



QUALITY MANAGEMENT PROGRAM
(Management Plan)



1. QUALITY MANAGEMENT

1.1 Introduction

A quality management program, encompassing all stages and disciplines of a project, is a key to the successful management and quality control of all projects and is fundamental to the project management services *Niroo Va Tavan(NVT)* provides to its clients. The following describes *NVT* philosophy and approach to quality control, and will be incorporated into the plans which we propose to provide.

1.2 The Quality Management Process

Quality Management is the control and monitoring of the processes of quality assurance and quality control to ensure conformance with specifications.

Quality is achieved by good performance. This requires that all activities be appropriately planned, implemented and controlled. Verification ascertains the existence of quality. The combination of performance and verification provide assurance of quality.

For a company to achieve quality, implementing a quality assurance program is required which is most generally arranged by the issuing of a company Quality Assurance Manual.

Quality Assurance Program means a program for defining, planning, conducting and controlling of all Quality Assurance activities that lead to the completion of a project with Quality.

Quality Assurance means all those planned and systematic actions necessary to provide adequate confidence that a structure, system or component will perform satisfactorily in service.

Quality Control means those quality assurance actions which provide a means to *control and measure* the compliance of characteristics of the work processes to established requirements.

The **Quality Assurance Manual** contains a number of procedures that must be undertaken by those controlling the 'work' to give adequate assurance that the required quality is being achieved. The 'work' embraces design, procurement, manufacture, installation and construction.

The preparation of a Quality Assurance Manual is a significant task. A copy of the typical Table of Contents of *NVT* Quality Assurance Manual is provided in Section 2.

1.3 Required Quality

In order to be able to judge whether the required quality is being achieved, it is necessary to first define the quality required. This is accomplished through a variety of documentation, depending on whether the aspect whose quality is being defined is engineering design, procurement, manufacturing, installation or construction.



1.3.1 Engineering Design & Procurement

The document defining the quality of engineering design is often referred to as a 'Design Criteria'. This document lists any design standards to be followed, the relevant values of design parameters to be employed and the design approach to be adopted. For instance for thermal generating station, design criteria would be required for all of the various types of electrical and mechanical equipment, including the performance requirements to be achieved not only by the equipment, but also by the systems of which the equipment is a part. The design criteria would be followed during the preparation of technical specifications for procurement, for the review of suppliers' designs, and later for the preparation of start-up and commissioning procedures.

The *Procurement quality assurance* procedure to ensure adequate quality is being achieved by the suppliers would

- describe the general and specific standards to which the equipment must be designed
- describe the types of checks that would be made of the assumptions and calculations produced by the designer as well as those by the supplier
- indicate the degree of the checking to be performed
- indicate who is responsible for making these checks.

1.3.2 Manufacturing

The quality of manufacturing to be achieved is defined by the contract technical specifications.

The manufacturing quality assurance procedures are needed to describe steps that will be taken during the manufacturing of the equipment to be supplied to the project. These steps will provide adequate assurance that the manufacturers are following the prescribed procedures and that they are achieving the required quality. The procedure would

- define which aspects during the manufacturing process require mandatory inspection by the client or his representative and which others may be inspected by the supplier and the results of such inspections documented and submitted
- indicate which shop tests will be witnessed by the client or his representatives
- advise whether inspection of packaging prior to shipping is required
- advise whether written clearance to ship is necessary.

For major custom-designed and manufactured equipment, it is usual that considerable quality assurance effort employed by the Client, since the quality and subsequent performance of the equipment is paramount to the success of the project. In such cases, the procedures are fairly lengthy and specific to the equipment in question. For standard off-the-shelf items, the Client generally retains the right of inspection and shipping clearance, but rarely exercises that right.

Section 2 contains a copy of a typical table of contents of a *NVT Quality Assurance Manual* as well as a *Quality Assurance Program for Manufacturing*. These documents demonstrate *NVT* approach and commitment to the implementation of a proactive quality assurance program.



1.3.3 Construction and Installation

A very proactive role should be taken by the Client during the construction and installation of the plant since only the Client or his representatives can be expected to have a full appreciation of the total project and, in particular, the ongoing satisfactory performance of the completed project.

Individuals, representing the Client, suitably skilled in the appropriate disciplines, should closely monitor and record the quality (and schedule) performance of the contractors.

