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|  | <b>Work Instruction</b> | <b>Medupi Power Station Project</b> |
|---|-------------------------|-------------------------------------|

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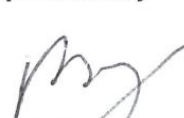
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## **Contents**

|   | Page |
|---|------|
| 1. Introduction.....  | 4    |
| 2. Supporting Clauses .....                                   | 4    |
| 2.1 Scope.....  | 4    |
| 2.1.1 Purpose.....  | 4    |
| 2.1.2 Applicability .....                                     | 4    |
| 2.1.3 Effective date.....                                     | 4    |
| 2.2 Normative/Informative References .....                    | 5    |
| 2.2.1 Normative.....  | 5    |
| 2.2.2 Informative.....  | 5    |
| 2.3 Definitions .....   | 6    |
| 2.4 Abbreviations .....                                       | 7    |
| 2.5 Roles and Responsibilities .....                          | 8    |
| 2.6 Related/Supporting Documents.....                         | 9    |
| 3. Medupi Project Engineering Change Management Process ..... | 10   |
| 3.1 Medupi Project ECM Process Overview .....                 | 10   |
| 3.2 Project ECM Process Description.....                      | 11   |
| 3.2.1 Query Identification.....                               | 11   |
| 3.2.2 Resolution and close-out phase.....                     | 14   |
| 3.3 Project ECM Principles.....                               | 25   |
| 3.3.1 Engineering Change Impact Assessment .....              | 25   |
| 3.3.2 Design Change Classifications .....                     | 26   |
| 3.3.3 Engineering Change Status Classification .....          | 27   |
| 3.3.4 Configuration Management Reporting .....                | 27   |
| 3.3.5 Document and records management.....                    | 27   |
| 3.3.6 Revision based on Pre-Approved Engineering Change ..... | 28   |
| 3.3.7 Cost Impact .....                                       | 28   |
| 3.3.8 Dispute Resolution .....                                | 28   |
| 4. RACI Matrix .....  | 29   |
| 5. Process for Monitoring.....                                | 30   |
| 5.1 Key Performance Areas and Indicators .....                | 30   |
| 5.2 Document Review and Self-Assessment.....                  | 30   |
| 5.3 Revision Period .....                                     | 30   |
| 5.4 Training Requirements .....                               | 30   |
| 6. Acceptance.....  | 31   |
| 7. Revisions.....   | 32   |
| Appendix A – Document Self-Assessment Checklist.....          | 33   |

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### **Tables**

|  |    |
|--|----|
| Table 1: Engineering Change Management Selection Criterion ..... | 14 |
| Table 2: ECP Criteria .....                                      | 23 |
| Table 3: Engineering Change Status Classification .....          | 27 |
| Table 4: Dispute Resolution .....                                | 28 |
| Table 5: RACI Matrix.....  | 29 |

### **Figures**

|  |    |
|--|----|
| Figure 1: Engineering Change Management Process Flow Diagram ..... | 10 |
| Figure 2: Request for Information Process .....                    | 13 |
| Figure 3: Request for Design Process.....                          | 16 |
| Figure 4: Engineering Response Process .....                       | 18 |
| Figure 5: Field Change Notice Process.....                         | 20 |
| Figure 6: Engineering Change Notice Process.....                   | 22 |

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## **1. Introduction**

Changes occur throughout the project lifecycle which necessitates engineering changes to an established engineering baseline. These changes may be due to; re-designing, plant optimisations, interferences, constructability - and commissioning issues, etc.

It is crucial that these changes are managed in a formal process to ensure (1) that the design integrity remains intact and (2) that the design baseline is maintained.

This work instruction defines a standardised process for managing all engineering changes that occurs on the Medupi Project. To ensure sustainable performance, all engineering changes should thus be correctly prepared, motivated, reviewed, approved and authorized before they can be implemented.

## **2. Supporting Clauses**

### **2.1 Scope**

The need for an engineering change on a new build project must be captured and executed through an approved Engineering Change Management process. This work instruction provides for query identification, process for resolution and for reporting on the status of all engineering changes.

#### **2.1.1 Purpose**

The purpose of this procedure is to ensure that the Eskom Design Base is maintained in such a way to enable sustainable performance. This will be achieved by controlling engineering changes to the Design Base during the execution phase of the project. The aim is to ensure that a structured approach is followed when making engineering changes to an approved design baseline.

This work instruction also ensures that all engineering changes can be traced and demonstrating compliance with auditable traceability.

This will ultimately ensures that the integrity of the Design Base is not degraded and the credibility of the design base is maintained throughout the project stages.

#### **2.1.2 Applicability**

This procedure applies to all employees including Group Technology, Group Capital, Contractors, Consultants and seconded personnel performing engineering work to the Medupi Project.

#### **2.1.3 Effective date**

Date of authorisation of this document.

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## **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] 32-1155 Eskom PLCM Policy
- [3] 240-68604731 Design Base Standard
- [4] 240-53113685 Design Review Procedure
- [5] 240-53114002 Engineering Change Management Procedure
- [6] 240-53114026 Project Engineering Change Management Procedure
- [7] 348-968545 Medupi ECM and PECM Interface Work Instruction
- [8] 240-42366126 Process Control Manual (PCM) – Control Change on the Project
- [9] 240-46693733 Process Control Manual (PCM) – Manage Technical Queries
- [10] 240-51093273 Process Control Manual (PCM) – Control Configuration Changes
- [11] 240-44271204 Process Control Manual (PCM) – Manage Engineering Delivery
- [12] 200-16714 (348-860840) Works Instruction Commissioning and Completion of Medupi Power Station
- [13] 200-1680 (348-883808) Document Management and Record Control
- [14] 200-69906 (348-883753) Medupi Project Data Capturing Guideline
- [15] 200-15399 (348-674625) Work Instruction: Manage and Control Project Variations (VO)
- [16] 200-85675 (348-643368) Contract Modification Work Instruction

### **2.2.2 Informative**

- [17] ISO 10007 Configuration Management
- [18] ISO 9001:2015 Quality Management Systems
- [19] 240-53114190 Management of Internal Audits within Group Technology
- [20] 32-644 Eskom Documentation Management Standard

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## **2.3 Definitions**

| <b>Term</b>                       | <b>Definition</b>   |
|-----------------------------------|---|
| Assessment                        | Activity undertaken to determine the suitability, adequacy and effectiveness of the subject matter to achieve established objectives.   |
| Asset/Plant                       | Machinery, property, buildings, vehicles and other items and related systems that have a distinct and quantifiable business function or service.  |
| 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.   |
| 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. |
| Engineering                       | Eskom Engineering, as represented within the project by Medupi Project Engineering.   |
| 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 original or existing System Structure of Component (SSC) design and/or specification or established baseline. This includes the replacement of SSC's with equivalent components of a different make or type.   |
| Engineering Change Classification | The categorisation of a modification depending on the level to which it affects safety, the environment, reliability, availability and costs  |
| Engineering Change Management     | Engineering Change Management ensures all engineering changes are correctly prepared, motivated, reviewed, approved, controlled and recorded.   |
| Engineering Change Notice (ECN)   | The outcome from the ECN Process used by the DA to issue a proposed revision to an approved document. An ECN contains the reasoning for the changes required as well as the impact of the proposed changes.   |
| Engineering Response              | Formal communications that does not require a change in design baseline. Generally in response to RFI.  |
| Field Change Notice (FCN)         | The outcome of the FCN Process is used during construction and commissioning to mark up the design documentation, typically by means of red marks on to documentation, to reflect the proposed changes that are required.   |
| Integration Meeting               | A standing panel consisting of LDEs or delegated person representing all engineering disciplines involved in the Project. The review panel members shall review the proposed engineering change proposal (ECP), analyse the impact assessment results and debate the feasibility of the proposed change. The EDWL is the chairman of this meeting.  |
| Life Cycle Status                 | The status provided to an engineering document indicating the intended use as determined by the DA, e.g. Final, preliminary, as built, issued for construction, issued for detail design.   |

