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1. INTRODUCTION

The control and execution of engineering changes on existing assets is critical in ensuring sustainable performance. All engineering changes must be correctly prepared, motivated, reviewed, approved and controlled.

This procedure defines a standardised process for all Eskom Generation and Transmission operational assets that shall be followed for the review, classification and implementation of an engineering change to existing Eskom assets.

2. SUPPORTING CLAUSES

2.1 SCOPE

The need for an engineering change on an existing Eskom asset must be captured through SAP ECM (Engineering Change Management) and follow due process for resolution. This procedure provides for the registration of engineering changes and for reporting on the status of engineering changes while the actual engineering work is processed outside of SAP using Eskom engineering governance practices.

The approach for design reviews shall provide assurance that the systematic evaluation of proposed solutions adhere to project, regulatory, client, and quality standards and requirements as stipulated in the design review procedure.

2.1.1 Purpose

The overriding purpose for this procedure is to ensure that Eskom assets shall be managed in such a way as to enable sustainable achievement of its business goals. It must be adopted in order to provide an effective process for controlling changes to plant, plant structures or technical documentation, and to manage any changes to a baseline in a controlled manner. Any proposed changes shall be traced – thereby controlling the integrity of the configuration and demonstrate compliance with auditable traceability.

2.1.2 Applicability

This procedure shall apply to all personnel involved in engineering changes executed on existing Eskom operational assets within the Generation and Transmission environment, where the design is not performed using SmartPlant (SPO). All parties interfacing with or working on Eskom Holdings SOC Limited assets are required to comply.

Note: This procedure has been developed based on the principles of the automated SmartPlant (SPO) process that will be rolled out at a later stage.

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] 474-1325, Design Review Procedure

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[3] 474-34, Project Engineering Change Procedure.

2.2.2 Informative

[1] 240-51093273, Process Control Manual (PCM) – Control Configuration Changes

[2] 474-190, Design Base Standard.

2.3 DEFINITIONS

2.3.1 Approve: The functional responsible person determines if the document is fit for purpose and approves the document content and therefore takes responsibility and accountability for the document content.

2.3.2 Asset/Plant: Machinery, property, buildings, vehicles and other items and related systems that have a distinct and quantifiable business function or service.

2.3.3 Authorise: The document authoriser authorises the release and application of the document and is accountable for document implementation.

2.3.4 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.

2.3.5 Engineering Change: Any permanent or temporary change, deletion or addition to any system, equipment, structure including permanent changes to operating/protection/control set points, software and technical documentation which will result in any deviation from the established Design Base. This includes the replacement of SSC components with equivalent components of a different make or type.

2.3.6 Engineering Change Classification: The categorisation of a modification depending on the level to which it affects safety, the environment, reliability, availability and costs.

2.3.7 Engineering Change Management: Engineering Change Management ensures all engineering changes are correctly prepared, motivated, reviewed, approved, controlled and recorded.

2.3.8 Engineering Change Prioritisation: Selection criteria, as part of the Engineering Change process that will guide the engineer and the CCC's on the priority of the engineering change into different levels. This will be dictated by the specific business.

2.3.9 Engineering Change Request: The entire document package containing the modification proposal, feasibility study, design package, reviewers report, implementation plan, works information schedule, commissioning procedures and the completion schedule. These documents will bear the approval signatures relevant to the engineering change classification and those signatures required for authorisation prior to implementation and Return to Service.

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2.4 ABBREVIATIONS

Abbreviation	Description
CC	Change Coordinator
CCC	Change Control Committee
CCCC	Central Change Control Committee
CRA	Concept Release Approval
DRA	Definition Release Approval
ECM	Engineering Change Management
ECN	Engineering Change Notification
ECO	Engineering Change Order
ECR	Engineering Change Request
ERA	Execution Release Approval
EWL	Engineering Work Lead
FRA	Finalisation Release Approval
PTE	Plan Technical Effort
RACI	Responsible, Accountable, Consulted, Informed
SCCC	Site Change Control Committee
SE	System Engineer
SPO	Smart Plant Enterprise Owner Operator
SSC	System Structure or Component
URS	User Requirements Specification

2.5 ROLES AND RESPONSIBILITIES

Role	Responsibility
Central Change Control Committee (CCCC)	<p>A committee/individual appointed by the Senior General Manager Engineering. Their responsibilities include:</p> <ul style="list-style-type: none"> Authorising the proposed Level 1 and Level 2 engineering changes Authorising the engineering change based on the principles, use of technologies, and alignment to the process and procedure Confirming the engineering change impact (change classification, environmental assessment, risk ranking, priority and technical content, etc.) Performing change level classifications Periodical reviews of Level 3 changes from SCCC <p>*The responsibilities of the committee could be delegated to one person in certain instances</p>
Change Coordinator (CC)	<p>The person(s) in charge of managing the permanent or temporary configuration to structures, systems, components or technical content of prescriptive or descriptive documentation that form part of the design and/or asset base and updating SAP ECM to reflect the</p>

