
ESS Procedure for Electrical Design

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1. PURPOSE

This procedure is subordinated to the ESS Process for Architectural Design [3].

The procedure guides electrical designers and stakeholders through all steps needed to complete the electrical design and prepare required documentation for procurement, manufacturing and installation. The procedure ensures quality, uniformity and efficiency in the design work by bringing the design through several design phases and reviews before reaching the released state.

It defines the design and review workflow, defines responsibilities for preparing and releasing electrical design documentation using the PLM system at ESS.

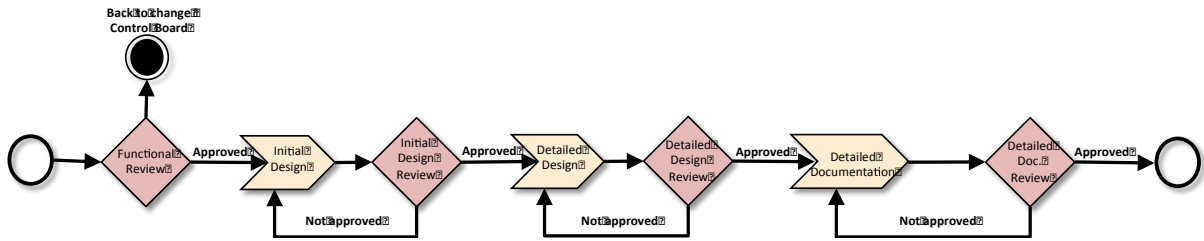
2. PROCEDURE APPLICABILITY

The ESS Procedure for Electrical Design addresses electrical design of the ESS systems, sub-systems assemblies, sub-assemblies and parts. It covers all the electrical design stages for safety critical systems as well as non-safety critical systems, starting after the conceptual design phase and ending when parts and assemblies reaches the released state. A safety critical system could be a system critical from the radiations point of view or a system critical from any other safety aspect such as machinery safety or safety in process applications. It applies to designs that require detailed electrical design specification to be produced. This procedure applies to electrical design and change procedure across the ESS Project. There can also be additional directives that apply for specific projects and systems. Electrical design has a natural link to other disciplines. Design procedures within the ESS are for that reason aligned to allow multi-disciplinary design work to be performed in parallel or in the same ECO workflow.

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3. ESS PROCEDURE FOR ELECTRICAL DESIGN

3.1. Procedure map



Input to the Procedure is a conducted PDR (Preliminary Design Review) of the parent system. Outputs are released BOMs (Bill Of Material), Descriptions and Specifications of a Part/System.

3.2. Procedure details

3.2.1. Input

The procedure is started based on the EDS (Engineering Design Specification). The EDS can be made up of documentation, i.e. space allocations, interface descriptions, requirement specifications, technical descriptions and a conceptual design [1]. Information about the documentation that the project is to produce and references to templates can be found in chapter 0.

The codes, standards and practices used for dimensioning the system, selecting materials, defining manufacturing, assembly, testing and operation procedures shall be identified in the EDS. The set of standards used will vary from project to project. The applicable set of standards is to be defined and clearly stated in the Requirements Specification.

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3.2.2. Functional Review

The functional review is performed by the Design Lead and the Project Engineer.

The following roles should attend in the functional review:

- Interface Stakeholders
- Design Lead
- Project Engineer
- Relevant stakeholders e.g. owner of parent system

The project engineer is responsible to call for the functional review and to assess and ensure that the EDS are complete and uploaded to the ECO.

This step ensures that the basic requirements are specified, that a safety & risk assessment has been carried out and that the specification is within the reach of the design team.

If there are conflicting requirements/prerequisites, or if there is a lack of specification (no boundary or interface specification for instance), the EDS will be revisited to define all required data for the electrical design to proceed.

Design Lead should review the EDS to ensure that all information needed to start initial design is given to him.

At this point, the design path is also discussed. If this is a prototype design project, design path needs to be discussed.

It should also be discussed whether a potential safety classification affects the design workflow and/or the deliverables from it.

For more information regarding input to Functional Review see chapter 4.1.