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## **2.4 Abbreviations**

| <b>Abbreviation</b> | <b>Explanation</b>                                |
|---------------------|---|
| C                   | Configuration Management                          |
| CM                  | Contracts Manager                                 |
| CoE                 | Centre of Excellence                              |
| DA                  | Design Authority                                  |
| DCN                 | Design Change Notice                              |
| DMO                 | Documentation Management Officer                  |
| ECM                 | Engineering Change Management                     |
| ECN                 | Engineering Change Notice                         |
| ECP                 | Engineering Change Proposal                       |
| ECSA                | Engineering Council of South Africa               |
| EDMS                | Electronic Document Management System             |
| EDWL                | Engineering Design Work Lead                      |
| ER                  | Engineering Response                              |
| ESKOM               | ESKOM Holding SOC                                 |
| FCN                 | Field Change Notice                               |
| FIDIC               | Fédération Internationale Des Ingénieurs-Conseils |
| LDE                 | Lead Discipline Engineer.                         |
| LOSS                | Limit of Supply and Services                      |
| MOM                 | Minutes of Meeting                                |
| NCR                 | None Conformance Report                           |
| PCR                 | Project Change Request                            |
| RFD                 | Request for Design                                |
| RFI                 | Request for Information                           |
| SoW                 | Scope of Work                                     |
| SPO                 | Smart Plant Owner Operator                        |
| URS                 | User Requirement Specification                    |

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## **2.5 Roles and Responsibilities**

| <b>Term</b>                         | <b>Definition</b>   |
|-------------------------------------|---|
| Contract Manager                    | Contract Manager(CM) shall be responsible for <ul style="list-style-type: none"><li>• Ensuring that this procedure is adhered to</li><li>• Executing their responsibilities and powers as delegated on the FIDIC contractual relationship.</li></ul>  |
| Contractor                          | The contractor executing the design during the construction phase.  |
| DA's representative                 | The DA representative shall be responsible for <ul style="list-style-type: none"><li>• Acting on behalf of the DA</li><li>• Considering proposals and changes on behalf of the DA</li><li>• Formalising approved change by means of an Engineering Response, Field Change Notice or Engineering Notice.</li></ul>   |
| Design Authority (DA)               | <p>The DA shall be responsible for</p> <ul style="list-style-type: none"><li>• Developing the design requirements as provided by the client and ensuring that the design output documents accurately reflect the design basis.</li><li>• Design control and ultimate technical adequacy of the design process.</li></ul> <p>Important to note that the professional accountability can either rest with:</p> <ol style="list-style-type: none"><li>1. Eskom, when acting as designer (Eskom the DA) or;</li><li>2. The external design office who works according to their own internal design processes.</li></ol> <p>In both these instances, the DA remains responsible and accountable for the correctness of the design documents, irrespective of whether these documents have been reviewed by Eskom or not. (</p> |
| Documentation Management Officer    | Person responsible for processing of change related documentation and load signed copies on SPO.  |
| Engineering Design Work Lead (EDWL) | <p>An ECSA professionally registered person who has been appointed and delegated responsibility to manage design related activities on the Project and to coordinate the design work performed by Lead Discipline Engineers.</p> <p>The Engineering Design Work Lead (EDWL) shall be responsible for coordination and authorization of engineering changes.</p> <p>This role of review coordinator and change authoriser may be delegated by the EDWL.</p>  |
| Integration Engineer                | <p>Compiler of the ECM Work Instruction and ensure that document is reviewed by relevant stakeholders once every six months.</p> <p>He/she ensures that:</p> <ul style="list-style-type: none"><li>• the correct process is followed to execute design changes</li><li>• the relevant engineering disciplines are involved and have been consulted during ECM process.</li></ul>  |

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|                                   |   |
|-----------------------------------|---|
| Impact Assessment Team            | The Impact Assessment Team is the team of Engineers that support the Impact Assessment Team Leader as subject matter experts in their respective fields/disciplines. The impact assessment team shall consist of all affected stakeholders and CoE representatives. Each member of the impact assessment team shall provide input (technical, financial, safety etc).   |
| Impact Assessment Team Leader     | An appropriate and qualified System/Project Engineer, who has the training, technical qualification and expert knowledge of the plant or systems affected by the engineering change. The impact assessment team leader shall be selected by the LDE and his/her function is to: <ul style="list-style-type: none"><li>• defines the impact assessment team</li><li>• leads the impact assessment</li><li>• present the engineering change report</li></ul>          |
| Lead Discipline Engineer          | The LDE shall ensure that the engineering change request is relevant, reviewed and fit for purpose to be implemented on the relevant plant area(s). The LDE appoints the impacts assessment team leader and verify that the engineering change impact assessment team is duly constituted of all affected stakeholders and CoE representatives.   |
| Project Engineering Manager (PEM) | Ensures compliance to this work instruction in the project environment. The project engineering manager (or delegated person) accepts the engineering change for implementation in the project based on comments and recommendation from the EDWL or design review panel in case of an ECP.   |
| Query Originator                  | The Query Originator has the responsibility to ensure that the engineering change and relevant documentation is based on accurate and correct information and that the proposed change will, or has the potential, to improve / sustain plant performance, safety, investment protection, operability and / or supports the plant life cycle.   |
| System Engineer                   | A competent and qualified site/plant-based discipline or System 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"><li>• To prepare the engineering change</li><li>• Preparation of an engineering change report (e.g. root cause analysis, investigation report, assessment report) and stakeholder request</li></ul> |

## **2.6 Related/Supporting Documents**

[21] 200-41878 (348-882193) – RFI Template

[22] 200-24284 (348-882694) – ER Template

[23] 200-13769 (348-884931) – Design Change Notice Template (incl. ECN, FCN, RFD)

[24] 200-74717 (348-882320) –Impact Assessment Template

[25] 240-70976432 - ECP Report Template

[26] 240-113413710 – ECP Impact Assessment Template

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### 3. Medupi Project Engineering Change Management Process

#### 3.1 Medupi Project ECM Process Overview

The phases within the engineering change management lifecycle shall be divided as indicated in Figure 1. These phases are:

- Query Identification and Issuing Phase (3.2.1)
- Resolution and Close-out Phase (3.2.2)