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	latest status of an ECN. The CC must ensure the minutes/decisions made by the SCCC and CCCC are recorded on the system.
Plant Engineering Change Authority	The person with the authority to authorise emergency change requests that arise outside the normal Engineering Change process
Design Review Team	The members of this team's responsibilities include: <ul style="list-style-type: none"> • Concurrence with the design review processes applied to the engineering design or engineering change • Ensuring that all design input has been adequately considered. In particular to ensure that the engineering change has been adequately reviewed with regard to interface issues between various disciplines, contractors etc. • Ensuring that all review cycles have been complied with • Making recommendations regarding engineering change approval • The nomination of additional independent reviewers if considered necessary
Engineering Design Work Lead (EWL)	Typically an appropriate Professionally Registered Engineer (P15-P18) who is designated through the work allocation process. He/She is delegated with the authority to perform the following functions: <ul style="list-style-type: none"> • Ensure that all steps are performed according to procedure • Perform a further technical review, if required, of the feasibility study and/or the engineering change package • Put together an engineering team led by himself/herself, who is responsible for ensuring that Level 1 and Level 2 classified Engineering Change Requests have been subjected to the appropriate review cycles and are acceptable for implementation. It may have, as its members, specialists and/or external consultant personnel on an ad hoc basis • Perform conceptual, basic and detail design (if applicable) • Coordinate compilation of a design report including all the necessary supporting documents for loading onto Hyperwave • Package the initial detail review thereof
Site Change Control Committee (SCCC)	A committee/individual at an Eskom plant appointed by the Manager of the Asset who: <ul style="list-style-type: none"> • Set execution route (Project or Work order) • Ratify change level classifications • Forward Level 1 and 2 changes to the central committee for authorization • Authorize changes for implementation • Periodically report details of Level 3 changes to the Central Control Chance Committee <p>*The responsibilities of the committee could be delegated to one person in certain instances</p>
System Engineer / Plant Engineer	A competent and qualified site/plant-based discipline or System/Plant Engineer, who has the training, technical qualification and expert knowledge of the plant or systems affected by the engineering change. His/her function is: <ul style="list-style-type: none"> • To prepare the engineering change • Preparation of a feasibility study, stakeholder requirements, Member of the Design Review Team

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2.6 PROCESS FOR MONITORING

- Compliance to SAP ECM process will be compulsory for all Eskom Generation and Transmission sites/plants.
- All engineering changes will originate and be tracked through SAP ECM. The responsibility to update status changes on SAP ECM will be plant specific, until the Design and Specification functions have been established on site.
- Each plant needs to provide and maintain an engineering change folder in an approved document management database that contains the engineering change notification/request to be reviewed locally and centrally.
- A report of all Level 1 and 2 engineering changes shall be visible to and managed by the Central Control Change Committee (CCCC) to facilitate the exchange of information.
- Periodically, Level 3 changes authorized by the Site Change Control Committee (SCCC) will be reviewed by the CCCC.
- All designs shall be executed and reviewed according to the responsibility matrix as stipulated in the Design Review Procedure (474-1325)
- The CCCC will monitor adherence to this procedure.

2.7 RELATED/SUPPORTING DOCUMENTS

Nil

3. ENGINEERING CHANGE MANAGEMENT PROCEDURE

3.1 OBJECTIVES

The objectives are:

1. Ensure the effective management of all engineering changes to increase plant reliability and availability over the full lifecycle of the asset and to reduce business risk.
2. Ensure a consistent approach is used for the classification and prioritisation of all engineering changes
3. Ensure the process/procedure and tools (SAP ECM) used for plant engineering changes and change management across all plant is standardised
4. Ensure that all engineering design is done by a suitably qualified design or system engineer (plant engineer), who has the training, technical qualification and expert knowledge of the plant or systems affected by the engineering change.

3.2 ENGINEERING CHANGE MANAGEMENT (ECM) PROCESS

The activities to be followed during the ECM process are show in the overview process in Figure 1.

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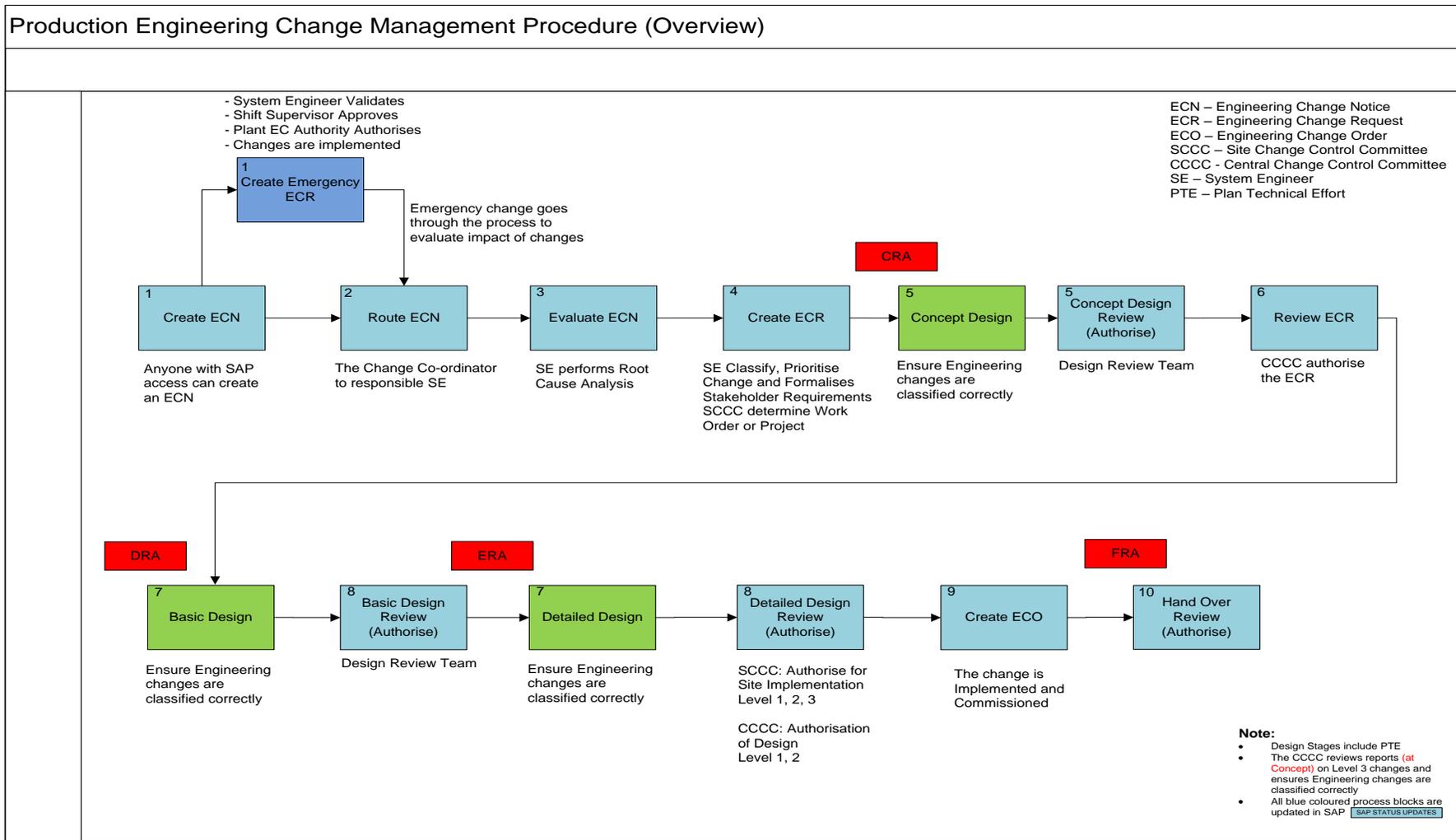


