**General Guidance**

This template is not intended to dictate format. It is understood that sites may also dictate document format.

The content of this template is required material in the sense that the project Systems Engineering Management Plan (SEMP) must address all of the items identified herein, as applicable to the type of project. It may be adapted for use within various types of projects, from New Product/Technology Introduction to Order to Requisition projects. If certain items are not applicable, they are to be identified as “not applicable” and supported by corresponding justification.

The SEMP should contain only those processes and plans that are unique to the program; otherwise simply include a link or reference to governing documents with applicable paragraphs. The link to a matrix of existing QMS processes/plans can be found in QMS document OGQ-ENG-0110.4R.

It is acceptable and preferred to reference material that is contained in other project documents (e.g., Master Project Schedule, established process documents, etc.).

**Special Formatting in This Document**

[NOTE: Red bracketed font is for descriptive purposes only and should be deleted from the final product.]

NOTE: Green italic font is for example/guidance purposes only and should be deleted/changed from the final product.

**[NOTE: Delete this page from the final product. *The instructions for the SEMP template in this document were intentionally left in color RED for identification*]**

**Approved By:**

*Type name or written signature*

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| Quality Systems Leader  Title |  | Software Engineering  Title |  | Name  Title |

*(Not required if controlled by electronic document management system)*

**Document Revision Chart**

The following chart lists the revisions made to this document tracked by version. Use this to describe the changes and additions each time this document is re-published. The description should include as many details of the changes as possible

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|  |  |  |  |  |
|  |  |  |  |  |

Contents

[1 Introduction 5](#_Toc420920102)

[1.1 Overview 5](#_Toc420920103)

[1.2 System Description 5](#_Toc420920104)

[2 References, Definitions, & Acronyms 5](#_Toc420920105)

[2.1 Internal References 5](#_Toc420920106)

[2.2 External References 6](#_Toc420920107)

[2.3 Definitions 6](#_Toc420920108)

[2.4 Acronyms 6](#_Toc420920109)

[3 Technical Planning & Control 7](#_Toc420920110)

[3.1 Task Description 7](#_Toc420920111)

[3.1.1 Deliverables 7](#_Toc420920112)

[3.1.2 Physical / Functional Architecture 8](#_Toc420920113)

[3.1.3 Work Breakdown Structure (WBS) 8](#_Toc420920114)

[3.1.4 Subcontractor Work Effort 8](#_Toc420920115)

[3.1.5 Schedule 8](#_Toc420920116)

[3.2 Engineering Work Plan 8](#_Toc420920117)

[3.2.1 Engineering Organization 8](#_Toc420920118)

[3.2.2 Risk/Opportunity Matrix 8](#_Toc420920119)

[3.2.3 Communications Management 9](#_Toc420920120)

[3.2.4 Safety Integrity Level Plan 10](#_Toc420920121)

[3.2.5 Technology Maturity (TRL) 10](#_Toc420920122)

[3.2.6 FMEA/FMECA Plan 11](#_Toc420920123)

[3.2.7 Certification 12](#_Toc420920124)

[3.3 Program/Design Reviews 12](#_Toc420920125)

[3.3.1 Milestones 12](#_Toc420920126)

[3.3.2 Gates Criteria 12](#_Toc420920127)

[3.3.3 Work Products to Customer 12](#_Toc420920128)

[3.4 Technical Control (PLM) 12](#_Toc420920129)

[3.4.1 Requirements Management 12](#_Toc420920130)

[3.4.2 Interface Control 13](#_Toc420920131)

[3.4.3 Configuration/Change Control 13](#_Toc420920132)

[3.4.4 Document Control 13](#_Toc420920133)

[3.4.5 Data Management 13](#_Toc420920134)

[3.5 Performance Control 13](#_Toc420920135)

[3.5.1 TPM Process 13](#_Toc420920136)

[3.5.2 Technical Measures 13](#_Toc420920137)

[4 Systems Engineering Processes 14](#_Toc420920138)

[4.1 Engineering Process 14](#_Toc420920139)

[4.1.1 Concept of Operations 14](#_Toc420920140)

[4.1.2 Requirements Definition/Allocation 14](#_Toc420920141)