Quality assurance procedures are required to describe the efforts to be taken by the site staff. These procedures need to be specific to the project. A generic version of such a Quality Assurance Procedure - Construction and Installation, is provided in Section 2.

2. QUALITY ASSURANCE PHILOSOPHY

2.1 Quality Assurance-Formula for Operation

2.1.1 General

Quality Assurance guarantees that each project will meet quality and delivery schedules and yet this important factor is often overlooked in initial planning stages. In many instances, Quality Assurance is not implemented until serious product failure has resulted in costly delays.

2.1.2 Scope

The scope of services may vary from a nominal advisory function to complete involvement in project undertakings, including review of procedures and specifications, pre-award evaluation of contractor's facilities, shop inspection, progress reporting, expediting of information and equipment, and site inspection during erection and commissioning.

2.1.3 Effect

The client can be certain that materials are supplied, and engineered products are built in the shops in accordance with the requirements of purchase documents, specifications, data sheets, approved procedures, drawings, and applicable codes and standards. Deviations are immediately disclosed and brought to the attention of the client, his delegates, or his engineers. By immediate initiation of corrective actions, cumulative errors are avoided and schedules are maintained.

2.1.4 Participation

Continuous participation in, and association with, modern engineering, manufacturing methods and quality control techniques place the *NVT* Quality Assurance Programs in a position of importance in the successful completion of *Engineering, Procurement and Construction* projects.

2.2 Procurement Services

2.2.1 Introduction

NVT procurement services comprise the purchase of materials, equipment and contractor services at the lowest cost compatible with project and client requirements. Services also include systematic expediting and inspection to ensure that all materials and equipment purchased are manufactured or fabricated in accordance with engineering specifications and delivered to the client on schedule.



A Purchasing Agent or Supervisor is assigned to control and direct purchasing, inspection, expediting, monitoring and reporting activities associated with the procurement phase of a project. *NVT* in-house procurement procedures are adapted to client and project or funding agency requirements when necessary.

2.2.2 Purchasing

Purchasing staff administer each purchase order or contract from the time an inquiry is issued until delivery and acceptance of items ordered.

2.2.3 Tasks include

- price and availability
- establishment of a vendor or supplier list
- prequalification of suppliers or contractors
- formulation of requests for quotation or tender document including commercial conditions, conditions of tender, bonding requirements, tax applications, and terms of payment
- issue of tender documents
- receipt of vendor proposals
- commercial evaluation of proposals including tabulation and comparison of commercial and technical proposals submitted considering present-work calculations, compliance checks and delivery schedules
- award recommendations
- issue of purchase orders or contracts including letters of intent or confirming purchase orders
- maintenance of a purchase order register and preparation of regular status reports either manually or by spreadsheet
- administration of purchase orders or contracts including invoice certification, claim management and the issue, as necessary, of amendments or change orders.

2.2.4 Inspection

NVT provides quality assurance testing and inspection services including

- assistance in establishing quality standards
- assistance in approval of bidders and tenders evaluation
- review of specifications for quality assurance requirements
- preparation and monitoring of quality surveillance plans
- shop inspection and reporting
- nondestructive testing, radiography and specialized inspection techniques.

2.3 Quality Assurance Procedure

2.3.1 Introduction

The *NVT* Quality Assurance Department is engaged in the provision of high-quality inspection and expediting services in factories and contractors' works on behalf of in-house project groups and/or outside clients.

The nature of this work necessitates particular emphasis on capability, conformance and reliability.

The procedures are set out in two plans, namely

- Part One - *Quality Assurance Plan*
Inspection, Witness Testing and Progress Reporting



- Part Two - **Expediting Plan**

Expediting, Measuring and Control of Procurement Progress

2.3.2 Objective

The objective of *NVT* Quality Assurance Management is to provide a service which ensures that the products, services and processes will conform to contractual requirements, codes, specifications, procedures and approved drawings.

2.3.3. Policy

To achieve this objective, it is the policy of *NVT* Quality Assurance Department to establish and maintain an effective **Quality Assurance Program** planned and developed in conjunction with other management functions. Determination of conformance of work to contract requirements shall be made on the basis of objective evidence of quality and quantity.