Figure 1 : Engineering Change Management Procedure (Overview)

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3.2.1 ECM Process Overview

1. Any authorised Eskom employee with SAP ECM access can create an Engineering Change Notification (ECN) (Normal or Emergency). Typically the ECN is created by an operator or maintenance personnel
 - Normal Engineering Change: Follows the process as illustrated in Figure 1
 - Emergency Engineering Change: Is implemented once authorised by the plant engineering change authority, there after follows the process as illustrated in Figure 1 to evaluate the impact of the change
2. The Change Coordinator (CC) enters the employee number and department of the responsible person (System Engineer/Plant Engineer) by updating the ECN in SAP.
3. The System Engineer (System Engineer/Plant Engineer) performs a validity check
4. The System Engineer/Plant Engineer performs a Root Cause Analysis and updates the ECN.
5. The CC register an ECR by entering the ECR information provided by System Engineer/Plant Engineer(description, priority and preliminarily classifies the change as Level 1, 2, or 3) prioritises and
6. The System Engineer/Plant Engineer defines and formalises the Stakeholder Requirements (URS). The SCCC authorises the ECR, confirms the priority and classification and sets execution route.
7. The Engineering Work Lead (EWL) plans and compiles the Concept Design. Design Review Team approves the design
8. The SCCC and CCCC reviews the Engineering Change Request (ECR), authorise concept design and validate project execution route
9. The EWL plans and compiles the Basic, and/or Detail Design
10. The Design Review Team reviews the Basic and/or Detail Design. The CCCC review the Level 1 and 2 designs prior to the SCCC authorising for implementation
11. The solution is Implemented and Commissioned after which the Configuration Information is updated
12. The Configuration Information is verified and corrected; SAP Master Data is updated to ensure it accurately reflects the existing plant. Operations and maintenance staff are made aware of and trained on the changes to the effected plant.

3.3 ECM PROCEDURE

The ECM procedure consists of Originating, Processing, Implementing, and the Close out of Engineering Changes.

(For the full process please see APPENDIX A: ECM Process)

3.3.1 Originate Engineering Change

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The process for originating an engineering change consists of the following four sub-systems: Create ECN, Route ECN, Evaluate ECN, and Create ECR, as shown in Figure 2.

