



Procedure

Generation Engineering

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1. INTRODUCTION

The design review procedure provides for the governance that prescribes a series of evaluations to determine the adequacy, correctness and adherence of designs in achieving objectives at each pre-defined phase of the design review procedure. The design review procedure is crucial for obtaining approval and acceptance for designs during the execution of the different phases in the Project Life Cycle (PLC), thereby authorizing the release to the following phase of the design review process.

Design reviews provide the necessary assurance that all previously set requirements at the end of each phase has been satisfactorily met. This ensures that a credible basis is set for the next phase in the PLC. Properly conducted design reviews will assist in avoiding re-work and will reduce the risk of adversely affecting project deliverables in terms of cost, quality, time and scope.

Engineering designs in and on behalf of Generation are done under various funding and ownership models include Build, Own, Operate and Transfer (BOOT), Private Sector Participation (PSP) and Eskom funded and contracting strategies including EPC and various levels of internal designs, necessitating various PLC models.

To conduct design reviews, it is essential to identify the PLC model and the accountability of Engineering in Generation before the end of phase baselines for the design reviews can be identified. These baselines will describe the requirements that need to be met for each phase/stage in the PLC in terms of designs, standards and deliverables.

2. SUPPORTING CLAUSES

2.1 SCOPE

This procedure covers the required steps for the execution of design reviews (end-of-phase and interim) for projects done by or on behalf of Generation as the full or partial owner of the developed asset.

2.1.1 Purpose

The purpose of this procedure is to define the essential steps that are required to ensure that a structured, systematic and consistent approach is followed when design reviews (end-of-phase and interim) are conducted.

The execution of these steps ensures that designs conform to requirements (user, technical, legislative, etc.), designs are correct (calculations, philosophy, etc.) and designs are integrated.

2.1.2 Applicability

This procedure applies to all practitioners delegated to perform engineering or engineering design related work in Generation. It, however, does not apply to Generation Nuclear.

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] [240-43327398](#): Engineering Policy
- [2] [240-46953552](#): Process Control Manual (PCM) for Plan Technical Effort
- [3] [240-43898151](#): Process Control Manual (PCM) for Perform Verification and Validation
- [4] 32-1155: Eskom PLCM Policy
- [5] [240-68604731](#): Design Base Standard

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- [6] [240-53114026](#): Project Engineering Change Procedure.
- [7] [240-53114002](#): Engineering Change Management Procedure
- [8] [240-51093273](#): Control Configuration Changes
- [9] [240-49910616](#): Engineering Management Plan Template

2.2.2 Informative

- [10] [240-53114190](#): Internal Audit Procedure
- [11] Engineering Profession Act No. 46 of 2000
- [12] IEC 61160: Design review
- [13] ISO 10007: Quality Management Systems – Guidelines for configuration management
- [14] ISO 9001: Quality Management Systems - Requirements
- [15] SANS 15288: Systems and software engineering - Systems life cycle processes
- [16] SANS 26702: Systems engineering - Application and management of the systems engineering process.

2.3 DEFINITIONS

Definition	Description
Architect Engineer	A professionally registered engineer, or team of appropriately registered built environment professionals including engineers, appointed and tasked to provide an overall design and integration of designs from various Design Authorities.
Baseline	A specification or product that has been formally reviewed and agreed upon, placed under configuration control and documentation management, and that thereafter serves as the basis for further development.
Build, Own, Operate and Transfer (BOOT)	The BOOT involves signing an upfront power purchase agreement (PPA) for a specified timeframe, with transfer of the asset and the debt onto Eskom's balance sheet at a specified time and date.
Client Office	A professionally registered engineer, or team of appropriately registered built environment professionals including engineers, appointed to provide the requirements in terms of standards, processes and scope as well as oversight over the project's design, development, execution, and/or finalisation.
Configuration	Interrelated functional and physical characteristics of a product defined in product configuration information.

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Definition	Description
Design	<p>The term Design shall cover following elements of Engineering Work, subject to the authority of the specific discipline/technology and shall involve the use of specialized design tools that are controlled by the specific discipline/technology:</p> <p>1. New asset creation or modification of existing assets: Design shall include all engineering analyses, calculations, studies, reports, and technical review checklists necessary to perform complete engineering design. The Design Output Documents shall identify the design output requirements that dictate the physical configuration of the facility. Any analysis that will require the use of the specialised tools to provide design output documents shall be considered Design Work.</p> <p>2. Analysis work during operation of the asset: Design shall include all engineering analyses, calculations, studies, and reports necessary to investigate the impact or risks associated with the operation of an asset outside the Design Base. Any analysis which requires the use of the specialised tools to provide a conclusion of the impact on the asset Design Base shall be considered part of Design work. In general, normal Engineering Work and task execution will be conducted using generic or Operations and Maintenance (O&M) tools and capabilities.</p> <p>Any analysis that is conducted for the practical application of the Design Base requirements as dictated in the Operating Technical Specification and Maintenance Base, using specialised O&M tools, with a view to managing and optimising the assets within the Design Base, shall be considered Engineering Work within the O&M domain and shall not be included in the definition of Design.</p>
Design Base	<p>The Design Base of an Asset is the combination of those key design outputs that define the functions, capabilities, capacities, physical sizes and dimensions (Physical Base), limits and set points, shutdown and start-up sequences, normal and out of normal operations (Operating Technical Specification) and maintenance elements (Maintenance Base), that are required for the asset to meet its required performance, reliability and availability within the limits of the external constraints.</p>
Design Authority	<p>A professionally registered engineer, or team of appropriately registered built environment professionals including engineers, appointed and tasked to provide a detail design. The Design Authority carries personal and professional statutory and legal liability for the design.</p>
End-of-Phase Design Review	<p>End-of-Phase Design Reviews are performed to establish design Baselines and to ensure the correctness, completeness, conformance and integrity of a design. End-of-Phase reviews are performed at key milestones during a project's life cycle, normally at the end of a defined phase in the project.</p>
EPC	<p>EPC is an outsourcing approach and delivery method in the construction industry. Companies that deliver EPC projects are commonly referred to as EPC Contractors. An EPC Contractor carries out the detailed engineering design or as allowed by the Owner of the project, procures all required equipment and materials, and delivers a functioning asset to the Owner. The EPC Contractor may or may not be responsible for commissioning and other interfacing activities.</p>

