

	<p style="text-align: center;">Report</p>	<p style="text-align: center;">RT&D</p>
-----------------------------------------------------------------------------------	-------------------------------------------	---------------------------------------------

Title: **Stakeholder Requirements
Definition for Renewable Hydrogen
Facility**

Document Identifier: **240-RTD-124**

Alternative Reference
Number:

Area of Applicability: **RT&D**

Functional Area: **RT&D**

Revision: **1**

Total Pages: **14**

Next Review Date: **March 2026**

Disclosure
Classification: **Controlled Disclosure**

Compiled by



C Moll
Lead Discipline Engineer

Date: 02/05/2023

Functional Responsibility



J Pistorius
Engineering Design Work Lead

Date: 02/05/2023

Authorised by



O Bosaletsi
**Gas & Renewables
CoE Manager**

Date: 04/05/2023

Content

Page

1. Introduction.....	4
2. Supporting Clauses	4
2.1 Scope.....	4
2.1.1 Purpose.....	4
2.1.2 Applicability	5
2.1.3 Effective date.....	5
2.2 Normative/Informative References	5
2.2.1 Normative.....	5
2.2.2 Informative.....	5
2.3 Definitions	6
2.3.1 Green Hydrogen.....	6
2.4 Abbreviations	6
2.5 Roles and Responsibilities	6
2.6 Process for Monitoring.....	7
2.7 Related/Supporting Documents.....	7
3. Stakeholder requirements definition.....	7
3.1 Need Statement	7
3.2 List of Stakeholders.....	8
3.2.1 End-Users	8
3.2.2 Internal to Eskom.....	9
3.2.3 External to Eskom	9
3.2.4 Governmental.....	9
3.2.5 Contractors and Consultants	9
3.2.6 Ownership or Shareholding Structures	9
3.2.7 Affected parties	9
3.3 Requirements Checklist.....	10
3.4 Requirements.....	11
3.4.1 Functional Requirements.....	11
3.4.2 Performance (Non-Functional) Requirements.....	13
3.4.3 Other Requirements/Constraints	13
4. Acceptance.....	14
5. Revisions.....	14
6. Development Team	14
7. Acknowledgements	14
Tables	
Table 1:Requirements Checklist	10
Table 2: RHF Functional Requirements	11

CONTROLLED DISCLOSURE

Table 3: Non-functional Requirements for the RHF 13
Table 4: RHF Other Requirements and Constraints 13

CONTROLLED DISCLOSURE

1. Introduction

Renewable (green) hydrogen production is a key priority to achieve net zero carbon emissions by 2050 in South Africa. It will directly contribute to Eskom's decarbonisation strategy and enable renewable energy deployment as it presents an excellent medium for long-term energy storage. Eskom already has experience in operating electrolysers at the Power Stations to produce grey hydrogen, however there are still various challenges across all areas of the value chain to produce renewable hydrogen that need to be resolved.

Developing a pilot Renewable Hydrogen Facility (RHF) will present Eskom with an informed pathway to plan for the adoption of hydrogen at a scale and cost that is competitive against alternate options such as hydrogen produced from fossil fuels (grey hydrogen). It will also present Eskom with an opportunity to develop skills through Eskom's participation in the key national initiatives in South Africa such as the South African Hydrogen Society Roadmap and South African Hydrogen Valley.

This document contains the Stakeholder Requirements Definition (SRD) for the RHF. It will be used to identify all the relevant stakeholders who are required for this project to compile a complete list of design requirements and activities that need to be carried out to ensure the successful execution of the design. The SRD will form a basis for transforming the requirements into technical requirements (technical specification). Different design options will need to be investigated to provide an optimal solution for the testing facilities, which complies with all relevant legislative, health and safety as well as Eskom Standards.

2. Supporting Clauses

2.1 Scope

The scope of the SRD includes the requirements for the design and further defines the:

- Stakeholders,
- Functional and non-functional requirements,
- Constraints, and
- Deliverables

2.1.1 Purpose

The purpose of this document is to provide a clear statement of the stakeholder's design requirements for the system or problem. This document defines both deliverables and design requirements, which shall be met by the design effort.

