TotalEnergies

COMPANY GUIDE AND MANUAL

GM-GR-HSE-307

Safety Engineering Checklist for Project Reviews

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Foreword	This English version must be considered as the reference version.

1. Purpose

In line with the CR-GR-HSE-001, expectation 09-02: “Self-assessment, Audit & Inspection program”, Branch directives (DIR-EP-09, DIR-RC-08, DIR-MS-06) have defined project reviews that are organized during project development phases.

GS-GR-HSE-300 defines safety design documents during industrial investment projects, which covers all project development phases. Among the development phases, this Guide and Manual specifically applies to the conception phases:

- Concept study / Screening phase;
- Pre-Project / Technical feasibility phase;
- Front End Engineering phase;
- Detailed Engineering phase.

Purpose of this Guide and Manual is to assist Safety auditors involved in those project reviews to:

- Point out minimum topics that have to be checked during such design phases;
- Ensure consistency of reviews over the time;
- Enhance the quality of reviews.

2. Scope

This Guide and Manual specifies a checklist for conducting Safety Engineering review during Project Reviews. The Project Reviews covered during the design phases as per branch referential are the following:

Branch	Project review	When
EP	PR0	End of conceptual phase
	PR1	End of pre-project phase
	PR2	End of basic engineering / FEED phase
	PR3	End of detailed engineering phase
RC	PR1	FEED gate (prior to entering FEED)
	PR2	EPC gate (prior to entering EPC phase)
	PR3	End of detailed engineering phase
MS	PR1	Basic gate (prior to entering Basic + FEED phase)
	PR2	Execution gate (prior to execution phase)

The proposed Safety Engineering checklist needs to be adapted for considering:

- The nature of the development (onshore / offshore, oil & gas, petrochemical, renewable, power, etc.);
- The duration of the review;
- The timing of the review (prior the anticipated window).

The recommendations and best practices described in this guide accompany the Company's referential on Audit during project development phase. These guidelines are developed to be used in the frame of the audits performed by 'One HSE' Safety Engineering specialists, contributing to project assurance processes of all TotalEnergies' LBU[1]s and affiliates[2], in compliance with their own respective decisions without prejudice to the legal and regulatory provisions in force at local level.

Within companies and structures not controlled by the Company (i.e. TotalEnergies SE or one of its subsidiaries), the representatives of TotalEnergies SE or its subsidiary must endeavour to promote the principles of this guid.

This GM-GR-HSE-307 has been written with the current project development processes of the branches et the time of its issuance. It may need to be updated later on, once the ongoing total or partial harmonization of those processes is defined and implemented by OneTech.

3. Project Reviews

3.1. General

The Project Reviews are part of the Company's internal validation and decision process for the development of projects. The purpose of the Project Review is to ensure that a "fit-for-purpose" approach has been implemented at every stage of the development process (from concept selection phase to start-up of operations), and that the Project is ready to go to next stage. The term "fit-for-purpose" signifies that concept selection, design, project execution, and operating philosophy are optimized in terms of value creation and risk management including compliance with the Project selected referential (Company Rules and General Specifications, Project Specific Specifications, National and International regulations).

The structure, format and duration of the Project Review can vary for Branches.

Project Review is led by an audit leader (for instance from the Audit Entity of the OneTech Branch) with a team of multidisciplinary specialists which are independent from the project organization. Safety Engineering discipline is always part of the review team. The team members are nominated by their line management, within the Branch Métiers, or from 'One HSE' direction.

The Project Review team leader issues terms of reference as per Branch referential, coordinate the review process with Project, consolidate discipline findings through review of documents and interviews. Generally, each finding is risk assessed using Company's risk prioritization criteria. Typically, draft Project Review report is issued to the Project Management for review and response. Once the project responses are incorporated, the Team leader formally issues the final report to the project management.

3.2. EP Branch Project Reviews

In EP Branch, six-part project reviews are identified CR-EP-AUD-002 during the project development phase (refer to Figure 1). Safety Engineering discipline form a part of the core review team in the first four Project Reviews.

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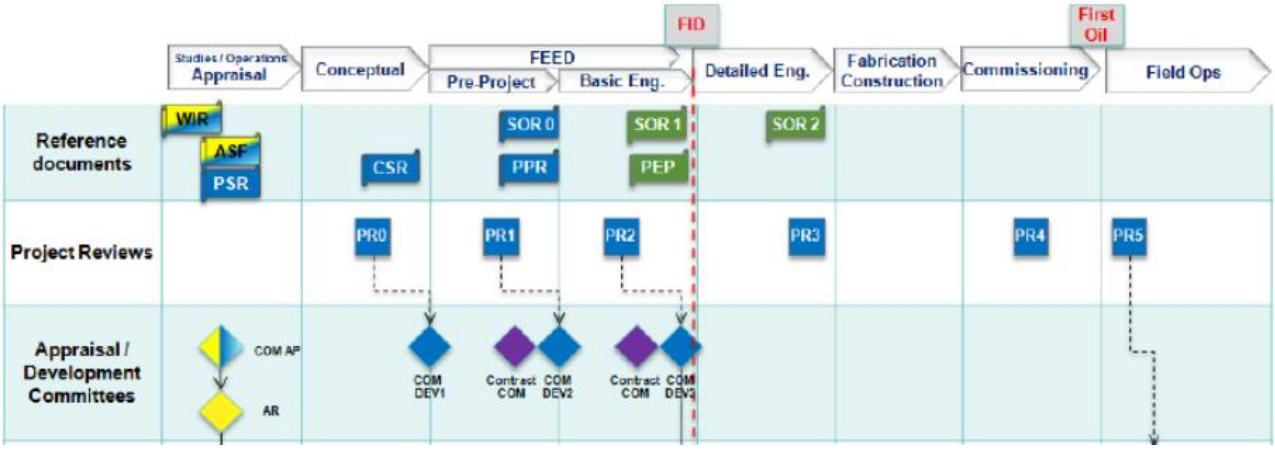
1 An LBU (Local Business Unit) is a branch, division, department or service within the Company.

