Florentia east
9-Thokoza North,Mpilisweni	18- Alberton Extentions and Parklands

City of Ekurhuleni

a partnership that works

Tips & Hints

- Quick Search - identify your Area or the Area closest are to you (Correct spelling)
- Select the stage once the initial schedule appears
- Print or save to your Laptop / smart phone / desktop
- This schedule is applicable for a month - now request the schedules for the remaining stages and do as above, as Stages may change.

For any queries and assistance on Load shedding, visit the Eskom Load shedding Website http://loadshedding.eskom.co.za/ or call our Contact Centers at **0860037566**

Proposed critical success factors to improve public experience during loadshedding

1. Adherence to Stage Plan
2. Adherence to Schedule switch times
3. Periodic reminder communications of Stage Plan and Schedules
4. Every customer linked to a schedule
5. Every customer informed of his schedule name
6. Reduction in Contact Centre Load Shedding queue calls
7. Reduction in negative Social media mentions
8. High response time on proactive communications related to Stage or Schedule deviations
9. All Stage Plan changes and Schedule changes communicated
10. Customer perceptions specific to Load Shedding effectiveness

Identified activities to improve customer experience

- A list of 27 itemized activities were presented and ratified at a previous ERCC (2nd December).
- The items consisted of improvements to the website, the schedules, self service technologies and communication.
- A project manager has been identified and will be responsible for driving these activities in a project management mode.
- The list has subsequently been work-shopped with all relevant stakeholders and been prioritized in accordance with the impact it would have on the customer experience and the effort required to deliver.
- The team identified a few “low hanging fruits” and these were implemented fairly quickly, included in these were:
  - Website default to applicable stage when load shedding (meaning the customer no longer has to select the appropriate stage when downloading his schedule).
  - IVR, change in queue position of load shedding option (customers will now have quicker access to load shedding queue, which will improve time and service levels of load shedding calls).
  - Significant progress in accuracy all Eskom and Municipal schedules (particularly Gauteng).
  - QA scheduled process in place and resources identified to ensure improved accuracy.

Contents

NRS 048-9 Ed.1: 2010

National Code of Practice: Emergency Load Reduction and System Restoration Practices

(*prepared on behalf of the NRS 048 Working Group*)

Published in 2010 by SANS
Approved as a Regulatory Standard by NERSA
All NERSA Licensees required to implement by April 2011
(or provide reasons why they cannot)

Overview - what is it?

NRS 048 Part 9 - Code of Practice – Edition 1

- A national protocol for the management of two types of emergencies: (i) **System constraints** - load *shedding* and/or *curtailment* (ii) **National or regional blackout** - load and system restoration.
- Guidelines on the appropriate treatment of: (i) *critical loads*; (ii) *essential load requirements* of customer installations.
  - **Critical loads**: loads that should as far as possible be protected from the *impact* of load shedding or loss of supply in order to either maintain the *operational integrity* of the power system, or to avoid a *cascading impact* on public infrastructure.
  - **Essential load requirement**: minimum *customer load requirement* (e.g. MW, notification time, and duration) to avoid a direct and significant impact on the *safety* of people, the *environment*, and physical *plant/equipment* for “nationally critical products”, and which has been specifically *notified* as such by the customer to the licensee.

(Important !) clarifications

System Emergency

- **Emergency load shedding/curtailment is the last resort** in managing supply/demand imbalances and supply network constraints - implemented in order to protect the power system from collapse.
  - **System emergency**: a situation arising on the system as a result of significant *loss* of generation, transmission, or distribution plant, and/or where all due *precautions and interventions fail* to prevent the integrated power system or a localised part of the system from *approaching or entering* a state of collapse.
- **The need exists** for a robust set of emergency load shedding protocols *even under healthy reserve margin conditions*.