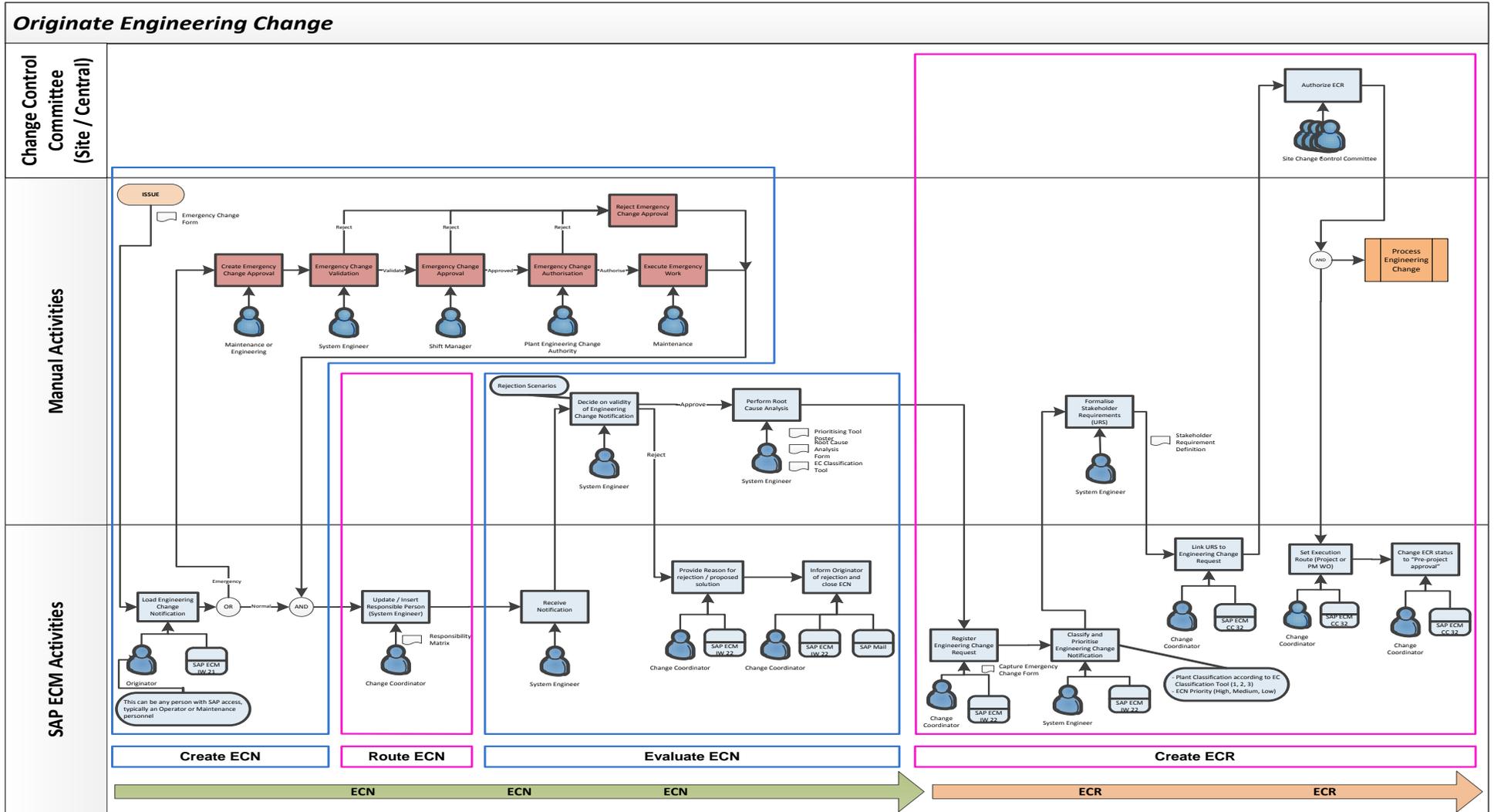


Figure 2 : Originate Engineering Change

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3.3.1.1 Create ECN

There are two types of engineering changes.

1. Normal Engineering Change
2. Emergency Engineering Change

Any authorised Eskom employee can create an ECN (Originator) which can be as a result of the operating process, incident and occurrence or maintenance process.

In the case of an Emergency engineering change notification:

1. The operator will load an ECN with Notification Type EC and clearly state the notification is for an emergency change.
2. An emergency change form is completed and the ECN number is recorded on the emergency change form.
3. This form is validated by the System Engineer/Plant Engineer, approved by the Shift Manager, authorised by a Plant Engineering Change Authority and then immediately implemented by the responsible team.

To ensure the change is properly evaluated and monitored it must then follow the Normal ECN process. The System/Plant Engineer must ensure that the emergency change form is sent to the CC who will capture the ECR and ensure that the Emergency change form must be scanned and attached to the ECR.

3.3.1.2 Route ECN

The Change Coordinator (CC) will view all new ECNs and update the ECNs by selecting the responsible department and System Engineer/Plant Engineer per ECN according to the Responsibility Matrix.

3.3.1.3 Evaluate ECN

The System Engineer/Plant Engineer must accept the SAP ECM notification and evaluate the validity of the ECN. The ECN is either approved or rejected at this stage.

If Rejected:

- The System Engineer's/Plant Engineer's must provide a reason for rejection/proposed solution and set the user status to rejected.
- A message will be sent via workflow to notify the Originator of the status of the ECN
- The CC will close out ECN on SAP ECM

If Approved the System Engineer/Plant Engineer must:

- Update the ECN status to ECN in progress
- A message will be sent via workflow to notify the Originator of the status of the ECN
- Perform Root Cause Analysis

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3.3.1.4 Create ECR

The CC registers an ECR on SAP ECM, and notifies the System Engineer/Plant Engineer, who then compiles the Stakeholder Requirements (URS). The ECR is preliminarily classified and prioritised according to Engineering Change Classification (Level 1, 2, 3) and Engineering Change Prioritisation (High, Medium, Low) respectively. The CC links this URS and associated documentation to the newly created ECR.

The System Engineer/Plant Engineer presents the ECR for authorisation to the SCCC where the priority and classification are ratified. Once authorised, the SCCC will set the ECR execution route.

The CC will then set the ECR status to pre-project approval.

3.3.2 Process Engineering Change

The process for processing an engineering change consists of the following three sub-systems: Concept Design, Review ECR, and Design as shown in Figure 3

