

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE

MANUAL

PROJECT QUALITY ASSURANCE

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PREFACE

PETRONAS Technical Standards (PTS) publications reflect the views, at the time of publication, of PETRONAS OPU/Divisions.

They are based on the experience acquired during the involvement with the design, construction, operation and maintenance of processing units and facilities. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good technical practice to be applied by PETRONAS' OPU/Divisions in oil and gas production facilities, refineries, gas processing plants, chemical plants, marketing facilities or any other such facility, and thereby to achieve maximum technical and economic benefit from standardisation.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where PTS may not cover every requirement or diversity of condition at each locality. The system of PTS is expected to be sufficiently flexible to allow individual operating units to adapt the information set forth in PTS to their own environment and requirements.

When Contractors or Manufacturers/Suppliers use PTS they shall be solely responsible for the quality of work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, the Principal will expect them to follow those design and engineering practices which will achieve the same level of integrity as reflected in the PTS. If in doubt, the Contractor or Manufacturer/Supplier shall, without detracting from his own responsibility, consult the Principal or its technical advisor.

The right to use PTS rests with three categories of users :

- 1) PETRONAS and its affiliates.
- 2) Other parties who are authorised to use PTS subject to appropriate contractual arrangements.
- 3) Contractors/subcontractors and Manufacturers/Suppliers under a contract with users referred to under 1) and 2) which requires that tenders for projects, materials supplied or - generally - work performed on behalf of the said users comply with the relevant standards.

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Without prejudice to any specific terms in respect of confidentiality under relevant contractual arrangements, PTS shall not, without the prior written consent of PETRONAS, be disclosed by users to any company or person whomsoever and the PTS shall be used exclusively for the purpose they have been provided to the user. They shall be returned after use, including any copies which shall only be made by users with the express prior written consent of PETRONAS. The copyright of PTS vests in PETRONAS. Users shall arrange for PTS to be held in safe custody and PETRONAS may at any time require information satisfactory to PETRONAS in order to ascertain how users implement this requirement.

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1. INTRODUCTION

1.1 SCOPE

This new PTS provides guidance on the implementation of Quality Assurance on a project.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by PETRONAS, the distribution of this PTS is confined to companies forming part of PETRONAS or managed by a Group company, and to Contractors and Manufacturers/Suppliers nominated by them.

Amended per
Circular 70/03

This PTS is intended for use by Group companies undertaking engineering projects.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this PTS, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this PTS which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this PTS as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

NOTE: Where in this PTS the words "Opco", "PETRONAS" or "client" are used, these will have the same meaning as "Principal".

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

The following definitions are from ISO 8402 or the Group publication "Quality - Improving our Business".

Asset Holder - The position which is accorded single point accountability by the Company chief executive for all aspects of the management, including budgetary control, of a clearly defined asset or group of assets, over part or all of its lifecycle in order to achieve corporate objectives.

Customer - Recipient of a product provided by the Supplier (ISO 8402). The 'product' may be a piece of hardware or a service.

Quality - Meeting agreed customer requirements.

Quality Assurance - All the planned and systematic activities implemented within the quality system, and demonstrated as needed, to provide adequate confidence that an entity will fulfil requirements for quality. (ISO 8402)

Quality Control - Operational techniques and activities that are used to fulfil the requirements for quality. (ISO 8402)

Quality Improvement - Actions taken throughout the organisation, to increase the effectiveness and efficiency of activities and processes to provide added benefits to both the organisation and its customers. (ISO 8402)

Quality Management - All activities of the overall management function that determine the quality policy, objectives and responsibilities, and implement them by means such as quality planning, quality control, quality assurance and quality improvement within the quality system. (ISO 8402)

Quality Planning - Determining and defining the customer's needs, and framing the objectives, standards and controls to meet them.

Quality Plan - A document setting out the specific quality practices, resources and sequence of activities relevant to a particular product, service, contract or project. (ISO 8402). The plan for the project as a whole should be termed the Project Quality Plan; plans prepared by Contractors or Suppliers may then be termed Contractor or Supplier Quality Plans [\(4.2\)](#).

Quality System - Organisational structure, procedures, processes and resources needed to meet the quality objectives. (ISO 8402)

Standard - A document providing rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.

Other Quality terms are defined in ISO 8402.