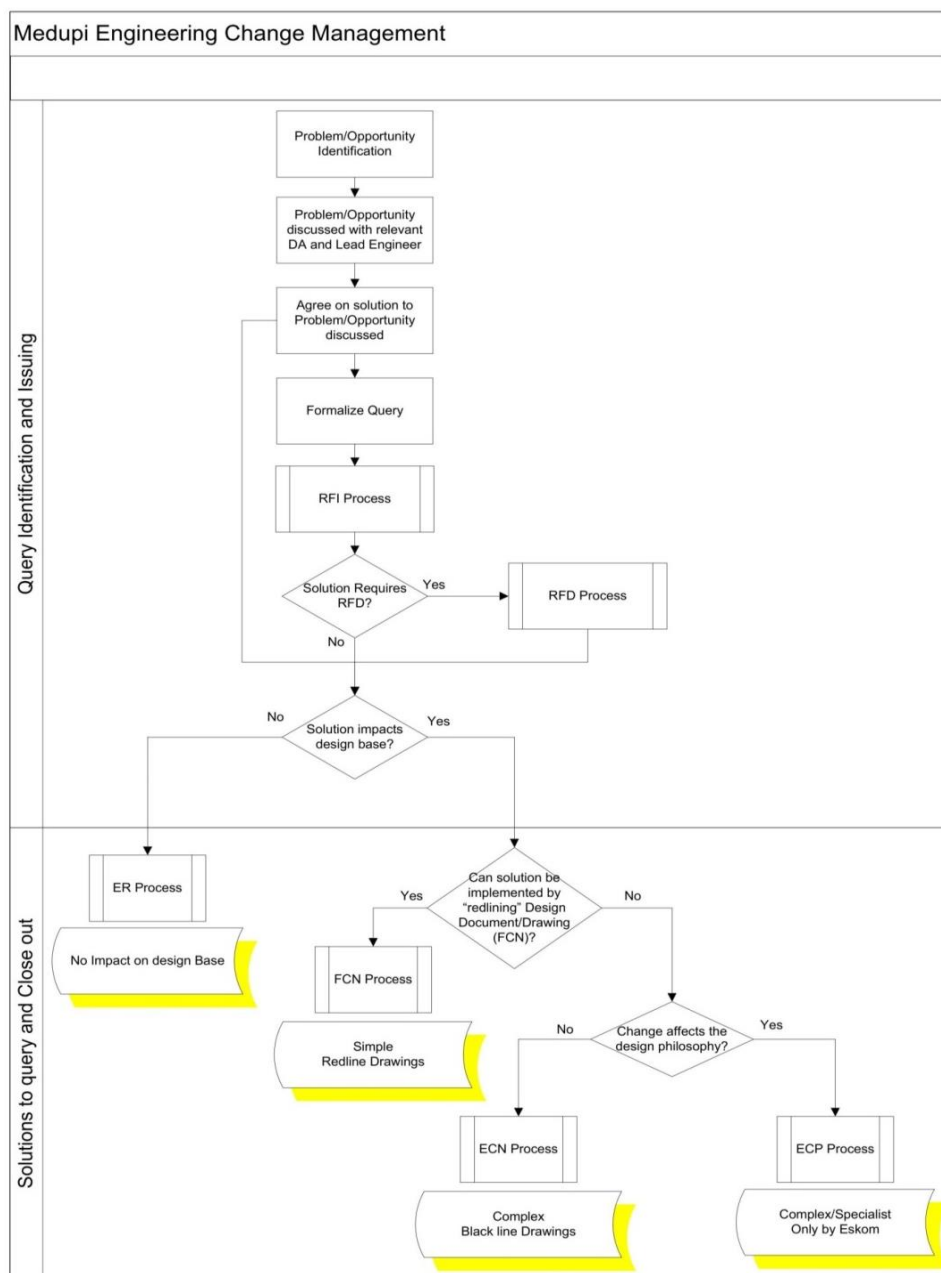


Figure 1: Engineering Change Management Process Flow Diagram

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## **3.2 Project ECM Process Description**

### **3.2.1 Query Identification**

All technical queries, whether identified through experiencing a problem or identifying an opportunity, might have consequences on an established baseline. All technical queries must be discussed with the Originator, Lead Discipline Engineer or System Engineer together with the DA Representative (where applicable) and a resolution on the way forward should be discussed before the query is formalised. The purpose of this discussion is to ensure the following;

- To determine if there is a problem
- The problem or opportunity is correctly identified
- Possible solutions are discussed
- How the change will affect other packages/systems
- Decide whether this should be taken further for resolution or not.

The resolution shall be an agreed problem statement with the way forward on how to problem will be addressed. The way forward shall also include the selection of the right avenue for addressing that particular query.

If the problem was not resolved and clarified during the discussion, the Originator shall formally submit a Request for Information (RFI). All RFI's shall be formally submitted to Eskom following the RFI Process outlined in section 3.2.1.1 below.

#### **3.2.1.1 RFI Process**

The RFI process provides a formal way in which technical queries shall be raised to the contractors or employer via the relevant Contract Managers (CM) for resolution. All technical queries should be discussed with the relevant stakeholders and properly identified by using the RFI Template [21] before issued to the CM. The RFI process is outlined in Figure 2.

Incoming RFI's shall be submitted to the Document Control Centre and distributed to the relevant CM for evaluation. Upon receipt of the RFI, the CM shall evaluate whether it require engineering input or not. All RFI's that requires engineering input, classified as technical queries, shall be distributed to the relevant Lead Discipline Engineer for resolution. The CM shall respond and close out all queries that do not require any engineering input.

All RFI's that have been sent for engineering input shall be assessed by the relevant Lead Discipline Engineer/System Engineer. The Lead Discipline Engineer shall ensure that the Impact Assessment Team Leader is appointed. An Impact Assessment Team shall be established by the Impact Assessment Team leader and comprises (where applicable) all Engineers, Construction Supervisors of the affected area, Contractor Site Representative(s) and DA Representative(s) affected by the RFI.

The Impact Assessment Team shall discuss the RFI and agree on a resolution. All responses that are classified as technical responses shall be executed using either the Engineering Response (ER) or any of the Medupi Engineering Change Management Processes (FCN, ECN or ECP).

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All responses that do not affect the design base shall be executed using the ER Process.

All responses that affect the design base shall be executed using any of the Medupi ECM processes. RFI's that requests additional design work shall first be facilitated through the Request for Design (RFD) process.

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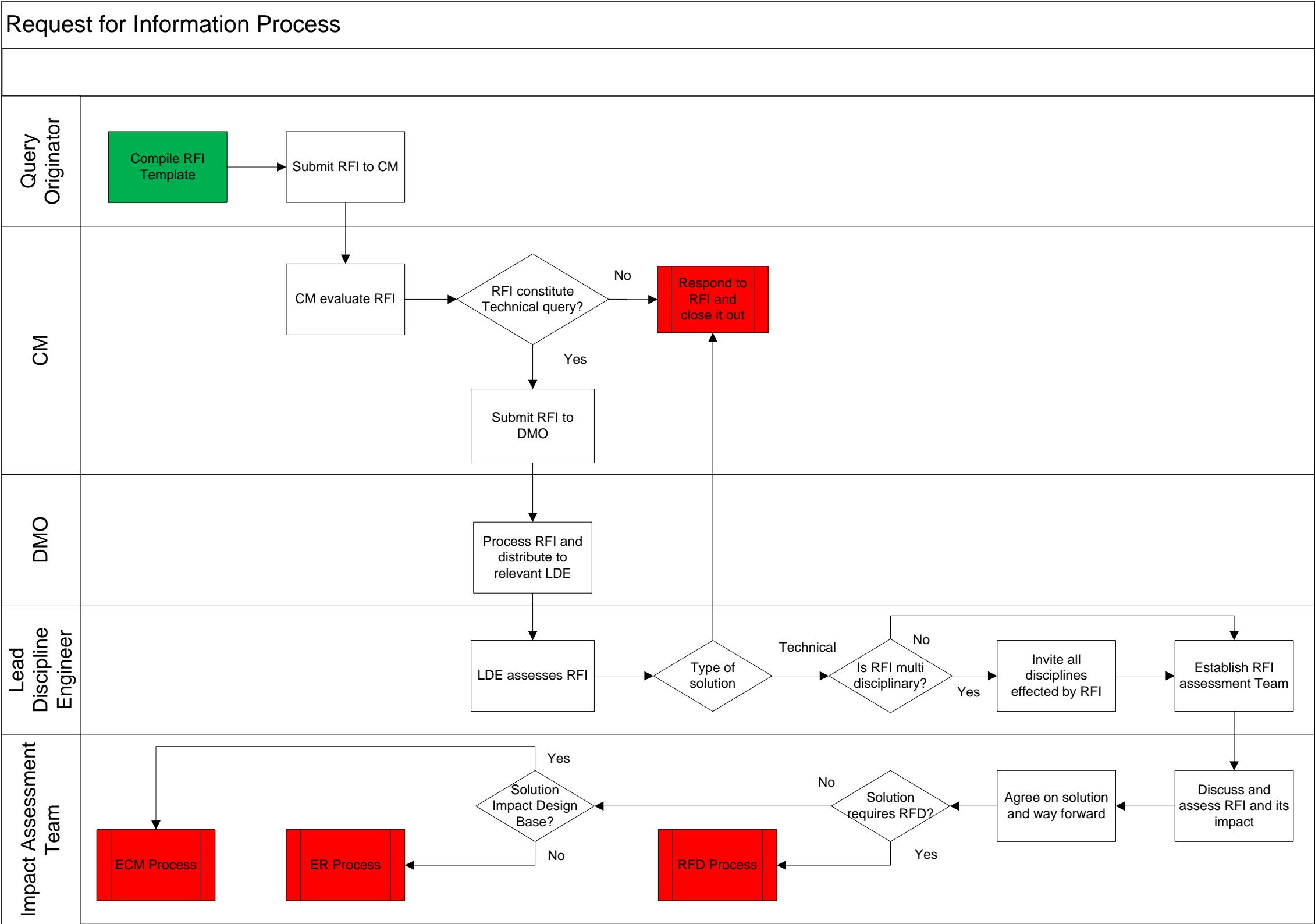


Figure 2: Request for Information Process  
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### 3.2.2 Resolution and close-out phase

As shown in Figure 1, all responses that affect the design base shall be executed using the response types listed below, and these are further discussed in the sections that follow.