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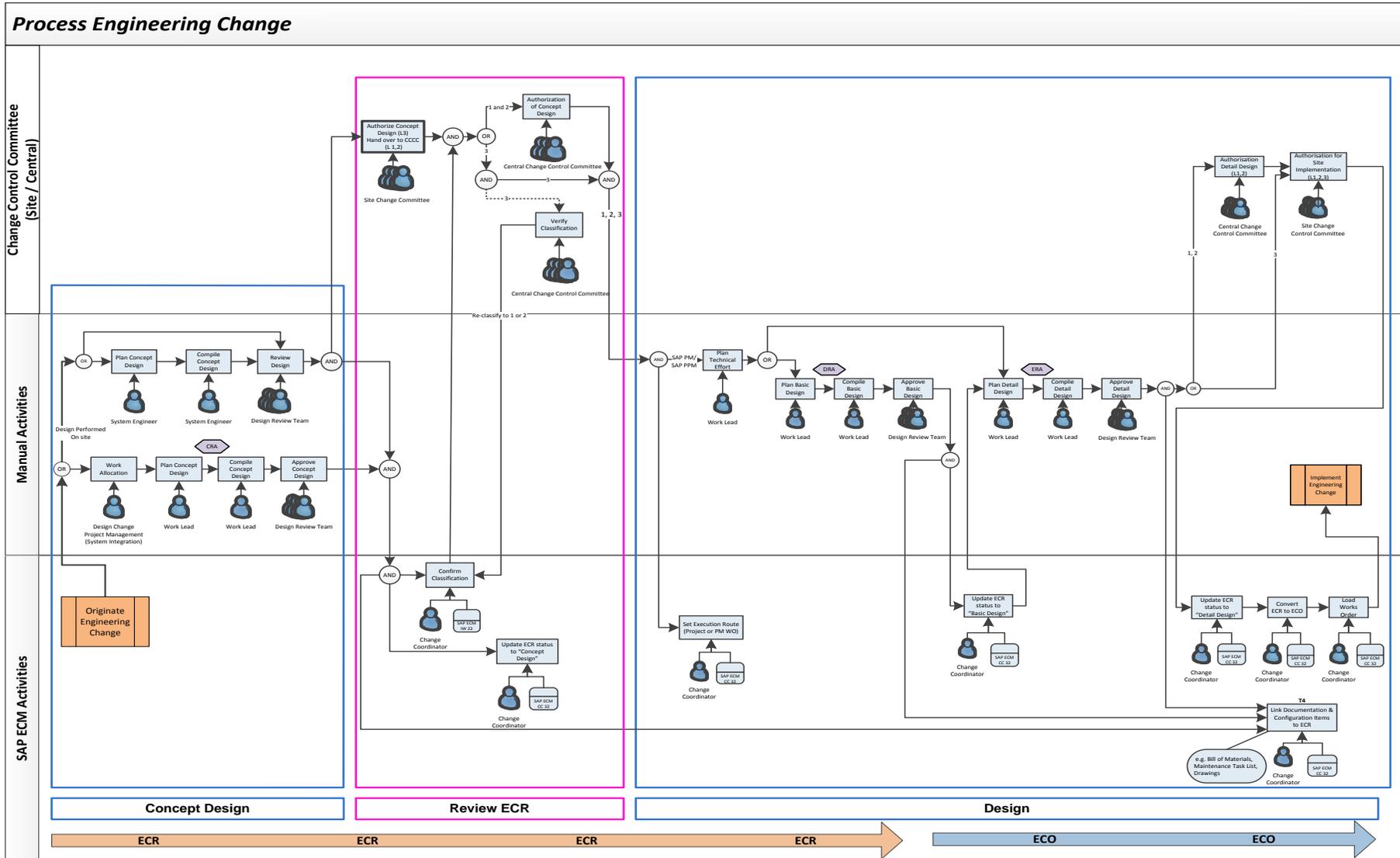


Figure 3 : Process Engineering Change

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3.3.2.1 Concept Design

The process to follow is dependent on the complexity of the ECR. For a non-complex/single discipline engineering change, the System Engineer/Plant Engineer may choose to perform the concept design on site or to bypass concept design if the available information is sufficient. However, the design must be reviewed by an independent Design Review Team, after which it will be sent to the SCCC for ratification of classification and approval of the governance process that has been followed. If the execution method is rejected by the SCCC, the ECR can be reassigned to an appropriate EWL to perform the Concept Design.

For complex/multi-disciplinary engineering changes, the ECR and Stakeholder Requirement (URS) are to be sent to the central Design Change Project Management (Systems Integration) department who will then route the work to an appropriate EWL.

The System Engineer/Plant Engineer /EWL needs to plan and compile the Concept Design. After the concept design is complete the engineering change is re-evaluated to ensure it was classified correctly.

3.3.2.2 Review ECR

The SCCC is responsible for authorising the go-ahead for all Level 3 ECR designs to proceed to basic and/or detail design and is responsible for accepting and sending all Level 1 and 2 ECRs to the CCCC.

The CCCC is responsible for authorising Level 1 and 2 ECRs for design. Level 3 ECRs approved by the SCCC move directly to the Basic/Detail Design phase, these classifications are verified on a monthly basis by the CCCC. The CCCC may reclassify a Level 3 change at any time, in which case the change must be brought before the CCCC for the approval of the Concept Design.

Once the concept design is approved by the Design Review Team and the Committees, the CC updates the SAP ECM status to “concept approval”.

The CCCC also evaluates the execution route; if it changes SAP ECM must be updated to reflect the change.

3.3.2.3 Basic and Detail Design

Based on the complexity of the required design work, and recommendation from the Committees, the EWL can progress to Basic Design or straight to Detail Design.

An independent Design Review Team is to review the designs at each stage following which the CCCC will authorise the implementation of Level 1 and 2 designs. The SCCC must then authorise Levels 1, 2 and 3 for site Implementation.

Once the basic design is approved, the CC updates the SAP ECM status to “definition approved” for all the approved ECRs. They must also ensure all design documentation and configuration items (e.g. bill of materials maintenance task lists and drawings etc.) are linked to the ECR on SAP ECM. The ECR status can then be updated to an Engineering Change Order (ECO).

