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**PERFORMANCE OF A QUALITY MANAGEMENT PRACTICE IN
CONSTRUCTION INDUSTRY IN TURKEY**

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DOKÜMANTASYON MERKEZİ**

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ÖZET

Mimar Sinan Üniversitesi “Yapım Proje Yönetimi” Yüksek Lisans Programı kapsamında Burcu Herkmen tarafından hazırlanan tezin konusu “Türkiye’de inşaat sektöründe kalite yönetimi uygulamasının etkinliği” olarak seçilmiştir.

Tez 5 ana bölümden oluşmaktadır.

Birinci bölüm olan “Giriş”te, inşaat projesinin üç temel öğesinin kalite, maliyet ve süre olduğu tanımlanmıştır. Türk inşaat sektöründeki firmaların kalite yönetimi ile tanışmalarının yurtdışındaki projelerde görev almalarından itibaren olduğundan bahsedilmiştir. Kısaca projenin yapısına bağlı olarak bu üç parametreden bazılarının öne çıktığı belirtilmiştir.

Çalışma sırasında Türkiye’de yakın zamanda uygulanan ve halen daha uygulanmakta olan bir proje üzerinde yapılan örnek çalışma ile kalite sistemi ve kalite yönetimi etkinliğinin irdelenmesi düşünülmüştür.

Tezin ikinci bölümü olan “Kalite Kavramı”nda kalite tanımları, kalitenin tarihçesi, kalite yönetimi ve kalite yönetiminin inşaat sektöründe uygulanması ile ISO Standardlarının tanımı, tarihçesi ve alt maddelerinin tanımları çeşitli kaynak ve dokümanlardan yararlanılarak kapsamlı bir şekilde açıklanmıştır.

Tezin üçüncü bölümünde ISO 9000 Standardlarının, inşaat projelerinde uygulanışından bahsedilmiş, uygulama kazanımları ve kayıpları anlatılmış, uygulama kayıplarına çözüm önerileri sunulmuştur.

Tezin dördüncü bölümünde halen uygulaması devam eden bir spor kompleksinde uygulanan kalite güvence sisteminin kuruluşu ve dokümantasyonu Ek’teki örnek belgelere dayanılarak incelenmiştir. Doğru kalite güvence uygulamasına rağmen ortaya çıkan beklenmedik bazı neticelerden bahsedilmiştir.

Tezin “Sonuç” bölümünde, tez ile ilgili genel değerlendirmeler yapılmıştır. Örnek çalışma’ya göre varılan sonuçlar ortaya konmuştur. Buna göre Kalite güvence sistemini tam olarak uygulanan durumlarda dahi öngörülmeyen ve beklenmeyen hadiseler oluşabiliyor ve bu hadiseler çözümlenirken projenin diğer parametreleri ister istemez etkileniyor. Toplam kalite kavramı sonsuz uygulanabilecek bir kavram olmayıp, ne derece

kapsamlı kalite uygulaması yapılacağını İşveren ve de yapılan işin gereği ve standardlar belirler.

Anahtar kelimeler: Kalite, Kalite Yönetimi, Kalite Güvence Sitemleri, ISO 9000, İnşaat Sektörü



ABSTRACT

“Performance of a quality management practice in construction industry in Turkey” is selected as the thesis topic prepared by Burcu Herkmen attending “Construction Project Management” Masters Degree Program at Mimar Sinan University.

Thesis consists of 5 parts;

First part which is “Introduction” defines that quality, cost and time are three basic elements of a construction project. Depending on the character of the project some of these three parameters may gain priority to others. This part also states that Turkish construction companies got acquainted with quality management through projects realized abroad. Through this study performance of quality system and quality management implemented are being investigated via a sample case recently applied and still continue execution in Turkey.

In second part, “Concept of Quality” ; overview and definitions, history of quality, application of quality management to construction projects, ISO Series of Standards including its history, classification and clauses are discussed in detail utilizing various sources and documents.

In the third part, implementation of ISO 9000 Standards to construction projects are discussed; benefits of implementing ISO Family of Standards and proposed solutions to implementation problems are put forth.

In the fourth part, establishment and documentation of quality assurance system at a foregoing sport complex project is being investigated. Also mentioned that even though appropriate quality assurance system was implemented, some unexpected results were observed.

In the “Conclusion” part, general evaluation in this thesis study is discussed and results related to sample case are given. Even in cases where quality assurance is fully implemented, some unexpected and unforeseen events may occur. In solving these problems other parameters may get involved. Quality concept is not indefinite; the extent to which it may be applied depends on the Client, necessities of the work and standards.

Keywords: Quality, Quality management, quality assurance systems, ISO 9000, construction industries.

1. INTRODUCTION

1.1. Significance of the area of research

Quality, cost and scheduling are the three most critical attributes of a construction project, each with its own priority. The order of importance of one of these critical attributes differs in most construction projects, according to the projects' priorities and restrictions. If the project does not result in facilities that are suitable for the intended use because of lack of quality, then the project has simply wasted a lot of time and money without accomplishing its objective. The most important factor is clients' satisfaction.

The construction industry was traditionally slow in embracing new management concepts. Recently they have realized that customer satisfaction is the secret to success. They were wrestling with the concept of the low bidder gets the job. The ones that survive this competitive nightmare will realize that through planned activities an organization can be more efficient, productive and profitable while providing a superior-quality product at a lower price.

Also it appears that a lack of structured inspection, quality control and quality assurance is common throughout the entire construction process. No one is willing to accept responsibility for the overall quality assurance activities in construction. In many cases, subcontractors, are paid before anyone realizes that a quality problem exists with the completed work.

Quality Management Systems are becoming a must in the construction industry both for the client and the contractor. For the client, they serve as a measure as to whether a contractor has performed the way he is supposed to. For the contractor, they provide a valuable tool for managing complicated internal processes, bringing out the best in technical and human resources available, and most of all, provide a continuous quality improvement.

In Turkey companies that have aimed permanent place at overseas markets and long-lasting place inland worked keenly on quality management systems. The studies have started in manufacture industries first and showed a slow progress in construction industry due to the special difficulties in this sector. The idea that quality will increase the cost has impeded the work in this area.

The Turkish Companies that held jobs abroad have been asked to meet concepts of Quality Management and Quality systems due to contracts of the bids. At first companies did not afford improving Quality assurance, however as idea of Quality Assurance gained importance world-wide they realized that there will be chance of competition as long as they could guarantee Quality assurance.

As the number of companies in construction industry that implement ISO9000 Quality Management/Quality Assurance Standards increase, a greater harmony will exist throughout a construction project resulting in a higher level of customer satisfaction. The key to this satisfaction will be quality project delivered on time at a fair price by the companies.

Nowadays function of a construction is the primary factor affecting quality. If the intended construction has to be completed in a fixed time (i.e. a hotel or a stadium project) then time is the prior unit and quality will be provided as much as time permits. How will cost affect quality? If there are errors such as design errors, then final cost will exceed the planned amount.

On the other hand there are certain group of building types where can no concession from quality; for i.e. dam constructions. In this case the intersection of quality-cost curve is important. Time is considered afterwards.

In residence construction sector the primary factor is cost for solitary or cooperative contractors. Cost is client's satisfaction then follows time and quality on equal basis. However this order may change for a residence at Bosphorus quality can over-role cost.

1.2. Statement of the research problem

Construction Project Management is the application of knowledge, skills, tools and techniques to project activities in order to meet or exceed the clients' needs and expectations from a project. Meeting of exceeding clients' needs and expectations invariable involves balancing competing demands among;

- Scope, time, cost and quality
- Clients with different needs and expectations
- Identified requirements (needs) and unidentified requirements (expectations)

There are sub-processes of construction project management such as; Time Management - Cost Management - Quality Management - Procurement Management etc. I have chosen to study my thesis in Quality Management.

The purpose is to examine the quality management performance as long as quality system is planned and put into practice precisely, cost and time will remain at a pre-established optimum value and most advantageous cost / time result will be achieved.

1.3. Previous work in the area of research

There has been variety of books published to explain the general outline of Quality Management and ISO Series of Standards. Also there are papers and thesis about quality management implementation in the construction industry. The selected bibliography for the books, articles and thesis are listed in part References.

1.4. Objectives of the research

The objective of the study is to examine the concept of total quality, quality management and ISO Series of Standards in general, to put forward the benefits and problems of the application of quality management in construction and finally review the subject with the sample case.

1.5. Scope and limitations of the research

In my thesis, a quality management application in construction under the focus of ISO 9000 particularly on a selective case from the construction industry in Turkey will be reviewed. There are many quality assurance procedures and particular work procedures, only the major construction work and some of the activities will be put in the thesis to give an idea about the implementation.

2. THE CONCEPT OF QUALITY

2.1. General

In every day usage, the word 'quality' is usually related with excellence. In this thesis, 'quality' will not be used in the meaning of excellence, but will be used in its engineering sense which is more related to the concepts of compliance with a defined requirement value, fitness, or customers satisfaction.

Quality is the totality of all features and characteristics of a product or service which together make a product or a service acceptable to the market. Therefore products and services lacking in quality will prove unmarketable in the long term, and the firms producing them will go out of business. So any enterprise should promote and control quality and accept this as a fundamental importance.

2.1.1. Overview and definitions

Some definitions related to quality are given to clarify the subject:

Quality: Quality is the ability of a product or service to satisfy implied or stated needs. Stated needs are determined by the contract, whereas implied needs are the functions of the market and must be identified and defined. These may include quality parameters such as safety, performance, reliability, economy, appearance, user friendliness, environment, etc. Alternatively the definition of quality may relate to such aspects as quality of market research, quality of design, quality of conformance, quality of construction, etc. In other words quality is the sum of characteristics of a product or a service which relies on its ability to satisfy the determined needs or the needs which may occur.

Quality is;

- suitability for usage. Dr. J. M. JURAN
- suitability to conditions. P. B. CROSBY
- the basis. Dr. J. M. YURAN
- the proportion of satisfying the needs.
- the customer satisfaction.
- complying with required conditions;
 - in the first time,
 - on time,
 - every time.

Quality Policy: Quality policy of an organization (company) is the overall quality intentions and direction of the organization which relate to quality, as formally expressed by top management. The quality policy forms one element of the corporate policy.

Quality Management: Quality management is the overall management function that determines and implements the quality policy:

The responsibility for quality management belongs to top management, and reaching the desired quality requires the commitment and participation of all members of the organization (company).

Strategic planning, allocation of resources and other systematic activities for quality, such as quality planning operations and evaluations are included in quality management.

The management of quality is very important for company survival and needs the commitment of top management. The primary responsibility for quality must lie with those doing the work. To enable production departments to accept responsibility for quality, management must establish systems for the control and verification of work, and educate and indoctrinate the work force in their application. The cost of education and training for quality, and any other costs which might be incurred, will be repaid many times over by greater outputs, less waste, a better quality product and higher profits.

Quality System: Quality system is the organizational structure, responsibilities, procedures, processes and resources for implementing quality management.

- The quality system should not be more comprehensive than needed to meet the quality objectives.
- Demonstration of the implementation of identified elements in the system may be required for contractual, mandatory and assessment purposes.

Quality Control: Quality control is the sum of the operational techniques and activities that are used to fulfill requirements for quality.

Quality Assurance: Quality assurance includes all those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality. Unless given requirement fully reflect the needs of the user, quality assurance will not be complete. For effectiveness, quality assurance usually

requires a continuing evaluation of factors that affect the adequacy of the design or specification for intended applications as well as verifications and audit of production, installation and inspection operations. Providing confidence may involve producing evidence. Within an organization, quality assurance serves as a management tool. In contractual situations quality assurance also serves to provide confidence in the supplier.

Difference between Quality Control and Quality Assurance: There is a distinct difference between quality control and quality assurance. Quality control is involved with the activities of specification, design, production or installation, inspection and review of usage. These activities are of the functional areas like purchasing, marketing, manufacturing, packaging and shipping, product, service, etc. Quality assurance is involved with these activities as well as the entire quality system. Quality control includes specific procedures involved in the quality assurance process. These procedures are mainly planning, coordinating, developing, checking, reviewing and scheduling the work.

2.1.2. History of Quality

Although quality, or the lack of it; has been highly publicized in recent years, it has been an important part of almost every culture. Quality was integrated into people's work. It was taken for granted; rather than being a separate part of doing business, it was the fulcrum upon which business balanced. In some cultures the quality of one's work was literally a matter of life and death. Failure to perform the necessary tasks to ensure quality could cost workers their lives.

Quality became a separate, stand-alone entity only after the beginning of the industrial revolution. It brought with it mass production, interchangeable parts, and the loss of people's identification with the products they made. Great armies of workers began making pieces and parts of the whole.

2.1.2.1. Quality In History

There is tremendous emphasis on quality in today's marketplace. The number one selling point for a product is the quality image it projects. One quick look around the super-market will prove the point. The phrases you will see most often are "*new and improved*" or "*high quality*".

Marketing people know the power of a quality image. Slogans such as "Quality Is Job One" or "The Quality Goes in Before the Name Goes On" are used continually to sell products.

Newspapers are full of stories about liability lawsuits filed against companies and individuals because of a lack of quality. Product liability insurance is a fundamental need for companies today.

If a company does not produce a quality product or service in today's market, that business will not last long. But the emphasis on quality did not develop overnight. Quality has been a serious business for all of recorded history.

2.1.2.1.1. Quality In Egypt

Quality is directly related to the ability to measure. If you can't measure it, you can't control it. Therefore, all measuring instruments must be "calibrated" to a standard. In ancient Egypt, the length of the Pharaoh's forearm was the unit of measure called the "cubit." A standard, called the cubit stick, was made to match the length of his arm. The cubit stick was the standard against which all other cubit sticks in the nation were measured. Every builder was required to have his or her cubit stick checked and calibrated once every full moon. Failure to comply with this regulation would cost the builder's life. In other words, if a cubit stick was the wrong length, the builder was killed. Quality was very important in Egypt. Maybe that is why the pyramids are still standing.

2.1.2.1.2. Quality In Rome

In the Roman Empire, quality was a life-and-death matter. If a building constructed by a Roman engineer were to collapse, and someone died, the engineer would be executed.

Many of the aquifers and bridges built by those engineers are still standing. It is hard to believe that a bridge thousands of years old could still be used. Perhaps the explanation lies in the fact that when the keystone that supported the bridge was laid, the engineer stood under the bridge. If the bridge collapsed, the engineer was the one who died.

This may seem somewhat barbaric, but things have not changed much. For example; an aircraft mechanic, repaired many airplanes, some for people who would not fly the plane unless the mechanic accompanied them on their first flight. The mechanic's flying in the plane is similar to the engineer's standing under the bridge —the effect is the same, only the technology has changed.

2.1.2.1.3. The French Revolution

In 1790, France was ripped apart and the metric system was born partly because of quality. The problem with the French was not that they had no standard, but that they had too many standards. Each province had a different standard for its unit of measure. Those in power could buy and sell using whichever standard they found profitable. Such abuses in measurement were among the causes of the French Revolution.

Imagine buying a two-liter bottle of soda only to find that it was smaller than the two-liter bottle purchased yesterday in another town.

2.1.2.1.4. A Case Of Poor Quality

In 1845, an expedition searching for the Northwest Passage ended in tragedy. The entire 130-person crew became sick with an unknown disease and died. For over a century mystery surrounded this expedition.

Recently, however, new evidence indicates that the crew died from lead poisoning in their food. Autopsies performed on three bodies that had been buried below the permafrost line provided that the expedition's lead-soldered cans of preserved meats, soups, and vegetables caused the death of the entire party.

Goldner Provisioners had been selected as the expedition's supplier over the objections of the ship's second officer. Although Goldner had never before provisioned a naval ship, it won the contract solely on the basis of its low bid. Poor quality in this case resulted in tragedy.

2.1.2.1.5. Quality And The Industrial Revolution

Before the industrial revolution, products were made one at a time. A craftsperson would make his or her craft product from beginning to end, *hand-fitting* every piece.

The quality of the product was judged by how well the pieces fit together. If the product ever broke, a person had to take it back to the craft-worker to have another part hand crafted for that particular product.

The first attempt at mass production came in 1798, when Eli Whitney won a contract from the U.S. government for 10,000 muskets. Whitney began by mass producing enough parts to assemble a partial order of 700 muskets. However, the error rate in the parts was so high that only 14 muskets could be assembled from that batch. Although the number that could be correctly assembled was less than exceptional, it did prove that mass production was possible and so, Whitney is credited with the concept of interchangeable parts.

Industry began to build its products piece by piece, instead of building a single item from beginning to end. Henry Ford started the first assembly line, and the responsibility for quality shifted from the craft-worker to the supervisor. As the number of workers grew, the supervisor could no longer inspect the work of each worker, and the inspection department was born.

Armies of inspectors were employed to police the quality of the assembly line workers. As productivity increased, even a large number of inspectors could not keep up with the massive amount of products being put out by manufacturing plants. At that point, techniques employing statistics were used to control the quality of the operation.

2.1.2.1.6. The Effect Of Culture On Quality

Tremendous changes have taken place since 1900. Changes in manufacturing processes and culture have affected the course of quality control. It is evident how the changes in manufacturing processes could affect quality. What may not be as clear is how culture can affect quality. Therefore, some time must be spent on the cultural aspect of quality, because culture still plays an important role in quality today.

In 1881, Frederick Taylor introduced the time motion studies that earned him the title of "Father of Scientific Management". Wishing to relieve the strain on industry, Taylor attempted to simplify the manufacturing process and thereby overcome the immigrants' lack of English communication and mechanical skills. This also reduced the cost of manufacturing by eliminating wasted time and effort.

The "Taylor Method," as it became known, was an overwhelming success. At that time in the history of the U.S. it was exactly what was needed. In effect, the Taylor Method put all authority into the hands of management. The work force was paid to work, not to think. It caused a polarization of management and labor. However, a polarization already existed for ethnic and religious reasons. Management began to think of labor as stupid and lazy. Labor started thinking of management as unfair and uncaring. Although later the literacy level of workers improved, management still viewed them as ignorant.

During World War II, the manufacturing industry was thrown into a production frenzy. Demanding schedules were inflicted on contractors for the war effort. For a short time, labor and management worked as a team. Productivity and quality were very high.

After the war, the American manufacturing industry was the only one in the world left intact. As such, postwar U.S. businesses supplied over 50 percent of the world's needs through exports and held 95 percent of the domestic market. Demand far exceeded supply. There was not a wide variety of things to buy, and people bought what they could get. This situation enabled manufacturers to dictate product requirements to customers over the next 25 years.

Foreign manufacturing industries finally recovered. Supply began to catch up with demand. In contrast to U.S. businesses, overseas companies began to ask customers what they wanted in the products they bought. Products were made to the customers' specifications, using new equipment and with positive input from the work force. The foreign strategy worked to their advantage.

In 1973, an unofficial oil embargo against the U.S. sent the price of oil to new heights. Before 1973, U.S. cars were large and fuel inefficient. Honda met the needs of customers by marketing small, fuel-efficient cars. Today, Hondas are among the most widely owned cars in the U.S. The American automobile industry was forced to compete on Honda's level or die.

In the early 1980s, the bottom fell out of the steel industry on a global basis. Cultural impact on quality can be evaluated by investigating how an American company and a Japanese company dealt with this situation. The steel market disappeared almost overnight. As a result, the American company laid off thousands of workers to cut costs. By contrast, the Japanese company did not lay off any of its workers. Instead of a layoff, everyone in the Japanese company took a pay cut—not just the workers, but everyone from the CEO to the janitors. The Japanese company also cut back its production, but faced the problem of what to do with all the idle workers. The decision was made to put them to work renovating the company facilities. The workers began to paint, rebuild, and clean the entire factory.

As time passed, the market did not improve. In fact, it worsened. The American company experienced a second payoff. The Japanese company experienced a second wage cut and continued to work on the factory. Both companies had virtually stopped all steel production at this point.

More time passed and all but a few American steel workers had been laid off, whereas the Japanese factory was upgraded and modernized. Still the market was depressed. The Japanese company again faced the situation of what to do with all the workers. The decision was made to build another blast furnace. So, using the steel that was stockpiled, the Japanese company began to build the furnace.

Finally, the market began to pick up. Demand increased as the world began to build again. The American company could not meet demands because its workers had been retrained in other fields and were not available. Therefore, a new work force needed to be trained. The Japanese company had its entire work force in place, a beautifully renovated factor and the second largest blast furnace in the world. The American steel industry still has not overcome this disaster and America is still struggling to catch up.

One might be tempted to condemn the management of the American company for laying off its workers., but look at the situation realistically. The problem lies in the way the two work forces think about their work. In America, labor and management are on adversarial terms. Neither labor nor management feels much responsibility toward the other. In America, many unions will not allow the workers' pay to be cut, so layoffs are the only way to cut costs.

On the other hand, Japanese culture fosters a great respect on the part of the workers for their company. Also, the management of the companies feels a responsibility for the well-being of its workers much like a parent child relationship.

Investors, management, and labor all create the culture of a company, just as on a national level it takes all of us to create a culture

2.1.2.1.7. How To Change A Culture

Quality control professionals are limited in their ability to alter the culture of a manufacturing organization. Some change may come through the workers' efforts; however, lasting changes in this area come only from the top down.

2.1.2.2. Prevalent Quality Philosophies

Global competition has increased in recent years; consequently, good quality management techniques have become more critical to the survival of all kinds of industries. Several philosophies have gained wide recognition in the quality industry.

Each philosophy is unique in some way, but they all have many areas in common. A company may tend toward one concept or another, but in reality, very few companies use only one philosophy. It will be very helpful for quality professionals to be able to draw from each school of thought when deciding on a course of action in quality improvement.

Every industry is different. Therefore, unique quality problems are created. Although each problem is unique, problems do tend to fall into general categories.

2.1.2.2.1. W. Edwards Deming

W. Edwards Deming (1901 -93) is one of the preeminent figures in the quality control profession. Deming worked as a consultant to the U.S. War Department (later the Department of Defense) during World War II. After the war, Deming tried to interest American industry in the use of statistics to improve productivity and quality. Most of the rest of the world had been devastated by the war, at that time America was able to sell everything it could produce. Therefore, American industry was not receptive to quality improvement.

The W. Edwards Deming Award for Quality is a national award presented annually in Japan to the company that has demonstrated the greatest quality improvement effort and to the individual who has been responsible for the greatest quality improvement. These are extremely high honors in Japan.

Deming's techniques tend to center around statistical controls on manufacturing processes. He believed that 85 percent of quality problems are generated by management. Deming developed a philosophy to facilitate quality improvement in a company through better management.

There are 14 steps to this philosophy aimed at management:

- a) Create a consistency of purpose toward the improvement of products and service, with a plan to become competitive and to stay in business. Decide to whom top management is responsible.**
- b) Adopt a new philosophy. We are in a new economic age. We can no longer live with commonly accepted levels of delays, mistakes, defective materials, and defective workmanship.**
- c) Cease dependence on mass inspection. Instead, require statistical evidence that quality is built in to eliminate the need for inspection on a mass basis. Purchasing managers have a new job, and must learn it.**
- d) End the practice of awarding business on the basis of a price tag. Instead, depend on meaningful measures of quality along with price. Eliminate suppliers who cannot qualify with statistical evidence of quality.**
- e) Find problems. It is management's job to work continually on the system (design, incoming materials, composition of material, maintenance, improvement of machines, training, supervision, and retraining).**
- f) Institute modern methods of on-the-job training.**
- g) Institute modern methods to supervise production workers. The responsibility of supervisors must be changed from sheer quantity to quality. Quality improvement will automatically improve productivity. Management must prepare to take immediate**

action on reports from supervisors concerning barriers such as inherited defects, machines poorly maintained, poor tools, and fuzzy operational definitions.

- h) Drive out fear so that everyone may work effectively for the company.**
- i) Break down barriers between departments. People in research, design, sales, and production must work as a team to foresee production problems that may be encountered with various materials and specifications.**
- j) Eliminate numerical goals, posters, and slogans for the work force. Ask instead for new levels of productivity without providing methods.**
- k) Eliminate work standards that prescribe numerical quotas.**
- l) Remove barriers that stand between the hourly workers and their right to pride of workmanship.**
- m) Institute a vigorous program of education and retraining.**
- n) Create a structure in top management that will push the above 13 points daily.**

These 14 steps are comprehensive in their coverage of management techniques. They are worth examining in greater detail.

- a) Create consistency of purpose toward improvement of products and service, with a plan to become competitive and to stay in business***

There are two major types of problems in industry. First, there are the daily problems of production (maintenance, budget, forecasts, production schedule, etc.). These problems are a continual source of irritation. Second, there are the problems of tomorrow (new product development, new material development, market trends, and advancements by competitors).

If quality improvement is focused on the daily activity and problems of production, there can be no lasting impact on quality. Production fluctuates daily; therefore, management must begin to look at the big picture. Daily “disasters” demand the

manager's attention. The problem comes when the manager falls into the habit of managing by disaster.

On a higher level, managers must stop looking at quarterly dividends as the means of setting objectives. Long-range planning is extremely important. Plans must reach out 3 years, 5 years, 10 years, even 20 or 30 years. Long-range planning should cover such areas as;

- New services or products
- New materials required and their costs
- Methods of production and possible changes in equipment
- New skills required
- Training and retraining of personnel
- Training of supervisors
- Cost of production
- Cost of marketing
- Performance improvement
- Satisfaction of the end user

Companies need to allocate funds into these areas and expand their budgets for research, education, equipment, and maintenance. Such allocations require a change in the company's philosophy—which leads to the second step.

b) Adopt a new philosophy

In postwar America, industry was overwhelmed by the demand for products, and companies could sell almost anything they produced. If there was a workmanship failure, the customer could take it to be fixed in a repair shop.

Times have changed! That type of business practice will send a company to bankruptcy in a hurry. Unfortunately, many industries have gotten into the habit of giving short shrift to quality, many to the point that they have forgotten how to meet the customer's requirements.

If a company is to survive in today's marketplace, a philosophy of quality must be instilled in every employee. If everyone from the president to the assembly line worker becomes involved, it will have a lasting impact on quality and productivity.

c) Cease dependence on mass inspection

In the past, the quality department was called the inspection department, although this type of thinking is on the decline. When a company finds defects by inspection, it is not improving quality—it is only keeping the bad product from reaching the customer. It may not even do a good job of catching all the bad product. Tremendous losses are involved with this kind of detection. In some cases, the cost of inspection can be prohibitive.

The causes of the defects must be removed from the manufacturing process. Inspection can then be used to ensure that the process is working as it should. When using inspection to check the process rather than the product, only samples need to be taken. If these samples begin to show a defective product, the process can be altered before high costs are incurred.

With these types of controls in place, a company can be confident about the outgoing quality of its product. The purchasing companies can buy the product with confidence that it will function properly.

d) End the practice of awarding business on the basis of a price tag

When Neil Armstrong awaited launch atop the huge rocket that was about to carry him to the moon, he was quoted as commenting, "It gives me no great comfort to know that the thousands of assemblies which make up this rocket were supplied by the lowest bidder." He was speaking out of personal interest—his very life depended on the functioning of the machine in which he sat. For e.g. the case of poor quality in Section 2.1.2.1.4. The food contract, awarded to the lowest bidder, cost the life of every person in the party.

Companies need to realize that their very existence depends on the function of the products and materials they buy. They can no longer allow the price tag to determine who receives their contract. Companies must begin to demand statistical proof of quality from their vendors. The price tag of the product a company uses is not the only money spent on that product. For example, a company buys a circuit board from a vendor, to be used in its own computer. The quality of the computer depends on the quality of the vendor's board. If the vendor's board is of poor quality, the purchasing company may need to repair

it, replace it, ship it back, slow its own production, or experience a host of other problems that cost money and therefore reduce productivity.

Purchasing agents must be trained in statistical techniques that will show which vendors ship a consistently acceptable-quality product. Companies must insist that vendors supply statistical data that indicates the quality of the products they make.

Companies must become aware that the processes of their vendors are an extension of their own process. If indeed a company understands this, it will help refine its vendors' processes. That will help reduce everyone's cost and increase profits.

Purchasing agents should not be blamed for the quality of the incoming product. Until recently, many companies have required them to award contracts on price alone, regardless of product quality. Upper management must change the way it thinks about awarding contracts. It must end the practice of awarding business on the basis of price tag alone.

e) Find problems

Managers must always be on the lookout for ways to improve process procedures. Manufacturing processes play only a small part in a company's overall performance. Other improvements may come in the areas of design, incoming materials, maintenance, machine improvement, training, customer service, and any other area that has an effect on the final product.

If a process is in statistical control, process improvements cannot be made by looking at the defective parts. The process is working as it was designed to work. Therefore, the process must be studied and analyzed for changes in its structure. This should be a continuing effort on the part of managers.

f) Institute modern methods of training

Training can be expensive. It includes:

- instructor's wages
- employee's wages
- machinery downtime
- possible slowdown in production

These are just a few of the related costs. Although it is much more costly for a company not to train its employees, it is harder for a company to track the cost of not training. Training appears to cost money rather than save it. However, this could not be further from the truth. Costs of training are temporary but production and quality increase when the training is completed. When training is left to trial and error, production goals may never be attained, and the production losses are endless. The costs associated with poor quality arising from lack of training are also never-ending. Rework, scrap material, poor morale, and many other costs must be accepted as a result of the corporate culture.

To a large extent, these costs could be reduced by training. This requires a line item in the budget for such a purpose. In fact, it may require a new department with a budget of its own. Is it becoming clearer what is required in a philosophy change?

g) Institute modern methods to supervise production workers

It is important for industrial management to realize that today's workers have a much higher educational level than before. Today's assembly workers and machine workers are generally literate. The work force of today, if given a chance, can be of great value to management. Who can determine the problem of the machine better than the operator?

Supervisors need to have the authority to revise processes and repair machines. Workers must also be given the training and tools to effect improvement. Management must find ways to break down the barriers that hinder communication between departments and between labor and management.

h) Drive out fear

Labor and management have had an adversarial relationship for many years. This is a cultural attitude prevalent in the U.S. It is not the case in many overseas countries. Japan, for instance, does not embrace this concept. Japanese executives consider that the workers are there for the good of the company and the company is there for the good of the workers. This makes everyone reach for the same goal—the good of the company.

Management must make every effort to remove workers' fear of job loss from the work place. Workers must be encouraged to make suggestions that would improve quality. They must also see some response to the suggestions they make. If improvement

is needed from a worker, methods of improvement must be suggested. Intimidation will only breed insecurity and cause workers to cover their mistakes better.

i) Break down barriers between departments

Each department has experts in its own area of manufacture. Often, individuals from one department assume that everyone in the plant knows as much about their area as they do. This is very seldom the case. Therefore, one department often unknowingly causes quality problems for another department.

These problems can be reduced by interdepartmental meetings on quality improvement. Representatives from engineering, production, sales, shipping, and research and development should get together on a regular basis. Their focus should be on improving existing processes and coordinating future processes.

j) Eliminate numerical goals, posters, and slogans

This type of rhetoric serves only to inflame workers. Placing posters on the walls proclaiming that quality is the most important aspect of the job, without management follow-through, amounts to lying to the workers. It proves that management sees the problems of the company as originating with the workers. Numerical quotas and slogans give the workers nothing to help them improve the quality of their work and merely place unrealistic requirements on the workers.

k) Eliminate quotas

Most production problems come not from the workers, but from the system. The employees will work to the limits of the system. To demand more will cause morale problems and job insecurity among the work force. Within a short time, frustration will set in for both labor and management.

If management is to see long-term improvement in quality and production, it must modify the manufacturing process. This may be done by upgrading machinery, training operators, or possibly instituting a whole new process. Demanding zero defects or increased production without giving the workers a means to accomplish the task will only breed frustration.

l) Foster pride in the work being performed

Everyone wants to feel good about the job he or she performs. In fact, our self-image is often tied to how we feel about our job. This need is basic in everyone.

It is amazing how industry tries to diminish this need in an individual. The need is disregarded when a company fails to provide the workers with consistent accept-and-reject standards, or when it requires people to work on a machine that is not in proper adjustment. When the company does not allow the workers to do the best job possible, it breeds hostility toward the company.

Often, the product quality advertised is not consistent with what the workers have experienced. Workers may take no pride in the product of such a company, fostering labor/management problems as well as problems of quality and productivity.

m) Institute education and retraining

The personnel needs of companies change as demand for the product changes. Often the company's answer to such a change is to lay off some workers and rehire others. In so doing, a company loses all it has invested in the furloughed workers.

Companies can reclaim the experience of the work force by training employees in other areas. This gives the company employees with a good background in more than one manufacturing process. It allows the workers to expand their areas of expertise. In turn, they feel better about themselves and their company.

n) Create management that will push the 13 steps daily

The last step to the Deming philosophy is to keep it going. This philosophy will only be as effective as management's commitment to it.

This approach is not a bandage to keep people from looking at a company's quality problems. It is a management philosophy that will eventually correct quality problems and permanently increase productivity.

Therefore, management must keep these steps progressing on a daily basis. Quality improvement never stops.

2.1.2.2.2. Joseph M. Duran

Juran is a well-respected authority in the quality industry and has written many books on the subject. In 1979, Juran established the Juran Institute, which promotes quality in every facet of industry service. The Juran philosophy is a combination of concepts put together from the ideas of other noted quality professionals and Juran's own ideas. Juran's basic approach is to use whatever tools are needed to solve quality problems one at a time, and then put a system in place to keep them from recurring once the process is fixed. Juran believed there is no hard-and-fast rule that applies to every situation. Rather, there are different rules and concepts that apply to each situation. An overview of Juran's philosophy would be to:

- Obtain quality attitudes
- Obtain quality solutions
- Obtain quality planning and control

These steps each allow for several different methods of achievement. Different methods work for different situations. Juran believed that following these steps will lead to quality in product or service.

According to Juran, the first step to quality is to obtain a quality attitude. A quality attitude is a mind-set that quality is the most important factor in any decision. He believed that everyone within an organization must have a quality attitude, from the line worker to the chief executive officer. To obtain a quality attitude, the worker must believe that quality is desirable and attainable. Without this belief, a quality attitude is impossible. Fortunately, the majority of society holds this belief to some extent.

Juran suggested that there are three types of worker: the inhibitor, the conservative, and the innovator. The inhibitor's desire for quality is outweighed by the belief that he or she has certain rights that are more important. For example, a product development manager may block or inhibit a promising proposal because the idea did not begin with, or would not be conducted by, the product development department. The conservative's desire for quality is superseded by his or her desire for security. He or she fears that an unproven process may endanger his or her position if the company uses it and it does not work. On the other hand, the innovator's desire for quality far outweighs everything else. He or she is not bound by the past nor the fear of losing job security. The

innovator will boldly implement a new process. According to Juran, these three types of people must be approached in different ways.

The innovator needs to be approached only with logical reasoning. The conservative must be shown a successful precedent obtained by innovators. The inhibitor may have to be coerced by peer pressure. Once everyone else has changed, the inhibitor will acquiesce because he or she is standing alone. All levels of an organization must participate in the acquisition of quality attitudes. Top management must state a policy toward quality and set the example by living up to the policy. Middle management must make quality attitudes a part of every job including its own. It can also create channels for the open communication of ideas. Breakthrough in quality attitudes is only the first step.

After the attitude has been adjusted, the second step can begin. Problems must be identified and a plan must then be created to correct the specific problems. There are two types of problems according to Juran: sporadic problems, which are dramatic deviations from the status quo, and chronic problems, often thought of as inevitable because they are longstanding and very difficult to solve. Often, chronic problems require a remedy through change. Juran uses the concept of "vital few and trivial many." This concept is called the "Pareto Principle." Under this principle, the vital few account for a large portion of the problems, whereas the trivial many account for only a small part of the total problem. Juran uses this principle to assign priorities to problem solving.

Once problems have been categorized and prioritized, Juran advocates the use of a "steering arm" and a "diagnostic arm" to set up a plan to solve the problem.

The steering arm consists of people who provide the following:

- Definition of the specific aim of the improvement program
- Ideas on possible causes of the problem
- Authority to experiment
- Authority to implement the solution

The diagnostic arm consists of people who determine the causes, not the remedies, of a problem.

Both of these arms work together to identify the problem, find the cause of the problem, and set up a solution for the problem and/or plan for production. Both work on

the basis of Juran's concept of "fitness for use." Standards are set by the customer, who determines when the product is fit for use.

Once a plan has been established, it must be implemented. Implementing a plan always proves to have obstacles and steps of its own. Juran suggested that the first step is overcoming resistance to change. Any proposed change may first be considered a threat to the workers' culture. Acceptance of change involves two steps: unlearning old habits, attitudes, and beliefs; and learning the new. This can be promoted by establishing some means of praise or approval. Juran recommends several ways in which change can be promoted. Planning and implementation should involve those who are affected. It is important to work with the leadership of the culture and to choose the right time to implement change.

Once resistance to change has been reasonably overcome, it's time to take action. The diagnostic and steering arms are composed of individual supervisors, who retain the responsibility for decisions, action, and results. Implementation of the plan by the various departments is explained by Juran in the spiral diagram (see Figure 1).

The model is a closed 360 loop in the form of a spiral that shows progression through time. Each individual process and department key works with and for another. Each subsystem must meet its individual goals if the plan is to be successful.

Taking action will not in itself implement change. There must be a transition period. The transition involves retooling, exchange of information, training, and following progress to ensure the sequence stays on course. Training can take time, and the more complicated the process, the more time it will take. Implementing a formula to take the place of a rule of thumb takes techniques that reward workers for using it and that make it easy to do. This will increase the probability that the formula will be used.

The information gathered by the diagnostic and steering arms must be communicated to the various subdivisions and departments. Once the transition has taken place, the progress must be followed to the next step required to obtain quality. Control is the final step in Juran's system to obtain quality in a product or service.

Control includes;

- Choosing the subject of control
- Using a unit of measure

- Setting and resetting a standard
- Choosing and using a type of sensor.

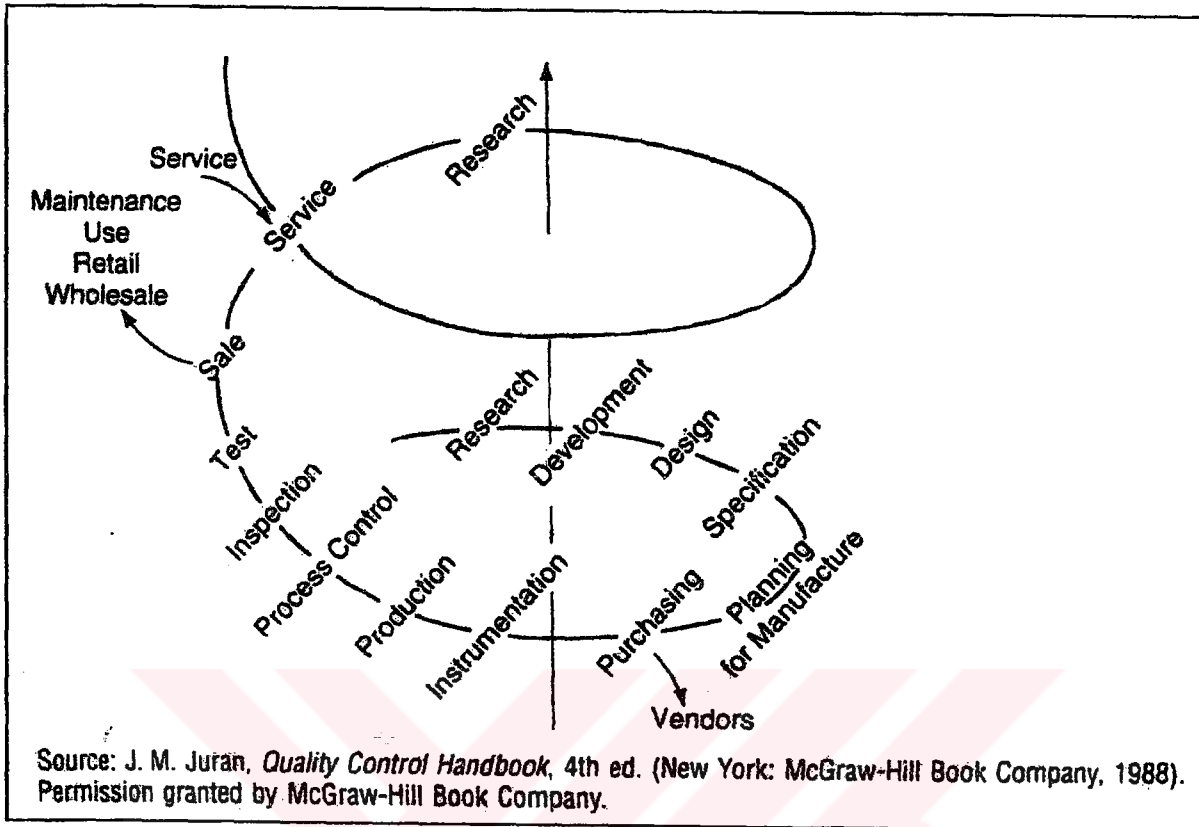


Figure 1 The Spiral of Progress in Quality

Control is adherence to standards, staying on course, and preventing change of direction. Identifying a control subject, such as part tolerance, cost, morale, corporate image, or the like, is a must. No progress can be made without this. After a control subject has been picked, a unit of measure must be chosen. Juran advocates the use of numbers to reduce debate over the meaning of the objectives—for example, the question of “how poor is poor quality?”

Even with a unit of measure, a decision cannot be made without a set standard. Again, Juran’s concept of fitness for use is applicable. The fitness standard is set by the customer; however, other standards need to be established to meet this end requirement.

Standards must be attainable, economical, applicable, consistent, and all-inclusive. They must be understandable, stable, maintainable, legitimate, and equitable. Standards begin to deteriorate the minute they are established, so formal reviews must be made. Standards also give a goal stating what should be done.

A sensor is needed to determine exactly what is being done. A sensor is a device used to sense specific stimuli and convert them into information. In a company, the most familiar sensors are time clock cards, materials requisitions, inspector's gauges, and sales representatives' call records, to mention a few. Juran notes three types of sensors—those that sense before the fact, those that sense during the fact, and those that sense after the fact. Sensing should be done in accordance with agreed opinion. Without an agreed sensor, the validity of the information will undoubtedly be questioned. With the sensor in place, actual performance can be measured and the tasks of developing quality attitudes, quality plan setting, plan implementation, and quality control can be repeated.

2.1.2.2.3. Philip B. Crosby

Zero Defect (ZD) is a program that originated during the production of the U.S. Army Pershing missile system in the 1960s. It was developed by Philip B. Crosby, quality manager for Martin Marietta Corporation's Martin Company in Orlando, Florida.

It seemed that the missile program was plagued by one disaster after another, usually because of small instances of human carelessness. It was on December 21, 1961, that Crosby's program was really noted as a success. On that day, Cape Kennedy received its first Pershing missile from the Martin Company with zero discrepancies.

The whole concept of ZD is to stop defects before they happen instead of waiting to find them during an inspection of the part, or worse, by the consumer at a later date! To do this, the definition of a defect and how it came to be must be known. First, the defect (or worker error) is caused by either a lack of knowledge, working with the wrong tools or without the proper facilities, or by 'the worker's inability to keep his or her attention on the work being done. Crosby's message was to motivate workers toward a mind-set that promotes business ethics and quality.

Crosby proposed that the thinking behind these "worker errors" is cultural. Americans are brought up to think that "to err is human" and "nobody is perfect." All through life workers have been given a certain margin of error. For example, C means passing work in school. Workers carry this thinking into their jobs, where they are allowed a certain percentage of errors, or defects, and can still remain on the job.

However, no matter how mediocre the worker's own performance, each worker tends to expect more than mediocrity from the people around him or her. For example, most people expect their doctor always to be right. Few people would fly on airplanes if

they thought that they could walk away safely from only 70 percent of landings. Realizing this, Crosby decided that if he was going to be able to initiate his ZD program, he would have to promote a constant, conscious desire to “do the job right the first time.”

Crosby believed the attainability of this goal was directly proportional to the attitudes or desires of individuals. Individual attitude is set, to a large extent, by corporate attitude. To get the worker to respond, direct management action is needed at the highest level.

Crosby developed five steps for management to follow:

- Present a challenge.
- Back the challenge with action of its own.
- Establish standards to be met.
- Check results.
- Act in accordance with the results to recognize accomplishments.

There are four absolutes that are an integral part of Crosby's concept:

- The definition of quality is conformance to requirements.
- The system of quality is prevention.
- The performance standard is ZD.
- The measurement of quality is the price of nonconformance.

ZD is a broad-based approach to quality improvement, independent of technology or particular quality techniques. The program is based on the concept that employees perform work at the standard set by management; therefore, employees perform a poor quality of work because of low standards adopted by management. “Management must repent by setting a standard of zero defects for their employees and sponsoring a program that allows the organization to make progress toward the new goal.”

There are 14 steps to implement a zero defects plan:

- Management commitment
- Quality improvement teams
- Measurements
- Cost of quality
- Quality awareness
- Corrective action
- Zero defects planning

- Supervisor training
- Zero Defects Day
- Goal setting
- Error cause removal
- Recognition
- Quality councils
- Do it over again

a) Management commitment

If the program is to be successful, the commitment of the top-level managers is essential. It must be more than lip service; the work force must be able to see a continuing commitment on the part of management. A corporate policy on quality must be developed. Top-level staff meetings should include reports on the quality improvement process, quality costs, and conformance. The chief executive officer and the chief operations officer need to make clear statements to their employees about quality to motivate the workers.

b) Quality improvement teams

In this phase, the company brings together representatives from each department to form the team. The purpose of the team is to "improve things around here." This is the starting point for low-level motivation programs. Programs such as quality circles are useful here.

c) Measurements

Here the company's quality measurements will be reviewed. What are the company's measurements? Are they working? Questions such as these should be asked and answered. From this, a quality status can be recorded. It will show areas of possible improvement that can be measured, give corrective action, and document actual improvement.

d) Cost of quality

The cost of quality is where changing what is wrong will profit the company. There are two areas of cost of quality: the price of nonconformance and the price of conformance. The price of nonconformance is all the costs incurred by doing things

wrong. The price of conformance is all the costs incurred by doing things right the first time. The first is the cost of a lack of quality; the second is the cost of doing business. Management must compile the quality 'costs to evaluate the scope of the financial loss the company is presently experiencing. In most cases, putting a dollar value on the cost of poor quality will motivate upper management toward improvement.

e) *Quality awareness*

This is management's effort to inform the employees about the measurements of the costs of non-quality. This is done through improvement materials such as booklets, films, and posters. Communication inside a corporation is very important. If the company does not have an overall communication system, quality awareness will never be successful.

Some companies have quality slogans such as "Do it right the first time" to help increase quality awareness. Everyone needs to be aware of management's commitment to quality, what the quality policy says, and the cost of doing things wrong. It may be helpful to make the company's quality awareness known to the general public, usually in the form of advertising the quality program. The goal of such a program is to project a quality image to the buying public.

f) *Corrective action*

The purpose of corrective action is to identify and eliminate problems forever. People are encouraged to talk about problems found through inspection, audits, or self-evaluation. Identifying a problem is the first step in corrective action. The idea here is to fix the problem, not fix blame.

g) *Zero defects planning*

For the program to have the most impact, all employees should be informed of the program and its goals on the same day. The day can be devoted to "kicking off" the ZD program. Three or four members of the quality team are selected to investigate how other companies have run their Zero Defects Day.

Speeches could be made by representatives from unions, city government, and customers. Information on the goals and objectives should be given to everyone at the

same time. Generally, this is done by department heads who have been trained in the ZD way. Often the company hosts a dinner or coffee to show its commitment.

h) Supervisor training

A formal orientation with all levels of management should be conducted prior to implementing all the steps. All managers must understand each step well enough to explain it to their staff. The proof of understanding is the ability to explain it.

Eventually, all the supervisors will be tuned into the program and realize its value for themselves. Then they should concentrate their action to further the program.

i) Zero Defects Day

The establishment of ZD as the performance standard of the company should be done in one day; that way, everyone understands it the same way. Supervisors explain the program to their employees and do something different in the facility so everyone will recognize that it marks a "new attitude" day. Making a day of the ZD commitment provides an emphasis and a memory that will be long-lasting.

j) Goal setting

Goal setting happens automatically right after measurement. Some quality improvement teams try to do Steps 1 through 14 consecutively, but actually most of them run in parallel (e.g., quality education never stops). The first six steps are all accomplished by management and need to be completed first. When the measurement of quality costs begins, people should immediately start to think about goals. The ultimate goal is ZD, and that is everyone's objective. Goals should be chosen by the group as much as possible, and should be put on a chart for everyone to see. Minor goals should not be listed; the goals should be obtainable but should also make the department work to obtain them.

k) Error cause removal

Individuals are asked to describe any problem that keeps them from performing error-free work. This is not a suggestion system; all they have to do is list the problems. The appropriate team will develop the answer. It is important that all problems listed be quickly acknowledged, generally within 24 hours. People will learn that their problems can

be heard and addressed. Once employees learn to trust this communication, the program can go on forever.

l) Recognition

Very few companies recognize their good performers. Many managers feel that people are being paid to do their jobs well and that should be that. Under this quality program, awards are established to recognize those who meet their goals or perform outstanding acts. The prizes or awards should not be monetary, because the act of recognition is what is important. For this recognition to be motivating, people must be on the social affiliation level or esteem recognition level on the Hierarchy of Needs. Genuine recognition of performance is something people really appreciate. They will continue to support the program, even if they did not personally receive an award.

m) Quality councils

Quality professionals and team chairpersons should be brought together regularly to communicate with each other and to determine the necessary action to upgrade and improve the quality program to be initiated. This council is the best source of information on the status of the program.

n) Do it over again

The typical program takes 12 to 18 months to install. By that time, turnover and changing situations will have wiped out much of the education effort. Therefore, it is necessary to set up a new team of representatives and begin again. For instance, ZD Day should be marked as an anniversary. The company might give a special lunch for all employees. The point is that the program is never over. Repetition makes the program perpetual. If quality is not ingrained in the organization, it may never be attained.

2.1.2.2.4. Armand Feigenbaum

Dr. Armand Vallin Feigenbaum is the originator of Total Quality Control (TQC). TQC is an approach to quality and productivity that has profoundly influenced the competition for world markets in the U.S., Japan, and throughout the industrialized world.

For 10 years, Feigenbaum managed worldwide manufacturing operations and quality control for the General Electric Company. He was the founding chairman of the International Academy for Quality and is past president of the American Society for Quality Control, which has presented him its Edwards Medal and Landcaster Award for international contributions to quality and productivity.

TQC is an extensive, companywide, quality improvement program. The Total Quality system gets everyone involved by developing an agreed-on companywide and plantwide work structure documented in effective, integrated technical and managerial procedures. This gives coordination to the actions of the work force, machines, and information of the company in the most practical ways, ensuring customer quality satisfaction and economical costs of quality.

Often, a company's quality control department deals only with production. The quality effort in the production area is extensive; however, this is not the only area in which quality costs are incurred. Feigenbaum realized that quality plays an important role in business. From the time of the initial contact with the customer to installing and servicing the product, the customer's requirements must be met.

The customer comes in contact with more than just the product in the course of business. Often, a problem in shipping, records, invoices, or any of a number of other areas of administration will influence how a customer feels about the product. TQC is a customer-based improvement program. If the customer is not satisfied, there is a lack of quality.

Feigenbaum's definition of quality is: "The total composite product and service characteristics of marketing, engineering, manufacture, and maintenance through which the product and service in use will meet the expectations of the customer." Feigenbaum is saying that the customer forms an opinion of the quality of the product by more than just the product itself. The customer must be satisfied in all areas of a transaction. The processes and procedures of marketing, engineering, purchasing, manufacturing engineering, manufacturing supervision, shop operation, mechanical inspection, functional testing, shipping, installation, and service must all meet the requirements of the customer.

American businesses can no longer develop procedures and processes in these areas and then expect the customers to change their requirements to fit. Competition in today's worldwide market is too great.