This document collects all the design related stakeholder requirements for the project and forms the basis of the design.

CONTROLLED DISCLOSURE

2.1.2 Applicability

This document shall apply to Eskom Research Testing and Development, Gas and Renewables Centre of Excellence.

2.1.3 Effective date

This document will be effective once approved by all parties.

2.2 Normative/Informative References

2.2.1 Normative

- [1] ISO 9001 Quality Management Systems
- [2] 240-RTD-122 Required Operational Capability for Renewable Hydrogen Facility Report
- [3] 240-RTD-125 Engineering Management Plan for the Renewable Hydrogen Facility
- [4] RES/RR/22/1963035 Pre-feasibility Study of a Renewable Hydrogen Facility at Eskom Research and Innovation Centre
- [5] RES/RR/22/1963033 Eskom Position Paper on Hydrogen
- [6] 240-53113953 Manage Engineering Accountability Procedure
- [7] 240-49104627 Engineering Workload and Resource Planning Procedure
- [8] 240-53114026 Project Engineering Change Management Procedure
- [9] 240-53114002 Engineering Change Management Procedure
- [10] 240-50317699 Manage Technical Queries Procedure
- [11] 240-53113685 Design Review Procedure
- [12] 240-48929482 Tender Technical Evaluation Procedure
- [13] 240-49910527 Procedure for Plan and Select Technologies
- [14] 240-49104739 Registration Procedure for Engineering Work
- [15] 240-51017654 Procedure for the Evaluation of Product Suitability
- [16] 240-48623157 Engineering Emergency Response Procedure for Asset Excursions
- [17] 240 56227413 Hydrogen Systems Standard

2.2.2 Informative

- [18] RES/RR/21/1962965 An Assessment of the Hydrogen Economy and Technology for Eskom
- [19] 240-53114186 Document and Record Management Procedure
- [20] 240-53114193 Occurrence and Incident Management Procedure
- [21] 240-53114192 Corrective and Preventive Procedure
- [22] 240-53114194 Control of Nonconforming Product Procedure

CONTROLLED DISCLOSURE

[23]240-53114190 Internal Audit Procedure

2.3 Definitions

2.3.1 Green Hydrogen

Renewable hydrogen is produced by water splitting via electrolysis and produces only hydrogen and oxygen. The electricity supply for electrolysis should be from renewable energy sources.

2.4 Abbreviations

Abbreviation	Explanation
BESS	Battery Energy Storage System
CoE	Centre of Excellence
EDWL	Engineering Design Work Lead
ERIC	Eskom Research and Innovation Centre
FCEV	Fuel Cell Electric Vehicle
LDE	Lead Discipline Engineer
OEM	Original Equipment Manufacturer
PED	Primary Energy Department
PEM	Project Engineering Manager
PM	Project Manager
PV	Photovoltaic
RACI	Responsibility, Accountability, Consult and Inform
RHF	Renewable Hydrogen Facility
RT&D	Research Testing and Development
SHE	Safety, Health & Environmental
SRD	Stakeholder Requirements Definition

2.5 Roles and Responsibilities

- **Engineering Design Work Lead (EDWL):** Co-ordinates the design work provided by the discipline design engineering roles and integrates this work into a final integrated design product. Is the custodian of the requirements set and the interface register between packages and part of his/her role is to maintain this information. Remains responsible for the integrity of the engineering product and is accountable for the overall management of interfaces and delivery of an integrated product.
- The **Authoriser** checks that the EDWL has applied the right procedures and governances during the design process.
- **Project Engineering Manager (PEM)** will ensure the requirements set out in this report are met during plant design.
- **Project Manager (PM)** will ensure that all the project requirements and governance are met from the start of the project to commissioning.