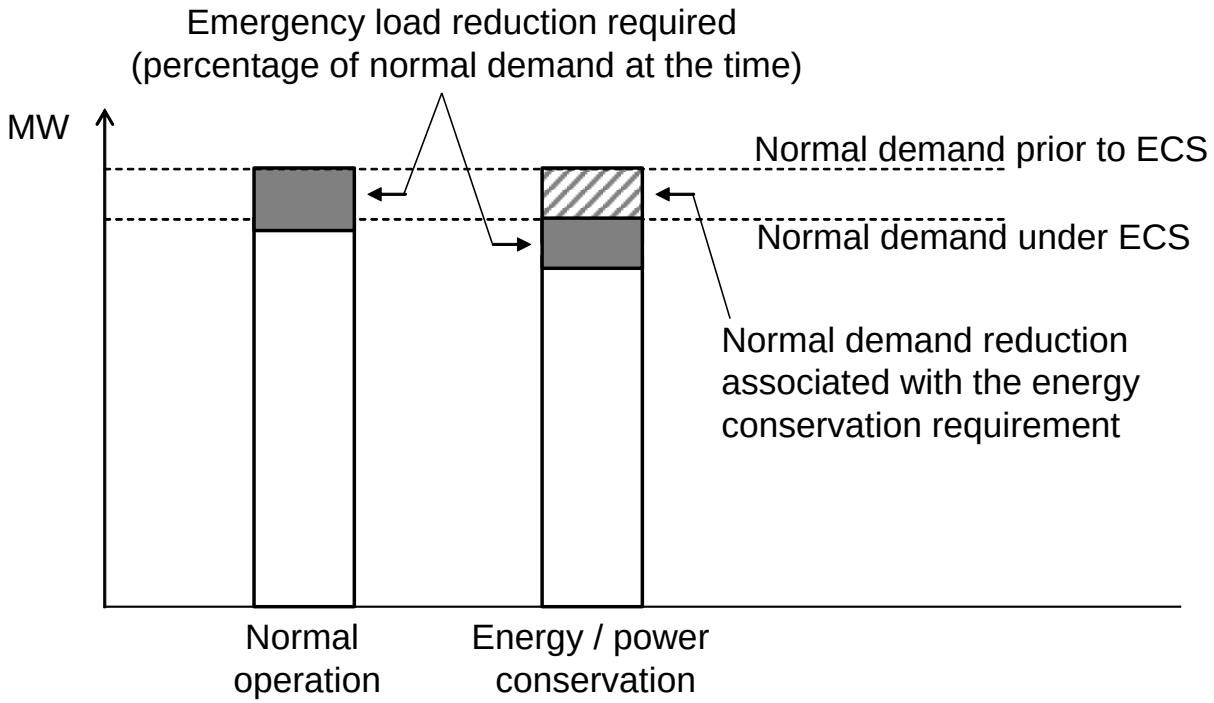
Principles

Load shedding / curtailment

- **Principle 1**: The integrity of the national automatic under-frequency load shedding system shall not be materially compromised by manual load-shedding or curtailment.
- **Principle 2**: All customer installations shall be considered for load reduction under a system emergency, based on broadly equitable participation by customers.
- **Principle 3**: Critical and essential load requirements shall be addressed in accordance with this part of NRS 048.
- **Principle 4**: Time-based manual load shedding shall be applied.
- **Principle 5**: Load shedding schedules shall be developed, maintained, and be available to customers.
- **Principle 6**: Load shedding schedules and curtailment requirements shall be defined up to a predefined maximum load. Where more load shedding is required, this is regarded as an extreme system condition explicitly excluded from principles 1 to 5, and which will be handled in accordance with the situation prevalent at the time.
- **Principle 7**: Customer reduction due to energy conservation programmes shall not be considered as emergency load reduction. *Consideration may however be given to customers who achieve more than the required reduction, and who meet specific requirements*

Principles

Load shedding / curtailment and ECS



National generation capacity constraints

Stages of load shedding / curtailment – facilitating "predictability"

Stage	Type	Reduction required from end-use customers by *load shedding*	Reduction required from customers eligible for *curtailment*
Stage 0	Unscheduled (pre-agreed)	Load offered for curtailment (ad hoc)	Load offered by customers under the *immediate* curtailment option
Stage 1	Scheduled / Notified	5% of national non-curtailment load (e.g. 1000 MW at peak)	10% of normal demand within 2h of *notification*
Stage 2	Scheduled / Notified	10% of national non-curtailment load (e.g. 2000 MW at peak)	
Stage 3	Scheduled / Notified	20% of national non-curtailment load (e.g. 4000 MW at peak)	20% of normal demand within 2hrs of *notification*
Stage 4	Unscheduled (instructed)	>20% of national non-curtailment load (e.g. >4000 MW at peak)	As *instructed* by the National System Operator at the time.

National generation capacity constraints

Stages of load shedding / curtailment – facilitating "predictability"

