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1. INTRODUCTION

This document contains the technical requirements for battery rooms housing stationary batteries.

2. SUPPORTING CLAUSES

2.1 SCOPE

This standard details the technical requirements with respect to the design and construction of battery rooms housing stationary vented and valve regulated batteries.

2.1.1 Purpose

The purpose of this standard is to specify the technical requirements for battery rooms and to assist the design engineer in the design of battery rooms that houses stationary, flooded (vented) batteries.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.
The minimum specific Eskom Divisional requirements are provided for in Table 1.

Table 1: Battery Room Divisional specific requirements

	Gx	Dx	Tx	Office	ET AC Power Site	ET Solar	Comment
Emergency lights	✓	X	✓	✓	X	X	Not a requirement for DX and ET sites as most work is performed during the day. If natural light is insufficient then emergency lights are required.
Smoke, Hydrogen, Air flow detection	✓	X	X	✓	X	X	DX, TX & ET areas are normally un-occupied sites.
COC	✓	✓	✓	✓	✓	✓	Refer to 3.5.1 Electrical equipment.
Temperature Control	✓	X	X	X	X	X	Refer to section 3.4.5

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] ISO 9001 Quality Management Systems.

[2] Occupational Health and Safety Act, 85/1993

2.2.2 Informative

[3]	ARP 0108	Regulatory requirements for explosion-protected apparatus
[4]	SANS 1091	National colour standard
[5]	SANS 10086-1	The installation, inspection and maintenance of equipment used in explosive atmospheres
[5]	SANS 10108	The classification of hazardous locations and the selection of apparatus for use in such locations
[5]	SANS 10119	Reduction of explosion hazards, presented by electrical equipment Segregation, ventilation and pressurization
[5]	SANS 10139	Fire detection and alarm systems for buildings - System design, installation and servicing
[6]	SANS 10400	The application of the National Building Regulations
[7]	SANS 50054-7	Fire detection and fire alarm system – smoke detectors
[8]	SANS 10142-1	The wiring of premises Part 1: Low-voltage installations
[9]	05TB-024	DX Technical Bulletin Emergency showers in battery rooms
[10]	240-56362221	Standard for safety signs used in DC applications
[11]	240-56176113	Classification of Battery Rooms Work Instruction
[12]	240-70164623	Design Guideline for HVAC in the Eskom Coal Fired Power Stations
[12]	240-89797258	The Safe Handling, Transportation and Disposal of Cells, Batteries and Electrolyte.
[13]	D-DT-5238	National standard combo control building types NOTE: applicable to DX as a guideline, any variation shall have to be requested
[14]	D-DT-5239	National standard relay house types
[15]	0.54/6622	Substation Standards : Water supply tank, booster pump and pipe routes water supply divided in two sections – 1 pump details and specifications
[16]	0.54/1150	Substation buildings. Battery room: Wash-up sink, drainer and shower Standard details

2.3 DEFINITIONS

Definition	Description
Chemical resistant	Is a resistance to the electrolyte contained in the battery room be it alkaline or acid.
Conservancy tank	A chemically resistant trap located underground outside the battery room. It is capable of holding a mixture of water and electrolyte for lengthy durations of time. Access to the tank is available from outside from which the electrolyte water can be safely extracted and disposed of.
Containment level	If the electrolyte of all the batteries contained in the battery room is thrown onto the floor and left to dam up (assuming there is no drainage of the electrolyte into the drainage system), then the containment level would be the level of the surface of the electrolyte.
Deluge shower	Is a full body shower which has spray nozzles located at various heights to ensure that the whole body gets drenched in water from different directions when the shower is turned on.
Eye wash	It has two fountains of water which gently cleans both eyes from the chemicals which have found its way into the eyes.
Gulley	Is a chemical resistant trench situated at the lowest end of the battery room collecting the spilled acid, alkaline or water at the lower end of the room.
Type 'e'	Equipment that does not produce arcs sparks, or dangerous surface temperatures in normal service, and which has been provided with certain additional protective features in order to increase its safety to a level that is suitable for use in potentially explosive atmospheres.

2.3.1 Classification

a. **Controlled Disclosure:** Controlled Disclosure to External Parties (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation	Description
AC	Alternating Current
BVR	Basic Ventilation Rate
COC	Certificate of Compliance
DX	Distribution Division
ET	Eskom Telecoms
GX	Generation Division
HVAC	Heating Ventilation and Air Conditioning
OHSACT	Occupational Health and Safety Act
RVR	Recommended Ventilation Rate
Sub	Substation
PVC	Polyvinyl Chloride
TX	Transmission Division

2.5 ROLES AND RESPONSIBILITIES

The design engineer shall ensure that all battery room designs comply with this standard.

2.6 PROCESS FOR MONITORING

This document will be reviewed and updated every five years or as and when required.