- Field Change Notice (FCN)
- Engineering Change Notice (ECN)
- Engineering Change Proposal (ECP)

In the event where an engineering change does not entails changing or updating of the design baseline, an Engineering Response (ER) shall be used to communicate the technical response.

The DA is responsible to produce designs of a high standard without design deficiencies. If the DA becomes aware of any deficiencies (including lack of information), the DA shall corrects these errors using the applicable Engineering Change Management processes. A guideline to be used when selecting the correct Engineering Change Management process is listed in Table 1 below.

**Table 1: Engineering Change Management Selection Criterion**

| Process    | Summary   | Complexity                  | Drawings Type       |
|------------|---|-----------------------------|---------------------|
| <b>ER</b>  | Used to respond to queries that does not affect design baseline   | -                           | -                   |
| <b>FCN</b> | Used to mark up changes to design documentation. Typically used during construction and commissioning to “redline” design documentation in order to reflect changes.                  | Simple                      | Redline Drawings    |
| <b>ECN</b> | Used for the revision of frozen design documentation. Typically used to reflect the “as built” or “as commissioned” state using the FCN’s and marked up documentation from the field. | Complex work                | Black line Drawings |
| <b>ECP</b> | ECP’s are initiated by employer and not DA. Typically used for missing scope, alignment of URS, or alternative design concepts.   | Complex and Specialist work | Black Line Drawings |

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### **3.2.2.1 Request for Design Process**

The RFD process provides a formal way in which design requests are raised to the relevant DA. All RFD's shall be discussed and properly identified on the RFD template [23] before they are issued. The RFD process is outlined in Figure 3 below.

Before an RFD template is populated, the Lead Discipline Engineer shall ensure that an Impact Assessment Team Leader is assigned and a detailed impact assessment is conducted using the impact assessment template [24]. The Impact Assessment Team shall perform an impact assessment on the design correctness, completeness and assign the relevant DA and contractor.

The completed RFD documentation shall be submitted to the EDWL for authorisation. The EDWL shall review the RFD to ensure that the RFD complies with the Medupi Project ECM Process, that the correct parties reviewed the request and that the impacts assessed is acceptable before authorisation. If an RFD have been rejected the response shall be communicated to the relevant Lead Discipline Engineer for correction and resubmission. Note that only the Project Engineering Manager, EDWL or delegated person can authorise a RFD.

After the RFD is approved by the EDWL, the Configuration Documentation Controller captures the RFD on the change register. The LDE/System Engineer submits the RFD to the CM for final approval which then compiles a transmittal note. The CM submits the signed RFD and transmittal note to the DMO which load the signed RFD and transmittal note in SPO and issues the fully signed RFD with a transmittal note to the DA.

Upon receipt, the DA shall evaluate the RFD and respond accordingly. Should the DA decide not to consider the RFD, an ER shall be used to respond to the RFD.

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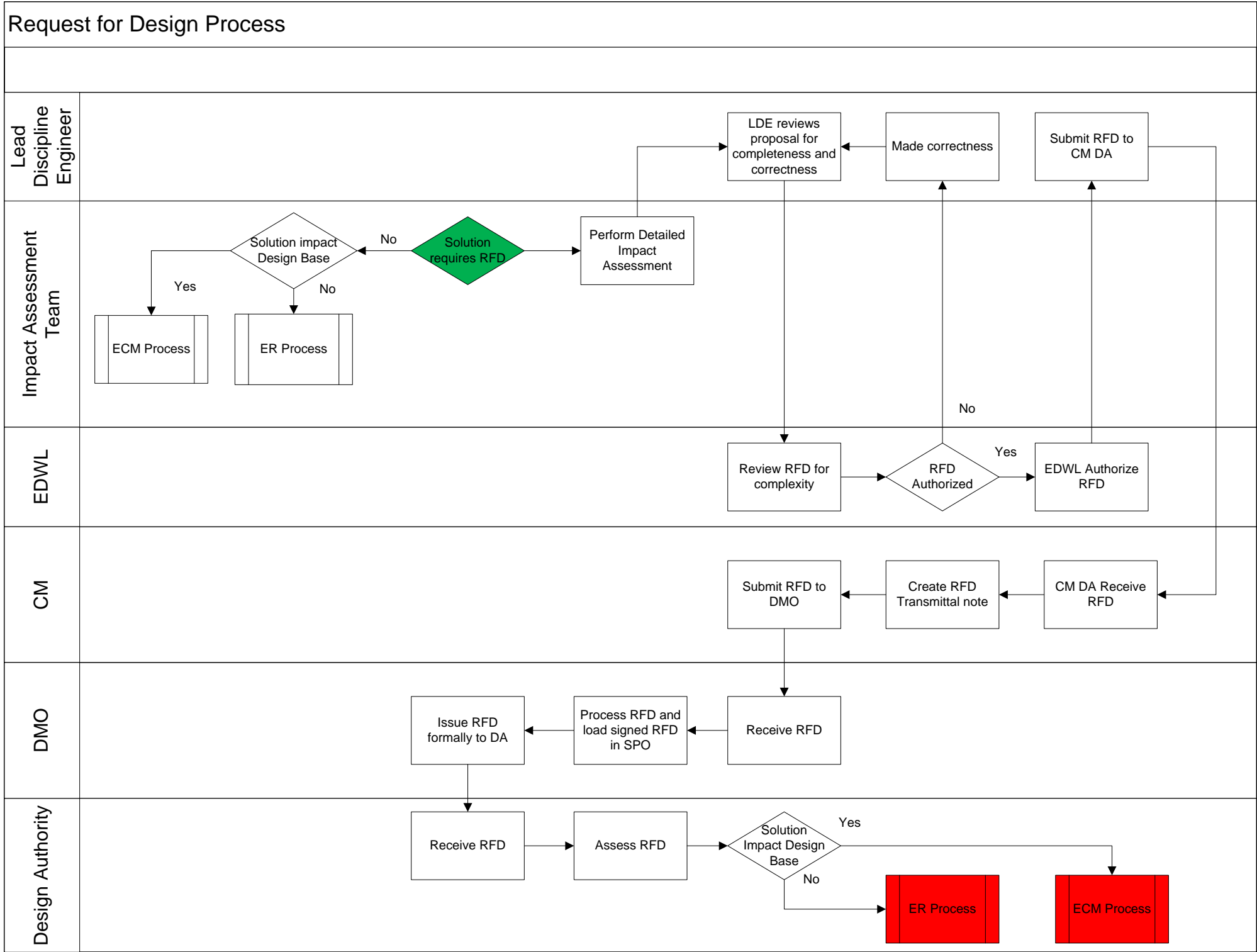


Figure 3: Request for Design Process

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### **3.2.2.2 Engineering Response (ER) Process**

In the event where the response to an RFI or RFD does not entails changing or updating of the design baseline, an ER shall be used to communicate technical responses that were discussed and agree by the Impact Assessment Team or DA. Figure 4 outlines a process on how ER shall be executed. An ER shall be issued by the DA or LDE by using the ER template [22].

All ER's shall be issued through the relevant CM and DMO and shall be registered, loaded on SPO and distributed to the affected parties as per the distribution list. The Lead Discipline Engineer shall review the ER before final authorisation. These reviews shall ensure that the correct parties reviewed the response and authorises the response by confirming that it does not impact on the overall integration of the plant.

All approved ER's shall be formally communicated to both the DA and the Constructor through their respective CM's. However, if an ER has been rejected the response shall only be communicated to the DA for correction and resubmission. For all approved ERs, the Query Originator shall, upon receipt of the ER, execute the response immediately.

