

National Code of Practice: Emergency Load Reduction and System Restoration Practices (NRS 048-9:2009)

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1. Introduction

The country's infrastructure, of which the power system forms an essential part, is exposed to a variety of threats. Unlike countries more regularly exposed to the impact of such threats, South African society is relatively unprepared for the associated disruptions. The increasing dependency of society on electricity, and the potential for such threats materialising, requires that deliberate predetermined measures to be implemented to manage such emergencies and enhance the resilience of the country in the face of such threats.

NRS 048-9 Edition 1 - *Load Reduction Practices, System Restoration Practices, and Critical & Essential Load Requirements under System Emergencies* - has been compiled by a working group including representatives of the South African Electricity Supply Industry, NERSA, Government, and customer groupings (inter alia formal representation of the Energy Intensive User Group). The document specifically addresses system emergencies – defined as: “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” [2].

2. Scope of NRS 048-9

NRS 048-9 is a *code or practice* that provides a national protocol for the management of two categories of system emergencies: (i) load

shedding and/or curtailment under national or regional system constraints, and (ii) load restoration after a national or regional blackout. It also provides guidelines on: (i) the treatment of critical loads; (ii) addressing essential power requirements of customer installations; and (iii) measures to be taken within individual customer installations in the event of supply interruptions or load shedding/curtailment.

3. Key Concepts and Definitions

The code of practice provides a set of national definitions (common vocabulary) for concepts related to system emergencies.

Key definitions are:

- *Blackout*: unplanned loss of supply over a wide geographic area (e.g. national or regional area).
- *Load curtailment*: load reduction obtained from customers who are able to reduce demand on instruction (by system operator or its agent).
- *Immediate load curtailment*: load that is curtailed within (typically 10 minutes) of the instruction being issued.
- *Notified load curtailment*: load that is curtailed within hours (typically with 2-hrs) of the instruction being issued.
- *Load shedding*: load reduction obtained by disconnecting load at selected points on the transmission or distribution system.
- *Automatic load shedding*: load that is shed by automatic defence schemes in response to a sudden threat to the system (e.g. sudden trip of several generation units)
- *Manual load shedding*: load that is removed by a human operator.

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- **Load reduction:** the reduction in system load that can be achieved by load curtailment and/or load shedding.
- **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.
- **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.

4. Load Reduction Principles

The (emergency) load reduction practices in the code of practice are based on seven principles:

1. The integrity of the national automatic under-frequency load shedding system shall not be materially compromised by manual load-shedding or curtailment.
2. All customer installations shall be considered for load reduction under a system emergency, based on broadly equitable participation by customers.
3. Critical and essential load requirements shall be addressed in accordance with the code of practice.
4. Time-based manual load shedding shall be applied.
5. Load shedding schedules shall be developed, maintained, and be available to customers.
6. Load shedding schedules and curtailment requirements shall be defined up to a predefined maximum load reduction. Where more load shedding is required, this is regarded as an extreme system condition explicitly excluded from the above principles 1 to 5 - and which will be handled in accordance with the situation prevalent at the time.
7. Load reduction achieved under an energy conservation programme shall not be considered as emergency load reduction – i.e. a customer complying with the full reduction requirements of such a programme shall *still be required to reduce load* under a system emergency in accordance with the requirements of this code of practice (Figure 1). Exemption from early stages of load shedding may be considered for customers who achieve *more than the required reduction*.

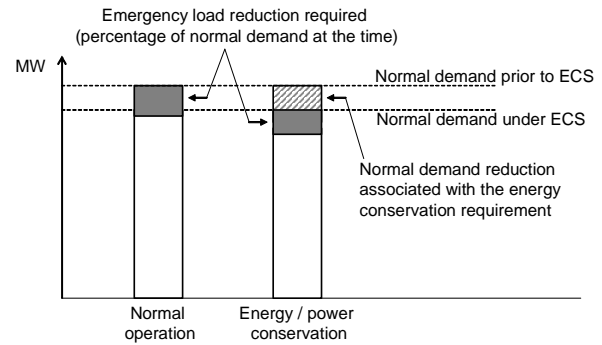


Figure 1 - Emergency load reduction required before and after energy conservations scheme implementation.