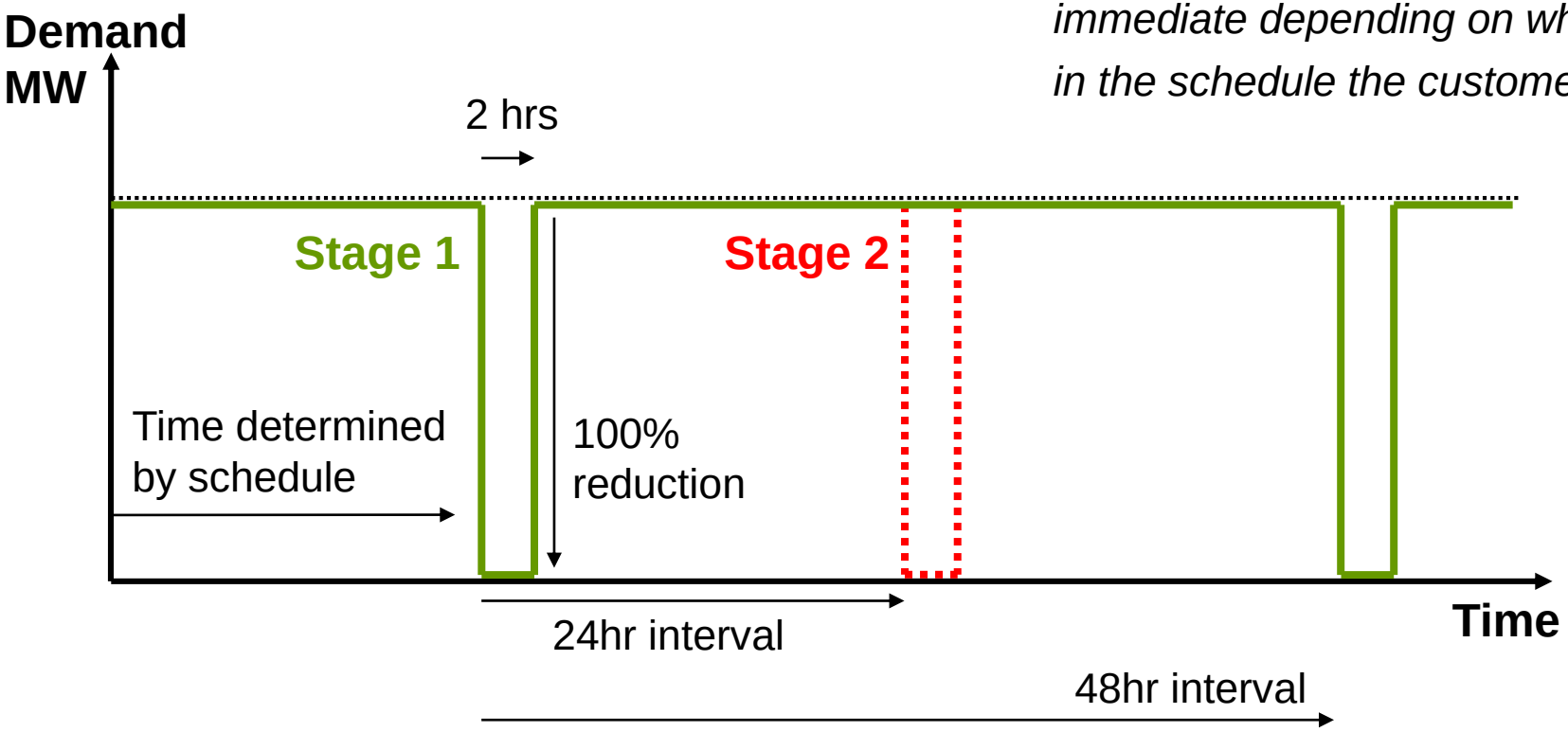
Stage	Type	Reduction required from end-use customers by *load shedding*	Reduction required from customers eligible for *curtailment*
Stage 0	Unscheduled (pre-agreed)	Load offered for curtailment (ad hoc)	Load offered by customers under the *immediate* curtailment option
Stage 1	Scheduled	5% of national non-curtailment load (e.g. 1000 MW)	10% of normal demand within 2h of *notification*
Stage 2	Scheduled	10% of national non-curtailment load (e.g. 2000 MW)	
Stage 3	Scheduled	20% of national non-curtailment load (e.g. 4000 MW)	20% of normal demand within 2hrs of *notification*
Stage 4	Unscheduled (instructed)	>20% of national non-curtailment load (e.g. >4000 MW)	As *instructed* by the National System Operator at the time.

Load shedding - example

Stage 1 & Stage 2 (SCHEDULED)

- Customers are by default on the schedule

Note: shedding could be immediate depending on where in the schedule the customer is