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Definition	Description
Engineering Work	The application of specific scientific disciplines in the process of developing, designing, maintaining, and operating assets with full cognisance of their design and design limitations in order to improve the lives of people.
Governance	The building of a balance between economic and social goals and between individuals and communal goals, with the aim of aligning as closely as possible the interest of individuals, organisations, and society.
Interim Design Review	Interim Design Reviews are performed on a day-to-day basis by a professional or team of professionals to review design documentation issued by an external Design Authority or a Generation internal Design Engineering Practitioner. These reviews are conducted during any phase of a project. Interim Design Reviews includes the detail review of design documentation.
Lead Discipline	Discipline or plant area with the majority of scope and accountable for the project/package/plant/system/asset.
Owner	The person or entity that owns the product of the construction project and to whom that product will be handed over at the time of its completion.
Owner's Engineer	A professionally registered engineer, or team of appropriately registered built environment professionals including engineers, appointed and tasked to provide oversight of a project's design, development, execution, and/or finalisation on behalf of the Owner. This role may be outsourced to the extent that the Owner lacks the necessary skills and/or resources to meet the legislative requirements set for this role. In matters concerning the administration of an EPC Contract, a person fulfilling the role of Owner's Engineer may also be appointed as the Contract Custodian.
Public Sector Participation	Eskom injects a percentage equity into the Public Sector Participation and builds plant in partnership with the private sector or Independent Power Producer (IPP).
Technology Principal	The Technology Principal role is foremost a Governance role responsible and accountable for the work under SCOT and functional responsible for the standards in a specific technology area. The Technology Principal role requires a well-recognised Subject Matter Expert for the specific technology and the applicability of the technology in Engineering Design in Generation. The role determines the competency requirements in MEA as well as the training and tools required for the technology area. A Technology Principal role is required for each technology area in Generation. The role does not have any line management accountability. The Technology Principal is appointed by the Generation Engineering General Manager.

2.4 ABBREVIATIONS

Abbreviation	Description
2 nd HO	Second Handover Review (to Generation as Owner/Operator)
BMH	Bulk Materials Handling
BOQ	Bill of Quantities
BOOT	Build, Own, Operate and Transfer

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Abbreviation	Description
BU	Business Unit/Power Station
BRA	Benefit Release Approval
C&I	Control and Instrumentation
CAPEX	Capital Expenditure
CCCC	Central Change Control Committee
CM	Configuration Management
CRA	Concept Release Approval
DMS	Document Management System
DOR	Division of Responsibility
DRA	Definition Release Approval
DRC	Design Review Committee
DRT	Design Review Team
EDWL	Engineering Design Work Lead
EIA	Environmental Impact Assessment
EMAP	Engineering Management Plan
EPC	Engineer, Procure and Construct
ERA	Execution Release Approval
FRA	Finalisation Release Approval
GA	General Arrangement
GM	General Manager
Gx	Generation
HOA	Handover Approval
LPS	Low Pressure Services
MEA	Manage Engineering Accountability
MDL	Master Document List
OE	Owner's Engineer
O&M	Operate and Maintain
P&ID	Piping and Instrumentation Diagram
PDE	Power Delivery Engineering
PDRA	Project Definition Readiness Assessment
PFD	Process Flow Diagram
PLC	Project Life Cycle
PLCM	Project Life Cycle Model
PPA	power purchase agreement
PSP	Public Sector Participation
SED	Station Electrical Diagram
SGM	Senior General Manager
SME	Subject Matter Expert

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Abbreviation	Description
SRD	Stakeholder Requirement Definition
TP	Terminal Point

2.5 ROLES AND RESPONSIBILITIES

- **Design Engineer:** The role of the Design Engineer is to perform design work throughout the project lifecycle where required and within his/her field of expertise. The Design Engineer works closely with the other discipline design engineering roles in the production of an effectively integrated project design. As the registered professional, the Design Engineer is ultimately accountable for the technical integrity of the domain design work as delegated. The Design Engineer shall have the required delegation to perform design from the appropriate authority delegated to perform Engineering Work. The Design Engineer shall have declared that he/she has the required competency as defined in the MEA system.

- **Lead Discipline Engineer:** The role of the Lead Discipline Engineer is to manage the technical integrity of the design and be accountable for the management of the internal interfaces within their specific engineering domain and/or discipline, including design or portions thereof that is contracted out. In addition, the Lead Discipline Engineer coordinates the discipline specific activities for the particular package/plant/system/asset such as Protection, Telecommunications, Control, Metering, Turbine, Boiler, Bulk Materials Handling (BMH), Civil, Electrical, Control and Instrumentation (C&I), Chemical, Auxiliary Systems, Renewables etc.

In addition, the Lead Discipline Engineer is accountable for the provision and establishment of all documentation required for a Design Review. The Lead Discipline Engineer is to ensure that a system of check sheets is being used in the review process and, before the design review package is put together for the end of phase design review meeting, he/she reviews and signs off on these documents.