Feigenbaum defined 10 product and service conditions that must be met or considered to satisfy customer requirements:

- **Specification of dimensions and operating characteristics**
- **Life and reliability objectives**
- **Safety requirements**
- **Relevant standards**
- **Engineering, manufacturing, and quality costs**
- **Production conditions under which the article is manufactured**
- **Field installation, maintenance, and service objectives**
- **Energy utilization and material conservation factors**
- **Environmental and other side effects considerations**
- **Cost of customer operation and use, and product service**

The aim of these conditions is that quality establishes the proper balance between the cost of the product or service, and the customer value it renders (including essential requirements such as safety).

Determining quality and quality costs actually takes place throughout the entire industrial cycle. This is why real quality control cannot be accomplished by individually concentrating on inspection, product design, reject troubleshooting, operator education, supplier control, statistical analysis, and reliability studies, as important as each individual element is. To install this concept, an alteration in the major business management strategy is required.

The total-customer-satisfaction oriented concept of quality, together with reasonable costs of quality, must be established as one of the primary business and product planning and implementation goals and performance measurements of the marketing, engineering, production, industrial relations, and service functions of the company. Assuring this customer-satisfaction quality and cost result must be established as a primary business goal of the quality program of the company and of the quality-control function itself—not some narrower technical goal restricted to a limited technical or production-oriented quality result.

2.1.2.2.5. Quality Circles

Quality circles rely heavily on the work force to identify and resolve the quality problems that exist within a company. Who better to identify problems than the people working the machines? Quality circles are often used in conjunction with the TQC concept. A quality circle is a small group of employees and their supervisors from a work area who voluntarily meet on a regular basis to study QC and productivity improvement techniques. These techniques are used to identify and solve work-related problems, present their solutions, and ensure that they work.

There are 14 criteria used in the formation of quality circles in a company:

- Quality circles are small (they range from 4 to 15 members).
- All members come from the same area (this gives the circle its identity).
- The supervisors come from the same area as the members.
- Supervisors are usually, although not always, the leaders of the circles (but they do not issue orders or make decisions).
- Participation is voluntary (this means everyone in the shop can join or refuse to join, quit or rejoin).
- Circles meet once a week, on company time, with pay.
- Circles meet in special rooms away from work areas.
- Circle members receive special training in the rules of quality circle participation (e.g., the mechanics of running a meeting/management presentation, techniques of group problem solving, brainstorming, flowcharts, Pareto analysis, and cause-and-effect diagrams).
- Circle members, not management, choose the problems on which they will work.
- Circle members collect all information, analyze problems, and develop solutions.
- Technical specialists and management assist circles with information and expertise whenever asked to do so.
- Circles receive advice and guidance from an advisor who attends all circle meetings, but who is not a circle member.
- Management presentations are given to those managers and technical specialists who would normally make the decision on a proposal.
- Circles exist as long as the members wish to meet. They can

inactivate themselves or reactivate; they can meet for one month or for years.

Although there are 14 criteria, not all are required for each individual business. The program may range from a small company with a single quality circle requiring only 1 or 2 of the 14 steps, to a large corporation with thousands of quality circles, which may need all 14 criteria in each of their circles.

The requirements of the Hierarchy of Needs must be met within the company if the quality circles concept is to work. To contribute ideas and implement solutions with others, employees must feel secure about their jobs and the work they do.

Careful planning must be done before the circles are started. The circles concept is not a temporary cure; it is an ongoing philosophy of personal, as opposed to personnel, management. A cultural change must accompany the philosophy. If change is not done properly, poor labor/management relations may result.

2.1.2.2.6. Summary of quality philosophies

At this point it should be apparent that all of the philosophies have many points in common, and each has points that are in direct contradiction to other philosophies. Distinctions should be drawn among the philosophies to define and separate them.

Deming's approach can be summarized by the use of statistics to allow the operator to obtain detailed information about the process by measuring the product. Deming developed a philosophy that requires a companywide effort to improve the quality system, resulting in a higher quality product. His is an upper-management-down approach.

Juran's philosophy can be summarized as improving quality on a problem-by-problem approach. His technique to improve quality is to evaluate a problem, using some statistics, and to develop a plan to eliminate the cause and keep it from recurring. His approach can be effectively implemented at an intermediate management level, but is most effective when approved and supported by upper management.

Crosby's view can be summarized as motivating the work force and business ethics. Crosby advocates business ethics in his slogans "Do it right the first time" and "If

it's not right don't ship it" as the foundation of his approach. Crosby's philosophy primarily concerns the motivation of workers and management. Crosby does not recommend the use of statistical analysis as a means of identifying and solving problems. He believes the workers can, if properly motivated, identify and eliminate 90 percent of the quality problems that occur in a plant.

Feigenbaum coined the term Total Quality Control. His approach is to get everyone involved, motivate both workers and management, use statistical analysis, and systematically improve quality. His approach requires upper management's total support and guidance.

Quality circles have evolved through the guidance of many quality professionals. The basic idea behind quality circles is to motivate workers and management to study a problem intensively to find the solutions. The motivation behind the circles is to allow everyone—from janitor to plant manager—to have the same opportunity for input regarding solutions to problems. Everyone is equal when solving a problem in a quality circle. Statistical analysis is used to help identify and solve problems.

Along with the points in common among the philosophies are points that are different. The main points in which the philosophies differ are the methods used to motivate workers, use of statistical analysis, and thoroughness of the initial program. Many authors focus on these differences instead of exploring the proper way to improve quality. Let us address and explore the differences at this point. One word of caution—this discussion of the differences should not be interpreted as a statement that one philosophy is better than another. Each method has had tremendous successes and can be used to improve quality. Motivation is one area where the philosophies differ most. Deming and Crosby approach motivation from opposite directions, whereas Juran and Feigenbaum are somewhere in the middle.

Deming's system eliminates slogans and banners from the factory. Deming believed this approach insults the workers' intelligence and could be counterproductive if the company does not live up to the slogans that hang in the shop. Deming suggests that true motivation comes when a worker is given total responsibility for quality, along with the authority to make the needed changes to improve quality.

Crosby believes that the use of slogans, signs, education, meetings, motivational speeches, lunches, and recognition is the proper approach. These two philosophies are in

direct conflict with each other Juran and Feigenbaum are close to each other in the way they advocate motivation. Both these philosophies empower the worker, explain the “why” behind a policy, allow the worker to have input into the resolution of a problem, and treat the worker with dignity.

Each of the approaches to motivation has a good track record in industry. The right approach to motivation is the one that works effectively in a shop. The use of statistical analysis is a second point where these philosophies differ. At the extremes are Deming and Crosby. Juran and Feigenbaum are again in the middle.

Deming is a reformed statistician and advocates the use of statistical analysis to identify, solve, and control virtually any variance in a process. This requires tremendous amounts of data to be collected and analyzed. It also requires in-depth training of the work force in statistical analysis.

Crosby is at the other extreme in his approach. He advocates no use of statistical analysis, because it tends to overwhelm the work force and the output can be adjusted to give a false impression. Juran and Feigenbaum advocate the use of statistical analysis when the problem or process under study requires its use. Both believe that if the problem or process can be studied without the use of statistical analysis, statistics will only cloud the issue and could make the solution to the problem harder to find. The third area of disagreement is in the extent of the system wide initial improvement program. In this area, Juran is at one extreme, whereas Deming, Crosby, and Feigenbaum take the opposite view.

Juran, though stating that a system wide approach will yield the greatest improvement, developed his approach to solve problems on a case-by-case basis. This approach can be implemented even when upper management takes a wait-and-see attitude or gives less than total support to the improvement program. Deming, Crosby, and Feigenbaum developed philosophies that require total support by upper management. If this support is not present, successful implementation of these programs will be at risk.

Each of these philosophies has had successes and failures. The best approach for many companies is to take the applicable parts of each philosophy and “custom make” a program that better fits the particular organization. If the decision is made to follow one approach to the exclusion of all others, the choice should be carefully made. The only thing worse than not having a quality improvement program in a company is to have a

program that fails. If no program is present, the credibility of the quality control department is in question; if a program fails, the credibility of the quality control department is totally destroyed.

2.2. Priority of quality in construction companies

2.2.1. Objectives of an organization

A company should seek to accomplish the following three objectives with regard to quality:

- The company should achieve and sustain the quality of the product service produced so as to meet continually the purchasers stated or implied needs.
- The company should provide confidence to its own management that the intended quality is being achieved and sustained.
- The company should provide confidence to the client that the intended quality is being, or will be, achieved in the delivered product or service provided. When contractually required, this provision of confidence may involve agreed demonstration requirements.

The relationship of the concepts, the definitions of which are quoted above are illustrated in Figure 2 and Figure 3.

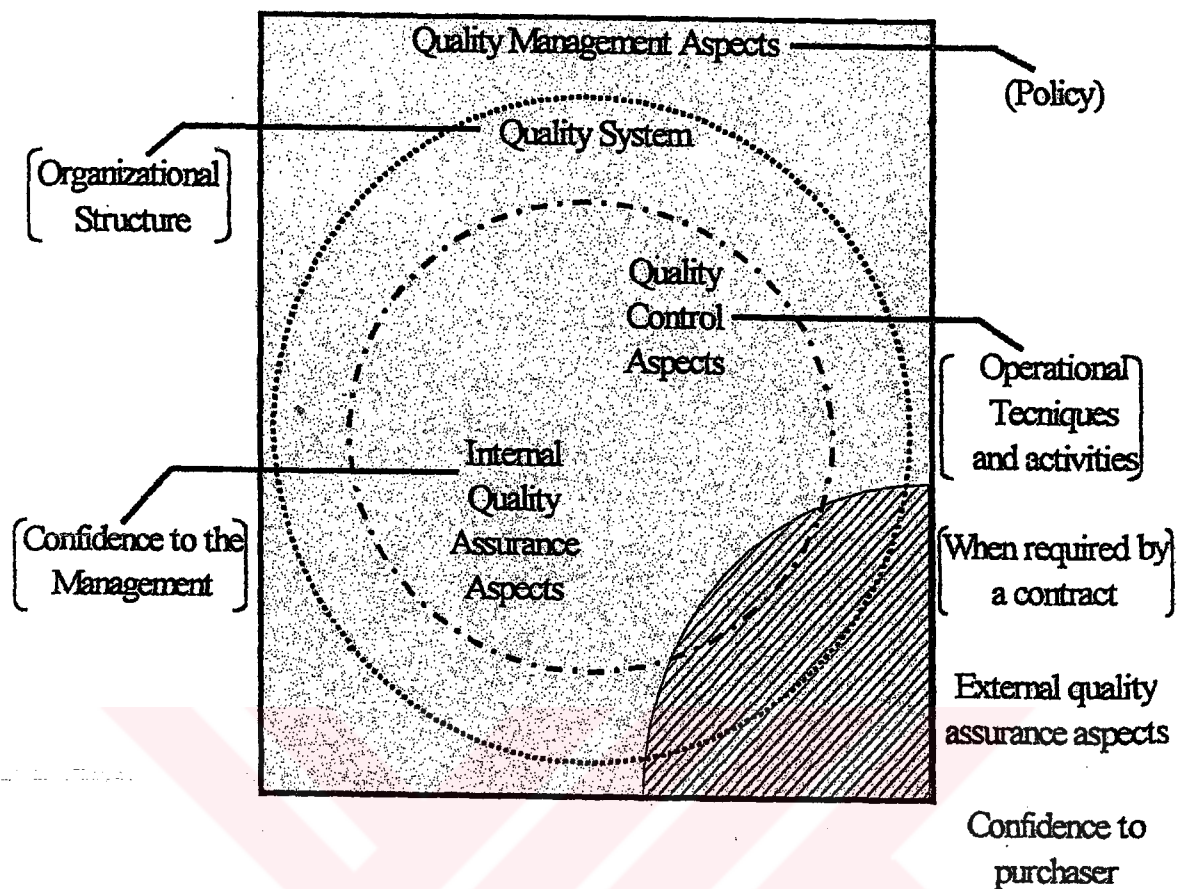


Figure 2 Relationship of concepts

This new need then gave rise to quality statements such as:

Leadership in quality has top priority.

Quality shall be given equal priority to cost and delivery.

Managerial decisions must give equal considerations to quality as well as to aspects of cost and schedule.

2.2.3. Approaches to quality

2.2.3.1. Preventive System Approach

If the faults are tried to be avoided before they occur, quality develops and improves, and as a result, getting into market gets quicker. Stages are:

- **Determination of client's needs (market research).**
- **Design and improvements activities.**
- **Process control.**
- **Marketing and sale.**

2.2.3.2. Corrective System Approach

Because the client complaint analysis or realization of the fault is necessary to correct the fault, this approach gives a slower result. Stages are:

- **Analysis of client complaints.**
- **Corrective action.**
- **Process control.**
- **Marketing and sale.**

Preventing is always easier and cheaper. There is always a possibility of fault. So; better approach is the Preventive System Approach.

2.3. Quality Management applications in construction

2.3.1. General

The early development work on quality management took place in a manufacturing environment and so it is not surprising that most literature on the subject is written in the language of a factory. This is unfortunate as it creates a mistaken impression in the minds of those engaged in activities other than manufacturing that the tenets of quality management hold no benefits for them. Nothing could be further from the truth. Only monopolies can effort to ignore the customer's demand for value for money and satisfaction of his needs. Any person or organization whose livelihood depends on successful performance in the market place can benefit from quality management, and this includes the construction industry.

This is not to say that quality management as practiced in factories can be transplanted unchanged into the construction industry. The differences between the factory and the construction side cannot be ignored. There are special factors which have to be taken into account -the susceptibility to weather, the mobility of labor, the fact that almost every job is a prototype, and so on.

Some of these factors are;

1. Construction projects are generally consist of unique production.
2. Contrary to the other industries that have a settled production unit and environment the production sites of the construction projects are different and special for each project.
3. In comparison with the other industries, the production process of projects in construction industry is long.
4. There aren't any clearly defined standards for quality evaluation in construction projects. That is why the construction projects are estimated subjectively.
5. The client affects the production process in construction projects.
6. The stakeholders (client, architect/ engineer, contractor, sub-contractors, municipalities) differs one project to another.

These realities undoubtedly make the introduction of quality management more difficult than another industries. But if it is true that the management of construction sites is a uniquely formidable task, it does not make sense to ignore the most significant advance in management technique to have arrived on the scene in recent years. In any case, times are changing. The differences between factories and construction sites are slowly but steadily disappearing. There is more and more assembly work and less and less craftsmanship.

So the techniques are there, available for the industry to use. All too many buildings and structures in recent years have failed to satisfy the legitimate requirements of their purchasers and the reasonable expectations of the community at large. The record is not one of which any manager or engineer can feel proud. There are faults in concept, design, materials and workmanship. Some of these are a result of technical advances; structures which were once designed by experienced engineer and erect by highly trained craftsmen are now increasingly being designed by computers and assembled by semi-skilled labor. Analysis shows, however, that only a minority of construction defects are technical in origin. Far more arise from inadequacies in the management structure of the industry, from lack of training and from the commercial pressures which stem from the almost universal custom of awarding work only to the lowest bidder.

Training is a problem in construction industry. The qualified personnel are not stable like other industries. The varying and uncertain environment, affects the training of qualified personnel negatively in the construction industry. It is important to remember that to obtain quality takes a long-lasting time. The most important of all during this process is to train all personnel at all levels to know about and to improve their skills for quality obtaining.

Recent advances in the techniques of construction management have increased the commercial pressures. More and more organizations are operating sophisticated computer-based programs for analyzing and presenting the facts, statistics and trends upon which management decisions may be based. No longer need the manager, or his superiors, be unaware of potential delays or budget overruns or cash-flow problems. The computer will present all the information needed, and more, with speed, accuracy and detail. These systems are powerful motivators. They enable organizations to set their managers exact goals and then report on the achievements of these goals quickly and precisely. Managers soon come to realize that the way to achieve recognition, salary increases, promotion and all the other rewards of work, is to make certain that the

information fed to the computer will be that which will tell their superiors what they want to hear. It would be naive not to recognize that, the quality of the product is likely to be the first casualty as managers succumb to the pressures and priorities exerted by the system. If this is the case, control of total cost, which is the express purpose of most project management systems, will be frustrated. The products of the construction industry are intended for a long life and those who construct them can be held liable for defects for many years after hand-over. The normal time cycle of monetary control is too short to collect all the costs which will eventually accrue and which should rightfully be charged against the project or work element. Project management systems which present their targets only in terms of cost and schedule can destroy a manager's natural instinct to produce work of which he can be proud. This is a very strong argument in favor of the establishment of a quality system. It can provide a counterpoise to the two forces of cost and schedule which, if not resisted, will pull the site manager in the wrong direction.

No one with experience of managing a construction site will underestimate the magnitude of the task. But, when one reviews the frequency of press reports of defective structures, when one considers the poor reputation of the construction industry for the quality of its products and, above all, when one contemplates the spiraling costs of litigation over latent defects, it can only be concluded that we do have a serious problem. The arguments in favor of applying the logic and rationality of quality management to the particular problems of the construction industry are very powerful.

2.3.2. Quality Management principles and explanations

A quality management principle is a comprehensive and fundamental rule or belief for leading and operating an organization, aimed at continually improving performance over the long term by focusing on customers while addressing the needs of all other stakeholders.

Principle 1 Customer-Focused Organization

Organizations depend on their customers and therefore should understand current and future customer needs, meet customer requirements and strive to exceed customer expectations.

Principle 2 Leadership

Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives.

Principle 3 Involvement of People

People at all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization's benefit.

Principle 4 Process Approach

A desired result is achieved more efficiently when related resources and activities are managed as a process.

Principle 5 System Approach to Management

Identifying, understanding and managing a system of interrelated processes for a given objective improves the organization's effectiveness and efficiency.

Principle 6 Continual Improvement

Continual improvement should be a permanent objective of the organization.

Principle 7 Factual approach to decision making

Effective decisions are based on the analysis of data and information.

Principle 8 Mutually beneficial supplier relationships

An organization and its suppliers are interdependent, and a mutually beneficial relationship enhances the ability of both to create value.

Table 1

Examples of application of the quality management principles in quality assurance and quality management

Quality Management Principles	APPLICATION FOR ISO 9001 (1994 EDITION)	QUALITY MANAGEMENT APPLICATION (ADDITIVE TO ISO 9001)
Principle 1 - Customer-focused organization Organizations depend on their customers and therefore should understand current and future customer needs, meet customer requirements and strive to exceed customer expectations.	Assure conformance to defined customer requirements.	Understand current and future customers needs and expectations. Measure customer satisfaction and act on it.
Principle 2 - Leadership Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives.	Set policy and verifiable objectives, deploy policy, provide resources and establish an environment for Quality.	Establish vision, direction and shared values. Set challenging targets and goals and implement strategies to achieve them. Coach, facilitate, and empower people.
Principle 3 - Involvement of People People at all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization's benefit.	Establish competency levels, train & qualify personnel. Provide clear authority and responsibility.	Create personal ownership of an organizations targets and goals, by using it's peoples knowledge and experience, and through training achieve involvement in operational decisions and process improvement.
Principle 4 - Process Approach A desired result is achieved more efficiently when related resources and activities are managed as a process.	Establish, control and maintain documented processes.	Explicitly identify internal/external customers and suppliers of processes. Focus on the use of resources in process activities, leading to effective use of people, equipment, methods and materials.
Principle 5 - System Approach to Management Identifying, understanding and managing a system of interrelated processes for a given objective improves the organization's effectiveness and efficiency.	Establish and maintain a suitable and effective documented Quality System.	Identify a set of processes in a system. Understand their interdependencies. Align the processes with the organizations goals and targets. Measure results against key objectives.

Table 1

Examples of application of the quality management principles in quality assurance and quality management

Principle 6 - Continual Improvement Continual improvement should be a permanent objective of the organization.	Through management review, internal/external audits and corrective/preventive actions, continually improve the effectiveness of the Quality System.	Set realistic and challenging improvement goals, provide resources and give people the tools, opportunities and encouragement to contribute to the continual improvement of the processes.
Principle 7 - Factual Approach to Decision Making Effective decisions are based on the analysis of data and information.	Management decisions and actions on the Quality System are based on the analysis of the factual data and information gained from reports on audits, corrective action, nonconforming product, customer complaints and other sources.	Decisions and actions are based on the analyses of data and information to maximise productivity and to minimise waste and rework. Effort is placed on minimising cost, improving performance and market share through the use of suitable management tools and technology.
Principle 8 - Mutually Beneficial Supplier Relationships An organization and its suppliers are interdependent, and a mutually beneficial relationship enhances the ability of both to create value.	Adequately define and document requirements to be met by sub-contractors. Review and evaluate their performance to control the supply of quality products and services.	Establish strategic alliances or partnerships, ensuring early involvement and participation defining requirements for joint development and improvement of products, processes and systems. Develop mutual trust, respect and commitment to customer satisfaction and continual improvement.

Table - 2 Alignment between quality management principles and Iso 9001 clauses

ISO 9001:1994 Clause Number	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.10	4.11	4.12	4.13	4.14	4.15	4.16	4.17	4.18	4.19	4.20
Quality Management Principles																				
1. Customer Focused Satisfaction	M		S	S	M	W	S	W		M	W		M	M		W			S	
2. Leadership	S	W		W					W					W			W	M		
3. Involvement of People	M	W	W	W					W	W				W	M		W	S		
4. Process Approach	W	M	M	M	S			S	S	M			W	M	S	S	M	W		S
5. Systems Approach to Management	M	S		W	S	W		M	M				W	W	W	M	S			
6. Continual Improvement	W		W			W			M				M	S			S			
7. Factual Approach to Decision Making	W	M		M	W	W		S	M	S	S	S	S	S		W	M			S
8. Mutually Beneficial Supplier Relationships					S	S			M				S							

S = Strong alignment link
M = Medium alignment link
W = Weak alignment link

2.3.3. Quality Management in terms of cost

2.3.3.1. Quality costs

What is the true cost of quality in an organization? The slogan 'Quality is Free' only applies if the operations are running perfectly. What are the main cost elements within a company and which should be addressed first?

By adopting a Quality Costing System designed around current financial reporting processes, the significant cost areas can be highlighted and appropriate action can be taken.

The cost elements are well known to most proponents of Quality and are well defined in ISO 9004.

The concept of quality cost has been the starting point for many quality programs. One of the reasons this is so is that the cost of quality has become staggering. "The cost of quality is on the order of ten percent [10 o/o] of the economy." This means that the potential for savings is also enormous. What makes this cost more shocking is that quality costs are only those costs that are related to making an unacceptable product. These costs would disappear if the product were made right the first time. A quality professional must make a thorough accounting of these costs to determine where the majority of a company's revenue is being lost. When: this is located, the company can take corrective action to eliminate the financial drain.

Quality costs can be divided into four areas, depending on where these costs occur. These costs incurred are:

- Internal failure
- External failure
- Appraisal
- Prevention

If these costs can be identified with precision, they can be eliminated.

a. Internal Failure Internal failure costs are those costs that are associated with locating the defective product before it is shipped to the customer. These costs include the following categories:

Scrap The total loss in labor, material, production costs, storage, and inspection of material that is defective and cannot be economically repaired.

Rework The total cost to correct a defective product and make it fit for use, i.e., cost of processing, labor, material, and storage.

Retest The total cost to inspect the product after it has been reworked.

Downtime The time, if any, that production is halted due to defective material. In continuous processing mills, this may be a factor because material from one process is directly fed into the next process. If the defective product is produced in the first process, it is removed and no product is present for the second process to use. This causes downtime for the equipment and labor force. For example, a newspaper press might be halted because of a major printing error.

Yield loss The cost of lower profit that could be eliminated if the production process were improved. A company that makes a soft drink would experience yield loss if it had poor control of the amount of liquid put in the bottle. This cost could become excessive. Suppose 50,000 bottles were filled to 32.5 ounces instead of 32 ounces. This example would lose the cost of production and the profit on 781 bottles of soft drink.

Disposition The cost to determine what to do with a nonconforming product. In many cases, this cost would include the cost of a material review board (MRB). An MRB is a group representing management, engineering, and production that decides the action to be taken on the nonconforming product. The total cost of this board would be included in the disposition.

Facilities These are the total facilities costs of producing a nonconforming product. On average, if a company produced 5 percent defective product, then 5 percent of the costs of the facilities, administration, and production would be used to produce this product.

b. External Failure External failure costs are those that are associated with shipping a defective product to the customer, including the following:

Complaint adjustment This includes the costs to investigate and make good the complaint.

Returned material This includes the total cost to replace or refund the purchase price of the defective product. It also includes the costs of storing, return shipment, and disposition of the defective product.

Warranty cost This includes all costs associated with servicing and repairing the defective product. For many companies, this cost includes regional repair facilities and repairpersons.

Allowances The cost of discounting a substandard product to a customer, for

example, clothing seconds and tire “blems.”

c. Appraisal Appraisal costs are all costs associated with determining the condition of the product the first time through.

Inspection and testing These include the costs of test equipment, material consumed during testing (e.g., X-ray film, chemicals), labor, facilities, and any product that is consumed during destructive testing.

Maintaining test equipment This includes the costs to calibrate and repair test equipment.

d. Prevention Prevention costs are those that are incurred to keep the internal and external failure costs to a minimum.

Quality planning This includes all costs related to planning and implementing the quality plan for a company or a process. These would include the costs of labor, material, and facilities.

Quality data acquisition, analysis, and quality reporting These include all costs associated with gathering, analyzing, and reporting on the quality status to middle and upper management.

Process control This includes the costs of material, labor, and facilities that are dedicated to controlling the output quality of a process used to produce the product.

Improvement projects These include all costs involved with planning, implementation, and maintenance of projects directed toward the improvement of the output quality of a process.

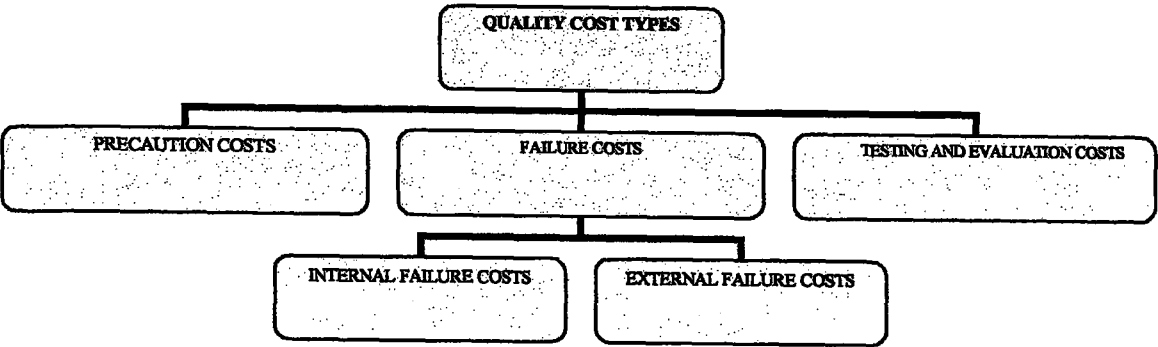
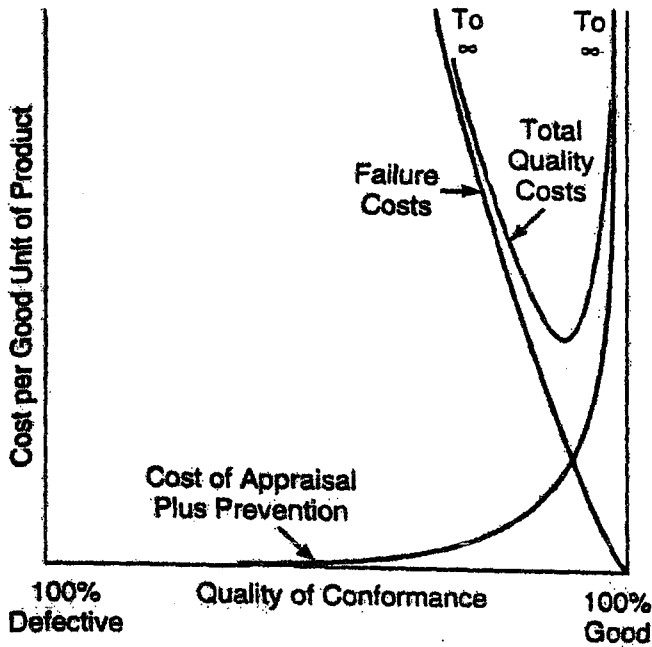


Figure 4 Quality Cost Types

The interrelationship of the four costs can be determined in the module for optimum quality costs (Figure 4).



Source: J. M. Juran, *Quality Control Handbook*, 4th ed. (New York: McGraw-Hill Book Company, 1988).

Figure 5

Total Quality Costs

If 100 percent of the product being produced were defective, the internal and external failure costs would be the total cost of production. The appraisal and prevention costs would be a zero output. As the product approaches 100 percent good, the internal and external failure costs would be reduced; however, to achieve this improvement, the appraisal and prevention costs would go up. Initially, the internal and external failure costs will be reduced at a greater rate than the appraisal and prevention costs will increase. This would result in a good return on investment. As the product quality gets closer to a 100 percent good product, the return on investment goes down. At a point near 100 percent good product, \$1 invested in improving the product yields a \$1 reduction in internal and external failures. Further improvement will yield a negative return on investment.

A quality manager must always keep the interest of the company in mind. The point where a \$1 investment yields a \$1 savings is the economic state of control. Unless industrial requirements force further improvement, this is the point at which a system should be put in place to maintain the process at this optimum point.

QUALITY COST ANALYSIS OF THE QUALITY COMPONENTS

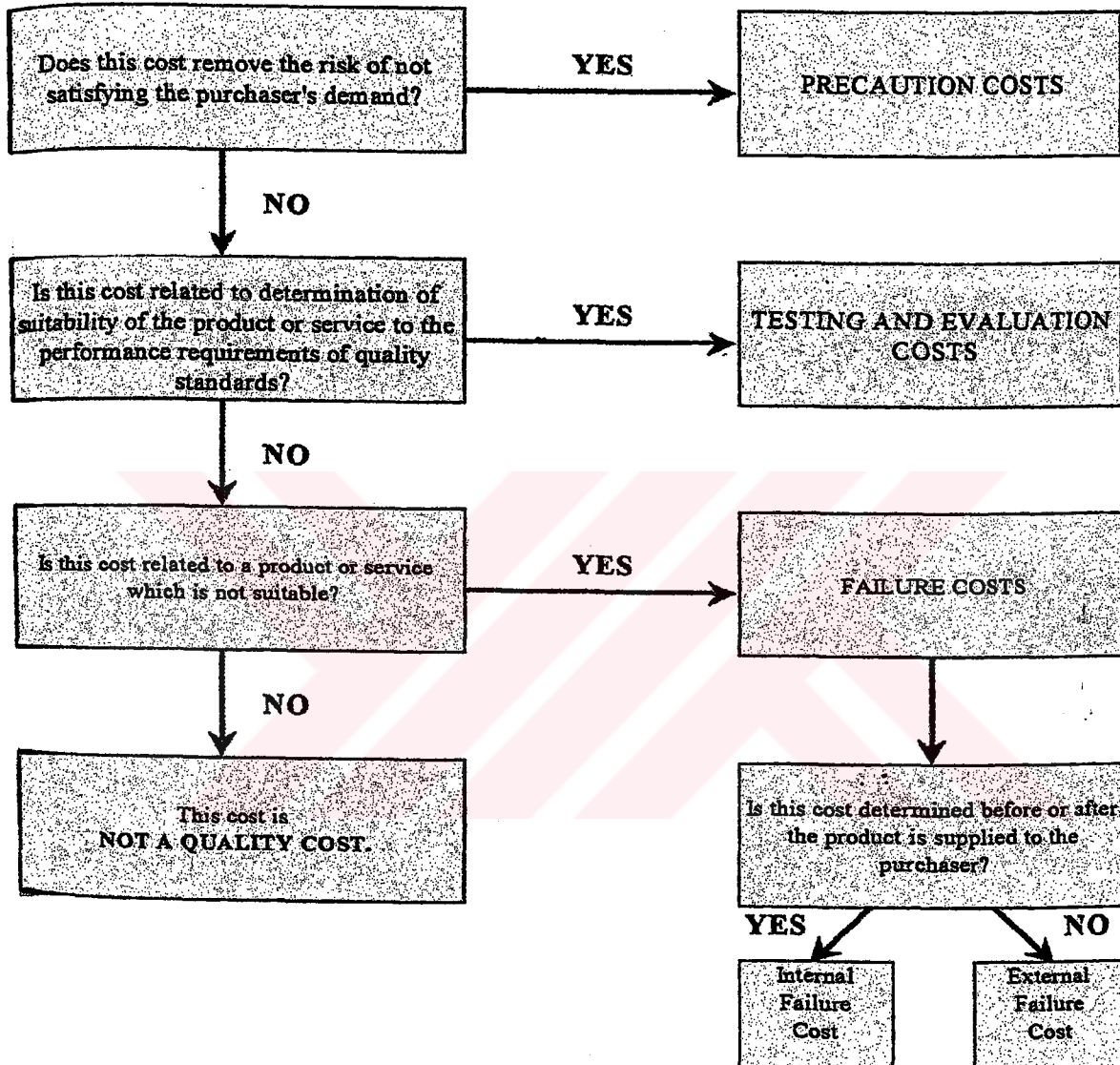


Figure 6 Quality cost analysis of the quality components

Table 3 Quality costs and examples

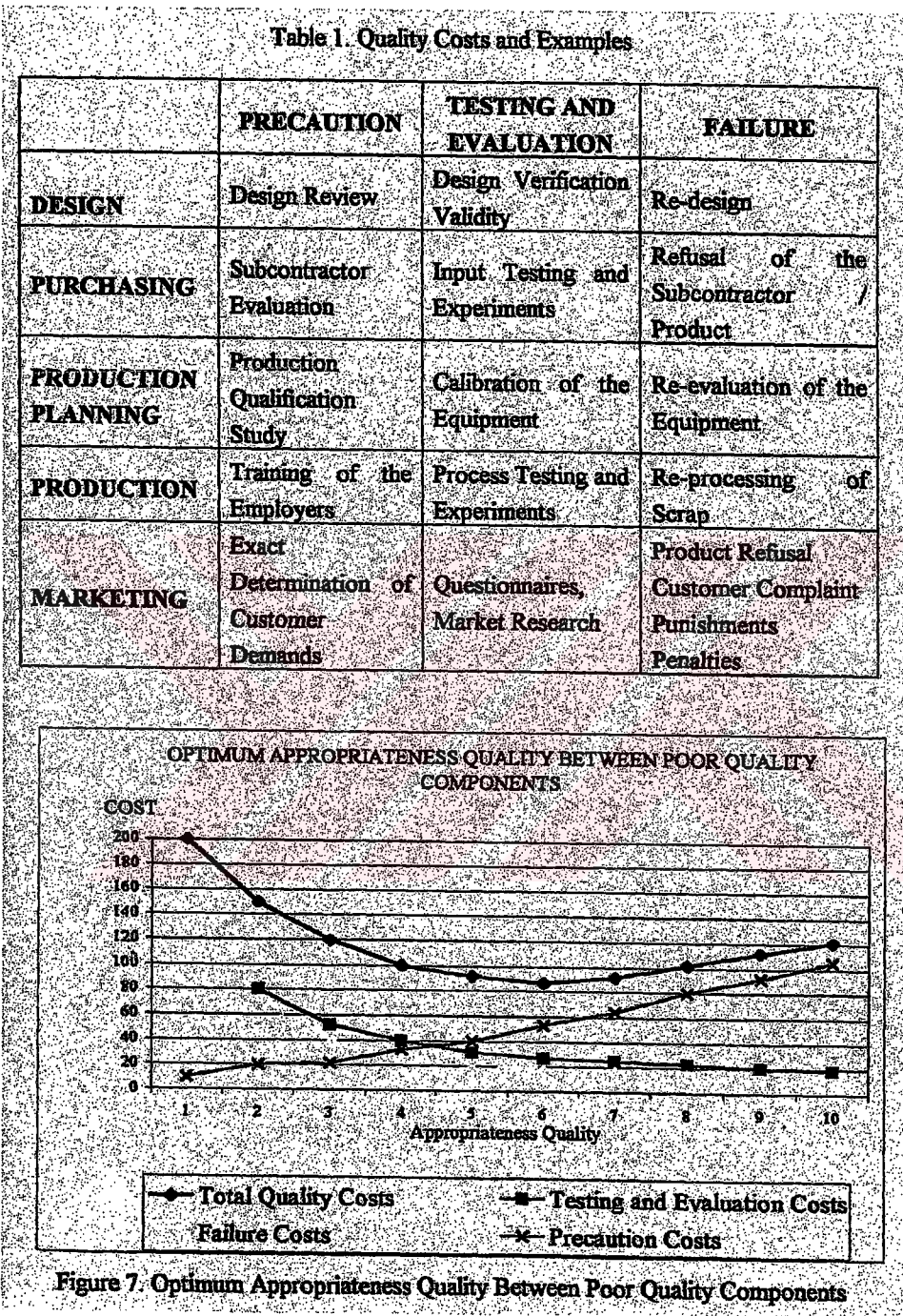


Figure 7 Optimum appropriateness quality between poor quality components

2.3.3.2. Risks of poor quality

Company:

- Loss of reputation
- Reduction of market share
- Waste of resources and reduction of productivity
- Loss of motivation
- Physical and moral compensations

Client:

- Human health and safety
- Dissatisfaction about products and services
- Lack of confidence
- Mistreatment

2.3.3.3. Costs of poor quality

Company:

- Waste of resources
- Junk and scrap
- Partial and re-process
- Repairs
- Changing
- Loss of production

Client:

- Purchasing
- Operation
- Repairs
- Loss of time

2.4. Quality Management processes in construction projects

2.4.1. Review of major Quality Management processes

Quality Management covers some processes which will answer the needs that have been specified formally. The 3 main processes of Quality Management are;

- Quality Planning
- Quality Assurance

- **Quality Control**

All of these 3 phases seem to be individual processes, yet they're related to and affected by each other during the execution of a project. We can say that each process generally occurs at least once in every project.

Project Quality Management must address both the management of the project and the product of the project. Failure to meet quality requirements in either dimension can have serious negative consequences for any or all of the project stakeholders.

2.4.1.1. Quality Planning

Planning involves identifying which quality standards are related with the project and determining how to implement these standards. One of the fundamental of the modern quality management is that quality is firstly planned and then inspected. Quality Planning includes 3 stages; these are inputs, tools & techniques and outputs.

Inputs to Quality Planning are:

- Quality policy
- Scope statement
- Product description
- Standards and regulations
- Other process outputs

Tools and techniques for Quality Planning are:

- Benefit/cost analysis
- Benchmarking
- Flowcharting
- Design of experiments

Outputs of Quality Planning are:

- Quality management plan
- Operational definitions
- Checklists

- Inputs to other processes

2.4.1.2. Quality Assurance

Quality assurance is all the planned and systematic activities implemented within the quality system to provide confidence that the project will satisfy the relevant quality standards. It should be performed throughout the project. Prior to development of the ISO series of standards, the activities described under quality planning were widely included as part of quality assurance. Quality Assurance includes 3 stages; these are inputs, tools & techniques and outputs.

Inputs to Quality Assurance are:

- Quality management plan
- Results of quality control measurements
- Operational definitions

Tools and techniques for Quality Assurance are:

- Quality planning tools and techniques
- Quality audits

Outputs of Quality Assurance are:

- Quality improvement

2.4.1.3. Quality Control

It is monitoring the project whether it complies with the relevant quality standards. Also it gives the chance of identifying ways to eliminate the causes of unsatisfactory results. It should be performed throughout the project.

The project management team should have a knowledge of statistical quality control. Among other subjects, they should know the difference between;

- Prevention and inspection
- Attribute sampling and variables sampling
- Special causes and causes

- Tolerances and control limits

Quality Assurance includes 3 stages; these are inputs, tools & techniques and outputs.

Inputs to Quality Control are:

- Work results
- Quality management plan
- Operational definitions
- Checklists

Tools and techniques for Quality Control are:

- Inspection
- Control charts
- Pareto diagrams
- Statistical sampling
- Flowcharting
- Trend analysis

Outputs of Quality Control are:

- Quality improvement
- Acceptance decisions
- Rework
- Completed checklists
- Process adjustments

2.4.2. Quality Assurance In Quality Management

It should be performed throughout the project. Assurance can be provided by internal or external quality assurance teams. Internal quality assurance team is in the management team of the performing organization while external quality assurance team can be provided by the customer or can be others that are not involved in the work of the project.

2.4.2.1. Inputs to Quality Assurance

- **Quality Management Plan**-The quality management plan should describe how the project management team will implement its quality policy. In ISO series of standards terminology, it should describe the project quality system: "the organizational structure, responsibilities, procedures, processes, and resources needed to implement quality management"

The quality management plan may be formal or informal, highly detailed, or broadly framed, based on the needs of the project.

- **Results of quality control measurements**-Quality measurements are records of the quality control tests and measurements. These records are kept to make comparisons and analysis'.
- **Operational Definitions**-They define what are the operations to be done in order to ensure quality and how these operations can be measured and recorded during Quality Control. Operational Definitions are sometimes called "Metrics"

2.4.2.2. Tools and Techniques for Quality Assurance

- **Quality Planning tools and techniques**-The tools and techniques for quality Planning such as Benefit/cost Analysis, Benchmarking, Flowcharting and design of experiments can be used for quality assurance as well.
- **Quality Audits**-It is a review of all Quality Management activities. It is done in order to improve the performance of the product. Quality Audits may be scheduled or random. Also they can be carried out by trained in house auditors(internal quality audit) are other third parties such as quality system registration agencies(external quality audit).

2.4.2.3. Outputs from Quality Assurance

- **Quality Improvement** It includes taking action in order to increase the effectiveness and the efficiency of the project. Mostly it requires preparation of change requests and will be handled, due to the procedures for the overall change control.

2.5. ISO Series of Standards

2.5.1. General

ISO (International Organization for Standardization) develops International Standards over almost the entire range of technology. Its membership comprises the national standards institutes of some 130 countries.

ISO standards are developed by international consensus among experts drawn from the industrial, technical or business sectors which have expressed the need for a particular standard. These may be joined by experts from government, regulatory authorities, testing bodies, academia, consumer groups or other organizations with relevant knowledge, or which have expressed a direct interest in the standard under development.

Although ISO standards are voluntary, the fact that they are developed in response to market demand, and are based on consensus among the interested parties, ensures widespread use of the standards.

Standards are documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products, processes and services are fit for their purpose.

International Standards thus contribute to making life simpler, and to increasing the reliability and effectiveness of the goods and services we use.

ISO's name:

Many people will have noticed a seeming lack of correspondence between the official title when used in full, International Organization for Standardization, and the sort form, ISO. Shouldn't the acronym be "IOS"? Yes, if it were an acronym- which is not.

In fact, "ISO" is a word, derived from Greek isos, meaning "equal", which is the root of the prefix "iso-" that occurs in a host of terms, such as "isometric" (of equal measure or dimensions) and "isonomy" (equality of laws, or of people before the law).

From “equal” to “standard”, the line of thinking that led to the choice of “ISO” as the name of the organization is easy to follow. In addition, the name ISO is used around the world to denote the organization, thus avoiding the plethora of acronyms resulting from the translation of “International Organization for Standardization” into the different national languages of members, e.g. IOS in English, OIN in French (from Organization internationale de normalisation). Whatever the country, the short form of the Organization’s name is always ISO.

ISO-9000 is a widely misunderstood standard that many companies are trying to implement today. The ISO-9000 series of standards is *not* a quality control standard.

What, then, is ISO-9000 if it is not a quality control standard? The standard is a guideline for the design, manufacture, sale, and servicing of a product; to successfully implement this standard, a group must view the ISO-9000 series as such. This program puts in place a system that develops consistency of purpose and involves everyone in the company.

2.5.2. History of ISO Family of Standards

During the early 1940s, World War II (WW II) raged throughout most of the world. To stop the march of Germany, Italy, and Japan, many countries (U.S., Great Britain, France, and others) united against the Axis countries. As the countries fought side by side, they encountered major problems. Not only did the Allied countries have different languages, customs, and religious beliefs with which to contend, but each country used different munitions, vehicles, and units of measure. The problems’ centered around the inability to share items such as bullets by forces from different countries fighting on the same side.

The incompatibility of components assembled by the Allied forces in WW II showed the military the need to develop a means of standardization to draw on resources from many nations. To keep this from becoming a future issue, the first military standards were developed.

Industry soon realized the merit of standardization and followed the lead of the military. Unfortunately, every industry in every country developed its own standards. Many of the standards that are used today are direct descendants of these early standards. The following is a list of a few of the standards that were developed over the years.

Year	Standard	Developer
1963	MLL-Q-9858A	U.S. military
1969	AQAP	NATO
1971	ASME BOILER CODE	Mechanical engineers
1973	DEFSTAN 05	UK modification
1975	CSA-Z299	Canadian standard
1975	AS1821/22/23	Australian standard
1979	BS5750	British standard
1985	CSA-Z299 (revision)	
1985	AS1821/22/23 (revision)	

The progression of standards has been along a normal course of development. One common element among many of the military, petroleum, and governmental standards was that the standards were heavily inspection oriented and focused on the end product. The standards tried to fit everyone into somewhat the same mold by employing armies of inspectors to look over other people's work. In other words, the standards focused on what the end product should be while ignoring the processes used to achieve the end result.

During the 1970s and 1980s, the world of quality control made normal changes and evolved from reactive (inspection-dominant) organizations to proactive (system-oriented) quality assurance organizations. The focus changed from the end result (the product) to the process by which the product was produced. The theory behind this change is that if the process used to produce the product is properly maintained and developed, the product being produced by the process will be consistent and the quality can be improved. This theory was set forth by the leaders in quality, such as Juran, Deming, Crosby, and Feigenbaum. This was the manufacturing approach taken by Japan in that country's climb to become an industrial power.

The problem was that many of the standards did not make the transition from product orientation to process orientation. Some countries saw the need and tried to make the change in their own standards. As markets became global, companies found themselves having to meet many standards for many countries. In some cases, the standards were conflicting, and in most cases they were confusing. In an effort to eliminate some of the confusion, the International Organization for Standardization convened to develop an international quality system standard and issued the ISO-9000

series in March 1987.

The ISO-9000 series standards have become the most widely recognized and accepted standards in the world. Currently it is mandatory in some cases to possess *certification* to the ISO-9000 series to participate in the European Community (EC), the largest continuous market in the world. EC countries control oil production in all sectors of the North Sea. Other countries, including Canada, are adopting these standards. Many of the countries have adopted the ISO-9000 standards and have written compatible national standards such as the following:

ISO-9000 clones

1987 ISO-9000 series
1987 BS 5750 (revision)
1987 AS 3900
1987 NZS 5600 series
approximately 20 others

In March 1993, the first recommended revisions to the ISO-9000 series standard were presented to the member countries for ratification. The draft standard was referred to as ISO/DIS-9000 through ISO/DIS-9004. The member Countries evaluated the standard and, in September 1993, voted to accept the modifications to the ISO-9000 standard. The modified standard was scheduled to be issued in the spring of 1994, with the U.S. version being issued through the American National Standards Institute. Although some minor editorial changes were expected to occur between the ISO draft and the formal issue of the ISO-9000 1994 series standard, no major content changes Or additional requirements were expected.

The ISO-9000 standard is a five-part standard that was written to address good business practices for every part of a business. The standard, as written, is not industry specific, but a general guideline for a good, efficient business operation. What is unique about the standard is that it allows a company to evaluate each element of the standard and decide how to meet effectively the intent of that element. This means that two companies may look at an element such as design control and decide to implement programs that are radically different in content and documentation, with both meeting the intent of the standard concerning design control. The standard is a guide to good business practices. It is up to the individual company to decide what makes sense for that organization in the way the elements are implemented. The ISO- 9000 series standard

provides companies in search of suppliers some assurance of consistency, quality of goods/services, and sound business practices on the part of potential suppliers having ISO-9001 or ISO-9002 certification. Companies that gain certification are awarded a pedigree attesting to their commitment to quality goods/services and sound business practices.

2.5.3. Classification of ISO Family of Standards

The ISO 9000 family

Standards and guidelines	Purpose
ISO 9000:2000, Quality management systems - Fundamentals and vocabulary	Establishes a starting point for understanding the standards and defines the fundamental terms and definitions used in the ISO 9000 family which you need to avoid misunderstandings in their use.
ISO 9001:2000, Quality management systems - Requirements	This is the requirement standard you use to assess your ability to meet customer and applicable regulatory requirements and thereby address customer satisfaction. It is now the only standard in the ISO 9000 family against which third-party certification can be carried.
ISO 9004:2000, Quality management systems - Guidelines for performance improvements	This guideline standard provides guidance for continual improvement of your quality management system to benefit all parties through sustained customer satisfaction.
ISO 19011, Guidelines on Quality and/or Environmental Management Systems Auditing (currently under development)	Provides you with guidelines for verifying the system's ability to achieve defined quality objectives. You can use this standard internally or for auditing your suppliers.
ISO 10005:1995, Quality management - Guidelines for quality plans	Provides guidelines to assist in the preparation, review, acceptance and revision of quality plans.

ISO 10006:1997, Quality management - Guidelines to quality in project management	Guidelines to help you ensure the quality of both the project processes and the project products.
ISO 10007:1995, Quality management - Guidelines for configuration management	Gives you guidelines to ensure that a complex product continues to function when components are changed individually.
ISO/DIS 10012, Quality assurance requirements for measuring equipment - Part 1: Metrological confirmation system for measuring equipment	Give you guidelines on the main features of a calibration system to ensure that measurements are made with the intended accuracy.
ISO 10012-2:1997, Quality assurance for measuring equipment - Part 2: Guidelines for control of measurement of processes	Provides supplementary guidance on the application of statistical process control when this is appropriate for achieving the objectives of Part 1.
ISO 10013:1995, Guidelines for developing quality manuals	Provides guidelines for the development, and maintenance of quality manuals, tailored to your specific needs.
ISO/TR 10014:1998, Guidelines for managing the economics of quality	Provides guidance on how to achieve economic benefits from the application of quality management.
ISO 10015:1999, Quality management - Guidelines for training	Provides guidance on the development, implementation, maintenance and improvement of strategies and systems for training that affects the quality of products.
ISO/TS 16949:1999, Quality systems - Automotive suppliers - Particular requirements for the application of ISO 9001:1994	Sector specific guidance to the application of ISO 9001 in the automotive industry.

2.5.4. Area of applications

The scope of ISO is not limited to any particular branch; it covers all technical fields except electrical and electronic engineering, which is the responsibility of IEC. The

work in the field of information technology is carried out by a joint ISO/IEC technical committee.

2.5.5. Why should Quality Systems and ISO 9000 Series of standards be applied?

2.5.5.1. Benefits of certification

Those organizations that have experienced the euphoria of being officially informed that they are registered to the ISO 9001 or ISO 9002 standard have had the opportunity to reflect on the process and articulate the benefits of registration to their companies. Some of the perceived - and actual - benefits to those companies include:

- Documentation of the company's quality management system.
- Reduction and variability resulting both from documentation and the use of statistical techniques to monitor the system.
- Using their registration to help develop and expand business, particularly those areas where registration is a prerequisite for doing business.
- Reduction or elimination of customer audits.
- Increased profitability/reduced costs.
- Improved communications, both internal and external.
- Greater awareness of quality by employees, accompanied by enhanced pride in their jobs and contribution to the company's quality system.
- Provision of training to all personnel
- Ability to remain/become competitive
- Elimination of redundancy.

2.5.5.2. Problems and challenges

With most benefits, there are also problems and challenges to attain those benefits; registration of an organization's quality system is no exception. Many issues may impact a company in its registration efforts.

No doubt the primary issue facing small businesses today is one of limited resources. Most companies, when asked, will identify money, personnel and time as their

problematic resources. The financial stability of many small companies may constantly be teetering between solvency and bankruptcy, which limits the financial resources that can be focused on areas like training, computer systems and, ultimately, implementation of an ISO 9000 quality system. Financial stability, or instability, may also be pivotal in allowing a company to take advantage of state and local funding for training as it leads to implementation of a quality system.

In a small company, each employee most likely wears a number of hats, thus limiting the amount of responsibility that can be placed on each person. When implementing a quality system, this obviously causes overlapping of responsibilities.