2.7 RELATED/SUPPORTING DOCUMENTS

This standard superseded the following documents listed:

- 240-56177186 Rev 1 Design Guide for Power Station Battery Rooms
- 240-56364501 (TST41-644) Rev 1 Battery Rooms Standard
- 240-53114309 (DSP 34-479) Rev 1 Standard for Battery Rooms

3. BATTERY ROOM REQUIREMENTS

3.1 GENERAL

a. Battery rooms shall provide easy access for installation of batteries and battery stands.

b. Battery rooms shall be dry, well lit, well ventilated and protected against the ingress of dust and foreign matter.

c. Battery rooms with different types of electrolyte shall not be installed in the same room. Two or more batteries sizes with the same type of electrolyte may be installed in the same room, but installed on separate battery stands.

d. The minimum reachable distance between any battery terminal and the nearest water outlet point shall be no less than 2000 mm.

e. Battery stands shall be positioned such that they do not obstruct the doorway.

f. The stands should be positioned perpendicular to the entrance wall to allow for an unobstructed escape path (minimum width of 600 mm) during emergency conditions.

g. Battery rooms shall provide for future plant expansion or refurbishment and therefore should be located at the end of the building. Battery rooms should be situated close to the associated loads and power electronic equipment.

3.2 BATTERY ROOM CIVIL REQUIREMENTS

3.2.1 Fire resistance

a) Battery rooms shall be constructed from non-combustible material.

Battery rooms in the following locations shall have a fire rating for paints, floors, ceilings, walls, roofs, cabling, ducts and doors as specified below:

1. In the basement of a building : 4 hours.
2. In a single storey building : 1 hour.
3. In a double storey building : 1 hour and 30 minutes.
4. In a building with more than three but less than eleven storeys : 2 hours.
5. In a building with more than eleven storeys : 3 hours.

b) Any duct, pipe, conduit, cable or other equipment that penetrates a wall, floor or ceiling, shall be fire sealed with a fire-resistant material in such a way that the fire resistance of the wall, floor or ceiling will not be negatively affected.

c) Ventilation ducting that passes through to adjacent rooms of the building shall have fire dampers installed to prevent fire from spreading to surrounding rooms.

d) The fire-resistant material used for filling holes in the wall shall be smooth and non-permeable to acid vapour.

3.2.2 Floor Construction

a) Expansion joints shall be avoided.

b) The floor shall have a smooth uniform surface finish.

c) The floor shall be designed to handle the mass of the batteries and battery stands.

d) Due to the mass of the batteries the floor shall be absolutely stable. Collapse of the floor at points of load shall not take place, as this will cause settling and tilting of the batteries with consequent straining of the battery connections.

e) The floor shall be given a uniform cement screed fall, 1:200 or as specified in Schedule A (not less than 1 in 200).

f) The lower end of the floor shall end with an open chemical resistant gulley (were required as specified in Schedule A). The gulley shall not more than 200 mm deep and between (150 – 400) mm wide, which shall slope to the appropriate drainage location.

g) The battery room shall be designed to hold 100% of the electrolyte contained in the battery room. To prevent fluid discharge from the battery room, the door entrance shall be elevated enough to ensure electrolyte containment. A sloping ramp shall be constructed between the floor and the door frame to minimise any tripping hazard and to prevent any fluid from discharging through the door way. (See Appendix B for an example.)

h) The colour of the battery room floor shall be light grey.

3.2.3 Floor Protection

a) As concrete is highly vulnerable to corrosion by acid, the floor shall be finished with a chemical resistance epoxy coating.
b) The floor finish shall form a continuous skirting against the wall. The skirting shall extend as specified in Schedule A (50 mm to 100 mm) above the identified containment level.
c) The epoxy floor finish shall:
    1. Be uniform and impermeable to the battery electrolyte.
    2. The epoxy shall have a high abrasion resistance and weathering resistance.
    3. The epoxy shall be resistant to chemicals of greater concentration then the battery electrolyte (35% sulphuric acid or 35% potassium hydroxide).
    4. The epoxy shall be no less than 5 mm thick when dry.
    5. The epoxy and floor preparations shall be done as specified by the epoxy manufacturer.

3.2.4 Walls

a) Walls shall be plumb and smooth.
b) Walls shall be continuous from floor to ceiling and shall be securely anchored.
c) Walls shall be painted with a chemical-resistant paint, which is:
    1. Resistant to occasional splashing of the chemicals being housed in the battery room.
    2. A minimum thickness of 100 micron.
    3. The walls of the battery rooms shall be painted with an approved, acid resistant primer and white enamel paint.

3.2.5 Windows

a) Windows shall not be provided in battery rooms.
b) Windows that have been installed in rooms being converted to battery rooms shall be suitably blanked off to form an impermeable barrier in accordance with SANS 10119.

3.2.6 Ceilings

a) The ceilings shall be flat with a minimum of 2500 mm above floor level.
b) If ducting is used within the battery room, the ceiling shall be higher than 2500 mm above floor-level to ensure the lowest point of the ducting is 2500 mm above floor level.
c) Being considerably lighter than air, the hydrogen given off during battery charging will rise and accumulate in the highest locations of ceilings and overhead structures. All such high points shall be vented to the atmosphere as described in ventilation section 3.4. Special attention shall be paid to this ventilation when structural beams form part of the ceiling.
d) The ceiling shall be constructed from non-combustible material.
e) Skylights shall not be used.
f) Ceilings shall be given the same paint treatment as specified for the walls.
g) Ceiling boards shall be screwed into place with screws, nails are not permitted.
h) Ceiling construction shall not consist of any metal parts except for the screws used to mount the ceiling boards.
i) Where ceilings are being used under a roof finish other than a tiled roof without a plastic dust cover, natural ventilation rated for sufficient dilution of the produced hydrogen, shall be provided for the cavity between the ceiling and the roof.