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3.3.3 Implement Engineering Change

The process for implementing an engineering change is shown in Figure 4

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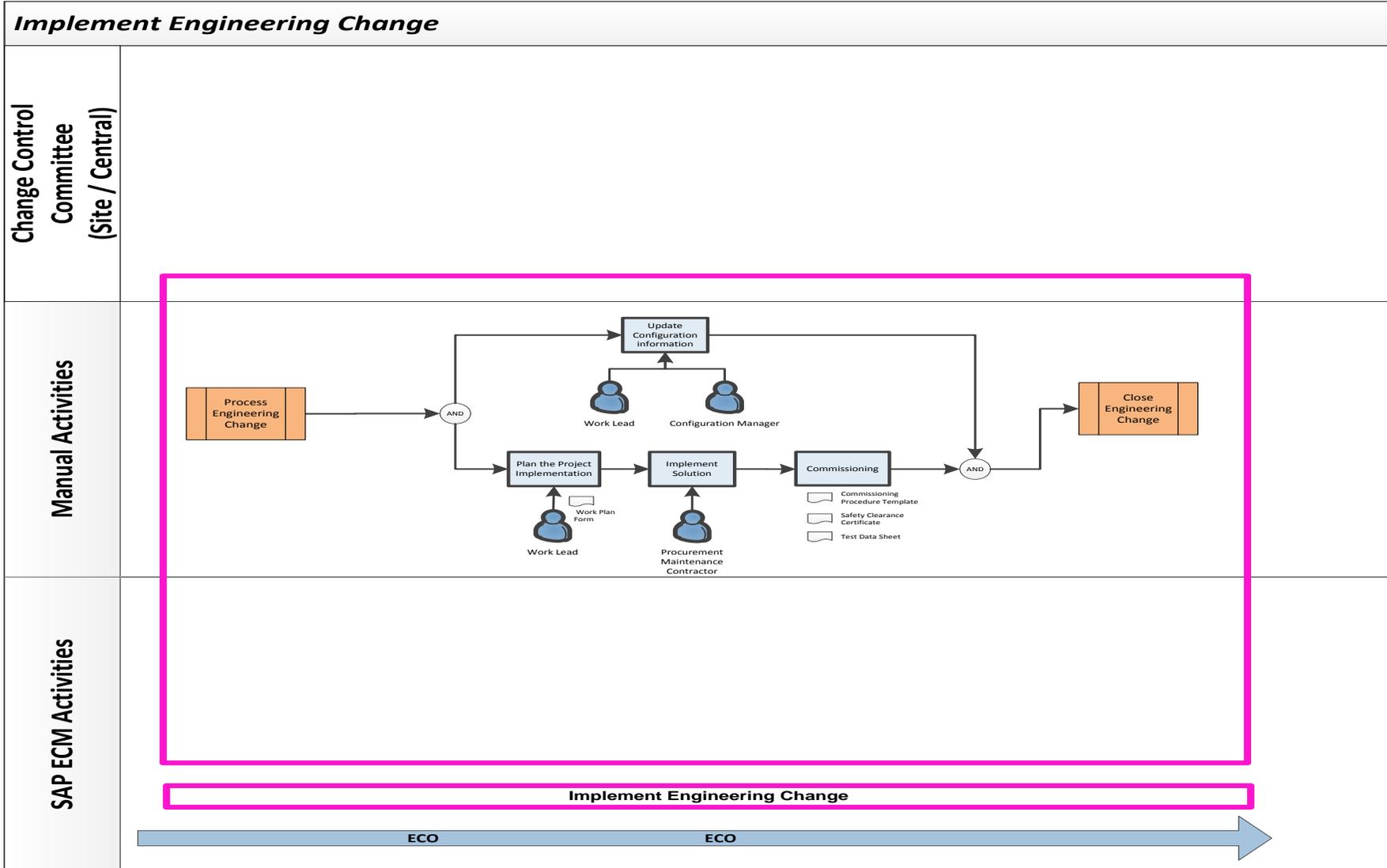


Figure 4 : Implement Engineering Change

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3.3.3.1 Implement Engineering Change

After the approval of the designs and the authorisation for site implementation, the EWL plans the implementation of the project and the CC loads a Works Order onto SAP. The solution is then implemented after which commissioning may commence.

Prior to completion of commissioning the EWL and Configuration Manager must ensure all Configuration Information is up to date.

Note: During the Implementation stage, it may be determined that the baselined detailed design requires an engineering change/s. When this occurs, the Project Engineering Change Procedure will be followed to manage the change.

3.3.4 Finalise Engineering Change

The process for Finalisation an engineering change consists of either the Close (Figure 5) or Close-out or an engineering change (Figure 6)