2 TotalEnergies' affiliate is a company in which TotalEnergies directly or indirectly holds the majority of voting rights.

Figure 1: Project Reviews during EP Branch development cycle (Extract from DIR-EP-09)



3.2.1. Conceptual Phase – PR0

In EP Branch, Project Review 0 (PR0) is a technical and value review at the conceptual phase and the requirements are addressed in CR-EP-AUD-002. PR0 is the first of the six-part reviews during a Project development in EP Branch (refer to Figure 1).

The scope of the review varies slightly depending on the next phase, either a pre-project (by Company) or directly a FEED (by Engineering Contractor).

The topics reviewed by the Safety Engineering specialist are:

- The coherence between the Project safety drivers, the retained basis of design, and the proposed development schemes;
- The completeness of development schemes options considered in the screening study and the consideration of safety, and the quality of the process used for selection of the scheme;
- The adequacy of the technical standards and local/international codes and laws retained with respect to Safety Engineering;
- Preliminary assessment of major risks including HSE aspects;
- If direct FEED (w/o pre-project) is the selected option, verifies that the basis of design in terms of Safety Engineering and the level of definition of the Project, including SoR, are sufficiently clear for the Engineering Contractor(s);
- Early identification of value engineering opportunities with respect to Safety Engineering.

3.2.2. Pre-project Phase – PR1

In EP Branch, Project Review 1 (PR1) is a technical and value engineering review at the pre-project phase and the requirements are addressed in CR-EP-AUD-002. PR1 is the second of the six-part reviews during a Project development.

Safety Engineering Discipline forms the core part of the multidisciplinary review team. The PR1 is composed of two parts: P&ID review and pre-project documents review.

The P&ID review includes a verification of the safety and operability of the facilities. P&IDs are also examined from a value engineering point of view trying to simplify/optimize the facilities if possible. This review is led by the Safety Engineering Discipline reviewer. The findings of the P&ID review are incorporated in the overall PR1 findings. The P&ID review methodology is further developed in Appendix 1.

The topics covered in the pre-project documents review by the Safety Engineering discipline are:

- Verify that the previous PR0 findings have been treated / considered;
- Verify that all stakeholders' expectations have been addressed in terms of Safety Engineering and risk acceptability;
- Assess the Safety Engineering standards selected by the Project (Company referential or PPS) and associated derogations;
- Verify that the defined facilities comply with the selected standards;
- Assess the outcome of any value engineering and identify / propose possible further cost reduction from design simplification or optimization in terms of Safety Engineering;
- Assess the relevance of any plan to carry over safety design options into Basic Engineering;
- Assess the Safety Concept with focus on technological risk;
- Verify that the development scheme, facilities design, safety concept and operating philosophy, have reached a level of technical definition and detail that will:
    - Guarantee safe and efficient operation;
    - Allow the Engineering Contractor(s) to proceed smoothly to Basic Engineering respecting the Project safety objectives in terms of value optimization.
- Verify completeness of Safety Engineering contents of the SoR in accordance with CR-EP-APP-001.

3.2.3. Basic Engineering Phase – PR2

In EP Branch, Project Review 2 (PR2) is an independent technical review towards the end of basic engineering or FEED and the requirements are addressed in CR-EP-AUD-002. PR2 is the third of the six-part reviews during a Project development (refer to Figure 1).

Safety Engineering Discipline forms the core part of the multidisciplinary review team. The PR2 is composed of two parts, namely: P&ID review and Basic engineering dossier review, supplemented by any clarification or modification proposed by the Contractor(s) recommended by the Tendering Committee. Specific attention is needed when reviewing Safety Engineering aspects when multiple FEED contractors are involved in a competitive FEED set-up.

The P&ID review includes a verification of the safety and operability of the facilities. P&IDs are also examined from a value engineering point of view trying to simplify the facilities if possible. This review is led by the Safety Engineering Discipline Auditor. The findings of the P&ID review are incorporated in the overall PR2 findings. The P&ID review methodology is further developed in Appendix 1.