2.3.4 Associated Inspection Authorities

To provide inspection and/or expediting services *NVT* may, with the approval of the purchaser, delegate responsibilities to firms with whom they have been associated and whose services have previously been rendered with satisfactory results in respect to similar equipment.

In the event of such delegation, the firm selected will perform services on behalf of and will report to *NVT* who will, in turn, report to the purchaser in a manner so arranged as to avoid undue reporting delays or other complications.

2.3.5 Reports

NVT inspection and/or Expediting reports are prepared and issued to the client as required, on an agreed schedule. These scheduled reports are distributed to all interested parties in accordance with a prearranged distribution list as directed by the client.

2.3.6 Responsibility

Clearly the responsibility for meeting quality and the delivery schedule is that of the vendor. This program is not intended to replace the vendor's duties in this respect.

2.4 Quality Assurance Plan

2.4.1 General

The **Quality Assurance Program**, together with associated procedures and contractual documents, is designed to ensure that clients' quality requirements are recognized by the vendor and that consistent and uniform control of this quality is adequately maintained. The **Quality Assurance Program** is assisted by formal written procedures approved by the engineer and/or client, and provides competent personnel and sufficient inspection coverage throughout all phases of the work furnished and performed by others in order to ensure conformance with contract requirements.

The **Quality Assurance Program** is established to meet the requirements outlined in the different national and international standards, codes, specifications and other customer requirements.



The **Quality Assurance Program** is adjusted to suit the complexity of products, quantity under process, reliability and interchangeability requirements, and production techniques. It includes provision for assurance of prompt detection of discrepancies and for timely and effective action.

2.4.2 Validity

Part one of Quality Assurance document describes the procedures and formalities in force within **NVT** to ensure that the contract requirements are being met and therefore Part One of the reliability of equipment in service will be achieved.

The **Quality Assurance Department** of "**NVT**":

- constitutes a divisional organization for quality directions and quantity follow-up of products for the client
- solicits and coordinates activities in the shops in order to create and maintain an optimum quality level for the products consistent with the ruling specifications, codes and drawings
- is responsible for ensuring that products comply with quality requirements of applicable standards.

These general directions imply that the "**NVT**" Quality Assurance Department

- reviews the manufacture of products during development and production stages, and continuously monitors established routine for changes in quality
- is responsible for ensuring that in-plant inspection of products during production stages is carried out satisfactorily by certified and responsible inspectors
- is responsible for ensuring that established inspection routines and procedures concerning special processes are maintained
- is responsible for ensuring the calibration and inspection of gauges and instruments are being followed satisfactorily
- is the coordinating influence for the client for failure reporting and, with the cooperation of the engineer and the necessary records, for analyzing the quality situation and initiating necessary corrections
- reviews and comments on the specified requirements, and alerts the client or engineer at an early stage if there are not prerequisites for obtaining an acceptable product
- deals with faults which are discovered during inspection, on an individual basis, according to the seriousness of their effect.

2.4.3 Workmanship

Every employee of the **NVT** Quality Assurance Department is responsible within the framework of his capability for :

- the correctness of his work and statements made in his report
- receiving documentation from the vendor and ensuring that it is representative of the material offered and that the material is of acceptable quality
- ensuring that faults are discovered and reported on a timely basis
- ensuring that reasonable measures are taken by the contractor to prevent repetition of such faults.

The above implies that the "**NVT**" Inspector is responsible for ensuring that;

- obvious defects throughout the manufacturing phases are corrected and that parts are carefully checked against applicable drawings, procedures and specified requirements
- checking takes place to the extent necessary or as reasonably judged necessary, to ensure compliance with all nondestructive, procedural and operational testing



2.4.4 Inspection Equipment

The *NVT* inspector will normally use instruments, measuring tools, tapes, rules, straight-edges, gauge blocks, meters, which are controlled by vendor and are known to conform to condition.

X-ray, ultrasonic, magnetic particle, dye penetrate, resistance, temperature and high-potential testing, due to the sophisticated nature of this equipment and attending regulations, will be witnessed by the *NVT* inspector in conjunction with the contractor's or vendor's personnel and in accordance with the restrictions imposed on outside inspectors by the suppliers and the ruling safety regulations.

In cases where the contractor or vendor does not maintain suitable test equipment or measuring devices, the Inspector may require him to obtain outside assistance to satisfy the requirements of the contract.