3.2.7 Doors

a) Battery room doors shall be equipped with an anti-panic bar door mechanism or as specified in Schedule A.
b) The doors shall be hinged, single action that opens outwards.
c) Each leaf shall be hinged by means of four hinges. The hinges shall be able to support the weight of the door.
d) The door and frame shall be given the same paint treatment as the walls.
e) Doors shall close and seal in such a way as to minimise dust ingress.
f) Battery room doors shall be lockable from the outside and every locking device fitted shall be suitable for the surrounding environment.
g) Electronic door locking devices shall unlock automatically when the power supply to the lock is interrupted or if the fire detection device is activated.
h) All doors shall have a closing mechanism.
i) Battery room doors shall not be less than 1 800 mm wide and 2 000 mm high, and shall consist of two leaves. For small substations and small communication stations, the door shall be a minimum of 850 mm wide and 2 000 mm high.
j) A rectangular glass observation panel with maximum dimensions of 300 mm x 100 mm shall be provided for battery rooms that are accessible from within a building,

3.3 PLUMBING

The plumbing requirements shall be read in conjunction with the divisional drawings listed.

a) Generation 0.54/1150 Sheet 25 (b)
b) Transmission 0.54/6622
c) Distribution D-DT-5238, National Standard control buildings – Details of battery room sink.
d) Eskom Distribution & Eskom Telecommunication only:

With reference too 05TB-024, deluge safety showers are not required in battery rooms.

3.3.1 Plumbing Requirements

a) Where possible there shall be two types of water supplied to a battery room namely:
   1. Demineralised water to top up battery cells.
   2. Potable water- used for the sink, eyewash and shower.
b) All water supplies shall be labelled.
c) All water supplied to the battery room shall be cold water.
d) At sites where water pressure is very low or non-existent:
   1. A potable water tank shall be installed external to the battery room at a high enough level to attain a minimum pressure of 3 bar. If 3 bar cannot be attained, then additional to elevating the tank, a pressure pump shall be installed at the tank. The pressure pump shall not run when the level within the tank is too low. The pressure pump shall have an upper and lower pressure limit of 4 bar and 3 bar respectively
   2. Water shall feed via gravity to the shower, eyewash and sink in cases when the booster pump fails or loses supply.
e) Where water is supplied from an elevated tank, the supply to the ablutions shall be situated 500 mm from the bottom of the tank ensuring that there is reserve water for the battery room water supply.

3.3.2 Plumbing layout

a) The deluge shower, eyewash and sink are to be located in two areas namely:
   1. At the lowest point of the sloping floor, but as near to the entrance to the battery room.
   2. Where there is not enough space for civil extensions to accommodate a deluge shower, it shall be located outside the battery room next to the door.

b) The deluge safety shower and the eyewash shall be either of single construction, or in very close proximity to each other.

c) The shower and eyewash shall be located next to the sink.

d) Deluge showers:
   1. The shower shall be a full body deluge shower which is activated by stepping on the platform below the shower.
   2. The shower and nozzles shall be fabricated from stainless steel.
   3. The shower shall comply with 0.54/1150 or 05TB-024.

e) Eyewash:
   1. The eyewash shall be activated with a bidirectional hand lever situated at the eyewash.
   2. The eyewash shall be fabricated from stainless steel.
   3. The eyewash shall comply with 0.54/1150.

f) Pipes:
   1. Pipes supplying demineralised water to the battery room shall be fabricated entirely from stainless steel.
   2. All pipes feeding the shower and eye washes shall be constructed from SABS approved material.

3.3.3 Sink and eyewash drainage

a) Where a drainage system is available for the eyewash and sink, the neutralised electrolyte shall discharge through the external wall of the battery room into the site drainage system or available conservancy tank or effluent neutralization drain sump.

3.4 VENTILATION

3.4.1 General

a) The fire resistance requirements stipulated in section 3.2.1 shall apply.
b) When determining the ventilation required then the following steps shall be taken