The challenge for the company becomes in finding ways not to overburden its employees. An ISO 9000 quality system may be the answer for many companies by allowing the company to focus on problem areas and helping to streamline those processes as well as eliminate duplication of tasks.

Time can become a severe limitation for a small business. Implementation of a quality system and, ultimately, registration of that system, may take anywhere from six to 18 months, depending on a variety of factors, including resources, management commitment and employee buy-in. The company may be pressured by customers to implement ISO 9000 within a certain time frame or potentially lose their business. It behooves small companies to become aware of external pressures within their industry and become proactive rather than end up behind the eight ball.

It may be difficult to start, but once deadlines are set, the whole process from beginning to end may take less than one year. However, awareness of the need to become ISO 9000-registered should begin more than a year before any documentation is actually written.

Another pitfall that small businesses seem to fall into rather frequently is the "external consultant syndrome" Large organizations usually can utilize their own personnel when implementing quality initiatives – not always so for the small company. The current downsizing trend has unleashed into the marketplace a plethora of external consultants whose sole focus appears to be "helping" small businesses become registered to the ISO 9000 standards. Many small companies hire and rely on these external consultants. Unfortunately, they may discover along the way that the consultant does not understand the organization's business or processes, resulting in a documented system that has little

or no merit. Although there are many excellent consultants out there, a company's limited financial resources may become the deciding factor between choosing a consultant who is cheap or a consultant who is capable.

The greatest challenge for the quality manager in a small company could be executive commitment. When the upper management in a company gives that quality manager a directive to become ISO 9000-registered, they may have little or in knowledge of the standard. This could result in lack of support when they discover, that the quality manager cannot implement ISO 9000 alone and in a vacuum.

The reasons that small businesses should implement a quality system and have it registered are: system improvement, market expansion and retention of existing business.

Working from a position of power, top manager can drive the entire organization to change to a more participative management style with open communication paths. However, without that kind of authority sanctioned by executive management, efforts to manage culture change inevitably are doomed.

2.5.6. The Structure of the Standard

ISO-9001 consists of 20 elements that make up the quality system. ISO-9002 consists of 18 of the 20, whereas ISO-9003 consists of 12 of the elements. To further define how the specification is structured, the 20 elements of ISO-9001 (which include all elements of ISO-9002 and ISO-9003) can be divided into the following three categories, based on the implementation activities:

- Management activities
- Companywide activities
- Specific requirements

Each of the 20 elements can be put under one of these categories, depending on the responsibility for *implementation*.

Management Activities

4.1 Management Responsibilities

4.2 Quality System

Companywide Activities

- 4.5 Document Control**
- 4.8 Product Identification and Traceability**
- 4.12 Inspection and Test Status**
- 4.13 Control of Nonconforming Product**
- 4.14 Corrective Action**
- 4.16 Quality Records**
- 4.17 Internal Quality Audits**
- 4.18 Training**

Specific Requirements

- 4.3 Contract Reviews**
- 4.4 Design Control**
- 4.6 Purchasing**
- 4.7 Purchaser-Supplied Product**
- 4.9 Process Control**
- 4.10 Inspection and Testing**
- 4.11 Inspection, Measuring and Test Equipment**
- 4.15 Handling, Storage, Packaging and Delivery**
- 4.19 Servicing**
- 4.20 Statistical Techniques**

With the elements properly divided, responsibility for the activities can be easily defined. The implementation process from this point becomes an individually structured exercise that companies must adjust to fit the organizational environment. Each of the elements has specific requirements for a manufacturer to fulfill to meet the intent of the

2.5.7. Clauses of ISO 9001

The party to a construction contract who makes the payment is the client, who may also be referred as the employer, the owner or the purchaser. In most quality system standards he is known as the purchaser.

1. Management Responsibility

1.1. Quality Policy

The supplier's management shall define and document its policy which includes organizational objectives for quality, and its commitment to, quality. The quality policy must address three additional requirements as follows:

- a. It must be relevant to the organizational goals.
- b. It must meet the expectations and needs of its customers.
- c. It must be understood and implemented at all levels of the organization.

Quality policy should be:

- in written
- approved
- understood in every level of the organization
- suitable to customers' expectations and needs
- continually implemented

In a quality policy the subjects which can be dealt with are:

- Quality level of the products
- Product reliability
- Relationships with customers (Will the needs and complaints of the customers be analyzed and evaluated?)
- Relationship with employers (Will support and participation of all employers be obtained?)
- Improvement of resources (Will training for human resources and continual protective and preventive maintenance for mechanical equipment be applied?)
- Environment (What will be the environmental sensitivity and commitments?)

The quality policy for an architectural/engineering organization will require extensive consideration because of the extended time commitment with the owner. The development of a suitable design, the liaison activity between the owner and the contractors, and the coordination of progress payments are some of the factors. The hardware distributor, on the other hand, would have a more narrow focus on customer

satisfaction, considering that the deliverable is high-quality materials delivered on a time schedule supported by installation training or operational training.

The key to an effective quality policy is that adequate time and resources are devoted to its formulation and understanding by top management and all others involved in quality decisions. In ISO 8402 a quality policy is defined as "the overall intentions and direction of the organization with regard to quality as formally addressed by top management".

Example of Quality Policy for a Construction Company

At AAAA Construction we are committed to execute Industrial, Residential and Commercial Civil Engineering Projects with allied infrastructure to the satisfaction of the customer, in a professional manner by constantly upgrading the working methods to enhance Quality, Time Schedules, Economics and Aesthetics of Structures. We will strive for continuous improvement towards our ultimate mission of being a World-Class company.

Example of Quality Objectives for a Construction Company

- To Co-Ordinate with Architects / Designers to bring out aesthetically pleasing and Eco-Friendly
- To Improve Quality of Construction by using standard materials, equipment, trained personnel and proper working methods.
- To mechanize construction processes wherever possible.
- To train Staff to improve their technical skills and upgrade their knowledge.
- To look after the welfare of construction

1.2. Organization

1.2.1. Responsibility and Authority

The responsibility, authority and the interrelation of all personnel who manage, perform and verify work affecting quality shall be defined and documented, particularly for personnel who need the organizational freedom and authority to:

- Initiate action to prevent the occurrence of product, process and quality

system nonconformity;

- Identify and record any product, process and quality system problems;
- Initiate, recommend or provide solutions through designated channels;
- Verify the implementation of solutions;
- Control further processing, delivery or installation of nonconforming product until the deficiency or unsatisfactory condition has been corrected.

Organization for quality consists of well-defined procedures as follows:

- Definition of duties of the individuals
- Definition of each department or function
- Determination of authorities and responsibilities
- Definition of works
- Formation of information flow

Coordination, communication and cooperation, hierarchical structure between persons and departments should be determined. For this to be implemented in an efficient way organization chart and definition of works give better results.

Each construction-related organization will have these common management Considerations when establishing a quality system. The establishment of responsibility, authority, and interrelationships is one of the key issues in a successful quality system.

1.2.2. Resources

The supplier shall identify resource requirements and provide adequate resources, including the assignment of trained personnel, for management, performance of work and verification activities including internal quality audits.

Resources for a company can be classified as follows:

- Trained personnel (for verification activities)
- Adequate time for performance of work
- Documented procedures
- Machinery — equipment
- Equipment for testing experiments for verification
- Working environment
- Financial resources
- Organizational standards

- **Accessibility to quality records and reachable quality audits**

The resource requirements will become identifiable as the elements of ISO 9001 are developed. Each element will require its own series of verification considerations. Although this is a defined management responsibility, the scope of its implication cannot be solidified early in the development of the system. Consideration must be given at each stage of development that addresses resource requirements. This is another management requirement common to all construction-related organizations. The only difference would be for architect/engineer organizations implementing ISO 9001 where the design element is required compared to a construction contractor implementing ISO 9002 where design is not required.

1.2.3. Management Representative

The supplier's management with executive responsibility shall appoint a member of the supplier's own management who, irrespective of other responsibilities, shall have defined authority for;

- **Ensure that a quality system is established implemented and maintained in accordance with international standards**
- **Report on the performance of the quality system to the supplier's management for review and as a basis for improvement of the quality system.**

Note: The responsibility of a management representative may also include liaison with external parties on matters relating to the supplier's quality system.

The management representative must be a recognized quality leader in the organization with access to executive management and have the authority to make things happen. The success of the quality system hinges on the individual's ability to carry out the activities required. If a quality assurance manager is already in place, this would be a logical candidate for the management representative.

1.3. Management Review

The supplier's management with executive responsibility must review the quality system at defined intervals to ensure its continuing suitability and effectiveness in satisfying the requirements of the international standards and the supplier's stated quality policy and objectives. Records of documented reviews must be maintained.

A thorough management review should be conducted and disseminated throughout the organization every six months.

There is a quality loop in management responsibility that addresses customer expectations and organizational needs. This quality loop is shown in Figure 8. It starts with the quality policy that addresses the goals and objectives of the organization, which leads to organization responsibility and authority to carry out these quality policy goals. Resources and trained personnel are essential to the implementation and continued success of the quality system. A management representative is essential to act as liaison between executive management and the quality system. A documented quality system is the foundation on which the organization operates. The quality system is measured by internal quality audits and customer feedback. Corrective and preventive actions are implemented to correct and improve the quality system. Scheduled reviews by executive management ensure the measurement of the quality system for suitability and effectiveness and make sure that the goals and objectives of the quality policy are being addressed.



Figure 8 Management responsibility quality loop

The subjects of this review may be;

- Corrective and preventive
- Results of internal control
- Customer complaints
- Revision of objectives
- Revision of training requirements
- Report prepared by management representative about efficiency of the quality system

2. Quality System

2.1. General

The supplier shall establish, document and maintain a quality system as a means of ensuring that product conforms to specified requirements.

A quality system consists of the following:

- **Organizational structure**
- **Procedures**
- **Processes**
- **Resources needed to implement quality management**

The quality system should function to provide confidence that:

- **The system is understood, implemented, maintained, and effective.**
- **The products satisfy customer needs and expectations.**
- **The needs of society and the environment are met.**
- **Emphasis is placed on problem prevention rather than detection.**

The structuring of the quality system is dependent on the unique characteristics of each organization. Figure 9 groups the quality system elements into three specific categories: management elements, core process elements, and foundation elements. The management elements are intended to oversee the continued suitability and improvement of the quality system. The core process elements deal with the physical movement of the product. The foundation elements support and reinforce the management and core process elements.

The quality system structure must also take into consideration the four basic facets of quality that are described as follows:

- 1. Quality due to definition of needs for the product.**
- 2. Quality due to product design.**
- 3. Quality due to conformance of product design.**
- 4. Quality due to product support.**

Additional factors to consider in managing the organization's total enterprises are as follows:

- **An established and reputable market place status.**
- **An established and reputable financial status.**
- **An established and reputable human resource status.**

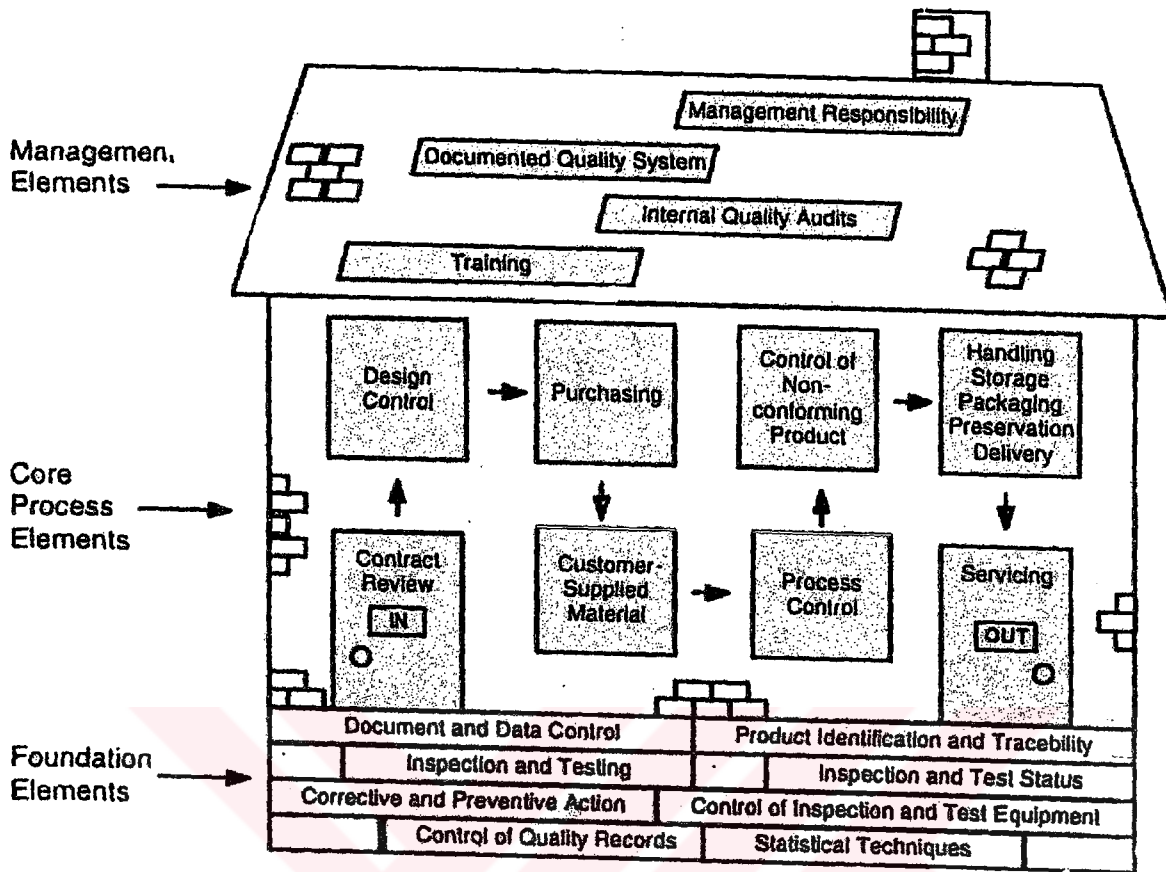


Figure 9 ISO 9000 House of quality

If these factors are in place, the customer may place higher value on the organization's offering. A well-defined and implemented quality system will help sustain these three factors and gradually improve the customer's perception of the organization through improved quality of the delivered product.

The supplier shall prepare a quality manual covering the requirements of the international standard.

Quality Manual:

- Includes Quality Policy
- Outlines the General System
- Is a Means of Marketing
- Is a Mechanism of Communication
- Is a Tool for Training
- Helps Revision and Control of the Quality System

Quality Manual is in 5 sections;

1. Control
2. Corporate Philosophy
3. Company Organization
4. Company Standing Instructions
5. Project Quality Assurance

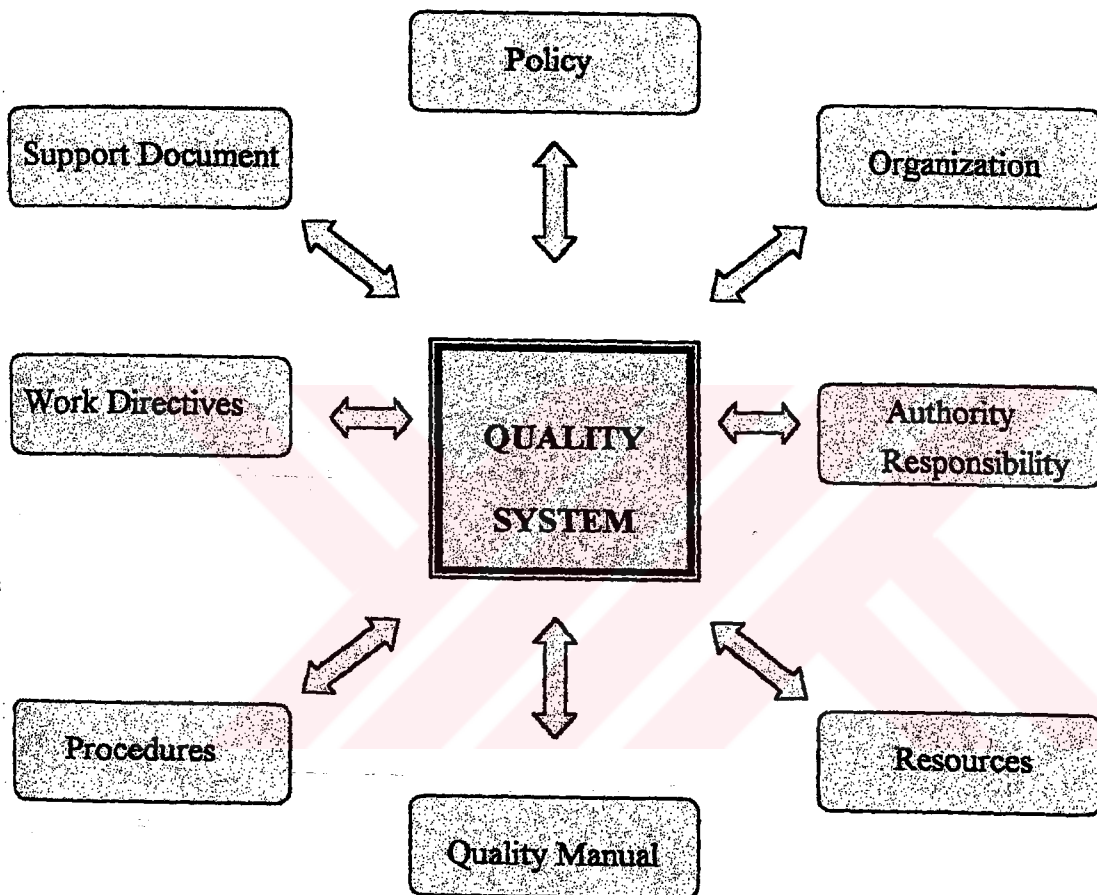


Figure 10 Quality system contents

2.2. Quality System Procedures

The supplier shall

- Prepare documented procedures consistent with the requirements of the international standard and the supplier's stated quality policy, and
- Effectively implement the quality system and its documented procedures.

Procedures shall be dependent upon:

- The complexity of the work
- The methods used
- Skills needed by personnel
- Training needed by personnel

The answers of the following questions should be included in the quality system procedures:

- WHAT will be done?
- WHY will it be done?
- WHERE will it be controlled?
- WHO is responsible for activity / control?
- HOW will it be done / controlled?
- WHEN will it be done / controlled

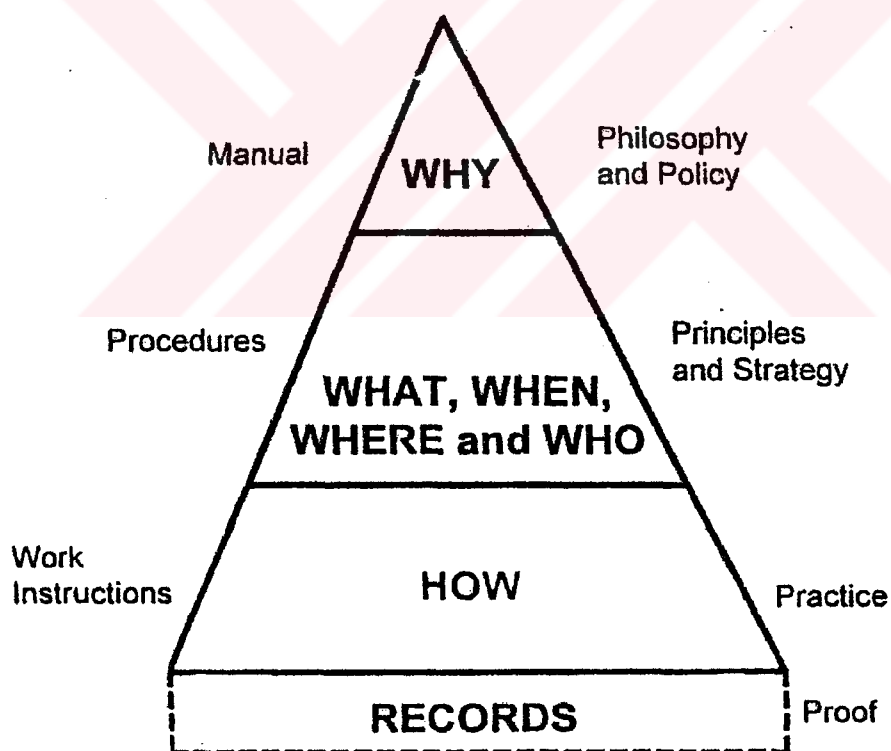


Figure 11 The documentation system in the quality system

2.3. Quality Planning

The supplier shall define and document how the requirement for quality will be met. Quality planning shall be consistent with all other requirements of a supplier's quality system and shall be documented in a format to suit the supplier's method of operation.

The following will be considered in meeting specific product, contract, or project requirements;

- Preparation of quality plans
- Identification and acquisition of controls, equipment, and skills
- Compatibility of design, process, installation, service, inspection, and testing
- Updating quality techniques
- Identification measure requirements beyond known state of the art
- Suitable verification at appropriate stages
- Clarification of unacceptable standards
- Identification and preparation of quality records

3. Contract Review

3.1. General

The supplier shall establish and maintain documented procedures for contract review and for the coordination of this review.

3.2. Review

Each contract shall be reviewed by the supplier to ensure that;

- All requirements are adequately defined.
- All verbal requirements are documented.
- Any requirements differing from those in the tender are resolved.
- The supplier is capable of meeting all contract requirements.

Subjects to be reviewed are:

- **Characteristics of the ordered to product**
- **Type and date of delivery**
- **Cost**
- **Study that proves the ordered product could be produced by the company**
- **Complete agreement with customer about ordering conditions**
- **Coordination in-between related units in reviewing stage**

Reviewing activities should be recorded and records should be maintained.

Contract review procedures will be unique to the type of contract being undertaken. Figure 12 helps to clarify the contract review process. It starts with the customer request to the sales organization, which initiates the contract review process that consists of defining the requirements, determining capability to deliver, and resolving differences with the customer. The design review activities result in a contract that will meet the customer's expectations and the operational needs of the organization. During the contract delivery process, any customer amendments requested must go back to the sales organization and be clarified with the customer. The customer amendments then are put through the contract review process and implemented as appropriate. Finally, the products from the amended contract are delivered to the customer. If the product is to meet a generic or existing configuration (for instance, a manufactured item to an ANSI specification), the contract review process will be relatively simple. The considerations will be limited to details—for instance, quantity, color, type, style, price, and delivery. Service contract details to consider are scope of service, number of people involved, timetables, and costs to the consumer.

To meet the requirements of ISO 9000, a quality plan assigning responsibility, authority, and delegation to perform required verification activities should be defined in all contract documents. Each organization involved in the project would be responsible for segments of the overall quality plan.

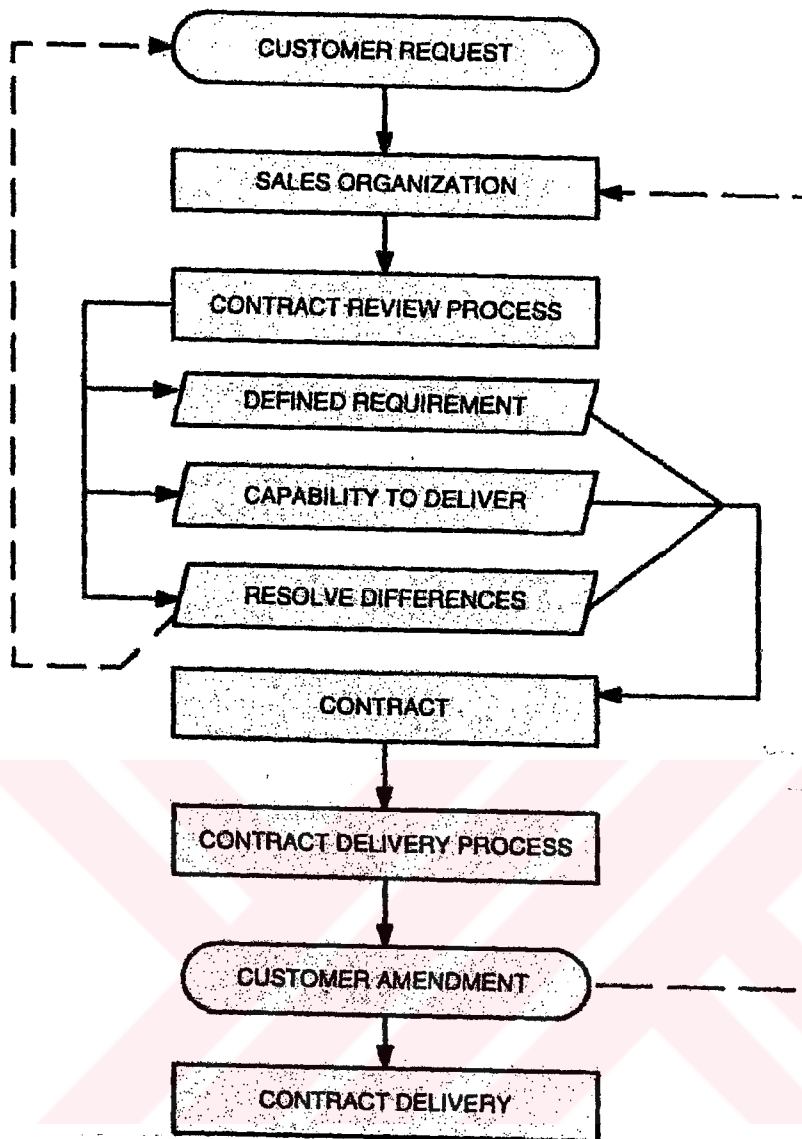


Figure 12 The contract review process

3.3. Amendments to contracts

The standard requires the organization to have documented procedures to effectively manage changes or modifications to contracts. The changes or modifications must be correctly translated and understood by all affected functions in the organization and the customer.

There are no specific guidelines provided in the ISO 9000 standards to assist, in implementation of changes or modifications. The requirement for effectively managing changes is basic to good business practice. The key to successful implementation is complete understanding of what is changing and accurately transmitting the details

throughout the appropriate functions of the organization. The final step is obtaining consensus from the originator of the change.

3.4. Records

Records of contract reviews and contract modification reviews must be maintained as quality records.

The organization must retain contract review records for a prescribed period of time as determined to be useful and appropriate. These records may be needed for future reference or objective evidence if requested by the customer or other interested parties.

4. Design Control

Design for construction requires an organization to take into consideration many factors beyond its intended function. Issues such as safety, environmental impact, reliability, dependability, performance, and fitness for use must be considered throughout the design and development phase.

Figure 13 illustrates the functional design activities that start with design inputs from the customer, which, through design and development planning, result in design outputs. Design review, through organizational and technical interfaces, determines if the design outputs equal the design inputs. Following design review, design verification is considered to make sure that the functional design meets the design outputs. Next, design validation determines if the design meets the customer's needs and, if resulting design changes are required, new design inputs will be implemented.

4.1. General

The standard requires the organization to maintain documented procedures to control and verify product design to ensure that specified requirements are met. The specified requirements are those agreed upon by the customer and the organization in the contract or in the product profile prepared by the organization.

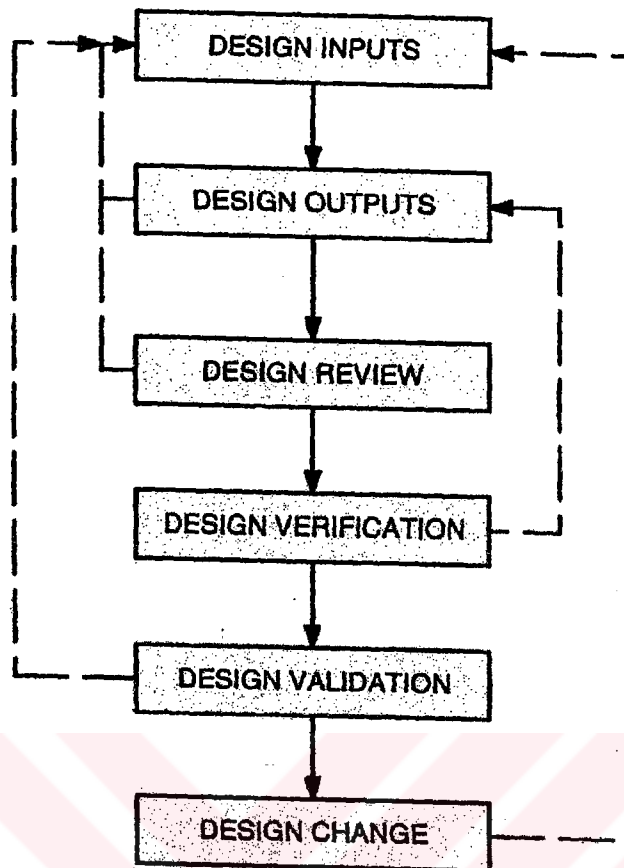


Figure 13 Design control

4.2. Design and Development Planning

The supplier shall prepare plans for each activity related to design and development. The plan shall describe each activity and assign responsibility, authority, and adequate resources for implementation. The plan shall be updated as the design progresses. The design and development activities shall be assigned to qualified personnel equipped with adequate resources.

Design development plan should include:

- Project description
- Definition of project inputs and outputs
- Organization of project resources
- Arranged and parallel work programs
- Design verification place and methods
- Safety, performance and reliability in product design

- Plans for product inspection, testing and acceptance criteria methods
- Distribution of appropriate responsibilities

4.3. Organizational and Technical Interface

Organizational and technical interfaces between different groups involved in the design process shall be defined. All necessary information will be documented, transmitted and regularly reviewed.

When design input is from multiple sources, the interfaces should be defined, documented, coordinated, and controlled. The various sources contributing to the design may include:

- Research and development
- Marketing
- Procurement
- Quality
- Engineering
- Materials technology
- Manufacturing
- Service
- Facilities management
- Warehousing / transportation / logistics
- Communications
- Information systems
-

Internal and external design work groups should establish:

- What information is important
- Identification of sending and receiving groups
- Purpose of information
- Identification of methods
- Document transmittal records maintenance

The architect/engineer must coordinate all design activities related to each specific contract. Individual phases of a construction project must be organized but, just as important, the various groups involved in design must be coordinated. This is especially critical when fast tracking is utilized to expedite construction.

4.4. Design Input

Design input requirements relating to the product, including applicable statutory and regulatory requirements, shall be identified, documented and their selection reviewed by the supplier for adequacy. Incomplete, ambiguous or conflicting requirements shall be resolved with those responsible for imposing these requirements.

Design input shall take into consideration the results of any contract review activities.

The elements of the product may include:

- Performance characteristics such as strengths, durability, and workability.
- Sensory characteristics such as visual, taste, touch, and smell.
- Safety and environmental conditions.
- Standards and statutory regulations.
- Handling, packaging, storage, and delivery.
- Quality assurance, verification.

All design inputs should be defined, reviewed and recorded to the design definition document by the supplier.

In the design inputs;

- In design developments activities, conditions related to the products should be defined in written form.
- Suitability levels of the defined conditions to the purpose should be controlled.
- Incomplete, ambiguous or conflicting conditions should be resolved after negotiations with the responsible units.

Design inputs are generally;

- **Functionality**
- **Productivity**
- **Reliability**
- **Useability**
- **Suitability for maintenance**

In addition to these, customer requests;

- **Low cost**
- **Safety**
- **Ergonomy**
- **Assembly, aesthetics**
- **Usage of disposal**
- **Environment**

For all organizations in construction involved in a product or service, a product brief or design description document is essential to translating the customer's design input requirements into finished designs. Generic design description document can be developed for each type of construction project that will act as a checklist to assure that all design elements of the project are being addressed. The statutory, safety, environmental, and regulatory requirements that may go beyond the customer's expectations will then be addressed as routine considerations. The generic design description document can be tailored to each specific customer contract.

4.5. Design Output

Design output shall be documented and expressed in terms that can be verified and validated against design input requirements.

Design output shall:

- **Meet the design input requirements**
- **Define the acceptance criteria**
- **Determine the important design characteristics that are crucial for the product's safe and correct functioning (e.g. operating, storage, handling, maintenance and disposal requirements)**

Design outputs are the final technical documents used to purchasing, construction, installation, inspection/testing and servicing.

These final documents include;

- Drawings
- Specifications (process and material properties)
- Instructions
- Softwares
- Service procedures

Construction-related design outputs will be generated by all of the current design activities from the architect/engineer, specifier, and the construction manager. These design output documents may include:

- Landscape drawings
- Mechanical and electrical drawings
- Buildings/structure drawings
- Construction schedules
- Hardware schedules
- Quality plans

4.6. Design Review

The standard requires that design results are to be reviewed at appropriate stages. These reviews are to be planned and documented. Representatives of all functions concerned with the design are to participate. Records of these reviews are to be maintained as quality records.

The following elements pertaining to the *customer needs* should be considered:

- Customer product specifications compared with technical specifications for material, product, and processes
- Design validation through prototype tests
- Ability to perform to expected use and environment
- Unintended use or misuse
- Safety and environmental capability
- Compliance with regulatory requirements, national and international

standards, and organizational practices

- Comparison with competitive designs
- Comparison with similar designs

The following elements pertaining to **product specification** should be considered:

- Dependability and serviceability requirements
- Permissible tolerances related to process capabilities
- Product acceptance criteria
- Installability, ease of assembly, storage needs, shelf life, and disposal
- Benign failure and fail-safe characteristics
- Aesthetic specifications including acceptance criteria
- Failure mode and effect analysis
- Ability to diagnose and correct problems
- Labeling, identification, traceability, warnings, and user instructions
- Use of standard parts

The following elements pertaining to **process specifications** should be considered:

- Ability to produce the product conforming to the design
- Capability to inspect and test the design
- Specification and availability of materials, components, and sub-assemblies including approved subcontractors
- Packaging, handling, storage, preservation, and shelf-life requirements¹ including safety factors related to incoming and outgoing items

Documented design reviews at each stage of design for a construction project are essential to assure that the customer specifications and expectations are being met. These reviews are not to be misinterpreted as project progress meetings.

4.7. Design Verification

At appropriate stages of design, design verification shall be performed to ensure that the design stage output meets the design stage input requirements. The design verification measures shall be recorded.

Note: Design verification may include activities such as:

- **Performing alternative calculations,**
- **Comparing the new design with a similar proven design, if available,**
- **Undertaking tests and demonstrations, and**
- **Reviewing the design stage documents before release.**

Design verification activities should be realized in accordance with the quality plan and the documented procedures.

Design verification should consider questions such as followings:

- **Do the designs satisfy all specified requirements?**
- **Are design and process capabilities compatible?**
- **Are safety considerations adequate?**
- **Do designs meet performance and dependability objectives?**
- **Have appropriate materials and facilities been selected?**
- **Are the materials, components, and service elements compatible?**
- **Is the design satisfactory with anticipated environmental and load conditions?**
- **Are components or service elements standardized, interchangeable, maintainable, and replaceable?**
- **Are plans for implementing the design technically feasible?**
- **Can tolerances be met consistently?**
- **Where computer software has been utilized in design activities, has it been validated, authorized, and verified?**
- **Have the software inputs and outputs been verified and**

documented?

- Are the assumptions made during the design process valid?

Before proceeding with construction or service delivery, the design stage outputs must meet the design stage inputs. Outside organizations and/or individuals independent of the design outputs should conduct the design verification. The key to design verification is that qualified individuals or organizations are employed to perform the verification and a thorough documentation is prepared and maintained. At least two methods of design verification must be conducted. Completed construction project that closely resemble the new design may be used as a comparison or an alternate comparison may be developed.

4.8. Design Validation

Design validation shall be performed to ensure that product conforms to defined user needs and / or requirements of the customer.

Notes:

1. Design validation follows successful design verification.
2. Validation is normally performed under defined operating conditions.
3. Validation is normally performed on the final product, but may be necessary in earlier stages prior to product completion.
4. Multiple validation may be performed if there are different intended uses.

Design validation is different from design verification, which matches the design output to design requirements. Design validation ensures that the product conforms to the defined customer requirements. Construction and construction services will be required to coordinate the validation process very thoroughly with the customer or owner to assure that all elements of the design meet their expectations. The construction or manufacturing conditions may involve aesthetics, function, location, comfort, size, capacity, utility, and economy of use.

The service elements may include coordination, planning, scheduling, quality

control, progress reporting, and authorizing progress payments.

4.9. Design Changes

All design changes and modifications shall be identified, documented, reviewed and approved by authorized personnel assigned by the design organization before their implementation.

Design changes could be done as a result of:

- Errors which occur in design stage, like calculation and material selection errors.
- Production difficulties which occur after design stage.
- Changes in the customer's requirements.
- Change in safety, legal or other conditions.
- Needs to change which occur after design verification.
- Requirements which occur as a result of corrective activities.

The importance of planned, documented, coordinated, and approved design changes cannot be overemphasized. The complexity of construction related to manufacturing and construction services historically has resulted in tremendous customer dissatisfaction. The magnitude of a construction project makes changes complex because most changes occur during the construction phase. Unless they are accomplished in a timely and systematic manner, great losses of material, resources, time, and money will result. Detailed change control procedures must be developed to offset the risks of poor introduction of design changes.

In addition to product design changes, process design changes must be given the same careful consideration. A construction, manufacturing, or service process has the same impact on the construction project and subjects all participants to the same risk factors.

5. Document and Data Control

5.1. General

The supplier shall establish and maintain documented procedures to control all documents and data that relate to the requirements of the international standard including, to the extent applicable, documents of external origin such as standards and customer drawings.

Note: Documents and data can be in the form of any type of media, such as hard copy or electronic media.

The following are examples of documents that require control:

- Drawings
- Specifications
- Inspection instructions
- Test procedures
- Work instructions
- Operation sheets
- Quality manual
- Operational procedures
- Quality system procedure

5.2. Document and Data Approval and Issue

All documents and data shall be reviewed and approved prior to issue by authorized personnel. A master list or equivalent document control procedure identifying the current revision status of documents shall be established and be readily available to preclude the use of invalid and / or obsolete documents.

This control shall ensure that:

- the correct issues of appropriate documents are available for use at all locations where the work is to be performed,
- invalid and / or obsolete documents are promptly removed from all points of issue or use, or other wise assured against unintended use,

- any obsolete documents retained for legal and / or knowledge-preservation purposes are suitably identified.

5.3. Document and Data Changes

Changes to documents and data shall be reviewed and approved by the same functions / organizations that performed the original review and approval, unless specifically designated otherwise. Pertinent background information shall be available for review and approval of the change.

Where practicable the nature of the change shall be identified in the document or the appropriate attachments.

Procedure relating the subject should include;

- Definition
 - Preparation
 - Approval
 - Issue
 - Distribution
 - Usage
 - Change
 - Reporting of changes
 - Definition of changed contents
 - Removal of unused items
- of documentation and data.

Document control is essential in all construction-related industries. Figure 14 demonstrates the document and data control process. Documents or data that are originated must be reviewed and approved. The approved document must be forwarded to the point of use as soon as appropriate. Any revisions or changes to the document must be performed on a timely basis, reviewed and approved by the same source that originally approved them, and the revised issue forwarded to the point of use to replace the original issue. The original issue that has been revised will immediately be withdrawn or identified in some manner to preclude its use, and a master list of documents will be maintained identifying the documents and their revision levels.

Because of the nature and complexities of a construction project, current copies of all specifications, drawings, and procedures must be available where they are needed. A master list of these documents assures that the work performed will meet current contract requirements. Each organization participating must have access to the master document list and have copies of the documents available for their specific use in performing their functions. Externally generated documents such as building codes, local regulations, and national standards must also be incorporated in the master list as applicable. All of these documents must have evidence of review and approval before they are to be utilized in the performance of work. These documents may be other than hard copy, such as computer software.

Document change control is also essential to successful work performance. Impending changes should be made known to all parties concerned to avoid confusion, delay, and unnecessary rework. Once the change is official it must be quickly disseminated to all parties concerned for implementation. Obsolete copies of previously approved documents must be removed or clearly marked as unofficial obsolete. Documented procedure must be developed to control the issue, approval, distribution, administration, and removal of obsolete documents. The issue control and withdrawal of all documents could be assigned to a representative of the owner or the agent representing the owner. Central control of documents would help avoid the loss of time, resources, and profits to all participants in the construction project.

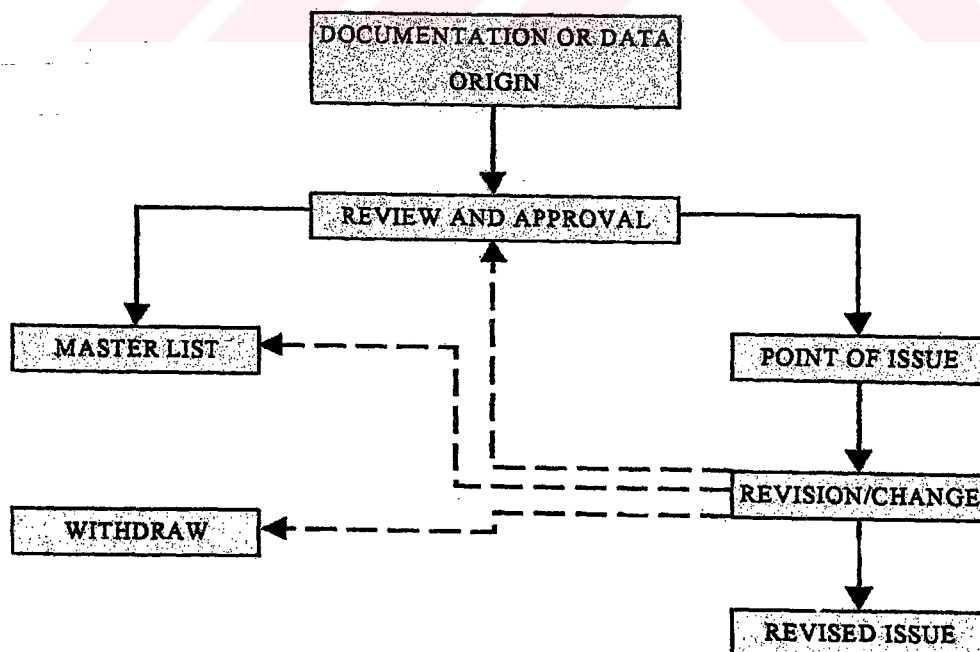


Figure 14 Document and data control

6. Purchasing

6.1. General

The organization is required to establish and maintain documented procedures as shown in Figure 15 to ensure that all purchased product meets specified requirements.

This can be accomplished by the following:

- Assessment and selection of subcontractors
- Accurate specification of purchaser requirements
- Detailed inspection plans
- Verification of purchased product

A working relationship and feedback system must be developed between the purchaser and the subcontractor.

The quality system for purchasing should include the following as a minimum:

- Issue of specifications, drawings, technical data, and purchased documents as applicable
- Selection of acceptable subcontractors
- Agreement on quality assurance

6.2. Evaluation of Subcontractors

The supplier shall:

- Evaluate and select subcontractors on the basis of their ability to meet subcontract requirements including the quality system and any specific quality assurance requirements,

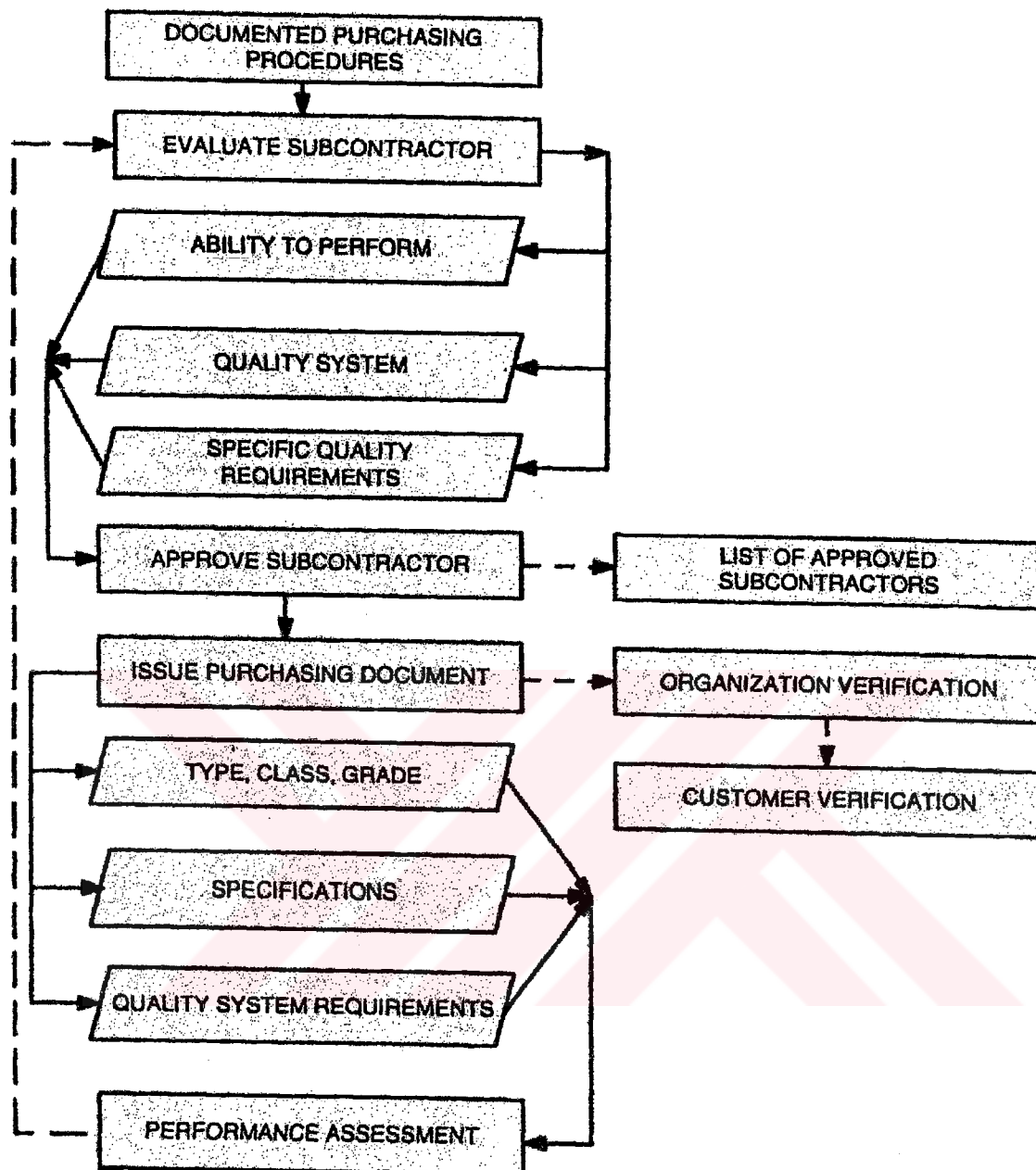


Figure 15 Purchasing

- Define the type and extend of control exercised by the supplier over subcontractors. This shall be dependent upon the type of product, the impact of subcontracted product on the quality of final product and, where applicable on the quality audit reports and / or quality records of the previously demonstrated capability and performance of subcontractors,
- Establish and maintain quality records of acceptable subcontractors.

Methods that can be used in subcontractor selection:

1. Evaluating subcontractor's qualification in meeting conditions of the contract
2. Evaluating past performance of the subcontractor supplying similar products and services
3. Selecting the subcontractor who has Quality Assurance System Certification
4. Evaluating product, service, quality conditions
5. Evaluating the subcontracting system
6. Published experiences of other users

Subcontractor Evaluation Criteria:

- Price
- Product quality level
- Appropriateness to specified requirements
- Work program
- Conditions of delivery
- Conditions of testing and inspections, etc.

Quality logs related to subcontractors:

- List of acceptable subcontractors
- Record of subcontractor selection and evaluation
- If appropriate, records related to subcontractor's qualification and performance

6.3. Purchasing Documents

Purchasing document shall contain data clearly describing the product ordered, including where applicable:

- the type, class, style, grade or other precise identification,
- the title or other positive identification, and applicable issue of specifications,

drawings, process requirements, inspection instructions and other relevant technical data, including requirements for approval or qualification of product, procedures, process equipment and personnel,

- the title, number and issue of the quality system standard to be applied to the product.

Purchasing documents will be reviewed and approved prior to release by an assigned representative of the organization.

More than 50% of the faults in purchasing activities occur as a result of insufficient definitions of purchasing data. Purchasing data should at least include the following:

- Characteristics relating the product or the service
- Quality demands
- Delivery, price and commercial conditions
- Agreement in verification methods when appropriate
- Acceptance and rejection criteria

6.4. Verification of Purchased Document

The standard requires that when the organization plans to verify the purchased product at the subcontractor's facility, it shall specify the verification arrangements and the method of product release in the purchase documents. When verification is specified by the customer at the subcontractor's facility and the product conforms to requirements, the organization shall not use verification / as evidence of effective control over the subcontractor. Verification by the customer does not absolve the organization of responsibilities for supplying acceptable product, nor does it preclude any subsequent rejection by the customer.

A construction organization that must purchase products, materials, or services must have documented procedures to ensure that all purchases meet specified requirements. This requirement would be inclusive of any item or service related to the construction project. Products may be purchased only from approved subcontractors that have the ability to satisfy the purchase requirements including an appropriate quality system and that can satisfy specific quality assurance requirements.

The purchase documents must contain all of the necessary data that clearly describes in detail the product ordered including the type, class, grade, and any other pertinent information. Also included would be reference documents such as drawings and specifications with their issue and revision levels.

The purchase documents must be reviewed and signed by a responsible individual of the organization. The provisions for verification at the source of supply by the organization or its customer must be clearly stated in the purchase documents. If the customer approves the product at the subcontractor's facility, the organization is still responsible to maintain vigilance over the subcontractor and to deliver an acceptable product to the customer. An example for requiring source inspection at the point of manufacture would be structural items that may be erected at the time of delivery directly from the truck to the foundation. Source verification of items being installed or erected when receipt inspection is impractical could avoid costly delays and modifications to accommodate the nonconforming product.

7. Control of Customer Supplied Product

It is common occurrence for the customer or owner to supply to construction organizations products that are utilized in the construction contract, items such as property, existing structures, utilities, and miscellaneous items such as hardware, software, and existing systems. All such items supplied by the customer/owner should be carefully identified, inspected, and protected from damage during their inclusion into the construction project. Any item found to be unsatisfactory should be recorded and resolved prior to utilization. Periodic assessment of the condition of these items should be made and the conditions documented to assure customer satisfaction.

Figure 16 summarizes the relationship between customer and organization when customer-supplied product is involved. The process begins with receipt of the customer-supplied product and verification of its suitability. Safeguarding during storage and maintenance of the product are essential. Report of loss or damage to the customer is required to avoid dissatisfaction and delays. Proper incorporation into the finished product becomes part of the quality plan, with final shipment or delivery completing the loop.

8. Product Identity and Traceability

When appropriate the organization shall establish and maintain documented procedures for identifying the product from receipt and during all stages of construction, installation, and delivery. When traceability is a contract requirement, the organization shall establish and maintain documented procedures for unique identification of individual products or lots as shown in. This identification shall be recorded.

