Eskom	**Procedure**	

Title:	**Design Review Procedure**	Unique Identifier:	**240-53113685**
		Alternative Reference Number:	**N/A**
		Area of Applicability:	**Eskom**
		Documentation Type:	**Procedure**
		Revision:	**2**
		Total Pages:	**19**
		Next Review Date:	**November 2015**
		Disclosure Classification:	**CONTROLLED DISCLOSURE**

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1. INTRODUCTION

Design reviews provide the necessary assurance that all previously set requirements at the end of each phase have been satisfactorily met. Design reviews also provide assurance that the design process for a particular phase has been properly followed. This ensures that a reliable basis is set for the next phase in the Project Life Cycle (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, technical performance and scope.

The ultimate aim of a well-managed design review process is to ensure that all designs are adequate, correct, integrated and not done in isolation.

2. SUPPORTING CLAUSES

2.1 SCOPE

This procedure covers the required steps for the execution of design reviews (end-of-phase and interim).

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 shall ensure 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 professionals delegated by the relevant Engineering Centre of Excellence to perform engineering or engineering design related work in Eskom Holdings SOC Ltd and its subsidiaries. It, however, does not apply to Nuclear environments.

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] 240-4332798: 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] 474-190: Design Base Standard

[6] 474-34: Project Engineering Change Procedure.

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2.2.2 Informative

[1] 474-59: Internal Audit Procedure

[2] Engineering Profession Act No. 46 of 2000

[3] IEC 61160: Design review

[4] ISO 10007: Quality Management Systems – Guidelines for configuration management

[5] ISO 9001: Quality Management Systems - Requirements

[6] SANS 15288: Systems and software engineering - Systems life cycle processes

[7] SANS 26702: Systems engineering - Application and management of the systems engineering process.

2.3 DEFINITIONS

Definition	Description
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.
Configuration	Interrelated functional and physical characteristics of a product defined in product configuration information.
Design Base	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.
End-of-Phase Design Review	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.
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 an Eskom internal Design Engineering Practitioner. These reviews are conducted during any phase of a project. Interim Design Reviews includes the detail review of detail design documentation.

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2.4 ABBREVIATIONS

Abbreviation	Description
BMH	Bulk Materials Handling
BOQ	Bill of Quantities
C&I	Control and Instrumentation
CAPEX	Capital Expenditure
CM	Configuration Management
COE	Centre of Excellence
DMS	Document Management System
DOR	Division of Responsibility
DRC	Design Review Committee
DRT	Design Review Team
Dx	Distribution
EIA	Environmental Impact Assessment
EDWL	Engineering Design Work Lead
GA	General Arrangement
GM	General Manager
Gx	Generation
LPS	Low Pressure Services
MDL	Master Document List
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
SED	Station Electrical Diagram
SME	Subject Matter Expert
TP	Terminal Point
Tx	Transmission

2.5 ROLES AND RESPONSIBILITIES

- **Engineering Design Work Lead (EDWL):** EDWL is the professionally registered engineer/technologist delegated by the relevant COE to coordinate the COE 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, Low Pressure Services (LPS), etc.

  The EDWL ensures that all End-of-Phase Design Reviews are identified and executed as defined in this procedure

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Typically on New Build projects the EDWL role is fulfilled by the Lead Discipline Engineering Practitioner. Typically on existing asset projects the EDWL role is fulfilled by the relevant O&M Engineering Practitioner.

- **COE Manager:** The COE manager ensures that his/her respective Design Review Committee/Team (DRC/DRT) is in place, properly constituted and representative of all relevant COE stakeholders as required per End-of-Phase design review and ensures implementation and compliance to this procedure.

2.6 PROCESS FOR MONITORING

This procedure will be monitored via [1] and self-assessments.

2.7 RELATED/SUPPORTING DOCUMENTS

[1] 474-1327: End-of-Phase Design Review Report Template.

3. DESIGN REVIEW PROCEDURE

3.1 DESIGN REVIEW TYPES

Two types of design reviews are conducted during the project lifecycle:

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

3.2 INTERIM DESIGN REVIEWS

3.2.1 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 an Eskom 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).