National generation capacity constraints

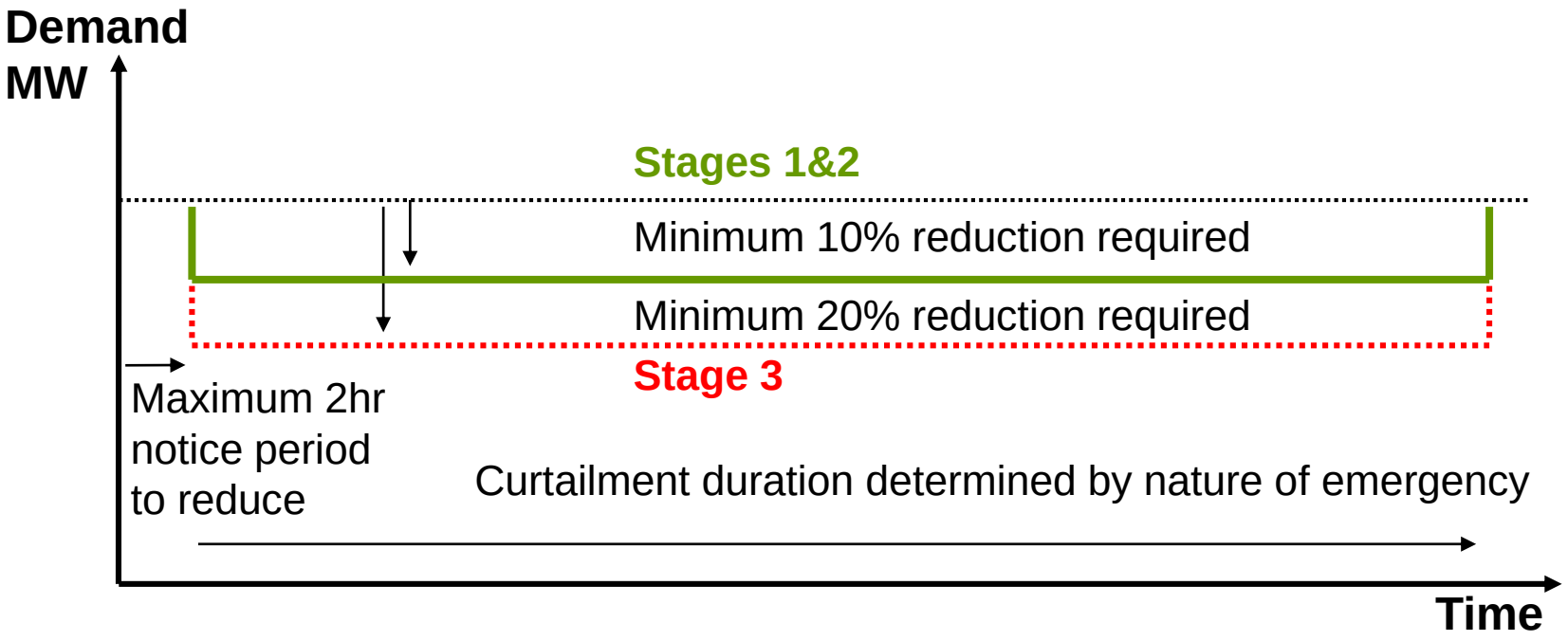
Stages of load shedding / curtailment – facilitating "predictability"

Stage	Type	Reduction required from end-use customers by *load shedding*	Reduction required from customers eligible for *curtailment*
Stage 0	Unscheduled (pre-agreed)	Load offered for curtailment (ad hoc)	Load offered by customers under the *immediate* curtailment option
Stage 1	Scheduled	5% of national non-curtailment load (e.g. 1000 MW)	10% of normal demand within 2h of *notification*
Stage 2	Scheduled	10% of national non-curtailment load (e.g. 2000 MW)	
Stage 3	Scheduled	20% of national non-curtailment load (e.g. 4000 MW)	20% of normal demand within 2hrs of *notification*
Stage 4	Unscheduled (instructed)	>20% of national non-curtailment load (e.g. >4000 MW)	As *instructed* by the National System Operator at the time.

Notified load curtailment

Stages 1, 2, & 3 (NOTIFIED)

- Customers who meet requirements may elect to curtail load 2 hrs after notification.



Notified load curtailment - requirements

Stages 1,2 and 3

- A licensee may identify specific customers that, *in lieu of being shed*, can provide a pre-defined amount of load to be curtailed with 2 h on instruction from the licensee.
- Customers who meet the following *requirements* will be eligible for notified curtailment:
  - The customer shall be able to offer at least 10% of normal load for curtailment under Stages 1 and 2, and 20% of normal load under Stage 3.
  - This curtailment shall be maintained for the duration of the emergency.
  - The curtailment can be effected within an agreed time frame (typically under 2 h).
  - This not affect the integrity of the national under-frequency load shedding scheme.
  - The required load curtailment can be measured and verified.
  - The customer's essential load requirement is met during this curtailment.
  - Protection of this customer from load shedding shall not result in the need to exclude significant other load from load shedding due to network limitations. Where this customer represents over 80% of the load supplied by a specific feeder, curtailment may be considered. Alternatively, where the customer can offer the equivalent load for curtailment, curtailment may be considered.
  - Actual load curtailment instructed during an event meets the requirements agreed on
- Where such conditions are *not met*, the customer shall not be eligible to be removed from the load shedding schedules

National generation capacity constraints

Stages of load shedding / curtailment – facilitating "predictability"