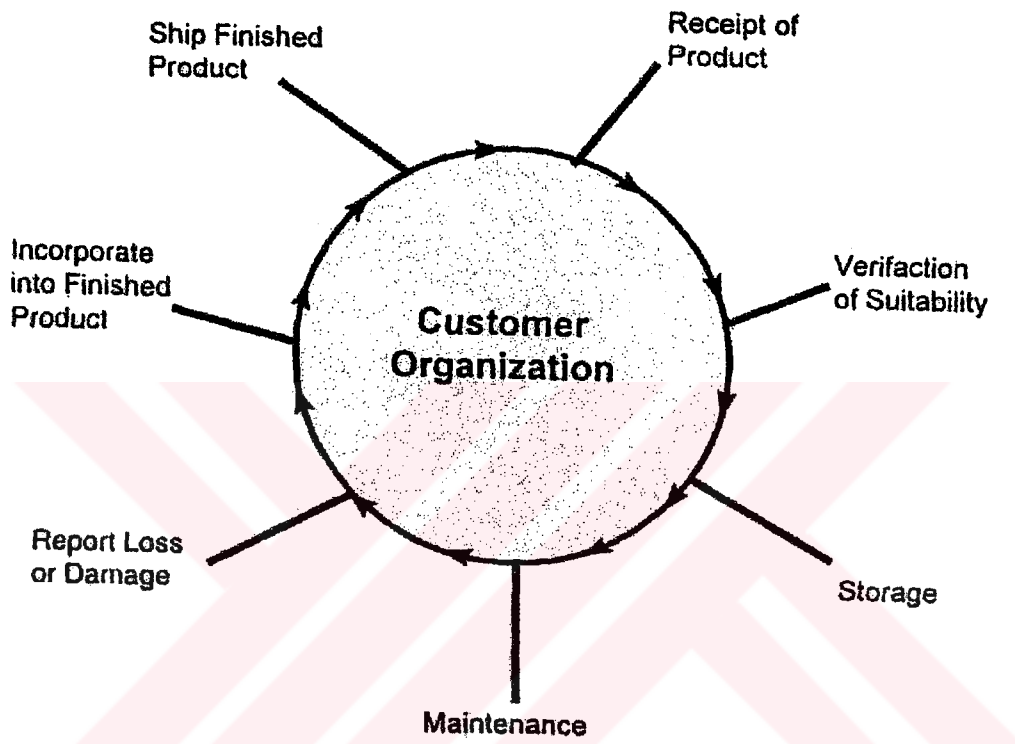


Figure 16 Control of customer supplied product

ACCEPTABLE PRODUCT IDENTIFIER (Traceability)

- Serial number
- Date code
- Batch code
- Lot number

ACCEPTABLE METHODS OF IDENTIFICATION

- Color code
- Tags
- Labels
- Physical marking
- Location
- Document serialization

9. Process Control

Everything that takes place at the construction site is a process and should have a documented procedure and work instruction including a quality plan to assure conformance to requirements. Figure 17 provides a simple step-by-step approach to each process being undertaken.

The following checklist will assist in making sure all points are covered:

- A detailed procedure with sequenced instructions is required.
- Personnel performing the work must be qualified.
- A quality plan to ensure conformance is required including standards of good workmanship.
- Equipment and tooling must be qualified, accurate, and maintained.
- The materials must be approved.
- The process to be completed must be capable of consistent acceptable on output.
- The process must be capable of performance to the specified requirements.
- Safety considerations must be satisfied including environmental and regulatory issues.
- Special processes should be prequalified and closely monitored.
- Auxiliary materials such as water, electricity, and compressed air must be verified and controlled.
- All documents and instructions must be understood, and all related standards and codes must be available and of the current revision.
- Documented records of the results of the process must be prepared and maintained.

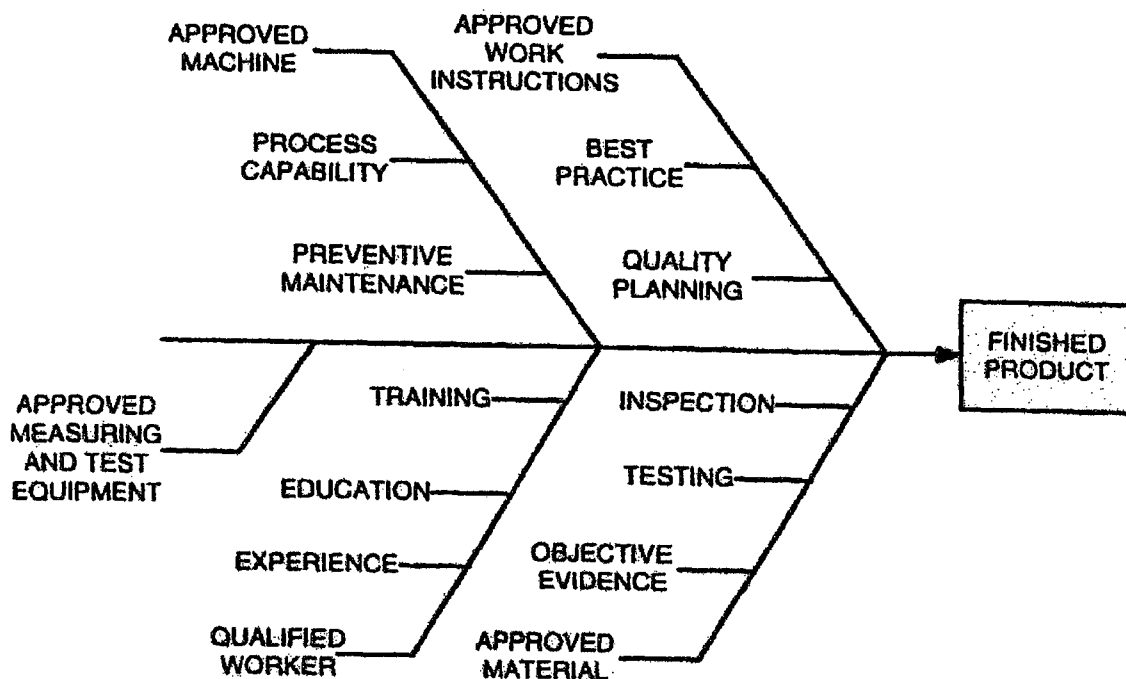


Figure 17 Process control

The requirements for any process operations qualification including associated equipment and personnel shall be specified. Records of qualified processes, equipment, and personnel shall be maintained.

10. Inspection and Testing

The standard requires documented procedures for receipt, in-process, and final inspection and testing activities in order to verify that specified product requirements are met. The details of this verification will be included in the procedures or quality plans.

10.1. Receiving Inspection and Testing - ISO 9001 Requirements

Organization shall ensure that incoming material is not utilized until it has verified as conforming to specified requirements. Once receipt verification is completed, this document becomes the permanent quality record. Once verification of contractual obligations related to quality has been established, the product can be released for construction or installation. The organization's procedures or quality plans should define how verification will be accomplished, that shipments are in accordance with specifications and complete, and that they are properly identified and undamaged. The

procedures should also specify provisions for verification that supporting documentation accompanies the material and that it is adequate (e.g., no test reports, nondestructive examination reports).

10.2. In-Process Inspection and Testing

The organization shall inspect and test the product at various stages as specified by the quality plan. The form becomes a permanent quality record of the inspections that were performed. Product may be held until the required inspections and tests have been satisfactorily performed. In-Process Inspection and Testing allows for early recognition of nonconformity and timely disposition of the item.

10.3. Final Inspection and Testing

The standard requires that the organization shall have documented procedures or a quality plan for final inspection and testing. This will provide assurance that the finished product meets the specified requirements. The documented procedures or quality plan shall require that all specified inspections and tests have been carried out including receipt and in-process inspections and tests and that the results meet specified requirements. No product will be released until all of the prescribed inspections or tests have been satisfactorily completed and records are available and authorized.

Two forms of verification of finished product are available. Either or both of the following may be used:

- Acceptance inspections and tests may be used to ensure conformance of finished product. Examples include 100% inspection, lot sampling, or continuous sampling.
- Product quality auditing of sample units selected as representative of completed lots may be continuous or periodic.

10.4. Inspection and Test Records

The organization shall establish and maintain records that provide evidence that the product has been inspected and tested in accordance with the quality plan. The quality plan that is developed in construction with the product design phase will provide the

planning, performance, and documentation of the verification process. This plan must address the receipt verification of incoming products and services, the in-process verification as work progresses and the final verifications after completion of each step. Figure 18 illustrates the inspection and test flow that will be defined the quality plan.

The records should clearly show if the products successfully passed or failed the inspections or tests to the defined acceptance criteria. Records should identify the inspection authority releasing the approved product.

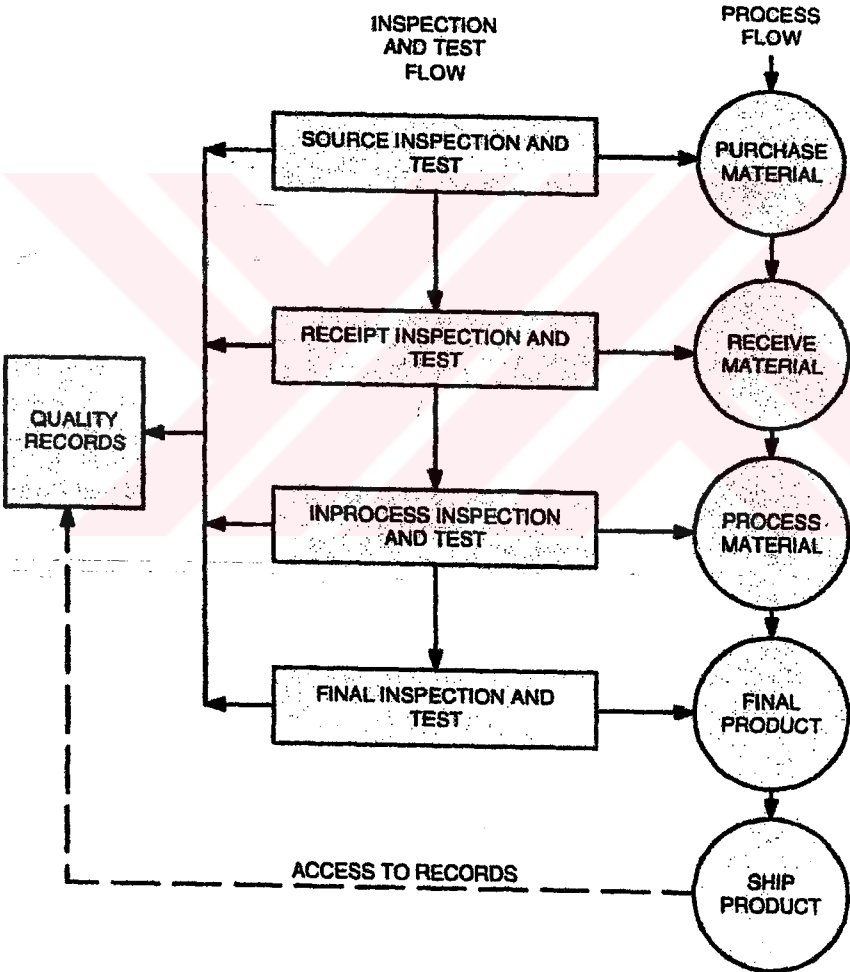


Figure 18 Inspection and testing

11. Control of Inspection (Measuring and Test)

11.1. General

The organization shall implement documented procedures to control, calibrate, and maintain inspection, measuring, and test equipment used to demonstrate product conformance to specified requirements. Inspection, measuring and test equipment shall be used in a manner to ensure that accurate results are obtained. Records shall be maintained as evidence of control.

11.2. Control Procedures

The standard requires that the organization shall:

- Determine the measurements to be made and select the appropriate inspection, measuring, and test equipment that is capable of the necessary accuracy.
- Identify all inspection, measuring, and test equipment affecting quality and calibrate and adjust it at prescribed intervals or prior to use against recognized standards.
- Define the method of calibration including details of equipment type, unique identification, location, frequency of checks, check method, acceptance criteria, and actions to be taken in case of unsatisfactory results.
- Identify calibrated items with a suitable indicator as record to show calibration status.
- Maintain calibration records.
- Assess and document the validity of inspection and test results when measuring and test equipment is found to be out of calibration.
- Ensure environmental conditions are suitable for the calibration activity.
- Ensure that the handling, preservation, and storage of inspection measuring and test equipment support the accuracy and fitness for use.
- Safeguard inspection, measuring, and test facilities including hardware and test software from adjustments that would invalidate the calibration setting.

Documented procedures should be established to monitor and maintain the measurement process. Statistical control should be implemented considering equipment considering skills. When accuracy is not adequate, action should be taken to correct the situation.

The procedure for control of inspection, measuring, and test equipment and the test methods incorporated should address as appropriate the following:

- Suitable selection and specification under specified environmental conditions including range, robustness, and accuracy
- Initial calibration prior to first use to assure accuracy including software and procedures controlling automatic test equipment
- Periodic recall for adjustment, recalibration, and repair considering usage, manufacturer's specification, and the results of prior calibration
- Documentary evidence covering unique identification, calibration frequency, calibration status, and procedures for recall, handling, adjustment, repair, preservation and storage, and installation and use
- Traceability to reference standards (where such standards do not exist, the basis for calibration should be documented)

12. Inspection and Test Status

Construction products and services require careful inspection and test status to ensure a high level of customer satisfaction.

The organization's quality system should ensure that required inspections and tests are performed. The status of the product or service should be known at every stage of the process. Figure 19 provides a model for product identification with a tagging system. Material that is inspected and accepted receives a green identification tag. Material that is rejected for suspected defects is identified with a yellow tag. Material that is not acceptable for use is identified with a red tag, and material for conditional release is identified with a blue tag. All yellow- and red-tagged material is segregated to a nonconforming product status until final disposition is made. Once the product has finally been accepted, it has a product identification label indicating its acceptance status. Status may be indicated by tagging, marking, or signing appropriate documents. Status should indicate whether a product has not been inspected, inspected and rejected, on hold awaiting disposition, or inspected and accepted. Distinct physical locations of these

categories of product status are the most effective method of assessing both status and disposition. In an automated environment, accurate disposition may be achieved by a computer database or other similar means.

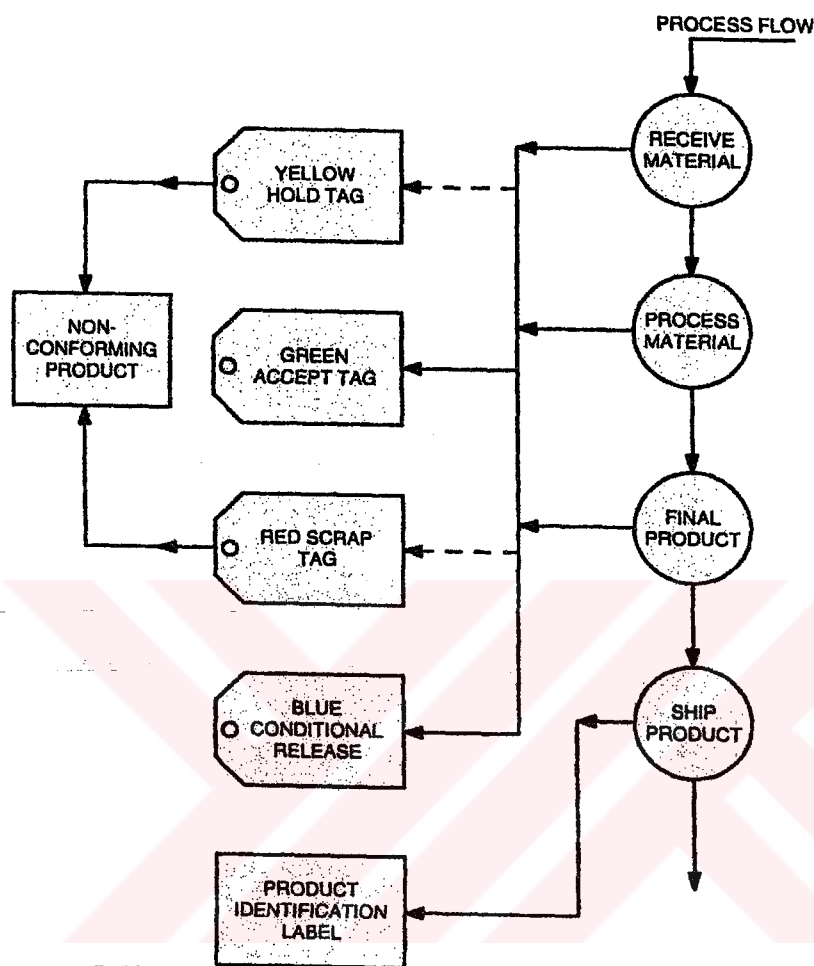


Figure 19 Inspection and test status

A system should be operated to indicate the inspection status of material during intermediate stages of processing or manufacture so that it is at all times possible to distinguish that which has been inspected and found acceptable from that which has not. In many cases, inspection status can conveniently be indicated by the attachment of stickers or labels. Another method is the use of check list. For example, airliner crews use pre-printed check sheets to tick off all the checks they are obliged to carry out at each stage of a flight. When signed by the captain the sheets also provide verification that the airline's quality system is being complied with. Although the presence of a signature or initials against an item on a check sheet does not by itself prove that the item is correct, the necessity to make one's mark does have a deterrent effect on those who may otherwise turn a blind eye.

A check sheet for use on a construction site is one of the verification documents, scheduled on the Inspection and Test Plan. It serves, for example, to record that the checks specified to be made prior to placing concrete have been correctly carried out by the contractor's supervisor and the purchaser's inspector, that all was found to be in order, and that concreting may proceed. Record sheets of this kind provide a discipline for the checking of the work. This discipline can be strengthened if they are also used to supplement or even supplant the quantity surveyor's measure for payment. A sub-contractor who knows he will not be paid until documentary evidence of compliance / with specification is complete will take more care than one who has only to satisfy a quantitative measure.

Inspection and test status is required at the time of receipt of product at the job site. All unqualified product should be placed in a clearly identified holding area to preclude possible use. Once verification is accomplished, the materials should be physically identified as accepted and staged on the job as required. The physical location on the construction site would then be considered as acceptable inspection and test status. Hold points during construction for in-process verification of construction and installation could be specified on the project plan and signed off when completed. Any nonconforming conditions could be identified as such and reworked or removed to a nonconforming holding area until dispositioned. Concessions to nonconforming conditions when accepted by the customer would be documented for record.

If the total project would be managed in this manner, inadvertent use of nonconforming product and services would be avoided and the end product would result in higher quality at lower cost.

13. Control of Non-Conforming Product

The standard requires that the organization shall establish and maintain documented procedures to eliminate the possibility of product that does not meet specification from being installed or used. The procedure shall provide for identification, documentation, evaluation, segregation, disposition, and notification to all functions concerned, as shown in Figure 20.

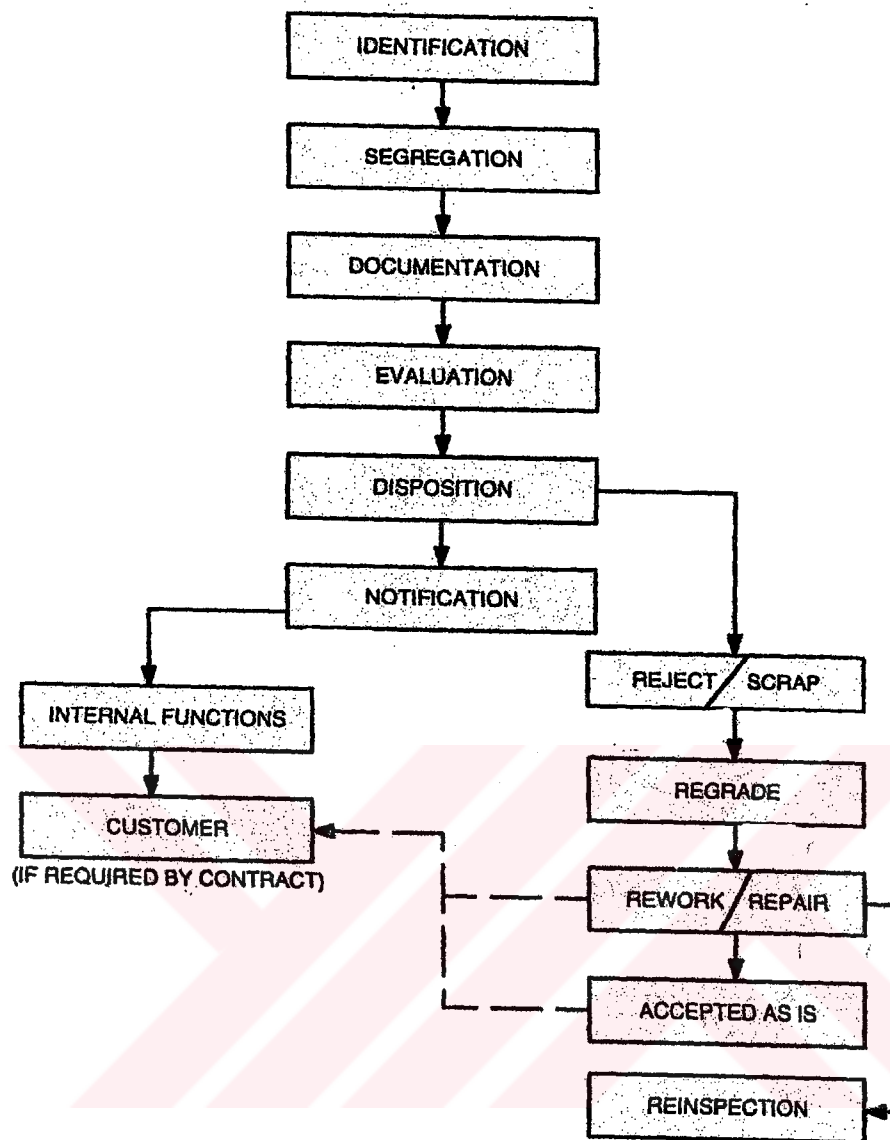


Figure 20 Nonconforming product

Documented procedure shall define the available dispositions of nonconforming product.

Nonconforming product may be:

- Reworked to meet the specified requirements.
- Accepted with or without repair by concession.
- Regraded for alternative application.
- Rejected or scrapped.

The entire construction process is ripe with opportunity for nonconforming product from the time of design until final acceptance by the owner. The ISO 9001

standard is very specific on how to deal with the occurrence when nonconformity is detected. The first key step is early detection and identification. Many times it is too late to segregate the nonconformance because it is already incorporated in the construction or installed in its final location. In this case timely disposition is essential to avoid additional costs and delays. The disposition must be made by someone with authority, and; the owner's representative may have final disposition as specified by the contract. Keeping in mind that customer satisfaction is fore most, the decision to accept the nonconformity for rework or to reject the product must be made very carefully. The customer may later decide that the condition is unacceptable, and demand resolution. Documented disposition by the owner to accept rework or repair will avoid later, costly resolutions and delays in completion. When a nonconforming condition is identified, a nonconforming product report, should be completed for systematic identification, disposition, and record of nonconforming product.

14. Corrective and Preventive Action

The standard requires the organization to establish and maintain documented procedures for implementing corrective and preventive actions. The organization shall record and implement any changes to the documented procedures effected by the corrective or preventive action.

Corrective action procedures shall include the following:

- Effectively handle customer complaints and nonconformity reports.
- Investigate and analyze the problem and record the results.
- Determine corrective action needed to eliminate the cause.
- Apply controls to ensure effectiveness of corrective actions taken.

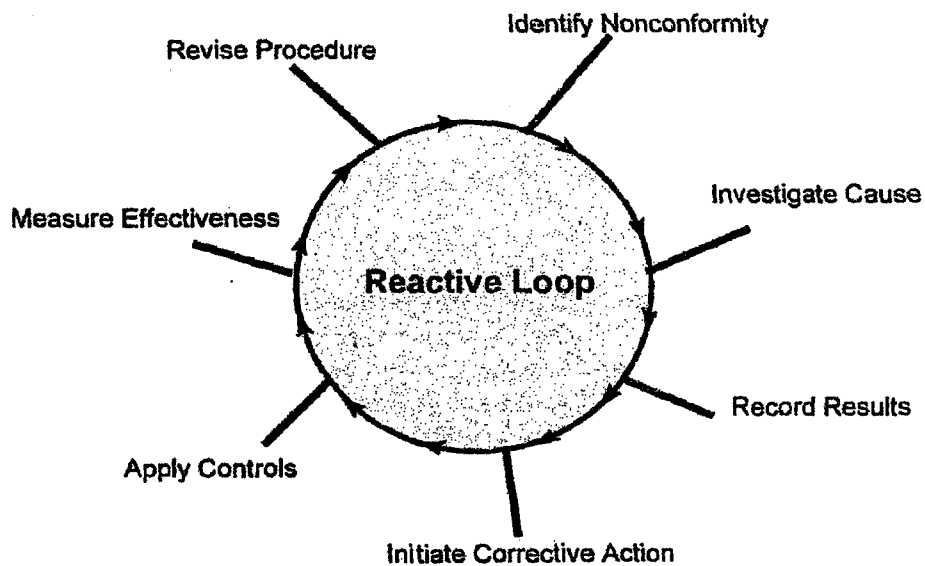


FIGURE 21 Corrective action

Preventive action procedures shall include the following:

- Use available information such as procedures and work instructions, audit results, concessions, quality records, and customer complaints to detect, analyze, and eliminate potential causes of nonconformity.
- Determine steps needed to deal with any problem that requires preventive action.
- Initiate preventive action and controls to ensure that it is effective.
- Submit relevant information to management for review.

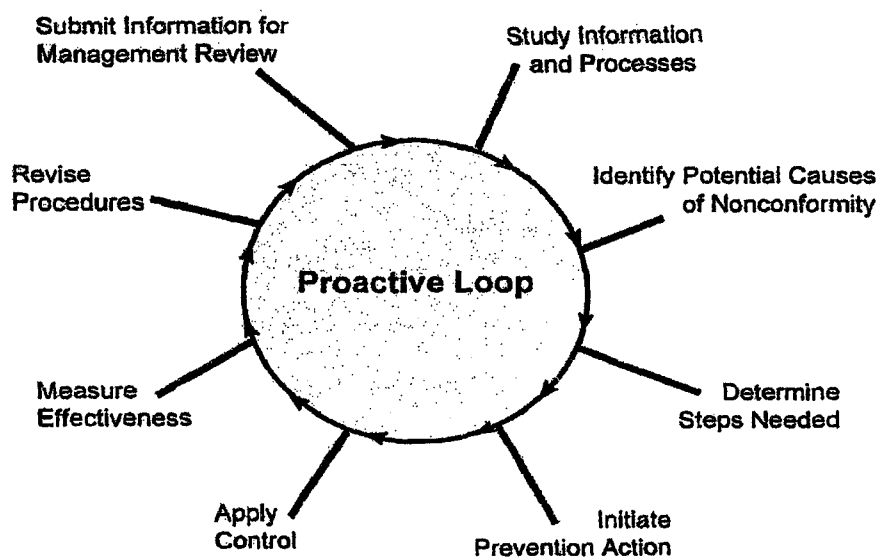


Figure 22 Preventive action

15. Handling, Storage, Packaging, Preservation and Delivery

The construction industry is made up of a variety of businesses that contribute to the end product for the customer. Handling, storage, packaging, preservation, and delivery mean different obligations for each of them. Each contributor to the construction site including the construction contractor must interface their activities to assure a final product that is acceptable to the owner. Handling procedures and equipment must be maintained at all levels, from the raw material to final installation. Storage is most critical at the construction site because of the vast amounts of material and limited facilities to accommodate it. In this case careful monitoring of environmental conditions must be considered and results documented. Packaging adequacy falls back on the manufacturing companies that supply the site, and inadequacies should be documented and recorded with corrective action requested. Preservation at the construction site must be an assigned responsibility to a specific party. A representative for the owner must oversee the conditions of materials and products to be utilized in the construction to assure that damaged or deteriorated items are not hidden in the end product being constructed. Delivery of products and materials to the construction site must be carefully controlled. Specific attention must be paid to the condition of items received. Damaged or deteriorated items should be handled in accordance with established procedures that assure appropriate resolution. The quality of the final constructed product relies greatly on the condition of the materials and products utilized in the construction process.

16. Control of Quality Records

The final phase of a site quality management system is the provision of objective evidence that work has been carried out in compliance with the drawings and specifications. Quality system standards envisage that most of this evidence will be provided by documentary record. They require that records should be maintained both to provide proof of compliance and to demonstrate the effectiveness of the quality system.

The following are examples of types of quality records including charts that require control:

- Inspection reports
- Test data
- Qualification reports
- Validation reports
- Survey and audit reports

- Calibration data
- Quality-related cost reports

The following are examples of the types of documents that require control:

- Drawings
- Specifications
- Inspection instructions and procedures
- Test procedures
- Work instructions
- Operation sheets
- Quality plans
- Operational procedures
- Quality system procedures

Quality records related to a specific construction project are evidence that the quality system principles of the various organizations contributing to the project resulted in a documented collection of inspection and tests conducted at necessary points during construction. All quality records must be managed in a manner to assure proper identification, collection, indexing, access, filing, storage, maintenance, retrieval, and disposition. Quality records are an excellent source for reviewing strengths, weaknesses, and trends of the quality system and the products it generates.

17. Internal Quality Audits

A quality audit is a systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

The internal quality audit should be performed for the following reasons:

- To determine the conformity and adequacy of the quality system elements
- To determine the effectiveness of the implemented quality system in meeting the quality objectives
- To meet regulatory requirements
- To provide continuous improvement opportunities

- To facilitate external audits

Audit programs should be established to cover the following:

- Planning and scheduling specific areas and activities to be audited
- Assigning qualified personnel to conduct audits
- Documenting procedures for carrying out audits to include recording and reporting results and reaching an agreement on timely corrective actions

Audit reports should be prepared and submitted to appropriate management for action and to executive management for management review activities.

The audit report should address the following:

- All examples of nonconformance or deficiency
- Timely and appropriate corrective action

The auditing must be conducted by trained individuals outside the activity being audited to avoid the influence of management personnel with authority over the auditor. The auditor is required to prepare a report reflecting the results of the audit and present it to the management personnel responsible for the area being audited. An agreement should be recorded by the auditor and responsible management for the corrective action to be taken and a time schedule for completion. A follow-up audit is to be conducted at a later date to confirm the completion and effectiveness of the corrective actions taken. A copy of the internal audit report must be forwarded, to executive management for periodic management review and action.

Construction projects where more than one contractor is involved should have a designed internal audit plan to monitor the construction activities of all participants that should be carried out by the agent of the owner as a routine verification activity. This internal audit program should dovetail with the internal audit program of each contractor when possible.

18. Training

Each position in an organization requires a prerequisite for education, training and experience in order to be minimally qualified to accomplish the duties defined in the documented job description. Regardless of the type of construction-related organization,

there is a common discipline required to describe the positions within the organization, define the scope of the duties to be performed in each position, and determine the educational, training, and experience levels required to be minimally qualified. All of this information is organized in the documented job description that can be used as a basis for hiring, transferring, and promoting individuals to meet the employment needs of the organization.

As the need for additional training arises, it must be provided in some organized manner and the records of the completed training must be maintained. The records of all training or education completed by an individual should be maintained by the organization in the individual's employment files.

19. Servicing

When a product requires follow-up maintenance as a contract requirement and servicing is specified, the following activities should be considered:

- Clarification of responsibilities among the organization, distributors, and users
- Planning of service activities to be carried out by the organization or a separate agent
- Validation of special tools or equipment used in the servicing activities
- Control of measuring and test equipment used for servicing
- Provisions and suitability of documentation including adequate instructions

Provisions for adequate backup including technical support, training, and spare parts supply

- Training of service personnel
- Feedback of information to improve the product or service design

Construction projects frequently require follow-up servicing or adjustment to equipment or hardware to satisfy customer needs. This may or not may be a contract requirement but it is essential to customer satisfaction.

20. Statistical Techniques

Statistical techniques can benefit the organization in data collection analysis and application. Also they are useful in product services and process design, process controls, problem analysis, and establishing product and process limits. The following statistical methods can be useful for these purposes:

- Graphical methods that help to diagnose problems (histograms, scatter plots, pareto diagrams, etc.)
- Statistical control charts for monitoring and controlling production and measurement processes for all types of products
- Design of experiments to determine influencing variables
- Regression analysis to measure effects of change
- Analysis of variants for variance component estimates
- Methods of sampling and acceptance
- In-process sampling
- Statistical methods for inspection and testing

Statistical results can be an effective way of demonstrating conformance to requirements for quality and can be used as quality records.

Application of statistical methods is important to control every phase of the organization's processes. Documented procedures should be established and maintained for selecting and applying statistical techniques for the following:

- Market analysis
- Product design
- Dependability, durability, and longevity prediction
- Process control and capability
- Sampling plans
- Data analysis
- Process improvement
- Safety and risk evaluation and risk analysis

Statistical methods for establishing, controlling and verification activities are as follows:

- Design of experiments and factorial analysis
- Regression and variance analysis
- Tests of significance
- Quality control charts
- Statistical sampling

Future quality planning should be directed in each construction-related organization to develop and implement statistical techniques as a tool of the future.

2.5.8. How to plan and implement an ISO 9000 Quality System?

PLANNING, IMPLEMENTATION, AND MAINTENANCE PHASES

Planning

I. Top Management Commitment

- A. Establish a steering committee (6 to 10 members)
- B. Develop a company quality policy
- C. Develop a strategy for implementation

II. Select a Champion (Facilitator)

- A. Qualifications
- B. Short-term time commitment
- C. Long-term time commitment

III. Select a Registrar

- A. Traceability to accreditation body
- B. Cost and scope of service
- C. Availability of registrar
- D. Check references for quality of service

IV. Plan the Schedule of Events

- A. Training schedules
- B. Development of manuals and procedures
- C. Implementation

- D. Pre-assessment
- E. Corrective action
- F. Assessment

Implementation

I. Conduct Training

- A. Facilitator
- B. Top management
- C. All employees

II. Structure Your Quality System

- A. Develop quality manual (policy)
- B. Develop procedure manual (department procedures)
- C. Develop standard procedures (work instructions)
- D. Develop forms

III. Implement Quality System

- A. Train all personnel on applicable ISO 9000 elements
- B. Qualify all processes vs. procedures
- C. Qualify all personnel to the process
- D. Establish documentation requirements for process
- E. Establish document control system

IV. Conduct Pre-Assessment by Outside Source

- A. Select qualified consultant
- B. Conduct a pre-assessment of total quality system
- C. Issue a report of strengths and weaknesses

V. Initiate Corrective Action and Documentation

- A. Revise process/procedures as required
- B. Conduct additional training if required
- C. Conduct internal audits
- D. Compile documentation and records

VI. Schedule Formal Assessment by Registrar

- A. Orient all personnel on upcoming events
- B. Assign and train guides
- C. Fine-tune system and continue audits
- D. Review records in all areas
- E. Participate in assessment

Maintenance

I. Follow-up, Facilitate, and Initiate Continuous Improvements

- A. Resolve all discrepancies
- B. Develop internal and external audit schedule
- C. Develop management review schedule
- D. Establish a long-term contract with registrar
- E. Develop annual quality system task list

3. APPLICATION OF ISO FAMILY OF STANDARDS IN CONSTRUCTION PROJECTS

3.1. General

Mostly the companies undertaken international projects state that quality plays a very important role in the international market. This proves that the new concept of quality and ISO 9000 series of standards are gaining more importance in the Turkish construction industry may be due to the fact that, when a company wants to rush in the international market, it has to achieve national and international recognition. Certification is the solution to this problem, which provides both national and international recognition.

However, entering into the international market is not the only reason for ISO 9000 certification. Some companies which do not have international projects also have the certification. Companies state that they have applied for certification;

- a) anticipating the national client's requirements, or
- b) achieving a better quality and management, even
- c) just documenting the quality system in their company.

3.2. Factors affecting Quality

If a construction company is able to develop a quality system, and to document properly and adequately the producers, then it is more likely that the company will be able to provide good quality services and products. But in the construction industry, there are lots of factors which affect quality negatively:

- Poor workmanship
- Poor coordination during construction
- Paying more attention to completing the works on schedule and in budget than quality
- Design not satisfying the relevant codes and standards
- Wrong material selection
- Lack of raw materials in appropriate quality
- Poor quality transportation companies

3.3. Benefits of implementing ISO Family of Standards

The construction contracting sector is generally more complex than others because it is the one which is affected by all of these factors since it involves more extensive coordination work, procurement of a large volume of building materials and the supervision of largely unskilled labor force. Despite the existence of these difficulties, most companies agree that ISO 9000 will improve the quality of construction projects if the contractor is obliged contractually.

The benefits of implementing ISO 9000 standards in construction industry can be tabulated and listed from most importance to least importance as follows:

- (a) Easier implementation, control and quantification of changes
- (b) Continuous improvement of the quality system
- (c) Systematic checking, resulting in the avoidance of costly errors, failures and extensive remedial works
- (d) Scrap and rework reduction
- (e) Improved client satisfaction
- (f) National and international industry recognition
- (g) Formalized delineation of responsibilities
- (h) Programmed and prompt arrival of drawings and other information
- (i) Documented proof that the work has been completed in accordance with contractual requirements
- (j) Improved subcontractor performance
- (k) Improved and more relevant specification writing
- (l) Systematized collection of information from clients to ensure that all requirements are defined before detailed design work proceeds
- (m) Easier identification and quantification of claims for costs and delays, which are frequently encountered in construction works
- (n) Social responsibility
- (o) Clearly defined lines of authority and the extent of that authority
- (p) Improved communications both internally and externally which usually improves quality, efficiency, on time delivery and customer / supplier relations.
- (q) Error reduction resulting from increased employee participation, involvement, awareness and systematic employee training.
- (r) Better products resulting from better design control.
- (s) Improved productivity resulting from planning and teamwork.
- (t) Reduction in costs associated with failures.

When the factors of clients, manpower and cost are considered, top management decides to implement ISO 9000 series of standards. However, contractors must not rush into implementing quality system simply because others are doing so. Proper planning at the top management level together with a clear understanding of the QA concept is essential before any decision to implement can be made. Only making the decision is not enough, the top management should always support the implementation of the quality system. As will be stated in the question about the implementation problems, the lack of management support for the quality system can be an important problem. Therefore, the top management, while making the decision should also commit all kinds of support related to the implementation of quality system.

3.4. Benefits and costs of hiring a consultant family

After the decision of implementing ISO 9000 quality standards, the next decision to be made is whether using a professional consultant company for implementation of the standards or not. For making this decision, benefits of hiring a consultant company should be considered.

The benefits of hiring a consultant company for implementing ISO 9000 standards in construction industry can be listed from most importance to least importance as follows:

- a) Provides guidance and direction in project management
- b) Provides expertise and experience
- c) Teaches company people how to use the quality system and its tools effectively
- d) Positions the company for future growth
- e) Provides a plan for achieving implementation of the quality system

Reviewing the benefits of hiring a consultant company, the other factor to be considered is the cost of hiring such a company. Cost of a consultant company depends on the number of employees in the company. A consultant company states that, for a company of 30 persons in the head office and a total of 100 persons including the head office and the sites, cost will be approximately \$7,000 to \$ 13,000. For larger companies like the ones in the interview, the cost will be around \$20,000 to \$25000. However, the companies in the interview stated that the consultant company costed just money, but they gained more. In other words, they did not give much importance to the money they paid for the consultant company comparing it with the benefits.

As in every profession in the world, there are goods and bads. The consultants selected should help the company to improve the business for the day, and position the of the quality system, combine this knowledge with the necessary business sense and have the capability to transfer this knowledge to the client in a simple manner. Therefore, the selection of the consultant company who would really help and add great value to the company is a very important issue. Consultants do cost money, therefore, the consulting resource must be carefully screened and selected and must be wisely used.

For selection of the consultant company, different companies consider different criteria. These criteria could be listed as follows:

- Consultant firm's references
- Consultant firm's resources/experience/success
- Implementation and training approach
- Meeting the needs
- Advises of other companies
- Consultant firm's fee structure

Finally, a good consultant is the one who does not tell his clients what exactly to do, write the quality policy or quality manual himself. On the contrary he should assist the company people in understanding what is required and help them to determine which solution will both meet the requirements and be the best solution for the company. He should allow the company people to decide which solution will be implemented. By this manner, it would be easier for the company people to understand what they are really doing, and to consider this quality system as their own. So, they would try to obey all requirements more willingly.

3.5. Problems encountered

It usually takes 6 to 12 months to register. Yet, this is just the certification period. Naturally it needs more than that, sometimes up to 3 years, for the decision making, organizational reconfiguration, external and internal training, etc.

Of course, it is not that easy and that straightforward. As in everything related with business world, there are some problems to be encountered. These problems may be classified in two groups; registering problems and implementation problems.

3.5.1. Registering Problems

Registering problems may be internal or external problems. Budget for a quality system and participation of all members of the organization are regarded as internal problems. Whereas problems related with the auditors of the registrar are external problems. An auditor may call a noncompliance as minor whereas the other one would as major. Also, the auditor in addition to a thorough knowledge of the appropriate ISO 9000 standards, should have professional background in the type of construction-related industry to provide scope and understanding of the areas being audited because the organization may face difficulties in defining the system to an auditor who is an outsider to the industry. Auditors should have a training about the industry which they would audit and they should be experienced about the subject.

3.5.2. Implementation Problems

As the quality concept in the construction industry in Turkey is a new born baby who will learn walking falling and standing up again, and as protecting is always more difficult than getting, implementation problems are more than the registering problems. The following problems are the ones most frequently encountered in the implementation of the quality standards in the construction industry.

- ***lack of control or cooperation from subcontractors/suppliers:***

If nominated subcontractors or suppliers are predetermined by the client, the degree of control the main contractor has over the subcontractor or supplier will be lower. This problem becomes acute when non-conformances are detected and corrective action needs to be taken.

- ***shortage of skilled labor:***

Most subcontractors e.g. bar-benders, bricklayers, plasterers and tilers have engaged unskilled labors to carry out most works with the supervision of one or two skilled workers on site. Expecting these subcontractors to produce good quality products or services through the introduction of the QA concept is therefore not an easy task.

- ***lack of training in quality:***

Although site staff are introduced briefly to the QA concept, the actual training on its application is, however, limited. For example, if the QA Manager is the only one who had a clear understanding of the QA concept while his most other staff merely listens to his instructions and then performing accordingly without knowing why they are doing it. This will create an unhealthy reliance on the QA Manager, as a result the QA concept becomes a “one man show”.

- ***confusing technical terms:***

With the introduction of the quality manuals, several new technical terms in relation to the QA concept are also unwillingly introduced. Site staff can find some of the terminology confusing. As a result some of the procedures specified in the quality manual will not be properly applied.

- ***difficult to cope with new roles and responsibilities:***

If burdens of taking on additional roles and responsibilities are added to people, e.g. construction team being the quality management team at the same time, site staff can find it difficult to cope with QA. They can be more concerned with meeting the project deadline than ensuring quality. The assurance of quality on site can therefore become a second priority.

- ***poor response in filling out standard forms:***

The site staff may consider the filling out of standard forms to be unnecessary and may feel that if they are to spend too much time form filling, delay in the scheduled completion time of the project might occur.

- ***lack of participation from the consultants***

Due to the nature of the construction industry, numerous parties are involved like design consultants, contractors, subcontractors, material manufacturers and suppliers. The individual efforts of one party is not always adequate for achieving quality in construction.

Although the contractor may have implemented a quality management the aim of quality may be affected by the consultants themselves who have not practiced QA. The discrepancies that occur in the drawings and specifications cause delays in construction time and reduce effectiveness of QA.

- ***high staff turnover***

Due to a high turnover rate in the industry, experienced site staff are sometimes retained even if they do not always follow the procedural requirements laid down in the quality manual. The enforcement of QA requirements is difficult in such a situation.

- ***lack of management***

Top management must not only support the effort, but must participate in the implementation and change initiative for success to occur. They must provide resources to get the job done.

The implementation problems encountered in construction industry can be listed from most importance to least importance as follows:

- a. Lack of management support
- b. Lack of control or cooperation from subcontractors / suppliers
- c. Poor response in filling out standard forms
- d. Difficult to cope with new roles and responsibilities
- e. High staff turnover
- f. Lack of training in quality
- g. Shortage of skilled labor
- h. Lack of participation from the consultants
- i. Confusing technical terms

3.6. Proposed solutions to the implementation problems

These problems, of course, have their solutions. Some solution recommendations to these problems would be:

a. Lack of management support

This problem may occur in the very early stages of development of implementation, but with a truly defined authorization and a full understanding of the quality system, it would be overcome.

b. Lack of control or cooperation from subcontractors / suppliers

The individual efforts of the main contractor is not always adequate for achieving quality in construction, but with clearly and carefully prepared specifications, the quality of subcontractors or suppliers would be improved.

c. Poor response in filling out standard forms

By the formation of limited content forms, this problem would not occur. Companies should try not to drown people in lots of paperwork.

d. Difficult to cope with new roles and responsibilities

If companies do not try to address people new roles and responsibilities, and instead, just teach them to record just what they do, it would be an easier job to cope with.

e. High staff turnover

With the solution of the above problem, this would not be a problem anymore.

f. Lack of training in quality

Training problem must be solved before certification period begins. It would be an error to have an idea of "first certification comes, then other problems would anyhow be solved". If training is left after certification it becomes an implementation problem and then it would be more difficult to resolve.

g. Shortage of skilled labor

If the education levels of the staff is increased from primary schools to professional high schools this often needs to dismiss some of the labor -production of good quality

products or services becomes easier because the staff's understanding level of the quality concept would increase.

h. Lack of participation from the consultants

This is an external problem and cannot be handled by the efforts of just one party, but as the quality concept is still a newly developing idea in Turkey, after a couple of years, it is hoped that this would not be a problem anymore.

i. Confusing technical terms

If all members of the organization, from upper levels to the lower, is taught to "write what you do and do what you write", formation of a new technical and unclear terminology would be prevented.

3.7. Subcontractors and suppliers

As it is stated a couple of times before, construction industry, because of its complex nature, numerous parties are involved like design consultants, contractors, subcontractors, material manufacturers and suppliers. In order to achieve good quality products or services, the materials, the products or the services supplied from other parties should be of adequate quality. The companies with ISO 9000 certifications prefer the subcontractors and purchasers with certification or at least, ones having a QA system, but there are still some problems about the suppliers and the subcontractors.

Companies sometimes have to select suppliers with a QA system for some of the raw materials even with higher prices in order not to decrease quality of their own products. However, it seems logical to improve the quality of the ones with lower prices with supplying required support and training. In addition, by the help of specifications, suppliers are strived to reach the same quality level. It is stated that subcontractors and suppliers who were resistant to change. their current situations in the beginning are now in adaptation and are showing continuous improvement.

However some suppliers in some regions who are in a position of being the only rifle, still resist to change their situations believing that the contractors anyhow need them. They think that if one goes, there is always another to come. The unconsciousness of

these suppliers has to be destroyed by forcing them to adapt a quality system by selecting suppliers with a QA system from other regions even with paying for the transportation. By putting a kind of embargo on them, they may understand that this is the century of a better quality.



4. CASE STUDY

A selective case on Quality Management Practice and Documentation of ISO 9000 Standards implemented at Istanbul Atatürk Olympic Stadium in construction industry in Turkey.

Istanbul Olympic Stadium is one of the basic investment project planned by the Preparation and Organization Council for the Istanbul Olympic Games.

The project, as the stadium only costs 115 million US \$ provided by French finance banks against Turkish Treasury guarantee, which is a part of approximately 10 % of the total investment, by cost, in the Atatürk Sport complex to be prepared and completed to the Olympic Games.

Istanbul Olympic stadium has 80 000 seats for Olympic games and 100 000 capacity for other activities. Stadium has steel-roof covered second stand on east side and steel-roof covered second and third stands at west side. A building complex with 40 000 m² covered slab area is constructed under the west second and third stands which provides/complies all the requirements of IAAF regulatory standards with all the necessary/compulsory functions of the Olympic games, such as safety, security, fire, medical, media, sport organizers, training, social and cultural like conferences facilities, activities and measures.

Construction of Istanbul Olympic Stadium project is one of the most covered and precisely implemented case in Turkey as per ISO 9000 Standards and requirements with a wide application of documentation as well providing a Quality Assurance Department having four well and/or highly experienced quality engineers.

In principle, in the Olympic stadium project it's assumed that the objectives of the total quality is achieved during manufacturing/production phase with the responsables; execution manpower, however the Quality Assurance Department is the authority in the organization to take care that quality system and quality control is being implemented by the execution responsables.

It is observed that;

- 1. First of all quality assurance Plan (for engineering activities) relevant to ISO 9000 was prepared.**

2. This plan includes appendices as follows;
 - Quality Policy.
 - A list that sets forth the order of the Quality assurance Procedures.
 - Project Organization Chart for design and construction (general).
3. Procedures were prepared step by step in order (shown in the list mentioned above) before construction work has started. For example; the methods of writing procedures, minutes of meeting, code systems in documentation etc.
4. Contractor has prepared these documents, according to the templates given, as construction begins, both for design and construction work.
5. All the procedures coded 0201-0220 were prepared, such as, Contractor's Management Structure including organization charts and job descriptions, etc.
6. Whenever needed additional procedures to the initial list of procedures were prepared, like, procedure for product receipt at factory, procedure for taking over certificate, final acceptance certificate, etc.
7. In accordance with fourth step, work procedures were prepared for each particular work item by the selected sub-contractors. 0209 coded procedure describes the way these PWP will be prepared and certified. (write what you do and do what you write is the basic idea of PWP)

Although quite well-done implementation was realized during the design phase as well as execution phase, still there might happen some unforeseen and/or unexpected cases and/or phenomenons, Such as;

a) In the design phases, although the design was prepared in France (by the well experienced and qualified designers on Olympic stadium concepts) and verified by Turkish well experienced Parties, there is still a need of wind curtain against strong north-south winds. This shall be rectified by either external solution or additional north-south upper stands. The solution is still not decided and under investigation. In any case it is expected a considerable fraction of the total cost of the project such as %10-%15. As per decided solution total schedule may be affected and extended 8 months more.

b) Most of the cutout and sleeves foreseen during the design stage inevitably couldn't be used and afterwards rectified by other means. The reason was improper and /or insufficient design sequence, such as shortage and/or lack of second review/modification of the structural design after the completion of all the other trades like

architectural, electrical and mechanical.

c) Having all detailed inspections and reports on geological and geophysical information at the beginning or in the design phase, still some unexpected cavities were found under the playground. These type of cavities have been filled by proper concrete compounds with extra cost and time.



5. CONCLUSION

The initial date for application of quality systems in Turkish construction Industry goes back to the establishment of the construction sites abroad. Due to the fact that procedures related to control mechanisms occupy an important part in contracts, Turkish construction industry has become acquainted with Quality Assurance Systems.

However it has been observed that concept of Quality assurance and Quality Control has been confused in companies that have been implementing Quality assurance since then.

The objective of companies in using and/or planning Quality System implementation is;

- a.** As the principle reason to minimize the cost caused by poor quality. This outcome has shown that the idea of improving quality and maintaining the achieved quality aspects would increase the cost are no longer accepted. On the other hand construction companies have realized the fact that the cost of establishing Quality assurance system is a minor feature compared to additional cost brought by rectification of failures and non-conformances.
- b.** As another significant reason the satisfaction of the Client. If a company aims to remain in the market, it must provide the clients with the best of its products and services. This can be accomplished by steady increase in the quality of products. Quality assurance system provides the companies to fulfill their targets to meet the production of quality products. Hence Turkish construction firms, by raising the quality level of their products, aim to stay in the market for a long time.

Quality policy is a very important aspect of Quality assurance and it must be specified and announced by Top Management to all personnel as well as second and third parties related.

In Turkish construction sector, utilization of subcontractors is very common. It must be assured that all workers of subcontractors must also follow up the procedures of Quality assurance system for the integrity.

In the case study Istanbul Olympic Stadium as a well implemented sample has been studied, some of the facts/outcomes are observed and analyzed.

Since the basic aim of Total Quality System is the customer (client) satisfaction. In some cases with some limiting parameters such as total cost of the project of the client may cause weakness and/or lack of quality in the overall project.

Although implementation of the total quality system is the major aim in the construction, the application is not unlimited but depends on cost and time constraints. Construction of building as the main outcome/product utilizes semi-finished and finished products as input supplies. Being applied the total quality system in the construction, to the design and execution, should cover the quality measures implementation not only in the construction project but also all the inputs.

Quality application coverage sometimes may be dependant on the client and the particular subject characteristics which might impose some limitations during the design and even in execution phase. Characteristics/limitations of the client such as cost might limit the total design/exécution or the precise and/or dangerous processes might require more strict application of quality/safety measures like petrochemical projects. On the contrary project as a total target has to be realized in foreseen and/or reasonable duration and cost.

As a conclusion, quality management is one of the most important aspect of construction sector. The important thing is to compare benefits with cost in order to come to a decision.