The topics covered in the Basic engineering dossier review by the Safety Engineering discipline are:

- Verify that the previous PR1 findings related to Safety Engineering have been treated / considered;
- Review specific technical subjects on Safety Engineering that may have been clarified /modified, since end of Basic Engineering or FEED, during the CFT process, especially those amended because of Contractor's proposals;
- Verify safety impacts on accessibility, maintainability, constructability, and inspect-ability (in particular, through Layouts and 3D models);
- Assess the Safety Engineering design standards and Technical Specifications chosen for the Project Detailed Engineering, and associated derogations;
- Assess the updated Statement of Requirement (SoR) and the Scope Change Notices (SCNs) with their impact with respect to safety;
- Assess the outcome of any value engineering and identify / propose possible further cost reduction from design simplification or optimization in terms of Safety Engineering;
- Assess the Safety Concept with focus on management of technological risk;
- Verify that all relevant Safety Engineering studies have been carried out, including technological risk assessments and demonstration of ALARP;
- Ensure that the Safety Engineering and risk assessment recommendations have been incorporated in the basic engineering design dossier or within the scope of EPC contractor.

3.2.4. Detailed Engineering – PR3

The Project Review at Detailed Engineering phase provides an independent assessment to identify any important deviation from the original scope and to assess the level of preparation of the successive phases, namely: construction, commissioning, start-up, and operations.

In EP Branch, Project Review 3 (PR3 is an independent technical review towards the end of detailed engineering phase and the requirements are addressed in CR-EP-AUD-002. PR3 is the fourth of the six-part reviews during a Project development (refer to Figure 1).

Safety Engineering Discipline forms the core part of this multidisciplinary technical review team. The PR3 team reviews the Detailed Engineering dossier (including the Vendors dossiers), and the global organization of the construction and commissioning covering the yards and sites.

The topics covered in the document review by the Safety Engineering discipline are:

- Verify that the previous PR2 findings on Safety Engineering have been treated / considered;
- Review detailed HAZOP study, SIL Assignment and achievements reports;
- Review “approved for construction” safety design documents and verify that the design intended regarding safety is properly implemented;
- Verify safety impacts on accessibility, maintainability, constructability, and inspect-ability (with the help of layout and 3D model reviews);
- Verify that the Project Safety Engineering specifications defined at Basic Engineering or FEED have been followed;
- Review associated derogation process;
- Verify that Project safety studies including technological risk assessment studies have been closed out and all findings for meeting ALARP have been incorporated in the final design;
- Assess the preparedness regarding definition of safety critical barriers and safety and environmental critical elements for providing input to technical integrity programs;
- Review SoR revision and change notices status and assess the impact on safety.

3.3. GRP Branch Project Reviews

Project Review governance is not defined so far in GRP Branch. Projects involving major risk exposure (e.g. LNG terminal, FSRU, green H2 production, power generation, etc.) follow EP Branch project review process.

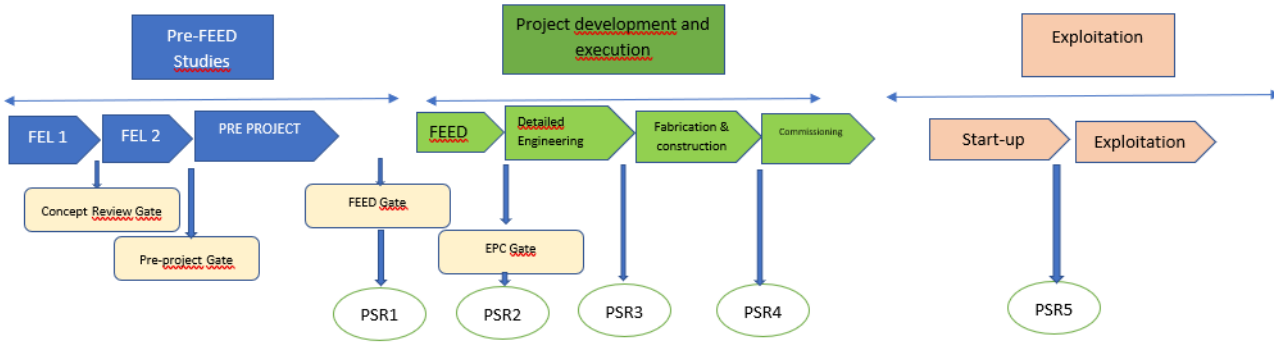
EP Checklist for project reviews may need to be customized considering specificities of GRP development.

Renewable energy projects are not so far the object of systematic Project Reviews involving Safety Engineering discipline, unless they are located nearby a major hazard site.

3.4. RC Branch Project Reviews

Project Reviews in RC branches as per DIR-RC-08 and CR-RC-PJC-302 are summarized in Figure 2.

Figure 2: Project Reviews during RC Branch development cycle



As per CR-RC-PJC-302, Conceptual Study / Screening phase is composed of Preliminary Study (Front End Loading FEL 1) and Concept Review (Front End Loading FEL 2). Depending on the size of the project both parts may be merged (for smaller projects with associated CAPEX < 1M€) or studied one after the other (for bigger projects).