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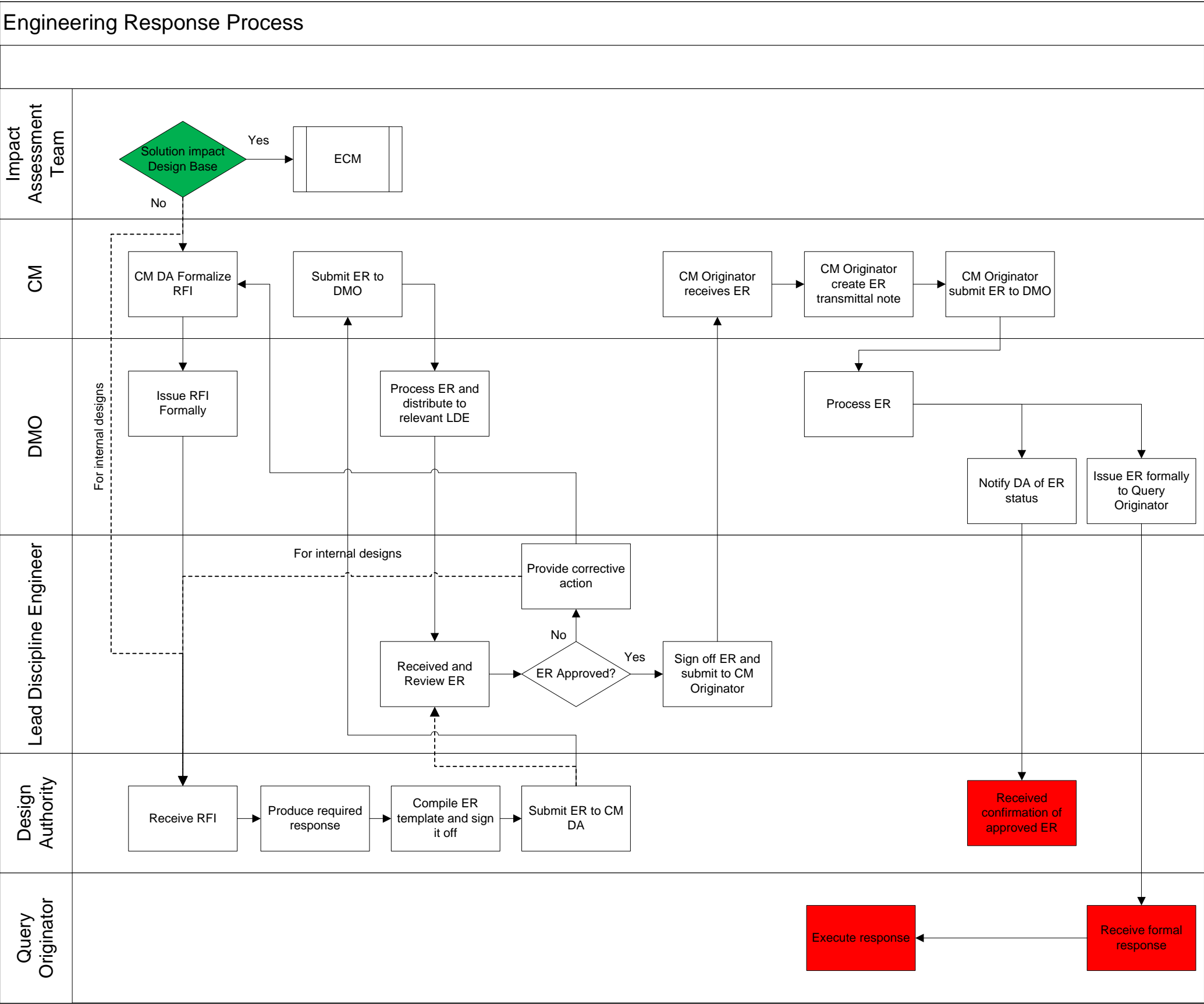


Figure 4: Engineering Response Process

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### **3.2.2.3 FCN Process**

In the event where the Assessment Team has discussed and agreed that the resolution to an RFI or issue shall be addressed by using an FCN, the DA shall identify and mark up the affected design documents using the latest authorised documentation.

The FCN shall be completed by using the DCN template [23] and shall be formally submitted to the CM and DMO. The DMO shall process the FCN on SPO and distribute it to the relevant CM and Lead Discipline Engineering for review and final approval. The Lead Discipline Engineer/System Engineer shall review the marked up documentation, FCN descriptions and classification.

The Impact Assessment Team Leader shall lead and complete the impact assessment before submitting the FCN to the EDWL for final review and approval. The EDWL reviews the FCN to ensure that the correct parties reviewed the response, that the impacts assessed are acceptable and verify if it does not impact the overall integration of the plant. After the FCN is approved by the EDWL, the Configuration Documentation Controller captures the FCN on the change register. Note that only the Project Engineering Manager, EDWL or delegated person can authorise the FCN.

The LDE or System Engineer submits the FCN to the CM for final approval which then compiles a transmittal note. The CM submits the signed FCN and transmittal note to the DMO which load the signed FCN and transmittal note in SPO and issues the fully signed FCN with a transmittal note to the DA.

The DA shall incorporate the redlined changes and issue a DCN with the update the design documentation. The DA shall correct and resubmit FCN's that have been rejected.

#### **3.2.2.3.1 Emergency FCN's or FCN's during Commissioning**

Changes that are captured on redlined drawings that has been agreed to by the DA or the DA's site representative, either by signature on the drawing or the accompanying (Eskom generated) FCN, can be tabled directly to the EDWL for approval. Where approval is urgently required (e.g. for safety clearance, after hours or over weekends), approval can be obtained from a delegated approver.

Such FCNs will be loaded on SPO and linked to the current revision of affected drawings. The FCN will be transmitted to the DA to produce black line updates of affected drawings. It remains the responsibility of the Lead Discipline Engineer to ensure that the design change has been reviewed and accepted by impacted disciplines, such approval recorded on accompanying impact assessment.

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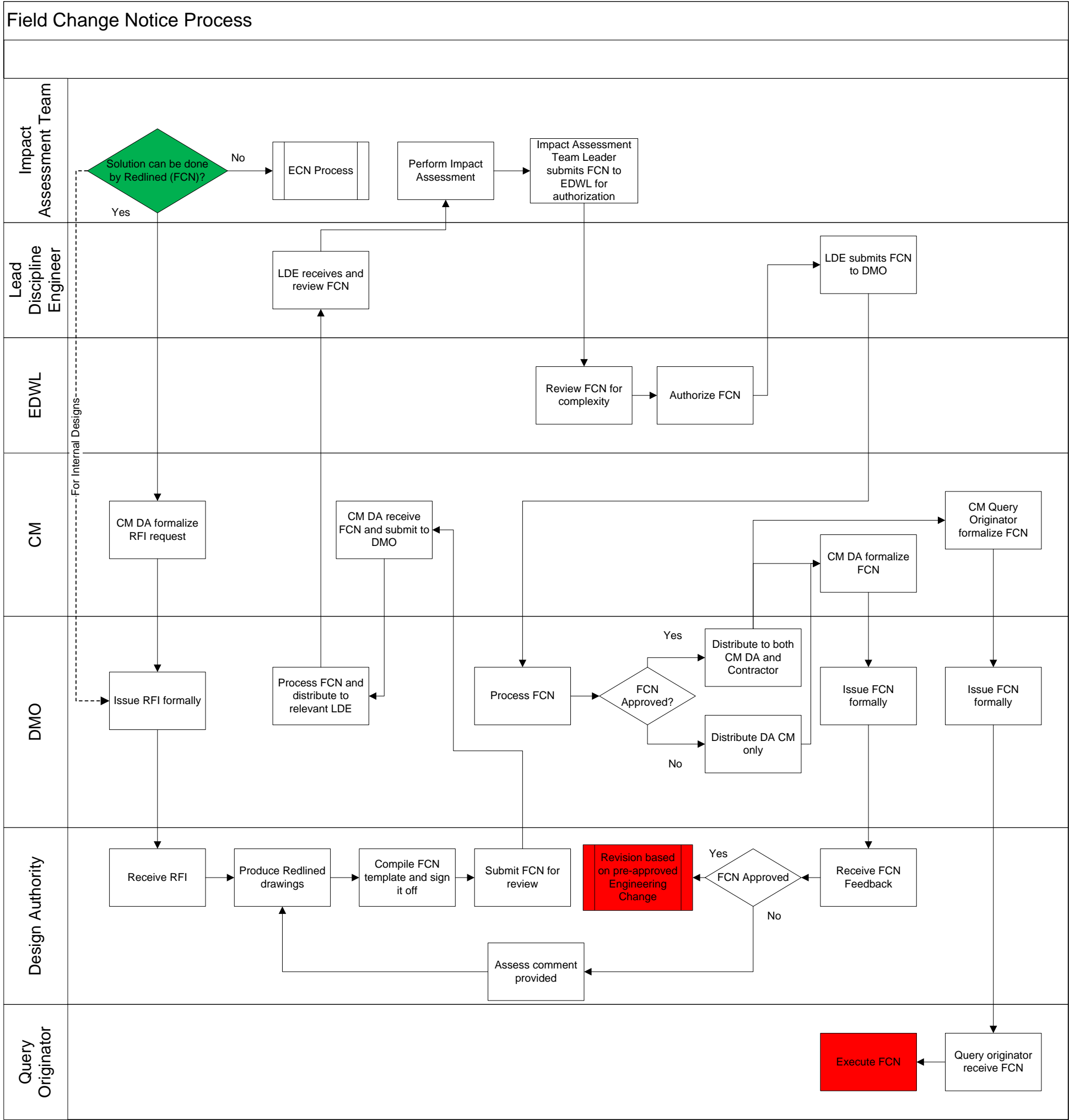