The benefits of implementing **ISO 9000** standards include;

- improved client satisfaction,
- improved profits
- increased efficiency
- less duplication of work
- fewer errors
- less waste
- increased competitiveness
- cost saving
- better motivated employees

- **better use of time and resources**
- **improved communications**
- **continuous improvements**
- **improved subcontractor performance**
- **national and international industry recognition**

It is hoped that, as the importance and consequences of quality systems are recognized and widely accepted by the professionals and institutions, considerable improvements in quality management will be achieved.



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- www.qualitytoday.com
- www.tse.org.tr
- www.enr.com

7. APPENDICES

Appendices has three parts;

Appendix A - Drawings of the sample case

Appendix B - List of QAP documents

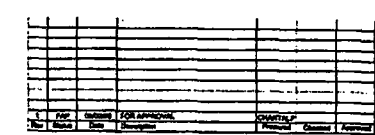
List of PWP documents

Appendix C - Sample Procedures

- **QAP - Quality assurance Plan**
- **QAP - Contractor's Management Structure**
- **QAP - Design Control**
- **QAP - Quality Plan Frame for Construction Activities**
- **QAP - Execution Follow-up Documents**
- **QAP - Establishing Particular Work Procedures**
- **QAP - Procedures Management**
- **QAP - Inspection and Testing Plan**
- **QAP - Controlling Non-Conforming Products**
- **QAP - Equipment/Product Identification and Traceability**
- **QAP - Procedure for Taking Over works from sub-contractors**
- **QAP - Product Receipt at Factory**
- **PWP - Test Procedure for HV Cables**

Appendix A - Drawings of the sample case





Design and construction of the Istanbul 80 000 seats Olympic Stadium

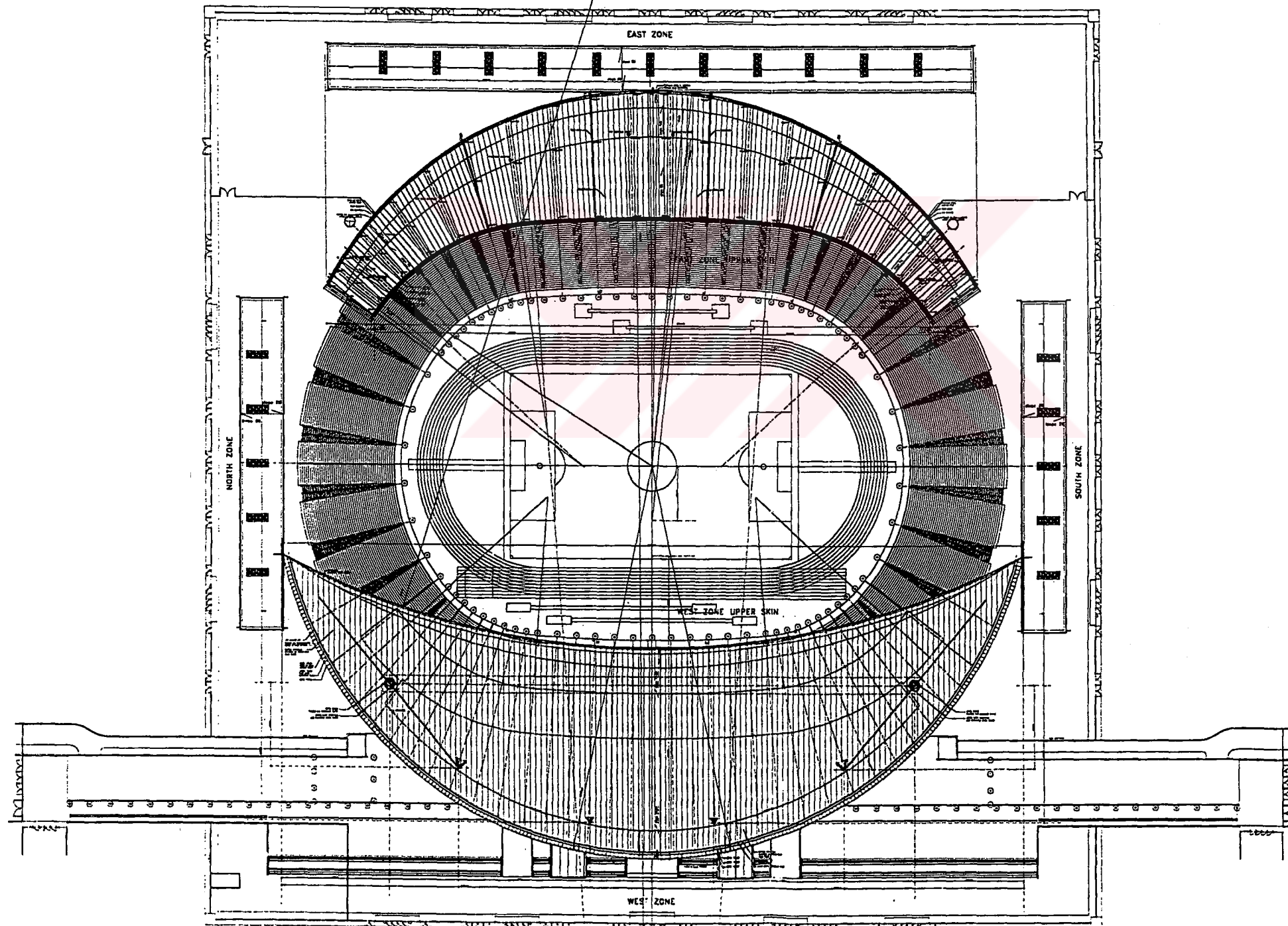


Level ROOF

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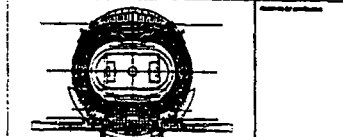
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NO.	REV.	DATE	BY	CHKD.	APP'D.	REMARKS

EMPLOYER

Design and construction of the Istanbul 2005 Olympic Stadium



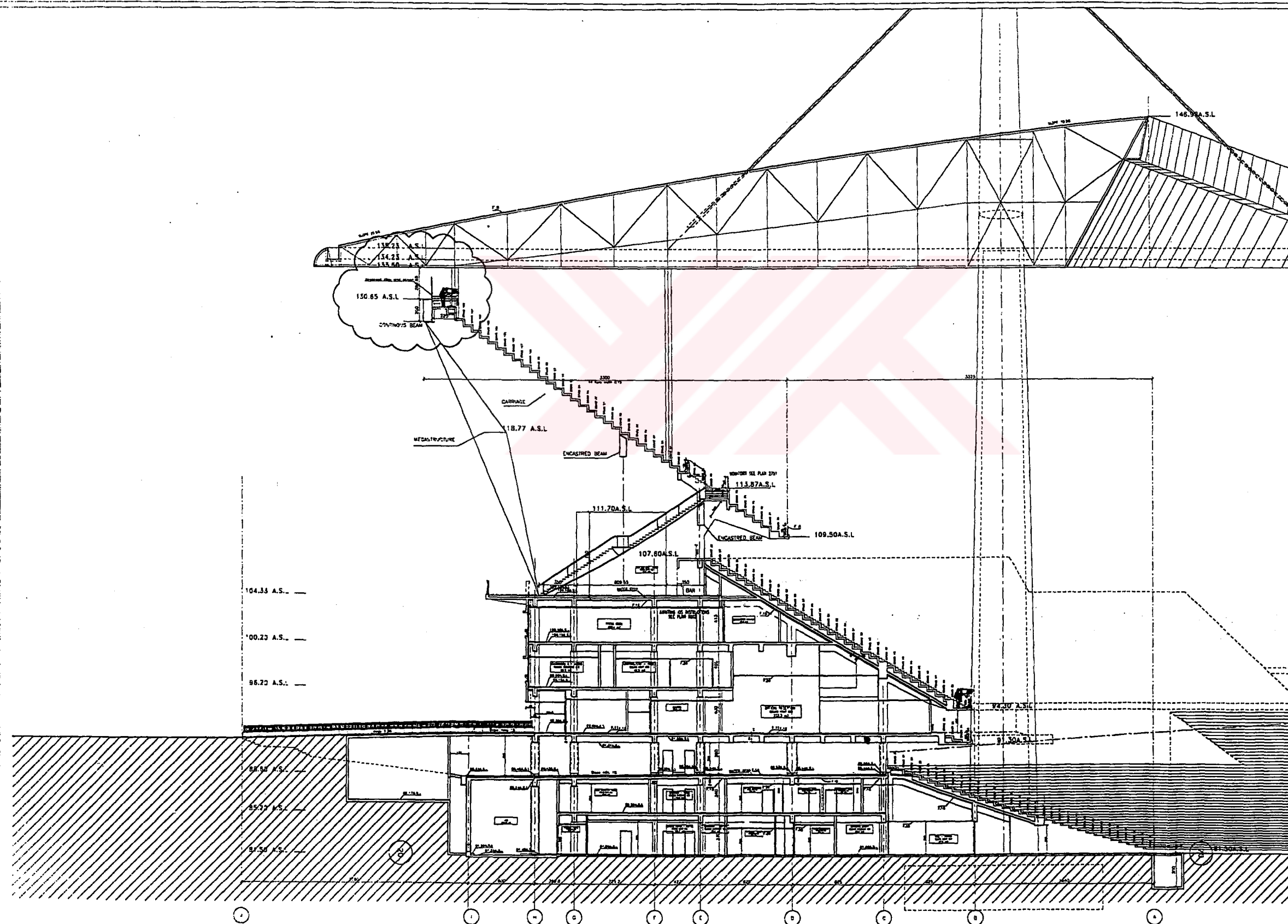
PLAN OF BUILDING

Level ROOF

CONTRACTOR

Contractor's Name: ...
Contract No.: ...
Contract Date: ...

NO.	REV.	DATE	BY	CHKD.	APP'D.	REMARKS

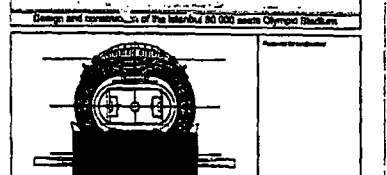


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- S.1 EXPOSED CONCRETE
- S.2 EXPOSED CONCRETE WITH DESACTIVATED FINISH
- S.3 CONCRETE STAIRS
- S.4 STAY
- S.5 CONCRETE CARRIAGE
- FINISHING
- F.1 ALUMINUM FACEDWORK
- F.2 BENDED ALUMINUM
- F.3 PERCAST CONCRETE FACEDWORK
- F.4 PAINTED STEEL SHEET 100X15 CLADDING
- F.5 STEEL STRUCTURE STAIRS
- F.6 STEEL HANDRAIL
- F.7 STEEL PARAPET
- F.8 CHIMNEY
- F.9 RENDERING
- F.10 ALUMINUM OR PVC MILLWORK
- F.11 LOCAL STONE PAVING FLAG
- F.12 CONCRETE STEPS
- F.13 CONCRETE SLAB
- F.14 ASPHALT
- F.15 COATED MACADAM
- F.16 COMPACTED AND ROLLED SOIL
- F.17 STEEL SLATED SHUTTER
- F.18 HEAT AND/OR ACOUSTIC INSULATION
- F.19 FLOOR TILE
- F.20 FALSE CEILING

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EMPLOYER

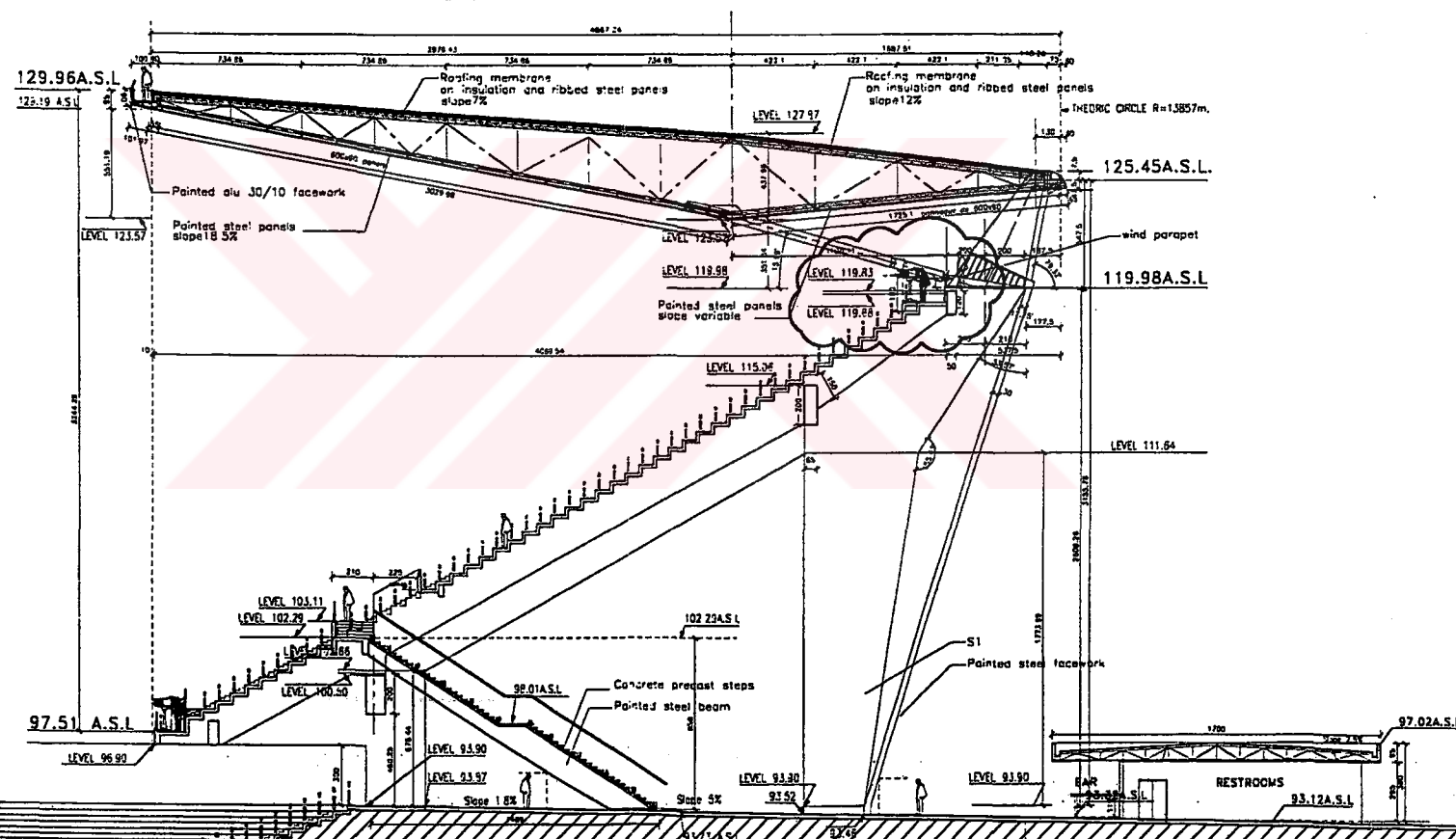


WEST SECTION 1
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CONTRACTOR

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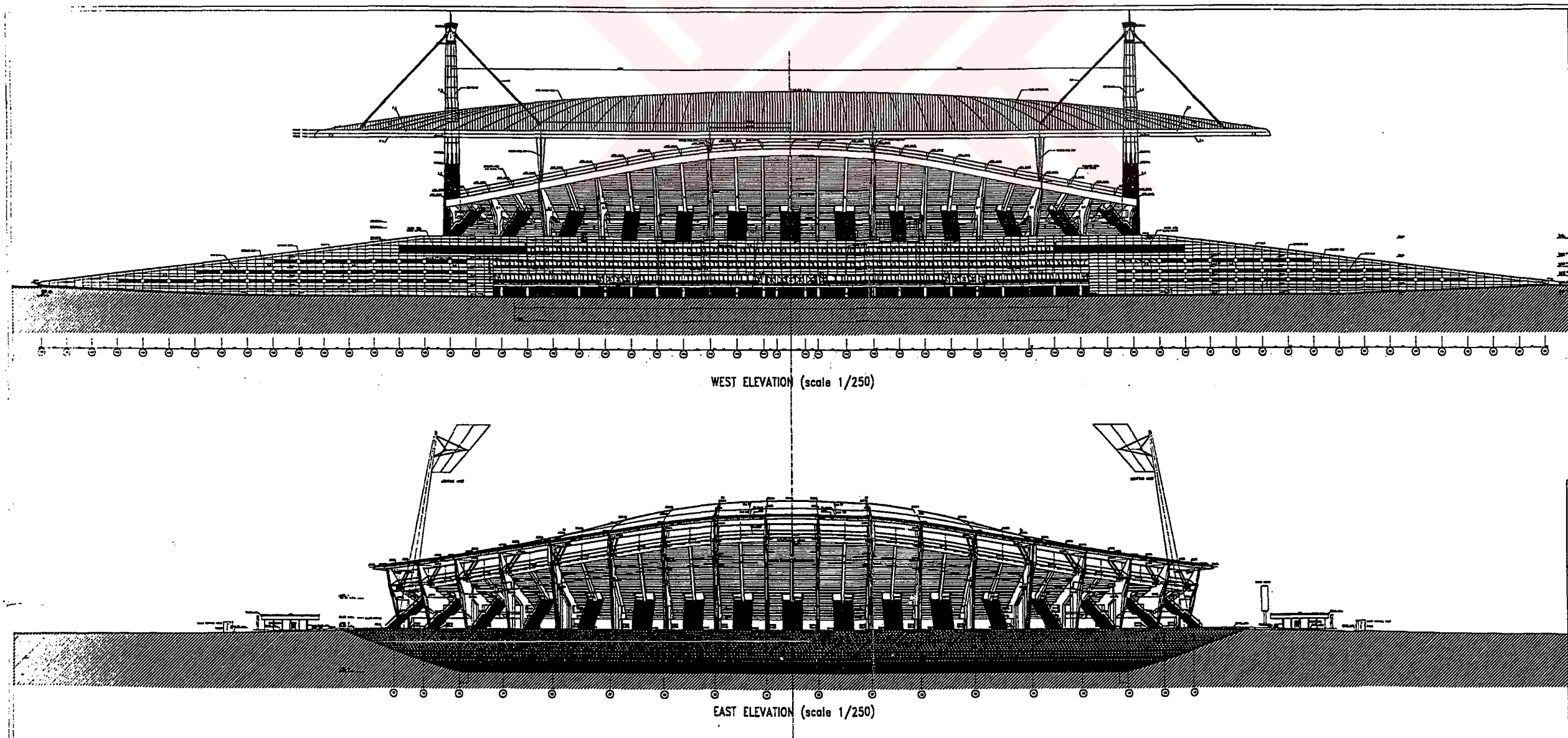
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- 5.2 EXPOSED CONCRETE WITH DESAECTIVATED FINISH
- 5.3 CONCRETE STAINS
- 5.4 STAIN
- 5.5 CONCRETE CANNAGE
- FINISHING
- F.1 ALUMINUM FACEWORK
- F.2 BENDED ALUMINUM
- F.3 PERCAST CONCRETE FACEWORK
- F.4 PAINTED STEEL SHEET SUFFIT CLADDING
- F.5 STEEL STRUCTURE STAIRS
- F.6 STEEL HANDRAIL
- F.7 STEEL PARAPET
- F.8 ONDULIT
- F.9 RENDERING
- F.10 ALUMINUM OR PVC MELLWORK
- F.11 LOCAL STONE PAVING FLAG
- F.12 CONCRETE STEPS
- F.13 CONCRETE SLAB
- F.14 ASPHALT
- F.15 COATED MACADAM
- F.16 COMPACTED AND ROLLED SOIL
- F.17 STEEL SLATED SHUTTER
- F.18 MEAT AND/OR ACOUSTIC INSULATION
- F.19 FLOOR TILE
- F.20 FALSE CEILING



EAST SECTION 1 (scale 1/100)

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LEGENDES

SHELL OF BUILDING = S.1.2.3...
FINISHING = F.1.2.3...

- SHELL
- S.1 EXPOSED CONCRETE
 - S.2 EXPOSED CONCRETE WITH REINFORCED LINCOLN
 - S.3 CONCRETE STAIR
 - S.4 STAIR
 - S.5 CONCRETE GARRAGE
- FINISHING
- F.1 ALUMINUM FACED
 - F.2 EXPOSED ALUMINUM
 - F.3 HUNGAR CONCRETE FACED
 - F.4 PAINTED STEEL SHEET ROOF CLADDING
 - F.5 STEEL STRUCTURE SPINE
 - F.6 STEEL WINDOW
 - F.7 STEEL WINDOW
 - F.8 WINDOW
 - F.9 WINDOW
 - F.10 ALUMINUM DE PINE WALLING
 - F.11 LOCAL STEEL FRAMING PLATE
 - F.12 CONCRETE STEPS
 - F.13 CONCRETE SLAB
 - F.14 ASPHALT
 - F.15 EXPOSED MASONRY
 - F.16 COMPACTED AND ROLLED SOIL
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 - F.19 FLOOR TILE
 - F.20 FLOOR CEILING



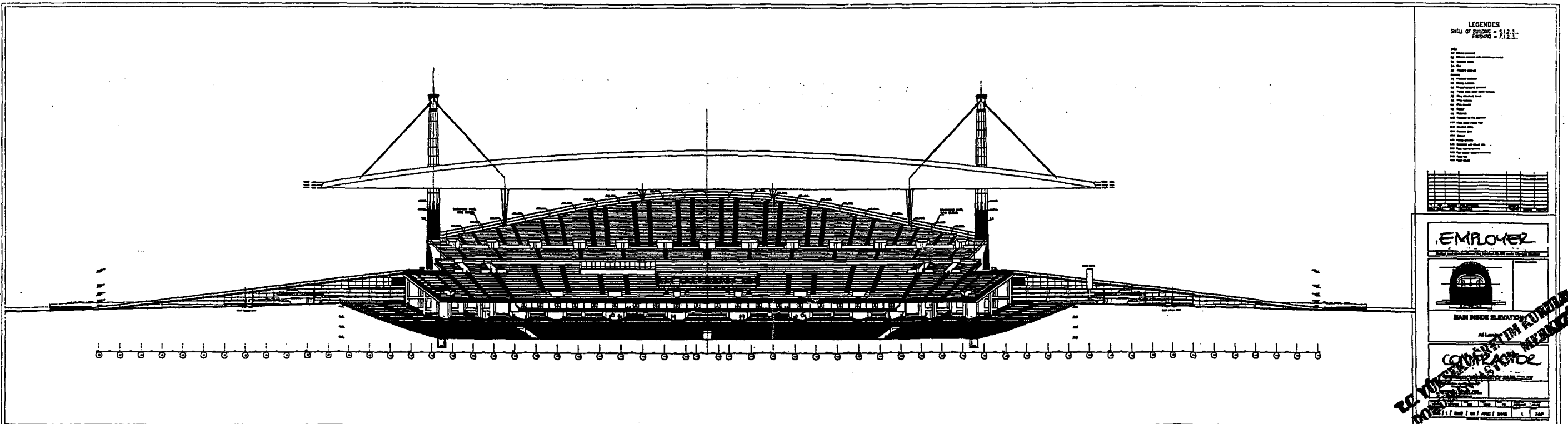
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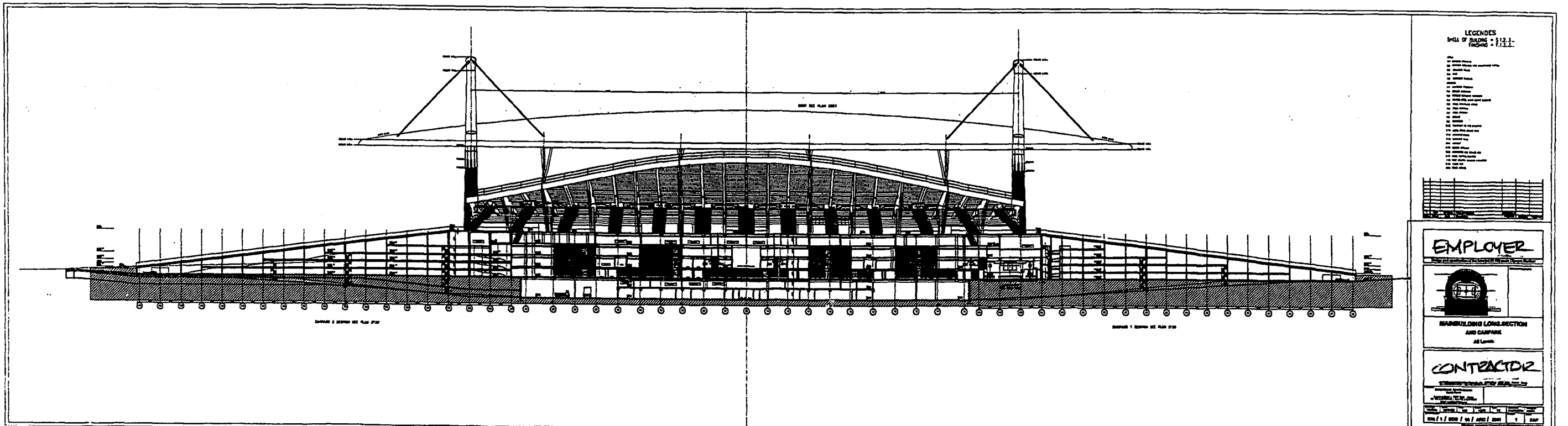


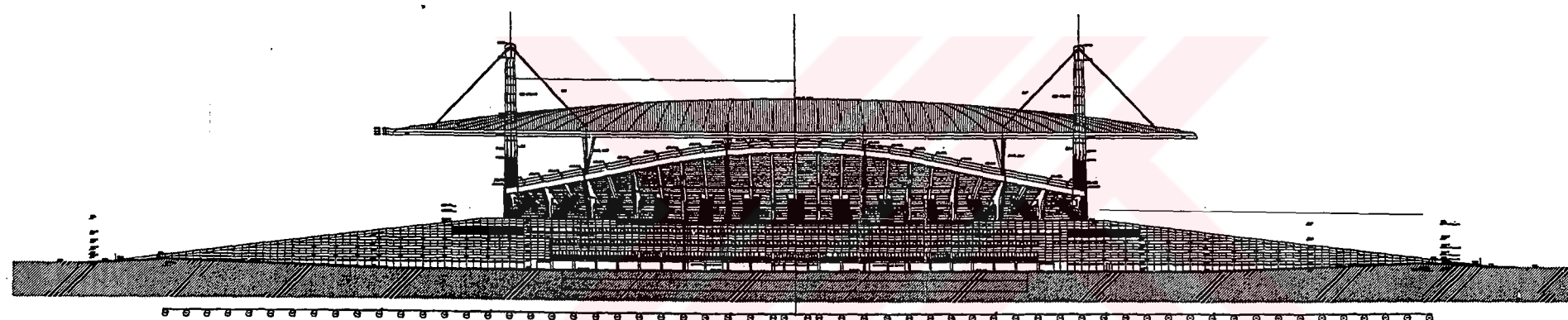
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ELEVATIONS

CONTRACTOR

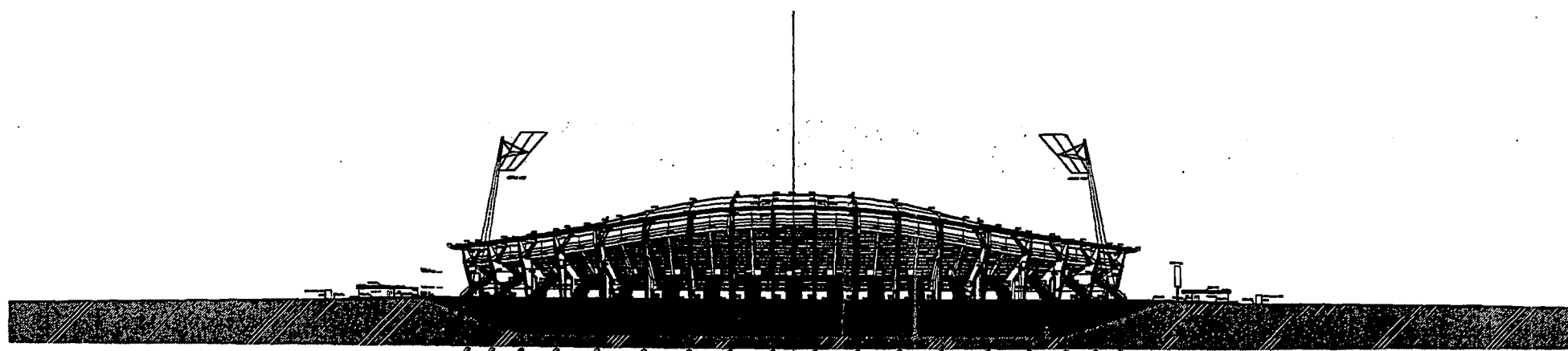
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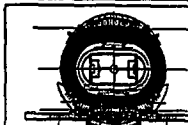
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EAST ELEVATION (scale 1/500)

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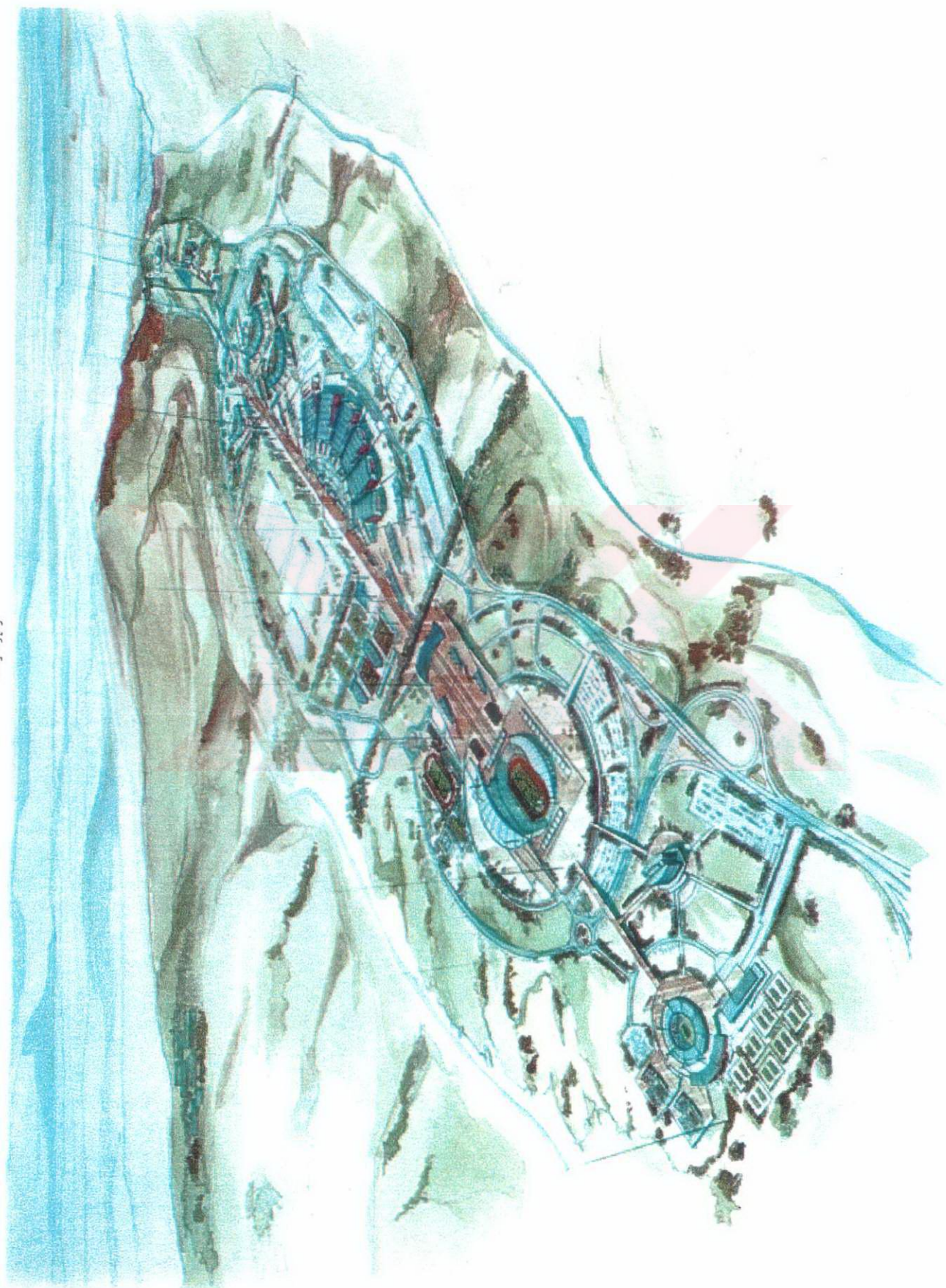
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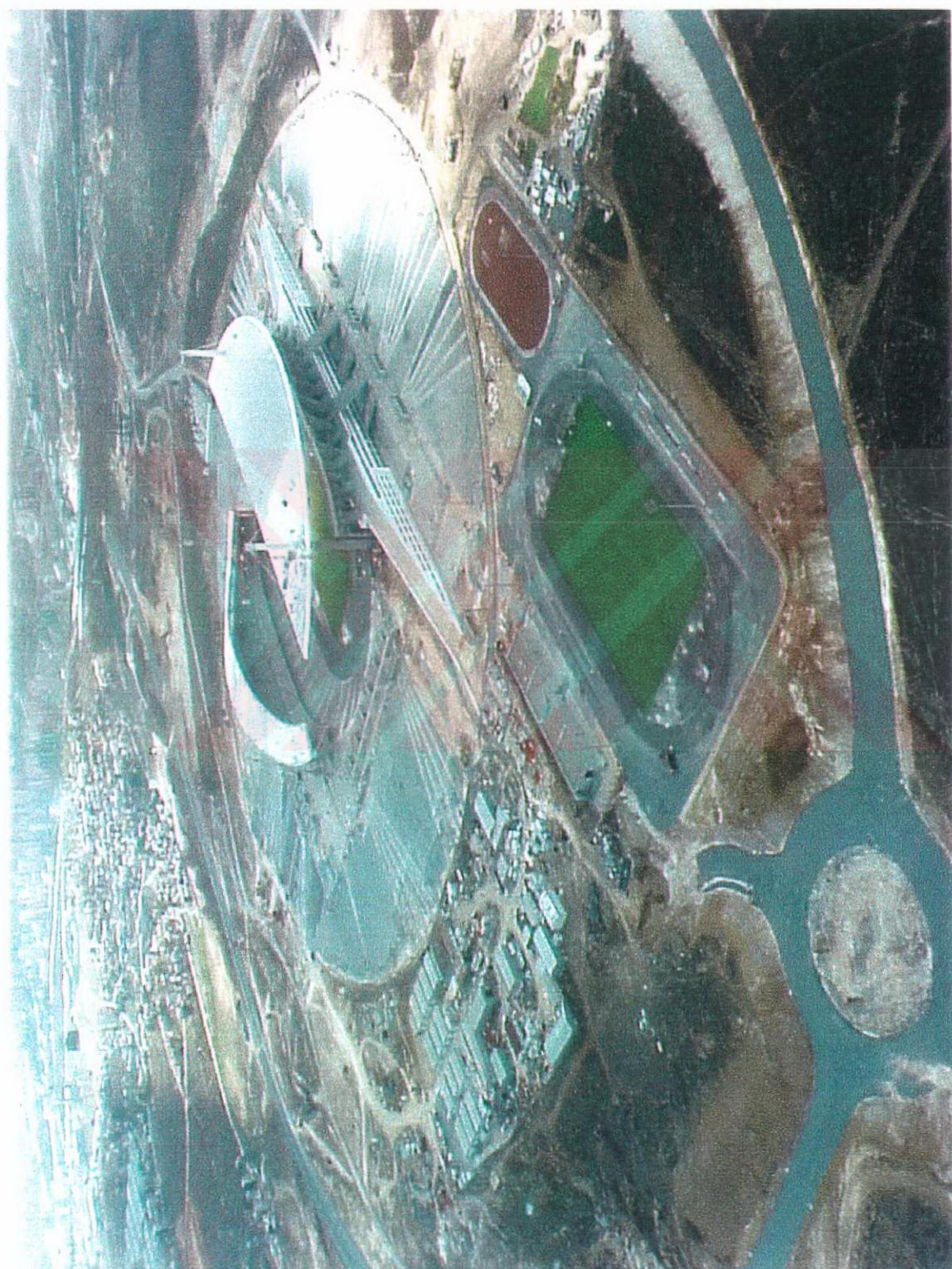


MAIN ELEVATIONS

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Appendix B - List of QAP documents
List of PWP documents



IC VIKSMAKRETTIN KURORTS
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TEL. 011 251 1000

List of QAP documents

Istanbul Olympic Stadium

Internal list of documents

Document number	Revision Date	Status	Title	Ref. ISO 9000	Size Scale
General					
IOS / 0 / QAP / 99 / ISB / 0001	25-May-98	cancelled	Quality Assurance Plan.....	4.2.3	A4
IOS / 0 / QAP / 99 / ISB / 0002	15-May-98	cancelled	Procedure Non-conformance handling.....	4.13	A4
IOS / 0 / QAP / 99 / ISB / 0003	B 29-Mar-00	internal doc.	Coding of Documents.....	4.5	A4
IOS / 0 / OAP / 99 / ISB / 0004	B 30-Mar-00	internal doc.	Procedure Documents format and presentation - Graphic charter.....	4.5	A4
IOS / 0 / OAP / 99 / ISB / 0005	B 15-Jun-00	internal doc.	Filing and Archiving.....	4.5	A4
IOS / 0 / OAP / 99 / ISB / 0006	15-May-99	cancelled	Functional organization chart.....	4.1.2	A4
IOS / 0 / OAP / 99 / ISB / 0007	C 31-Mar-00	internal doc.	Mail Management.....	4.5	A4
IOS / 0 / OAP / 99 / ISB / 0008	C 04-Apr-00	internal doc.	Records of meetings.....	4.5	A4
IOS / 0 / OAP / 99 / ISB / 0009	1 07-May-98	approved	Procedure Interfaces Control - Exchange of Documents.....	4.5	A4
IOS / 0 / OAP / 99 / ISB / 0010	C 04-Apr-00	internal doc.	Procedure - Contract review.....	4.3	A4
IOS / 0 / OAP / 99 / ISB / 0011	06-May-98	cancelled	Control of Permanent Works Design.....	4.4	A4
IOS / 0 / OAP / 99 / ISB / 0012	C 04-Apr-00	internal doc.	Material submittal.....	4.6	A4
IOS / 0 / OAP / 99 / ISB / 0013	D 13-Sep-00	internal doc.	Clarification / Field Change / Derogation Requests.....	4.4	A4
IOS / 0 / OAP / 99 / ISB / 0014	C 04-Apr-00	internal doc.	Selection of Subcontractors and Suppliers.....	4.6	A4
IOS / 0 / OAP / 99 / ISB / 0015	C 04-Apr-00	internal doc.	Approval of subcontractors by the Employer.....	4.6	A4
IOS / 0 / OAP / 99 / ISB / 0016	C 13-Jan-00	internal doc.	Procedure Design Documents Management.....	4.4	A4
IOS / 0 / OAP / 99 / ISB / 0017	B 30-Jun-99	internal doc.	Procedure Back-up Team Activity Purchase of Incorporated Materials.....	4.6	A4
IOS / 0 / OAP / 99 / ISB / 0018	C 09-Aug-99	internal doc.	Procedure Back-Up Team Activity Subcontracting.....	4.6	A4
IOS / 0 / OAP / 99 / ISB / 0020	C 03-Oct-00	internal doc.	Procedure - Site Measurement Record.....	4.10	A4
• IOS 1 0 QAP 99 ISB 0201	2 11-Aug-99	for approval	Procedure - Quality Assurance Plan - Design & Construction Works.....	4.2.3	A4
IOS / 0 / OAP / 99 / ISB / 0202	B 20-Jan-00	internal doc.	Procedure - Contractors Management Structure.....	4.1.2	A4
IOS / 0 / OAP / 99 / ISB / 0203	B 27-Oct-99	internal doc.	Procedure - Design Control - Design & Construction Works.....	4.4	A4
IOS / 0 / OAP / 99 / ISB / 0204	B 11-Oct-99	internal doc.	Procedure - Document Control - Design & Construction Works.....	4.5	A4
IOS / 1 / OAP / 99 / ISB / 0206	B 27-Oct-99	internal doc.	Procedure - Quality Plan Frame For Design Activities.....	4.2.3	A4
• IOS / 0 / QAP / 99 / ISB / 0207	2 16-Aug-99	internal doc.	Procedure - Quality Plan Frame For Construction Activities - Design & Construction Works.....	4.2.3	A4
• IOS / 0 / QAP / 99 / ISB / 0208	B 27-Jun-00	internal doc.	Execution Follow - Up Documents - Design & Construction Works.....	4.9	A4
• IOS / 0 / QAP / 99 / ISB / 0209	2 10-Aug-99	internal doc.	Procedure - Establishing Particular Works Procedures - Design & Construction Works.....	4.9	A4
IOS / 0 / OAP / 99 / ISB / 0210	B 24-Apr-00	internal doc.	Procedure - Procedures Management.....	4.2.2	A4
IOS / 1 / OAP / 99 / ISB / 0211	B 23-Sep-99	internal doc.	Procedure - Conducting Audits.....	4.17	A4
IOS / 0 / OAP / 99 / ISB / 0212	B 24-Aug-00	internal doc.	Procedure - Material Delivery & Storage.....	4.15	A4

Internal list of documents

Document number	Revision	Date	Status	Title	Ref ISO 9000	Size I Scale
IOS / 0 / QAP / 99 / ISB / 0213	B	30-Nov-99	internal doc.	Procedure - Inspection and Testing Plan.....	4.10	A4
IOS / 0 / QAP / 99 / ISB / 0214	B	28-Mar-00	internal doc.	Inspection, Measuring and Testing Equipment Control -0 & C Works.....	4.11	A4
IOS / 0 / QAP / 99 / ISB / 0215	B	31-Jan-00	internal doc.	Controlling Nonconforming Products - D & C Works.....	4.13	A4
IOS / 0 / QAP / 99 / ISB / 0216	B	30-Mar-00	internal doc.	Training - D & C Works.....	4.18	A4
IOS / 0 / QAP / 99 / ISB / 0217	B	14-Jul-01	internal doc.	Equipment/Product Identification & Traceability Procedure - D. & C. Works.....	4.8	A4
IOS / 0 / QAP / 99 / ISB / 0219	E	25-Sep-01	preliminary	Procedure End of Construction Report General Design & Construction Works.....	4.3	A4
• IOS / 0 / QAP / 99 / ISB / 0220	1	10-May-01	approved	Procedure Execution of Maintenance Works Period of Maintenance - Defects Liability Period	4.19	A4
• IOS / 0 / QAP / 99 / ISB / 0221	1	18-Feb-00	for approval	Importation of Goods & Materials to be Incorporated in the Works - Customs Clearance.....	4.6	A4
IOS / 0 / QAP / 99 / ISB / 0222 A			preliminary	Files to be archived at the end of the project -0. & C. Works.....	4.16	
IOS / 0 / QAP / 99 / ISB / 0223	B	06-Feb-01	preliminary	Procedure for Taking Over Works from Subcontractors Design & Construction Works	4.6	A4
IOS / 0 1 QAP / 99 / ISB / 0224	B	12-Feb-01	preliminary	Procedure Product Receipt at Factory Design & Construction Works.....	4.10	A4
IOS / 1 1 QAP / 99 / ISB / 0225	1	24-Sep-01	for approval	Procedure Taking Over Certificate & Final Acceptance Certificate.....	4.6	A4
• IOS / 0 / QAP / 99 / ISB / 0231	1	20-Apr-01	approved	Procedure End of Construction Report - Civil Works Drawings Design & Construction Works.....	4.3	A4
• IOS / 0 / QAP / 99 / ISB / 0232	1	20-Apr-01	approved	Procedure end of Construction Report - Steel Works Drawings Design & Construction Works.....	4.3	A4
• IOS / 0 / QAP / 99 / ISB / 0233	1	31-Oct-01	approved	Procedure End of Construction Report - Electro-Mechanical Drawings Design & Construction Works.....	4.3	A4
• IOS / 0 / QAP / 99 / ISB / 0234	1	31-Oct-01	approved	Procedure End of Construction Report Architectural Drawings Design & Construction Works.....	4.3	A4
IOS / 0 / QAP / 99 / ISB / 1000	A	16-Sep-99	internal doc.	Procedure General Suppliers Invoices' Approval.....	4.6	A4
IOS / 0 / QAP / 99 / ISB / 1001	A	20-Sep-99	internal doc.	Procedure General Warehouse & Procurement Section Management.....	4.15	A4
IOS / 0 / QAP / 99 / ISB / 1002	A	22-Sep-99	internal doc.	Procedure General Purchasing Section Management.....	4.6	A4

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Late document Document for the Engineer Area= all

Document type= QAP Originator code= ISB Trade number= all Status all

key-words= none

List of PWP documents

Internal list of documents

Document number	Revision	Date	Status	Title	Size / Scale
Earthworks					
IOS / 0 / PWP / 02 / ISB / 0100	A	20-Aug-98	Internal doc. approved for approval	Works Procedure: General Earthworks - Site Grading	A4
• IOS / 0 / PWP / 102 / ISB / 0102	1	30-Nov-98		Works procedure - Ground treatment	A4
• IOS / 0 / PWP / 102 / ISB / 0111	1	15-Mar-01		Particular Works Procedure Filling Cavities Under Main Playground	A4
Site survey					
IOS / 0 / PWP / 03 / ISB / 0101	D	01-May-00	Internal doc. approved	Works Procedure Surveying Works	A4
• IOS / 0 / PWP / 103 / ISB / 0107	1	07-Jul-99		Works procedure - Calibration and control of survey instruments	A4
General civil work					
IOS / 0 / PWP / 19 / ISB / 0001	B	23-Nov-99	Internal doc. Internal doc approved approved approved approved Internal doc Internal doc.	Particular Works Procedure - Evaluation of Concrete Strength by Maturity Design & Construction Works	A4
IOS / 0 / PWP / 19 / ISB / 0002	C	10-Feb-00		PWP - Casting and Protection of Concrete During Cold Weather	A4
• IOS / 0 / PWP / 119 / ISB / 0010	2	02-Oct-01		Particular Working Procedure Anchor Bond Tests for Post Tensioning Bar Diameter 50	A4
• IOS / 0 / PWP / 119 / ISB / 0103	1	04-Jun-99		Works procedure- Grouting of starter bars (Concreting Activities)	A4
• IOS / 0 / PWP / 119 / ISB / 0104	1	04-Jun-99		Works procedure - Monitoring and repair of cracks in concrete (Concreting Activities)	A4
• IOS / 0 / PWP / 119 / ISB / 0105	1	04-Jun-99		Works procedure - Repair of concrete (Concreting Activities)	A4
• IOS / 0 / PWP / 119 / ISB / 0106	1	04-Jun-99		Work Procedure - Plugging of Holes on RC Walls (Concreting Activities)	A4
IOS / 1 / PWP / 19 / ISB / 0108	B	12-Oct-99		Particular works procedure - Testing of concrete works	A4
IOS / 1 / PWP / 19 / ISB / 0109	B	10-Oct-99		Particular works procedure - Operating instructions for North tower concrete surface testing - Schmidt hammer	A4
Roof west stand steel structure					
IOS / 1 / PWP / 20 / ISB / 0005	A	20-Jul-00	preliminary preliminary Internal doc. preliminary preliminary preliminary	PWP for Lifting of Megatruss - Blocking of the Megatruss on the Pylon during Immobilization Time	A4
IOS / 1 / PWP / 20 / ISB / 0006	A	20-Jul-00		PWP for Lifting of Megatruss - Organization and Communication during the Lifting Operation	A4
IOS / 1 / PWP / 20 / ISB / 0007	A	20-Jul-00		PWP for Lifting of Megatruss - Parameters to be Monitored Before & During the Lifting Operation	A4
IOS / 1 / PWP / 20 / ISB / 0008	A	20-Jul-00		PWP for Lifting of Megatruss - Urgencies Procedures	A4
• IOS / 1 / PWP / 20 / ISB / 0009	B	24-Jan-01		West Stand Steel Structure - Procedure for Final Installation of Permanent Pot Bearings	A4
IOS / 1 / PWP / 20 / ISB / 0011	A	25-Sep-01		West Stand Repair Level 3 ~40 & ~50 Mac Alloy Bars - Temporary Fixing Devices	A3
Roof east stand steel structure					
IOS / 1 / PWP / 24 / ISB / 0003	B	15-May-00	Internal doc. preliminary	Steel Structure East Rear Columns Compliance Grouting Test	A4
IOS / 1 / PWP / 24 / ISB / 0110	B	15-Jan-01		East Stand Steel Structure Rear Columns - Grouting of Base Plates	A4
Small steelworks, staircases, fencing, Locksmith					
IOS / 1 / PWP / 33 / ISB / 0004	A	19-Jun-00	preliminary	West and East Intermediate Steel Staircases Erection	
Electricity: high voltage and lightning					
IOS / 0 / PWP / 43 / ISB / 1001	A	20-Jun-00	preliminary	Particular work procedure - Temporary 34.5 kv power supply to Annex Substation	A4

Legend:

Selection summary: Documents listed= 024

Late document Document for the Engineer Area= all Document type=PWP Originator code= ISB Trade number= all Status= all
key-words= none

Appendix C - Sample Procedures

- **QAP - Quality assurance Plan**
- **QAP - Contractor's Management Structure**
- **QAP - Design Control**
- **QAP - Quality Plan Frame for Construction Activities**
- **QAP - Execution Follow-up Documents**
- **QAP - Establishing Particular Work Procedures**
- **QAP - Procedures Management**
- **QAP - Inspection and Testing Plan**
- **QAP - Controlling Non-Conforming Products**
- **QAP - Equipment/Product Identification and Traceability**
- **QAP - Procedure for Taking Over works from sub-contractors**
- **QAP - Product Receipt at Factory**
- **PWP - Test Procedure for HV Cables**



2	FAP	11/08/99	Revised – Issued for approval	RE	AG	GR
1	FAP	29/05/99	For Approval	CG	AGY	GR
A	PRE	06/05/99	first issue	CG	A GY	GR
Rev	Status	Date	Description	Prepared	Checked	Approved

EMPLOYER

ISTANBUL OLYMPIC STADIUM

Design and construction
of 80 000 seats Olympic Stadium

PROCEDURE

QUALITY ASSURANCE PLAN DESIGN & CONSTRUCTION WORKS

CONTRACTOR

Originator :

CONTRACTOR-Quality Dept.

Prepared by AAAAA		Date 11 / 08 / 1999	Status For approval	Associated file ISB0201-2		Total number of pages 16+1	
Istanbul Olympic Stadium IOS	Area 0	Document type QAP	Trade 99	Originator ISB	Chrono number 0201	Revision 2	

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2 1.2 INTRODUCTION & MAIN CONTRIBUTING PARTIES

1.2.1 Introduction

The purpose of this QUALITY ASSURANCE PLAN is to define the main arrangements established by the Istanbul Stadium Builders Joint venture (ISB) to manage the design stage 2 and the construction works of the ISTANBUL OLYMPIC STADIUM, in reference with:

- the Main Contract (Clause 37 part 1 – General Conditions)
- the Campeon Bernard SGE Quality Assurance Manual.
- the Quality Assurance Plan – Engineering Activities IOS 0 QAP 99 ISB 0001

1.2.2 Main Contributing Parties

1.2.2.1 "Employer" means the Preparation and Organisation Council for the Istanbul Olympic Games who has signed the Main Contract with the Contractor and any assignee and duly authorised representatives of the Employer.

1.2.2.2 "Engineer" means the Employer's department or the authorised engineer(s) acting within the scope of the duties and responsibilities entrusted to him from time to time by the Employer in respect of the Main Works.

1.2.2.3 "Main Works" means design, supply and construction of the Istanbul Olympic Stadium and its maintenance for one year.

1.2.2.4 "Contractor" means the under-described Joint Venture who has been employed by the Employer to execute the Main Works under the Main Contract. Its name is ' ISTANBUL STADIUM BUILDERS JOINT VENTURE (ISB-JV) '

Relations between main contributing parties within the Contractor's organisation are defined in the Contractor's Design & Construction Project Organization Chart (see procedure IOS 0 QAP 99 ISB 0202 and appendix 3 – Functional Organisation Chart). This will be updated as required.