1.4 ABBREVIATIONS

HSE	-	Health, Safety and Environment (including Welfare)
QA	-	Quality Assurance
QC	-	Quality Control
ROM Engineering	-	Reliability, Operability and Maintainability Engineering

1.5 CROSS-REFERENCES

Where cross-references to other parts of this PTS are made, the referenced section number is shown in brackets. Other documents referenced by this PTS are listed in [\(9\)](#).

2. THE ROLE OF QUALITY ASSURANCE

2.1 THE NEED FOR QUALITY ASSURANCE

Quality is 'meeting agreed customer requirements', and quality management aims to do this at the lowest overall cost. For an engineering project, the ultimate customer is the Asset Holder, but there are also internal customers; for example the fabricator is a customer of the designer. Management systems should be used to assure technical integrity, since quality failures result in cost and schedule over-runs and lead to higher operating costs and safety or environmental risks over the whole of the lifecycle. Operational quality failures are equally serious in cost and risk terms, and the QA approach forms the basis for sound HSE and general operations management. In addition, there is an increasing need to make management of the business transparent to regulators and to others. This PTS provides guidance to all staff who are setting up project management systems, or have to evaluate a Contractor's or Supplier's system.

The principles described herein apply to the management of any aspect of a project, for example safety, environment, organisation, information, cost/budget and schedule.

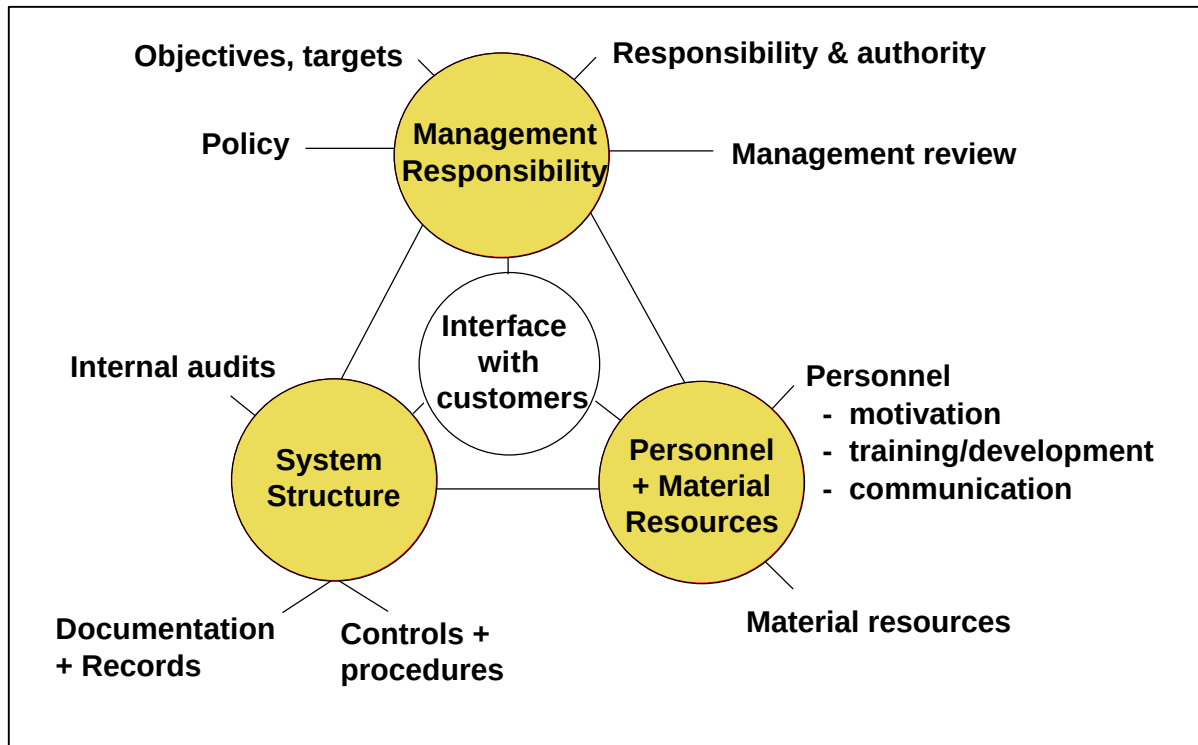
2.2 LINK WITH QUALITY MANAGEMENT

Quality Management embodies three interlinked elements: Quality Planning, Quality Control and Quality Improvement. The overall aim for a company is to achieve continuous performance improvement through the management of the underlying business processes, as described in EP 92-0945. From the perspective of an individual project, however, the emphasis will be upon **Quality Assurance** (QA), which is the combination of Quality Planning and Quality Control. Although most lessons learned during project execution will be fed back into the organisation, leading to improvement in subsequent projects, some may be incorporated into the project itself.