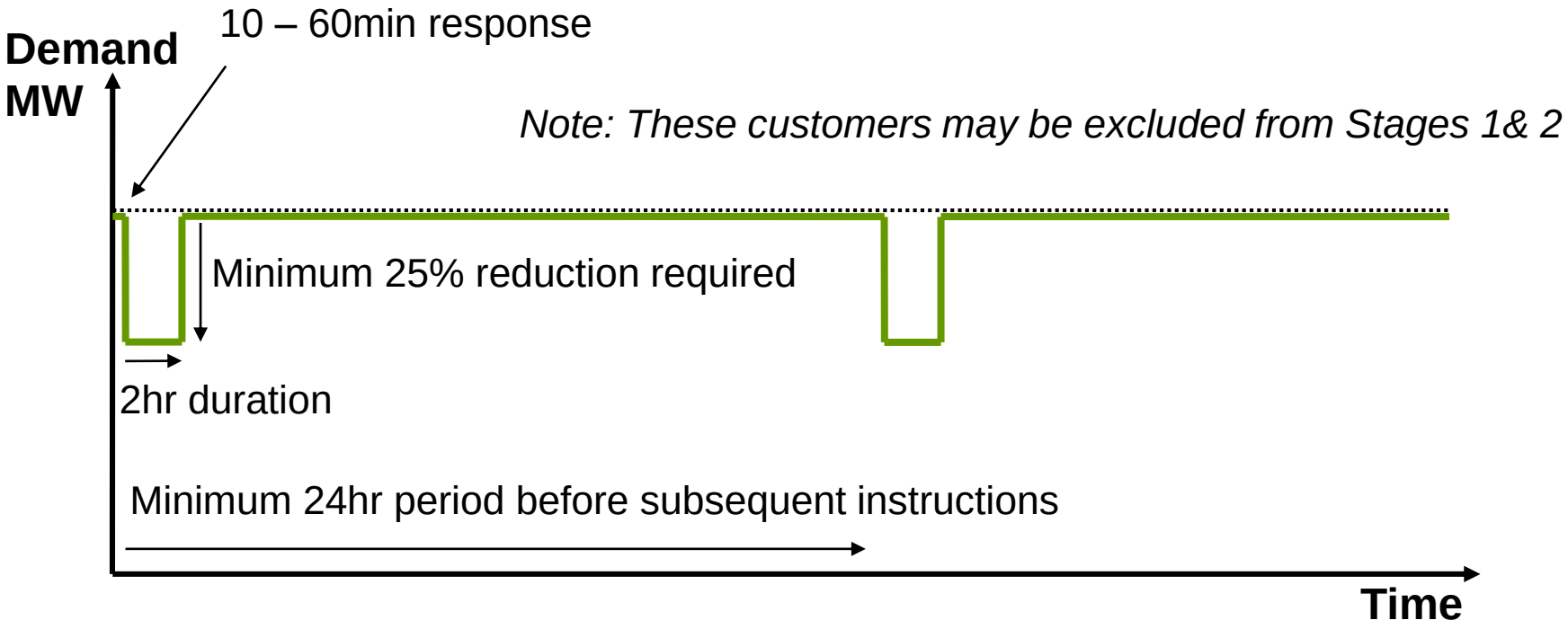
Clarification of use of limiting & appliance control (ERA Reg 773)

		Reduction required from end-use customers by *load shedding*	Reduction required from customers eligible for *curtailment*
Stage 0	Unscheduled (pre-agreed)	Load offered for curtailment (ad hoc)	Load offered by customers under the *immediate* curtailment option
Stage 1	Scheduled	5% of national non-curtailment load (e.g. 1000 MW)	10% of normal demand within 2h of *notification*
Stage 2	Scheduled	10% of national non-curtailment load (e.g. 2000 MW)	
Stage 3	Scheduled	20% of national non-curtailment load (e.g. 4000 MW)	20% of normal demand within 2hrs of *notification*
Stage 4	Unscheduled (instructed)	>20% of national non-curtailment load (e.g. >4000 MW)	As instructed by the National System Operator at the time.

Immediate load curtailment

Stage 0 (UNSCHEDULED, UNNOTIFIED)

- Customers who meet requirements may elect to curtail on instruction.



National generation capacity constraints

Stages of load shedding / curtailment – facilitating "predictability"

Stage	Type	Reduction required from end-use customers by *load shedding*	Reduction required from customers eligible for *curtailment*
Stage 0	Unscheduled (pre-agreed)	Load offered for curtailment (ad hoc)	Load offered by customers under the *immediate* curtailment option
Stage 1	Scheduled	5% of national non-curtailment load (e.g. 1000 MW)	10% of normal demand within 2h of *notification*
Stage 2	Scheduled	10% of national non-curtailment load (e.g. 2000 MW)	
Stage 3	Scheduled	20% of national non-curtailment load (e.g. 4000 MW)	20% of normal demand within 2hrs of *notification*
Stage 4	Unscheduled (instructed)	>20% of national non-curtailment load (e.g. >4000 MW)	As *instructed* by the National System Operator at the time.