1.2.2.5 "Main Contract" means the agreement made between the Employer and the Contractor for the execution of the Main Works.

2.0 QUALITY SYSTEM ELEMENTS

2.1 MANAGEMENT RESPONSIBILITY

2.1.1 Quality policy

The Quality Policy Statement for the Project is included in Appendix 1.

The Quality Policy established for the Project results from the determination of the Contractor to fulfill its contractual obligations and satisfactorily control the Works, with its broad scope, complexity and large number of parties contributing to the overall result. This will be achieved by establishing a quality system defined with reference to the international standard ISO 9001:1994.

Compliance and review of the Quality System will assure the Employer that the Work completed

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complies with all Main Contract requirements.

2.1.2 Organisation

The Contractor's Design & Construction Project Organization Chart.

2 The Organization Chart and Job Descriptions of the key staff in charge of the Project are described in procedure IOS 0 QAP 99 ISB 0202 the « Contractor's Management Structure – D & C Works », including the Back-up Team and the Studies Coordination activities.

The Project QA/QC Manager is a qualified engineer experienced in quality management, reporting on site to the Project Manager, with a functional reporting route to the Corporate Quality Manager with whom he works in close cooperation and who provides him with advice and assistance.

2.1.3 Management Review

The Project QA/QC management system implemented by the Contractor is reviewed annually by the Project Management in consultation with the Corporate Quality Manager, the Project QA/QC Manager and other Department Managers as appropriate.

2 The review is based on monthly quality progress reports on the system prepared by the Project QA/QC Manager, log of non-conformance reports and associated corrective or preventive actions, and internal/external audit reports.

2 The first monthly quality progress report shall be prepared one month after the Effective Date.

The review shall discuss and agree with those actions necessary to ensure the continuing suitability and cost effectiveness of the QA system. Each review is minuted in accordance with procedure IOS 0 QAP 99 ISB 0008 « Records of Meetings».

2.2 QUALITY SYSTEM

The documented quality system comprises the types of documents referenced below.

2.2.1 Preparatory Documents

These documents are drafted by contributing parties and form the formal framework for the quality system and generally belong to one of the following categories :

- the Contractor's Quality Assurance Plan and the associated Quality Assurance Procedures, prepared by the Project QA/QC Manager,
- the Subcontractors and Suppliers' Quality Assurance Plan and their associated Quality Assurance Procedures if any, prepared by the relevant Subcontractors and Suppliers' Quality Manager,
- Particular Works Procedures for the realization of critical tasks or operations, prepared in accordance with procedure IOS 0 QAP 99 ISB 0209 « Establishing Work Procedures – D & C Works »,
- 2 - Inspection and Testing Plans , prepared in accordance with procedure IOS 0 QAP 99 ISB 0213 « Inspection and Testing Plan – D & C Works »,
- 2 - Typical Inspection Checklists , prepared in accordance with procedure IOS 0 QAP 99 ISB 0213 « Inspection and Testing Plan – D & C Works ».

The Contractor's Quality Assurance Plan has been divided according to the 20 criteria of the ISO 9001:1994 to fulfill contracted obligations. It is complemented by the Quality Assurance

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Procedures, as listed in Appendix 2.

Preparatory documents are drafted and issued prior to the commencement of the relevant activity.

2.2.2 Execution Follow-up Documents

These documents are forms, reports, certificates or formal records of tests and prove that the required quality is obtained, step by step. They generally comprise:

- Survey forms
- Execution Tracing Files,
- completed Inspection Check-lists,
- specific records of measurements, inspections or tests,
- Certificates of Compliance,
- Nonconformance Reports,
- ...

Execution Tracing File specific to the execution of a part of the works and for the relevant trades consists of a folder containing the different follow-up documents. Inspection Checklist concerns the execution of a phase of the works.

- 2 Procedure IOS 0 QAP 99 ISB 0208 « Execution Follow-up Documents – D & C Works » details the Execution Tracing Files and Inspection Checklists and describes the conditions under which
2 they are used, as well as the practical operating methods and conditions for using these
2 documents.

2.2.3 Quality Assurance Follow-up Documents

These documents are related to internal audits and corrective actions.

They generally comprise :

- 2
- a yearly audit calendar,
 - audit reports,
 - quality meetings reports,
 - Corrective Action Requests forms,
 - Recommendations forms,
 - Monthly Quality reports
 - ...

2.3 CONTRACT REVIEW

The bid package has been analyzed by Contractor's Management during the contract bidding and negotiations period in accordance with procedure IOS 0 QAP 99 ISB 0010 « Contract Review ».

The Project Manager shall ensure that the requirements concerning the execution of the Construction Agreement are defined accurately, consistently and in full, and are known to all concerned. Any divergences, inaccuracies or missing information is identified and formally resolved with the Engineer in order to arrive at a clear definition of the Project. A record of the review is prepared in accordance with procedure IOS 0 QAP 99 ISB 0008 « Records of Meetings ».

If during the design of the Project, or during the preparatory or execution phases, the Contractor, identifies any ambiguities, mistakes, incompatibilities or contradictions in the Construction Contract documents (Specifications or Drawings), or suggest to modify Works, Procedures or

Drawings for simplification or improvement without any impact of the final quality, he raises a Clarification Request or Field Change Request according to procedure IOS 0 QAP 99 ISB 0013 « Clarification, Field Change and Derogation requests ».

Likewise, if during the same periods, the Contractor considers that a specified requirement cannot be achieved, he raises a Derogation Request, then issues it to the Engineer in accordance with procedure IOS 0 QAP 99 ISB 0013 « Clarification, Field Change and Derogation requests ».

2.4 DESIGN CONTROL

2 The design control activity for stage 2 applies to permanent works design and is carried out according to procedure IOS 0 QAP 99 ISB 0203 « Design Control – D & C Works ».

This Quality Assurance Procedure is dealing with the design and development planning, the organizational and technical interfaces, the design input, the design output, the design review, the design verification, the design validation and the design changes.

The design is managed by the Technical Department and the Studies Coordinator.

The design is subcontracted and each design Subcontractor issues a specific Quality Assurance Plan for Contractor's review and approval.

2 The provisions of procedure IOS 0 QAP 99 ISB 0203 « Design Control – D & C Works » shall apply to all design data prepared or adopted in connection with any permanent works.

2.5 DOCUMENT AND DATA CONTROL

2 Documents are managed in accordance with procedure IOS 0 QAP 99 ISB 0003 « Coding of Documents », IOS 0 QAP 99 ISB 0004 « Documents format and presentation », IOS 0 QAP 99 ISB 0016 « Design Documents Management » and IOS 0 QAP 99 ISB 0204 « Documents Control – D & C Works » and shall be reviewed and approved for adequacy by authorized personnel prior to commencement of the activity.

Suppliers and Subcontractors shall follow procedure IOS 0 QAP 99 ISB 0003 « Coding of Documents » and IOS 0 QAP 99 ISB 0004 « Documents format and presentation ».

Changes to documents are suitably identified and are subject to the same approval process as the original issue. Obsolete documents are removed promptly from all points of use or cancelled with some visible marking.

2 A Master List is established to identify the current revision of each document in accordance with procedure IOS 0 QAP 99 ISB 0204 « Documents Control – D & C Works » and IOS 0 QAP 99 ISB 0016 « Design Documents Management ».

Each intervening party is responsible for the control of all documents issued by itself, and is obliged to keep and regularly circulate lists of all documents as required.

This is particularly relevant for execution documents, methods documents and quality documents.

Letters, memoranda, fax and notes are controlled according to procedure IOS 0 QAP 99 ISB 0007 « Mail Management ».

2 Quality Assurance or Particular Work Procedures from ISB, and Quality Assurance or Particular Work Procedures from sub-contractors, are controlled according to procedure IOS 0 QAP 99 ISB 0210 « Procedures Management – D & C Works ».

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2.6 PURCHASING

- 2 All works will be subcontracted. ISB JV will however purchase and supply the concrete and the
2 steel to the relevant subcontractors.

2.6.1 Identification and Selection of Subcontractors and Suppliers

Procedure IOS 0 QAP 99 ISB 0014 « Selection of Subcontractors and Suppliers » and IOS 0 QAP 99 ISB 0015 « Approval of Subcontractors by Employer » are applied by the Project Team in Istanbul.

- 2 The specific IOS 0 QAP 99 ISB 0017 « Back-up team activity - Purchase of Incorporated Materials
2 » and IOS 0 QAP 99 ISB 0019 « Back-up team activity - Subcontracting » are applied by the Back-up Team in Paris.

a) Identification

The Subcontractors/Suppliers identified are selected for their known or reputed technical capability to execute the required service (previous references, reputation or examination of a comparable documentation).

b) Selection

After an objective comparison of the offers, the choice of the Subcontractor/Supplier depends upon :

- confirmation of its capability to provide the service (resources, technical capability and quality of organization),
- examination and test on representative samples (Supplier),
- its ability to meet completion dates (human and material resources),
- The overall price offered to the Contractor.

Assessment of the Subcontractor/Supplier capabilities is based upon :

- the Contractor's prior knowledge of the applicant,
- The results of an investigation (comparable references, examination of documents pertaining to the organization, inspection of a job-site in progress) or an audit.

The Contractor establishes and maintains an up to date list of selected Subcontractors, Suppliers, and Service Providers. These lists are available for review by the Engineer at all times.

2.6.2 Purchasing Data

2

a) Purchase Orders

- Incorporated materials and components

Prior the purchase of permanent material to be incorporated in the works, relevant technical specifications are prepared by the Execution Design Office.

Purchase Requisition Orders are reviewed by the Project QA/QC Manager to ensure that the appropriate quality management obligations are referenced in the Orders and that the technical specifications have been reviewed by qualified people.

The quality assurance level requirements stated in the purchase order, make the Supplier

responsible for the preparation and implementation of Quality Assurance / Quality Control documentation (specific Quality Plan, Certificate of Conformity, test reports, ...) depending on the impact of the materials and items with regard to quality.

- Consumable, Standard and Off-the-Shelf Products

Purchase Orders for consumable, standard and off-the-shelf products are raised following receipt of an appropriately authorized requisition and are signed by the Construction Manager or his Assistant.

b) Subcontracts

Subcontract Tenders are prepared by the Contract Manager. The technical part of the Tender is prepared under the responsibility of the Execution Design Manager for the design Subcontractors, and of the Construction Manager for the construction Subcontractors. They are reviewed by the Project QA/QC Manager to ensure that the appropriate quality management obligations are referenced in the Tender Documents.

The Contractor requires each Subcontractor to appoint a « Quality representative » and to establish a specific Quality Assurance Plan complying with the ISO 9001 or ISO 9002, complementary to that defined in the current Contractor's Quality Assurance Plan. This specific Quality Assurance Plan can be established according to procedure IOS 0 QAP 99 ISB 0206 « Quality Assurance Plan Frame for Design Activities – D & C Works » and IOS 0 QAP 99 ISB 0207 « Quality Assurance Plan Frame for Construction Activities – D & C Works ».

The Contractor's Quality Assurance Plan specifies the Quality Assurance Procedures to be directly applied by Subcontractors and Suppliers. To this end, the applicable Quality Assurance Procedures are attached to Contracts signed with relevant Subcontractors and Suppliers.

Subcontractors are not allowed to subcontract any part of their works before receiving the Contractor's prior approval.

Likewise, Subcontractors are not allowed to use any incorporated material before receiving from the Contractor, the approval on the relevant Material Submission Sheet as defined in procedure IOS 0 QAP 99 ISB 0012 « Material Submittal ».

2.6.3 Verification of Purchased Product

a) Materials Supplies

The Purchase Orders define the material to be checked. When this verification is performed, procedure IOS 0 QAP 99 ISB 0212 « Material Delivery and Storage – D & C Works » specifies the arrangement, either at the factory prior to shipping, or on arrival at site.

b) Subcontracted Services

Documents prepared by Subcontractor / Design Consultant are submitted to the Contractor for comment / review within the framework of the applicable specific Quality Assurance Plan, and prior to the commencement of related activities.

The works carried out by construction Subcontractors are verified by Contractor's Representatives as defined in relevant Inspection and Test Plans.

2.7 CONTROL OF EMPLOYER SUPPLIED PRODUCT

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- 2 In compliance with the contract, no product will be supplied by the Employer. This is therefore not
2 applicable. If the present situation was to change a specific procedure will then be written.

2.8 PRODUCT IDENTIFICATION AND TRACEABILITY

When identification and/or traceability is required or is considered necessary, the items are identified, either by a batch number or part number indicated on the product, or by identification indicated on the manufacturing or works follow-up documents. The Work Procedures, orders or purchasing specifications stipulate the arrangements to be adopted.

A list of items which require traceability, will be established and updated regularly by the Project QA/QC Manager.

2.9 PROCESS CONTROL

- 2 The Particular Works Procedures are set up to handle critical tasks and works which need special preparation and staff instructions. They are prepared by qualified staff and are checked by the Project QA/QC Management, the Construction Manager or his Assistant, and approved by the Project Manager.

- 2 They list the various standards and regulations used for working and testing, the means and materials, the working stages and inspections. The Particular Works Procedures are set up
1 according to procedure IOS 0 QAP 99 ISB 0209 « Establishing Particular Works Procedures – D
2 & C Works ».

- 2 A list of these Particular Works Procedures is attached to the Quality Plan of each intervening party.

2.10 INSPECTION AND TESTING

Definition :

A witness point requires the requester to be informed when work has progressed to such an extent that inspection is possible, however if the requesting party does not attend the inspection, the work may nevertheless continue.

At a hold point it is forbidden to continue work until the requesting party has carried out and formally recorded its inspection on the Execution Follow-up Documents.

- 2 Procedure IOS 0 QAP 99 ISB 0213 « Inspection and Testing Plan – D & C Works » is applicable to the Contractor, for its own works if any , and to its Subcontractors and Suppliers.

2.10.1 Project Inspection - Principles of Organisation

The purpose of the Quality Inspection System implemented by the Contractor is :

- to check the conformity of the Works,
- to prove this conformity has been verified,

and by the way to give confidence to the Employer that the works handed over are complying on all its aspects with all requirements.

To ensure the effectiveness and the reliability of this Inspection system the Engineer is entitled, during manufacture, fabrication and preparation at any places where work is being carried out to inspect, examine and test the materials and workmanship, and to check the progress manufacture, of all plants and materials to be supplied under the Contract.

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The overall system of quality inspection is applied to all intervening parties, and is divided into three levels :

- « Internal » inspections by an intervening party

For each production unit, the performer of the work systematically checks the conformity of his work (self inspection and hierarchical inspection). Execution follow-up documents are issued after inspections are carried out. The works team quality representatives may perform a spot check of the suppliers and the subcontracted works.

- « External » inspections by an intervening party

The Project QA/QC Manager is assisted by QA/QC Engineers to perform periodical evaluations and audits during the construction works and to ensure the proper implementation and the efficiency of the quality system.

The Project QA/QC Manager is assisted by QC Inspectors to perform spot checks or external inspection of hold and witness points. Follow-up documents are then issued. The Construction Manager is responsible for carrying out the general supervision of the works. The Construction Department and/or the Quality Representative responsible for monitoring the particular function (activity) may also commission an external laboratory or a design consultant to perform external inspections.

- « Independent » inspections

The Contractor may also implement an independent inspection of its Suppliers, Subcontractors and Service Providers.

The Engineer may as necessary, conduct independent tests.

2.10.2 Delivery Inspection and Testing

2 Materials to be incorporated into the Works are inspected by the JV upon delivery according to procedure IOS 0 QAP 99 ISB 0212 « Material Delivery and Storage – D & C Works ».

Provisions have been taken in this Quality Assurance Procedure to avoid any use of material for which evidence of conformity is not provided.

2.10.3 Inspections and Tests during the Works

2 The Inspection Test Plans established in accordance with procedure IOS 0 QAP 99 ISB 0213 « Inspection and Testing Plan – D & C Works », define the list of successive inspection operations for a particular activity, identifying who carries out the inspections, and follow-up document on which the inspections are reported.

The Inspection Checklist is specific to an activity, and the various Inspection Checklists are established on the basis of the Inspection and Test Plans. The way an Inspection Checklist is used to give documentary evidence of the different levels of inspection is set out as an appendix to the relevant Particular Work Procedure.

When required, services or activities are inspected or tested on completion according to an established program.

2 The Quality Assurance Procedure IOS 0 QAP 99 ISB 0202 dealing with the organization charts and job descriptions sets out the tasks incumbent on the individual contributing parties with

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regard to inspection.

2.10.4 Final Inspection and Testing

2 The Project QA/QC Management Department, under the responsibility of the Project QA/QC Manager, ensures for each activity, that inspection and test outlined in the Quality Assurance Plan have been implemented and that follow-up documents confirm that the works conform to requirements. In each case, the hand-over of the whole works or only a part thereof is undertaken.

2.10.5 Inspection and Test Records

A qualified representative of the Contractor is signing the Inspection Checklist, including his name and date of verification or inspection in order to confirm that results comply with specifications. If not, it is stated on the Execution Tracing File or on a Nonconformance Report.

2 On completion of a particular activity, an inspection document is established and filed to provide evidence of compliance with specified requirements. The file, comprising Execution Tracing File, Inspection Checklists and other follow-up forms, are compiled in accordance with procedure IOS 0 QAP 99 ISB 0208 « Execution Follow-up Documents – D & C Works ».

2.11 CONTROL OF INSPECTION, MEASURING AND TEST EQUIPMENT

2 Procedure IOS 0 QAP 99 ISB 0214 « Inspection, Measuring and Test Equipment Control – D & C Works » defines the checking and the calibration of contractor equipment used by the JV for inspection, measuring and testing.

A study of the tolerances is carried out during the preparation phase to check that the degree of accuracy with regard to inspection, measuring and test equipment is appropriate. This study is carried out by the Project QA/QC Management Department closely with the Technical or Construction Department.

The Technical or Construction Department shall ensure that environmental conditions are suitable for calibration and inspection, measuring and testing. Each piece of equipment is identified and a follow-up sheet attached containing the frequency of calibrations or checking, completed with written.

Proof that they have been carried out, and their results. Any item of equipment or instrument which is not correctly adjusted or not in working order is identified by an « out of service » label and withdrawn from use.

Special care is taken with regards to the condition of use and storage of inspection, measuring and test equipment so that the reliability is not affected. Equipment belonging to Subcontractors and Suppliers are maintained by them.

2.12 INSPECTION AND TEST STATUS

The main materials which have not been accepted are segregated from checked items. When necessary, special acceptance procedures specify the marking to be carried out. In any case, inspection reports provide documented proof of conformity with the Construction Contract obligations. In order to certify that an inspection has been carried out or that a test is valid, the Construction Representative or the Quality Inspector shall sign the corresponding works follow-up documents, or apply a mark to the product itself as set forth above.

2.13 CONTROL OF NONCONFORMING PRODUCT

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Nonconformity is a failure or a physical deviation from a result requirement or a definition specified in the Contract. Filing and handling of nonconformance reports, ordered in four levels, is outlined in procedure IOS 0 QAP 99 ISB 0215 « Controlling Nonconforming Products – D & C Works » which shall be applied by each intervening party on site. The nonconformance reports are managed as per this Procedure. A nonconforming product may be :

- modified, altered or repaired to meet the Contract requirements,
- accepted with or without repair,
- rejected or scrapped,
- regraded for alternative applications.

The Nonconformance Reports are attached to the Execution Tracing Files.

Suppliers providing factory products may use their own procedure to deal with nonconformity on conditions that the procedure has been reviewed and approved by the Contractor and that the supplies delivered to the job-site comply with specifications after the nonconformity have been dealt with.

2.14 CORRECTIVE AND PREVENTIVE ACTION

Corrective and preventive actions are undertaken by the Management after audit by the Project QA/QC Management Department or qualified auditors. In the event of existing or potential nonconformity of a product, or non-compliance with the quality system in respect to an applicable standard (ISO 9001/9002, Quality Plan), corrective or preventive actions are undertaken by means of a Nonconformity Report, a Corrective Action Request or a Recommendation. Typical forms of Corrective Action Request and Recommendation are defined in procedure IOS 0 QAP 99 ISB 0211 « Conducting Audits – D & C Works ».

2.15 HANDLING, STORAGE, PACKAGING, PRESERVATION AND DELIVERY

Goods and materials are stored and handled in accordance with specified requirements to maintain integrity prior to incorporation into the works.

For the more delicate/fragile materials and incorporated products the conditions of marking, packaging, handling, storage and transport are defined in the Purchase Order.

The conditions of reception, storage and handling on site are described in procedure IOS 0 QAP 99 ISB 0212 « Material Delivery and Storage – D & C Works ».

Suppliers providing factory products may use this or a similar procedure on condition that their procedure has been reviewed and approved by the Contractor, more particularly for the follow-up document purposes.

2.16 CONTROL OF QUALITY RECORDS

Procedure IOS 0 QAP 99 ISB 0005 « Filing and Archiving » defines the provisions for quality records control during the works as well as after the commissioning.

Procedure IOS 0 QAP 99 ISB 0219 « End of Construction Report – D & C Works » specifies the arrangements to be set up by the Contractor and its Subcontractors and Suppliers in order to control Quality Records. The End of Construction Records includes :

- The executed structure file - "As-Built Drawings" or ESF
- The quality file or QAF, composed of the Preparatory Documents :
 - . the Quality Assurance Plan documents,

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- . the associated Procedures.
 - . the Particular Works Procedures.
 - The Works file, (i.e. the execution follow up documents) and composed of :
 - . the Suppliers Works file or SWF (i.e. ETFs, ICLs, NCRs, etc...),
 - . the Contractor's Works file or CWF (i.e. ETFs, ICLs, NCRs, etc...),
 - The maintenance file or MAF.
- 2

End of Construction Quality Records are made available to the Employer.

2.17 INTERNAL QUALITY AUDITS

The Project QA/QC Manager, the CB-SGE Corporate Quality Manager or qualified auditors will carry out audits of the Contractor's quality management system and of its Subcontractors and main Suppliers according to an established audit schedule which is regularly reviewed, depending on the importance of the materials or items with regard to quality.

The auditors will issue a report that includes Corrective Action Request and Recommendation forms when necessary.

- 2
- Procedure IOS 0 QAP 99 ISB 0211 « Conducting Audits – D & C Works » outlines procedures to conduct these audits.

2.18 TRAINING

The Contractor identifies training needs and provides appropriate training for all personnel performing activities affecting quality.

Where necessary, the qualification requirements for operators are defined in the relevant Work Procedures.

The Project QA/QC Management will ensure that contributing parties have received the necessary training to achieve a clear understanding of the requirements of the Contractor's quality system.

The authors of the Work Procedures and the site supervisory personnel will ensure that the contributing parties responsible for implementing these requirements are familiar with them and are aware of their obligations. Where necessary, sufficient training is provided.

Specific qualifications required under standard rules or regulations, or to comply with the Contractor's requirements are documented.

- 2
- Records of training are retained in accordance with procedure IOS 0 QAP 99 ISB 0216 « Training – D & C Works ».

2.19 SERVICING

- 2
- A maintenance period of 1 year is foreseen by clause 50 of the contract. Procedure IOS 0 QAP 99 ISB 0220 « One year Maintenance – D & C Works », details the preparation and issue of utilization notices, specific maintenance procedures, list of spare parts and training of Employer's staff. An organization chart as well as a job description of each of the main intervening parties will be issued in due course.
- 2

2.20 STATISTICAL TECHNIQUES

Sampling procedures are developed when required to estimate objectively the level of quality achieved. Such procedures are based upon the appropriate statistical methods.

QUALITY ASSURANCE PLAN – DESIGN & CONSTRUCTION WORKS

The results of sampling inspections are documented and evaluated to ensure timely corrective action should significant variations in work operations be identified.

The project QA/QC Manager edits and issues to the CB-SGE Corporate Quality Manager a monthly quality report.

2 3.0 ENCLOSURES

- 2
- 1
- 2
- Appendix 1
- 2
- 3
- QUALITY POLICY
- SCHEDULE OF APPLICABLE QUALITY ASSURANCE PROCEDURES
- DESIGN & CONSTRUCTION PROJECT FUNCTIONAL ORGANISATION CHART



APPENDIX 1

QUALITY POLICY STATEMENT

2 The Construction Joint Venture named Istanbul Stadium Builders (ISB) and made up of three
2 Contractors,

is formed to undertake the design and construction of the ISTANBUL OLYMPIC STADIUM. The nature of this activity places particular emphasis on communication, capability, expertise, reliability and maintenance of quality standards.

To achieve this co-operation and co-ordination, a quality system that complies with the international standard ISO 9001:1994 has been established to assure compliance with statutory and contractual obligations.

The system has been planned and developed in conjunction with other management functions to provide systematic, planned, cost-effective procedures, and uniformity of working methods, to determine and achieve the required quality and eliminate deficiencies.

The Project Manager is responsible for ensuring that the quality system is implemented consistently and is regularly reviewed to reflect the requirement of the Construction Joint Venture and the Construction Contract.

2 The Quality assurance / Quality control (QA/QC) Manager is responsible for monitoring the implementation of the quality system and has organizational independence free from technical and commercial constraints.

The effective operation of the quality system is the responsibility of all concerned and is fundamental to the management of the project.

2 Date : 28.01.99



The Project Manager

QUALITY ASSURANCE PLAN – DESIGN & CONSTRUCTION WORKS

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APPENDIX 2

SCHEDULE OF APPLICABLE QUALITY ASSURANCE PROCEDURES

- ISB 0001 Quality Assurance Plan – Engineering Activities
 - ISB 0003 Coding of Documents
 - ISB 0004 Documents Format and Presentation
 - ISB 0005 Filing and Archiving
 - ISB 0007 Mail Management
 - ISB 0008 Records of Meetings
 - ISB 0010 Contract Review
 - ISB 0012 Material Submittal
 - ISB 0013 Clarification / Field Change / Derogation Requests
 - ISB 0014 Selection of Subcontractors and Suppliers
 - ISB 0015 Approval of Subcontractors by Employer
 - ISB 0016 Design Documents Management
 - ISB 0017 Back-up team activity: Purchase of Incorporated Materials
 - ISB 0018 Back-up team activity: Subcontracting
 - JVF 0001 Invoices processing
 - JVF 0002 Temporary Import Processing
-
- ISB 0201 Quality Assurance Plan - Design and Construction works
 - ISB 0202 Contractor's Management Structure – D & C Works
 - ISB 0203 Design Control – D & C Works
 - ISB 0204 Documents Control – D & C Works
 - ISB 0206 Quality Plan Frame for design activities – D & C Works
 - ISB 0207 Quality Plan Frame for construction activities – D & C Works
 - ISB 0208 Execution Follow-up Documents – D & C Works
 - ISB 0209 Establishing Particular Works Procedures – D & C Works
 - ISB 0210 Procedures Management – D & C Works
 - ISB 0211 Conducting Audits – D & C Works
 - ISB 0212 Material Delivery and Storage – D & C Works
 - ISB 0213 Inspection and Testing Plan – D & C Works
 - ISB 0214 Inspection, Measuring and Test Equipment Control – D & C Works
 - ISB 0215 Controlling Nonconforming Products – D & C Works
 - ISB 0216 Training – D & C Works
 - ISB 0219 End of Construction Report – D & C Works
 - ISB 0220 One year maintenance – D & C Works

QUALITY ASSURANCE PLAN – DESIGN & CONSTRUCTION WORKS

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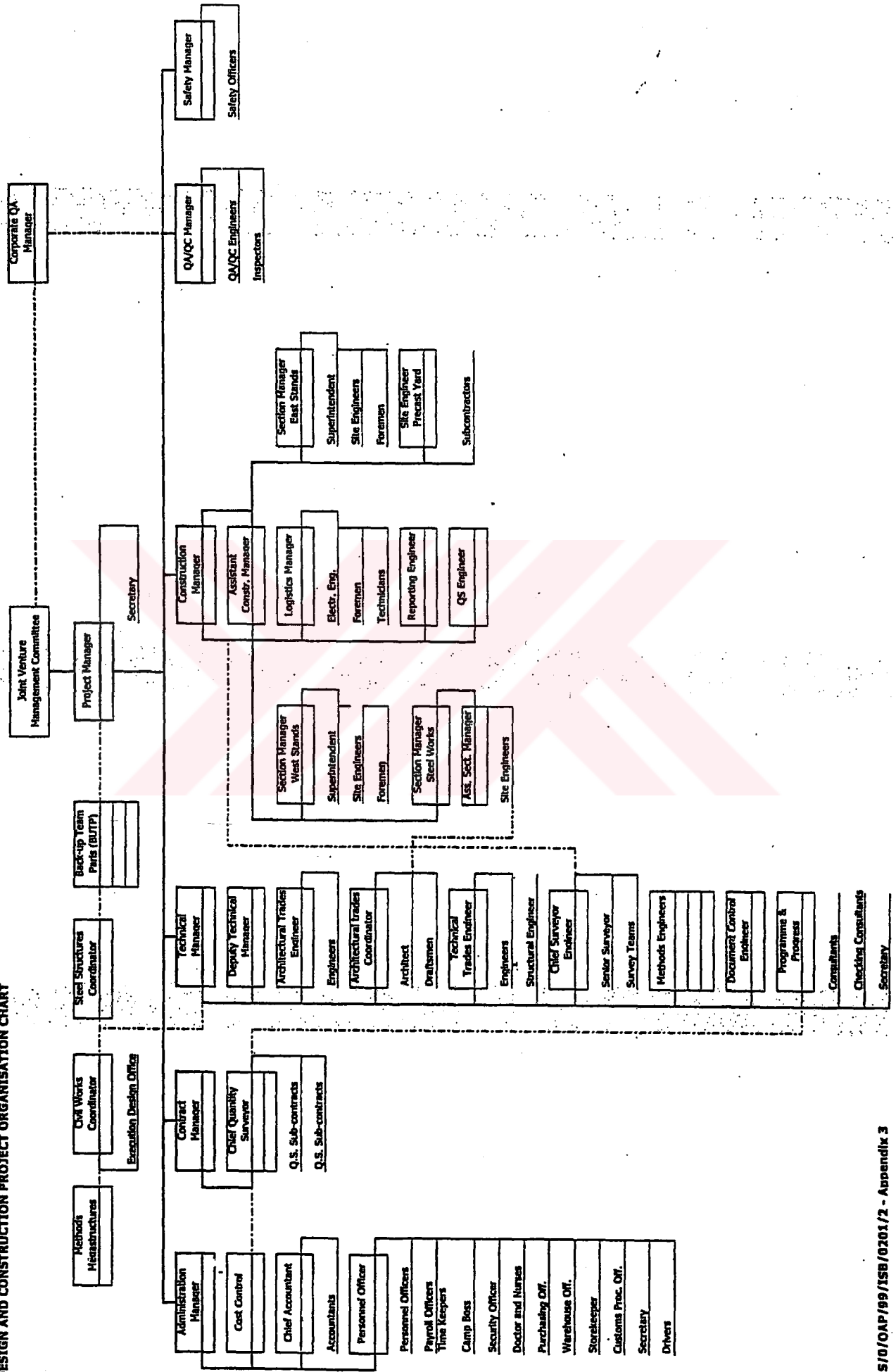
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DESIGN AND CONSTRUCTION PROJECT ORGANISATION CHART



B	INT	2000-01-20	Updated following 15to 17/6/99 Audit	RE	AGY	GR
1	FAP	10/06/99	For approval	CG	AGY	GR
A	PRE	24/05/99	First issue	CG	AGY	GR
Rev	Status	Date	Description	Prepared	Checked	Approved

EMPLOYER

ISTANBUL OLYMPIC STADIUM

Design and construction
of 80 000 seats Olympic Stadium

PROCEDURE

CONTRACTOR'S MANAGEMENT STRUCTURE

DESIGN & CONSTRUCTION WORKS

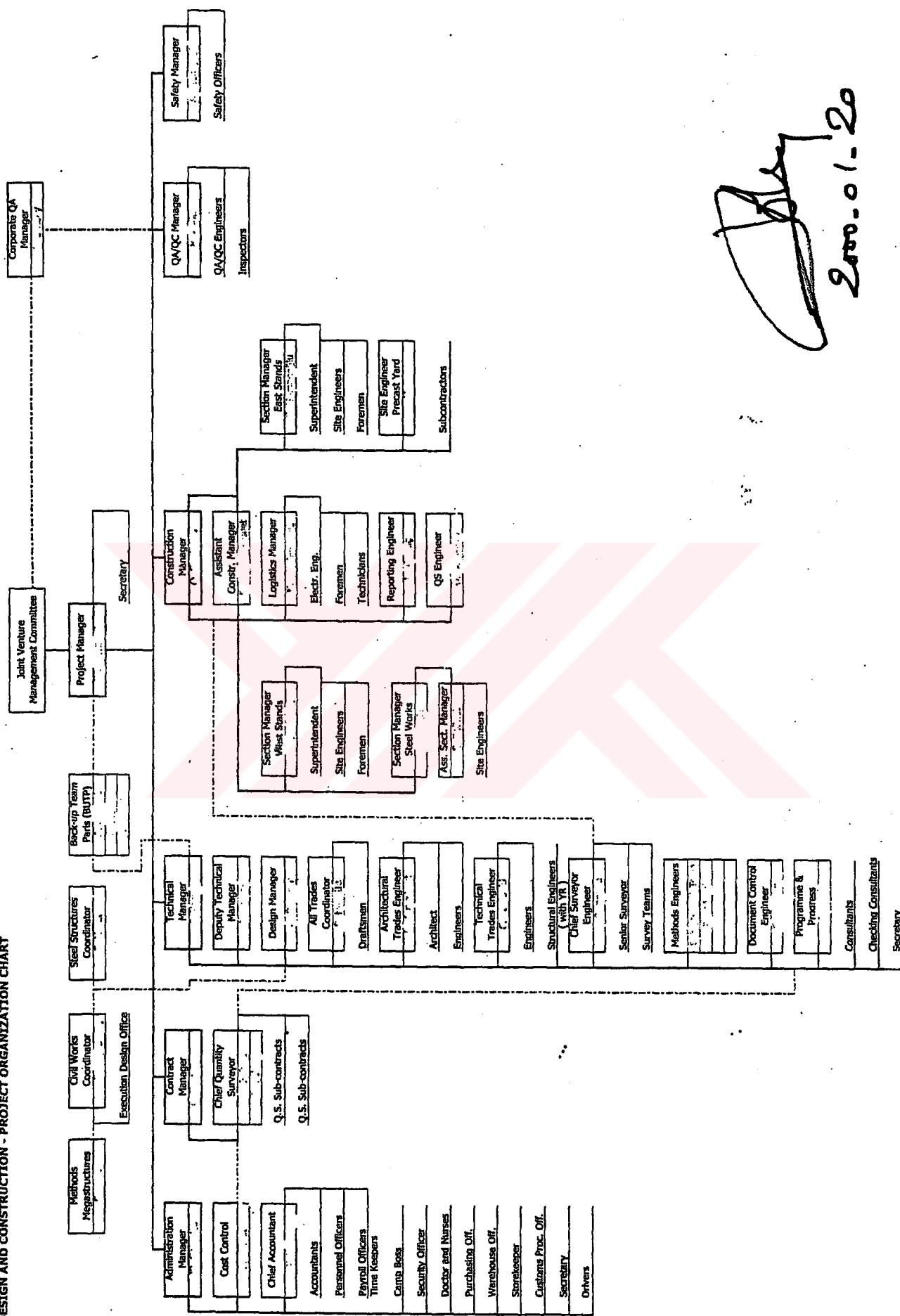
CONTRACTOR

Originator :

CONTRACTOR-Quality Dept.

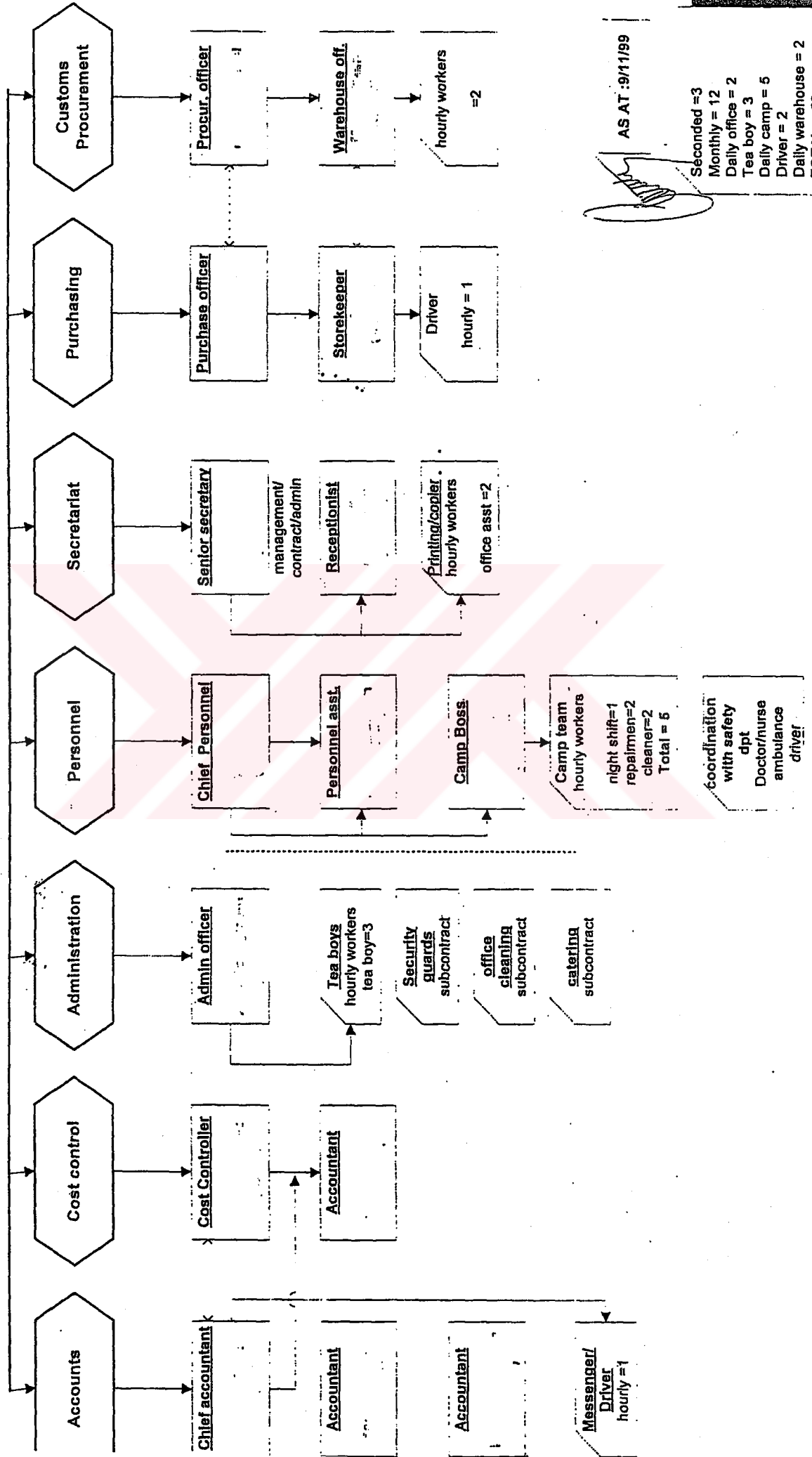
Prepared by AAAAA		Date 2000-01-20	Status Internal	Associated file ISB0202B	Total number of pages 2+43 appendices	
Istanbul Olympic Stadium	Area	Document type	Trade	Originator	Chrono number	Revision
IOS	0	QAP	99	ISB	0202	B

DESIGN AND CONSTRUCTION - PROJECT ORGANIZATION CHART



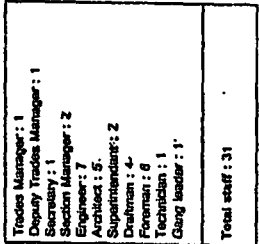
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2000.01.20

Administrative and Finance Manager



AS AT : 9/11/99

Seconded = 3
 Monthly = 12
 Daily office = 2
 Tea boy = 3
 Daily camp = 5
 Driver = 2
 Daily warehouse = 2
TOTAL = 29



JOB DESCRIPTION

Abbreviation

FUNCTION : Project Manager
NAME :

PM

SUBSTITUTE : Contract Manager
NAME :

CTM

REPORTS TO : Employer
NAME :

AREAS OF RESPONSIBILITY :

- Is in charge of the overall and daily management of the performance of the works, in compliance with the provisions of the Contract.
- Represents the Joint-Venture in dealing with the Employer and third parties and attends to correspondence with them.
- Manages the Contract, taking all necessary administrative and organizational measures.
- Ensures the implementation of the Quality Plan and other subsequent quality obligations.
- Ensures sufficient authority and organizational freedom for the Quality Management Department to take appropriate action when the Quality Plan is not implemented.
- Signs on behalf of the Joint-Venture subcontracts, purchase orders, rental agreements, including the acquisition of equipment, spare parts and materials for the performance of the Design & Construction Contract. In case of delegation scope and limits will be formally defined.
- Ensures that all staff are qualified for the job they are in charge of.

Name :

Date :

Signature :

JOB DESCRIPTION

Abbreviation

FUNCTION : Contract Manager
NAME :

CTM

SUBSTITUTE : Senior Quantity Surveyor
NAME :

REPORTS TO : Project Manager
NAME :

PM

AREAS OF RESPONSIBILITY :

- Contractual relationship between the Joint Venture and the Engineer/ Employer.
- Contractual relationship with main suppliers and third Parties
- Contractual relationship with the subcontractors
- Prepare and review contractual documents for all subcontracts
- Prepare and/or review contractual correspondence with Engineer/Employer
- Prepare and review monthly payment statements
- Prepare and follow-up claims lodged under the Main Contract
- Manage resolution of disputes with Employer/Engineer, subcontractors and other third parties
- Provide other department with advices on contractual matters

Name :

Date :

Signature :

JOB DESCRIPTION

Abbreviation

FUNCTION : Construction Manager
NAME :

CM

SUBSTITUTE : Assist. Construction Manager
NAME :

ACM

REPORTS TO : Project Manager
NAME :

PM

AREAS OF RESPONSIBILITY :

- Implement all necessary actions to ensure the progress of the works according to schedule, budget, environmental and quality requirements.
- Prepare and control his budget, approve the sub-contractors monthly progress payment.
- Ensure the availability of adequate resources including staff, plant and equipment, materials for all sections of the construction.
- Manage the personnel of the Joint Venture for the works performed by the Joint Venture.
- Select the sub-contractors in charge of constructions sub-contracts.
- Manage the constructions sub-contracts with regard to the Quality Assurance System.
- Prepare periodical reporting relating to construction matters.
- Has received safety subdelegation from the Project Mnagaer and ensures that the safety regulation is implemented on site.
- Is assisted by assist. construction manager, section managers, reporting engineer and QS engineer.

Name :

Date :

Signature :

JOB DESCRIPTION

Abbreviation

FUNCTION : Construction Logistic Manager
NAME :

SUBSTITUTE : Mech. Foreman
NAME :

REPORTS TO : Construction Manager **CM**
NAME :

AREAS OF RESPONSIBILITY :

- Is responsible for a works section: Personnel, supplies, monthly and weekly detailed planning.
- Works closely with the Method Department, the Survey section, the Mechanical section, Electrical section, QA/QC Dept and the Safety Engineer.
- Is assisted by electrical engineer, general foreman, foremen, concrete technician.
- Is responsible for the quality of the works in accordance with the Quality Assurance Plan.
- Is responsible to prepare material submissions for the structural concrete works.
- Is responsible to prepare the Particular Works Procedures or ensure that the sub-contractors have prepared theirs in due time.
- Is responsible for the execution of the works in conformity with the approved drawings and specifications.
- Is responsible for the implementation of the safety within his works section area.
- Coordinates with other construction sections.

Name :

Date :

Signature :

JOB DESCRIPTION

Abbreviation

FUNCTION : Admin. and Finance Manager
NAME :

AFM

SUBSTITUTE : Chief Accountant
NAME :

REPORTS TO : Project Manager
NAME :

PM

AREAS OF RESPONSIBILITY :

- Deal with all administrative problems relating to the Project
- Supervise the Administrative, Finance Department, Cost Control and Purchasing sections
- Supervise accounts, cash and balance sheets
- Make calls of funds to the Partners when necessary
- Manage relations with banks, taxation departments, customs and other government departments as required
- Supervise bank accounts and arrange Bank guarantees
- Manage from an administrative point of view, the property of the JV in particular fixed assets and equipment
- Invoice the Third parties, pay all suppliers and subcontractors
- Sign employment contract of JV employed staff, supervise the preparation and payment of the JV staff salaries
- Ensure periodical reporting of administrative status to the PM and Partners
- Coordinate the preparation of the Project cost forecasts and budget with the assistance of cost controller, and produce the monthly cost report.

Name :

Date :

Signature :

JOB DESCRIPTION

Abbreviation

FUNCTION : Safety Manager
NAME :

SM

SUBSTITUTE : Safety Officer
NAME :

REPORTS TO : Project Manager
NAME :

PM

AREAS OF RESPONSIBILITY :

- Supervise the implementation of Site Specific HS Plan on:
 - i) Prevention of injury to personnel and damage to material and equipment,
 - ii) Further improvements in existing working methods,
 - iii) Application of Company Safety Procedures and those of the Project
 - iv) Insuring availability of valid and appropriate test certificates for hired materials and equipment,
 - v) Potential hazards on new sections before work starts,
 - vi) The site/work area safety organization and fire precautions required.
- Carry out survey and inspections on regular basis in association with supervision to ensure that safe working practices are followed.
- Supervise the recording and analysis of information on injuries, damage and production loss, assess accident trends and review overall safety performances.
- Assist in the training of all levels of employees to promote awareness of injury prevention and damage control.
- Arrange for safety lectures and film presentation as much as possible for all grades.
- Arrange for safety posters, signs, bulletin boards and change material at regular intervals.

Name :

Date :

Signature :

JOB DESCRIPTION

Abbreviation

FUNCTION : Technical Manager
NAME :

TM

SUBSTITUTE : Assistant Technical Manager
NAME :

ATM

REPORTS TO : Project Manager
NAME :

PM

AREAS OF RESPONSIBILITY :

- Manages the technical relationship between the Joint Venture and the Engineer / Employer as well as all third parties, in particular by monitoring all technical correspondence,
- Prepares the technical part of all subcontracts and review the whole subcontract,
- Assists the Contract Manager in the preparation of the payment applications,
- Provides the Construction Manager with all technical documents necessary for the execution of the works.
- Selects all sub-contractors in charge of design sub-contracts,
- Prepares and submit all technical submissions to the Engineer and gets approval thereof,
- Coordinates the programme of works for all sections of the Project, and ensures the correct progress accordingly.
- Prepares periodical reports of technical matters,

Name :

Date :

Signature :

JOB DESCRIPTION

		<u>Abbreviation</u>
FUNCTION NAME	: Design Manager	DM
SUBSTITUTE NAME	: Technical Manager	TM
REPORTS TO NAME	: Technical Manager	TM

AREAS OF RESPONSIBILITY :

- The Design Manager is responsible for the overall and daily management of the performance of the design of the works in compliance with the provisions of the Contract.
- The Design Manager is in charge of providing the Construction Department with all documents necessary for the execution of the works, approved by all relevant authorities.
- The Design Manager shall:
 - i) Manage the design offices taking all necessary organisational measures,
 - ii) Manage the design sub-contractors so that they provide approved and certified documents in accordance with the agreed programme and the specifications of the Contract,
 - iii) Obtain maximum benefit from any possible optimisation,
 - iv) Ensure that the Quality Plan for Design is fully implemented in the organization,
 - v) Ensure that the design is prepared in accordance with the methods of construction,
 - vi) Ensure that all technical documents are forwarded to the Construction Manager for execution,

Name :

Date :

Signature :

JOB DESCRIPTION

Abbreviation

FUNCTION : Document Control Engineer
NAME :

SUBSTITUTE : Draftswoman
NAME :

REPORTS TO : Technical Manager
NAME :

TM

AREAS OF RESPONSIBILITY :

- Ensure the compliance of document control with procedure ref. IOS/0/QAP/99/ISB/0016
- Follow up, co-ordination and updating of data base in computer
- Archiving of drawings, calculation notes, specifications
- Follow up and dispatch of periodic "Technical Document Lists"
- Follow up and co-ordination of "Weekly Report" of documents.
- Technical documents additional reproduction and dispatch when needed.

Name :

Date :

Signature :

JOB DESCRIPTION

Abbreviation

FUNCTION : Planning Engineer
NAME :

SUBSTITUTE :
NAME :

REPORTS TO : Technical Manager
NAME :

TM

AREAS OF RESPONSIBILITY :

- General Working Programme.
- Consolidation Programme.
- Distrubition of the quantities according to the working programme.

Name :

Date :

Signature :

JOB DESCRIPTION

		<u>Abbreviation</u>
FUNCTION NAME	: Trades Manager :	TRM
SUBSTITUTE NAME	: Technical Manager :	TM
REPORTS TO NAME	: Project Manager :	PM

AREAS OF RESPONSIBILITY :

- Manages all the technical and architectural trades within the Joint Venture,
- Prepares the technical part of all subcontracts and review the whole subcontract,
- Assists the Contract Manager in the preparation of the payment applications,
- Provides the Construction Manager with all technical documents necessary for the execution of the works.
- Selects all sub-contractors in charge of design sub-contracts,
- Prepares and submit all technical submissions to the Engineer and gets approval thereof,
- Coordinates with the Technical Manager the programme of works for all sections of the Project, and ensures the correct progress accordingly.
- Prepares periodical reports of trades matters

Name :

Date :

Signature :

JOB DESCRIPTION

Abbreviation

FUNCTION : Quality Manager
NAME :

QM

SUBSTITUTE : Quality Civil Works Engineer
NAME :

REPORTS TO : Project Manager
NAME :

PM

AREAS OF RESPONSIBILITY :

- Is the representative of the Joint-Venture with the Employer for all matters concerning Quality.
- Supervises the quality department, and the Quality engineers
- Prepares and implements the Quality Assurance Plan of the Project, and its associated procedures.
- Schedules and carries-out internal and external (to subcontractors and suppliers) audits.
- Approves Particular Works Procedures (PWP) after review by the Quality Engineer, and the Works Section Managers.
- Approves Subcontractors' Quality Assurance Plans and associated Procedures after review by the Quality Engineer, and the Works Section Managers.
- Organizes random spot inspections as well as hold points and witness points.
- Ensures at random, the effectiveness and efficiency of the Quality Engineers actions.
- Signs the final inspection of Execution Tracing Files (ETFs).
- Indicates to the concerned departments, any Nonconformances encountered.
- Approves Nonconformances, when corrections and corrective actions are found, and closes them after implementation.
- Issues Corrective Action Requests (CARs) and Recommendations (RECs), when necessary.
- Prepares internal monthly reports (site and CB-SGE main office).

- Participates to SIPM meetings and any other particular ones as required.
- Reviews and signs Material Submission Sheets (MSS).
- Reviews contracts with Subcontractors for all Quality matters.
- Keeps the Project Manager and the CB-SGE Corporate Quality Manager informed of any Quality problems.
- Reports to the Project Manager.



Name :

Date :

Signature :

JOB DESCRIPTION

Abbreviation

FUNCTION : Quality Electro-mechanical Engineer
NAME :

SUBSTITUTE : Quality Manager
NAME :

QM

REPORTS TO : Quality Manager
NAME :

QM

AREAS OF RESPONSIBILITY :

- Reviews the Quality Assurance Plans of Subcontractors, and their associated procedures.
- Reviews Particular Works Procedures (PWP) of Subcontractors.
- Checks the implementation of the above PWPs.
- Carries out regular random spot inspections, releases hold and witness points which have been defined on Inspection and Test Plans, and checks any documentation of third party inspections.
- Indicates to the concerned departments, any Nonconformances encountered.
- Follows-up on Nonconformances, until corrections and corrective actions are implemented.
- Keeps and updates any Quality assurance records, as requested by the QM.
- Attends the Weekly Site Meetings, and any other as required.
- Participates to any process improvement meetings.
- Keeps the Quality Manager informed of any Quality problems.
- Coordination with Site Production teams.