[4.1.3 System Architecture 14](#_Toc420920142)

[4.1.4 System Integration 14](#_Toc420920143)

[4.1.5 System Verification 15](#_Toc420920144)

[4.1.6 System Validation 15](#_Toc420920145)

[4.1.7 Related Processes 15](#_Toc420920146)

[4.2 Trade Studies & Evaluation 15](#_Toc420920147)

[4.2.1 Pugh Matrix 15](#_Toc420920148)

[4.2.2 Detailed Trade Methods 15](#_Toc420920149)

[4.2.3 Prototyping/Fastworks 16](#_Toc420920150)

[4.3 Design Optimization 16](#_Toc420920151)

[4.3.1 Modeling Tools 16](#_Toc420920152)

[4.3.2 Analysis Tools 16](#_Toc420920153)

[4.3.3 Design-to-Cost 16](#_Toc420920154)

[4.4 Documentation 16](#_Toc420920155)

[4.4.1 Specification Tree 16](#_Toc420920156)

[4.4.2 Other Documents 16](#_Toc420920157)

[4.4.3 Document Generation Methods 17](#_Toc420920158)

[4.5 Training & Skills 17](#_Toc420920159)

[5 Engineering Specialty Integration 17](#_Toc420920160)

[5.1 Integrated Logistics Support Plan 17](#_Toc420920161)

[5.2 Reliability/Maintainability/Availability Plan 18](#_Toc420920162)

[5.3 Safety Plan (EHS) 18](#_Toc420920163)

[5.4 Human Factors Plan 18](#_Toc420920164)

[5.5 Electromagnetic Effects Plan 18](#_Toc420920165)

[5.6 Security Plan 18](#_Toc420920166)

[5.7 Value Engineering Plan 18](#_Toc420920167)

[5.8 Materials Engineering Plan 18](#_Toc420920168)

[6 Appendix 19](#_Toc420920169)

Table of Figures

[Include a list of figures here, if any exist.]

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Table of Tables

[Include a list of tables here, if any exist.]

[Table 1: Internal References 5](#_Toc420920170)

[Table 2: External References 6](#_Toc420920171)

[Table 3: Communication Plan Matrix 9](#_Toc420920172)

# Introduction

## Overview

[Identify the system and this document in one sentence. Use a sentence or two to summarize the purpose of this plan.]

[This Systems Engineering Management Plan (SEMP) describes the organization, activities, and management of the Systems Engineering tasks to be accomplished for the [program name] program {or the [program life cycle phase] phase of the [program name] program}. The objective of the Systems Engineering effort is to assure successful development of the [system of interest] system primarily by defining processes for clear and accurate system requirements and verifying compliance of the system to those requirements. This SEMP will be updated throughout the project lifecycle to reflect changes in technical plans. No provision of this SEMP shall relieve the program of meeting the performance, cost, and schedule requirements of the Contract.]

## System Description

[Describe the system, using text and/or figures as appropriate.]

# References, Definitions, & Acronyms

## Internal References

[These are GE based documents. List the applicable QMS documents, etc. here]

The following documents of the exact issue shown form a part of this document to the extent specified herein. For those documents showing no date of issue or revision, the latest issue or revision applies. A list of applicable QMS documents for each section/subsection is available in OGQ-ENG-0110.4R.

Table 1: Internal References

|  |  |
| --- | --- |
| OGQ-SYS-0110.1 (O&G SE Portal) | [GE Oil & Gas Systems Engineering Handbook](http://supportcentral.ge.com/products/sup_products.asp?prod_id=338370) |
| OGQ-ENG-0110.4R | SEMP Reference Applicability Matrix |

## External References

[These include API, government and other regulating bodies, in addition to customer documents.]

The following documents of the exact issue shown form a part of this document to the extent specified herein. For those documents showing no date of issue or revision, the latest issue or revision applies.

Table 2: External References

|  |  |
| --- | --- |
| NASA/SP-2007-6105 | NASA Systems Engineering Handbook |
|  |  |

## Definitions

[Define specific equipment, tools or processes that are unique to the project here. Keep the description short.]