5. National Generation Constraint

The specific reduction in load required to stabilise the system under a national generation constraint will be dictated by the conditions prevailing at the time. However, in order to facilitate the development of load shedding and curtailment schedules (that can be made available to the public) pre-determined stages of load reduction are specified. These stages are summarised in Table 1. Under a system emergency, the National System Operator will declare the applicable stage of load shedding.

4.1 Load Reduction: Stage 0

Stage 0 represents the *first stage* of load reduction under a system emergency. It is intended to be available at short notice and is hence *unscheduled*. The actual level of load reduction called on will be determined by the amount of load made available by customers under the immediate curtailment option. Customers eligible for this option shall meet the following requirements:

- At least 25% of normal load can be made available for immediate curtailment.
- This curtailment can be 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 min to an hour).
- This curtailment does not affect the integrity of the national under-frequency load shedding scheme (i.e. load that is on the under-frequency shedding scheme may not be eligible for curtailment under this stage).
- 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 (i.e. recognising this customer may not be on the same circuit as other customers that are on the load shedding scheme). 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.

Curtailment in the event of a system emergency is considered an "imposed" reduction rather than a contracted reduction as in the case of demand-market participation (which in many cases will have already been called upon before the emergency).

Customers who participate under the immediate load curtailment scheme (Stage 0):

- 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 Stage 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.
- May revert to notified curtailment within 24 hrs notice to utility.

4.2 Load Reduction: Stages 1, 2, 3

The national level of reduction required under Stages 1 to 3 is defined at each stage as a percentage of the national load. This reduction is achieved by both load shedding (according to pre-defined schedules) and by reduction required from customers eligible for notified curtailment

All customers are by default included in load shedding schedules, with the exception of: (i) critical loads and loads with essential load requirements, where such exceptions are provided for in the code or practice, (ii) loads that meet the requirements for immediate or notified curtailment, and (iii) some loads that participate in the merit order.

4.2.1 Load Shedding (Scheduled)

Licensees shall develop and maintain load shedding schedules. Maintenance of the schedules shall include ad-hoc revisions in response to changes in the operating environment, as well as a formal review every year.

In the case of Stage 1 & 2 schedules, the total load required to be shed by a licensee shall be scheduled by assigning customer loads to specific time slots. Schedules shall be prepared from 06:00 to 22:00 daily. Where possible, these schedules shall be designed to minimise the impact on various types of customers in the selection of time slots. In the interest of "stable" schedules, published schedules might indicate that customers are impacted for 2h every second day under Stage 1 and for 2h every day under Stage 2 (i.e. Stage 1 schedule is doubled in frequency).

Stage 3 schedules shall be prepared to meet the additional reduction requirement on a 24 hour basis. In the (unlikely) event that national load shedding is required between the hours of 22:00 and 06:00, such shedding shall be undertaken on an ad-hoc basis under instruction from National Control.

Although utilities would establish time-based schedules using specific time slots (e.g. 2 hrs), customers may engage with utilities to consider alternatives such as doubling the duration of being shed, whilst reducing the frequency of such shedding. Such discussions need to be finalised well before an emergency to ensure that the schedules are adapted for this request. It is noted that such requirements may not in all cases be possible to accommodate.