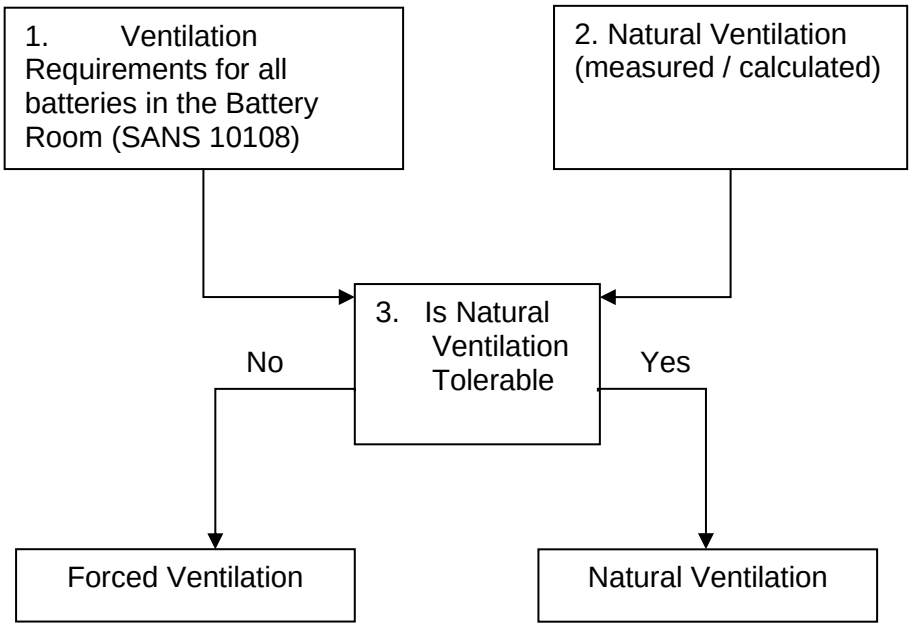

Figure 1: Ventilation flow diagram

c) Ventilation shall prevent the accumulation of hydrogen gas in excess of the recommended safe limit of 0.8% of the volume of free air in the room. The minimum number of air changes per hour shall be calculated using SANS 10108, for the specific type of battery at end of life or at elevated voltages as indicated in SANS 10108.
d) Where recombination units are used, the efficiencies of the recombination units at end of life shall be used to adjust the ventilation requirements.
e) The following two types of ventilation extraction methods are acceptable. The application thereof depends on the surrounding pollution level, type of pollution and the ventilation requirements as calculated using SANS 10108:
    1. Artificial ventilation by means of electrically powered fans which shall be used in applications where the battery room is enclosed by adjacent rooms or when a ventilation calculation deems natural ventilation inadequate. With artificial ventilation the exhaust ducting shall not be connected to the building ventilation (air-conditioning) system.
    2. Natural ventilation which is accomplished by the movement of air caused by wind and/or temperature gradients. Wind powered extractors shall be used in these cases. Where the minimum number of air changes required is more than what is attained by natural air changes then forced ventilation shall be used.
f) Battery rooms may be naturally ventilated with roof ventilators and filtered louver air inlets in the exterior walls. In cases where battery rooms have no exterior walls and/or it is not practical to provide natural ventilation, a forced ventilation system shall be provided
g) The maximum height of the inlet louvre (bottom of the louvre) shall be the same height as the top of the lowest battery cell in that specific battery room.
h) All air inlets shall have site specific, removable dust filters.

i) Extraction mechanisms shall be selected to provide the required performance when operating against normal system resistance, including dust-laden filters, and taking into account the prevailing wind and any other detrimental effects.
j) All extraction duct inlets/fans shall be located at the highest point and equal to, but not below the level of the light fittings.
k) Fans which motors are not located in direct line of air flow and are not situated within the battery room do not have to be EXE rated.
l) In battery rooms with deep roof beams or various hydrogen collection points in the ceiling, extraction inlets shall be located within every possible air pocket.
m) Ventilation of the room shall be strategically located to ensure there is cross-flow of air across all the top of the battery cells. The principle is illustrated in Figure 2.

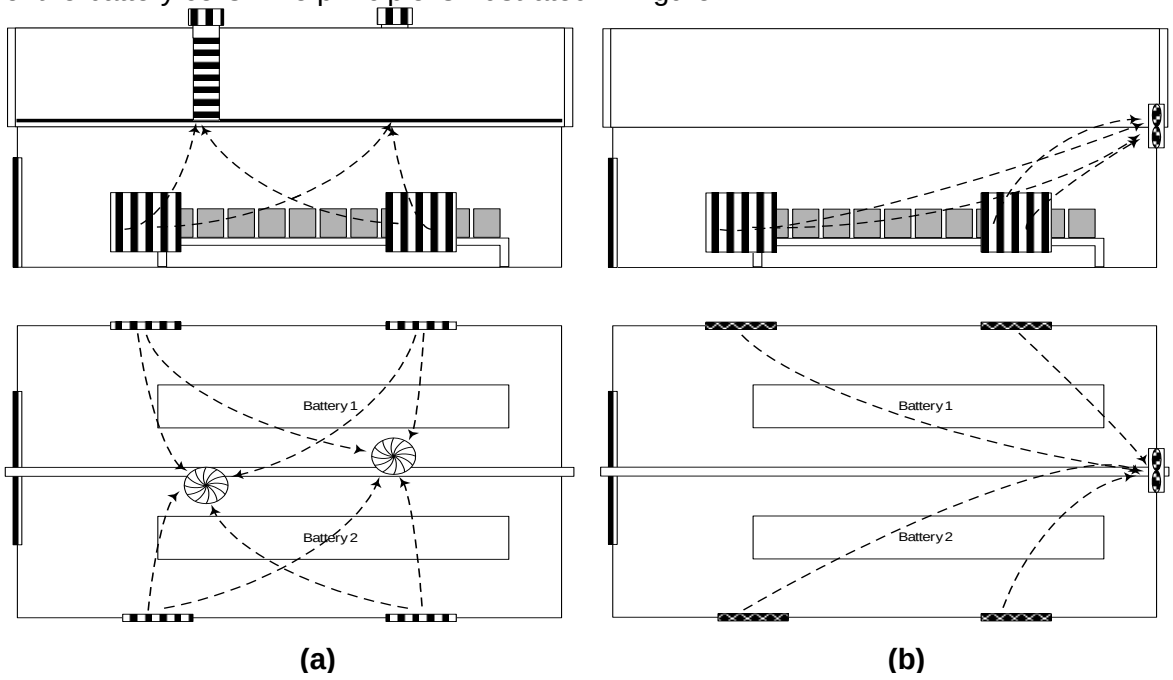

Figure 2: Cross-flow ventilation principle in the battery room (a) wind powered extractors (b) extraction fans

3.4.2 Ducting

a) All hydrogen filled air shall be safely vented safely to an area i.e. to the atmosphere.
b) The exhaust end of extraction system ducting shall be located above the highest point of the building. This end shall be designed not to allow excessive dust or water ingress
c) The ducting shall be suitably sealed at the joints or bends in the ducting

3.4.3 Natural ventilation

a) The doors and external walls shall be suitable to have a removable, washable air filter mounted behind fixed louvers.
b) The filter media shall be washable and be able to resist degradation due to cleaning.
c) When using a wind-powered extraction fan where a ceiling is present, a flexible duct shall provide passage from the ceiling inlet opening to the extractor fan.
d) The extractor fan, filters and louvres shall be rust-resistant.