2.4.5 Manufacture and Assembly

To ensure satisfactory operation at the site, specified equipment is assembled either into one unit or sub-assembled units. This enables the Inspector to check the various fitting practices, tolerances, and operating clearances as stipulated in the contract or specifications. The Inspector witnesses all static and hydrostatic testing and all functional and operational tests.

2.4.6 Inspection Procedure

Inspection procedures require:

- monitoring of manufacturing processes and preparation for shipment; witnessing of tests as may be required by the codes of specifications
- procurement from the vendor and confirmation of necessary details regarding production, welder qualifications, material test reports, repair procedures and dimensional details.

Deviations, concessions and any other matters requiring engineering judgment are reported to the engineer or the client as required for approval.

"*NVT*" releases equipment from the factory, but final acceptance of the product is at the jobsite.

Conditions affecting delivery, installation, performance or reliability will be detected and corrected before such problems or difficulties have had time to produce a chain reaction.

2.4.7 Quality Assurance Testing

In the initial contact, *NVT* informs all suppliers; and through them, all relevant subcontractors, of their inspection and testing document under the title of: "Test and Inspection Procedure" establishing test and inspection procedures and stages and / or tests to be witnessed under the specifications. At the agreed stages on completion of manufacturing, *NVT* performs the agreed inspection.

Destructive testing to cover physical properties such as tensile, yield point, elongation, reduction of area, impact and hardness will be witnessed in the vendor's laboratory. Nondestructive testing of ferrous and nonferrous metals for surface and internal defects, as provided by the vendor or as occasion demands, will be witnessed. Inspection reports are issued after each visit or series of visits as may be appropriate or required.

The Inspector may waive inspection or witnessing of tests on minor items, repetitious procedures or certain rolled material when he feels that testing would generate more accurate results during manufacturing. Under these circumstances, *NVT* accepts the original manufacturer's test certificates.



Test certificates are checked and evaluated in order to determine that the results obtained by the supplier, in his inspection, are valid and objective.

Additional testing, outside of the normal requirements, that may be deemed necessary are subject to the written approval of the client, if any additional cost to him would thereby be incurred.

At any time during the manufacture of equipment or materials at the vendor's premises or those of subcontractors, *NVT* whenever necessary, exercises the right on behalf of the client to reject components or manufacture on grounds of faulty workmanship. In the event of such rejection having an effect upon the stipulated contract or purchase order completion date, *NVT* immediately informs the engineer and the client of the occurrence and the reasons for such rejection; otherwise the full information is presented in the subsequent routine report.

In the event of sufficiently serious defects being found in materials or components being manufactured or submitted for inspection or test, *NVT* requires the vendor to submit to the client his proposals, with appropriate sketches, or repairs. Immediately following, and if necessary during any such repair, *NVT* re-inspects the affected material or equipment and indicates whether manufacture and/or testing can continue.

When manufacturing procedures that have not been previously used are involved *NVT* will witness, at the supplier's premises or at such testing laboratories as may be agreed, such type tests as may be required to demonstrate the suitability of the process for the duty it will have to perform in service. Documentation is then issued to verify that manufacturing has complied with specified type tests.

2.4.8 Nonconforming Material

By definition, nonconforming material is that which in the raw or finished condition, whether purchased or manufactured by a vendor, shows faults or which does not conform to the specification or good workmanship.

Nonconforming materials which have been detected shall be reported to the client or engineer, stating the type of fault or appearance of the fault, and measures to be taken by the vendor to salvage or correct the condition.

Nonconforming material which has been detected, where the fault is of such type that an acceptance should be considered, is reported to the engineer or client and the vendor's quality control. The material is accepted only after written approval is received from the engineer or client.

A complicated fault detected during final inspection of a completed component or product is immediately brought to the attention of the vendor. A decision is then made on the remedial action to be taken.

2.4.9 Documentation

The contractor or prime vendor is responsible for and required to draw up complete inspection and Quality Assurance records covering all technical stipulations, deviations, test data, certification and dimensional details, and submit copies of such records to *NVT* through their visiting Inspector.

Copies of technical correspondence between the contractor and the engineer need to be forwarded to the Quality Assurance Department of *NVT* in order to maintain up-to-date information regarding the progress of approvals and/or changes to the specified requirements of the contract to ensure that the group always has applicable and complete information.