- **Reviewers:** Responsible to perform design reviews in accordance to this procedure. The level of design review is done in accordance with the agreed RACI in the EMAP.
- **Technology Principal:** The Technology Principal is the ultimate engineering authority for design work and is responsible for and is the custodian of technical knowledge within their engineering domain.
- **The Engineering Line/Discipline Manager** at BU or the equivalent at Central Engineering ensures that his/her respective Design Review Committee/Team (DRC/DRT) is in place, properly constituted and representative of all relevant stakeholders as required per End-of-Phase design review and ensures implementation and compliance to this procedure.
- **Power Station Engineering Manager (or individuals delegated to perform Engineering work at the BU/Department level):** The **Power Station Engineering Manager** is responsible and accountable for all engineering work related to their specific BU and provides assurance for compliance of multidisciplinary work.
- **Engineering Design Work Lead (EDWL):** The EDWL is an engineering that co-ordinate the design work provided by the discipline Design Engineering roles, LDE roles and possible contracted out designs and integrates this work into a final integrated design product. The EDWL is the custodian of the requirements set and the interface register between packages and part of his/her role is to maintain this information. The EDWL 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 EDWL ensures that all End-of-Phase Design Reviews are identified and executed as defined in this procedure.

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- **Project Engineering Manager (PEM):** The PEM, where the role is either delegated to an individual or fulfilled by the Power Station Engineering Manager, is accountable to plan for design reviews in conjunction with the EDWL and the Project Planner. He / she shall also ensure that Design Reviews are incorporated into the relevant project's Master Schedule and programme. The PEM ensures compliance to this procedure in the project development and execution environment.

2.6 PROCESS FOR MONITORING

This procedure will be monitored via [10] and self-assessments.

2.7 RELATED/SUPPORTING DOCUMENTS

[17] [240-57934588](#) : End-of-Phase Design Review Report Template.

3. DESIGN REVIEW BACKGROUND

3.1 OBJECTIVES OF DESIGN REVIEWS

The main objective of design reviews is to ensure that on an ongoing basis the plant or system being designed conforms to all requirements as defined by the various stakeholders.

The design review process defined in this procedure is based on sound engineering principles and processes and provides engineering governance assurance to the owner throughout the asset creation life cycle.

In principle a design review process is implemented to ensure the following:

- the design meets all the stakeholder requirements;
- the design meets the technical specifications of contracts;
- the design is correct (this includes calculations, philosophy, etc. where applicable)
- that all mandatory and legislative requirements (organizational, local or national) to which a plant, component or system to which the design pertains needs to comply, have been identified, stated and verified for compliance;
- the design assumptions are accepted as being reasonable and adequate;
- plant designs will meet the specified and/or conventional design reliability and availability;
- the eventual plant, component or system allows, and is equipped for, ease and speed of maintenance;
- the eventual plant, component or system allows, and is equipped for, ready access and ergonomically accommodating for normal and abnormal operating;
- adequate safety levels are met in building, operating and maintaining the plant / system;
- capital costs are optimized whilst considering all specified requirements;
- levelized life cycle costs are properly addressed throughout design lifecycle;
- the plant / system can operate safely and reliably within the specified design margins;
- components can be operated within the specified performance and stress ratings;
- all Interfaces with other plants or systems have been identified;
- all interface impacts or cross-coupling are assessed and catered for;
- all necessary design, manufacturing and installation codes and standards are used;
- design methodologies and philosophies are stated and verified as acceptable;

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- supply chain considerations are included;
- designs are constructible;
- all IM requirements are identified, evaluated and appropriately addressed;
- specific risks stemming from the design are identified and stated in the design package, to assist in the effective review;
- where plant, component or system are likely to be replaced or upgraded in future, that the design allows for this to be readily achieved;
- based on the value, criticality, etc. of the plant, component or system, that adequate protection, control, indication, alarm and condition monitoring forms part of the design;
- the reliability of the design meets the standards of power generation;
- the plant and its elements can be disposed of in a safe and economical manner.

3.2 DESIGN REVIEW TYPES

Formal reviews are carried out to approve design packages and are performed at key milestones during the project's life cycle, normally at the end of a defined phase or stage in the project. It is not practical to have formal design reviews too frequently due to the time and effort required to arrange, prepare and conduct these meetings. Hence, in addition to end-of-phase formal reviews, interim or day-to-day reviews should be held on a regular basis to support technical coordination as well as interface- and integration management. These reviews assist to avoid miscommunication, interface clashes and the development of inadequate designs. Hence, two types of design reviews are conducted during the project lifecycle:

- Interim Design Reviews; and
- End-of-Phase Design Reviews.

4. GENERATION DESIGN REVIEW PROCEDURE

Engineering designs in and on behalf of Generation are done under various project life cycle and various funding and ownership models. The responsibility and accountability (RACI) for the engineering and design work therefore can reside with various internal and external parties.

It is the accountability of Engineering in Generation to provide the correct level of technical assurance on the design work done by or on behalf of Generation through interim and end-of-phase design reviews.

The level of design review is dependent on the engineering work, design and design change management RACI. The RACI is defined in the EMAP [9].

4.1 LEVELS OF DESIGN REVIEWS

In principle, interim and end of phase design reviews should be done on all types of projects throughout the project lifecycle by the relevant engineering parties. The responsibility and accountability of Engineering in Generation in terms of design reviews is provided below in general and is detailed in the project specific EMAP [9].

4.1.1 External Owners Engineer

Where the Owners Engineering function is contracted out, a Generation Client Office function will determine the Owners Requirements including the technical requirements (SRD) done by Engineering in Generation, to be fulfilled by the Owner's Engineer (OE).