FEL1 phase allows to appreciate an opportunity to increase value, to assess its economic viability and its technical solidity. Several schemes, processes, or licensors may then be investigated. The most adequate ones are preselected.

FEL 2 phase allows to study these pre-selected options and to make a choice between the different alternatives.

Key documents such as “Statement of requirements” and “Work Breakdown Structure”, preliminary HSE studies are generally available for medium and large size projects (i.e. CAPEX > 5M€) during this phase, along with preliminary technical requirements and preliminary Project Organization.

An optional Project Review is organized at the end of this phase. It is most often a Peer Review and a value analysis. Safety Engineering representatives for this review can be from OneTech Branch.

3.4.1. Feed Gate – PR1

As per CR-RC-PJC-302, the Pre-project phase is optional in RC Branch. It allows to detail the technical solution after the Concept review phase at a sufficient level to be able to reach FEED phase and launch call for tenders.

Project Review 1 (PR1) allows to ensure that at the end of the Pre-project Phase (or Concept review phase if pre-project is by-passed):

- Project risks including HSE risks are identified, assessed and adequate measures are foreseen to mitigate them;
- Installations are designed according to RC standards and specifications, or other standards including derogations, if justified.

PR1 is done at the end of the pre-Project phase (or Concept review phase when all key deliverables are finalized).

Project Review is named Independent Project Review (IPR) on non-operated projects. Peers have a key role as challengers by sharing experiences and good practices.

3.4.2. EPC Gate – PR2

As per CR-RC-PJC-302, the objective of FEED phase is to freeze the technical definition of the chosen option in terms of integration in existing facilities, definition of the Project organization and strategy, specification of

procurement policy (for long term items for instance), launching of Call for Tenders, preparation of all elements to be able to obtain FID and attribution of EPC contracts.

Project Review 2 (PR2) allows to ensure that at the end of the FEED Phase:

- Previous PR findings have been treated / considered;
- The project is compliant with SoR;
- Project risks including HSE risks are identified, assessed and adequate measures are implemented (or planned to be implemented) to mitigate them;
- Installations are designed according to RC standards and specifications, or other standards if justified;
- All Safety Engineering deliverables are ready, have good quality and are compliant with Branch rules.

PR2 is done at the end of the FEED phase.

3.4.3. Detailed Engineering Phase – PR3 and PR4

As per CR-RC-PJC-302, the EPC Phase (Detail Engineering, Procurement, Construction, Commissioning) allows to make sure that:

- Previous PR findings have been treated / considered;
- Detailed studies are in accordance with what was planned during FEED phase, such as procurement, building, and commissioning activities;
- Transfer to operator is done with respect to safety and quality, with all the documentation needed, and by optimizing strategy to minimize production loss on existing associated facilities;
- All required permits are well-prepared and obtained on time;
- Maintenance, inspection, and start-up operations are anticipated.

Project Review 3 (PR3) is done during detailed studies.

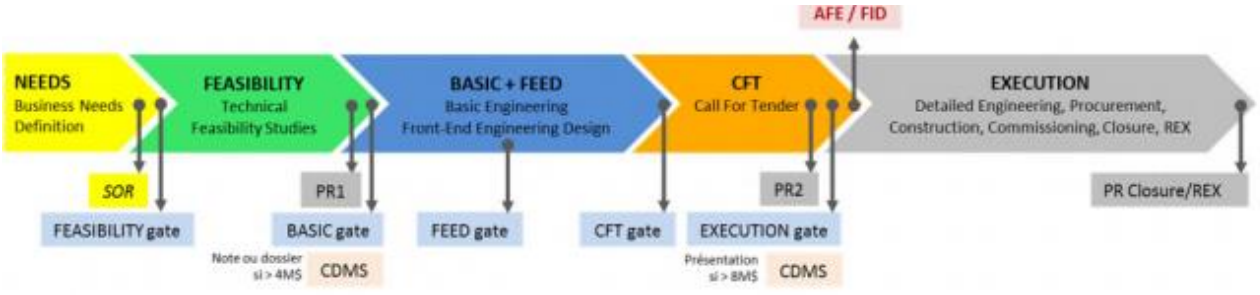
- The first part, PR 3.1 is done when 30% of the detailed studies are completed and is focused on studies and procurement;
- The second part, PR 3.2 is done when 60% of the detailed studies are completed and is focused on procurement and construction.

Project Review 4 (PR4) is done after 50% of the construction is completed and is focused on end of construction and transition to commissioning, start-up, and operation.

3.5. MS Branch Project Reviews

Project Reviews in MS branch as per DIR-MS-06 and CR-MS-PJC-001 are summarized in Figure 3. There are two key project reviews executed during the project development phase, namely Basic Gate PR1 and Execution Gate PR2 and two optional project reviews.

Figure 3 Project Reviews during MS Branch development cycle (Extract from CR-MS-PJC-001)



3.5.1. Feasibility Gate

As per DIR-MS-06, Conceptual Study / Screening phase is named NEEDS (Business needs definition). The objective of this step is to validate the interest of the project and to formalize client needs in terms of business before launching the first feasibility studies.

At the end of the NEEDS step, the Feasibility Gate is reached.