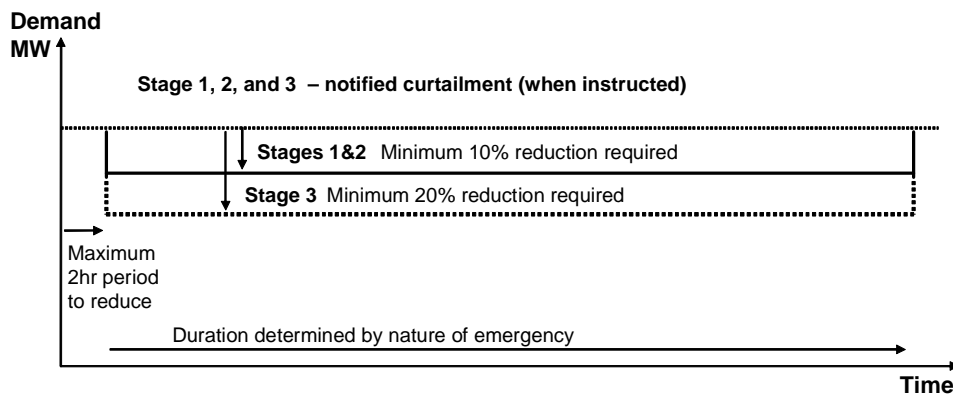
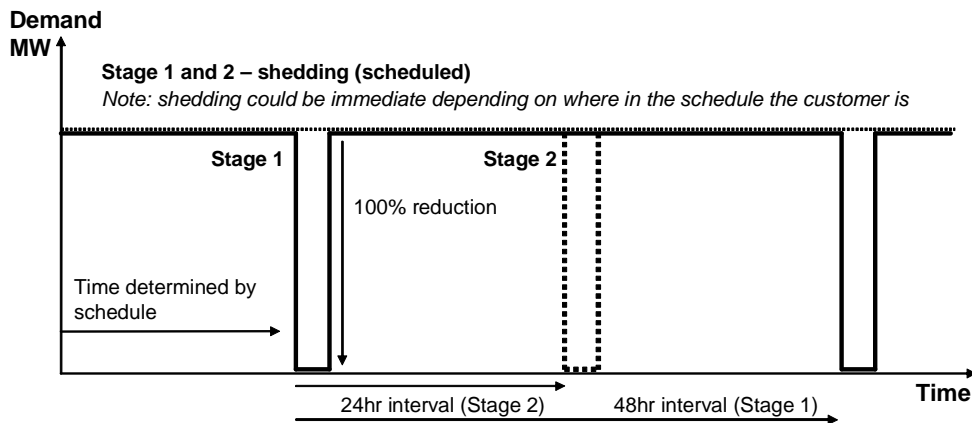
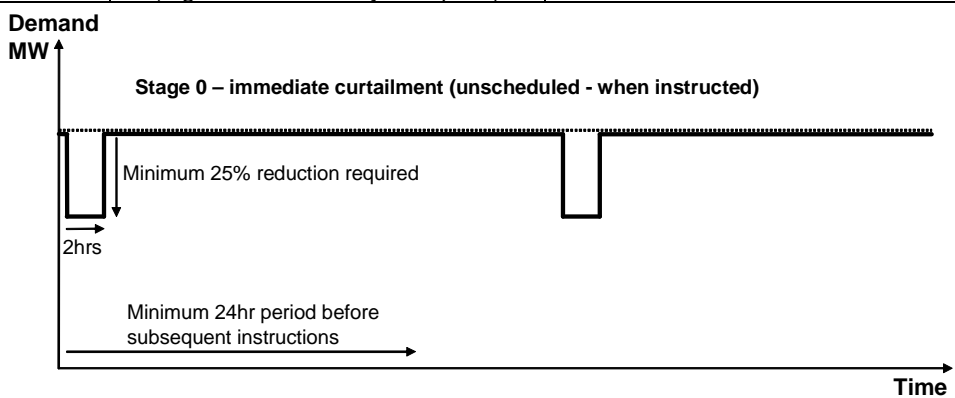
Licensees shall construct load shedding schedules based on the normal feeder annual peak demand associated with a particular feeder breaker.

Licensees shall further take into consideration potential diversity between feeder demand so as to ensure that the overall reduction meets the requirement in each time slot (i.e. shedding should attempt to follow the natural load profile of their system – providing the full allocation at peak).

Where technology options such as curtailment by load limiting relays becomes available, the schedules shall be revised accordingly (i.e. shedding replaced by curtailment).