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The interim reviewers shall provide general technical oversight to provide assurance that the OE is fulfilling its duty as contracted and that the design requirements and technical deliverables meets the intent of the SRD.

The OE shall, depending on the contracting, funding and operating model (EPC, PSP, BOOT etc.) provide end-of phase design review reports as agreed in the EMAP for review by the Engineering in Generation Client Office function.

Engineering in Generation shall have access to all design information through OE and can chose to provide review comments through the OE. The Design Authority can choose to act on the comments accept where it pertains to the requirements in the SRD.

4.1.2 Limited Internal Owners Engineer

Where Generation provides investment funding for assets that will not be build, operated or transferred to Generation, Generation will act in a limited Owners Engineering capacity and review the concept design to protect the investment interest.

4.1.3 Internal Owners Engineer

Where Generation acts as the Owners Engineer on a project/package/plant/system/asset, the interim reviewer(s) shall review the design documentation issued by the Design Authority to ensure that:

- The design satisfies the SRD (i.e. validation of design deliverables against stakeholder requirements).
- Where an external Architect Engineer is appointed, the design satisfies the technical requirements of the AE contract. Engineering in Generation shall have access to all design information and can chose to provide review comments to the AE Contractor. The AE Contractor can choose to act on the comments and/or pass it through to the Design Authorities, accept where it pertains to the requirements in the SRD and the requirements in the AE Contract.
- Where the full design (EPC) or portions thereof is contracted out, the design satisfies the technical requirements of the EPC contract. Engineering in Generation shall have access to all design information and can chose to provide review comments to the EPC Contractor. The Design Authority can choose to act on the comments accept where it pertains to the requirements in the SRD and the requirements in the EPC Contract.
- Where the created asset is operated by an external party for an extended period of time (BOOT), the as installed documentation and plant condition satisfies the requirements for handover as stipulated in the Operating and Maintenance contract.
- General technical oversight is provided over the design.

4.1.4 Internal Architect Engineer

Where Generation is accountable for the overall design and integration of designs on project/package/plant/system/asset, the interim reviewer(s) shall review the design documentation issued by the Design Authority to ensure that:

- The design satisfies the SRD (i.e. validation of design deliverables against stakeholder requirements).
- Where the full design (EPC) or portions thereof is contracted out, the design satisfies the technical requirements of the EPC contract. Engineering in Generation shall have access to all design information and can chose to provide review comments to the EPC Contractor. The Design Authority can choose to act on the comments accept where it pertains to the requirements in the SRD and the requirements in the EPC Contract.

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- The design is integrated by identifying all interfaces with other packages/plant systems/assets and ensuring that these interfaces are catered for.
- Foreseen technical risks are identified and addressed / challenged with the Design Authority.
- General technical oversight is provided over the design.

4.1.5 Internal Design Authority

Where Generation is accountable for the detail design on a project/package/plant/system/asset, the interim reviewer(s) shall review the design documentation to ensure that:

- The design satisfies the SRD
- The design satisfies the design requirements.
- All relevant Generation Engineering design standards, procedures and guidelines have been adhered to.
- The design is suitable and correct (calculations, philosophy, functionality, etc.).
- Best Generation Engineering practices were applied.
- The design is integrated by identifying all interfaces with other packages/plant systems/assets and ensuring that these interfaces are catered for.
- Where the design or portions thereof is contracted out, the design satisfies the technical requirements of the contract.

It should be noted that the Design Authority remains responsible and accountable for the correctness of the design documents, irrespective of whether these documents have been reviewed by Generation or not.

A summary table of the generic accountability of Engineering in Generation (Central, Sites. Client Office) for both design review and management of design changes is given in Table 1.

Table 1 : Summary of the accountability of Engineering in Generation

		Design Review	Project Engineering Design Change Management	Engineering Change Management
External Owners Engineer	All funding and contracting models	SRD, OE contract, access to design information	SRD, OE Contract, Approve changes to investment status	
Limited Internal Owners Engineer	Build: Eskom Finance Own: Others Operate: Others (not transferred to Gx)	Review concept to protect Eskom investment interest	Approve changes to investment status	
Internal Owners Engineer	External Architect Engineer	SRD, AE contract, access to design information	SRD, AE Contract, Approve changes to investment status	
	EPC	SRD, EPC contract, access to design information	SRD, EPC Contract, Approve changes to investment status	

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	Build: Various strategies Own: Various Financing models Operate: Initially by others Transfer to Gx own (partially or fully) and operate	SRD, Build Contract, access to design information, As Installed Baseline review, 2 nd HO review	SRD, Build Contract, O&M Contract, Approve changes to investment status	Manage changes to Design Base during external O&M
Internal Architect Engineer	Multiple EPC packages	SRD, Agreed PLCM end-of-phase baselines, interim reviews	SRD, Agreed PLCM phases	
Internal Design Authority		SRD, Accountable design PLCM end-of-phase baselines, interim reviews	SRD, Accountable design PLCM phases	

4.2 INTERIM DESIGN REVIEWS

4.2.1 Background

Interim Design Reviews are performed on a day-to-day basis during any phase of a project by a professional or team of professionals to review design documentation issued by an external Design Authority or a Generation internal Design Engineering Practitioner as represented in Figure 1. These reviews are conducted to accept / not accept documentation issued by the Design Authority (internal or external).