The duration of this step and the nature of the documents is fitted to the size and the complexity of projects.

As per CR-MS-PJC-001, for projects with CAPEX higher than 1M$, an optional Project Review may be organized, led by the Project Review team. The Safety Engineering reviewers assess the quality of documents prepared, provide advice and support to the Project Team, give recommendations, and issue a preliminary HSE/Technical opinion about solidity of the Project before going to the next step.

At that stage, generic Safety Engineering aspects are covered by disciplines such as PJC (Architecture) and ENG (Project Engineer).

3.5.2. Basic Gate – PR1

As per DIR-MS-06, the objective of this technical feasibility phase is to study the viability of the Project in technical, safety, environmental and economic terms as described by the SoR (Statement of Requirements) and establish a +/- 30% cost.

As per CR-MS-PJC-001, for projects with CAPEX higher than 1M$, a formal Project Review (PR1) is organized involving Safety Engineering representative. The Project Review team:

- Review and assess the quality of documents prepared;
- Provide advice and support to the Project Team;
- Give recommendations about the viability of the Project; and;
- Issue a first HSE/Technical opinion about the Project before going to the next step.

3.5.3. Execution Gate – PR2

As per DIR-MS-06, the FEED phase is composed of BASIC, FEED and CFT “sub-phases”. The objective is to study the different options described in the SoR in order to:

- select one of them and establish the cost from +/-30% at the beginning of FEED phase to +/- 10% at the end of the phase;
- elaborate all documents necessary to go to Call for Tender in accordance with Purchasing Department
- obtain technical and commercial offers;
- to be able to build liable planning and budget.

As per CR-MS-PJC-001, a formal Project Review (PR2) is organized involving Safety Engineering representative, at the end of the FEED phase and after the Call for Tender. In addition, a HSE review is preferably done before launching the CFT to make sure all technical aspects are considered.

The Project Review team:

- Review and assess the quality of documents prepared;
- Provide advice and support to the Project Team;
- Give recommendations about the viability of the Project;
- Issue an opinion on the soundness of the project (Technical, HSE, Cost, Planning, Purchase, Supply, Profitability, etc.) before presentation to CDMS and FID request.

3.5.4 Execution Phase

As per CR-MS-PJC-001, a technical review is recommended during detailed engineering phase (when 60% completed) before launching construction to check the quality of design and its compliance with applicable standards. At the end of the phase, a PR is organized (“closure/ REX”) to consolidate feedback. During this PR, the Project Review team review:

- As built plans;
- All detailed engineering documents;
- Maintenance plans;
- Geotechnical dossier;
- Technological risk analysis;
- Environmental risk analysis.

4. Safety Engineering Review Checklist

The proposed checklist is a basis for Safety Engineering project review. It can be adapted to:

- The nature of the development (oil and gas onshore / offshore, petrochemical plant, renewable, power, etc.);
- When the review is conducted (beginning or end of phase).

It generally includes oil and gas development but excludes new non-oil and gas development that may have some specificities which are not captured in the proposed checklist. Therefore, it is recommended to customize the checklist according to the nature of the project.

Only one checklist in Excel template is available (see Appendix 2) covering all branches and all development phases. Contextual filters help define the suitable basis for a project review by selecting:

- Development phase; and/or;
- Branch.

For contextualizing the Safety Engineering review, the check list includes the following fields which can be utilized for narrowing down the topics as per the development:

Topics	Subtopics	
1. Safety / HSE Concept	1.01	Safety concept general
	1.02	Codes and standard within safety concept
	1.03	Layout principles
	1.04	Permitting matters
	1.05	Fire protection (AFP & PFP)
	1.06	Technological Risk Assessment summary
	1.07	HVAC principles
	1.08	Hazard assessment summary
	1.09	Specific hazard management
	1.10	Pressure protection, ESD and EDP
	1.11	Flare and Vent

Topics	Subtopics	
	1.12	Liquid drainage
	1.13	Fire and Gas detection
	1.14	Telecommunication
	1.15	Emergency Power
	1.16	Escape Evacuation and Rescue
	1.17	Personal safety
	1.18	Navaids and obstruction lights
	1.19	Derogation Dossier
	1.20	Best available technologies topic
2. Safety Studies	2.01	MUSE study
	2.02	HAZID (Hazard Identification) & HAZOP
	2.03	HAZAN (Hazard Analysis)
	2.04	Flare Vent Gas dispersion study
	2.05	Firewater and foam demand calculation
	2.06	Technological Risk Assessment (TRA)
	2.07	Fire and Explosion Risk Assessment / Quantitative Risk Assessment
	2.08	Collision risk
	2.09	Dropped object risk
	2.10	Escape Evacuation and Rescue assessment
	2.11	High Integrity Protection System dossier / Safety Integrity Level
	2.12	HSE Plan & Safety Dossier
3. Layout Drawings	3.01	Overall plot plan
	3.02	General arrangement
	3.03	Hazardous Area Classification drawings

Topics	Subtopics	
	3.04	Safety distance layout (Escalation areas, Restricted area, Impacted Area)
	3.05	Escape Evacuation and Rescue and layout
	3.06	Fire & Gas layout review
	3.07	Firefighting layout
4. Project Review Recommendations	4.01	Review of previous project review recommendations and status
5. Others	5.01	Safety Equipment Specifications, Project development Plan, Statement of Requirements, etc.