## Acronyms

|  |  |
| --- | --- |
| API | American Petroleum Institute |
| ATQ | Approval to Quote |
| CDR | Concept Design Review |
| CDRL | Contract Data Requirements List |
| CMP | Communication Management Plan |
| CTH | Controlled Title Holder |
| CTQ | Critical to Quality |
| DPP | Design Process Plan |
| FMEA | Failure Mode and Effects Analysis |
| FMECA | Failure Mode Effects and Criticality Analysis |
| HMI | Human Machine Interface |
| I/O | Input / Output |
| ILS | Integrated Logistics Plan |
| IP | Intellectual Property |
| ISDS | Integrated Software Dependent System |
| ITO | Inquiry to Order |
| MoC | Management of Change |
| MTBF | Mean Time Between Failure |
| NPI | New Product Introduction |
| OTR | Order to Remittance |
| PBS | Product Breakdown Structure |
| PLM | Product Lifecycle Management |
| PRD | Product Requirements Document |
| SIL | Safety Integrity Level |
| SE | Systems Engineering or Systems Engineer |
| SEMP | Systems Engineering Management Plan |
| SRA | Safety Requirements Analysis |
| SRS | Safety Requirements Specification |
| TRL | Technical Readiness Level |
| TRS | Technical Regulations and Standards |
| WBS | Work Breakdown Structure |
|  |  |

# Technical Planning & Control

[This describes the proposed process for planning and control of the engineering efforts for system’s design, development, test and evaluation.]

## Task Description

[Define the technical work that must be performed under the contract, statement of work, directive, initiative, etc.]

### Deliverables

[Indicate the flow down of Contract Data Requirements List (CDRL) items to work packages. The deliverables list becomes a set of specified outputs (a quantity and quality specification) for each milestone of the project. For each significant element of the project, define a deliverable(s) which is the concrete output and evidence of the work. This can be in the form of a report, article delivery, etc.]

### Physical / Functional Architecture

[Show the major subsystems and describe their functions. Show key interfaces as applicable. Define using a tree or diagram if feasible.]

### Work Breakdown Structure (WBS)

[Show the Work Break­down Structure (WBS) and describe the scope of each technical work package. The WBS should be a product-based, hierarchical division of deliverable items and associated services.]

### Subcontractor Work Effort

[Define the work efforts to be performed by subcontractors or teammates under the contract. Identify the WBS work packages containing this effort.]

### Schedule

[Show the program schedule. Identify development phases and major milestones. Show task network of task dependencies, with critical path. (Copy the one page Master schedule from the Integrated Master Plan (IMP) and link to the detail schedule or IMS)]

## Engineering Work Plan

[Define the Systems Engineering technical plans.]

### Engineering Organization

[Show a diagram of the technical project organization. Also include diagrams of the related program organization and functional organizations. Provide a textual description of the responsibilities of each person in the technical project organization, including the SE team. Cross-reference responsibilities to the WBS.]

### Risk/Opportunity Matrix

[Describe the plans to manage and mitigate technical risks on the program. Identify risk levels, threshold criteria and decision authority. Identify methods to identify risk, analyze risk and track risks. Identify what technologies are critical and follow the steps outlined for risk management. Each risk/opportunity shall be identified and evaluated in terms of probability and impact. Each critical risk will have mitigating actions. Use of a risk register is encouraged. (Make the detailed Risk Management Plan a separate document and provide an overview here with links to the detailed plan).]

### Communications Management

[Define the Communications Management Plan (CMP) which will promote the success of a project by meeting the information needs of project stakeholders. It defines the communication requirements for the project and how information will be distributed:

* What information will be communicated—to include the level of detail and format
* When information will be distributed—the frequency of project communications both formal and informal
* Who is responsible for communicating project information
* Communication requirements for all project stakeholders
* The flow of project communications
* Any constraints, internal or external, which affect project communications
* Any standard templates, formats, or documents the project must use for communicating

The following table identifies an example of Communication Matrix for a generic project:

Table 3: Communication Plan Matrix

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Communication Type | Objective of Communication | Frequency | Audience | Owner | Deliverable | Format |
| Kickoff Meeting | Introduce the project team and the project. Review project objectives and management approach. | Once | - Project Sponsor - Project Team - Stakeholders | Project Manager | - Agenda - Meeting Minutes | - Soft copy archived on SharePoint site and project website. |
| Project Team Meetings | Review status of the project with the team. | Weekly | - Project Team | Project Manager | - Agenda - Meeting Minutes - Project Schedule | - Soft copy archived on SharePoint site and project website. |
| Technical Design Meetings | Discuss and develop technical design solutions for the project. | As Needed | - Project Technical Staff | Technical Lead | - Agenda - Meeting Minutes | - Soft copy archived on SharePoint site and project website. |
| Monthly Project Status Meetings | Report on the status of the project to management. | Monthly | - PMO | Project Manager | - Slide Updates - Project Schedule | - Soft copy archived on SharePoint site and project website. |
| Project Status Reports | Report the status of the project including activities, progress, costs and issues. | Monthly | - Project Sponsor - Project Team - Stakeholders - PMO | Project Manager | - Project Status Report - Project Schedule | - Soft copy archived on SharePoint site and project website. |

### Safety Integrity Level Plan

[Describe how the project will prepare for and meet the requirements of SIL. Safety Integrity Level will be achieved in cooperation with the customer.  At the beginning of the project the customer will conduct a safety hazard and risk assessment.  This safety risk assessment process is described in the standards.  The safety risk assessment will define the necessary safety instrumented function (SIF) and safety instrumented system (SIS) function in the system.  The SE team in cooperation with the customer will draft a Safety Requirements Specification (SRS).]

### Technology Maturity (TRL)

[Describe how the project will prepare for and meet technology readiness level requirements. Provide a list of subsystems and/or components, or processes with a Technology Maturity Level, based on Figure 1. Identify the path to move from a low TRL to a minimum TRL of 6 during the project development.]

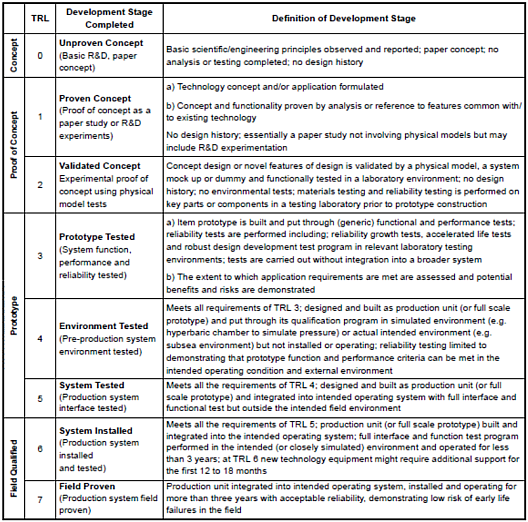


Figure 1 - TRL Chart for Oil and Gas Domain

### FMEA/FMECA Plan

[Describe the plan for drafting an FMEA for the project. Failure mode and effect analyses (FMEA) will be held at many points in the process to support a strong design, TRL maturity, and SIL related activities. FMEAs will be held at the subsystem as well as the system level in the program, resulting in in the appropriate number of FMEAs for the program. These activities should be facilitated by someone who has been trained or has experience in FMEA analyses (e.g., systems or reliability engineers). For any system or subsystem being analyzed FMEAs should be held at the concept level (functional FMEA), the preliminary level, the detail design level, and if necessary during the V&V. Some of these sessions may result in no updates to the FMEA and others will result in many additions or changes due to the increased maturity of the design.]

### Certification

[Define the certification methods to be used in the documentation of the project. This may be driven by customer input.]

## Program/Design Reviews

[Define the process to be followed for program and design reviews. This paragraph should describe the planning, administration, and conduct of technical reviews. Address the distribution of review packages, development of review agenda and the conduct of reviews, including rules for participation and chairpersonship. The total documentation release system should be discussed, including signoff.]

### Milestones

[Show a schedule for the specific program and design reviews to be used. Describe the purpose and content of each review. (The reviews should be listed on the Master schedule. Only describe them here if the project is deviating from the organization’s standard processes for reviews).]

### Gates Criteria

[Reference to the standard GE O&G process, or describe the deviation from the process, based on complexity, customer needs, etc.]