Name :

Date :

Signature :

JOB DESCRIPTION

Abbreviation

FUNCTION : Quality Civil Works Engineer
NAME :

SUBSTITUTE : Quality Manager
NAME :

QM

REPORTS TO : Quality Manager
NAME :

QM

AREAS OF RESPONSIBILITY :

- Supervises the quality inspectors.
- Reviews the Quality Assurance Plans of Subcontractors, and their associated procedures.
- Reviews Particular Works Procedures (PWP) of Subcontractors.
- Checks the implementation of the above PWPs.
- Carries out random spot inspections, releases hold and witness points which have been defined on Inspection and Test Plans, and checks any documentation of third party inspections.
- Indicates to the concerned departments, any Nonconformances encountered.
- Follows-up on Nonconformances, until corrections and corrective actions are implemented.
- Keeps and updates any Quality assurance records, as requested by the QM.
- Attends the Weekly Site Meetings, and any other as required.
- Participates to any process improvement meetings.
- Keeps the Quality Manager informed of any Quality problems.
- Coordination with Site Production teams.

Name :

Date :

Signature :

JOB DESCRIPTION

Abbreviation

FUNCTION : Quality Steel Works Engineer
NAME :

SUBSTITUTE : Quality Manager
NAME :

QM

REPORTS TO : Quality Manager
NAME :

QM

AREAS OF RESPONSIBILITY :

- Reviews the Quality Assurance Plans of Subcontractors, and their associated procedures.
- Reviews Particular Works Procedures (PWP) of Subcontractors.
- Checks the implementation of the above PWPs.
- Carries out regular random spot inspections, releases hold and witness points which have been defined on Inspection and Test Plans, and checks any documentation of third party inspections.
- Indicates to the concerned departments, any Nonconformances encountered.
- Follows-up on Nonconformances, until corrections and corrective actions are implemented.
- Keeps and updates any Quality assurance records, as requested by the QM.
- Attends the Weekly Site Meetings, and any other as required.
- Participates to any process improvement meetings.
- Keeps the Quality Manager informed of any Quality problems.
- Coordination with Site Production teams.

Name :

Date :

Signature :

1.0 SCOPE

- B The purpose of this Quality Assurance procedure is to present the overall organization chart of the Project, set in place by the Contractor for the design and the construction works of the ISTANBUL OLYMPIC STADIUM. It also defines the organization of each department with the job description of the main staff members.

2.0 REFERENCE DOCUMENTS

2.1 Contractual Documents

The main contract (clause 37 part 1 – general conditions)

ISO 9001 : 1994 "Quality System – Model for quality assurance in design, development, production, installation and servicing".

2.2 Others Documents

IOS O QAP 99 ISB 0201 : Quality Assurance Plan - D & C Works.

3.0 GENERALITIES

- B The organization charts attached to this procedure, as well as the related job descriptions shall be revised and distributed each time a change is made. This will not imply a revision of the procedure itself unless otherwise necessary

4.0 PROCEDURE

The overall organization chart is set-up by the project Manager. It is supplied to the Management committee for information (see appendix 1).

The departments' organization charts are set-up by the department heads and approved by the Project Manager (see appendixes 2 to 5).

All job descriptions of the main staff members are enclosed in appendix 6 (37).

- B Each department head is in charge of gathering the required information related to the updating of his organization chart and its related job descriptions. They are supplied to the QA/QC manager who will dispatch them as required.

CONTRACTOR'S MANAGEMENT – DESIGN & CONSTRUCTION WORKS

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1	FAP	25/06/99	For approval	OU	AGY	GR
A	PRE	07/06/99	First issue	OU	AGY	GR
Rev	Status	Date	Description	Prepared	Checked	Approved

EMPLOYER

ISTANBUL OLYMPIC STADIUM

Design and construction
of 80 000 seats Olympic Stadium

Procedure

Design Control
DESIGN & CONSTRUCTION WORKS

CONTRACTOR

Originator :

CONTRACTOR-Quality Dept.

Prepared by AAAAA		Date 27/10/1999	Status Int	Associated file ISB0203B		Total number of pages 4
Istanbul Olympic Stadium	Area	Document type	Trade	Originator	Chrono number	Revision
IOS	0	QAP	99	ISB	0203	B

1. Scope

The purpose of this procedure is to ensure that the design complies with the ISO 9001 international standards and the specifications of the contract.

2. Reference documents

IOS/0/QAP/99/ISB/0201 Quality Assurance Plan - Design and Construction Works, and its associated Quality Assurance Procedures.

3. Field of application

This procedure shall apply to all design activities.

4. Procedure

4.1) Design and Development Planning

4.1.1) Organization

The Technical Department Organization Chart and Job Descriptions are given in Procedure IOS/0/QAP/99/ISB/0202 - Contractor's Management Structure.

4.1.2) Assignment & Planning of Design Activities

Works Program is prepared for the project, under responsibility of Works Department & Technical Department Managers. In this program, activities are described and scheduled. Design activities are then planned accordingly, and responsibilities for their implementation are defined. ISB-JV assigns, if necessary, Design Subcontractors. This is performed through IOS/0/QAP/99/ISB/0014 - Selection of Subcontractors and Suppliers and IOS/0/QAP/99/ISB/0015 - Approval of Subcontractors by Employer.

Progress of this Plan is updated according to the development in design.

Studies Coordinators monitor the design works and take remedial measures, if actual periods exceed the planned periods

4.2) Organizational and Technical Interfaces

Each design subcontractor shall issue a specific Quality Assurance Plan for ISB-JV's review and approval.

The Studies Coordinators manage the design activities, in other words the organizational and technical interfaces between ISB-JV, the Design Subcontractors who produce the execution drawings, the Works Subcontractors who produce eventual workshop drawings and the Employer. For interfaces management and dispatch of documents see IOS/0/QAP/99/ISB/0016 - Design Documents Management.

4.3) Design Input

The Design Input comprises several levels of documents:

4.3.1) The contract between the Employer and ISB-JV is the technical basis of the project. Design input is extracted from the contract and its specifications (These are the DDD documents approved by the Client).

Design Control

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4.3.2) For the missing input that are not defined in the contract or the specifications, the applicable data shall be obtained through IOS/0/QAP/99/ISB/0013 Clarification Field Change and Derogation Requests, by the Technical Department from the Design Subcontractors', the Works Subcontractors or if necessary from the Engineer (Employer's representative).

4.3.3) In case design activities require local data that are not defined in specifications (such as Geotechnical, topographic, population, climate, hydrology, etc.), these shall be obtained by the intervening party, in charge of this part of the Design.

4.3.4) Should design input require decisions to be made about the system or materials, comparison of any alterations and decision making are the responsibility of the Technical Manager.

4.3.5) The result of all Contract Reviews, having consequences on the design input, will be transmitted to the intervening parties (Design Subcontractors' and Works Subcontractors).

Data input specific note (s) will be established and submitted to the Customer's approval.

4.4) Design Output

The Design, prepared by ISB-JV or by their subcontractors, and which the Employer and / or competent authorities approve, is called "Design Output".

Design output documents are reviewed before release.

All design output are documented and filed in the Technical Department.

4.5) Design Review

Design review stages are defined in design planning such as Kick-off meetings and specific reviews at defined stages for each activity, and if necessary by part of building construction.

Technical Manager coordinates and participates to the design review meetings. In case Employer wants to participate, his representative may also take part. Participants to the design review include :

Technical Manager and / or his deputy

Coordinators, as applicable

External experts if necessary

Construction Manager or his deputy, for taking into accounts construction methods.

Design subcontractors, as applicable

Works subcontractors, as applicable

The Technical manager keeps the records of minutes of meetings.

4.6) Design Verification

Design is verified through alternative calculations where appropriate, asking advice to external experts, or comparing with similar design that is previously verified, testing and reviewing at different stages. The Technical Manager and the Design Manager coordinate design verifications.

Design Control

Verification performed by the design subcontractors shall be defined in their Quality Assurance Plan.

B Design output is verified to correspond to the input data and acceptance criteria, before the approval of the Employer. This task is carried out by the Design Management team under supervision of the Design Manager. A special form titled DVS is used (as detailed in procedure ref. IOS/0/QAP/99/ISB/0016 – Design Documents Management).

B All records of said verifications are kept in the Technical Department.

4.7) Design Validation

B Design validations are performed if required at various stages of the design, to ensure that product conforms to defined needs and/or requirements. Records of these validations will be kept by the Technical Department.

4.8) Design Changes

B All changes and modifications of design are submitted to the Employer for approval before execution under responsibility of The Technical Manager. Design changes are managed according to the IOS/0/QAP/99/ISB/0013 Clarification, Field Change & Derogation Requests.



2	FAP	16/08/99	Revised - issued for approval	RE	AG	GR
1	FAP	08/06/99	For approval	CG	AGY	GR
A	PRE	07/06/99	First issue	CG	AGY	GR
Rev	Status	Date	Description	Prepared	Checked	Approved

EMPLOYER

ISTANBUL OLYMPIC STADIUM

Design and construction
of 80 000 seats Olympic Stadium

PROCEDURE

QUALITY PLAN FRAME FOR CONSTRUCTION ACTIVITIES DESIGN & CONSTRUCTION WORKS

CONTRACTOR

Originator :

CONTRACTOR-Quality Dept.

Prepared by AAAAA	Date 16/08/99	Status For approval	Associated file ISB0207-2		Total number of pages 18	
Istanbul Olympic Stadium IOS	Area 0	Document type QAP	Trade 99	Originator ISB	Chrono number 0207	Revision 2

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1.0 SCOPE

The purpose of this Quality Assurance Procedure is to give a Quality Plan frame which can be used as a guide by Subcontractors and Suppliers for construction activities of the ISTANBUL OLYMPIC STADIUM Project, in order to define how they intend to manage the quality for there activities.

However, Suppliers and Subcontractors can prepare their Quality Plan according to their own practice as long as their Quality Plan complies with ISO 9001 or ISO 9002.

2.0 REFERENCE DOCUMENTS

2.1 Contractual Documents

The Main Contract (clauses 14 and 37 part 1 – general conditions).
ISO 9001:1994

2.2 Other References

IOS 0 QAP 99 ISB 0003 Coding of Documents
IOS 0 QAP 99 ISB 0004 Document Format and Presentation
IOS 0 QAP 99 ISB 0012 Material Submittal
IOS 0 QAP 99 ISB 0013 Clarification, Field Change and Derogation requests
IOS 0 QAP 99 ISB 0201 Quality Assurance Plan – D & C Works
IOS 0 QAP 99 ISB 0208 Execution Follow-up Documents – D & C Works
IOS 0 QAP 99 ISB 0209 Establishing Particular Works Procedures – D & C Works
IOS 0 QAP 99 ISB 0211 Conducting Audits – D & C Works
IOS 0 QAP 99 ISB 0212 Material Delivery and Storage – D & C Works
IOS 0 QAP 99 ISB 0213 Inspection and Testing Plan – D & C Works
IOS 0 QAP 99 ISB 0214 Inspection, Measuring and Testing Equipment Control – D & C W.
IOS 0 QAP 99 ISB 0215 Controlling Non-conforming Products – D & C Works
IOS 0 QAP 99 ISB 0220 One year maintenance – D & C Works

3.0 GENERALITIES

When required, Subcontractor/Supplier shall submit to the Contractor QA/QC Manager for review and approval, a fully documented, Quality Plan.

This Quality Plan shall comply with ISO 9001 or ISO 9002 and shall apply to all aspects of the subcontracted Work/Supply and describe in detail the quality assurance and control measures that will be employed during the execution of the Work/Supply.

It may be established according to this Quality Assurance Procedure for which application of certain ISO 9001 or 9002 / 1994 criteria are not described because not required by the Contractor for this project.

A quality assurance procedures manual, instructions checklists, etc., may be used to provide detail if referenced. However, the Quality Plan shall clearly identify and reference sections of the quality assurance manual, procedures, instructions, and checklists applicable to the Works / Supply; these documents shall be submitted to the Contractor when required.

Control of corrections, revisions and distribution of the Quality Plan and its supporting procedures manual, instructions and checklists shall also be defined.

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2 The Quality Plan shall refer both to applicable Contractor's Quality Assurance Procedures listed in § 2.2 when applicable, and to Subcontractor's Specific Procedures if any.

2 Once approved by the Contractor, the Quality Plan is the basis for evaluating quality assurance and quality control activities of the Works / Supply.

4.0 PROCEDURE

2 Subcontractor / Supplier while establishing his Quality Plan by using this Quality Assurance Procedure must delete pages 1 to 4.

Remember to check the number of pages and of documents attached to your Specific Quality Plan and to place the mentions on the page in the background.

2 In order to use this document as a «guide » to establish a Quality Plan, the issuer takes into account the following list that can be used on a colour monitor or a paper printed colour :

- Text typed in RED: The text is to be modified or erased.

- Text typed in BLUE: The text is to be checked in order to be adapted to the operation.

Comments (*) are included in the text and need to be erased for the final Quality Plan.

2 Subcontractor/Supplier shall incorporate into his Quality Plan any additional requirements that he considers necessary to properly manage the quality of the Work/Supply.

The Quality Plan Frame is available on a floppy disk under Microsoft Word software.

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SUBCONTRACTOR/SUPPLIER
QUALITY PLAN FRAME
FOR CONSTRUCTION ACTIVITIES

DESIGN & CONSTRUCTION WORKS

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SUMMARY

0- PRESENTATION OF THE WORKS AND INTERVENING PARTIES

1 - RUNNING PRINCIPLE OF THE QUALITY SYSTEM - ORGANISATION

2 - QUALITY SYSTEM

2.1 - General

2.2 - Supplier's own quality system

2.3 - Forecasted list of documents to be set up

3 - CONTRACT REVIEW

4 - DESIGN CONTROL

5 - DOCUMENT AND DATA CONTROL

6 - PURCHASING

7 - CONTROL OF CONTRACTOR-SUPPLIED PRODUCT

8 - IDENTIFICATION AND TRACEABILITY

9 - PROCESS CONTROL

10 - INSPECTION AND TESTING

11 - CONTROL OF INSPECTION, MEASURING AND TEST EQUIPMENT

12 - INSPECTION AND TEST STATUS

13 - CONTROL OF NONCONFORMING PRODUCT

14 - CORRECTIVE AND PREVENTIVE ACTION

15 - HANDLING, STORAGE, PACKAGING, PRESERVATION AND DELIVERY

16 - QUALITY RECORDS

17 - AUDIT

18 - TRAINING

19 - SERVICING

20 - STATISTICAL TECHNIQUES

APPENDIX A : Subcontractor / Supplier organisation chart

APPENDIX B : List of preparatory documents associated to the Quality Plan

APPENDIX C : List of Work procedures

APPENDIX D : List of inspection, measuring and testing equipment

Comments : replace everywhere the words « Subcontractor/Supplier » by the real name.

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0- PRESENTATION OF THE WORKS AND INTERVENING PARTIES

- 2 The purpose of this QUALITY PLAN is to present the quality assurance and quality control dispositions to be set up by :

Subcontractor / Supplier (Name/Address) :

Product or service to be provided :

to manage quality during the execution of the ISTANBUL OLYMPIC STADIUM, Project whose main intervening parties are:

- 2 called the Contractor or : Istanbul Stadium Builders Joint Venture (ISB-JV)

1 - RUNNING PRINCIPLE OF THE QUALITY SYSTEM – ORGANISATION

Our quality system refers to the ISO 9001 / 9002: 1994. ,

The quality system to be set up for the operation comes from a contractual requirement which is specified in the Main Contract (clauses 14 and 37 part 1 – general conditions).

We undertake to comply with the Contractor's Quality Assurance Procedures listed in appendix B.

- 2 In addition, we detail, thanks to this Quality Plan, the specific quality dispositions that we will use for our activities.

- 2 Our company organisation chart is attached in appendix A.

Job description of staff in charge of the project are described in the specific procedure « Subcontractor/Supplier Organisation Chart & Job Description ».

Comments : Job description of staff in charge of the project may also be defined in the Subcontractor/Supplier Specific Quality Plan.

Our Senior Manager responsible for the execution of the contract is :

M. : Tel. :

Address :

- 2 Our on-site Representative is :

M. : Tel. :

Our Quality Responsible (head office) is :

M. : Tel. :

Address :

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Our Quality Responsible on site is :

M. : Tel. :

- 2 The Senior Manager is responsible for ensuring that the Quality Plan is implemented consistently and is regularly reviewed to reflect the requirement of the Contract. His signature on the cover page of the QUALITY PLAN prove his commitment.

Our Quality Responsible on site is responsible for monitoring the implementation of the quality management system. He has organisational independence free from technical and commercial restraints.

2- QUALITY SYSTEM

2.1 – General.

Our Quality System includes :

- this Quality Plan,
- Contractor's Quality Assurance Procedures and,our own Particular Works Procedures listed in appendix B.

We undertake to ask ISB-JV all useful explanation about the use and application of his Quality Assurance Procedures.

2.2 – Subcontractor's/Supplier's own quality system (if any).

Our company has already set up a quality approach based on the following standards :

. A Quality Assurance Manual : ref. n° dated

. A certificate issued by(name of the Third Party Certification Agency).....dated..... valid until.....according to the reference :

- 2 Coding and presenting of documents will be as defined in the IOS 0 QAP 99 ISB 0003: « Coding of Documents » and the IOS 0 QAP 99 ISB 0004: « Documents Format and Presentation » .

2.3 – Forecast list of documents to be set up.

2.3.1 Preparatory documents .

- 2 Preparatory documents belong to one of the following categories :

- 2 - Contractor's Quality Assurance Procedures,
- 2 - Quality Plan and associated Particular Works Procedures (PWP) (listed in appendix B), prepared by the Quality Responsible on site; the latter are required for the realization of critical tasks or operations,
- 2 - Inspection and Testing Plan (ITP),
- 2 - Typical Inspection Checklists (ICL).
- 2 - Miscellaneous documents such as drawings, calculation notes, methods statements, planning, work procedures, inspection test plans, etc., that we will set up during the preparation or just prior the works.

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2.3.2 Execution follow-up documents.

Execution follow-up documents shall include documents that demonstrate the achievement of the required standards (Execution Tracing File (ETF), Inspection Check List (ICL), etc.). They are listed here below.

Conditions for establishing ETFs and ICLs are specified in ISB-JV's Quality Assurance procedure ref. IOS 0 QAP 99 ISB 0208: « Execution follow-up documents – D & C Works».

2.3.3 Official reports for measures, test or inspection.

These documents may be related to inspections/tests requested by regulation/specifications and carried out by organisations hereafter specified.

Official reports for measures, test or inspection	-	Organisation name
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2.3.4 Working and maintenance documentation

The working and maintenance documentation is to be specified hereafter. It will be handed over at the end of the contract. This documentation must include all necessary information for the maintenance.

Working and maintenance documentation	-	To be issued before
---------------------------------------	---	---------------------

3- CONTRACT REVIEW

If during the construction / supply of the Works, the Subcontractor/Supplier should identify any ambiguities, mistakes, incompatibilities or contradictions in the Contract Documents (Specifications or Drawings), or if it is considered that a specified requirement cannot be achieved, the Subcontractor / Supplier will raise either a « Derogation Request », or a « Clarification Request », or a « Field Change Request », and shall issue it to the Contractor in accordance with the IOS 0 QAP 99 ISB 0013 : «Clarification requests and field change requests».

4- DESIGN CONTROL

Comments : Describe here-below your internal methods for controlling your design.

5- DOCUMENT AND DATA CONTROL

The Senior Manager will keep and regularly circulate to document holders sufficiently full and up to date lists of all documents (in and out).

Expired documents will be withdrawn or cancelled by their holders in an obvious way to avoid any non deliberate use.

Comments : Describe here below your internal methods for controlling document and data.

6- PURCHASING

Comments : this chapter shall contain procedures that clearly delineate the sequence of actions to be accomplished in the evaluation of your own subcontractors (if any), preparation, review, approval, and control of procurement documents, including the measures which assure that changes or revisions to procurement documents are subject to the same review and approval requirements as the original documents.

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- Preliminary list of main supplies :

-
-

- Preliminary list of subcontracted Activities:

-
-

2 Any part of the works cannot be subcontracted before receiving the Contractor's prior approval.

2 Material Submission Sheets (MSS) will be issued by the Senior Manager to the Contractor according to the IOS 0 QAP 99 ISB 0012 « Material Submittal » prior to any purchasing.

7- CONTROL OF CONTRACTOR-SUPPLIED PRODUCT

The different items of material, product, or data supplied by the Contractor will be inspected by the Senior Manager upon receipt, to verify compliance with specified requirements and determine if any special instructions apply, prior to incorporation into the construction. These instructions shall be prepared by the Contractor.

At the Quality Plan set up date, these products are :

8- IDENTIFICATION AND TRACEABILITY

When traceability is mandatory or is considered necessary, the materials, parts and components of sub-assemblies shall be marked, preferably at the time of production, in the factory or on site, or by a batch number or part number indicated on the product, or by a reference indicated on marked up documentation or on the Execution Follow-up Documents.

These measures particularly apply to elements prefabricated on site or in the factory.

They do not apply to standard off-the-shelf materials or products stored in a warehouse. Products with a given shelf life will be administered according to special rules (first in, first out) paying particular attention to ensure they are used before the expired date.

2 *Comments : the Subcontractor / Supplier defines practical arrangements in this chapter or in his Particular Works Procedures.*

9- PROCESS CONTROL

2 Particular Works Procedures are established in accordance with the IOS 0 QAP 99 ISB 0209:
2 « Establishing Particular Works Procedures – D & C Works » for the control of tasks or activities which impact upon final quality, and for the control of special processes.

2 PWP's shall be prepared by the person responsible for the activity and shall be reviewed by the Quality Responsible on site and approved by the Senior Manager prior to submission to the Contractor's Representative for comment.

2 PWP's shall describe necessary maintenance of the material or product.

2 A list of PWP's is permanently maintained by the Quality Responsible on site. A preliminary list is attached in appendix C.

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10- INSPECTION AND TESTING

- 2 Procedure IOS 0 QAP 99 ISB 0213 : « Inspection and Testing Plan – D & C Works » applies for inspection and testing activities carried out during the execution of the Works.

The overall system of quality inspection is applied to all intervening parties, and is divided into three levels :

- « Internal » inspection by the Subcontractor/Supplier

For each production unit, the issuer of the document will systematically check the conformity of the Works (self inspection and hierarchical inspection):

- « External » inspection

Our Quality Responsible on site will perform periodical evaluations and audits during the construction works and to ensure the proper implementation and the efficiency of the quality system.

Comments : Describe here below your internal methods for external inspection.

- « Independent » inspection

All subcontracted activities are subject to independent inspections. These inspections will be carried out by the Contractor or by organisations commissioned by him.

11- CONTROL OF INSPECTION, MEASURING AND TEST EQUIPMENT

- 2 A study of the tolerances stated in the contract is carried out during the preparation phase to check that the degree of accuracy with regard to inspection, measuring and testing equipment is appropriate.

- 2 A list of inspection, measuring and testing equipment, containing their calibration frequency and verification methods is managed on site.

Each piece of equipment is identified by a follow-up sheet attached to it, containing the frequency of calibrations or checking, completed with written proof that they have been carried out, and their results. Any item of equipment or instrument which is not correctly adjusted or not in working order is identified by an « out of service » label and withdrawn from use.

Special care is taken with regards to the condition of use and storage of inspection, measuring and test equipment so that the reliability is not affected.

Small equipment checking is under the user's responsibility who may request the foreman to replace the one broken down.

12- INSPECTION AND TEST STATUS

Conforming works and materials shall not be subject to physical marking.

Any materials or work found to be nonconforming shall be clearly identified (see paragraph below) and, when possible, segregated to prevent inadvertent use.

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For overlaid works or covered-up works, tested and approved parts of works shall be clearly identified on marked-up plans or schedules, in order to avoid any further works on parts or layers which have not been approved.

13- CONTROL OF NONCONFORMING PRODUCT

- 2 Filing and handling of nonconformance reports is outlined in procedure IOS 0 QAP 99 ISB 0215 : « Controlling Non Conforming Products – D & C Works ».

Nonconformance reports will be numbered; identify the product, materials, and/or activity, and the specific problem; give reasons for the problem and indicate necessary correction and corrective action.

Comments : Subcontractor/Supplier manufacturers who manufacture their products in a factory (beam, segment, etc...) may either use this procedure or use their own, on condition that the procedure has been reviewed and approved by the Contractor and that documents comply with specifications after the non conformities have been dealt with and that the supply delivered on site is complying after the nonconformance was handled internally.

14- CORRECTIVE AND PREVENTIVE ACTION

- 2 As far as possible, nonconformance reports should indicate what impact the problem will have on Works costs and schedule, in order to initiate corrective and preventive actions.

- 2 When deficiencies in the implementation of the quality management system are identified as a result of audit (see paragraph 17), corrective action shall be implemented to correct the condition and prevent its recurrence. Depending upon the nature of the deficiency it shall be addressed/documented in one of the following ways :

- comments indicated on Execution Follow-up Documents
- Corrective Action Request (CAR) form,
- Recommendation (REC) form,

15- HANDLING, STORAGE, PACKAGING, PRESERVATION AND DELIVERY

15.1 Handling, Storage, Packaging and Preservation

Products and materials shall be stored and handled in accordance with specified requirements to maintain integrity prior to incorporation into the works.

For the more sensitive materials and products the conditions of marking, packaging, handling, storage and transport shall be defined in the contract.

When appropriate materials shall be stored off the ground on pallets, racking or timber supports and items subject to deterioration shall be stored in a suitably dry protected environment.

Suppliers of factory products may use this procedure or a similar one, on condition that the latter is reviewed and approved by the Contractor, more particularly regarding the proposed follow-up documents.

15.2 Hand-over of Completed Works

- 2 Hand-over of completed works will be carried out according to ISB-JV's requirements.

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2 Upon completion of the Works, the Senior Manager shall prepare a final file as defined in paragraph 16.

16- QUALITY RECORDS

Comments : describe here below your internal methods for identification, retrievability, filing, indexing for fabrication, record books, quality of reproductions, number of copies, archive requirements and final disposition at completion of your contract.

2 Records will be protected from damage.

2 Retained records includes operating logs, result of reviews, certificates, inspections, tests, audits, and material analysis, Particular works procedures, qualification of personnel, equipment, and other documentation such as, drawings, specifications, purchasing documents, and nonconformance and corrective action reports.

Charts, reports and other engineering data, including electronic documents and drawings, photographs, and radiographs will:

- be easy to exploit during their archiving,
- be stored and filed in a controlled manner,
- become the CONTRACTOR's property, upon completion of the contract.

2 A monthly Quality Program Report will be issued by the Quality Responsible on site identifying the quality problem areas and what will be done about them. This will be handed over to the Contractor for information.

The final file will include :

- The executed structure file - "As-Built Drawings" or ESF
- The quality file or QAF, composed of the Preparatory Documents :
 - . the Quality Plan documents,
 - . the associated Procedures,
 - . the Particular Works Procedures,
- The Works file, (i.e. the execution follow up documents) and composed of :
 - . the Suppliers Works file or SWF (i.e. ETFs, ICLs, NCRs, etc...),
- The maintenance file (MAF).

Upon hand-over of the Works one copy of the Final File shall be delivered to the Contractor by the Senior Manager.

17- AUDIT

2 An Audit program will be developed and implemented to ensure that all elements of the Quality Plan are being carried out in a timely manner. All audits will be executed by our Quality Responsible. Audits will be performed using checklists and conducted by qualified personnel not having direct responsibilities in the areas being audited.

2 Audits will be scheduled regularly on the basis of the status and safety importance of activities being performed and shall be initiated early enough to assure effective quality assurance during the work, procurement, and construction activities. Contractor will be informed of all scheduled audit events on a monthly basis and shall be copied on all audit reports, if requested by the Contractor.

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18- TRAINING

Training needs, including quality assurance and quality control training will be identified by the Senior Manager, who will provide for the training of all personnel performing activities affecting quality of the Work..

Personnel performing specific assigned tasks will be qualified on the basis of appropriate education, training and/or experience, as required. Records of training will be maintained.

19- SERVICING

A maintenance period of 1 year is foreseen by clause 50 of the contract. Procedure IOS 0 QAP 99 ISB 0220 « One year Maintenance – D & C Works », details the preparation and issue of utilization notices, specific maintenance procedures, list of spare parts and training of Employer's staff. An organization chart as well as a job description of each of the main intervening parties will be issued in due course.

Comments : if any

20- STATISTICAL TECHNIQUES

Sampling procedures shall be developed when required to estimate objectively the level of quality achieved. Such procedures shall be based upon the appropriate statistical methods.

The results of sampling inspections shall be documented and evaluated to ensure timely corrective action should significant variations in work operations be identified.

When guidance on frequencies of testing is contained in Contract Documents, or standard specifications, these requirements shall be incorporated into the quality system.

Comments : if any

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Appendix A

Subcontractor / Supplier Organisation Chart

2 To be supplied.



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Appendix B

- Preparatory Documents - Quality Assurance Procedures :

IOS 0 QAP 99 ISB 0003 Coding of Documents
 IOS 0 QAP 99 ISB 0004 Document Format and Presentation
 IOS 0 QAP 99 ISB 0012 Material Submittal
 IOS 0 QAP 99 ISB 0013 Clarification, Field Change and Derogation requests
 IOS 0 QAP 99 ISB 0208 Execution Follow-up Documents – D & C Works
 IOS 0 QAP 99 ISB 0209 Establishing Particular Works Procedures – D & C Works
 IOS 0 QAP 99 ISB 0211 Conducting Audits – D & C Works
 IOS 0 QAP 99 ISB 0212 Material Delivery and Storage – D & C Works
 IOS 0 QAP 99 ISB 0213 Inspection and Testing Plan – D & C Works
 IOS 0 QAP 99 ISB 0214 Inspection, Measuring and Testing Equipment Control – D & C Works
 IOS 0 QAP 99 ISB 0215 Controlling Non-conforming Products – D & C Works
 IOS 0 QAP 99 ISB 0220 One year maintenance – D & C Works

- Specific Procedures :

CODIFICATION	DOCUMENT TITLE	TO BE ISSUED BEFORE :
	« Organisation Chart and Job Description »	

- Typical Inspection Test Plan :

CODIFICATION	DOCUMENT TITLE	TO BE ISSUED BEFORE :

- Typical Inspection Check lists :

CODIFICATION	DOCUMENT TITLE	TO BE ISSUED BEFORE :

- Miscellaneous :

CODIFICATION	DOCUMENT TITLE	TO BE ISSUED BEFORE :

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Appendix C

List of Particular Works Procedures

[illegible]

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Appendix D

List of Inspection, Measuring and Testing Equipment

Name / Type	Tolerance	Name of the Responsible	Date of last calibration



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Rev	Status	Date	Description	Prepared	Checked	Approved

EMPLOYER

ISTANBUL OLYMPIC STADIUM

Design and construction
of 80 000 seats Olympic Stadium

PROCEDURE

EXECUTION FOLLOW-UP DOCUMENTS
DESIGN & CONSTRUCTION WORKS

CONTRACTOR

Originator :

CONTRACTOR- Quality Dept.

Prepared by AAAAA		Date 20/08/99	Status For approval	Associated file ISB0208-2		Total number of pages 6+7 app.
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3.2 Structure of an ETF

4.0 PROCEDURE

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5.0 APPENDICES

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Appendix 3 Observations and Minor Non-Conformities

Appendix 4 Non-Conformities Synthesis form

Appendix 5 to 6 Inspection Checklists

B Appendix 7 Request for Inspection/Test

B Appendix 8 Execution Follow-up Documents Chart

Execution Follow-up Documents

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1.0 SCOPE

The purpose of this Procedure is to describe the preparation, composition and processing of the Execution Tracing File (ETF) and Inspection Checklist (ICL), documents used by the staff on line in order to:

- prepare the implementation
- keep a record of the inspections carried out
- testify during the implementation that programmed inspections are being done, and are satisfactory.

ETF is a part of the documents to be incorporated into the "End of Construction Report".

2.0 REFERENCE DOCUMENTS

2.1 Contractual Documents

The Main Contract (clauses 14 and 37 part 1 – general conditions)
ISO 9001: 1994

2.2 Other Documents

IOS 0 QAP 99 ISB 0201 "Quality Assurance Plan – D & C Works"
The associated Quality Assurance procedures, and in particular:

IOS 0 QAP 99 ISB 0003 "Coding of Documents"

IOS 0 QAP 99 ISB 0005 "Filing and Archiving"

IOS 0 QAP 99 ISB 0204 "Documents Control – D & C Works"

IOS 0 QAP 99 ISB 0213 "Inspection and Testing Plan – D & C Works"

IOS 0 QAP 99 ISB 0219 "End of Construction Report – D & C Works"

3.0 GENERALITIES AND STRUCTURE OF AN EXECUTION TRACING FILE (ETF)

3.1 Generalities

Setting-up and management of execution follow-up documents, are part of the quality assurance fundamental approach which implies total involvement of the project engineering and allows the quality system to be credible.

The attached forms are those used by ISB-JV. They can also be used by the different subcontractors, without renouncing to the utilization of their own follow-up forms, developed for their own activity. These will have to be approved by the JV.

Purposes of the quality system are:

- to prepare what is to be done,
- to do what was programmed,
- to prove what has been done
- to get the trace of the full execution documents, showing the total compliance with the contract requirements.

3.2 Structure of an ETF

The Concerned Works Manager defines a division of the works, in trades, activities, groups, parts or areas (zones) of construction which shall be subject of an ETF.

Execution Follow-up Documents

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The activities for this project are: Concreting, Steel roofs, Architectural (including steel stairs), Mechanical, Plumbing, Electrical (for example: the concreting activity is divided in Areas, Levels, Zones as per the Coding of Measurements document). For the other activities, the Concerned Works Manager should also define the division of their own activity.

The ETF gathers the whole inspection documentation established for the concerned part.

ETF includes the following:

- the cover page (appendix 1) which allows to:
 - locate the concerned parts,
 - specify the defining documentation to be used,
 - make observations at the end of the works, when the ETF is closed,
 - testify for the compliance of the concerned works.
- a second internal page that allows to set up the list of the types of different documentation included in the file (appendix 2),
- a third internal page that allows to gather observations made during the implementation, and especially minor conformities (appendix 3),
- one back page which allows the synthesis of the opened non-conformance reports (appendix 4).

ETFs will be available at any time during the execution of the works. They are usually kept in the Technical Office (the third internal page shall be available on Site Offices, in A4 format, to allow internal/external inspectors record their observations regarding the ETF and it shall be attached to the ETF before closure).

4.0 PROCEDURE

4.1 Raising an ETF

An ETF shall be raised by the Concerned Works Manager, following internal meetings which identify the phases and parts of the work and the inspection points, including "Report", "hold point"s and "witness point"s which shall be identified on the relevant Inspection and Testing Plan (see QAP's ISB 0213: Inspection and Testing Plan – D & C Works), and/or in the Works Procedures. The ETF shall be raised earlier before any operation according to works schedules: placing concrete, compacting, boring, etc. For ETFs no time limit shall be deemed a constraint. N° of ETFs shall be kept in a reasonable amount to simplify the follow-up while tracing every single activity.

The ETF is completed with inspection documentation by raising specific Inspection Check List (ICL) coded as follows (other ICLs can be raised for specific works, such as prestressing, etc.):

- Concreting inspection Check List (CCL)
- Electrical inspection Check List (ECL)
- Mechanical inspection Check List (MCL)
- Plumbing inspection Check List (PCL)
- Architectural inspection Check List (ACL)

An Inspection Check List for Works Approval (ICL) concerning important and critical phase of works will be raised for clearance of an ISB Hold Point (HP).

Execution Follow-up Documents

IOS	0	QAP	99	ISB	0208	B -INT	page 4/6
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B	According to the nature of the construction part to be done, and to the preliminary risk analysis, each inspection on previously identified sensitive points is mentioned by the one in charge of the works on checklists (appendices 5 and 6: CCL and typical checklist for other trades).
B	The checklists shall be used in order to follow-up the execution of construction or parts of construction of the same nature and shall include the following:
B	- the ETF N° that is concerned - the RIT (Request for Inspection/Test) N° that is concerned (this the form that is used to request the employer to inspection and / or test and to get his acceptance for the structure / area / line / etc. – see Appendix 7)
B	- the list of inspections - the programmed internal inspections and the mention of witness and hold points (internal and external control) - the mention of the type of official reports to be established.
	This step implies that:
	- a witness point requires that its requester be informed of the time of the inspection, but his absence doesn't prohibit the pursuit of the works, - a report for a typical inspection (ie: dimensional) is required, but doesn't prohibit the pursuit of the works, - a hold point doesn't allow the pursuit of the operation as long as the requester has not made or documented his inspection on the checklist and thus allowed the pursuit of the works.
B	
	4.2 Implementation of an ETF
	Before starting the work, the ETF is opened and documented on folio 1 (appendix 1) including:
	- form number,
B	- concerned parts of the works (area, zone, level, type, N°, etc.)
B	- list of particular works procedures for special cases at their last revisions (water tank slipform, etc.) - possible particular points.
B	Types of different documents included in ETF are listed on folio 2 (appendix 2), and nonconformance reports are listed on folio 4 (appendix 4).
	During the implementation, observations made after any internal/external inspection may be documented on folio 3 of the ETF (appendix 3).
B	Inspections carried out during the progress of the works are documented on the checklists according to the specific code and by People in charge.
B	Possible Official Reports are to be checked by Construction and QA/QC Departments and maintained by QA/QC Department. These reports are reference of the special reports to solve the inspection points (Laboratory report, External Expert report, Test report, etc.), and shall not be included in the ETF. Construction Manager and QA/QC Manager shall certify on ETF front page that all the results are satisfactory.
B	

Execution Follow-up Documents

IOS	0	QAP	99	ISB	0208	B -INT	page 5/6
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B	Possible FADs and CRQs concerned shall be listed in the ETF with their latest revisions. The RITs shall be maintained by the QA/QC Department during the works and shall be collected in the ETF before closure. Possible nonconformance reports shall be included in the ETF. In particular for steel works ETF, the names of the concerned welders shall be included. As there is no checklists applicable for steel works, list of the bolting and welding control reports and test reports shall be included in the ETF.
B	4.3 Use and Circulation of an ETF The Concerned Works Manager shall coordinate the use and circulation of the ETF with all contributing parties including: - advance notification to any concerned party of witness and hold points being reached, - obtaining of written release for hold point prior to work commencing, - verification ensuring the ETF is properly filled and signed by the Works responsible persons and any other identified party, - checking the ETF, once the concerned works are over, - dispatching the ETF to the QA/QC Engineer or Inspector, to show any observation or non-conforming apparent situation.
B B B B	4.4 Closing an ETF When closing an ETF the Concerned Works Manager shall: - check the presence of all necessary documents, ensuring each page is numbered and that each included document is listed on folio 2, - check the availability of required test results, such as concrete test cube results retained by the Laboratory, and compliance with requirements for test results control, - check any recorded non-conforming situation has been treated and satisfactorily resolved. (An ETF cannot be closed, until an identified non-conforming condition has been resolved and the date on which it was resolved added to the follow-up of "ICL"). After final checking, the Concerned Works Manager shall sign page 1 and forward the complete ETF to the QA/QC Manager for checking its contents, including verifying resolution of all non-conformance, prior to his signature. Sequence of operations is shown on appendix 8. After signature of all parties, the QA/QC Manager shall send the ETF to IOBC. After his signature the ETF is transmitted to Document Control for filing. Page 1 is designed in a way that, the subcontractors' representatives can sign for final conformity when the works are subcontracted : Works Manager and Quality Assurance representative.

Execution Follow-up Documents

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Execution Tracing File

I	O	S	1	E	T	F			I	S	B				
Area			Trade			Originator			Chrono						

Level	

Zone	

DESIGNATION :

Documents Used (Title)	Reference No	Rev	Concerned Works
Drawings			
Inspection or Test Procedures			
Inspection Check Lists			Particular Points
Methods Documents			

Observations When the ETF is to be Closed:

Conformity Certificate Subcontractor 1 :			Conformity Certificate Subcontractor 2 :			Conformity Certificate Subcontractor 3 :		
Company :			Company :			Company :		
Date :			Date :			Date :		
Name :			Name :			Name :		
Signature :			Signature :			Signature :		

Final Conformity Certificate ISB Works dept.:			Conformity Certificate by ISB QC dept.:			Approval by IOBC if necessary:		
Date :			Date :			Date :		
Name :			Name :			Name :		
Signature :			Signature :			Signature :		

Istanbul Olympic Stadium

Documents Included

In the Execution Tracing File (ETF) No:

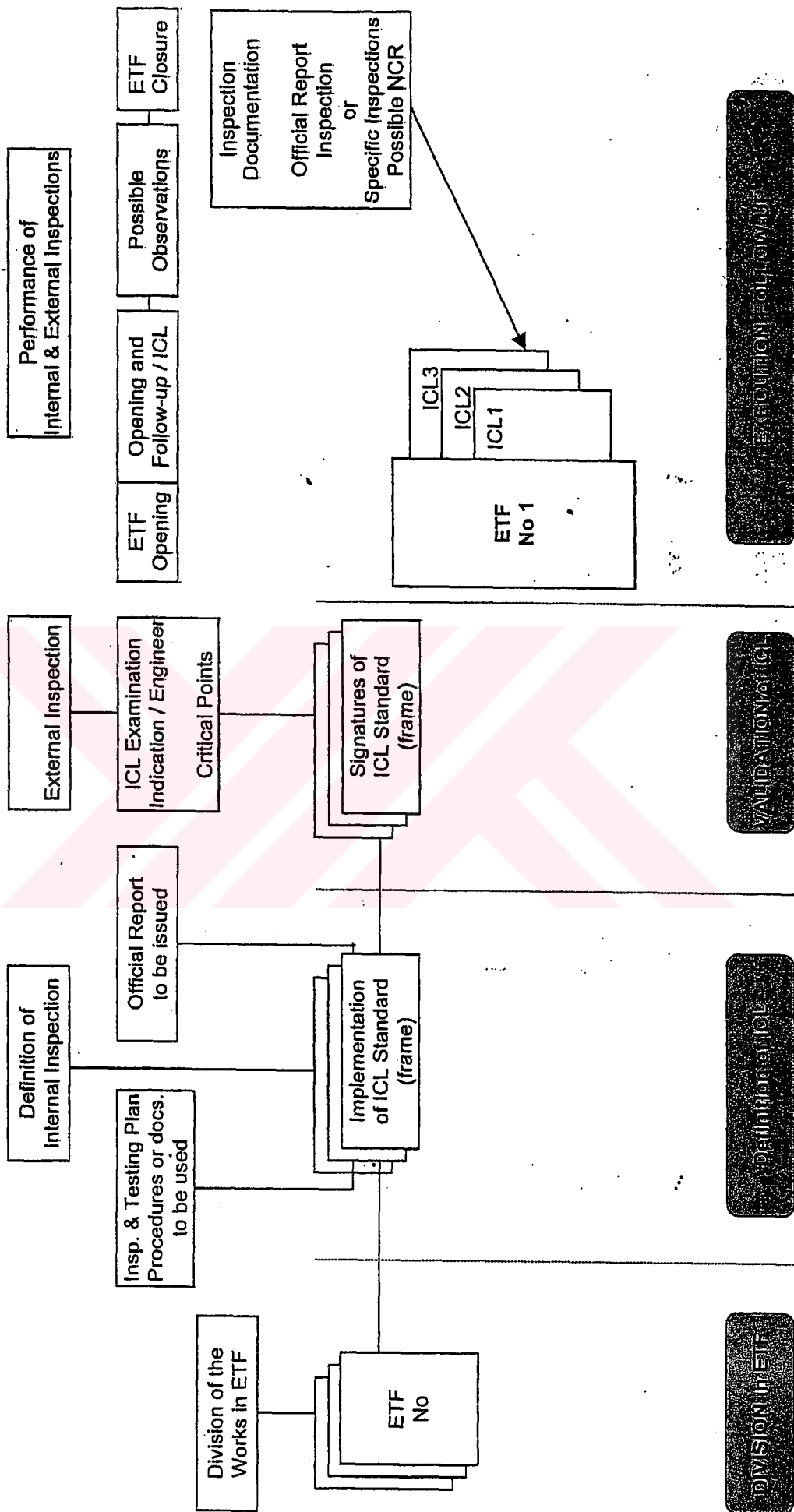
I O S 1 E T F I S B

No	Nature	Observations

I	O	S	1	E	T	F			I	S	B				
---	---	---	---	---	---	---	--	--	---	---	---	--	--	--	--

No	Wording	Issuer / Date	Person in Charge	Closure Date / Signature	Observations - WP/HP Witness & Hold Points

EXECUTION FOLLOW-UP DOCUMENTS CHART



2	FAP	10/08/99	Revised as indicated	RE	AG	GR
1	FAP	07/06/99	For Approval	CG	AGY	GR
A	PRE	05/06/99	first issue	CG	AGY	GR
Rev	Status	Date	Description	Prepared	Checked	Approved

EMPLOYER

ISTANBUL OLYMPIC STADIUM

Design and construction
of 80 000 seats Olympic Stadium

PROCEDURE

ESTABLISHING PARTICULAR WORKS PROCEDURES DESIGN & CONSTRUCTION WORKS

CONTRACTOR

Originator :

CONTRACTOR- Quality Dept.

Prepared by AAAAA		Date 17/08/99	Status For Approval	Associated file ISB0209-2		Total number of pages 7
Istanbul Olympic Stadium IOS	Area 0	Document type QAP	Trade 99	Originator ISB	Chrono number 0209	Revision 2

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ESTABLISHING PARTICULAR WORKS PROCEDURES

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1.0 SCOPE

- 2 The purpose of this Procedure is to describe the preparation and control of Particular Works Procedures (PWP).
- 2 A PWP is a document which defines the resources, materials, operating instructions and
- 2 inspections to be applied to the execution of part of the works or a specific operation, activity or task where it is important to instruct on-line staff.

2.0 REFERENCE DOCUMENTS

2.1 Contractual Documents

The Main Contract (clauses 14 and 37 part 1 – general conditions)
ISO 9001: 1994

2.2 Other Documents

- 2 IOS 0 QAP 99 ISB 0201 " Quality Assurance Plan - D & C Works ",
- IOS 0 QAP 99 ISB 0003 " Coding of Documents ",
- 2 IOS 0 QAP 99 ISB 0004 " Documents format and presentation ",
- 2 IOS 0 QAP 99 ISB 0204 " Documents Control – D & C Works ",
- 2 IOS 0 QAP 99 ISB 0208 " Execution follow-up documents - D & C Works ",
- 2 IOS 0 QAP 99 ISB 0212 " Material Delivery and Storage - D & C Works "

3.0 GENERALITIES

3.1 Coding

- 2 The coding of each PWP is established in accordance with the IOS 0 QAP 99 ISB 0003: " Coding of Documents ".

3.2 Preparation, Review and Approval

The Construction Manager responsible for a sensitive activity, shall ensure that a PWP addressing the performance and control of that activity, is available prior to the activity commencing.

When necessary, the Construction Manager shall nominate a person experienced in the particular activity, to undertake the preparation of the Procedure. The Person nominated may consult other person experienced in performing the activity.

- 2 PWP to be applied to all work activities, or special processes, shall be prepared by the Construction Managers or nominee.
- 2 When completed, the PWP shall be checked by the Construction Manager and the Technical or Design Manager prior to forwarding to the QA/QC Manager for review.

The QA/QC Manager shall review the document for compliance with quality management system requirements and if necessary shall ask for clarification on technical aspects from the Technical or Design Manager.
- 2 Following the review, the PWP shall be approved by the Project Manager.

ESTABLISHING PARTICULAR WORKS PROCEDURES

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2 Completion of the "Preparation, Review, Approval" process, shall be demonstrated by the relevant person signing the appropriate box on the PWP title block.

The PWP shall be forwarded to the Employer under For Approval (FAP) status for review and/or comments in accordance with the Main Contract.

3.3 Distribution

The distribution of a PWP shall be in accordance with the IOS 0 QAP 99 ISB 0204 " Documents Control – D & C Works ".

2 The relevant Construction Manager shall retain a Distribution Record for each PWP established within that section, and the original document will be filed in the Technical department.

3.4 Revisions

During the progress of the works, it may become necessary to amend a PWP as a result of feedback from users, audit or a management review. The amendment, review and approval process for the revised document shall be the same as for the original issue.

4.0 PROCEDURE

4.1 Summary

Each PWP shall have a "Title Block" prepared to a standard format and standard "Follow-on" pages as defined in the IOS 0 QAP 99 ISB 0004 " Documents Format and Presentation".

The PWP shall be developed, as far as possible, under the following headings :

- Scope
- Reference Documents
- Resources
- Materials
- Operating Instructions
- Inspections

4.2 Comments

4.2.1 Title Block

The Title Block shall include the following information :

- Name of the Contract
- Name of the Employer
- Name of the Project
- Name of the Contractor
- Name of the Issuer
- Title of the PWP
- Revision grid (including the following) :
 - * Revision index
 - * Date
 - * Names and Signatures of Issuer, Reviewer, Approver

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4.2.2 Follow-on-Pages

4.2.2.1 Scope

- 2 Scope, shows field and limits of application.

4.2.2.2 Reference Documents

- Contractual Documents

Applicable Contractual references, texts, standards and codes shall be reminded.

- Execution Documents

The different documents established by the Contractor, including quality, technical documents and suppliers data sheets, which will be used for the execution or test, are to be quoted. Reference to sketches, method drawings, or supplementary procedures may also be made.

4.2.2.3 Resources

Resources include the description of the following :

- Equipment
- Personnel

The equipment and operating personnel (qualification) which allow the implementation of the work, or the means of replacement, are to be fully specified.

Calibration of equipment for measurement and test shall be specified when needed.

4.2.2.4 Materials

- 2 Check that necessary submissions were established and obtained for the more sensitive
2 materials, in accordance with the IOS 0 QAP 99 ISB 0012 "Material submittal – D & C Works"
2 and IOS 0 QAP 99 ISB 0212 "Material Delivery and Storage – D & C Works"

Detail handling and storage requirements and detail the particular grade or trade mark.

Materials refer to :

- Incorporated materials
- Consumable materials

2 4.2.2.5 Safety measures

- 2
2 Detail safety measures to be taken prior to starting; also refer to applicable safety codes, rules
2 and regulations.

4.2.2.6 Operating Instructions

Operating Instructions refer to the definition of the following ;

- Principle
- Phases.

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The principle of execution, the technical requirements and different phases of implementation and constraints of time which influence the schedule, are to be described briefly. Sketches can be appended to the procedure to show the different phases

When the procedure describes a construction or a part of the construction, details of the individual parts shall be attached and shall identify the relevant Execution Tracing Files and Inspection Checklist.

For equipment tests, the quality approach includes two phases :

- Ensure (with objective evidence) that each elementary component can assure its function in the specified conditions. This phase is composed of a series of preliminary tests before the real test of the complete equipment.
- Consider the global capacity of the equipment (comprising the assembly of elementary components) and capability for the testing.

A typical Inspection Checklist shall be established, identifying the different phases of the test and shall reference the particular reports to be prepared.

4.2.2.7 Inspections

- Parties

The persons in charge of different inspections are to be mentioned: Internal inspection (construction team and possible independent organizations) or external inspection by the Contractor.

The different inspections are identified on the Inspection Checklists, which are established in conjunction with the procedure.

- Result value requirements

Remind the required values for each kind of control.

- Sensitive points

A sensitive point is an execution point which requires particular attention from the internal inspection. It might be a "hold point" or "witness point".

- Hold and witness point

"Hold Point" and "Witness Point" identified, are to be mentioned. They will be included on the established checklist. Their definition is reminded below :

A Witness Point requires that the requester shall be informed of the time of the inspection, but absence at the time of the inspection, does not go against the continuation of the works.

An Hold point, forbids the continuation of the work as long as the requester has not documented the inspection on the execution follow-up documents.

- Tests

Tests for equipment are indicated in clause 4.2.2.5 here above.