Salient points (1)

Specific customers

- **International customers** shall be treated equitably with SA customers – i.e. same percentage load reduction as required in SA.
- **Merit order:** *Interruptible load* contracted on a commercial basis as part of the merit order may be excluded from the first stages of load reduction. *DMP* customers who participate with a min 25% of their total load & *Emergency DMP* customers who participate with a minimum of 40% of total load may be excluded from Stages 1 & 2.
- **Aggregation**: Customers may manage the required percentage reduction across several independent installations in a supply area.
- **Customers meeting ECS requirements** are *required* to participate in emergency load shedding (all stages). Customers *exceeding* ECS requirements may be excluded from early stages – in accordance with *additional energy saving achieved* and associated rules. (i.e. a customers saving 20% may be excluded from Stages 1 & 2)

Salient points (2)

Technology & Communication

- **Where a metro or municipality has embedded generation** not contracted as an ancillary service to the System Operator, this *may be used to reduce the internal emergency load reduction required*.
- **Voltage reduction schemes** may be applied on carefully selected feeders to reduce demand during an emergency, where this is *not likely* to result in contraventions of the requirements of NRS 048-2.
- **Smart metering / load limiting schemes** may be used by licensees to off-set load shedding requirements (e.g. Stages 1 to 3).
- **Customer communication:** *load shedding schedules* shall be updated & made available to customers
- **Operational communication:** *National system status* shall be made available by the System Operator
  - Example: *www.eskom.co.za* - system adequacy report

Regional system capacity constraints

Load shedding/ curtailment

- *Where possible* in the event of a regional supply constraint, load reduction should be undertaken using the schedules developed for national load shedding.

CRITICAL & ESSENTIAL LOADS

Responsibility of utilities

Essential and Critical Loads

All utilities retain accountability for their essential and critical loads, even if they have chosen to be shed by their upstream electricity provider

The challenge

Load shedding / curtailment

- The more some customers are “protected” from shedding or curtailment, the more frequently other customers are required to shed / load is required to be curtailed.
- A customer embedded in a network that needs to be protected from shedding will require that all customers on that feeder be removed from the schedules.
- Given system limitations, NRS 048-9 considers various alternatives (curtailment, scheduled times etc)
- Load shedding is not the ideal – curtailment may be a much better long-term solution. Where system limitations exist, curtailment requires technology interventions, and until then, load shedding is the only “pragmatic” alternative

Essential loads

Application by customers

- The essential load requirements may be subject to verification by the licensee in terms of the following criteria:
  - critical safety;
  - critical environment impact; and
  - critical national product.
- Where the submission does not comply with these verification requirements, the licensee shall inform the customer.
- All customers shall be entitled to provide licensees with essential load data.
- Customers with essential load requirements shall ensure that appropriate backup systems are in place, as restoration times cannot be guaranteed for the various possible system emergencies that could occur.

Essential loads

Identified loads

- deep level mines
- hospitals and medical centres with life-support requirements
- sewerage systems
- prisons
- refineries
- national key points reliant on electricity for their core operations
- potable water systems

Critical loads

General

- Critical loads are loads that are critical for maintaining the operational integrity of the power system, or for avoiding a cascading impact on public infrastructure in the event of a system emergency.
- These should as far as possible be protected from the impact of load shedding or loss of supply. Protection measures include the exclusion from load shedding schedules, installing back-up facilities, or implementing specific protocols for interaction between the customer and the licensee.
- Licensees are required to appropriately interact with customers in addressing critical load requirements as defined in this section.
  - **NOTE**: A licensee cannot guarantee that the requirements can be met under all supply emergencies and it is incumbent on the customer to take appropriate measures in such cases.
- Customers operating critical loads shall evaluate their level of preparedness in terms of the practices in this part of NRS 048.
- All customers shall be entitled to apply for critical load status

Critical loads

Identified loads

- **Identified** critical loads (additional may be motivated):
  - Public transport (e.g. commuter rail, airports), Water pumping (power station requirements, potable water), Sewerage, Refineries & fuel pipelines, Coal mines supplying power stations, Critical loads associated with essential services (e.g. police, fire fighting), Telecommunications infrastructure, Traffic lights, Sports Stadiums
- **Treatment** of critical loads includes:
  - **Exclusion** from load shedding schedules and curtailment requirements (*limited cases*).
  - **Curtailment** - where not severely impacted by such curtailment.
  - **The specific time of day** that these loads are shed (i.e. when not as severely impacted).
  - **Interventions** within the installation (e.g. appropriate backup supplies).
  - **Protocols** for interaction between these customers operating and the utility.

Automatic under-frequency load shedding

Example of integrating UFLS with load shedding

- Given a UFLS 1st stage set of loads totalling 100MWs, 105% of the requirement, and a schedule of 10 time slots:

Time slot	Manual load shedding	UFLS on load shedding	UFLS available	UFLS % available
6-8	200	11	89	93%
8-10	200	8	92	97%
10-12	200	12	88	92%
12-2	200	9	89	93%
2-4	200	10	90	95%
4-6	200	10	90	95%
6-8	200	11	89	93%
8-10	200	9	91	95%
10-12	200	10	90	95%

- What can be seen is that the UFLS loads are split among all the various time slots. This means that all the loads contribute to load shedding, but the UFLS system is not materially affected. The gap is only the amount of UFLS used at any one time, in this case the largest is 12MWs, which reduces the scheme in the worst case to 92% of requirement. Therefore an additional installation of 12MWs of UFLS will cover the deficit.
- The downside is a slight over-shedding during a UFLS event, when not load shedding, which is likely.