Work instructions and special procedures need to be forwarded to the Quality Assurance Department in order that the Inspector may ensure adherence.



2.4.10 Packaging and Transportation

Upon completion of manufacture and following the satisfactory conclusion of all final inspection and tests, *NVT* will, whenever required or considered necessary, check the transport and shipping arrangements previously proposed for each different type of equipment involved. *NVT* also checks, as required before shipping, the packaging of the various items, the location of material lists and the application of case markings. Handling and distribution is supervised as necessary. If also relevant, *NVT* ensures that the work of forwarding or shipping agents is carried out in a timely and efficient manner and, if specifically required and whenever possible, *NVT* will arrange for a final inspection of the equipment to be made on board the carrier in which it is to be transported.

2.4.11 Management Audit

The Head of the *NVT* Quality Assurance Department is kept informed of the quality level and trends in the various vendor's factories, and advises the client, vendor and engineer of the quality when required.

Periodic meetings between representatives of the client, engineer and vendor are attended by the Head of the Quality Assurance Department to assist in the resolution of deviations and production problems and the preparation of special procedures.

The Head of the Quality Assurance Department functions as a part of the material evaluation board, and liaison with the various engineers is normally through this channel. The Head of the Quality Assurance Department acts on behalf of the Project Manager in reviewing the technical aspects of specifications to ensure that testing and acceptance standards meet the requirements and intent of the client and the present day codes.

2.5 "Niroo Va Tavan" Quality Assurance Manual (Typical Table of Contents)

The following is a typical table of contents of a quality assurance manual:

- Quality Assurance Program
- Scope of Work
- Work Assignment
- Technical Criteria
- Design Description
- Calculations
- Reports
- Specification
- Release of "*Niroo Va Tavan*" Drawings
- Review of Vendors' Documents
- Record-Set Documents
- Regulations, Standards and Codes
- Document Approval List
- Special Reviews
- Quality Assurance Audit
- Control of Computer Programs

2.6 Quality Assurance Program - Manufacturing (Typical Table of Contents)

The following is a typical table of contents and brief outline of procedures which would be included in a typical manufacturing quality assurance program. The procedures detailed are based on national and internationally recognized quality assurance standards and requirements.



2.6.1 Policy and Organization

Lists the written procedures for manufacturing quality assurance and gives general details of management activities and direction to provide 'objective evidence' that a quality program exists and is being implemented at the manufacturing works.

2.6.2 Technical Specification Review

Describes the steps necessary to ensure that quality assurance requirements in procurement documents are specified in a manner that is compatible with technical and jurisdictional requirements, and are achievable.

2.6.3 Evaluation of Bidders QA Program

Details those aspects and functions necessary to provide a quality assurance program and is to be used in conjunction with Item 4, below.

2.6.4 Evaluation of Contractor's Quality Assurance Manual

Identifies the categories of a quality assurance program and provides a typical questionnaire for each category in a check list format.

2.6.5 Evaluation of Suppliers Facility

Provides audit check lists or questionnaires that should be used to verify that functions and activities listed in the suppliers quality assurance manual actually exist and are being implemented in the shop or factory.

2.6.6 Evaluation of Manufacturers Inspection Plan

Describes the actions necessary to review and comment on a suppliers or manufacturer's inspection and test plan.

2.6.7 Quality Assurance Audit

Describes the activities required when a quality program is subjected to an annual audit as required and specified. To be used in conjunction with Items 3 and 4, above.

2.6.8 Surveillance Plan

Describes how to prepare an inspection and test plan that provides adequate confidence that a component or piece of equipment being manufactured will perform in accordance with specifications.

2.6.9 Selection of a Quality Assurance Representative (inspector)

Describes qualities and attributes required in an individual who will perform the specified inspections.

2.6.10 Concession Application

Details actions necessary for the disposition of a nonconforming item.



2.6.11 Review of History Dockets

Describes those inspection records needed to provide objective evidence that the fabrication or manufacture of a component is in compliance with specification requirements.

2.6.12 Surveillance Report and Shipping Release

Describes the contents of report to be made on completion of fabrication or manufacture and confirmation that item has been released for shipment.

2.6.13 Internal Audit

Defines the activities necessary to audit the surveillance quality program to ensure that it is performing as required.