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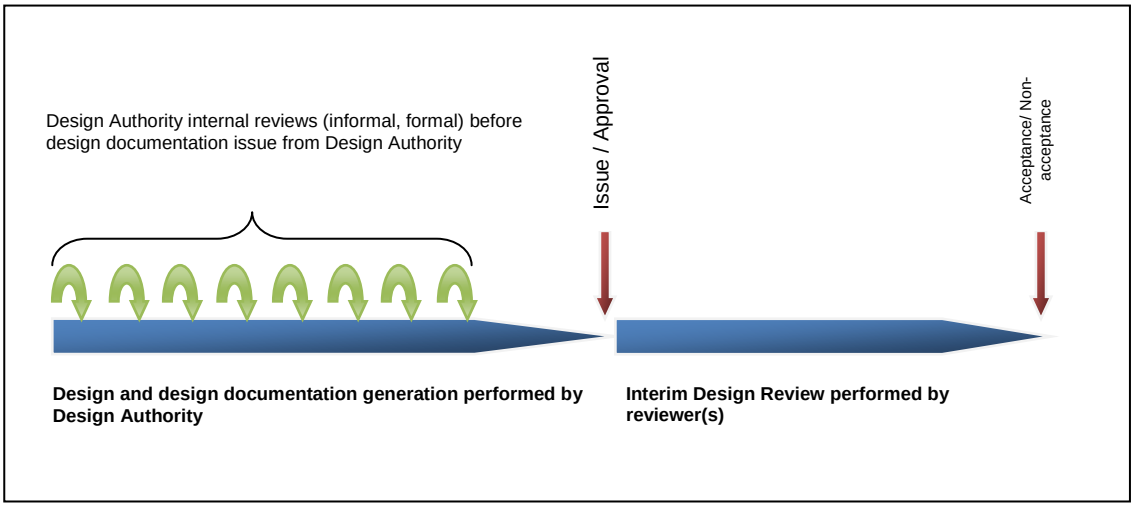

Figure 1 : Interim Design Reviews

Note: Only the Design Authority can approve design documentation. Interim Design Reviewers can only accept / not accept documentation issued by 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.

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3.2.2 Roles and Responsibilities during Interim Design Reviews

When Eskom 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 stakeholder requirements (i.e. validation of design deliverables against stakeholder requirements).
- general technical oversight is provided over the design.

When Eskom acts as the **Architect 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 stakeholder requirements (i.e. validation of design deliverables against stakeholder requirements);
- 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.

When Eskom acts as the **Design Authority** on a project/package/plant/system/asset, the interim reviewer(s) shall review the design documentation to ensure that:

- the design satisfies the design requirements;
- all relevant COE design standards, procedures and guidelines have been adhered to;
- the design is suitable and correct (calculations, philosophy, functionality, etc.);
- best COE 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.

3.2.3 Process

Step 1: Distribution of design review documentation

The EDWL responsible for the package/plant/system/asset shall evaluate from which parties (EDWLs, SMEs, Configuration Management (CM), etc.) he/she requires comments on the design documentation. All affected parties and interfacing Centres of Excellence 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 time[1];
- Prepare detailed review comments (this may include document/drawing redlines, etc.);

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

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- 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 a COE shall occur before comments are returned to the EDWL for final consolidation.

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

Step 4: Finalisation of interim design review

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

3.2.4 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 EDWL 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.

3.3 END OF PHASE DESIGN REVIEWS

3.3.1 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:

NOTE: Not all specified End-of-Phase Design Reviews in Table 1 are necessarily performed during the execution of a project. The required End-of-Phase Design Reviews for a particular package/plant system/asset shall be predetermined and agreed as per the Engineering Management Plan**.**

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Table 1 : End-of-Phase Design Reviews

End-of-Phase Design Review	Associated Engineering Baseline
Stakeholder Requirements Review	Stakeholder Requirements Baseline
Concept Design Review	Concept Design Baseline
Basic Design Review	Basic Design Baseline
Pre-Enquiry Review[2]	Acquisition Requirements Baseline
Contract Award Review	Contract Award Baseline
Design Freeze Review (Detail Design)	Design Freeze Baseline(s)
System Integrated Design Review (Detail Design)	Integrated Design Baseline
Pre-Commissioning Review	As-Built Baseline
Acceptance Testing Review	As-Commissioned Baseline
Handover Review	Handover Baseline

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

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3.3.1.1 Stakeholder Requirements Review[3]

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: • 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.	• Stakeholder requirements

3.3.1.2 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

[3]Refer to figure 10, SANS 26702 [7] for information.

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Concept Design Review	Establish agreed concept design baseline by: • 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 concept designs' technical feasibility and risks. • 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	• 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

3.3.1.3 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	Establish agreed basic design baseline by: • 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	• 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

3.3.1.4 Pre-Enquiry Review

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

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End-of-Phase Design Review	Focus of Design Review	Typical Review Documentation
Pre-Enquiry Review	Establish agreed acquisition requirements baseline by: • 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	• 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

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3.3.1.5 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	• 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	• Contract package Works Information/Employers Requirements (signed). • Changes to Works Information/Employers Requirements (deviation/variation protocol) • Technical Evaluation Reports • Verification and Validation Report

3.3.1.6 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.