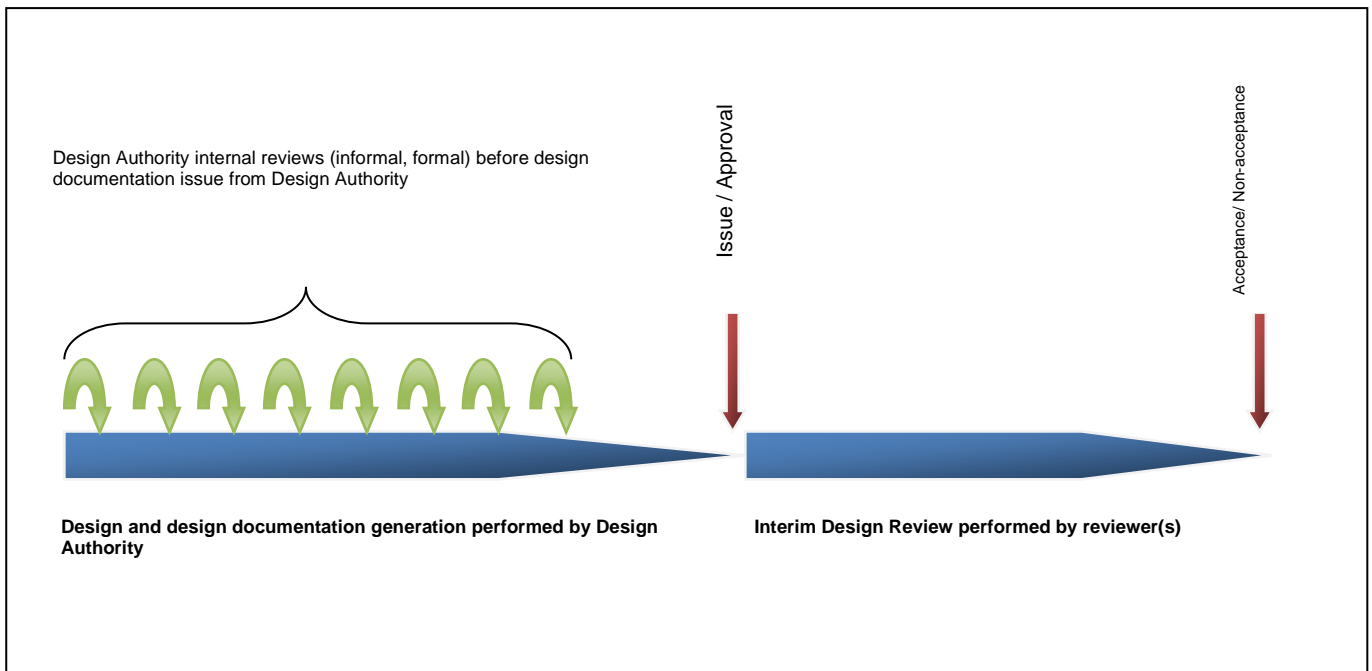


Figure 1: Interim Design Reviews

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Note: Only the Design Authority can approve design documentation. Interim Design Reviewers can only accept / not accept documentation issued by the Design Authority. Reasons for not accepting the documentation needs to be provided for the review by the Design Authority. The ultimate design decision is lies with the Design Authority.

Typical Interim Design Review documentation includes:

- Functional and technical descriptions;
- Design drawings (SEDs, PFDs, P&IDs, General Arrangement drawings, 3D model, etc.);
- Load lists, cable schedules, logic diagrams;
- Design specifications/calculation reports;
- Design manuals and operating manuals.

After the design documentation have been approved (by the Design Authority) and accepted in the Interim Design Review it could thereafter typically be used for:

- Project sourcing;
- Construction;
- Manufacturing;
- Installation; and/or;
- Design input for interfacing system designs.

4.2.2 Process

Step 1: Distribution of design review documentation

The Lead Discipline LDE responsible for the package/plant/system/asset shall evaluate from which parties (LDEs, SMEs, Configuration Management (CM), etc.) he/she requires comments on the design documentation. All affected parties and interfacing Engineering Discipline delegates shall be included in the interim review.

Further distribution of design documentation may occur, as required.

Step 2: Review of design documentation

All identified reviewers shall perform a design review on the design documentation.

It is the responsibility of the reviewer(s) to:

- Perform the review within the specified time¹;
- Prepare detailed review comments (this may include document/drawing redlines, etc.);
- Assign a review status to each reviewed document as specified in the Document Management System (DMS) - if not specified label as: accepted, accepted with comments or not-accepted.

Step 3: Consolidation of comments

Consolidation of comments within an engineering discipline shall occur before comments are returned to the Lead Discipline LDE for final consolidation.

¹ This time frame could be specified in the relevant contract, specified by the LDE or agreed upon as per Engineering Management Plan.

The Lead Discipline LDE responsible for the package/plant/system/asset shall assess all received comments and consolidate as required. The Lead Discipline LDE shall also facilitate the resolution of all clarifications and conflicting comments.

Step 4: Finalisation of interim design review

The Lead Discipline LDE responsible for the package/plant/system/asset shall, after consolidation of all received comments, assign a final review status to each reviewed document.

4.2.3 Documentation and Records Management

All Interim Design Reviews' consolidated comments as well as the associated design review final statuses (linked to the reviewed document) shall be formally recorded on the relevant Document Management System (DMS). The Lead Discipline LDE shall be responsible to ensure that this is recorded to ensure traceability and safekeeping. All individual reviewers shall have access to view the final assigned design review status for each design review.

4.3 END OF PHASE DESIGN REVIEWS

4.3.1 Background

End-of-Phase Design Reviews are performed to approve design Baselines and to ensure the completeness, conformance and integrity of a design.

End-of-Phase Design Reviews are performed as required at key milestones during the project's life cycle.