3.4.4 Forced ventilation

a) Each application shall be checked to ensure that fan noise will not be objectionable in adjacent occupied spaces.
b) The following types of configurations can be used
    1. Powered roof ventilator with panel filters at the air inlets in at least the one wall.
    2. Powered roof ventilator with replacement air provided by one or more fan-filter units. This system allows the use of bag filters that have greater dust holding capacity than the panel filters.
c) In applications where there is complete dependence on forced ventilation, it is recommended that redundancy be provided in the extractor fans, with suitable non return dampers and alarm interface to the battery charging equipment.
d) Where a central ventilation system is not supplied, the ventilation fan shall be powered from the same source as the battery charging equipment and controlled in such a way that maximum available ventilation is assured when batteries are on charge (gassing is likely to form).
e) Extraction fans shall run all the time during normal running conditions of the charging equipment.
f) Where both force supply and extraction systems are provided, they shall be selected to ensure that there will, under normal conditions, be a slight negative pressure in the battery room.

3.4.5 Temperature control

a) Where specified in Schedule A and with reference to Table 1, the battery room's temperature shall be maintained at a constant 25 °C (+3 °C or -5 °C). The temperature operating range averts battery size increase due to temperature compensation and negative impact on battery expected life.
b) The HVAC system shall not recirculate the air. The battery room HVAC system shall be separate from the rest of the building's HVAC system.

3.4.6 Declassification

a) Battery rooms may be considered non-hazardous provided that natural ventilation is tolerable ensuring the hydrogen levels are kept satisfactorily low in accordance with SANS 10108.
b) Under any other conditions, the battery room shall be classified in accordance with SANS 10108.

3.5 ELECTRICAL REQUIREMENTS

3.5.1 Electrical equipment

a) Electromagnetic compatibility
    1. All electrical equipment shall be immune to Electromagnetic Compatibility (EMC) as specified in SANS 61000-6.
b) Electrical equipment (classified zones)
    1. All electrical equipment shall comply with SANS 10142.
    2. All equipment installed in the battery room shall comply with the zone classification as per SANS 10108; close attention shall be paid to the gas class and temperature rating of equipment installed.
    3. All electrical installations in battery rooms shall be issued with a Certificate of Compliance (CoC) by a registered master installation electrician.
    4. Fan motors which are not placed in a hydrogen environment or directly exposed to the flow of hydrogen do not have to comply with the aforementioned statement.
    5. Evidence in the form of type test reports and certificates shall be provided as proof of compliance with SANS 10108 for each piece of equipment.

3.5.2 Cabling

a) Where the cable entry is through the floor, the following shall be adhered to:
   1. The cable opening shall be adjacent to the wall and located where the battery stands will be installed.
   2. PVC cable pipes, with a 110 mm diameter, curved to a slow bending radius shall be cast into the floor in such a way that the entry of the cables into the battery room is perpendicular to the floor.
   3. To prevent fluids or foreign matter from entering the pipe, its upper end shall extend 50 mm to 100 mm above the identified electrolyte containment level.
b) Any other form of cable entry shall be either against the wall, from above or horizontally (at a suitable height) through one of the battery room walls.
c) After installation of the cables, ducts and pipes, all entrances shall be sealed with a suitable material, to prevent acid vapour, liquids, dust and vermin from entering the cable ducts.

3.5.3 Lighting

a) The luminaires shall be mounted in parallel with the battery stands, but not over the battery stands. Maintainability of the lighting to be kept in mind when positioning the lights.
b) Main lighting installation:
   1. The installation shall consist of energy-efficient fluorescent luminaires.
   2. The lighting shall preferably be mounted on the ceiling in such a way that the fitting is slightly lower than the ceiling to ensure the fitting is away from the point where H_2 will accumulate.
   3. The lights shall maintain a luminance of a minimum of 100 lux above all of the battery cells.
   4. Lighting shall be planned in such a way as to minimize shadows in the room. The room shall be equally illuminated throughout the entire battery room.
c) Emergency lighting installation:
   1. The installation shall consist of energy efficient luminaires.
   2. The maintained level of emergency lighting required in this area shall not be less than 20 lux at floor level to enable employees to evacuate the workplace safely.
   3. The lighting shall activate within 5 s of the failure of the normal lighting and shall reach the required luminance within 10 s or as specified in Schedule A.
   4. Emergency lighting shall be supplied from a battery bank where applicable.

3.6 SAFETY AND MAINTENANCE

3.6.1 General

a) The response, through design, to a failure shall be such that a single failure does not lead to a series of failures or a chain reaction of failures.
b) Any failure shall be restricted to a local event, otherwise the hazard and probability for damage are greatly enhanced.
c) The ventilation system design shall be that a single failure will not result in an increase of risk, hazard or probability of an event. Therefore power to the ventilation system should be monitored and one of two other options made available at the charger interface alarm as the contingency for ventilation failure, namely:

   1. hydrogen detectors or
   2. air flow monitoring.