CONTROLLED DISCLOSURE

- The **Site representative** will collaborate with the design team and serve as the interface between engineering and site to ensure that the information and data used during design are according to the client's requirements.
- **Lead Discipline Engineer (LDE):** Each lead discipline engineer will ensure that the work required for the respective engineering discipline specific designs are carried out and that the correct procedures and governances are adhere to.
- A **stakeholder:** Is anyone that has an interest in the outcome of the project.
- **Design Team:** The group responsible for completing the in-house design, consisting of Design Engineering Practitioners, Lead Discipline Engineers, Technical Designers, and the Engineering Design Work Lead.
- **Client:** The client is defined as the end user which will be Gas and Renewable Centre of Excellence (CoE), Research, Testing and Development (RT&D).

2.6 Process for Monitoring

The process used for monitoring the application of the SRD is as per the Engineering Management Plan [3] and the Design Review Procedure (240-53113685) [11], which entails assuring that the design achieves the requirements set out in this document.

The process relating to the management of requirements will be used in addition to the Design Review Procedure, since the process provide a mechanism of monitoring the extension and achievements of the requirements set out in this document.

2.7 Related/Supporting Documents

N/A

3. Stakeholder requirements definition

3.1 Need Statement

Hydrogen is seen as a driver for renewable energy deployment and decarbonisation but challenges as an emerging technology exist across all areas in the value chain. Research and development are a key requirement for solving these challenges, specifically with regards to scale, safety and costs.

Developing a Renewable Hydrogen Facility (RHF) pilot facility will present Eskom with the pathway to plan for the adoption of hydrogen at a scale and cost that is competitive against alternative options. It will also present Eskom with the opportunity to take part in the key initiative for South Africa, to empower the hydrogen economy through the Hydrogen Roadmap and SA Hydrogen Valley, while also starting to develop much needed hydrogen related skills.

CONTROLLED DISCLOSURE

The RHF will focus on these needs and challenges to reduce the hydrogen value chain cost, improve skills development, engineering, and safety as well as address environmental issues that would enable a rapid adoption of hydrogen technology, when required. Additionally, the facility will be focused on an applications basis, and not on fundamental technology research. These applications will be related to Eskom's line divisions existing operations and future needs.

Thus, the necessities for developing the RHF includes the following:

- Commence hands-on understanding and engagement of the hydrogen technology value chain, from production to usage at Pilot and Demonstration scale.
- Study the integration of renewable energy, battery storage and demineralised water plants in a hydrogen production, storage and use system.
- Flexibility to test electrolysis and fuel cell technologies.
- Practical experience on the performance comparison of electrolyzers and fuel cells.
- Study the requirements and factors that are associated with the usage of hydrogen.
- The application of safety codes, standards, and regulations with regards to the production, storage, and use of hydrogen.
- Capacitate and develop hydrogen related skills via the pilot and demonstration process for Eskom.
- Pilot hydrogen technologies before their application into Eskom line divisions can be further investigated.
- Practical experience on the use of turnkey mobile (containerised) hydrogen production solution.
- Incorporation and integration with e-Mobility activities by powering fuel cell electric vehicles (FCEVs) for research and development or South African Hydrogen Valley initiative.

3.2 List of Stakeholders

The following stakeholders have been identified for the development of the RHF:

3.2.1 End-Users

The end-users identified for the RHF are:

- Department of Science and Innovation – Hydrogen Valley
- Eskom Generation: Hydrogen Users
- Eskom Distribution: Hydrogen Users
- Eskom Research and Innovation Centre – e-Mobility
- Eskom Rotek Industries – Forklifts
- Fuel Cell Suppliers
- Turbine and Engine Manufacturers

CONTROLLED DISCLOSURE

3.2.2 Internal to Eskom

The stakeholders internal to Eskom are:

- Eskom RT&D General Manager: Custodian of the plant
- Eskom RT&D Gas and Renewables CoE: Plant owners and Operator
- Eskom RT&D, Gas and Renewables CoE: PV Plant Owner and Operator
- Eskom RT&D: Battery Energy Storage Owner and Operator
- Eskom Real Estate: Property Owner

3.2.3 External to Eskom

The following external Stakeholders have been identified:

- City of Johannesburg: Malvern Fire Brigade
- Rheinmetall Denel Munition
- Transnet
- CSIR
- Universities (Stellenbosch, Northwest)
- SANEDI