Table 1 - National load reduction requirements (load shedding and curtailment) under a system emergency - declared by the National System Operator in the event of a national generation capacity constraint

Stage	Type	Reduction required from end-use customers by load shedding	Reduction required from end-use customers eligible for curtailment
Stage 0	Unscheduled (agreed)	Load made available for curtailment by licensees / the public in response to an appeal to avoid subsequent stages of load reduction	25% demand reduction for 2 hrs offered by customers who select the immediate curtailment option (pre-agreed with the utility)
Stage 1	Scheduled	5% reduction in load profile of the national non-curtailment load (e.g. 1000 MW at system peak)	10% reduction in normal demand profile within 2h of notification (excluding customers that have elected to participated under Stage 0)
Stage 2	Scheduled	10% reduction in load profile of the national non-curtailment load (e.g. 2000 MW at system peak)	
Stage 3	Scheduled	20% reduction in load profile of the national non-curtailment load (e.g. 4000 MW at system peak)	20% reduction in normal demand profile within 2hrs of notification
Stage 4	Unscheduled (instructed)	>20% reduction in load profile of the national non-curtailment load (e.g. >4000 MW at system peak)	As instructed by the National System Operator at the time.



To address the potential implications of manual load shedding on the load required for automatic under-frequency load shedding, the following procedure shall be applied:

- Each Control Centre shall determine the load under its control.
- For the first 10% of system load required for automatic under-frequency load shedding, a percentage of this total requirement may be allocated to various time slots on the load shedding schedule.
- A proportionate increase in the available load for under-frequency load shedding scheme shall then be implemented to address the load that may not be available in any given time slot

In the case of special events (such as a national sporting events involving large numbers of people), certain loads should be temporarily protected from load shedding. It shall be the responsibility of the licensee to revise the schedules, whilst still ensuring that the required load to be shed is available.

4.2.2 Load Curtailment (Notified)

A licensee may identify specific customers that, in lieu of being shed, can provide a pre-defined amount of load to be curtailed within 2 h on instruction from the licensee. Customers who meet the following requirements will be eligible for notified load curtailment under Stages 1,2 and 3:

- The customer shall 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).
- The curtailment does not affect the integrity of the national under-frequency load shedding scheme. The customer shall indicate whether the load curtailed to obtain the required reduction is or is not also on the under-frequency 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 (i.e. this customer may not be on the same circuit as other customers that are on the load shedding scheme). Where this customer represents over 80% of the load supplied by a specific feeder, curtailment may be considered (i.e. other loads protected). 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 with the licensee.

Where such conditions are not met, a customer shall not be eligible to be removed from the load shedding schedules (and may be placed back on the schedule if the actual load curtailment is not achieved during an event).

Customers who participate under the delayed load curtailment scheme may not exceed normal demand for 12 hrs after the emergency. In the event that a customer does not achieve the load curtailment requirements during an emergency, the licensee shall have the right to shed the customer after reasonable notice has been given, and/or shall have the right to place the customer on the load shedding schedule going forward.

Customers may select to manage the required percentage reduction across several independent installations (e.g. a customer may choose to completely close down one plant while other plants remain in operation). This arrangement applies to a load reduction required under a national emergency. It may not apply in the event of a regional or local system capacity constraint.

4.3 Stage 4 (unscheduled)

The shedding and curtailment requirement under Stage 4 is unscheduled and will be instructed by the National System Operator at the time.

4.4 Operational information

Regional control centres shall provide the National System Operator with information on the manner in which load reduction requirements have been implemented for the various stages. Municipal and metro control centres shall provide the regional control centres with information on the manner in which load reduction requirements have been implemented for the various stages.

The National System Operator shall make daily system status information available to regional and municipal/metro control centres. This information should provide an indication of the expected need for emergency load reduction for the day.

At the time of publication of this code of practice, technical information on the weekly system status can be found at www.eskom.co.za - i.e. the national system adequacy report.