A ReadMe section is included in the Excel sheet for explaining the use of the Safety Engineering checklist.

5. Terms and definitions

5.1. Definitions

As Low As Reasonably Practicable (ALARP)

A risk reduced to levels such that further risk reduction measures would be so disproportionate that it would be objectively unreasonable to implement them.

Barrier

Risk control which purpose is to prevent an accident or to limit or mitigate the escalation of such an accident

Contractor

A company providing a TotalEnergies' LBUs or affiliates with a product or service under a signed contract.

Major risk

Risk associated with a major scenario which is leading to catastrophic or disastrous consequences for people, the environment, or assets according to the Company risk matrix

Technological risks

Risks to people, the environment, or assets, resulting from the accidental exposure related to:

- The toxic, explosive, flammable, or harmful products used;
- Manufacturing and production processes;
- Flows of raw materials and finished, stored, or transported products

Value

Character of a project that is given to it by the simplicity or the optimization of the installations

5.2. Abbreviations

Abbreviation	Signification	Abbreviation	Signification
AFP	Active Fire Protection	BDV	Blowdown Valve
CAPEX	Capital Expenditure	CFT	Call for Tender
DHSV	Down Hole safety Valve	EDP	Emergency Depressurisation
EPC	Engineering, Procurement and Construction	ESD	Emergency Shutdown System
ESDV	Emergency Shutdown Valve	FEED	Front End Engineering Design
FEL	Front End Loading	FID	Final Investment Decision
HAZAN	Hazard analysis	HAZID	Hazard Identification
HAZOP	Hazards and Operability	HIPS	High Integrity Protection System
HSE	Health, Safety and Environment	HVAC	Heating, Ventilation and Air Conditioning
LBU	Local Business Unit	LNG	Liquified Natural Gas
MUSE	Multi-criteria Safety and environmental Evaluation	MV	Manual Valve
P&ID	Piping and Instrumentation Diagram	PFD	Process Flow Diagram
PFP	Passive Fire Protection	PR	Project Review
PSV	Pressure Safety Valve	PVSV	Pressure Vacuum Safety Valve
REX	Return Of Experience	SCN	Scope Change Notice
SIL	Safety Integrity Level	SoR	Statement Of Requirement
UFD	Utility Flow Diagram	WV	Wing Valve

6. Reference documents

Company HSE

Reference	Title – Company documents
CR-GR-HSE-001	One HSE-MAESTRO Expectations
GS-GR-HSE-300	Safety Design Documents During Industrial Investment Projects
GS-GR-HSE-304	Emergency Shutdown and Emergency Depressurisation (ESD & EDP)
GS-GR-HSE-305	Pressure Protection and Relief Disposal Systems
GR-GR-HSE-307	Liquid drainage

EP Branch

Reference	Title – Company documents – EP branch
DIR-EP-09	Appraisal and Development
CR EP AUD 002	Project Reviews
CR EP APP 001	Project Statement of Requirement (SOR)
GM EP ECP 110	Piping and Instrumentation Diagrams (P&ID's) in pre-project phase

RC Branch

Reference	Title – Company documents – RC branch
DIR-RC-08	Project Development and Execution
CR-RC-PJC-302	Gate process for managing capital investment projects

MS Branch

Reference	Title – Company documents – MS branch
DIR-MS-06	Definition and principles for conducting MS capital expenditure projects
CR-MS-PJC-001	Management Process for Capital Expenditure Projects

External documents

Reference	Title – External documents
API RP 14C	Recommended Practice for Analysis, Design, Installation, and Testing for Basic Surface Safety Systems for Offshore Production Platforms

7. Bibliography

No document is to be mentioned in the bibliography.

8. List of appendixes and complementary documents

Reference	Title
APPENDIX 1	P&ID Review Methodology (EP Branch)
APPENDIX 2	Project Review Checklist

9. Distribution conditions and date of effect

The current guide and manual is recommended starting from its publication in REFLEX.

10. Revisions

REV.	DATE	PURPOSE	WRITTER	CHECKER	APPROBATION
00	02/05/2022	Creation	STS/HSE/RM/APC Virginie HOUILLIEZ	STS/HSE/RM/APC Jean-Christophe CAUDIN	STS/HSE/RM Pierre OZON

APPENDIX 1 – P&ID Review Methodology (EP Branch)

A1.1 What is a P&ID Review?

It is a high-level coarse review that is not to be confused with the formal detailed HAZOP review performed by engineering Contractor at Basic and Detailed engineering stages.

As part of the scope of the PR1 and PR2, the P&ID review is a multidisciplinary team exercise led by the Safety Engineering specialist part of the PR team.

A1.2 Main Objectives of the P&ID Review

The objective is not to perform a detailed examination of the P&ID's, but the P&ID review is to be seen as a high-level checking exercise of the safety and operability of the processing facilities, within the imposed time frame allocated for the review.