The following End-of-Phase Design Reviews are typically performed during the project life cycle, however not all specified End-of-Phase Design Reviews in Table 2 are necessarily performed during the execution of a project.

The End-of-Phase Design Reviews performed is dependent on the project, funding and ownership models.

The required End-of-Phase Design Reviews for a particular project/package/plant system/asset is predetermined and agreed in the EMAP which is supported by the Generation Engineering General Manager.

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Table 2 : End-of-Phase Design Reviews

Project Phase	Gate	Project Stage	End of Phase Design Review	Engineering Baseline
<i>Pre-Project Planning</i>	<i>CRA</i>	<i>Define Need Identify Alternatives</i>	-	-
<i>Concept</i>	<i>DRA</i>		Stakeholder Requirements Review	Stakeholder Requirements Baseline
		<i>Develop Alternatives</i>	Concept Design Review	Concept Design Baseline
		<i>Select Single Solution</i>		
<i>Definition</i>	<i>ERA</i>	<i>Develop Solution</i>	Basic Design Review	Basic Design Baseline
			Pre-Enquiry Review ²	Acquisition Requirements Baseline
<i>Execution</i>	<i>HOA³</i>	<i>Finalise Solution</i>	Contract Award Review	Contract Award Baseline
			Design Freeze Review (Detail Design)	Design Freeze Baseline
			System Integrated Design Review (Detail Design)	Integrated Design Baseline
		<i>Implement</i>	Pre-Commissioning Review	As-Built Baseline
		<i>Commissioning and Handover</i>	Acceptance Testing Review	As-Commissioned Baseline
			Handover Review	Handover Baseline
<i>Finalisation</i>	<i>FRA</i>	<i>Close Project</i>	-	-
<i>Operating and Maintenance (O&M)</i>	<i>HOA2⁴</i>	<i>Handover after O&M</i>	Performance Testing Review	As-Installed Baseline
			Handover Review	Handover Baseline
<i>Post Project</i>	<i>BRA</i>	<i>Realise Benefits</i>	-	-

²Note: This review can also be referred to as the Works Information Review or Employers Requirements Review.

³ Where handover to Generation as Owner and Operator occurs after asset creation

⁴ Where handover to Generation as Owner and Operator occurs after a period of operation by others (BOOT)

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4.3.1.1 Stakeholder Requirements Review⁵

Stakeholder Requirements Reviews are performed to analyse and agree on stakeholder expectations/requirements.

End-of-Phase Design Review	Focus of Design Review	Typical Review Documentation
Stakeholder Requirements Review	Establish agreed stakeholder requirements baseline by: <ul style="list-style-type: none"> Analysing stakeholder expectations/requirements. Analysing project technical, engineering, legal, regulatory and environmental constraints. Analysing all technical risks. Defining external stakeholders. Confirming PDRA requirements are met. Identifying and resolving conflicting requirements. 	<ul style="list-style-type: none"> Stakeholder requirements

4.3.1.2 Concept Design Review

Concept Design Reviews are performed to evaluate the feasibility, suitability and correctness of a proposed concept design.

End-of-Phase Design Review	Focus of Design Review	Typical Review Documentation
Concept Design Review	Establish agreed concept design baseline by: <ul style="list-style-type: none"> Verifying whether concept design(s) complies with stakeholder requirements. Verifying that concept design deviations from stakeholder requirements were identified and managed by means of formal Engineering Change Management. Analysing and comparison of concept designs' technical feasibility, cost estimations and risks (options analysis) and selection of most feasible option. Analysing all technical risks taking into account plant modifications and incident investigations. Assessing technology and technology maturity and market availability. Estimating Capital Expenditure (CAPEX)/Lifecycle Cost Defining concept design's preliminary project and system technical boundaries and interfaces. Analysing proposed works scope allocation within project. Confirming PDRA requirements are met 	<ul style="list-style-type: none"> Applicable design standards. Concept design feasibility analysis. Environmental Impact Assessment (EIA) Concept design documentation as applicable (SEDs, PFDs, GA's, concept plant operational philosophy, etc.) Stakeholder Requirements Verification & Validation Report

⁵Refer to figure 10, SANS 26702 [16] for information.

4.3.1.3 Basic Design Review

Basic Design Reviews are performed to evaluate the suitability and correctness of basic design deliverables.

End-of-Phase Design Review	Focus of Design Review	Typical Review Documentation
Basic Design Review	<p>Establish agreed basic design baseline by:</p> <ul style="list-style-type: none">• Verifying whether basic design(s) complies with stakeholder requirements or previously set baseline.• Verifying that basic design deviations from previously set baseline were identified and managed by means of formal Engineering Change Management.• Analysing basic design parameters.• Analysing all technical risks.• Analysing basic design's physical and functional interface requirements.• Analysing lifecycle costing• Analysing proposed works scope allocation within project.• Confirming PDRA requirements are met	<ul style="list-style-type: none">• Applicable design codes and standards.• EIA• Basic design documentation as applicable (P&IDs, GA's, functional descriptions, design criteria, operational capability, etc.)• Division of Responsibility (DOR)• Interface register/definitions• Verification & Validation Report

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4.3.1.4 Pre-Enquiry Review

Pre-Enquiry Reviews are performed to ensure that technical specifications are complete, integrated and correct before market enquiry.