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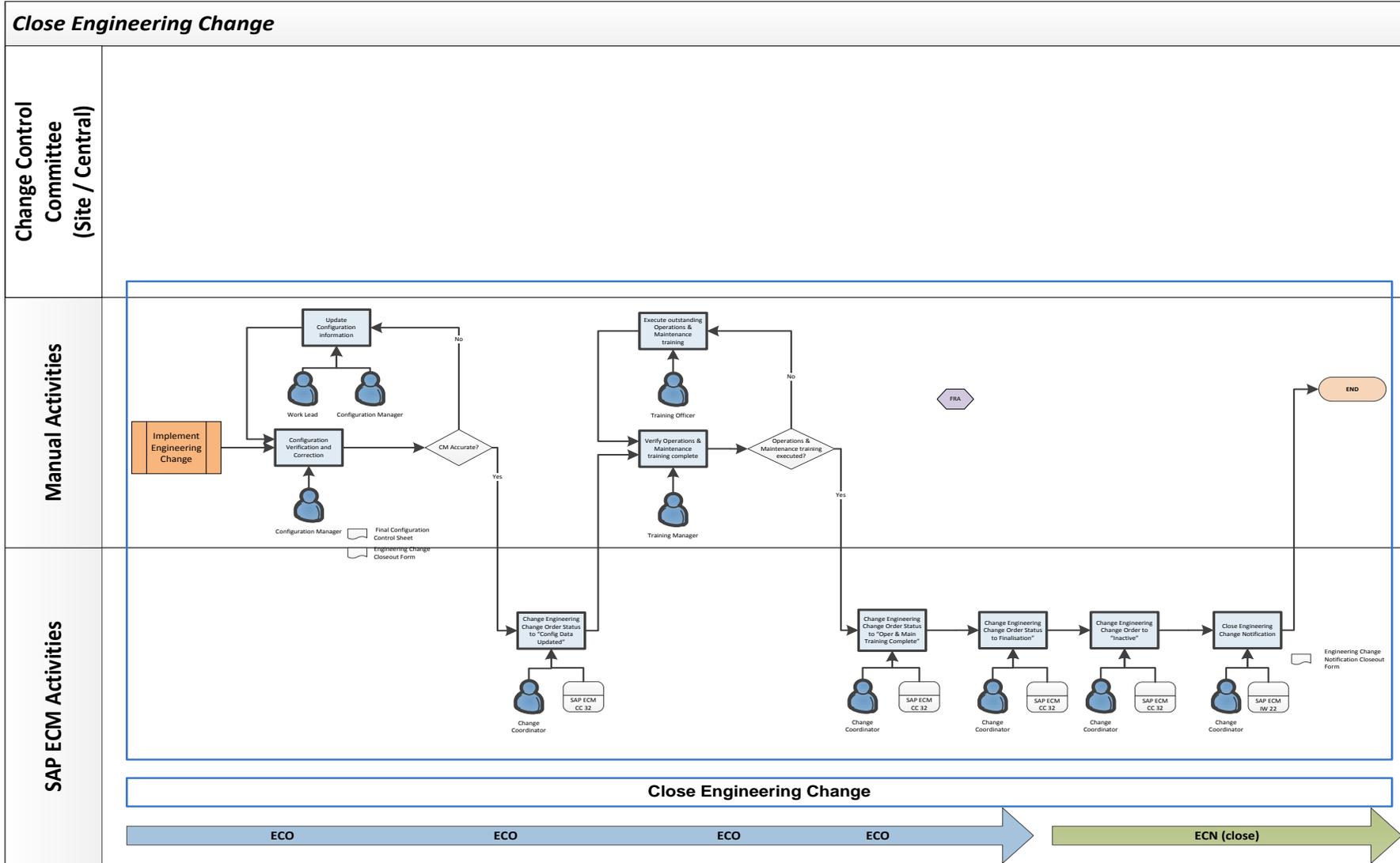


Figure 5: Close Engineering Change

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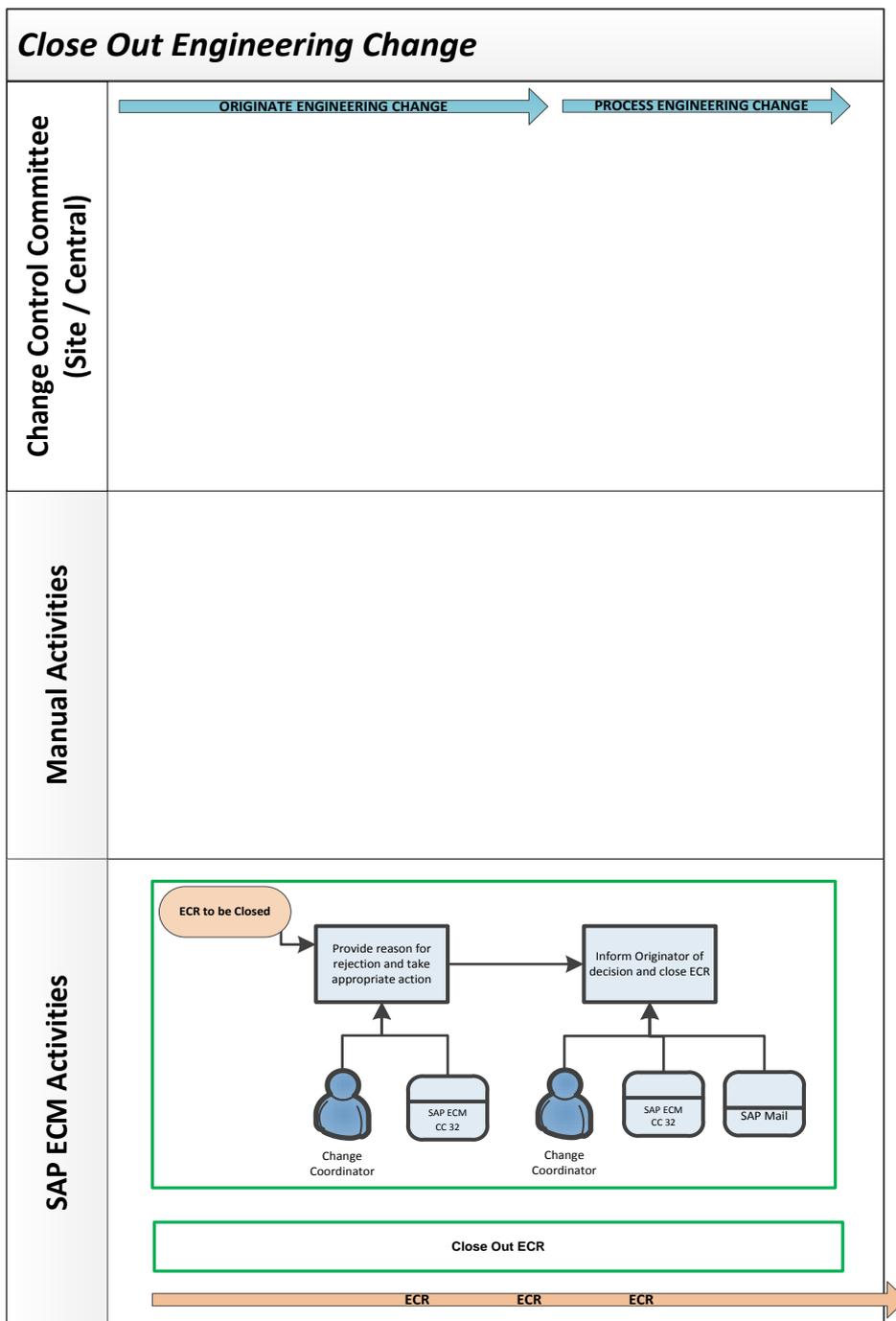


Figure 6 : Close-out Engineering Change

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3.3.4.1 Finalisation

The finalisation process ensures that the Design Base is updated by ensuring that the Configuration Information is verified and corrected. The process also ensures that the engineering change is captured and accurately reflects the existing plant on SAP.