P&IDs are also checked from a value engineering point of view with the objective to identify and propose possible simplifications or optimizations in the design.

A1.3 Time Schedule and Organisation

The review team is typically composed of:

- Safety specialist (leader of the P&ID review);
- PR team leader;
- Field Operations specialist;
- Process specialist.

Depending on the type of facility to be reviewed, an ad-hoc specialist can be invited to participate to the P&ID review on special demand and at the initiative of the PR leader.

The time allocated for the P&ID review is defined by the PR audit team leader in conjunction with the Project entity, and is budget driven.

A dedicated slot (2 to 4 days in average) is allocated for the P&ID review within the time frame of the PR. This time slot is generally not extendable irrespective to the size and level of complexity of the project.

At pre-project stage (PR1), simplified P&IDs are typically developed with a limited level of definition and details (refer to GM-EP-ECP-110). It can be coarsely estimated that reviewing an average of 10 to 15 P&IDs per day is reasonably achievable.

At Basic engineering stage (PR2), the level of details of the P&IDs being more advanced, their examination is generally more time-consuming. It can be coarsely estimated that reviewing an average 5 to 10 P&IDs per day is reasonably achievable.

For the case of brownfield projects, it is difficult to predict the time necessary for the P&ID review since this closely depends on the number of tie-ins, connections, interfaces, and various checks to be made with regards to the design compatibility between new and existing facilities. If necessary, a coarse estimation can be made in advance of the PR session, based on the P&IDs content and the scope of the brownfield modifications.

In case the time slot allocated is not compatible with the number of P&IDs to be reviewed:

- Either an extension of the time slot can be proposed by the PR team leader to the Project entity, in order to adapt the timing to the number of P&IDs to be reviewed;
- Or, a limited number of P&IDs is selected in order to make the review compatible within the imposed time frame. This selection should be ideally established in agreement between the P&ID review leader, the PR team leader, and the Project entity expectations. The usual approach is to give priority to the

main processing and safety facilities so that systems with the highest risks are guaranteed to be reviewed within the time frame. Lowest risks facilities (e.g., Low Pressure utilities) are generally not included in the scope of the review, unless time allows before end of the main review.

A1.4 Preparation Work

Well ahead from the PR session, the P&ID review leader should liaise with the PR team leader to collect information about the quantity of P&ID's to be reviewed, the scope and battery limits, and the time slot allocated for the review.

The P&ID review leader will ask the PR team leader to ensure that the following documents are made available by the project entity for each reviewer:

- P&ID + PFD's + UFD's (pdf electronic version + A3 format paper version);
- ESD logic diagrams (pdf electronic version + A3 format paper version);
- Piping material classes specification and coding (A4 paper version);
- Operating philosophy (A4 paper version).

A1.5 Methodology

The P&ID review being by nature a team exercise, it should be ideally carried out in the presence of all participants in a dedicated meeting room, to facilitate the coordination of the review, as well as discussions and exchanges.

Before starting the P&ID review, and to align the review team at the same level of understanding:

- The Safety team leader briefs the review team on the objectives and expectations of the P&ID review;
- The Process representative of the Project briefly presents the main processing facilities and functionalities, design intent, key design parameters, operating envelope, as well as the various expected operating modes;
- The team performs a short high-level review of the PFD's/UFD's to have a global vision of the various processing systems and interfaces, key operating, and design parameters.

The P&ID review is then performed system by system, or unit by unit.

A typical approach can consist in reviewing the various process streams separately (e.g. gas streams, oil streams, water streams).

Note that at PR2 stage, the status of outstanding findings from previous PR1 P&ID review are to be checked.

In any case, the level of detail of the P&ID review is to be adapted to the imposed allocated time frame.

It is recommended to focus the review on identifying and capturing the main deficiencies in the design that could result in hazardous situations (e.g. missing process safeguards/barriers), or that could result in operational issues (e.g. lack of process controls, lack of maintenance facilities, lack of sparing).

To adapt the P&ID review to the timing constraints at PR2 stage, a possible alternate approach can firstly consist in evaluating the quality of the HAZOP report, and secondly cross-checking the major findings raised in the HAZOP report with the corresponding P&IDs.

The review should cover in priority the following key topics:

- How equipment is protected from excursions of key design parameters beyond design limits:
  - Identification of piping specification breaks, HP/LP interfaces;
  - Equipment design pressure adequacy;
  - Overpressure protection and corresponding ultimate barriers (e.g. PSVs, HIPS);
  - Vacuum protection (e.g. PVSV's);
  - Process general safeguarding, double barrier principle as per API RP 14C for each key design parameter (i.e. pressure, flow, temperature, level);
  - Corresponding shutdown functions and consistency with the ESD logic diagram;

- Provisions for emergency isolation or depressurisation devices (ESDVs, DHSV's, BDVs);
- Connections, interfaces with flares, vents, drainage systems, against Company design requirements;
- Specific safety design arrangements for flares/vents systems, drainage systems, any other specific facilities (e.g. wells, storages, LNG facilities, floating production units, subsea systems) against Company design requirements;
- Operability: various modes of operation, sparing philosophy, provisions for inspection, maintenance, isolations, inerting facilities, manual depressurisation, bypasses, locking devices, interlocks.