2.7 Quality Assurance Procedure Memorandum Construction and Installation - Typical

2.7.1 Survey

- (a) Check measuring equipment is in a known state of calibration (prior to use).
- (b) Establish benchmarks, control networks (initial).
- (c) Check benchmarks at all locations (weekly).
- (d) Check borehole depths, have soil analyzed, check borehole location, quantity and diameter (as necessary).
- (e) Check excavations, location, depth and size (as necessary).
- (f) Check earthworks location, foundation make-up, compactness, (as required).
- (g) Check contractors inspection and test plan is being implemented, inspections and tests are performed, records maintained (daily).
- (h) Check that drawings in use are latest issue (daily).

2.7.2 Buildings

2.7.2.1 Concrete

- (a) Check measuring equipment is in known state of calibration (prior to use).
- (b) Check that drawings in use are latest issue (daily).
- (c) Check anchoring, piling and location.
- (d) Check reinforcement, material certification, dimensions, interconnection, location (as necessary).
- (e) Check shuttering for adequacy, strength, location.
- (f) Check concrete for mixture, aggregate, temperature, consistency, distance to travel, height and thickness of lift. Bonding between pours, flatness and textures. Take samples from pours for analysis (as necessary).
- (g) Check location of components that will be buried or embedded in primary concrete (prior to pour).
- (h) Check contractors inspection and test plan is being implemented, inspections are performed, records maintained (daily).

2.7.2.2 Structural Steel

- (a) Check measuring equipment is in known state of calibration (prior to use).
- (b) Check that drawings in use are latest issue (daily).
- (c) Check anchoring, piling and location (on occurrence).



- (d) Check foundation reinforcement, material certification, dimensions, interconnections, locations (as necessary but prior to pour).
- (e) Check location of components that will be embedded in concrete (as necessary, prior to pour).
- (f) Check main supports are in corrected locations (prior to pour) and material certification is available and checked.
- (g) Check concrete for mixture, aggregate, temperature, consistency, depth of lift. Bonding between pours, flatness and texture. Take samples from pours for analysis (as necessary).
- (h) Check supporting steelwork, material certification, location and bolt torque (as erected).
- (i) Check placement of exterior cladding insulation for dimensions, grade (as erected).
- (j) Check contractors inspection and test plan is implemented, inspections and tests are performed and records maintained (daily).

2.7.2.3 Building Interiors

- (a) Check measuring equipment is in known state of calibration (prior to use).
- (b) Check drawings and latest issue (on occurrence).
- (c) Check locations of stairways, entrance/exit doors, access ways, cableways, HVAC ducts, lighting, etc. (as erected).
- (d) Check contractors inspection and test plan is implemented, inspections are performed and records maintained (daily).

2.7.3 Receiving Material

2.7.3.1 Contractor

- (a) Check that each contractor has a system for identifying material/components.
- (b) Check that each contractor has an inspection plan or checklist for receiving incoming material.
- (c) Check that material is inspected by contractor and records maintained.
- (d) Check that such material is within scope of supply.
- (e) Check that received material is properly identified, has documentation to provide 'objective evidence' that material satisfies requirements.
- (f) Check that contractor can provide safe and secure storage for receiving material.
- (g) Check that contractor has documentation to show status and location of receiving material. Nonconforming material must be clearly identified.
- (h) Check that material is located as per contractors documentation. Check that contractor has latest issue of specification, drawings, purchase order, etc., at receiving inspection.
- (i) Check that contractor is storing and inventorying spare parts 'as built' drawings and installation manuals if supplied with material.

2.7.3.2 Client

- (a) Check that safe, secure, clean area with restricted access is available for storage of material.
- (b) Establish method of identifying all received material, recording its status and location.
- (c) Inspect all material as required by specification and latest issue of drawings. Maintain records.
- (d) Ensure that Client supplied material is accepted only if sufficient support documentation is provided as objective evidence that specified inspection and test have been performed. Maintain records.
- (e) Clearly identify and segregate all nonconforming material. Maintain records including implemented corrective action.
- (f) Check that the necessary handling tools are available for all material being received.
- (g) Inventory all spare parts, 'as built' drawings, installation manual if supplied with material.
- (h) Release material for installation by signatures only when satisfied that the material and documentation is in accordance with specified requirements and the location to which the material is designated is clear and safe.