2.3 THE ISO 9000 STANDARDS

The ISO 9000 Standards for QA have wide applicability, but are written in a general way, identifying some 20 elements which make up a 'complete' system for a company. They are summarised in [Figure 1](#).

FIGURE 1 ELEMENTS OF THE ISO 9000 STANDARDS



ISO 9004 provides guidance on the implementation of a quality management system. ISO 9001 defines requirements for assurance throughout design, manufacture, installation and servicing. ISO 9002 deals with manufacturing and installation and ISO 9003 covers simpler items in which quality can be verified by final inspection and test only.

3. IMPLEMENTATION OF QUALITY ASSURANCE

3.1 ACTIVITIES

Not all the elements will apply to a particular project, but all projects shall have QA input and a Project Quality Plan (4.1) which is part of the Execution Plan for the project. To maintain asset quality and to achieve its objectives, a project should "organise itself in such a way that the technical, administrative and human factors affecting the quality of its products are under control. All such control should be oriented towards the reduction, elimination and, most importantly, prevention of quality deficiencies" (as defined in ISO 9004). A well structured quality system enables management to optimise and control quality in relation to risk and cost/benefit.

The management system is documented in the Project Quality Plan, addressing critical activities, such as:

- determination of customer needs;
- definition of the methods to be employed to achieve them;
- assessment of the criticality of activities and products;
- allocation of responsibility and definition of controls;
- generation and maintenance of quality records;
- QA audit and review;
- quality improvement.

3.2 STAFF

As with safety, quality is the responsibility of line management and of each and every individual working on the project. Competent and motivated staff, supported by a well-understood system of working, are the ingredients for success. Depending upon the size of the project, they shall be backed up by dedicated or corporate QA staff, who must retain a high degree of independence and objectivity, reporting directly to the project manager and with a functional link to the corporate quality organisation. Typically, QA staff will be responsible for:

- coordinating the preparation of the Project Quality Plan;
- assessment of potential Suppliers' and Contractors' quality systems and quality plans;
- monitoring:
 - the implementation of the project quality system;
 - activities of Contractors and Suppliers in implementation of their quality plans;
 - the gaining of regulatory permits for the project;
- the execution of audits and reviews and the follow-up of any actions arising from them.

Responsibility for inspection is sometimes added to the QA staff, but it more properly belongs with Engineering. Similarly, project document control should be handled by administration staff.

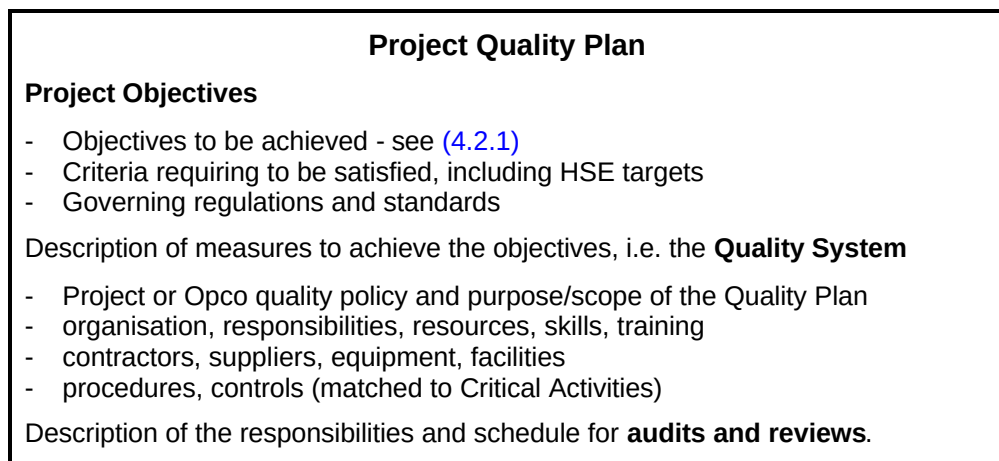
3.3 DOCUMENTATION

Formal QA is fully documented. **Critical** activities (5.1) are performed according to written procedures or work instructions based on proven techniques, and evidence of compliance recorded. It is accordingly essential that engineers (with the operators) exercise proper judgement in deciding which hardware systems and activities are critical. Over-control costs money and time as well as swelling the 'paper mountain' to be handed over to Operations. Quality can for example be assessed by properly controlled sample checking; complete validation is not always necessary. Having established that an activity is critical, the way in which it is to be controlled is decided by the engineer concerned, who is responsible for specifying the necessary standards and devising and documenting the management controls (such as design reviews or inspection). If a new procedure is required, guidance is given in Appendix B. QA activities are incorporated into the workscope of the project and are scheduled and monitored through the Quality Plan.