Responsible:

Design Lead



Output/product

Approved EDS

At least these documents shall be released to ensure traceability:

System Requirement Specification

Concepts of Operation Description

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3.2.3. Initial Design

Design according to the EDS is commenced. Delivery units are being defined, initial design is done and space allocations are confirmed and created as required. Preliminary calculations and analysis are made. Interfaces are verified and the detailed design specification (DDS) is prepared.

Design lead is responsible to prepare the documentation and the DDS in order to take the design into the initial design review.

Project Engineer should assess and define the interfaces to other services and work packages within the ESS.

Project engineer should assess and define functional specifications of the system and ensure that safety & risk assessments are updated.

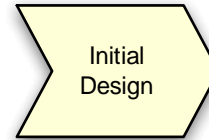
Project engineer makes initial contact with Supply Procurement and Logistics Division, informing about contents of the design. This is to ensure that preparation for procurement and dialogues with suppliers can start at an appropriate time.

Project Engineer is in this phase responsible to call for the initial design review, to assess and ensure that review team is provided the documentation needed to make good assessment in the review and to distribute the documentation subject to the review.

Input to the Initial Design phase is an approved EDS.

Responsible:


Design Lead
 Project Engineer



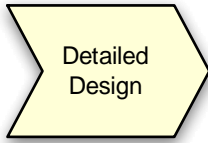
Output/product

Detailed Design Specification which includes:
 Initial CAD drawings & Schematics
 Initial BoM
 Calculations and analysis data

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3.2.4. Initial Design Review	
<p>The Review team perform this review. When required, personnel with particular (special) skills may be included in this review as well as representatives from ES&H and QA-Division.</p> <p>The following roles should attend in the functional review:</p> <ul style="list-style-type: none"> - Interface Stakeholders - Design Lead - Review Team - Project Engineer - EPL Coordinator <p>The purpose of this review is to ensure that the initial design corresponds to the EDS and that the design documentation is being prepared for the review and approval (at the final design review stage).</p> <p>The review should also review and assess that the safety & risk assessments have been updated and that the design fulfils applicable safety requirements.</p> <p>For more information regarding input to Initial Design Review see chapter 4.2.</p>	<p>Responsible: Review Team</p> 
Output/product	Approved Detailed Design Specification (DDS).

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3.2.5. Detailed Design	
<p>Full detailed design is performed. Specifications of products to be purchased are prepared.</p> <p>Design Lead is responsible to prepare and upload the documentation needed to the ECO in order to bring the design into the detailed design review.</p> <p>Project engineer is responsible to ensure that contact with Supply Procurement and Logistics Division is done.</p> <p>Project Engineer is in this phase responsible to call for the detailed design review , to assess and ensure that review team is provided the documentation needed to make good assessment in the review and to distribute the documentation subject to the review.</p> <p>Input to the Detailed Design phase is an approved DDS.</p>	<p>Responsible: Project Engineer Design Lead</p> 
<p>Output/product</p>	<p>Detailed CAD drawings & Schematics Final BoM Relevant calculations and analysis data.</p>

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3.2.6. Detailed Design Review

Review of the detailed design is performed by the Review Team. When required, personnel with particular (special) skills may be included in this review as well as representatives from ES&H, QA-Division and Supply & Procurement Division.

The following roles should be represented in the Detailed Design Review:

- Interface Stakeholders
- Design Lead
- Review Team
- Project Engineer
- EPL Coordinator

The Detailed Design Review ensures that the final detailing does not impede any performance characteristics or any safety performance of the system (or other systems) and that the design corresponds to the DDS. The Detailed Design Review also ensures that documentation created is properly uploaded to the PLM-system.

For more information regarding input to Detailed Design Review see chapter 4.3.

Responsible:

Review Team



Output/product

Approved detailed CAD drawings and relevant calculations and analysis data

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3.2.7. Detailed Documentation

All detailed Documentation such as manuals and descriptions are being produced.

Design Lead is responsible to prepare and to upload the needed documentation to the ECO in order to bring the design into the detailed documentation review.

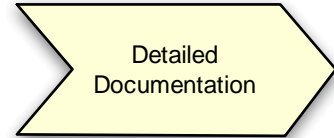
Peer reviews are performed on all parts, descriptions and specifications.