Figure 5: Field Change Notice Process

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#### **3.2.2.4 ECN Process**

ECN's are used when the issue cannot be resolved by an FCN or when a revision to an accepted document is updated and submitted to Eskom. Table 1 outlines the guidelines on when to use an ECN. ECN's shall be completed using the DCN template [23], correctly identifying and revising all the design documents and clearly indicating the changes in the revision blocks. ECN's should clearly state the problem, solution as well as the expected impacts on the design, construction and commissioning.

All completed ECN's shall be formally submitted to the CM and DMO for processing. ECN's shall be processed in SPO and distributed to the relevant CM and Lead Discipline Engineering for review and approval. The relevant Lead Discipline Engineer/System Engineer shall review the updated design documents as well as the ECN descriptions and classification, and involve affected parties.

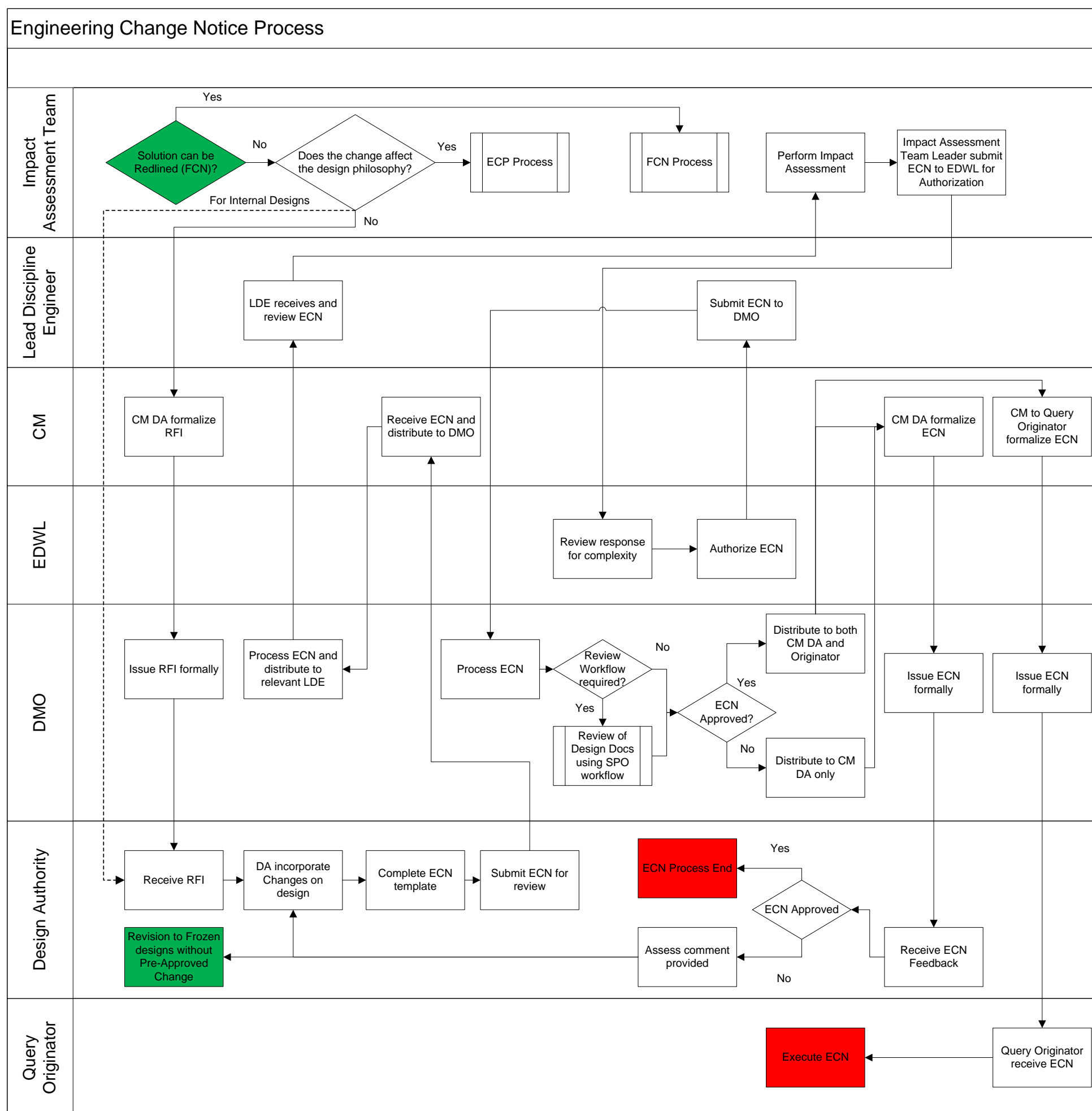
The Impact Assessment Team Leader shall lead and complete the impact assessment before submitting the ECN to the EDWL for final review and approval. The EDWL shall review the ECN to ensure that the correct parties reviewed the response and that the impact assessed is acceptable before authorising the ECN. After the ECN is approved by the EDWL, the Configuration Documentation Controller captures the ECN on the change register. Note that only the Project Engineering Manager, EDWL or delegated person can authorise the ECN.

The LDE/System Engineer submits the ECN to the CM for final approval which then compiles a transmittal note. The CM submits the signed ECN and transmittal note to the DMO which load the signed ECN and transmittal note in SPO and issues the fully signed ECN with a transmittal note to the DA. The DA shall correct and resubmit FCN's that have been rejected.

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**Figure 6: Engineering Change Notice Process**

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**3.2.2.5 ECP Process****3.2.2.5.1 ECP Criteria**

An Engineering Change Proposal (ECP) is initiated when a change affects the design philosophy and is classified as per table below. An ECP Report is compiled by the System Engineer using ECP Report - [25] and ECP Impact Assessment Template [26]. The report should be circulated for review at least 5 days prior the presentation at the Integration Meeting.

**Table 2: ECP Criteria**

| <b>Level</b> | <b>Criteria</b>   | <b>Approval Body</b>  |
|--------------|---|---|
| L1           | Proposed change affects any of: <ul style="list-style-type: none"><li>• Compliance to SRD</li><li>• Health and safety</li><li>• Time or cost greater than 5% on overall project</li><li>• Regulatory compliance;</li></ul> or avoidance of major equipment damage;<br>or prevention of production loss. | <b>Acceptance :</b><br>All affected LDEs<br>Client representative<br><br><b>Approval:</b><br>EDWL<br><br><b>Authorisation:</b><br>Project Engineering Manager |
| L2           | Proposed change affects multiple systems or disciplines (COE) or impact on: <ul style="list-style-type: none"><li>• Plant reliability</li><li>• Availability</li><li>• Environmental</li><li>• Operations</li></ul>   | <b>Acceptance :</b><br>All affected LDEs<br><br><b>Approval:</b><br>EDWL<br><br><b>Authorisation:</b><br>Project Engineering Manager                          |
| L3           | Proposed change affects one plant system or discipline (COE) and has no impact on: <ul style="list-style-type: none"><li>• Safety</li><li>• Operations</li><li>• Environment</li></ul>  | <b>Acceptance :</b><br>Affected LDE<br><br><b>Approval:</b><br>EDWL<br><br><b>Authorisation:</b><br>Project Engineering Manager                               |

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### **3.2.2.5.2 Engineering Change Design Review Panel**

Only ECP's are presented at the Integration Meeting and should be submitted to the Configuration Management Document Controller 5 days before the meeting.