4. QUALITY ASSURANCE OF PROJECT MANAGEMENT

4.1 THE QUALITY PLAN

All projects shall have an approved **Project Quality Plan**, prepared at the start of the project by the project engineer, and updated to include more detail as the project advances. Site-specific plans should be prepared prior to starting activities on a construction site. The Project Quality Plan is a documented description of the project management system and must be approved by the project manager or engineer, in part to demonstrate his commitment to quality but primarily since it is the means by which technical and administrative authorities are delegated throughout the project. It draws together the key documents which describe the objectives of the project, identifies the critical activities and defines the controls required to ensure that the project quality objectives are met.

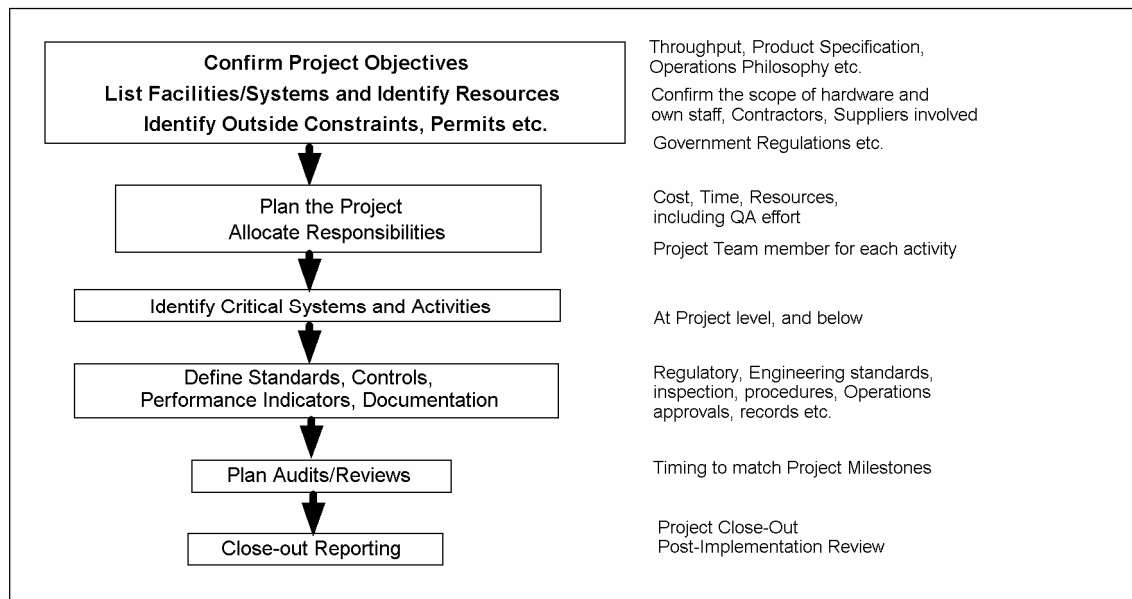


The contents of typical Quality Plans for large and small projects are summarised in [Appendices A.2](#) and [A.3](#). The quality system should only be as comprehensive as needed to meet the project objectives. On major stand-alone projects the very nature of the project demands that it is supplied with the necessary levels of expertise and that the relevant controls and plans are in place. However, in the multi-project environment less experienced staff are often placed in decision-making roles and reliance is placed upon the use of standard procedures. Experience has shown that such procedures are often ignored for a variety of reasons (e.g. pressure of work/conflicting priorities/non-availability of third parties, etc.). The management system as documented in the Quality Plan overcomes these problems by ensuring that the review cycle is adequately planned, has third party and management pre-commitment, and provides well documented records which give an audit trail. It also ensures that records and handover documentation are properly planned and completed during the work. In a multi-project environment such Quality Plans may be prepared in a standard format.

4.2 PREPARATION OF A QUALITY PLAN

A flowchart for the preparation of a Quality Plan is given in [Figure 2](#).