Project Engineer is in this step responsible to call for a Detailed Documentation Review , to assess and ensure that review team is provided the documentation needed to make good assessment in the review and to distribute the documentation subject to the review.

Project Engineer is also responsible to ensure that Peer Reviews are performed before the Detailed Documentation Review is commenced.

Input to the Detailed Documentation phase is approved detailed CAD drawings and relevant calculations and analysis data.


Responsible:
 Design Lead
 Project Engineer



Output/product

Manufacturing and installation documentation
 All Parts related to the ECO in Lifecycle state **Approved.**
 All Descriptions related to the ECO in Lifecycle state **Approved**
 All Specifications related to the ECO in Lifecycle state **Approved.**

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3.2.8. Detailed Documentation Review	
<p>Review of the final design is performed by the Review Team.</p> <p>The following roles should be represented in the Detailed Design Review:</p> <ul style="list-style-type: none"> - Interface Stakeholders. - Design Lead. - Review Team. - Project Engineer. - EPL Coordinator. - QA/QC Representative. <p>The review ensures that the produced detailed documentation package is appropriately uploaded to the PLM-system, complying with set standards and that all information (regarding manufacturing, special treatments, etc.) is included.</p> <p>For more information regarding input to Detailed Documentation Review see chapter 4.4.</p>	<p>Responsible: Review Team</p> 
<p>Output/product</p>	<p>Released Manufacturing and installation documentation ECO with all related Parts and Specifications in Lifecycle state <i>Released</i></p>

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4. DOCUMENTS

The set of documents and contents of documents to be produced in the various phases of the design workflow is to be assessed in each case. Output from the design phase must comply with ESS standards as well as applicable IEC/EN/SS - norms and standards for the system to be designed. Reviewers must be provided suitable documentation in order to make good assessments in the reviews. A project engineer or his team cannot review or approve their own work in isolation, which means that a review team must consist of at least one independent individual.

4.1. Input to Functional Review

Input to the functional review is an Engineering design specification (EDS)

The purpose of the EDS is to specify how a design shall be implemented and which requirements it should fulfil. Engineering Design Specification should consist of (but is not limited to) the following information:

- System Requirement Specification (Required)
- Concepts of Operation Description (Required)
- Functional Specification (Required)
- System Design description
- System Verification and Validation Plan
- System Architecture Description
- Interface Description
- System Integration Plan

Descriptions and specifications prepared in the conceptual design phase could also in addition to the documents mentioned above be enclosed to the EDS.

After the functional review, the required documents shall be released to ensure traceability in the design workflow and for change management to handle in any changes to these.

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4.2. Input to Initial Design Review

Input to Initial Design Review is a detailed design specification.

Detailed design specification purpose is to clarify exactly how a system/part shall be designed and implemented. The initial design should update the documents that came from the EDS and the functional review, and a detailed design specification is created.

As a complement to the detailed design specification the following documentation is also submitted:

- Initial CAD drawings and Schematics.
- Initial BoM-list.
- Calculations and Analysis.

4.3. Input to Detailed Design Review

Input to Detailed Design Review is detailed drawings, calculations and analysis data.

Documents from initial design phase are to be updated in the detailed design phase, and detailed drawings and schematics of all functions of the part/system shall be produced in the detailed design phase.

Documentation submitted to detailed design review could consist of:

- Detailed CAD Drawings, Schematics and Tables.
- Final BoM.

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4.4. Input to Detailed Documentation Review

Input to the Detailed Documentation Review is the Manufacturing and installation documentation.

Manufacturing and installation documentations purpose is to deliver the detailed documentation of the design for procurement, manufacturing and installation. The documentation could consist of the following information.

- System Requirement Specification.
- Concepts of Operation Description.
- System Design description.
- System Verification and Validation Plan.
- System Architecture Description.
- Interface Description.
- System Integration Plan.
- Detailed CAD drawings and Schematics.
- BoM-list
- Calculations and Analysis.
- System User Documentation.
- System Maintenance Manual.

At the end of the procedure all documentation produced shall be released for historical reasons to be able to see what was sent from design phase and received for construction.