The engineering change design review panel members shall:

- Perform an assurance check on the engineering change process followed
- Review the completeness / make-up of the impact assessment team
- Review the engineering change (ECP) report
- Review if due process has been followed in covering all interfaces, changes have been adequately motivated and engineering standards and statutory requirements have been complied with.
- Jointly agree, led by the EDWL or delegated individual, on an engineering change status classification. Should the panel disagree, the project engineering manager shall, depending on the risk, make the final decision.

The engineering change design review panel chair person shall ensure that:

- Record is kept of decisions and comments from the review panel.
- Record of attendance register is kept.
- Sign the engineering change report with the relevant status classification.

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### **3.3 Project ECM Principles**

#### **3.3.1 Engineering Change Impact Assessment**

The impact assessment team led by impact assessment team leader (LDE or any delegated engineer) shall perform impact assessment by using the impact assessment template [24]. The shall perform the following;

- Review the engineering change and determine the relevant criteria needed to be taken into consideration in evaluating the acceptability of the proposed change.
- Identify and review all documentation affected by the proposed engineering change.
- Identify all affected plant KKS or any plant codification
- Identify all affected package baselines
- Analyse the engineering change for impact on:
  - Technical
  - Financial
  - Safety
  - Environmental
  - Operating
  - Timing
  - Information management
- Perform trade-off analysis on the affected systems and propose alternative solutions, if appropriate.
- If applicable, develop / update the suggested scope of work (SoW), LOSS diagrams and terminal points for engineering change implementation.
- Keep minutes of meeting as a record of issues considered and decisions made.
- Once an impact assessment is conducted, the impact assessment team leader shall compile an engineering change report (FCN, ECN, RFD, ECP).

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### 3.3.2 Design Change Classifications

Before the DCN is submitting for review, the DA shall classify it in terms of the following:

- **Drawing Error or Omission** – Updating of drawings only
- **Design Document Error or Omission** – The DA erred during the design process and requires a correction to the approved design document in order to make it functional and/or safe.
- **As Build** – Submission of As Build documentation
- **Functionality/Logics** - Design Change required up update logics only
- **Value Engineering** – Although the current design is fully functional and safe, by performing a change to the design as proposed, certain saving in time and/or costs may be achieved that will exceed the additional design costs and time incurred.
- **Design Error** – Change as a result of design error
- **Design Improvement** – Although the current design is fully functional and safe, in the professional opinion of the DA Representative a change is required in order to cater for specific conditions not envisaged as part of the original design.
- **Temporary System or Work Around** – A temporary physical plant, equipment or component, etc. or electronic attributes (setting, logic, etc.) that is fulfilling the function of the part, or whole of the design during the commissioning stages of the project, but is not intended to be handed over as part of the final design, thus the workaround will be decommissioned and removed before handover.
- **Safety** – Design Change required to ensure that plant is safety compliant
- **Legislative** - Design Change required to ensure that comply with legislation
- **Construction Integration (Clash)** – During the construction of the design it is found that certain changes must be made in order make the overall (cross package) design functional and/or safe.
- **KKS Coding** - Design Change required to update KKS coding
- **NCR Incorporation** – A concession is evaluated and incorporated into the overall design, changing the design base, and making the construction compliant. If the construction concession acceptance is for a specific component only, without changing the design base, the drawings are not updated and the concession is reflected on the quality records only.
- **Scope Omission** - Design Change required addressing scope omission.

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### **3.3.3 Engineering Change Status Classification**

**Table 3: Engineering Change Status Classification**

| <b>Status</b>          | <b>Description</b>   |
|------------------------|--|
| Accepted               | Engineering change is authorised. Engineering Change shall be implemented.   |
| Accepted with comments | Engineering change authorised but subject to the inclusion of EDWL or panel comments. No engineering change re-presentation to panel required in the case of an ECP. |
| Cancelled              | Engineering change cancelled prior to review at Integration Meeting.   |
| Rejected               | Engineering change rejected by EDWL or change review panel. Engineering change shall not be implemented.   |
| Rework                 | Engineering change requires rework. After completion of rework, engineering change to be re-presented to EDWL or change review panel.                                |

### **3.3.4 Configuration Management Reporting**

Configuration management activities shall be performed throughout the lifecycle of a project to record and report the status of all proposed engineering changes. An engineering change register shall be maintained throughout the lifecycle of the project. The register shall, as a minimum, include the following:

1. Date
2. Unique identifier (SPO and alt doc number)
3. Change type (RFD, FCN, ECN)
4. Change description
5. Package
6. Change category
7. Cost impact
8. Status
9. Responsible person

### **3.3.5 Document and records management**

All relevant engineering change documentation, signed reports and panel minutes of meetings shall be managed and recorded on SPO.

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### 3.3.6 Revision based on Pre-Approved Engineering Change

If the DA was requested to update design documentation based on an approved FCN, ECN, or ECP, the DA shall clearly indicate the reference number of the previously approved change for that specific revision on the transmittal note. These documents shall be reviewed using the standard SPO workflow review process.

If the DA deviates from the pre-approved change the ECN process must be followed.

### 3.3.7 Cost Impact

On receipt of the relevant request (RFD) or DCN (FCN, ECN, ECP), the CM shall determine if a PCR is to be initiated. If this process is to be initiated, the CM shall complete the required form and compile the necessary documentation for approval in line with the Manage and Control Project Variations (VO) [15] – and Contract Modification Work Instruction (where applicable) [16].

### 3.3.8 Dispute Resolution

When a dispute arise within the engineering change management process, the right authorities will have to settle and resolve the dispute in a manner that properly controlled, transparent and fair. The table below prescribes the correct dispute resolution bodies that shall settle and resolve any dispute that may arise within the project depending which stakeholders are involved in the dispute.

**Table 4: Dispute Resolution**

| Affected Stakeholders |     |        |      |     |                        |                  | Dispute resolution stakeholders |
|-----------------------|-----|--------|------|-----|------------------------|------------------|---------------------------------|
| Client                | CoE | LDE    | EDWL | PEM | EC Design Review Panel | Contract Manager |                                 |
|                       | x   | x      |      |     |                        |                  | CoE Senior Manager              |
|                       | x   |        | x    |     |                        |                  | CoE Senior Manager              |
|                       |     | x (x2) |      |     |                        |                  | EDWL and PEM                    |
| x                     |     |        |      | x   |                        |                  | GM Engineering                  |
|                       |     | x      |      |     | x                      |                  | PEM                             |
|                       |     |        | x    |     | x                      |                  | PEM                             |
|                       |     |        |      |     | x                      | x                | PEM and EDWL                    |

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#### 4. RACI Matrix

Table 5: RACI Matrix

| Process Step                         | CM  | Design Authority | Project Engineering Manager | Technical Lead | Engineering Design Work Lead | Impact assessment Team Leader | Impact Assessment Team | Lead Discipline Engineer | System Engineer | Query Originator | Document Management Officer |
|--------------------------------------|-----|------------------|-----------------------------|----------------|------------------------------|-------------------------------|------------------------|--------------------------|-----------------|------------------|-----------------------------|
| 1. Query Identification              | I   | C                |                             |                | C                            | C                             | C                      | A                        | R               | R                | I                           |
| 2. Upload into EDMS and distribution | R   |                  |                             |                |                              | I                             | I                      | C                        | C               | C                | A                           |
| 3. RFI Process                       | I   | C                |                             |                | C                            | I                             | I                      | A/C                      | R               | R                | I                           |
| 4. Request for Design                | I/C | C                | C                           | C              | C                            | C                             | C                      | A                        | R               | R                | I                           |
| 5. Engineering Change Notice         | I/C | C                | C                           | C              | C                            | C                             | C                      | A                        | R               | R                | I                           |
| 6. Field Change Notice               | I/C | C                |                             |                | C                            | C                             | C                      | A                        | R               | R                | I                           |
| 7. Engineering Response              | I   | C                |                             |                |                              | C                             | C                      | A                        | R               | R                | I                           |
| 8. Approval of RFD, ECN, FCN         | I   | I                |                             |                | A/R                          |                               |                        | I                        | I               | I                | I                           |
| 9. Loading of signed DCN's in SPO    | I   |                  |                             |                | I                            |                               |                        | A                        | C               | C                | R                           |

##### a) Responsible

Those who do the work to achieve the task. There is at least one role with a participation type of responsible, although others can be delegated to assist in the work required.