3.2.4 Governmental

The following Governmental Stakeholders have been identified:

- Department of Science and Innovation
- Department of Water and Sanitation
- Department of Forestry, Fisheries, and the Environment
- Department of Mineral Resources and Energy
- Local Municipality (City of Johannesburg Metropolitan Municipality)

3.2.5 Contractors and Consultants

Not yet identified

3.2.6 Ownership or Shareholding Structures

Eskom Research, Testing and Development will be the owner of the plant. In case of a partnership or joint development, the ownership and shareholding structure will be re-evaluated.

3.2.7 Affected parties

- Local Communities and Businesses
- Employees and contractors working at ERIC (Security)

CONTROLLED DISCLOSURE

3.3 Requirements Checklist

The checklist (Table 1) is a mechanism to ensure (as far as possible) that the relevant aspects of the RHF are included.

Table 1: Requirements Checklist

Item / Aspect	Definition	Relevant	Requirements (IDs) that relate to the relevant aspect
Functional requirements	What the system should do or what it should be.	<input checked="" type="checkbox"/>	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,27.
Performance Requirements	How the system should perform.	<input checked="" type="checkbox"/>	23,24,25,26,27.
Operational Requirements	Operational requirements are the essential capabilities, associated requirements and performance measures	<input checked="" type="checkbox"/>	1,2,3,5,7,8,9,10,11,12,13,16,18,20,21.
Maintenance Requirements	Requirements related to the maintenance strategy	<input checked="" type="checkbox"/>	30,34,35,36.
Waste Management	Requirements linked to the activities and actions required to manage waste from its inception to its final disposal	<input checked="" type="checkbox"/>	4,33.
Communication Requirements	All communication related requirements such as CBMS, etc.	<input checked="" type="checkbox"/>	14,15,32.
Health and Safety	Requirements to ensure the safety, health, and welfare of employees	<input checked="" type="checkbox"/>	12,28,30,31,32.
Security	Functional requirements that enforce security	<input checked="" type="checkbox"/>	28.
Reliability, Availability and Maintainability	Requirements pertaining to reliability, availability, and maintainability	<input checked="" type="checkbox"/>	5,7,20,30,34,35,36,37.
Expandability	Requirements that cater for future expansions	<input checked="" type="checkbox"/>	21,22,29.

CONTROLLED DISCLOSURE

Standardisation	All relevant requirements pertaining to the affected system being refurbished	<input checked="" type="checkbox"/>	1,2,3,8,9,10,11.
Legal/Environmental/Licence Requirements	All project-specific requirements pertaining to legislation, environmental legislation and licencing	<input checked="" type="checkbox"/>	23,24,25,26.
Site Specific Requirements	Additional requirements specific to the site	<input checked="" type="checkbox"/>	1,2,3,4,9,10,11.
Configuration Management Requirements	The documentation, configuration, and software requirements for the project	<input checked="" type="checkbox"/>	37.
Execution/ Handover Requirements	FAT, SAT, Training and documentation, Commissioning, Decommissioning and Construction Requirements	<input checked="" type="checkbox"/>	38,39,40.

3.4 Requirements

3.4.1 Functional Requirements

Table 2 summarise the functional requirement for the RHF.

Table 2: RHF Functional Requirements

Requirement ID	Requirement Description	Stakeholder ID
1.	The RHF should be integrated with the Rosherville Photovoltaic (PV) plant	Integration with existing plant, boundary limits
2.	The RHF should be integrated with the Rosherville Battery Energy Storage System (BESS)	Integration with existing plant, boundary limits
3.	The RHF should be integrated with the ERIC Ring Network	Integration with existing plant, boundary limits
4.	The RHF water supple will be obtained from municipal supply to the building (discharge to be returned to sewer system / stored and removed with other building waste streams)	Integration with existing plant, boundary limits