Before any part or system is sent for procurement the project engineer must ensure that parent system has passed the CDR.

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5. ROLES AND RESPONSIBILITIES

Several roles are needed in order to bring a design through the design workflow to a released state.

Project Engineer

The project engineer is the person responsible for delivery of the project in question. At division or group level, this might be a work package/unit leader, a project leader or a lead engineer. In the context of this document, The Project Engineer is a person responsible for delivering (and managing) the body of work that requires design support.

Responsibilities of the Project Engineer

- Plan activities, resource requirements and request resources from the line organisation.
- Ensuring all project/work package participants are aware of good design and management practices to meet project cost, schedule, safety and technical objectives.
- Ensuring that suitably qualified personnel perform electrical calculations that are related to safety or function.
- Ensuring that suitably qualified personnel performs reviews of the designs.
- Assign timeline and budget for the project.
- Ensure particular responsibilities (electrical design, performance, physics) are covered for the particular project (when required, special engineering services group may assist in supervising particularly complex projects).
- Ensuring that all design related documentation is collected and recorded as per ESS procedures and policies.
- Ensuring that design analysis and design choices are appropriate.
- Ensuring coordination of integration.
- Ensuring that interfaces are properly defined communicated and maintained.

Supervise processing of modifications of both requirements and resulting electrical design. When the changes are beyond responsibility scope of The Project Engineer, appropriate CCB is involved in review and approval [2].

The above responsibility is direct or delegated down the line when required and appropriate to do so. Bearing in mind that this procedure refers to matters concerning electrical design (i.e. not cost, time management etc.).

Project Engineer has the responsibility to ensure that design work packages are prepared and allocated corresponding to the WBS, LBS and the FBS.

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Design Lead

The Design Lead is the person responsible for the electrical design of the project. This person is responsible to coordinate the design work and for delivery of the detailed drawings package. The Design Lead might involve a team of electrical design engineers (Design Team) to perform the electrical design.

Responsibilities of the Design Lead:

- Coordinates the design work from a technical point of view.
- Lead the Design Team.
- Finds and analyses technical solution in order to fulfil user & functional requirements.
- Reports to project engineer.
- Support project engineer in discipline specific issues.
- Electrical design analysis and design choices of the project.
- Prepare and upload appropriate documentation of the electrical design.
- Communication and coordination regarding integration and interfaces that could affect the electrical design, or that could be affected by the electrical design.

Review Team

The Review Team is responsible for review of the electrical design performed by the Design Team. Gives permission to take the design into the next phase of the procedure or not by approve or reject the design in the review phases. The Review team shall consist of at least one independent individual external to the project. When required, personnel with particular (special) skills may be included in the team as well as representatives from ES&H, QA-Division and Supply & Procurement Division.

Where applicable, the EPL Coordination team provides additional checks through reviews, ensuring that detailed designs and interfaces between different systems are consistent with ESS approved configuration.

Responsibilities of the Review Team:

- Review the work performed by the design team.
- Give a reject or an approval in the reviews.
Establish review reports where decisions and recommendations are clearly stated.

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6. GLOSSARY

Abbreviation	Definition
BOM	Bill of Material [List of parts to be produced and/or procured]
CF	Conventional Facilities
CHESS	Collaboration Home at ESS, <i>implementation of Dassault Systèmes Enovia system at ESS.</i>
EDS	Engineering Design Specification
DDS	Detailed Design Specification
EPL	ESS Plant Layout, the 3D master model of ESS
ECO	Engineering Change Order
ES&H	Environment, Safety and Health
FBS	Facility Breakdown Structure
LBS	Location Breakdown Structure
PDR	Preliminary Design Review
CDR	Critical Design Review
SE	Systems Engineering
WBS	Work package breakdown structure

7. REFERENCES AND CREDITS

1. ESS-0002908: "System Engineering Management Plan"
2. ESS-0001879: "ESS Procedure for Change Control of ESS Facility"
3. ESS-0015094: "ESS Process for Architectural Design"

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Revision	Reason for and description of change	Author	Date
1	First revision of the ESS Procedure of the Electrical Design.	Joakim Meyer Jonas Widing Magnus Täcklind Mikael Olsson	2016-03-20