End-of-Phase Design Review	Focus of Design Review	Typical Review Documentation
Pre-Enquiry Review	<p>Establish agreed acquisition requirements baseline by:</p> <ul style="list-style-type: none"> • Verifying whether Works Information/Employers Requirements comply with previously set baseline. • Verifying that deviations from previously set baseline were identified and managed by means of formal Engineering Change Management. • Reviewing complete scope of supply/services/extent of work. • Reviewing all requirements (such as system operating philosophies, performance requirements, and all particular system requirements). • Reviewing the applicability of all specified codes, standards and procedures (internal and external). • Reviewing technical schedules. • Reviewing technical tender returnables. • Reviewing referenced drawings in Works Information/Employers Requirements. • Reviewing Bill of Quantities (BOQ) as applicable. • Reviewing tender technical evaluation strategy. • Reviewing all detailed system/package boundaries and interfaces. • Reviewing the contract strategy • Confirming PDRA requirements are met • Reviewing that all Terminal Points and Interfaces have been correctly identified, defined and detailed 	<ul style="list-style-type: none"> • Applicable design codes, standards and procedures. • Complete Works Information/Employers Requirements package. • Division of Responsibility (DOR) • Interface definitions • Technical evaluation/contract strategy. • Technical evaluation strategy • Verification & Validation Report

4.3.1.5 Contract Award Review

Contract Award Reviews are performed after contract award to ensure that all waivers from the Works Information/Employers Requirements during negotiations are addressed and catered for.

End-of-Phase Design Review	Focus of Design Review	Typical Review Documentation
Contract Award Review	<ul style="list-style-type: none"> • Review awarded contract's compliance to Pre-Enquiry Works Information/Employers Requirements prior to signing of the contract. • Review changes in scope and interfaces. • Confirming PDRA requirements are met 	<ul style="list-style-type: none"> • Contract package Works Information/Employers Requirements (signed). • Changes to Works Information/Employers Requirements (deviation/variation protocol) • Technical Evaluation Reports • Verification and Validation Report

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4.3.1.6 Design Freeze Review (Detail Design)

Design Freeze reviews can be conducted as End-of-Phase Design Reviews or as a series of Interim Design Reviews with the aim to design freeze a system or subsystem/asset in order to enable subsequent designs to progress. If applicable, contractual acceptance of contractor design documentation (P&IDs, GAs, etc.) during Interim Design Reviews are regarded as design freeze for the accepted plant/system/asset.

Typical Design Freeze reviews include:

- Process design freeze;
- Plant Layout/Arrangement design freeze;
- Equipment design freeze.
- Design freeze reviews are conducted on an as-required basis.

4.3.1.7 System Integrated Design Review (Detail Design)

System Integrated Design Reviews are performed to ensure that designs are fully integrated.

End-of-Phase Design Review	Focus of Design Review	Typical Review Documentation
System Integrated Design Review	Establish agreed system integrated design baseline by: <ul style="list-style-type: none">• Analysing all interfacing package/plant/system/asset's design status.• Ensuring closure of all issues regarding the integrated detail design.• Performing interfaces checks both physical and functional.• Confirming PDRA requirements are met• Verifying that design documentation set is complete	<ul style="list-style-type: none">• Project Package(s) Master Document Lists (MDLs)• Interface documentation (piping Terminal Points (TPs), signal lists, load lists, cable schedules, etc.)• Construction/installation methods and plans• Verification & Validation Report

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4.3.1.8 Pre-Commissioning Review

End-of-Phase Design Review	Focus of Design Review	Typical Review Documentation
Pre-Commissioning Review	<p>Establish agreed As-Built Baseline by:</p> <ul style="list-style-type: none">• Verifying that actual plant/asset configuration conforms to detail design.• Verifying that design as-built documentation set is complete <p>Provide assurance that system is ready for commissioning by:</p> <ul style="list-style-type: none">• Reviewing all interfacing services' availability for commissioning.• Reviewing system commissioning procedures.• Confirming all required safety clearances are in place.• Confirming PDRA requirements are met	<ul style="list-style-type: none">• System commissioning procedures.• As built drawings.• Verification & Validation Report

4.3.1.9 Acceptance Testing Review

End-of-Phase Design Review	Focus of Design Review	Typical Review Documentation
Acceptance Testing Review	<p>Establish agreed As-Commissioned Baseline by:</p> <ul style="list-style-type: none">• Verify/Validate that plant/asset performance and functions meet stakeholder/technical requirements.• Confirming PDRA requirements are met	<ul style="list-style-type: none">• Commissioning/Acceptance Test Report• Verification & Validation Report

4.3.1.10 Performance Testing Review

End-of-Phase Design Review	Focus of Design Review	Typical Review Documentation
Performance Testing Review	<p>Establish agreed As-Installed Baseline by:</p> <ul style="list-style-type: none">• Verify/Validate that plant/asset performance and functions meet stakeholder/technical requirements as defined after the period of operation by others.	<ul style="list-style-type: none">• Performance Test Report• Verification & Validation Report

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4.3.1.11 Handover Review

End-of-Phase Design Review	Focus of Design Review	Typical Review Documentation
Handover Review	<p>Provide assurance that a system/asset is ready for handover by:</p> <ul style="list-style-type: none">• Reviewing that the technical hand-over documentation set is complete as per Stakeholder Requirements.• Confirming PDRA requirements are met.	<ul style="list-style-type: none">• Technical Hand-over package.• Verification & Validation Report

4.3.2 Process

Step 1: Planning and Preparation

The responsible package/plant system/asset Lead Discipline LDE shall ensure that End-of-Phase Design Reviews, as prescribed by this procedure, are scheduled as the project progresses through the project lifecycle.

The relevant End-of-Phase Design Review approver as per Table 3 shall ensure that the Design Review Committee/Team (DRC/DRT) is properly constituted for the relevant End-of-Phase Design Review to represent all Generation stakeholders including the relevant Design Engineers, relevant LDEs and SMEs.