### Work Products to Customer

[Identify and describe work products that will be delivered to the customer or other stakeholders. Describe any specific format and dependency criteria. Reference the Project Management Plan for details of delivery and acceptance of work products.]

## Technical Control (PLM)

[Define the Product Life Cycle Management controlling functions.]

### Requirements Management

[Describe the plans to manage the requirements database, and the tools to be used. Define the verification plan that will be written to define the items to be verified and which methods will be used to verify performance.]

### Interface Control

[Describe the plans to control interfaces within the system and between the system and other systems. Identify the interfaces to be controlled. Also define the formal and informal technical interfaces to others. Consider customer and internal technical interface meetings, interface control working groups, and standards committees. Define how to control the interfaces authority and responsibility.]

### Configuration/Change Control

[Describe the plans to control baseline configuration of the system design. Configuration change management is achieved via the systematic proposal, justification, and evaluation of proposed changes, followed by incorporation of approved changes and verification of implementation. If a separate Configuration Management Plan exists, refer to it.]

### Document Control

[Describe the plans to control the documents on the program. Consider master documents, copies, and distribution. Include documents created by the program team and those received from external sources. (The plans should include an "Information Architecture" diagram. Include the diagram in this section along with the descriptions recommended.)]

### Data Management

[Describe how the project will manage the information generated by execution of the project including how the data will be generated, processed, authorized, protected, distributed, analyzed and archived.]

## Performance Control

### TPM Process

[Define the process to gather and calculate Technical Performance Measures (TPM). Define the frequency of measurement. Define the methods to disseminate the results, including management visibility.]

### Technical Measures

[Define the TPMs to be calculated. Define the raw data required and sources. Define the calculation methods for each TPM. The total number of TPMs should be limited to 3-5 total, and can include range, accuracy, weight, size, availability, power output, power required, process time, etc.]

# Systems Engineering Processes

[This section includes specific tailoring of the SE process, implementation procedures, trade study methodology, types of models to be used for system and cost effectiveness evaluations, generation of applicable documentation and specifications.]

## Engineering Process

[In the subsections that follow, describe (as they apply) the project-unique processes in each phase. Use standards as a reference, and do not restate the processes therein. Consider each activity in each phase. Specifically address the automated tools that will be used and their interconnection.]

### Concept of Operations

[Define scenarios for customer usage from operation, anomalies, and through disposal. The process is used to gain consensus among stakeholders on the uses, operating and support concepts, employment, capabilities, and benefits of an asset, capability, or system.]

### Requirements Definition/Allocation

[Describe each of the requirements analysis techniques to be used, the criteria for use of the technique, and, where applicable, the detailed selection of technique(s) against requirements analysis tasks. Example techniques for description include flow down of customer needs, input/output diagrams, use cases, context flow analysis, context analysis, states and modes analysis, mission / scenario analysis, derivation and allocation of requirements, etc.]

### System Architecture

[Describe the methods to be used in defining and updating the system architecture.]

### System Integration

[Describe in detail the integration strategy that will be used, include diagrams and sequence flows where they would be helpful. Define the plan for documenting what integration tests will be performed and the facilities needed.]

### System Verification

[Describe in detail the verification strategy that will be used, include diagrams and sequence flows where they would be helpful. Define the plan for developing and documenting the verification procedures, test cases, test scripts and any other supporting documentation. Identify test facilities and equipment needed. Be sure to define who is to perform and witness the verification of each item.]

### System Validation

[Describe in detail the product validation strategy that will be used, include diagrams and sequence flows where they would be helpful. Define the plan for developing and documenting the product validation procedures, test cases, test scripts and any other supporting documentation. Identify test facilities and equipment needed.]

### Related Processes

[Related processes can include: Mechanical, Electrical, Software, Instruments/Controls. Elaborate in this section as appropriate.]

## Trade Studies & Evaluation

[Describe the process to be used in performing trade studies. Consider trade matrix formats, depth of analysis, and types of information. Make sure the difference between a «must» & «want» is clear.]

### Pugh Matrix

[The Pugh Matrix is the most common tool used when considering architectural trades. Define the trades to be performed in the scope of the project.]