3.3.1.7 System Integrated Design Review (Detail Design)

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

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End-of-Phase Design Review	Focus of Design Review	Typical Review Documentation
System Integrated Design Review	Establish agreed system integrated design baseline by: • 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	• 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

3.3.1.8 Pre-Commissioning Review

End-of-Phase Design Review	Focus of Design Review	Typical Review Documentation
Pre-Commissioning Review	Establish agreed As-Built Baseline by: • Verifying that actual plant/asset configuration conforms to detail design. • Verifying that design documentation set is complete Provide assurance that system is ready for commissioning by: • Reviewing all interfacing services' availability for commissioning. • Reviewing system commissioning procedures. • Confirming all required safety clearances are in place. • Confirming PDRA requirements are met	• System commissioning procedures. • As built drawings. • Verification &Validation Report

3.3.1.9 Acceptance Testing Review

End-of-Phase Design Review	Focus of Design Review	Typical Review Documentation
Acceptance Testing Review	Establish agreed As-Commissioned Baseline by: • Verify/Validate that plant/asset performance and functions meet stakeholder/technical requirements. • Confirming PDRA requirements are met	• Commissioning/Acceptance Test Report • Verification &Validation Report

3.3.1.10 Handover Review

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End-of-Phase Design Review	Focus of Design Review	Typical Review Documentation
Handover Review	Provide assurance that a system/asset is ready for handover by: • Reviewing that the technical hand-over documentation set is complete as per Stakeholder Requirements. • Confirming PDRA requirements are met.	• Technical Hand-over package. • Verification &Validation Report

3.3.2 Process

Step 1: Planning and Preparation

The responsible package/plant system/asset EDWL 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 authoriser shall ensure that the Design Review Committee/Team (DRC/DRT) is properly constituted for the relevant End-of-Phase Design Review to represent all Technology stakeholders including the COE manager, relevant EDWLs and SMEs.

The responsible package/plant/system/asset EDWL 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 checklist[4], 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 COE manager at least 10 working days[5] 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 days[6] of the scheduled review;
- Consolidate all comments for discussion during the conduct of the End-of-Phase Design Review.

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

[5]This time may differ as agreed upon by the lead COE manager.

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Step 2: Conduct End-of-Phase Design Review

The End-of-Phase design review authoriser 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 EDWL shall present the End-of-Phase design review with specific focus on the items as tabled in sections 3.3.1.1 through 3.3.1.10.

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 3.3.3.

Should the review panel disagree on approval, the authorisation shall be escalated to the relevant Technology General Manager (GM).

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

3.3.3 End-of-Phase Design Review Approval and Authorisation

Scope of Design	Design Review Panel
Package/plant/system/asset confined to one COE.	▪ **Approval:** Relevant COE DRC ▪ **Authorisation[6]:** Relevant COE manager
Package/plant/system/asset involves multiple COE.	▪ **Approval:** Relevant COE DRC[7] ▪ **Authorisation[7]:** Relevant Senior Manager

Table 2 : End-of-Phase Design Review Panel (Gx New Build and Refurbishment Projects)

[6] Authorisation may be delegated.

[7] The DRC shall be constituted by the relevant EDWL's COE manager to represent all required stakeholders from interfacing COEs including the relevant SMEs.

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Scope of Design	Design Review Panel
Package/plant/system/asset confined to one COE.	▪ **Approval:** Relevant COE DRT ▪ **Authorisation:** PDE DRT Chairman
Package/plant/system/asset involves multiple COE.	▪ **Approval:** All Relevant COE DRT ▪ **Approval:** PDE DRT ▪ **Authorisation:** PDE DRT Chairman

Table 3 : End-of-Phase Design Review Panel (Tx Projects)

The Distribution design review panels will be set up by the PDE DRT. This shall include the rules for jurisdiction over projects by scope or value, and rules for escalation of technical decisions. This detail shall be included in the PDE DRT Terms of Reference.

3.3.4 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 [1]):

- 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 3.3.3).

4. AUTHORIZATION

This document has been seen and accepted by:

Name	Designation
A Jansen	B2B Engineering Tools Business Architecture
B Fair	B2B Engineering Tools: Process Architecture
C Malan	Project Tools and Processes - Integration
D Bhimma	Senior Manager Production Engineering: Coal
D Odendaal	General Manager: Power Plant
F Sithole	General Manager: Engineering Projects Management (Acting)
J Fourie	Engineering Senior Manager: Outside Plant
K Elliot	B2B Engineering Tools: System Stream Lead
L Fernandez	Senior Manager: System Integration
P Moyo	General Manager: Power Delivery (Acting)
S Pasquallie	Middle Manager: Technical

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5. REVISIONS

Date	Rev.	Compiler	Remarks
March 2007	0	P Knothe	First Issue of document (45-4)
July 2010	1	SC Engelbrecht	▪ 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	▪ Complete document rewrite including principles, terminology and responsibilities. Final Review by F Bosch for DM.

6. DEVELOPMENT TEAM

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

- TA Botha,
- SC Engelbrecht,
- WJW Naudé

7. ACKNOWLEDGEMENTS

None

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