FIGURE 2 PREPARATION OF A QUALITY PLAN

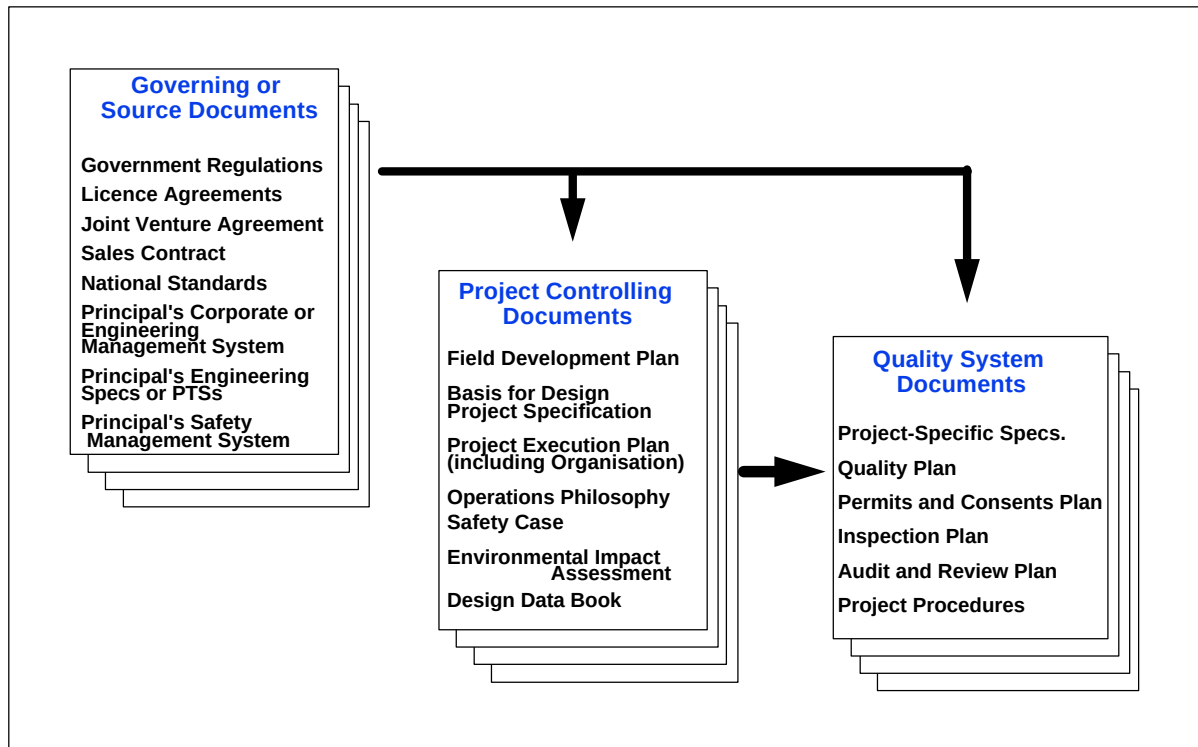


The Quality Plan document itself should be kept as compact as possible by briefly summarising information contained in other documents. It should contain the following elements:

4.2.1 Objectives, resources and constraints

If all the objectives of the project are to be achieved, it is essential that they be formally agreed with the ultimate Asset Holder, properly recorded and communicated to all. Any particular constraints arising from regulators, special environmental factors, the need to use certain technology etc. should also be defined. This is as important for the small project (in which key staff may be part-time) as it is for a major project (where the team may be located in the offices of several Contractors). The objectives of the project, and the governing documents detailing them form the top level of the **Quality System** (Figure 3).

FIGURE 3 STRUCTURE OF THE QUALITY SYSTEM



Key documents controlling the project will be the:

- Field Development Plan
- Basis for Design
- Project Specification
- Project Execution Plan (including Organisation)
- Operations Philosophy and Operations Reference Plan
- Safety Case
- Environmental Impact Assessment
- Design Data Book.

The Design Data Book should be produced in a loose-leaf format, with a one- or two-page section for each system or plant unit. The initial issue shall embody the Basis for Design, and it should later be updated to incorporate and 'freeze' the key parameters of each system as they are developed and agreed during the design phase. The internal notes, minutes of meeting etc. recording such decisions can be included or referenced in the section concerned. It forms an excellent medium to track and record the development of the design from concept to handover, and can be used to formalise at a high level the future Asset Holder's agreement to the design.