3.6.2 Hydrogen detectors

In accordance with Table 1, where hydrogen detectors are installed:

a) The hydrogen detectors shall be able to detect the percentage of hydrogen regardless of the background surrounding gas.
b) The detector shall be located a minimum of 400 mm above the top of the door. It is preferred that hydrogen will be detected at a level above any light fittings, normally at the highest point where hydrogen build-up most likely will occur.

3.6.3 Air flow sensors

In accordance with Table 1, where forced ventilation is installed:

a) There shall be a differential pressure sensor located across every fan to monitor individual fans.
b) Airflow sensors shall measure the differential pressure across fan blades.
c) Airflow sensors shall have a minimum of EXn rating.

3.6.4 Smoke detectors

a) Battery rooms with an area > 500 m² shall have smoke detectors installed.
b) Smoke detection is optional as in accordance with Table 1.
c) Smoke detectors shall comply with the requirements of section 3.5 Electrical Requirements.
d) Detection of smoke shall hinder the supply of fresh air into the battery room.
e) Detectors shall be installed and maintained by a competent person as per SANS 10139.
f) All smoke detectors shall be mounted on the ceiling.

3.6.5 Alarms

a) All battery room alarms shall be sent to the Control desk.
b) All safety alarming and indication shall be fail safe, thus even when the detecting equipment fails then the alarm will be triggered.
c) The following alarms are to be present where required:
    1. No/ limited airflow (Forced ventilation) and/or
    2. High hydrogen level
    3. Smoke detection

3.6.6 Fire extinguishers

a) There shall be 1 x 5 kg carbon dioxide (CO_2) portable fire extinguishers per 50m² of battery room.
b) Extinguishers shall be installed at each entrance to the battery room.

3.6.7 Safety signs

a) All safety signs shall be manufactured and installed in accordance with *240-53114264 Standard for Safety signs used in DC applications.*

b) The required safety signs are specified in Table 2.

Table 2: Safety signs required for battery rooms

Description of safety sign	Safety Sign Location	Eskom code drawing number
A notice identifying the room as being a battery room and its type of hazardous classification. It clearly sets out the elementary first aid procedures in the case of eye and / or skin contact with an acid or alkali. A no-smoking prohibitive sign and corrosive substance warning sign are also posted on the notice. The notice also displays that unauthorized entry to the battery room is prohibited.	At the designated entrance to the battery room.	DCSS 4
This notice shows that open flames are prohibited inside the battery room. It also shows that an apron, eye protection and gloves shall be worn	On wall directly opposite the entrance to the battery room.	DCSS 3: D-DT-5022 Sheet 3
A notice indicating the location of the emergency shower.	Next to the emergency shower.	GA 20: D-DT-5023 Sheet 1
A notice indicating the location of the eyewash equipment.	Next to the eyewash equipment.	GA 19: D-DT-5023 Sheet 2
A notice showing that the drinking of water is prohibited (when applicable)	On wall above battery room sink or water container.	PV 5: D-DT-5023 Sheet 3

3.6.8 Warning notices

a) The following warning notices shall be easily visible:

1. A notice indicating the location of the first-aid box and the name of the person in charge of the box.
2. A notice clearly setting out the elementary first-aid procedures required in cases where personnel receive burns as a result of contact with acids or alkalis, or as a result of exposure to radiation from electric arcs.
3. A notice indicating where the fire extinguisher is placed.

3.7 MANAGEMENT OF BATTERY ACID SPILL IN THE BATTERY ROOMS

Battery room acid spillages shall be managed in accordance with 240-89797258 The Safe Handling, transportation and disposal of cells, batteries and electrolyte.

3.8 TESTS

a) Certification in accordance with the requirements of 240-56176113 - *Classification of battery rooms work instruction* shall be provided upon handover.

3.9 MARKING AND LABELLING

a) At sites where access to the outside of the battery room is regulated, all details pertaining to the battery room dimensions and the ventilation rate; maximum and minimum assumed temperatures; and detection mechanisms shall be made available on a battery room nameplate, which shall be located outside the battery room, and easily visible.
b) Refer to Table 3 for an example of a battery room nameplate

Table 3: Example of battery room nameplate

ESKOM HOLDINGS LIMITED GENERATION	
Location of Battery Room	ABC Substation
Total Volume Air (Empty Room)	(10 m x 10 m x 3 m) 300 m³
Total Ventilation Rate	10 m³/h
Maximum Room Temperature	40 °C
Minimum Room Temperature	-5 °C
Type of Monitoring Systems	Hydrogen detection, air flow detection
Chemical Containment Volume	3 m³

4. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
T. Jacobs	DC & Auxiliary Supplies Study Committee Chairperson
Danie Odendaal	Senior General Manager Engineering (Acting)
Richard McCurrah	PTM&C TC Chairperson

5. REVISIONS

Date	Rev.	Compiler	Remarks
November 2012	1.0	RE Mulder	41-644, 474-113, GGG0838, 34-479
August 2016	1.5	MJ Magano	1) Document type and title amended. 2) Table 1 updated. 3) CoC requirement added. 4) References too standards updated. 5) Schedule A&B aligned with document content. 6) Appendix A LAP/CAP assessment removed. 7) Reference to 240-53114256 Standard for Lead Acid Battery Stands removed. 240-53114256 superseded by 240-56360034.
September 2016	1.6	MJ Magano	Updated Final Draft for Comments Review Process
November 2016	1.7	MJ Magano	Updated Final Draft after Comments Review Process
November 2016	2	MJ Magano	Final Rev 2 Document for Authorisation and Publication