The process also ensures that the operations and maintenance staff are aware of the change and are trained to operate and maintain the effected plant.

The CC is to ensure the training status is captured in SAP ECM before the ECN can be closed out.

3.3.4.2 Close out

At any stage during the ECM process, the System Engineer/Plant Engineer, SCCC, or CCCC, can reject the ECN. Once an ECN has been rejected the CC must link the reason/s for the rejection, as well as list any proposed solutions to the ECN on SAP ECM, and notify the originator of rejection. The ECN must then be close out SAP ECM

If Rejected the CC must include the reason for rejection and provide feedback to the ECN originator.

3.3.4.2.1 Typical Rejection Scenarios

The ECN/ECR can be closed out for various reasons. Typical scenarios for rejection could be:

- Design Base drawing not reflecting Plant configuration:
 - Plant is correct (drawing to be updated); or
 - Drawing is correct (plant to be modified);
- Office air conditioning setting change
- Change Request rejected at CCC and re-submitted
- Change Request rejected at CCC and closed
- Update Training Manual (no Design Base impact)
- Update Training Manual (cause is an out-dated P&ID)
- Swop-out of parts of same model and manufacturer
- Analyse Insulation of high pressure piping effectiveness
- Steps in Maintenance task to be updated.
- Equipment was operated outside Operating Parameters and thereby failed.
- An operator slipped on oil and broke a leg due to maintenance work taking place:
 - Operating procedure did not mention securing the area; or
 - Operating procedure did specify securing the area.

3.4 DECISION CRITERIA

Throughout the ECM procedure several key decisions need to be made, these include: the classification and prioritisation of the engineering change, committee criteria to review for approval or rejection, the execution routing to effect the change i.e. SAP PM or SAP PPM. To ensure consistency all key decisions will be based on the standardised criteria discussed in the sections below.

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3.4.1 ENGINEERING CHANGE CLASSIFICATION AND PRIORITISATION

The classification of engineering changes shall be consistently implemented for systems, components, structures and parts according to the classification categories (Level 1, 2 and 3) as below. Furthermore every engineering change will be prioritised according to the following prioritisation categories (High, Medium and Low).

Engineering change classification is divided into three levels and a SAP ECM drop down menu will be used to determine the classification.

The classifications and related descriptions provide a guideline for the classification of an Engineering Change as follows:

- Level 1
The impact of a change that could result in failure on the plant or compromises personnel safety or major equipment damage
- Level 2
The impact of a change that could result in a decrease of plant availability and reliability
- Level 3
All changes which do not meet the criteria for Level 1 or Level 2.

Components within a system shall be classified with respect to the safety function they fulfil and these may be different from the overall system or equipment classification. Components with multiple functions shall be classified according to the function that gives the highest safety classification.

Level 1 plant shall be subjected to more stringent specifications and processes than Level 2 and subsequently Level 3 plant to ensure that the processes applied are in line with the plant criticality level.

3.4.2 Committee Review Criteria

In order to ensure the various committees are consistent in their review of ECR's it is imperative that the correct information is provided. The committee ensures that proper governance has been followed and the engineering change package has sufficient data for the informed decision to be made. As a minimum the package should contain the following:

1. A summary of the problem / deficiency clearly described
2. Insight into the alternative solutions that were considered and an explanation of which alternative was selected
3. Impact of the modification as well as the risks that were identified
4. It is necessary to present evidence that the design was approved and has been reviewed according to the design review procedure
5. All assumptions made during the design, irrespective of the stage of the design.
6. All applicable documentation has been identified and updated or deleted for the purpose of the engineering change
7. Copies of the record of decision of the relevant asset needs to be presented, with required signatures

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3.4.3 Engineering Change Routing CRITERIA

Each site is to develop and populate its own RACI that will enable the CC to accurately and correctly route ECNs to its respective System Engineer/Plant Engineer.

The CC will use this RACI to identify the System Engineer/Plant Engineer within whose system the ECN falls.

3.4.4 Project or Work Instruction Decision Criteria

The criteria are used to define whether work is classified as a project or a work instruction. Project or Work Instruction Criteria are to be developed by the Back to Basics team.

4. AUTHORIZATION

This document has been seen and accepted by:

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M Mthembu	Senior Manager: Production Engineering Integration Coal (Boilers)
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R Cormack	Senior Manager: Power Delivery
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5. REVISIONS

Date	Rev.	Compiler	Remarks
17 October 2012	1	G Olukune	First Issue

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6. DEVELOPMENT TEAM

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

- Shamita Jagjiwan
- Dustin Fransman
- Pieter Meiring
- Alida Engelbrecht
- Machiel Viljoen
- Danie Louw
- Jaco van Staden

7. ACKNOWLEDGEMENTS

Nil

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APPENDIX A: ECM PROCESS

Refer to the attached ECM Process as documented elsewhere in document

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