National or regional blackouts

Restoration plans

- **National System Operator** - responsible for developing, maintaining, and testing plans for restoring supply after a national blackout (including the availability of black-start facilities).
- **National Disaster Management** - oversee development of multi-sectoral plans for a country response to regional/national blackout.
- **Licensees** - responsible for developing, maintaining, and testing plans for restoring supply after a regional or local blackout. Development and maintenance of *essential loads register*.
- **Customers** - provide their suppliers with information on essential load requirements in terms of NRS 048-9 requirements.
  - A *critical safety* requirement
  - A *critical environmental* impact requirement
  - A *critical national product* requirement (potential damage to plant)

Load shedding schedules

Allocation of load shedding/curtailment quotas per control centre

- In determining load shedding and curtailment quotas for the various licensees, the following methodology shall be applied:
  - Each Control Centre shall determine the load under its control (see note 1).
  - From this load, critical loads (and any loads that form part of the merit order that are explicitly excluded from shedding) served by the Control Centre shall be subtracted to obtain the base load on which the required reduction for that Control Centre is determined.
  - All the base loads in the country shall be added together to determine the national base load.
  - Each Control Centre's base load is divided by this national base load to calculate its required contribution (as a percentage) per emergency load reduction event.
  - The allocation will be determined at the upstream Control Centre based initially on the values given to Eskom Distribution Control Centres by the National System Operator.
  - The load on which the quota to be shed by each Control Centre shall be determined by subtracting the load under curtailment from the Control Centre's base load.
- The same method of allocation will be applied to municipal and metro licensees, when allocating the percentage of the Eskom Distribution Control Centre load.
- The above calculation determines the load to be reduced continuously over the full period of load shedding. An individual licensee may choose be completely shed in lieu of implementing its own rotation.
-

Immediate load curtailment - requirements

Stage 0

- Stage 0 represents the first stage of load reduction under a system emergency.
  - **NOTE**: This will typically be called upon by the National System Operator after the normal merit order of resources at its disposal has been exhausted.
- Customers who meet the following *requirements* will be eligible for immediate curtailment:
  - The customer can offer at least 25% of normal load for immediate curtailment.
  - This curtailment can maintained for an agreed period after the instruction is given to curtail (e.g. for a period of 2h).
  - The curtailment can be effected within an agreed time frame (typically 10 minutes to an hour).
  - This does not affect the integrity of the national under-frequency load shedding scheme.
  - The required load curtailment can be measured and verified.
  - The customer's essential load requirement is met during this curtailment.
  - Protection of this customer from load shedding shall not result in the need to exclude significant other load from load shedding due to network limitations Where this customer represents over 80% of the load supplied by a specific feeder, curtailment may be considered. Alternatively, where the customer can offer the equivalent load for curtailment for the total feeder, curtailment may be considered.
  - Actual load curtailment instructed during an event meets the requirements agreed on with the licensee

Immediate load curtailment …(continued)

Stage 0

- Customers who participate under the immediate load curtailment scheme:
  - Shall be excluded from Stages 1 & 2 of load shedding and/or curtailment until 24 hours after notice to reduce under Stage 0 has been given, and shall not be called upon again within 24 hrs during Stages 0.
  - May return to normal demand after the agreed curtailment period (subject to the system emergency remaining under Stages 0, 1, or 2).
  - May not exceed normal demand during the emergency
  - Shall participate under the delayed curtailment or shedding schemes for Stages 3, and 4 if required.
- Customers who are have selected and agreed to the conditions for immediate curtailment, shall be called upon under Stage 0. The instruction to curtail is unscheduled.
  - **NOTE**: Although called upon first under Stage 0, this option allows customers who meet the requirements to maintain full operation for the rest of the 24 hrs period after the event, should Stage 1 and 2 load shedding be subsequently required

Load shedding

Stages 1,2 and 3

- All customers shall be on the load shedding schedules.
- … with the exception of:
  - Critical loads and loads with essential load requirements, where such exceptions are provided for under conditions set out in this part of NRS 048 (see sections 6 and 7),
  - Loads that meet the requirements for immediate or notified curtailment (see 4.4.2 and 4.4.4).
  - Some loads that participate in the merit order (see 4.4.6)
- Load shedding shall be undertaken in accordance with published schedules. These schedules shall be designed to be rotational, should the need for protracted load reduction arise. Schedules shall be prepared for Stages 1, 2, and 3 in accordance with the requirements of 4.6