6. DEVELOPMENT TEAM

The following people were involved in the development of this document:

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7. ACKNOWLEDGEMENTS

None

APPENDIX A: SCHEDULES A AND B

Schedule A and Schedule B provide technical details against tendered equipment/Tenderer's statement of compliance or non-compliance. Information requested in this schedule may be provided on separate submission documents and reference provided in Schedule B

Table 4: Schedule of technical compliance

ITEM	Description	Units / Requirement	Schedule A	Schedule B
3.2	**BATTERY ROOM Civil Requirements**			
3.2.1	Fire resistance			
3.2.1a)	Fire rating of structure, paint, floor, ceiling, roof, cabling, ducts, doors, walls, ceiling, sealants, hole fillers.	Hour(s)		
3.2.2	**Floor Construction**			
c)	Mass of the batteries and battery stands	kg		
e)	Slope	Ratio (1:200)		
f)	Gulley	Yes / No		
	Gulley Depth (<200) mm	mm		
	Gulley width (150-400) mm	mm		
g)	Volume of electrolyte to be contained (100%)	cubic meters		
h)	Battery room floor colour	Light Grey		
3.2.3	**Floor Protection**			
a)	Floor Coating	Chemical resistant epoxy		
b)	Skirting height	(50-100) mm		
c)	Epoxy thickness when dry	(5) mm		

ITEM	Description	Units / Requirement	Schedule A	Schedule B
3.2.4	**Walls**			
c)	Wall chemical resistant material	Specify		
	Wall paint resistance	Alkaline or Acid		
	Wall paint thickness	100 Micron minimum		
	Wall paint colour	White		
3.2.6	**Ceilings**			
d)	Ceiling non-combustible material	Specify		
f)	Ceiling paint thickness	100 Micron minimum		
i)	Roof construction material	Specify		
3.2.7	**Doors**			
a)	Anti-panic mechanism	Yes / No		
b)	Door direction opening	Outwards		
c)	Number of hinges per door	4		
d)	Door non-combustible material	Specify		
	Door paint resistance	Alkaline or Acid		
f)	Doors lockable	Yes / No		
g)	Electronic door automatic unlock due to loss of power or activation of fire detection.	Yes		
i)	Door leaf dimensions (mm)	Specify		
j)	Observation window	Yes / No		

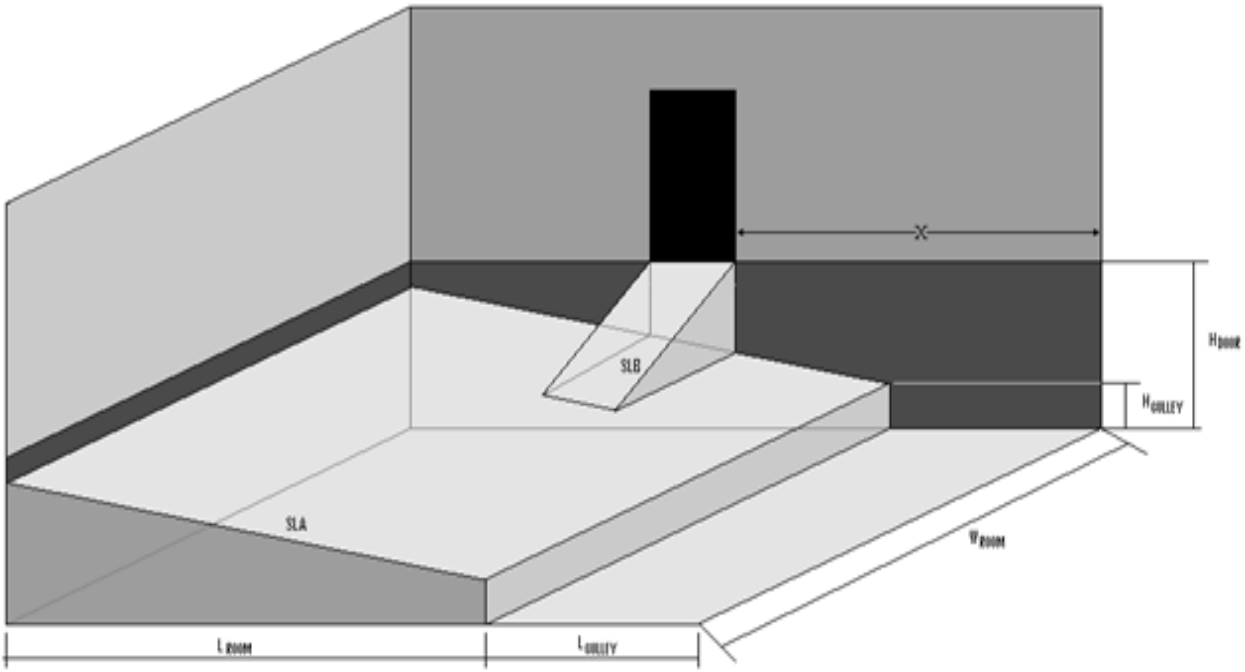
ITEM	Description	Units / Requirement	Schedule A	Schedule B
3.3.1	**Plumbing Requirements**			
a)	Water supplies required	Portable and (or) Demineralised		
d)	External water tank required	Yes/No		
3.3.2	Plumbing **layout**			
d)	Deluge shower required	Yes/No		
e)	Eyewash required	Yes/No		
3.3.3	**Sink and eyewash drainage required**	Yes/No		
3.4	**Ventilation**			
b)	Natural or forced	Natural or forced		
e)	Extraction method (fans /vents /louvers)	Specify		
f)	Inlet method (fans / vents /louvers)	Specify		
g)	Height of extraction openings	Specify (metre)		
	Height of inlets (Lowest battery cell)	Specify (metre)		
h)	Air inlet filter removable dust filter	Yes/No		
	Filter type	Specify		
	Room pressure	Negative / Positive		
3.4.2	**Ducting compliance**	Yes / No		
3.4.3	**Natural ventilation compliance**	Yes / No		
3.4.4	**Forced ventilation**			
a)	Noise level of fans	dB		
c)	Redundancy required (fans & dampers)	Yes/No		
d)	Ventilation system integration to battery charging equipment and philosophy	Yes/No		