In the event of a high risk of national load shedding, the National System Operator shall issue an alert communication. In the event that national load shedding is initiated, the National System Operator shall instruct regional control centres on the level of load reduction required. Regional control centres shall instruct municipal and metro control centres on the level of load reduction required.

Licensees shall make load shedding schedules available to their customers. Such schedules may be published in print media, available on a website, and/or attached to electricity bills. An appropriate mechanism for communicating changes to schedules shall be implemented. Where possible, customers shall be notified when there is a high probability that load shedding may be required.

Licensees may choose to define a specific set of customers that will be notified by direct communication (e.g. SMS, telephone, email), whilst the bulk of customers may receive such communication via the media (primarily radio, television).

6. Specific Provisions

6.1 International customers

Cross-border load reduction requirements shall be at least the same percentage as the load reduction required in South Africa – i.e. the exports from South Africa to these countries shall be reduced by the same amount under the curtailment option in relation to each stage of reduction (e.g. 10% under stages 1 & 2).

6.2 Participation in the Merit Order

Where interruptible load has been contracted on a commercial basis as part of the merit order (i.e. in terms of a special pricing agreement or in terms of demand market participation) these may be excluded from the first stages of manual load reduction schedules. Under emergency conditions, agreement may be reached with these customers on further load curtailment.

Where it is technically feasible to isolate demand market participation customers who participate with a minimum of 25% of their total load, these shall only be included in Stages 3 or 4. Emergency DMP customers who participate with a minimum of 40% of their total load shall only be included in Stages 3 or 4.

6.3 Metro / Municipal Generation

Where a metro or municipality has embedded generation, and such generation is not already contracted as an ancillary service to the System Operator, such generation may be used to offset the load reduction required under emergencies. Such generation may be offered as unscheduled reduction under Stage 0, particularly where the possibility of further stages of load reduction can be avoided. Where this generation has been considered as part of the load reduction required during subsequent stages, offering such generation during Stage 0 shall not increase the requirement from individual municipalities / metro's during subsequent stages of load reduction. Offering such generation will reduce the likelihood of load shedding being called upon (i.e. Stage 1).

6.4 Geyser Control (Hot Water Storage)

If geyser control is used as a normal part of managing peak demand by a licensee, *additional* demand reduction will be required during a system emergency. These may however be useful if implemented during off-peak periods under emergency conditions. Geyser control should be used with care to ensure that load pick-up does not negate the demand reduction required. Geyser control may be offered as unscheduled reduction under Stage 0, under the same conditions indicated for generation (see above in section 6.3).

6.5 Voltage Reduction Schemes

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 (minimum power quality standards) [3].

6.6 Smart metering / load limiting

Smart metering and load limiting schemes should be considered as a technology solution to limit the impact of emergency load reduction on customers. Application of these technologies on feeders supplying critical loads should in particular be considered. Smart metering and load limiting schemes may be used by licensees to off-set load shedding requirements (Stages 1 to 3). These technologies may be offered as unscheduled reduction under Stage 0, particularly where the possibility of further stages of load reduction can be avoided.

6.7 Customers Exceeding ECS Targets

Customers may be excluded from load reduction under Stages 1 & 2 (not Stages 3 and 4) under the following conditions:

- Where it can be demonstrated that an equivalent demand reduction (in MW) accompanies the energy saving.
- The customer meets the requirements for notified curtailment.
- The saving has not been traded in terms of ECS rules.
- The equivalent demand reduction (over and above the ECS requirement) is equivalent to the stage of shedding required from the system operator – i.e. the customer may be excluded from Stage 1&2 shedding if the customer demonstrates a continuous demand reduction of 10% over-and above the ECS requirement.
- The customer shall demonstrate that the reduction achieved is not related to a reduced output of the plant, but due to actual process savings (or investment in local generation).
- The saving shall be in place for a year, and the exclusion shall be reviewed annually.
- Should the customer not meet the continuous reduction agreed to, the customer will be placed back on load shedding or curtailment schedules. The licensee shall notify the customer that this is the case.
- This exclusion may in some cases not apply in the case of a regional constraint.
- This exclusion shall only apply to existing sites.