Critical loads

Treatment

- In the case of critical loads not identified in this part of NRS 048, licensees and customers shall co-operate in addressing the requirements of these loads by considering at least the following alternatives:
  - Exclusion from load shedding schedules and curtailment requirements. This shall in principle be limited to cases where the load can be isolated so that other loads that should be shed are not also protected from the schedules.
    - **NOTE**: Exclusion from load shedding is possible where the customer load is supplied directly (not one of several loads on a given feeder), or where smart metering / load limiting technologies have been installed on all loads on the feeder.
  - Whether the installation meets the conditions for load curtailment as described in section 4, and not be severely impacted by such curtailment.
  - If shedding is required, the specific time of day that these loads are shed (i.e. when these may not be as severely impacted).
  - Interventions within the installation (e.g. appropriate backup supplies).
    - **NOTE**: In the case of many critical loads, this may in any case be necessary to protect the installation in the event of a supply interruption due to a local network outage.
  - Protocols for interaction between these customers operating and the utility.
    - **NOTE**: For example, provision of a direct line of communication to the regional or municipal/metro control centre in the event that the on-site backup supply fails.

Critical loads

Specific requirements

- State and private hospitals shall be treated equally.
- Tertiary hospitals shall be included in load shedding schedules.
  - These hospitals shall provide their own back up facilities or shall be required to declare their essential load requirements.
  - Protocols shall be in place for hospitals to contact the local operations centre directly in the event of an emergency, for example, if the back-up facility is out of service at the time of load shedding.
- Secondary hospitals shall be included in load shedding schedules.
  - Hospitals shall be required to declare their essential load requirements and should, if practicable provide their own back up facilities,.
  - Protocols shall be in place for hospitals to contact the local operations centre directly in the event of an emergency.
- Clinics and medical centres shall be included in load shedding schedules.
  - Clinics and medical centres shall be required to declare their essential load requirements, but are not classified as critical loads

Critical loads

Specific requirements

- Rail
  - Metro rail shall be excluded from schedules and load curtailment requirements.
  - Long-distance goods transport shall be required to participate in emergency load shedding or curtailment.
  - Licensees shall interact to ensure that load shedding schedules have the minimum impact.
- Water
  - Water supply systems to power stations shall be excluded from load reduction requirements.
  - Potable water supply systems shall be included in the emergency load reduction requirement. Licensees shall interact with the operators of such systems to optimise the scheduling of these systems on the load shedding schedule
- Refineries and fuel pipe lines shall be excluded from emergency load reduction requirements.
- Mines supplying power stations shall be excluded from load shedding schedules.
- Generally, sewerage systems shall be included in load shedding schedules. Special attention shall be taken to identified linked pump stations and to coordinate load shedding to ensure that shedding will not result in adverse environmental consequences. Where this is not possible, these may be removed from load shedding schedules

Critical loads

Specific requirements

- Traffic lights
  - The electricity supply infrastructure to traffic lights may not allow for isolation from other loads in the event of load shedding.
  - These intersections are defined as those that would lead to significant congestion on major highways, in central business districts, or important access points (e.g. roads to airports).
  - One of the following treatment methods is recommended:

  High impact intersections:

  - Backup systems able to support the supply for at leat 4 hrs
  - Alternatively, where theft is of concern, effective deployment of pointsmen should be planned.

  Medium impact intersections:

  - Contingency plans shall be implemented at these intersections to ensure that traffic flow is maintained. Plans may include the coordinated deployment of pointmen or traffic officials, based on the schedules.

  Low impact intersections:

  - No specific interventions are required

Critical loads

Specific requirements

- Sports stadiums shall be required to participate in emergency load shedding or curtailment.
  - Where an sports stadium is on the load shedding schedule, the scheduled time for shedding shall be between the hours of 06h00 and 17h00.
  - Stadiums shall ensure that on-site backup supplies shall be available for critical processes.
  - The licensee Control Centre managing the emergency load reduction of the stadium shall provide the stadium with direct access to the Control Room in the case of an emergency (e.g. failure of backup generators).
  - In the case of a major sports events, schedules may be adjusted as per 4.9.
- The facilities of telecommunication service providers shall be included in load shedding schedules. These customers shall provide their own back-up facilities.
  - **NOTE**: These facilities are generally within communities and would result in significant sections of load not being shed to maintain supply to these installations.

Critical loads

Specific requirements

- Police, fire fighting, and other essential services shall be included in load shedding schedules. These customers shall provide their own back-up facilities.
  - NOTE: These facilities are generally within communities and would result in significant sections of load not being shed to maintain supply to these installations.
- Generally educational facilities shall be included in load shedding schedules, but can be declared as critical loads by National or Provincial Government at critical times of the academic year.
  - NOTE: These facilities are generally within communities and would result in significant sections of load not being shed to maintain supply to these installations.
- Airports shall be required to participate in emergency load shedding or curtailment.
  - Where an airport is on the load shedding schedule, the scheduled time for shedding shall be between the hours of 09h00 and 17h00.
  - The licensee control centre managing the emergency load reduction of the airport shall provide the airport with direct communication and co-operation to the control room in the case of an emergency (e.g. failure of backup generators).
  - Airports shall ensure that on-site backup supplies shall be available for critical processes.