##### b) Accountable (also approver or final approving authority)

The one ultimately answerable for the correct and thorough completion of the deliverable or task, and the one who delegates the work to those responsible. In other words, an accountable must sign off (approve) work that responsible provides.

##### c) Consulted

Those whose opinions are sought, typically subject matter experts; and with whom there is two-way.

##### d) Informed

Those who are kept up-to-date on progress, often only on completion of the task or deliverable; and with whom there is just one-way.

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## **5. Process for Monitoring**

### **5.1 Key Performance Areas and Indicators**

The following Key Performance Areas/Indicators (KPA's/KPIs) shall be measured, analysed and reported. The Process Owner shall be accountable, and assign the responsibility at the frequency as indicated below, documented as part of the QMS measurement, analysis and improvement initiative.

| <b>KPA</b>                      | <b>KPI</b>                          | <b>Target</b> | <b>Measure Frequency</b> | <b>Responsible</b>             | <b>Record</b>   |
|---------------------------------|-------------------------------------|---------------|--------------------------|--------------------------------|-----------------|
| Document and Records Management | Signed Changes loaded in SPO.       | 100%          | Weekly                   | Documentation Management Dept. | Change Register |
| Document and Records Management | Signed ECP's and MOM loaded in SPO. | 100%          | Monthly                  | Configuration Management       | ECP Register    |

### **5.2 Document Review and Self-Assessment**

The "Process Owner" of this document along with departmental personnel and the project QMS Engineer shall undertake a "self-check" review of the process defined in this document at six monthly intervals, commencing from the effective date of this document, to check:

- a) The process / work instruction operational integrity
- b) Process efficiency
- c) The level of stakeholder knowledge and implementation.

Participants and results of the "self-check" review shall be documented by the Process Owner in the "Self-Assessment Checklist" (**QMS Template No. QMS PTZ 200 - 75592**) included as Appendix A to this document which shall be issued to medupiq@eskom.co.za by the Process Owner once completed.

Process Owner shall proceed with any revision requirements in line with Medupi work instruction PWI 200-5665 "Development and Change of Medupi QMS Documents" and PPZ 200-1680 "Document and Record Management".

### **5.3 Revision Period**

This work instruction shall undergo a 3 yearly compulsory revision period from effective date.

### **5.4 Training Requirements**

The contents of this work instruction will be presented to Project Engineering, Documentation Management - and Contracts Management Department as and when required.

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## **6. Acceptance**

This document has been seen and accepted by:

| <b>Name</b>         | <b>Designation</b>  |
|---------------------|---|
| Andre Venter        | FIDIC Engineer  |
| Chuma Mketo         | Manager: Configuration Management                                   |
| Everard De Kock     | Lead Discipline Engineer: Unit Integration                          |
| Hendrik Smith       | Lead Discipline Engineer: Low Pressure Services                     |
| Isaac Gama          | Lead Discipline Engineer: IT & Comms                                |
| Jacky Mathobela     | Project Engineering Manager   |
| Joseas Seabela      | Manager : Documentation Management                                  |
| Kelvin Morei        | Lead Arrangement Design   |
| Kgaugelo Shebe      | Lead Discipline Engineer: C&I Engineering                           |
| Lebo Ngakatau       | Lead Discipline Engineer: Turbine Engineering                       |
| Ludwig Louw         | Lead Discipline Engineer: System Design                             |
| Mandla Nkosi        | Lead Discipline Engineer: Unit Integration                          |
| Mpho Ramunenyiwa    | Lead Discipline Engineer: Electrical Engineering                    |
| Msondezi Polisi     | Lead Discipline Engineer: Chemical Engineering                      |
| Philip Steyn        | Engineering Design Work Lead  |
| Rofhiwa Nemutandani | Technical Lead<br>Lead Discipline Engineer: Bulk Materials Handling |
| Sarita Henning      | Technical Lead  |
| Tebza Chunga        | Lead Discipline Engineer: Boiler Engineering                        |
| Thelma Madzhiga     | Manager: Documentation Management                                   |
| Willie Beetge       | Lead Discipline Engineer: Civil Engineering                         |

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## 7. Revisions

| Date           | Rev. | Compiler  | Remarks   |
|----------------|------|-----------|---|
| January 2020   | 7    | L.L. Louw | <ul style="list-style-type: none"> <li>• Update coverpage</li> <li>• Update document review period</li> <li>• Update introduction, scope, purpose, references, definitions, abbreviations and roles and responsibilities</li> <li>• Update report structure (outline)</li> <li>• Update report with current practice</li> <li>• Update report with ECP template</li> <li>• Include Project ECM Principles</li> <li>• Include KPAs and KPI's</li> <li>• Update document acceptance section</li> <li>• Update document self-assessment section</li> </ul> |
| April 2018     | 6    | L.L. Louw | <ul style="list-style-type: none"> <li>• Update report to new Quality Management template</li> <li>• Update Engineering team in section 5</li> </ul>  |
| May 2015       | 5    | L.L. Louw | <ul style="list-style-type: none"> <li>• Update abbreviations and definitions</li> </ul>  |
| September 2014 | 4    | L.L. Louw | <ul style="list-style-type: none"> <li>• Compile procedure on new template</li> <li>• Update references</li> <li>• Add definitions</li> <li>• Add RACI Matrix</li> <li>• Edit RFD description</li> <li>• Edit ER description</li> <li>• Edit ECP description in Table 1</li> <li>• Emergency FCN / FCN during commissioning</li> <li>• Revise RFI and DCN templates</li> </ul>  |

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## Appendix A – Document Self-Assessment Checklist

| Discipline: Project Engineering |             | Applicable Document No.: PPZ 200-5664 Rev 07  |           |      |                                  | Self- Assessment Date:<br>/ / |  |
|---------------------------------|-------------|---|-----------|------|----------------------------------|-------------------------------|--|
| Item No                         | Ref Section | Self-Assessment Question  | Compliant |      |                                  | Comment                       |  |
|                                 |             |   | Yes       | Part | No                               |                               |  |
| 1                               | 3.1         | Is the overall Medupi Engineering Change Management Process still effective?          |           |      |                                  |                               |  |
| 2                               | 3.2.1.1     | Are the RFI process (fig 2) effective and the RFI template still applicable?          |           |      |                                  |                               |  |
| 3                               | 3.2.2.1     | Are the RFD process (fig 3) effective and the RFD template still applicable/ updated? |           |      |                                  |                               |  |
| 4                               | 3.2.2.2     | Are the ER process (fig 4) effective and the ER template still applicable?            |           |      |                                  |                               |  |
| 5                               | 3.2.2.3     | Are the FCN process (fig 5) effective and the DCN template still applicable?          |           |      |                                  |                               |  |
| 6                               | 3.2.2.4     | Are the ECN process (fig 7) effective and the DCN template still applicable?          |           |      |                                  |                               |  |
| 7                               | 3.2.2.5     | Are the ECP process effective and the ECP template still applicable?                  |           |      |                                  |                               |  |
| Comments                        |             |   |           |      |                                  |                               |  |
| Self-Assessment by:             |             | Name:   | Position: |      | Revision Required?<br>(Yes / No) | Planned Revision Date:        |  |
| Attendees                       |             |   |           |      |                                  |                               |  |

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