CONTROLLED DISCLOSURE

5.	Two or more electrolyzers needs to be installed	Plant requirement / Supplier
6.	Plant must be containerised and movable	Plant requirement / Supplier
7.	The electrolyzers should be independent from one another with the ability to operate and test them separately (Need the ability to isolate one of the electrolyzers)	Plant requirement / Supplier
8.	Auxiliary system (demineralisation plant, H ₂ storage, etc) are to be shared between the electrolyzers.	Plant requirement / Supplier
9.	The plant total capacity shall not exceed the installed PV and BESS capacities	Functional integration
10.	Operate the electrolyzers from a continuous load supplied via the BESS	Functional integration
11.	The facility should allow for the electrolyser(s) to load follow the PV plant to determine the ramp-up and down capability	Functional integration
12.	Purging capabilities as per Hydrogen Standard	Safety
13.	The facility should produce a continuous supply of adequate hydrogen gas at the correct pressure and purity (99.9% purity)	Functional, end product
14.	All plant parameters and associated on-site data system shall be remotely accessible in real time via a remote user interface for users with necessary permissions and access	C & I
15.	Adequate measurement of the gas purity with an in-line gas analyser (Hydrogen and Oxygen)	C & I
16.	The facility will require continuous drying of the hydrogen gas	Functional, operations / end product
17.	Low pressure storage	Functional, end product
18.	Ability to compress hydrogen to pressures up to 700 bar max	Functional, end product
19.	High pressure storage	Functional, end product
20.	The facility should have storage capacity for 15 days.	Functional, end product

CONTROLLED DISCLOSURE

21.	Tap-in points should be made available for testing various other end-uses	End Product
22.	Allow for testing of fuel-cells	End Product

3.4.2 Performance (Non-Functional) Requirements

The non-functional requirements for the RHF are summarised in Table 3.

Table 3: Non-functional Requirements for the RHF

Requirement ID	Requirement Description	Stakeholder ID
23.	Meet green certification requirements	Regulatory
24.	Application of Green Hydrogen Regulations, Standards and Codes	Regulatory
25.	Must comply with municipal bylaws	Regulatory
26.	Must be below the trigger for EA / permit / licence	Regulatory
27.	The lifetime of the plant should be limited to 15 years	Reliability, Availability and Maintainability

3.4.3 Other Requirements/Constraints

The other, financial, economic, technology and schedule requirements and constraints are summarised in Table 4 below:

Table 4: RHF Other Requirements and Constraints

Requirement ID	Requirement Description	Stakeholder ID
28.	The facility will require access control, only authorised personnel should be able to access the facility	Access and safety
29.	Allocated space for additional electrolysers should be made available	Expansion
30.	Plant must contain isolation points and lockout points	Safety and Maintenance
31.	The facility should have the necessary fire protection	Safety
32.	Ambient monitoring for H ₂ leaks with alarm system (linked to process C&I system for local and online alarms)	Safety

CONTROLLED DISCLOSURE

33.	Waste streams to be disposed in accordance with the waste management act (NEM:WA)	Waste
34.	Maintenance Requirements as per OEM Specifications	Maintenance
35.	Standard spare must be readily available (either kept on site or available off the shelf in South Africa)	Maintenance
36.	Access to service agent within 24 hours	Maintenance
37.	Operational and Maintenance manual to be provided, including start up, shutdown, commissioning, decommissioning, schedules, check, and emergency procedures.	Documentation
38.	Operational training with operator competence certification.	Training
39.	Maintenance training with competence certification and authorisation to service/work on equipment.	Training
40.	Handover of the plant to take place after 1 year of operation to an operator who is competent to operator and maintain equipment.	Hand over

4. Acceptance

This document has been seen and accepted by:

Name	Designation
Mike Beeslaar	UCG Specialist
Nyiko Baloyi	Mechanical Engineer
Shaun Pershad	Mechanical Engineer
Jeanie Pistorius	Chemical Engineer
Ouma Bosaletsi	Electrical Engineer

5. Revisions

Date	Rev.	Compiler	Remarks
March 2023	1	C Moll	SRD

6. Development Team

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

- Jeanie Pistorius

7. Acknowledgements

N/A

CONTROLLED DISCLOSURE