7. Critical Loads

Licensees are required to appropriately interact with customers in addressing critical load requirements. Licensees shall identify the feeders to which these loads are connected. Customers operating critical loads shall evaluate their level of preparedness in terms of the practices in this part of NRS 048. 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 (i.e. exclusion from load shedding is possible where the customer load is supplied directly, or where smart metering / load limiting technologies have been installed on all loads on the feeder).

- Where the installation meets the conditions for load curtailment, the critical loads can be accommodated under this option.
- If shedding is required, careful selection of the specific time of day that a critical load is shed (i.e. when it is not as severely impacted).
- Interventions within the installation (e.g. appropriate backup supplies). In the case of many critical loads, it is necessary to protect the installation in the event of a “normal” supply interruption – i.e. due to a local network outage.
- Implementing protocols for interaction between the customers operating critical loads and the electricity supply utility. (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).

The following loads are specifically considered as critical loads in terms of this part of NRS 048:

- *Public transport (e.g. rail):* Metro/commuter rail shall be excluded from load shedding and curtailment. However, 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 on a rail line crossing different supply areas.
- *Water:* Water supply systems to power stations (including co-generators) shall be excluded from load reduction. Potable water supply systems shall be included in the load reduction requirement. Licensees shall interact with the operators of such systems to optimise the scheduling of these systems on the load shedding schedule to ensure that adequate reservoir levels can be maintained.
- *Sewerage:* Generally, sewerage systems shall be included in load shedding schedules. Special attention shall be taken to identify 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.
- *Refineries and fuel pipe lines:* Refineries, fuel pipe lines, and associated loading and off-loading depots shall be excluded from emergency load reduction requirements.
- *Coal mines supplying power stations:* Mines supplying power stations (including co-generation plant) shall be excluded from load shedding schedules.
- *Educational facilities:* Generally educational facilities shall be included in load shedding schedules, but may be declared as critical loads by National or Provincial Government at critical times of the academic year.

- *Critical loads associated with essential services:* Police, fire fighting, and other essential services shall be included in load shedding schedules. These customers shall provide their own back-up facilities. Processes shall be in place to provide fire fighting services with information when load shedding has commenced. In the event of a fire, these services shall liaise directly with the control room should water pumping be required.
- *Telecommunications infrastructure:* The facilities of telecommunication service providers shall be included in load shedding schedules. These customers shall provide their own back-up facilities.
- *Traffic lights:* High impact intersections (those that would lead to significant congestion on major highways, in central business districts, or important access points) should either be equipped with backup systems able to support the supply for at least 4 hrs or effective deployment of pointsmen should be planned. Contingency plans shall be implemented for medium-impact intersections to ensure that traffic flow is maintained (plans may include the coordinated deployment of pointsmen or traffic officials, based on the schedules).
- *Airports:* 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). Protocols shall be in place for notifying these customers that load shedding has commenced – so as to allow them to start up the backup generators if required. Airports shall ensure that on-site backup supplies shall be available for critical processes.
- *Major sports stadiums:* These shall be required to participate in emergency load shedding or curtailment. Where a 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). Where the licensee is notified of a major sporting event, protocols shall be agreed on for notifying these customers that load shedding has commenced – so as to allow them to start up the backup generators.
- *Hospitals & medical facilities:* State and private hospitals shall be treated equally. Hospitals with life support systems: (i) shall be included in load shedding schedules, (ii) these hospitals shall provide their own back up facilities and shall be required to declare their essential load requirements, (iii) 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, (iv) protocols shall be in place for notifying these customers that load shedding has commenced – so as to allow them to start up the backup generators. Hospitals without life support systems shall: (i) be included in load shedding schedules, (ii) Hospitals shall be required to declare their essential load requirements and should, if practicable provide their own back up facilities, (iii) Protocols shall be in place for hospitals to contact the local operations centre directly in the event of an emergency, (iv) protocols shall be in place for notifying these customers that load shedding has commenced – so as to allow them to start up the backup generators. 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.
- *Public health and safety:* All officers in charge of public buildings and facilities shall be required to assess the risks to the public associated with power interruptions and declare their essential load requirements. By exception such buildings or facilities may be considered as critical loads.
- *National critical product:* Where the destruction or damage to plant, equipment, or facilities would disrupt production of a nationally critical product, the minimum power required to prevent such damage may be considered as an essential load requirement.