The checklist provided in table 1 below can be used as a complementary guidance to the P&ID review. This checklist is not intended to be exhaustive, but typical topics that can be checked along the P&ID review are proposed.

Minor or low impact findings being raised along the P&ID review are generally not recorded in the main finding table due to obvious timing constraints. However, these can be captured on a set of marked-up P&IDs delivered to the Project at the end of the review and to be incorporated in the PR final report by the PR team leader.

A1.6 Reporting

The findings raised along the P&ID review are recorded by the Safety team leader into the PR finding table and the wording is agreed collegially with the review team.

If new findings are further raised along the PR general documentation review but were not initially captured during the P&ID review due to lack of information, then these new findings can be incorporated into the PR main finding table.

The Safety team leader can either take the ownership of all findings raised by the team or, specific findings can be allocated on a case-by-case to the relevant discipline representative, according to the nature of the finding.

At the end of the PR review, the Safety team leader summarises and presents the main findings to the project during the PR final debriefing session.

When project responses to findings are received, the Safety team leader proposes answers to each finding, submits these to the P&ID review team for comments, and finally agree on a common wording and status (i.e. "Resolved", "Unresolved", "To be checked").

Table 1 - P&ID review typical check list (❖ priority topics)

GENERAL PROCESS SAFEGUARDING / BARRIERS ❖ Double barrier principle as per API RP 14C for each key design parameters (pressure, flow, temperature, level) ❖ Overpressure protection, Vacuum protection ❖ Corresponding shutdown functions and consistency with the ESD logic diagrams	**CONNECTIONS TO / INTERFACES WITH** ❖ Vents/flares systems vs GS-GR-HSE-305 ❖ PSVs, BDVs relief lines ❖ Drainage systems vs GS-GR-HSE-307 (e.g. isolation arrangements, piping rating, material selection, slopes, low points, elevations) ❖ Manual depressurization lines ❖ Utilities, chemical injection, etc.
PRESSURE ❖ High Pressure/Low Pressure interfaces, piping specification breaks ❖ Material pressure rating adequacy ❖ Safeguarding (e.g. PSHH, PSLL) & corresponding executive actions in ESD logic ❖ Ultimate overpressure protections (e.g. PSVs, HIPS) ❖ Vacuum protection (e.g. PVSV's) ❖ Operating pressure controls, alarms	**SPECIFIC SAFETY DESIGN ARRANGEMENTS** ❖ Vent / flares relief systems vs GS-GR-HSE-305 requirements (e.g. HP/LP relief systems segregation principles, protection against flashback & deflagration, slopes, low points, elevations, material selection, closed flare systems) ❖ Drainage systems vs GS-GR-HSE-307 (e.g. open/closed drains systems segregation principles, drainage recovery and collecting system including slopes, elevations, piping rating, material selection)
FLOW ❖ Safeguarding (e.g. FSHH, FSLL) & corresponding executive actions in ESD logic ❖ Vibration / hammer effects scenarios ❖ Operating flow controls, alarms ❖ Flow Assurance (hydrates, chemicals, etc.)	**ESD & EDP ARRANGEMENTS vs GS-GR-HSE-304** ❖ ESDVs, SDVs provisions ❖ Wells DHSVs, MVs, WVs provisions ❖ BDVs provision; Trapped inventories not depressurized ❖ Main ESD executive actions shown on P&IDs versus consistency with ESD logic diagrams
TEMPERATURE ❖ Typical low temperature scenarios - d/s chokes, Restriction Orifices RO, globe valves ❖ Over-temperature, thermal expansion scenarios ❖ Material temperature rating adequacy ❖ Safeguarding (e.g. TSHH, TSLL) & corresponding executive actions in ESD logic ❖ Operating temperature controls, alarms	**OPERABILITY & MAINTENANCE** ❖ Modes of operation: Normal, Start-up/Shutdown, Downgraded ❖ Sparing philosophy, availability ❖ Provisions for maintenance, inspection, isolations, drains, manual depressurization, inerting facilities bypasses, locking devices, interlocks ❖ Chemical injection facilities ❖ Automation & information, alarms, human factors

LIQUID LEVEL	MISCELLANEOUS
❖ Overflow scenarios ❖ Gas-blow-by scenarios ❖ Safeguarding (e.g. LSHH, LSLL) & corresponding executive actions in ESD logic ❖ Level controls, alarms, liquid interfaces controls	❖ Specific systems, facilities vs relevant General Specification's requirements (e.g. Wells, Storages, LNG facilities, Floating Production Units, Subsea systems, Fired equipment) ❖ P&ID notes; "HOLDS" ❖ Any other matters based on team experience

APPENDIX 2 – Project Review Checklist

The Excel file of the checklist is attached in any referential pyramid where this GM can be found (REFLEX or any Branch referential), under a suffixed reference: “GM-GR-HSE-307-APP2EN”

End of document.

Original version signed.