### Detailed Trade Methods

[Define the detailed trade studies which will be performed. Provide the preferred criteria/attributes and weighting factors to be used during the trades. Identify the major system trade studies to be performed.]

### Prototyping/FastWorks

[Define the prototyping methods and tools the project plans to use, including FastWorks principles that allows us to get closer to our customer by making us more nimble – within the project, processes, or technologies.]

## Design Optimization

[Describe the planned use for design optimization on the project, and the resources needed.]

### Modeling Tools

[Describe the modeling tools to be used in the scope of the project. This can include electronic modeling or physical mockups.]

### Analysis Tools

[Describe the mathematical, simulation, and/or prototyping methods to be used to optimize the design and measure its effectiveness. Define how these methods will be used to impact the design, in which phases. Identify the specific tools to be used. Describe how to handle multi­ dimensional interdependencies.]

### Design-to-Cost

[If Design-to-Cost is a priority, describe how the project will accomplish its goal and still satisfy the customer with the project’s fixed budget. Refer to the “Designing to Constraints” section of the GE Oil & Gas Systems Engineering Handbook for more detail on this subject.

## Documentation

### Specification Tree

[Show a hierarchical diagram of the specifications that will be created for the system and its elements. Identify the type of each specification. Indicate which specifications are internal and which must be delivered. (Replace the specification tree with a document tree or information architecture diagram for a more complete description of project documentation.)]

### Other Documents

[List other documents that will be created. Indicate which documents are internal and which must be delivered.]

### Document Generation Methods

[Describe the methods to be used to generate documents. Identify the specific tools, and their required interconnections. Describe the review and sign-off process.]

## Training & Skills

[Define the training plan which will be employed in support of the project. Describe critical skills needed by the team to ensure success. An example is listed here.]

To properly prepare the staff for SIL, multiple types of courses will be required.

SIL certification courses will be conducted at a minimum for the functional safety leader, all functional safety engineers, and the system engineers on the project. It may be beneficial to have at least one controls engineer, one quality engineer and one software engineer trained at this level in addition to the minimum staff defined above. This certification will be done by an external consultancy such as TUV, Exida, etc.

SIL awareness training will be conducted for all project participants including engineering, sourcing, quality, project management, etc. SIL is a highly cross functional requirement and will affect nearly all areas of the business. This training may be conducted by an external consultancy or by the GE functional safety leader. It is preferred that this training be done at GE.

The SIL control systems will incorporate a limited variability software language. Training on the language and tools will be provided for the software engineers. This training will be conducted by the vendor of the control system.

# Engineering Specialty Integration

[This section describes the integration of technical discipline efforts and parameters into the SE process. Each section is to be filled out as appropriate for specific project. Indicate the information needed by the responsible discipline and its source and time of need. Indicate the expected results and when.]

## Integrated Logistics Support Plan

[Summarize the approach to Integrated Logistic Support (ILS). Refer to a separate ILS Plan, if available. Consider the aspects of Logistic Support Analysis, Provisioning, Transportation, Packaging and Training. ]

## Reliability/Maintainability/Availability Plan

[Summarize the approach to Reliability/Maintainability/Availability (RMA) analysis and control. Refer to a separate RMA Plan or plans, if available.]

## Safety Plan (EHS)

[Summarize the approach to safety analysis and control, and the information needed by EHS such as Management of Change, Safety Risk Assessment (SRA), lift plans, etc. Refer to a separate Safety Plan, if available. This may include the need for Hazard Analysis and FMEA.]

## Human Factors Plan

[Summarize the approach to human factors analysis and control. Refer to a separate HFE Plan, if available.]

## Electromagnetic Effects Plan

[Summarize the approach to electromagnetic effects analysis and control. Consider EMI, EMC and TEMPEST as appropriate. Refer to a separate plan, if available.]

## Security Plan

[Summarize the approach to security analysis and control. Refer to a separate Security Plan, if available.]

## Value Engineering Plan

[Summarize the approach to value engineering analysis and control. Refer to a separate plan, if available.]

## Materials Engineering Plan

[Summarize the approach to materials engineering analysis and control. Refer to a separate plan, if available.]

# Appendix