ITEM	Description	Units / Requirement	Schedule A	Schedule B
3.4.5	**Temperature control**			
a)	HVAC Required	Yes/No		
a)	Required HVAC Room temperature	Degrees Celsius	25 ˚C (+3 ˚C,- 5 ˚C)	
3.5.1	**Electrical equipment**			
3.5.1 b)	Electrical equipment (classified zones)	Yes / No		
3.5.1 b) 3	Certificate of Compliance (CoC) required	Yes		
3.5.2	Cable entry	Floor, wall, ceiling		
3.5.3	**Lighting**			
3.5.3 b)1	Luminaire type	Specify		
3.5.3 b)3	Light intensity	minimum 100Lux		
3.5.3 c)	Emergency lighting installation: required	Yes/No		
3.5.3 c) 1	Emergency lighting fitting type	Specify		
3.5.3 c) 2	Emergency light intensity at floor level	minimum 20 Lux		
3.5.3 c) 3	Emergency light activation time (5 sec)	minimum 5 seconds		
3.5.3 c) 3	Emergency light time to reach full luminance	10 seconds		
3.5.3 c) 4	Emergency Lighting Power source	Internal or external		
3.6	**Safety and Maintenance**			
3.6.2	Hydrogen detectors required	Yes/No		
3.6.3	Air flow sensors required	Yes/No		
3.6.4	Smoke detectors required	Yes/No		
3.6.5	Alarm(s) integration and philosophy required	Yes/No		
3.6.6	Fire extinguisher weight(s)	Kilogram		

ITEM	Description	Units / Requirement	Schedule A	Schedule B
3.6.7	Safety Signs			
	Battery room notice	Yes/No		
	Hazardous location notice	Yes/No		
	No smoking notice	Yes/No		
	Unauthorised entry notice	Yes/No		
	Open flames prohibited notice	Yes/No		
	Personal protective clothing notice	Yes/No		
	Emergency shower notice	Yes/No		
	Eyewash notice	Yes/No		
	Drinking water prohibited notice	Yes/No		
	First aid box notice	Yes/No		
	First aid procedures notice	Yes/No		
	Fire extinguisher notice	Yes/No		
3.9	**Marking and Labelling**			
b)	Name Plate	Yes/No		

APPENDIX B: FLOOR DESIGN CALCULATION

Appendix B provides the floor calculations.



WHERE

SLA	SLOPE OF THE ROOM
SLB	SLOP OF THE DOOR RAMP
L_{ROOM}	LENGTH OF THE ROOM
L_{GULLEY}	LENGTH OF THE GULLEY
W_{ROOM}	WIDTH OF THE ROOM
H_{GULLEY}	HEIGHT OF THE GULLEY
H_{DOOR}	HEIGHT OF THE DOOR
X	DISTANCE FROM THE LOWEST POINT

Figure 3: Illustration for floor design calculation

The battery room shall be designed to contain 100% of the battery electrolyte.

With reference to Figure 3:

The slope is given by a ratio 1:200, meaning that the floor falls 1 m for every 200 m.
Thus, when referring to slope of the room (SLA) or slope of the door ramp (SLB),
the value is given as a ratio,

i.e. $\frac{1}{200}$

$$V_{CHEMICALS} = (V_{UNDER\ DOOR} - V_{FLOOR\ SLOPE} + V_{GULLEY} - V_{DOOR\ SLOPE})$$

Firstly, the volume excluding anything is calculated:

$$V_{UNDER\ DOOR} = (L_{ROOM} + L_{GULLEY})(W_{ROOM})(H_{DOOR})$$

The volume of the slope shall be deducted:

$$V_{FLOOR\ SLOPE} = \frac{1}{2}(L_{ROOM} + L_{GULLEY})^2(SLA)(W_{ROOM})$$

The volume of the gulley is then added:

$$V_{GULLEY} = (H_{GULLEY})(L_{GULLEY})(W_{ROOM}) + \frac{1}{2}(L_{GULLEY})^2\ (SLA)(W_{ROOM})$$

The volume of the door slope is then deducted:

$$V_{DOOR\ SLOPE} = \left(\frac{1}{2}\ (H_{DOOR} - [X][SLA]\left(\frac{1}{SLB}\right)(DOOR_{WIDTH})\right)\{(H_{DOOR} - [X][SLA]) - (DOOR_{WIDTH})(SLA)\}$$

From the preceding equations, the height of the door can be calculated for specific types of batteries.