4.2.2 Plan the project and allocate responsibilities

A high-level project plan is first developed, and each activity allocated to an accountable person and included in a written job description. This can be brief but shall include:

- Title of description of the position
- Primary responsibilities of that position
- Reporting and interfacing structure of the position.

The accountable engineer should then break down his activities to the next level making more detailed plans, again allocating responsibilities and identifying linkages and interfaces with others, including any Contractors. In most Opcos small projects are handled by a standard development and engineering process; the flow of activities will be similar for each project. It is these overall processes which will be managed (EP 92-0945). In such matrix

organisations it is particularly important for the project engineer to identify the departments and individuals responsible for carrying out the activities for his project, and to confirm that they are competent to carry them out. In general the smallest activity described in such a Project Quality Plan should correspond to the workscope of a lead discipline engineer.

4.2.3 Identify critical hardware systems and activities

A system or equipment item will be critical if it safeguards the integrity of the facility or impacts upon its ability to meet its performance objectives. The evaluation of criticality and hence the appropriate quality programme is given in [\(5.1\)](#).

**Amended per
Circular 70/03**

An activity can be critical by reason of its importance to the success of the project or through **risks** associated with it. For instance, an activity will be safety-critical if it involves identifying, assessing, controlling or recovering from a hazard (the 'Hazard Management Process' described in EP 95-0100). Typical activities which affect the quality of a project phase are given as a checklist in [Appendix C](#).

4.2.4 Define standards, controls and performance indicators

The critical activities can be summarised in a table as illustrated in [Figure 4](#), including details of responsibilities, standards, methods of verification and records. A similar format can be used to cover the whole of a small project.

FIGURE 4 TYPICAL QUALITY PLAN MATRIX FOR ONE PHASE OF A MAJOR PROJECT

Quality Plan Matrix - Front End Engineering															
Item	Quality Related Activity	Activity Execution Responsibility										ISO 9001	Opco Standard,	Quality Record of Activity	Note
		Specific Staff to be nominated										Section Reference	Control or Project Procedure No.		
1	Petroleum Eng. Design Basis		P									4.4		e.g. FDP	
2	Engineering Design Brief			P		S			S			4.9	e.g. Data Book		
3	Design Control Procedure			P					S		P	4.9			
4	Design Verification								S			4.4			
5	Interdiscipline Review								P			4.9			
6	Design Approval			P					P			4.9			
7	Design Review Actions			P			S					4.9			
8	Weight Control								P			4.9			
9	Technical Interface Control			P	S	S	S	S	S		S	4.4			
10	Engineering Change Control	P	S	S				S				4.5			
11	Regulatory Approvals			S					P			4.5/4.9			
12	Reliability/Operability Assessment			S						P		4.4			
13	Maintainability Assessment			S				P				4.4			
14	HSE Case	P		S	S	S	S					4.4			
15	HAZOP, HAZAN etc.			S						P		4.4			
16	Software Validation and Control										P	4.9			
17	Contract Specifications Prep/Cont.			P								4.4/4.6			
18	Document Control									P		4.5			
19	QA Review/Audit							P				4.17			
20	Pipeline Activities			S						P		4.4	PTS 31.40.00.10		
21	Contractor Appraisals			P	S	S	S			S	S	4.6			

P = Responsibility for execution of activity as defined in 'Tasks and Targets'
S = Supporting role as defined in procedures

Controls fall into five categories:

Audit and Review - A periodic review of an activity shall be carried out by the responsible manager or by an independent person to confirm that the control framework is appropriate and being properly implemented.

Organisational - The organisation shall be designed to ensure that there is single-point accountability for each activity, that responsibilities and authorities are clear and that staff have the required expertise and time to complete the work to the proper standard. The responsible engineer must confirm that the activity is within the competence of the individuals or team doing it or whether any special training or assistance is required.

Policy - A policy provides general principles and guides for action which influence decisions. Project staff and Contractors shall be made aware of the relevant Opco policies governing, for example health, safety and environmental matters, relations with local communities etc.

Procedural - Written procedures and work instructions must be available to and understood by the staff required to work to them. Project-specific procedures may be required, and are described in [Appendix B](#).

Supervisory - Senior engineers shall ensure that procedures are understood and followed, but also check that they are appropriate for the current circumstances - perhaps they can be simplified or improved. In addition supervising engineers will verify critical and inter-discipline activities, or ensure that they are checked by other colleagues.