8. Blackout Restoration

The National System Operator shall be responsible for developing, maintaining, and testing plans for restoring supply after a national blackout (including the availability of black-start facilities). The plans shall be reviewed annually and shall take essential load requirements into consideration. National Disaster Management shall oversee the development of multi-sectoral plans for a country response to a regional or national blackout.

Individual licensees are responsible for developing, maintaining, and testing plans for restoring supply after a regional or local blackout. These plans shall be reviewed annually and shall take essential load requirements into consideration.

Customers may be required to cooperate in exercises related to blackout preparedness.

9. Essential Load Requirements

An essential loads register is required by a licensee for the prioritisation of restoration of supply in the case of a blackout. It is critical for customers to provide the necessary information to ensure that they are prioritised for restoration after a blackout event. The essential load requirement is the minimum customer load requirement should Stage 4 load reduction be implemented.

Licensees are required to collect essential load data and to appropriately address customer essential load requirements. Licensees shall notify customers at least every 2 years that such information is required. A licensee shall provide its upstream electricity supplier with the power supply requirement to meet its own essential load requirements and that of its customers. In the absence of a submission from a licensee, the maximum essential load allocated to a licensee shall be 10% of the notified maximum demand. A licensee shall evaluate its essential power requirements, and where these are greater than this amount, this will need to be justified based on (i) individual essential load requirements from its customers and (ii) essential load requirements in its area of supply. The upstream licensee shall notify the licensee of the agreed essential load requirement. A licensee cannot guarantee that essential load requirement can be met under all supply emergencies.

Customers shall notify their licensee of their essential load requirements in accordance with the format in NRS 048-9. Such requirements shall be regularly (at least every 2 years) updated by the customer to reflect any changes to processes and/or requirements with regard to safety or the environment. Where a customer does not provide an essential load requirement, the licensee shall be entitled to assume that no such requirement exists. It is incumbent on a customer to ensure that appropriate measures are taken in the case of a failure in the supply of electricity to an essential load. The essential load requirement may be subject to verification by the licensee in terms of: (i) a critical safety requirement, (ii) a critical environment impact requirement, (iii) a critical

national product requirement. Where the submission does not meet 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 back-up systems are in place – as restoration times cannot be guaranteed for the various possible system emergencies that could occur. All customers in the following categories shall be required to provide essential load details: (i) deep level mines, (ii) hospitals & medical centres with life support requirements, (iii) sewerage systems, (iv) prisons, (v) refineries, (vi) national key points reliant on electricity for their core operations. Supply may be cut off to a customer if this customer exceeds the notified essential load data during the restoration process.

10. Technical Considerations

Many municipalities and some metro's require the manual switching of circuits. This may impact the ability to switch at feeder level. In such cases it may be prudent/necessary to switch at a point further back in the network. This may impact customers wishing to be considered for notified or immediate curtailment.

Care needs to be taken when returning load after it has been shed. Cold load pick up may be significantly higher than normal full load - placing the system under stresses beyond its design limits.

11. Conclusion

NRS 048-9 provides a national code of practice for load shedding and system restoration under emergency conditions. As such it answers the call made by many stakeholders for a "*national protocol for load shedding*".