The responsible package/plant/system/asset Lead Discipline LDE shall ensure that the following activities are performed in preparation for an End-of-Phase Design Review:

- Prepare the design review package (design review report, design review checklist⁶, all reference documentation);
- Schedule the relevant End-of-Phase Design Review;
- Ensure that the design review package is distributed to all review panel members as identified by the relevant Line/Discipline manager at BU or Central Engineering at least 10 working days⁷ before the scheduled review. All review panel members shall perform an individual review on the distributed design review package and return all comments to the responsible person within 5 working days⁸ of the scheduled review;
- Consolidate all comments for discussion during the conduct of the End-of-Phase Design Review.

⁶ The End-of-Phase Design Review Checklist shall be developed by the LDE and include all checks deemed necessary. The review panel shall review the checklist for appropriateness / completeness.

⁷ This time may differ as agreed upon and depending on the complexity of the project/plant/package.

⁸ This time may differ as agreed upon and depending on the complexity of the project/plant/package

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Step 2: Conduct End-of-Phase Design Review

The End-of-Phase design review approver shall determine if a quorum is present. In the event where no quorum is present, no End-of-Phase Design Reviews shall be conducted or authorised.

The responsible package/plant/system/asset Lead Discipline LDE shall present the End-of-Phase design review with specific focus on the items as tabled in sections 0 through 4.3.1.10.

The panel members shall discuss and address all comments received during the individual reviews of step 1.

The panel members shall ensure that all items have been satisfactorily addressed in the specific End-of-Phase Design Review before approval and authorisation.

Step 3: Authorisation of End-of-Phase Design Review

Authorisation shall only occur should all review panel members approve the End-of-Phase design review and the necessary assurance are provided that all issues / items have been satisfactorily addressed.

End-of-Phase design review reports (See [13]) shall be approved by all review panel members and authorised by the relevant authoriser as per paragraph 4.3.3.

Should the review panel disagree on approval, the authorisation shall be escalated to the Power Station Engineering Manager where Engineering Work is executed at BU level and to the Generation Engineering General Manager for Engineering Work executed centrally.

The resolution of the panel shall be minuted and recorded on the relevant DMS.

4.3.3 End-of-Phase Design Review Approval and Authorisation**Table 3 : End-of-Phase Design Review Panel (Generation review accountability)**

Scope of Design	Design Review Panel	Chair of Design Review + Approval	Authorisation ⁹
Package/plant/system/asset confined to one engineering discipline.	<ul style="list-style-type: none"> Relevant Design Engineers Relevant LDEs Relevant Technology Principal¹⁰ Client/Client Office Representative 	LDE	Line/Discipline Manager (BU or Central)
Package/plant/system/asset involves multiple engineering disciplines.	<ul style="list-style-type: none"> All affected / involved Design Engineers All affected / involved LDE's Project Engineering Manager Relevant Technology Principals⁶ Client/Client Office Representative 	EDWL	Generation Engineering General Manager ¹¹ / Power Station Engineering Manager ¹²

⁹ Authorisation may be delegated

¹⁰ All designs must be signed off by the Technology Principal

¹¹ For centrally executed Engineering Work

¹² For decentralized execution work

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4.3.4 End-of-Phase Design Review Reports

All finalised End-of-Phase Design Review reports shall be recorded on the relevant Document Management System (DMS).

End-of-Phase Design Review reports shall typically include (see [17]):

- A summary/short description of the package/plant system/asset being reviewed;
- A summary of the scope of package/plant system/asset being reviewed;
- A reference list to all applicable review documentation;
- All issues/risks identified during the design review;
- All signatures obtained from the End-of-Phase Design Review panel (as per paragraph 4.3.3).

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5. AUTHORISATION

This document has been seen and accepted by:

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6. REVISIONS

Date	Rev.	Compiler	Remarks
March 2007	0	P Knothe	First Issue of document (45-4)
July 2010	1	SC Engelbrecht	<ul style="list-style-type: none"> Document supersedes N.PPZ 45- 4. Update on general content. Updated structure and format. Updated Figure 1. Updated conventional naming. Updated responsibility Matrix (Table 2 & 3). Inclusion of section 3.5.3: System/Subsystem Design Freeze Review Process. Updated figure ANNEXURE A: End-of-Phase Design Reviews Alignment of ANNEXURE A: End of Phase Reviews with Table 1. Insert of 3.8: Minimum Documentation for Design Reviews
November 2012	2	TA Botha SC Engelbrecht WJW Naudé	<ul style="list-style-type: none"> Complete document rewrite including principles, terminology and responsibilities. Final Review by F Bosch for DM.
September 2015	2.1	RA Mandavha	<ul style="list-style-type: none"> Update on general content Reference document number updated to 240 D004FC number Align role of EDWL and LDE Final Draft for Comments Review
January 2016	2.2	RA Mandavha	<ul style="list-style-type: none"> Updated Final Draft after Comments Review Process Document approved by Eskom P&P Steerco
September 2016	3	RA Mandavha	<ul style="list-style-type: none"> Final Document prepared for Authorisation and Publication by F Bosch for DRM
January 2023	3.4	JC van Tonder	<ul style="list-style-type: none"> Review in line with Divisionalisation Review to align with Generation Engineering Functional Leader Model. Alignment with various PLC, funding and ownership models
February 2023	3.5	JC van Tonder	Final Draft after Comments Review Process
February 2023	3.6	JC van Tonder	Additional updates Completed
February 2023	3.7	JC van Tonder	Final Draft after Additional updates completed
February 2023	4	JC van Tonder	Final Rev 4 Document for Authorisation and Publication

7. DEVELOPMENT TEAM

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

8. ACKNOWLEDGEMENTS

- None

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