This first edition is based on the limited options presently available for demand reduction. It makes allowance, where possible, for load curtailment rather than shedding. Whilst this edition addresses the phased introduction of new demand management technologies (such as load limiting relays and smart meters), future editions can be expected to further emphasise the use of these technologies before load shedding as a response to a system emergency. As a more targeted approach to curtailing loads on MV and LV feeders becomes possible, this may allow for reduced curtailment / shedding requirements on sectors that contribute more to the economy (see Appendix A).

It is essential to recognise that this code only addresses *emergency load reduction*. Until national generation capacity is increased, it remains imperative that other demand management solutions are implemented.

12. References

- [1] M Chettiar, K Lakmeharan, RG Koch, "A Review of the January 2008 Electricity Crisis in South Africa: A Problem a Decade in the Making", Cigré Southern Africa Regional Conference, Somerset West, South Africa, 18-20 August 2009.
- [2] NRS 048-9 Ed. 1 (WG Draft 5), Electricity Supply - Quality of Supply - Load Reduction Practices, System Restoration Practices, and Critical & Essential Load Requirements under System Emergencies, 4 September 2009.
- [3] NRS 048-2 Ed.3, Electricity Supply - Quality of Supply - Voltage Characteristics, Compatibility Levels, Limits and Assessment Methods, 2008.

13. Acknowledgements

The NRS-048 working group acknowledges the contributions made by various stakeholders throughout the drafting process – including the stakeholder consultation forum held at the SABS in July 2009.

APPENDIX A - Summary of the development of load reduction processes

The diagram below illustrates the progressive improvements in national load shedding that have come into effect since the summer of 2007/8.

The optimisation of key criteria is illustrated (i.e. (i) Safety and environment, (ii) predictability of shedding, (ii) equitable participation, (iii) social impact, (iv) economic impact, and (v) technical impact).

The last three criteria may only be optimised once "universal curtailment" is possible using smart metering and load limiting technologies.

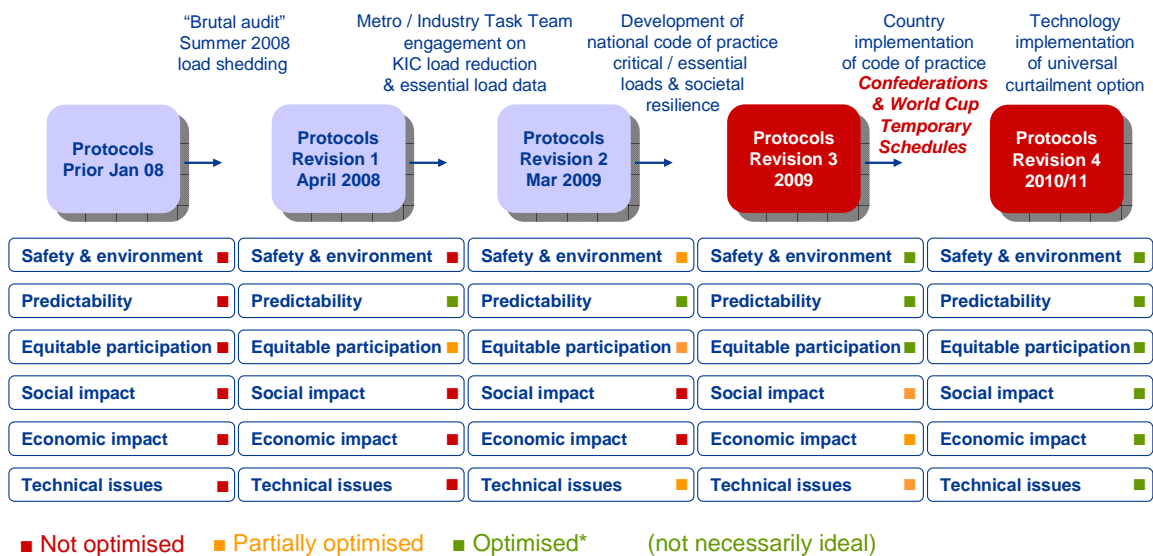


Figure A.1 – Roadmap and progress in improving load reduction schemes under system emergencies.