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Tests to be carried out before the application of the procedure, are to be described. The obtained and requested values are to be mentioned in the test report, including mandatory test requirements.

- **Documentation**

The type of document where the controls are identified (generally an inspection checklist) is to be specified. Attach particular sample copies if they are not given with other existing documents.

The distribution shall be identified, taking into account the setting up of the Execution Tracing File.



ESTABLISHING PARTICULAR WORKS PROCEDURES

B	PRE	2000-04-24		MR/OU	CY	GR
A	PRE	27/10/99	First Issue	OU	RE	GR
Rev	Status	Date	Description	Prepared	Checked	Approved

EMPLOYER

ISTANBUL OLYMPIC STADIUM

Design and construction
of 80 000 seats Olympic Stadium

Procedures Management

CONTRACTOR

Originator :

CONTRACTOR- Quality Dept.

Prepared by AAAAA		Date 2000-04-24	Status Preliminary	Associated file ISB0210B.DOC		Total number of pages 3
Istanbul Olympic Stadium IOS	Area 0	Document type QAP	Trade 99	Originator ISB	Chrono number 0210	Revision B

1. Purpose

The purpose of this procedure is to define the system for management of the Quality Assurance Procedures and Particular Works Procedures.

2. Reference documents

- IOS/0/QAP/99/ISB/0201 : Quality Assurance Plan
- IOS/0/QAP/99/ISB/0204 : Documents Control
- IOS/0/QAP/99/ISB/0209 : Establishing Particular Works Procedures
- IOS/0/QAP/99/ISB/0003 : Coding of Documents
- IOS/0/QAP/99/ISB/0004 : Documents Format and Presentation
- IOS/0/QAP/99/ISB/0005 : Filing and Archiving

3. Field of Application

This procedure shall apply to all the Quality Assurance Procedures and the Particular Works Procedures within the scope of the quality system of ISB-JV.

4. Procedure

4.1 General

IOS/0/QAP/99/ISB/0204 "Documents Control" procedure is referred for handling (issue, review, approval, etc.) any document. For coding, formatting and presentation QAP's: IOS/0/QAP/99/ISB/0003 "Coding of Documents" and IOS/0/QAP/99/ISB/0004 "Documents Format and Presentation" are referred. Once approved, the originals of the procedures are kept in the archive of Technical Department as per IOS/0/QAP/99/ISB/0005 "Filing and Archiving".

Both QAP's and PWP's are internal documents, therefore they are not sent to client for approval.

QAP's and PWP's are entered in the program Arthur (Documents Control System Software) when they are first issued. And updated for all review and validity as explained in the QAP IOS/0/QAP/99/ISB/0204 "Documents Control".

4.2 QAP's

Each Quality Assurance Procedure corresponds to related articles of ISO 9001-1994 as explained in IOS/0/QAP/99/ISB/0201 "Quality Assurance Plan". Explanations are given and the responsibilities are addressed to define how the quality requirements are complied with.

These procedures are prepared by the concerned department managers or people designated by them. Procedures are checked by QA/QC Department, in terms of ISO requirements and scope of the activities. Procedures are approved by CB-SGE Corporate Quality Manager.

Following the approval, QAP's are issued as internal documents.

QAP's define what is implemented and how it is done. Therefore, they are reviewed regularly once a year or when deemed necessary, to keep them up-to-date and appropriate. Review is done by the writers of the document. And same process is applied for the checking and approval stages.

4.3 PWP's

ISB subcontracts the works. For particular works, subcontractors are requested to have documented procedures. Referring the QAP IOS/0/QAP/99/ISB/0209 "Establishing Particular Works Procedures", subcontractors develop their PWP's.

PWP's are prepared, checked and approved by the organization of the subcontractors. Then they are submitted to ISB-JV for checking, and internal approval. When found appropriate, conforming the requirements and/or standards, they are issued as **internal documents**.

Same process is applied for the review of PWP's, as explained for QAP's.

Checking and incorporation of comments:

Technical Department - Documents Control will receive 01 copy of the procedure, under status PRE (preliminary), revision A.

The document shall be duplicated and copies shall be distributed through transmittal note to the concerned people, for review and comments :

01 copy to concerned Construction Section Manager / Trades Responsible

01 copy to concerned QA/QC Engineer

01 copy each to the other concerned engineers / architects

Following review, comments shall be returned to ISB Technical Department - Documents Control within a week from the date of receipt, using the QA form "Document Verification Sheet" (DVS).

Comments through DVS are incorporated and communicated to the Construction Section Managers / Trades Responsibles.

- **DVS shall be returned even with no comments.**
- **In case of discrepancy between several DVSs, the Construction Section Manager / Trades Responsible will solve the issue with the concerned parties.**

In case document needs revision as per finalized comments, the procedure shall be repeated until the document is internally approved.

4.4 Internal Document Issue:

Any revision on an internally approved document shall be subject to the implementation of the revision procedure. **Superseded revisions** shall be destroyed by the holders to avoid misuse of the previous revisions, and **shall be kept only by Document Control**.

Concerned Construction Section Manager or QA/QC Manager will give the internal approval with corresponding revision number, at the latest one day before the scheduled starting date for the corresponding works.

5. Appendices

Circulation – Dispatch of PWP's Flow Chart

Procedures Management

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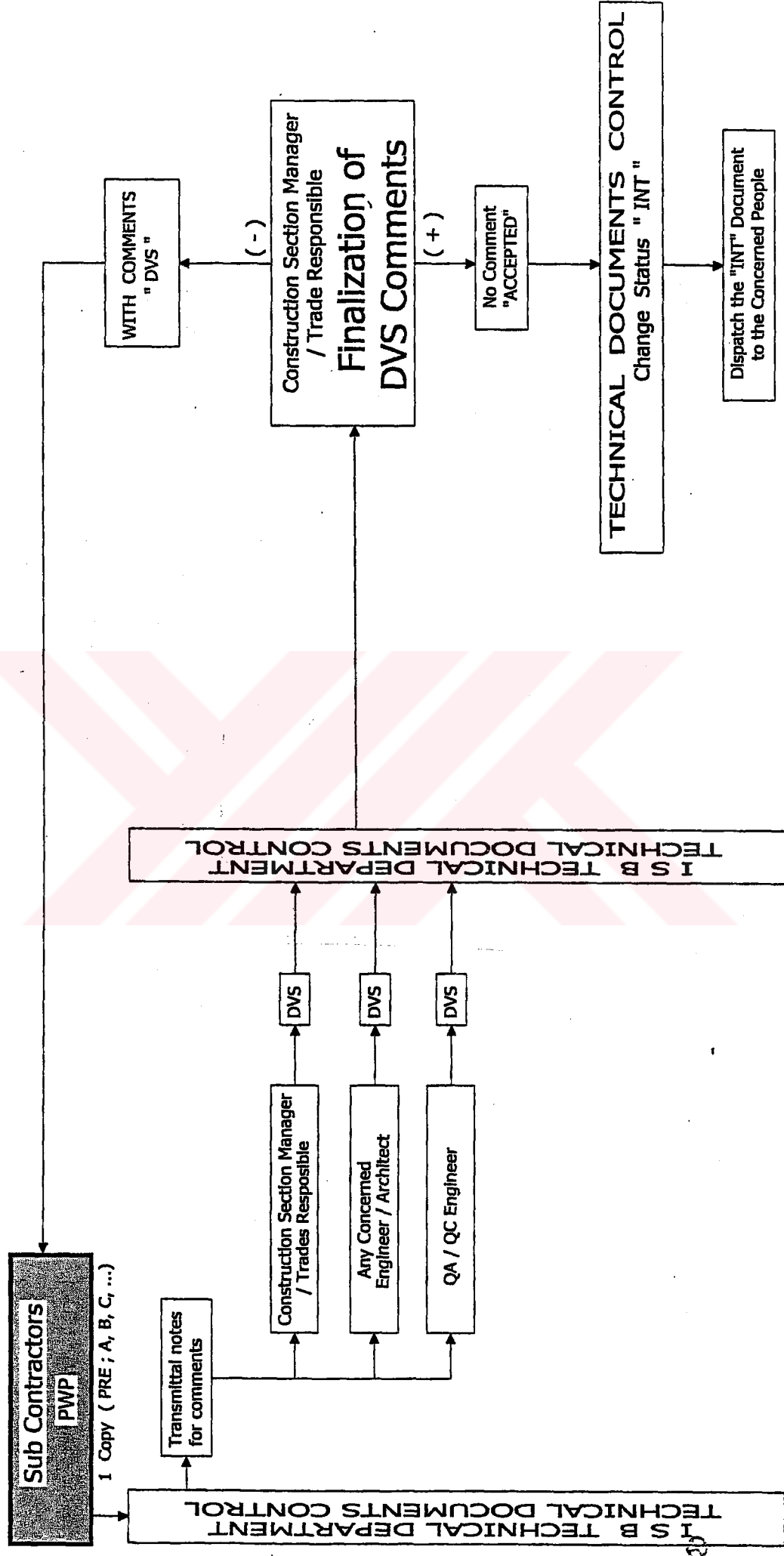
0210

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CIRCULATION - DISPATCH OF PARTICULAR WORKS PROCEDURE FLOW CHART



B	INT	02/11/99	Review and reissue	OU	RE	AGY
1	FAP	10/06/99	For approval	CG	AGY	GR
A	PRE	07/06/99	First issue	CG	AGY	GR
Rev	Status	Date	Description	Prepared	Checked	Approved

EMPLOYER

ISTANBUL OLYMPIC STADIUM

Design and construction
of 80 000 seats Olympic Stadium

Procedure

Inspection and Testing Plan

DESIGN & CONSTRUCTION WORKS

CONTRACTOR

Originator:

CONTRACTOR-Quality Dept.

Prepared by AAAAA		Date 10/11/99	Status Internal	Associated file ISB0213B.doc		Total number of pages 5+1 app.
Istanbul Olympic Stadium	Area	Document type	Trade	Originator	Chrono number	Revision
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4.2 Approval

4.3 Distribution

4.4 Review

Appendix 1: Inspection and Testing Plan

1.0 SCOPE

The purpose of this Procedure is to describe the system for establishing and controlling Inspection and Testing Plan (ITP), setting out inspection and test requirements against which the quality of materials, fabrication, construction and installation is checked in each section of the Construction Department.

Sub-Contractors have to apply the same system, providing their own ITP.

2.0 REFERENCE DOCUMENTS

2.1 Contractual Documents

The Main Contract (clauses 14 and 37 part 1 – general conditions)
ISO 9001: 1994

2.2 Other Documents

IOS/O/QAP/99/ISB/0201: "Quality Assurance Plan – D & C Works"
B IOS/O/QAP/99/ISB/0003: "Coding of Documents"
IOS/O/QAP/99/ISB/0204: "Documents Control"
IOS/O/QAP/99/ISB/0208: "Execution follow-up documents"

3.0 GENERALITIES

The ITP specifies for each construction, part of construction or task, the inspection points and frequency, inspection method, criteria of approval, inspections responsible, documents related to the inspections (follow-up documents, procedure, drawings, etc.) and the type of inspection (witness point, hold point or report).

This plan includes also all necessary information to ensure an appropriate quality assurance and to set up execution follow-up documents complying to the quality requirements.

Related to a Works Procedure, the ITP is always written, before the execution follow-up documents and before starting the works, by the ISB-JV Construction Manager or their
B Subcontractors or by a formally identified nominee in relation with the QA/QC Manager, or by a
B formally identified nominee.

4.0 PROCEDURE

4.1 ITP Content

The person nominated shall prepare the ITP document to a standard format (appendix 1) and shall allocate a document number in accordance with the QAP IOS/O/QAP/99/ISB/0003: "Coding Documents".

This person shall ask, when necessary, guidance and advice from the Technical Department for matters related to Contract Specifications or Technical information, and from the QA/QC Manager regarding Quality Management System requirements.

Preparation of ITP shall provide appropriate information as follows (appendix 1):

- Item Number - this column specifies the chronological order of the inspections (numerical codification).

Inspection and Testing Plan

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- **Inspection Points** - the inspection and test activity to be undertaken shall be fully described:

- tests and inspections stated in standard and regulations texts,
- tests and inspections specified in the contract,
- tests and inspections required by external inspection, if any,
- internal inspections issued from professional rules,
- appropriate documents.

B

B - **Frequency** – specify if necessary, the frequency of performance of inspections.

- **Inspection Method** - identify the Method (visual, non-destructive tests, survey, dimensional, measurement, laboratory, etc.) with the relevant inspection Procedure(s) for controlling the activity.

B

B - **Acceptance Criteria** – specify the required tolerances, resistance, characteristics of equipment or part of works, or refer to the document specifying these requirements.

- **Follow-up documents** - identify the type of record. The Follow-up Documents are generated after inspections which are divided into three levels:

- **Internal Inspection** : self inspection and hierarchical inspection.

- **External Inspection** : inspections performed by the QA/QC Assurance Engineers (evaluations and audits), and by QA/QC Inspectors (spot checks or external inspections for hold points and witness point).

- **Independent Inspection** : inspections performed according to contractual documents.

When inspection and test activities are controlled by a Procedure, the "follow-up document" will normally comprise a completed Inspection Checklist (CL).

- **Inspection Activities** – indicate the nature of the inspection activity to be undertaken by the Sub-Contractor, the Contractor, and the Employer using the coding listed on the front sheet of the ITP.

B

B The ITP may be submitted to the Employer's approval. The latter will eventually identify the witness and hold points he wishes to define.

4.2 Preparation

The person nominated to prepare an ITP shall sign and date the front page of the ITP and shall provide it to the relevant Works Section Manager for checking and signing. After signing, the **Works Section** Manager shall submit the document to the QA/QC Manager for review and verification of compliance with quality requirements. Upon receipt of the ITP, the QA/QC Manager shall indicate the inspection requirements (witness / hold points) to be performed as external inspection, and then forward (if required) a copy to the employer, according to contractual documents, for comments and indication of inspection requirements (witness / hold point / report). After completion of the review, the QA/QC Manager shall forward the document to the **relevant** Construction Manager for signature.

B

B

ITP prepared by Sub-Contractors shall be signed and dated by the person nominated to prepare an ITP, and by Sub-Contractor's Works section Manager (internal), who shall forward the ITP, to the ISB - JV **Works section** Manager for verification and signing. After signing, the **Works section** Manager shall submit the document to the ISB - JV QA/QC Manager for review and verification of compliance with quality management system requirements and signature. Upon receipt of a Sub-Contractor's ITP, the QA/QC Manager shall forward (if required) a copy to the employer, according to contractual documents, for comments and indication of inspection

B

B

Inspection and Testing Plan

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B requirements (witness / hold point / report). After completion of the review, the QA/QC Manager shall forward the document to the **relevant** Construction Manager for signature. The ISB-JV Section team will be in charge of the external inspections, prior to any inspection by the QA/QC team.

Note 1: The **Relevant** Construction Manager is the ISB-JV Construction Manager for civil works and steel roofs works. He is the ISB-JV Technical Manager for Electromechanical and Architectural works.

B Note 2: The **Works section** Manager is the ISB-JV responsible for each of the following work activities: Civil, Steel Roofs , Electromechanical and Architectural.

4.3 Approval

The **relevant** Construction Manager shall review the ITP and shall indicate approval by signing the front page, before returning the document to the QA/QC Manager, who shall forward it according to contractual documents, for indication of agreement requirements by dating and signing the front page.

4.4 Distribution

B When the ITP has been signed and returned, it shall be distributed by the **Relevant** Construction Manager in accordance with the procedure IOS/0/QAP/99/ISB/0204 "Documents Control".

B The ITP should be the necessary basic documents to raise the Inspection Check List (ICL) to be included in the Execution Tracing File. See procedure IOS/0/QAP/99/ISB/0208 "Execution follow-up documents"

4.5 Review

The ITP shall be regularly reviewed and updated as necessary. Review, approval and distribution of the updated document shall be as for the first issue.

Inspection and Testing Plan

Inspection and Testing Plan

I O S . I T P I S B rev page /

Author		Internal Approval		ISB Works		ISB Const.		ISB QA/QC		IOBC	
Name		Name		Name		Name		Name		Name	
Date		Date		Date		Date		Date		Date	
Signature		Signature		Signature		Signature		Signature		Signature	
	/ /		/ /		/ /		/ /		/ /		/ /

CONSTRUCTION, PART OF CONSTRUCTION OR TASK:

[illegible]

<u>Inspection</u> <u>Type</u>	H	Hold Point
	W	Witness Point
	O	Other

IOS//QAP/99/ISB/0213/B - Appendix

B	INT	2000-01-31	Reissued according to practices	OU / RE	AGY	GR
1	FAP	1999-06-07	For Approval	CG	AGY	GR
A	PRE	1999-06-06	First issue	CG	AGY	GR
Rev	Status	Date	Description	Prepared	Checked	Approved

EMPLOYER

ISTANBUL OLYMPIC STADIUM

Design and construction
of 80 000 seats Olympic Stadium

PROCEDURE

CONTROLLING NONCONFORMING PRODUCTS DESIGN & CONSTRUCTION WORKS

CONTRACTOR

Originator :

CONTRACTOR- Quality Dept.

Prepared by AAAAA		Date 2000-01-31	Status Internal	Associated file ISB0215B		Total number of pages 5 + 2 appendixes
Istanbul Olympic Stadium	Area	Document type	Trade	Originator	Chrono number	Revision
IOS	0	QAP	99	ISB	0215	B

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Controlling Nonconforming Products

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1.0 SCOPE

The purpose of this procedure is to describe the process to be applied to all intervening parties (Contractor, Subcontractors, Suppliers / Manufacturers) for identifying and controlling any manufactured product or product being manufactured, as not conforming to specified requirements and how it is controlled to prevent from unintended use or installation.

2.0 REFERENCE DOCUMENTS

2.1 Contractual Documents

The main contract (clauses 14 and 37 part 1 – general conditions)
ISO 9001: 1994

2.2 Other Documents

IOS 0 QAP 99 ISB 0201 : Contractor's Quality Assurance Plan – Design & Construction Works
The associated Quality Assurance procedures

3.0 GENERALITIES

3.1 General

A non-conformity is a situation, when a contract specified condition, standard, rule, drawing or technical criterion is not fulfilled.

A non-conformity may result from, the non-observance of a particular works procedure, documented instruction, error, accidental cause, or when the deficiency cannot be corrected by immediate reworking at the time of identification.

A non-conformity shall be recorded on the ETF (Execution Tracing File) and the deficiency shall be addressed by a Non-Conformance Report (NCR) (appendix 1), when necessary (see levels of non-conformity).

3.2 Levels of non-conformity

A deficiency can be sited into four levels of non-conformity according to the importance of the consequences :

-Insignificant non-conformity – Level 1 (or NC1) :

Concerns only an execution procedure, which can be easily and quickly solved on site (example : concrete curing). This kind of non-conformity is not filed. In case of recurrence, it has to be noted in the follow-up documents and may create an NCR.

-Minor non-conformity – Level 2 (or NC2) :

Does not affect the final conformity of the product and can be solved by applying professional rules or an existing procedure (example : forgotten starter bars, replaced by equivalent bars embedded in drilled holes, additional compaction of earthworks to achieve the required density).

Minor non-conformity is noted into the follow-up documents. In case of recurrence, an NCR is to be opened.

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-Major non-conformity – Level 3 (or NC3) :

Does not affect the final conformity of the works and can be solved by applying a specific repair procedure (example : concrete cracks repaired by epoxy resin injection).

Major non-conformity implies to open an NCR.

-Critical non-conformity – Level 4 (or NC4) :

Affects the final contractual quality of the works, even its capacity to be used satisfactorily (example : non-respected clearance, wrong coordinates for a pile).

This situation implies to present a Derogation Request to accept the product which does not comply with the specifications. The NCR has to be attached to the request.

At this stage, (opening of NCR), a non-conformity becomes critical and product can be accepted with or without repair, rejected or scraped.

When accepted with repair, the non-complying part of works belongs to level 3, as the corrected product shall comply with the specified request.

3.3 Definition

Deficiency : Failure to comply with specified technical criteria, specification, drawings, general procedure or documented instruction.

Rework : Process by which any non-conforming work, item or materials made to conform to specified requirements by re-construction, re-machining, re-assembling or other corrective means.

Repair : Process of restoring a non-conforming characteristic to a satisfactory condition, although still not conforming to specified technical criteria.

4.0 PROCEDURE

4.1 Raising a Non-Conformance Report

B An NCR is opened when the non-conformity may be classified on level 3 or 4 (major or critical).
Exceptionally on level 2 (minor) if risk of recurrence.

B The Construction Responsible, Subcontractor, Manufacturer or Supplier raising a Non-Conformance Report(identified as " Issuer "), shall complete the Document number box, by taking the next available number from the "Non-Conformance Report Register"(appendix 2) in the QA/QC Department and shall complete the boxes, prior to forwarding the NCR to the QA/QC Manager, who will issue it through a memo to the relevant parties (Technical, Design, etc...).
B

Immediately after the NCR has been raised, the deficient work, item or material, shall be identified and tagged "HOLD" by the person identifying the deficiency.

Deficient work shall remain "HOLD" until reparation, and item or material shall be removed to a disposal area to prevent unintended use or installation.

The Construction responsible of the relevant activity shall ensure the "HOLD" identification is maintained until the appropriate remedial action has been determined and completed.

Controlling Nonconforming Products

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B Once identified as "HOLD", no rework, repair or installation work shall be carried out on the non-conforming work, item or material, until the correction proposed on the NCR has been approved by the client. The "HOLD" identification shall remain until the specified rework or repair has been completed.

B 4.2 Correction of Non-Conformance

The Construction Manager or the construction responsible shall complete the following sections of the NCR :

- "Proposed solution / correction"
- "Corrective Action"

The form shall be passed to the Design or Technical Manager to review (if necessary), signed and forwarded to the QA/QC Manager to review for completeness.

B When all parties involved have approved the proposed solution / correction and the corrective action, it is forwarded to the client for approval.

B 4.3 Implementation of Correction

When the approved "correction / solution" and "corrective action" have been implemented, the relevant construction responsible shall verify the satisfactory implementation.

B 4.4 Verifying Implementation of Correction

When satisfactory implementation of the "Correction" has been verified, the construction responsible shall sign and date the NCR and shall forward it to the Construction Manager for review.

B The Construction Manager shall verify satisfactory resolution of the deficiency and shall sign and date the form before forwarding it to the QA/QC Engineer for final review.

4.5 Distribution and Filing of Non-Conformance Report

B The QA/QC Manager shall sign and date the form after QA/QC Engineer verifies the satisfactory resolution of the deficiency and satisfactorily completion before up-dating the Non-Conformance Report Register, and shall keep the form in the NCR File in QA/QC Department. File shall be
B dispatched to the involved persons by internal memo from QA/QC Manager.

4.6 Review of Non-Conformance

B The QA/QC Manager shall maintain and up-date the "Non-Conformance Report Register", showing the status of the NCR's, which have been raised. This register also indicates the status of relevant corrective actions, if any. These are closed by the QA/QC Manager when they
B have been implemented, and he judges they are efficient.

Controlling Nonconforming Products

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Non Conformance Report

I	O	S	1	N	C	R													
Area				Trade		Originator				Chrono									

NCR type : ☐ NC2 ☐ NC3 ☐ NC4Area, system :Subject :Related documents :

rev	
rev	
rev	
rev	
rev	
rev	

✓ here if attached

☐
☐
☐
☐
☐
☐
☐

Other documents :

☐
☐

Description of the non-conformance :

Proposed solution / correction :

Corrective actions :

Issuer :

Date :

Name :

Signature :

Approved by :

(Tech. Dept. / Design Off.)

Date :

Name :

Signature :

Reviewed by QA/QC dept.:

Date :

Name :

Signature :

Answer from IOBC :

☐ approved☐ approved with comments☐ rejectedcomments :Answered by :

Date :

Name :

Signature :

Confirmed by :

Date :

Name :

Signature :

Closure of the non-conformance : solution was implemented by ISB JV Works dept. as described above .

Issuer :

Date of implementation :

Name :

Signature :

Checked by (ISBJV QC dept.):

Date :

Name :

Signature :

Non Conformance Report Register

CS/0/QAP/99/ISB/0215/B - Appendix 2

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Rev	Status	Date	Description	Prepared	Checked	Approved

EMPLOYER

ISTANBUL OLYMPIC STADIUM

Design and construction
of 80 000 seats Olympic Stadium

PROCEDURE

Equipment / Product Identification and Traceability
DESIGN & CONSTRUCTION WORKS

CONTRACTOR

Originator:

CONTRACTOR- Quality Dept.

Prepared by AAAAA		Date 2001-07-14	Status Internal	Associated file ISB0217B.doc		Total number of pages 4+3 App.
Istanbul Olympic Stadium	Area	Document type	Trade	Originator	Chrono number	Revision
IOS	0	QAP	99	ISB	0217	B

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3.0 GENERAL

4.0 PROCEDURE

- 4.1 Identification
- 4.2 Traceability

Appendix 1 :: Equipment Traceability Sheet (ETS)

Appendix 2 :: List of ASW equipment to be identified and traced

Appendix 3 :: List of SNEF equipment to be identified and traced

Equipment/Material Identification and Traceability

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1. SCOPE

The purpose of this procedure is to describe the process followed by ISB-JV for identification and traceability of the equipment / product to be utilized within the IOS project, from approval of MSS to the testing and commissioning.

The procedure for the identification and tracing of the equipment by the Subcontractor is a part of their own Quality Assurance Plan. Nevertheless, follow-up may be performed at any stage of the process by ISB-JV.

2. REFERENCE DOCUMENTS

2.1 Contractual Documents:

The Main Contract (clauses 14 and 37 part 1 – general conditions)
ISO 9001: 1994 Clause § 4.8 Product Identification and Traceability

2.2 Other Documents

IOS 0 QAP 99 ISB 0201 "Contractor's Quality Assurance Plan"
IOS 0 QAP 99 ISB 0012 "Material Submission"
IOS 0 QAP 99 ISB 0212 "Material Delivery and Storage"
IOS 0 QAP 99 ISB 0208 "Execution Follow-up Documents"

And the associated Quality Assurance procedures of ISB (QAP's of ISB)

3. GENERAL

The relevant Trades Department shall be responsible to ensure that equipment / product is subject to be checked and inspected (MRI) as per IOS 0 QAP 99 ISB 0212 "Material Delivery and Storage" procedure to verify compliance with the requirements of the approved MSS and to ensure that equipment / product is identified by serial number or part number by the manufacturer.

The ISB-JV Receiving Inspectors, defined in IOS 0 QAP 99 ISB 0212 "Material Delivery and Storage" procedure shall be responsible to ensure the identification of the received equipment / product as per the requirements of this procedure.

The lists of equipment to be identified and traced are given in appendices-2 & 3.

4.0 PROCEDURE

4.1 Identification

The Subcontractor shall establish and maintain the documentation and / or lists to identify each individual equipment / product by suitable means from receipt. These lists are subject to update as necessary.

Where and to the extent that traceability is the specified requirement, the Subcontractor shall establish and maintain an Equipment Traceability Sheet (ETS), given in appendix-1, for unique identification of individual and / or each equipment / product.

Equipment/Material Identification and Traceability

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The identification system of the equipment / products do not base on a coding system. The coding is done by abbreviations (of the equipment / product) followed by the chrono as specified in the appendices 2 & 3.

In the drawings the equipment / product shall be referred to as indicated in the attached lists. Cross checking shall be available through these documents.

4.2 Traceability

Traceability process basically consists of the following topics and/or sections to be followed up through ETS form during the execution of project for which the related responsible(s) are also referred :

- a) **Nomination** is to assign a name to equipment which is used in all the drawings and/or documentation, on the physical nameplate or tag fixed on/onto equipment → shall be done by Subcontractor.
- b) **Documentation** is the verification of existence of approved MSS, MDS and MRI → shall be done by Subcontractor.
- c) **Identification** is provision of detailed information about equipment as well as the origin and conformity to the standards and/or codes → shall be done by Subcontractor.
- d) **Receipt** is the information as date of actual appearance of equipment on site which is the indication of enforcement of this procedure for each and every piece → shall be provided by Subcontractor.
- e) **Usage** is the confirmation of installation details, location and/or place as well as date → shall be confirmed and traced by Trades Department.
- f) **Inspection** is the confirmation of inspection and tests information as well as date, calibration if necessary → shall be confirmed and traced by Quality Assurance / Quality Control Department.

ETS form shall be initiated by relevant Subcontractor as one original, having completed the requirements, handed over to Trades Dept. and similarly to QA/QC Dept. afterwards.

At the end of the project i.e. having completion of installation and testing ETS of each equipment shall be reviewed, confirmed, attested once more by Subcontractor, Trades Dept, QA/QC Dept. and handed over to Client (IOBC) for approval as well as reference information.

Equipment/Material Identification and Traceability

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Equipment Traceability Sheet

I	O	S		E	I	T	S		I	S	B	
Area				Trade				Originator				Chrono

S/C: _____

During the execution ;

	Requirements	Information	Action by	Name/Signature
Nomination	IOS Nameplate / Tag No		S/C	
	Equipment		S/C	
Documentation	MSS No	I O S M S S	S/C	
	MDS No	I O S M D S	S/C	
	MRI No	I O S M R I	S/C	
Identification	Supplier / origin		S/C	
	Sort / Type / Manufacturer Ref		S/C	
	Serial No		S/C	
	Type/Factory test Date : Conformity Certificate	No :	S/C	
	Certificate of Origin Date : Origin	No :	S/C	
Receipt	Delivery Date		S/C	
Usage	Usage (System/Branch)		Trades Dept.	
	Installation Location	Zone Level Room No Row to Axis to	Trades Dept.	
	Installation Date		Trades Dept.	
Inspection	Check List No	I O S C L	QA/QC Dept.	
	Test (Report) Date		QA/QC Dept.	
	Calibration Date : Validity :		QA/QC Dept.	
NOTES				

After testing and Commissioning ;

<u>Installed and Tested By :</u> Subcontractor (S/C) Name: _____ Date: _____ Visa: _____	<u>Checked By :</u> ISB Trades Dept. Name: _____ Date: _____ Visa: _____	<u>Witnessed / Reviewed By :</u> ISB QA/QC Dept. Name: _____ Date: _____ Visa: _____	<u>Approved By :</u> IOBC Name: _____ Date: _____ Visa: _____
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B	INT	2001-02-06	Revised as per comments	BO/OU	CKT/TBK	GR
A	PRE	2001-01-11	First issue	BO/OU	TBK	GR
Rev	Status	Date	Description	Prepared	Checked	Approved

EMPLOYER

ISTANBUL OLYMPIC STADIUM

Design and construction
of 80 000 seats Olympic Stadium

PROCEDURE

Procedure for Taking Over works from Subcontractors
DESIGN & CONSTRUCTION WORKS

CONTRACTOR

Originator:

CONTRACTOR- Quality Dept.

Prepared by AAAAA		Date 2001-02-06	Status Internal	Associated file ISB0223B.doc		Total number of pages 4+5 App.	
Istanbul Olympic Stadium IOS	Area 0	Document type QAP	Trade 99	Originator ISB	Chrono number 0223		Revision B

1. SCOPE

The purpose of this procedure is to define the activities to be followed for Taking Over the works from Subcontractors. This procedure shall apply to all subcontract works within IOS project.

2. REFERENCE DOCUMENTS

2.1 Contractual Documents

The Main Contract (clauses 14 and 37 part 1 – general conditions)
The Subcontracts
ISO 9001: 1994

2.2 Other Documents

IOS 0 QAP 99 ISB 0201 "Quality Assurance Plan"
And the associated Quality Assurance procedures of ISB (QAP's of ISB)

3. GENERAL

Taking over means: taking over of the works within the scope of a Subcontractor by ISB.

A **taking over committee** is to be established for every separate taking over, from the members of the below listed departments:

Construction or Trades Department
Technical Department
Contracts Department (as witness)
QA/QC Department (as witness)
Architect
Subcontractor

Construction or Trades Department's representative is the **leader** of the committee unless specified the contrary.

A short **explanatory meeting** shall take place just before the site visit(s) with attendance of the taking over committee.

4. PROCEDURE

4.1 Planning of the taking over process

In most cases, it is essential to plan the taking over in advance. The planning should be done with presence of at least three parties: Construction / Trades Dept., Architect and Subcontractor. Subcontractors should comply with the dates that they request for taking over.

4.2 Request for taking over

When the whole of the works have been substantially completed and have satisfactorily passed any final test that may be prescribed by the Subcontract, the Subcontractor may give a notice to that effect to the Contractor stating their commitment to complete any outstanding work during the period of maintenance.

The Subcontractor shall establish and complete the documentation as necessary (checklists, site measurement records, etc.) and Non-conformance Reports NCRs should have been closed to proceed for taking over the works in their scope and the request shall be in writing.

This request shall be replied by ISB with the date of visit, which shall not be later than 21 days from request, for taking over. In this reply, the taking over committee shall be identified.

4.3 Meeting and visit to site

During the explanatory pre-visit meeting, all works specified by the Subcontract shall be understood and clarified, and necessary drawings shall be examined together. Leader of the committee shall also be assigned. The program of the visit should be concluded by the parties and responsibilities should be distributed within the committee in order to use the time efficiently and not to omit any item.

The visit attendance list (appendix 5) shall be filled and signed by the attendees. The committee shall visit the area/room/element/item(s) and shall take notes as necessary.

4.4 Listing and follow-up of the outstanding items and Taking Over Certificate

Following completion of the visit, the committee shall gather with their notes and Construction / Trades Department shall draft the List of Outstanding Items OUT (appendix 3). This list shall be confirmed by the Architect and the Subcontractor. Then the date for completion of each item shall be concluded by the parties. The draft shall be conveyed to the Contracts Department to assign a chrono and to issue OUT officially together with the Taking Over Certificate TOC (appendix 1).

Information about the Subcontract, Subcontractor, milestone dates, works concerned (scope as per Subcontract), the date of request, date of site visit shall be filled on TOC.

The originals (of OUT and TOC) shall be signed by the parties and the attendance list shall be attached. Contracts Department shall keep the original of TOC and copy of OUT.

The outstanding items shall be followed, checked and approved by Construction / Trades Department on the original of the OUT. Upon timely checking on site, OUT shall be updated by putting the date of clearance of each item. This sheet shall be maintained by Construction / Trades Department and shall be copied to Contracts Department periodically, to outline the latest situation of outstanding items.

4.5 Closing Taking Over Certificate

Following the completion and clearing of all the outstanding points, Construction / Trades Department shall hand over the completed, signed OUT to the Contracts Department, to finalize and close the TOC. TOC shall be closed by Contracts Department by checking the box at the bottom, by putting the actual date for completion and by signing. The OUT shall be attached to the TOC.

4.6 Partial Taking over

In case of multiplicity and recurrence and/or if deemed necessary, part of the works might be subject to partial taking over. Subcontractor, in his letter, shall state his intention for partial taking over. Construction / Trades Department shall decide if the request for partial taking over is applicable or not.

Same procedure applies as detailed above for taking over. Planning of partial taking over is slightly more important: It should be indicated how the works shall be separated and when the partial taking over for each part shall take place.

When a partial taking over is done, Partial Taking Over Certificate **PTO** shall be issued (appendix 2). TOC shall be issued and approved, following approval of the last PTO. TOC shall include all the Partial Taking Over Certificates issued earlier as attachments.

4.7 Final Acceptance of works from Subcontractors

Following receipt of the Final Acceptance of works from the Employer after the expiration of the period of maintenance, by the **Final Acceptance Certificate** *stating that the Works have been completed and maintained to his (Employer's) satisfaction*, ISB shall issue the Final Acceptance Certificate **ACC** (appendix 4) to the Subcontractor to release their part of works.

5. APPENDICES

Appendix 1	Taking Over Certificate	TOC
Appendix 2	Partial Taking Over Certificate	PTO
Appendix 3	List of Outstanding Items	OUT
Appendix 4	Final Acceptance Certificate	ACC
Appendix 5	Visit Attendance List	

Taking Over Certificate

I	O	S	O	T	O	C			I	S	B					rev	
project			area		document type			trade		originator			chrono				Subcontractor

Date of Visit :

Attendees : See the Visit Attendance List

Scope :

This is to certify that the above described works specified in the Subcontract, have been examined and accepted as substantially completed in accordance with the Subcontract. The outstanding works to be executed in order to reach a full completion are listed in attached document (List of Outstanding Items - OUT), and the Subcontractor undertakes to achieve them at the indicated dates.

Signature :

OUT No :

1	0	S	0	0	U	T					I	S	B				
project		area		document type		trade				originator		chron					

 REV

--

☐ Outstanding Items - OUT : completed, signed, approved and attached to this document.

Verified by ISB JV Contracts Department :

Signature :

Very important : *The works specified hereabove are subject to the acceptance of the works by the Employer.*

Partial Taking Over Certificate

I	O	S	O	P	T	O			I	S	B								
project			area		document type			trade		originator			chrono			rev			

Subcontractor		no
---------------	--	----

Works Performed By :

Date of Request :

Date of Visit :

Attendees : See the Visit Attendance List

Subcontract No :

Subcontract Date :

Subcontract Milestone Dates :

Scope :

This is to certify that the above described works specified in the Subcontract, have been examined and accepted as substantially completed in accordance with the Subcontract. The outstanding works to be executed in order to reach a full completion are listed in attached document (List of Outstanding Items - OUT), and the Subcontractor undertakes to achieve them at the indicated dates.

For and on behalf of ISB JV :For and on behalf of Subcontractor :

Date :

Date :

Name :

Name :

Position :

Position :

Signature :

Signature :

OUT No :

I	O	S	O	O	U	T			I	S	B								
project			area		document type			trade		originator			chrono			rev			

☐ Outstanding Items - OUT : completed, signed, approved and attached to this document.
Verified by ISB JV Contracts Department :

Actual Completion Date :

Name :

Position :

Signature :

Very important : The works specified hereabove are subject to the acceptance of the works by the Employer.

I	O	S	O	O	U	T			I	S	B					rev			/		
project			area			document type			trade			originator			chrono			Subcontractor		no	page

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For and on behalf of Subcontractor	For and on behalf of Architect	For and on behalf of ISB JV
Date :	Date :	Date :
Name :	Name :	Name :
Position :	Position :	Position :
Signature :	Signature :	Signature :

The approval of the ISB JV undersigned shall mean that all the outstanding items have been cleared and completed. Please return to Contracts Department.

ISB JV Construction / Trades Department		
Actual Completion Date :	Date : Name : Position :	Signature :

Final Acceptance Certificate

I	O	S	O	A	C	C			I	S	B					rev		
project			area		document type			trade		originator			chrono				Subcontractor	

Works Performed By :

Date of Request :

Date of Visit :

Actual Completion Date :

Subcontract No :

Subcontract Date :

Scope :

This is to certify that the above described works specified in the Subcontract, have been completed and maintained to Employer's satisfaction.

TOC NO :

I	O	S	O	T	O	C			I	S	B					rev	
project			area		document type			trade		originator			chrono				

OUT NO :

I	O	S	O	O	U	T			I	S	B					rev	
project			area		document type			trade		originator			chrono				

For and on behalf of ISB JV :

For and on behalf of Subcontractor :

Date :

Date :

Name :

Name :

Position :

Position :

Signature :

Signature :

TAKING OVER VISIT ATTENDANCE LIST

SUBCONTRACTOR :		TAKING OVER CERTIFICATE NO :		DATE :
	NAME IN CAPITALS	COMPANY	POSITION / TITLE	VISA
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
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A	INT	2001-01-12	First issue	MR	AGY	GR
Rev	Status	Date	Description	Prepared	Checked	Approved

EMPLOYER

ISTANBUL OLYMPIC STADIUM

Design and construction
of 80 000 seats Olympic Stadium

PROCEDURE

Product Receipt at Factory
DESIGN & CONSTRUCTION WORKS

CONTRACTOR

Originator:

CONTRACTOR- Quality Dept.

Prepared by AAAAA		Date 2001-01-12	Status Internal	Associated file ISB0224A.doc		Total number of pages 4+1 App.
Istanbul Olympic Stadium IOS	Area 0	Document type QAP	Trade 99	Originator ISB	Chrono number 0224	Revision B

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1.0 SCOPE

2.0 REFERENCE DOCUMENTS

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- 2.2 Other Documents

3.0 GENERAL

4.0 PROCEDURE

Appendix 1 : List of product/equipment to be Product Receipt at Factory

Product Receipt at Factory

IOS

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1. SCOPE

The purpose of this procedure is to describe the process followed by ISB-JV for Inspection and Testing of the equipment / product to be utilized within the IOS project, at Factory before delivery to site fulfilled the required completion of product as per purchase order and/or its integral conditions.

2. REFERENCE DOCUMENTS

2.1 Contractual Documents

The Main Contract (clauses 14 and 37 part 1 – general conditions)
ISO 9001: 1994 Clause § 4.10.2 Receiving Inspection and Testing

2.2 Other Documents

IOS 0 QAP 99 ISB 0201 "Contractor's Quality Assurance Plan"
IOS 0 QAP 99 ISB 0012 "Material Submission"
IOS 0 QAP 99 ISB 0212 "Material Delivery and Storage"
IOS 0 QAP 99 ISB 0208 "Execution Follow-up Documents"
IOS 0 QAP 99 ISB 0217 "Equipment / Product Identification and Traceability"
IOS 0 QAP 99 ISB 0207 "Mail Management"

And the associated Quality Assurance procedures of ISB (QAP's of ISB)

3. GENERAL

The relevant Trades Department shall be responsible to ensure that incoming equipment / product is subject to be checked and inspected as conforming to specified requirements. Verification of specified requirements shall be in accordance with the documents as per procedures i.e. Purchase Order, approved MSS, Specification, related drawings etc..

In determining the amount and nature of receiving inspection and test, consideration shall be given to the amount of control exercised at the Factory's premises and the witnessed and recorded evidences of conformance provided and proved.

4. PROCEDURE

Product Receipt at Factory process basically consists of the following topics and/or sections to be followed up during the execution of project for which the related responsible(s) are also referred :

- a) **Coverage** : Any product and/or equipment/system is to be factory receipt by inspection and test at manufacturer's facilities for which the site conditions and facilities are not sufficient and/or not been authorized to do on site. ISB "Trades Department" has right to perform and/or ask Product Receipt at Factory for any trade and/or product via subcontractors to the satisfaction as per documents. A List of product/equipment to be Product Receipt at Factory, foreseen as a guide but not limited to, is enclosed as Appendix-1
- b) **Arrangement** : Subcontractor(s) is to provide in advance in written form, by contacting the producers, the inspection & test; dates, place, program, types, forms for the review and approval of ISB.

Product Receipt at Factory

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- c) **Invitation of Client** : Trades Department on behalf of ISB produces a letter to inform and request from Client that whether anybody shall attend and/or who will attend, if desired, to the Product Receipt at Factory inspection and tests.
- d) **Assignment** : The Inspector(s) is/are to be assigned, as per advise or proposal of Trades Department, by Project Manager in written form.
- e) **Inspection and Tests** : Inspection and Tests as per producers procedures as; Routine and/or Type tests, Operational and/or Functional tests, Special tests are to be performed with/within laboratories/test benches/test environment of the manufacturer as well as all the aspects of physical, dimensional inspections are to be checked and/or controlled, to the satisfaction of Inspector(s) and Client if attended.
- f) **Verification** : All the documented results of inspection and tests are to confirm the order documentation; Purchase Order, approved MSS, Specifications and drawings. The Inspector(s) are responsible from complete verification to the requirements and the suitability to the purpose/application.
- g) **Certification** : All the documented results are to be provided as/within a Final Inspection & Test Report and Release Note counter signed by all Responsible(s).
- h) **Proof** : Product Receipt at Factory process is to be proved by the provision of certificates, mentioned above in (g), at least one original document with original signatures, by Subcontractor(s) through a cover letter and/or Inspector(s) enclosed to a memo, to Project Manager.
- i) **Dispatch** : PM's secretariat (executive secretary or mailing officer) shall treat the received document, mentioned above in (h), as an incoming correspondence (Channel R) and be responsible of dispatching:
- Original document(s), Report and Release Note, with original signatures to Contract Department,
 - One copy to Trades Department,
 - One copy to QA/QC Department.
- j) **Archiving** : Original document(s), Report and Release Note, with original signatures are to be kept secure by/under responsibility of Contract Department.
- k) **Submittal** : One copy of certification document, Final Inspection & Test Report and Release Note, is to be submitted to Client through official correspondence by Contract Department.

Product Receipt at Factory

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List of product / equipment to be Product Receipt at Factory

Trade	Product / Equipment description	Subcontractor
Electrical	Sound system fixtures	SNEF
Electrical	Sound system amplifiers, racks	SNEF
Electrical	34.5 kV Incoming substation	SNEF
Electrical	HV distribution 34.5 kV	SNEF
Electrical	HV/LV transformers	SNEF
Electrical	Back up power supply	SNEF
Electrical	LV main distribution boards	SNEF
Electrical	Secondary distribution boards (roofs)	SNEF
Electrical	Secondary distribution boards	SNEF
Electrical	Internal TV distribution system	SNEF
Electrical	CCTV system (brackets)	SNEF
Electrical	CCTV system (cameras, screens)	SNEF
Electrical	Giant graphic board	SNEF
Mechanical	Boilers	ASW
Mechanical	Chillers	ASW
Mechanical	AHU	ASW
Mechanical	Electrical panel boards	ASW

1	FAP	2001/08/10	For Approval	T.ADIGÜZEL	F.REDON	R.VIAL
A	PRE	2000/08/06	First issue	T.ADIGÜZEL	F.REDON	R.VIAL
Rev	Status	Date	Description	Prepared	Checked	Approved

EMPLOYER

ISTANBUL OLYMPIC STADIUM

Design and construction
Of 80 000 seats Olympic Stadium

PARTICULAR WORK PROCEDURE

TEST PROCEDURE FOR HV CABLES

CONTRACTOR

Originator :

SUB-CONTRACTOR

Prepared by T.ADIGÜZEL	Date 2001 / 08 / 10	Status FAP	Associated file SNF PWP 0102.doc	Total number of pages 4
Istanbul Olympic Stadium IOS	Area 1	Document type PWP	Trade 43	Originator SNF
			Chrono number 0102	Revision 1

Revisions follow-up Sheet

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Particular Work Procedure Test Procedure For HV Cables

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PWP

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0102

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IC YATIRIM KURULU
BUTLANTISYON MERKEZİ

1/ CUBICLES TO CUBICLES LINKS FOR 34.5kV:

a) Testing equipment:-

HV DC test generator
Model: Hagenuk T99

5kV Insulation resistance meter
Model: Megger BM11D

b) Tests

b1) Phase checking

By means of megger BM11D 1kV will be applied to each conductor to check phase sequence.

b2) HVDC test

72kV DC will be applied between conductor to screen. While screen is earthed. $U_0=18kV$ (time:15mm)

b2) Insulation resistance test(after HVDC test)

5kV will be applied by Megger BM11D between conductor to screen to measure insulation resistance.

2/ CUBICLES TO TRANSFORMER LINKS FOR 34.5kV :

Stage b1, b2 and b3 will be performed.

3/ CUBICLES TO CUBICLES LINKS FOR 20kV :

Same as then 1 except the HVDC test will be 48kV DC. $U_0=12kV$ (time:15mm)

4/ CUBICLES TO TRANSFORMER LINKS :

Same as item 2

5/ REPORT OF TESTS :

See the sheets attached.

Note: Test are performed according to CEI 60502. The value U_0 given by ALCA TEL.

Particular Work Procedure Test Procedure For HV Cables

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DEMİNER KABLO CONTRACTING

IR. 21

SITE TEST REPORT

CUSTOMER :
CABLE TYPE :
CIRCUIT :

MEASUREMENT OF INSULATION RESISTANCE

Min Insulation Resistance value = GOhm . km

$$R_i' = R_i \times L \text{ (GOhm . km)}$$

Length (km)	Phase	Result(R _i) (GOhm)	Result(R _i ') (GOhm . km)	Remarks

TEST INSTRUMENT : Battery Megger BM 11 (or equivalent)
Made by Megger, England

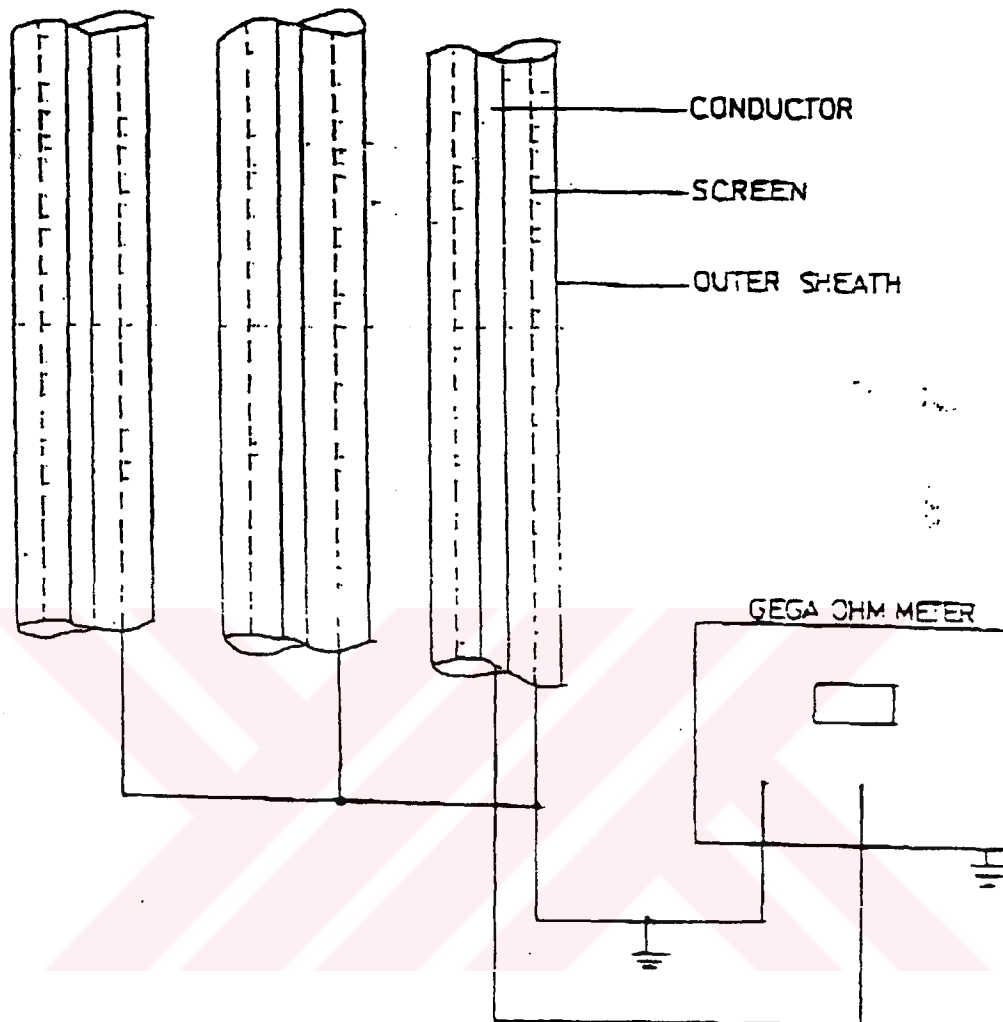
COMMENTS

DATE

Executed by

Witnessed by

MEASUREMENT OF INSULATION RESISTANCE



The insulation resistance R_i measured between each individual conductor and metal sheath. The insulation resistance per kilometer R'_i is calculated from,

$$R'_i = R_i \times L \text{ (GOhm . km)}$$

R_i Insulation Resistance in GOhm . km

R_i Measured insulation Resistance in GOhm

L Cable Length in km



DEMİREK KABLO CONTRACTING

H.V.T. 3.1

SITE TEST REPORT

CUSTOMER :-

CABLE TYPE :-

CIRCUIT :-

H.V. D.C. TEST

Final tests according to :-

Test instrument :-

HV Test Equipment

Time (Min.)	Phase	Voltage (kV)	Remarks
15			
15			
15			

Charging Current (mA)			
Time (Min.)	Phase	Phase	Phase
1			
5			
10			
15			

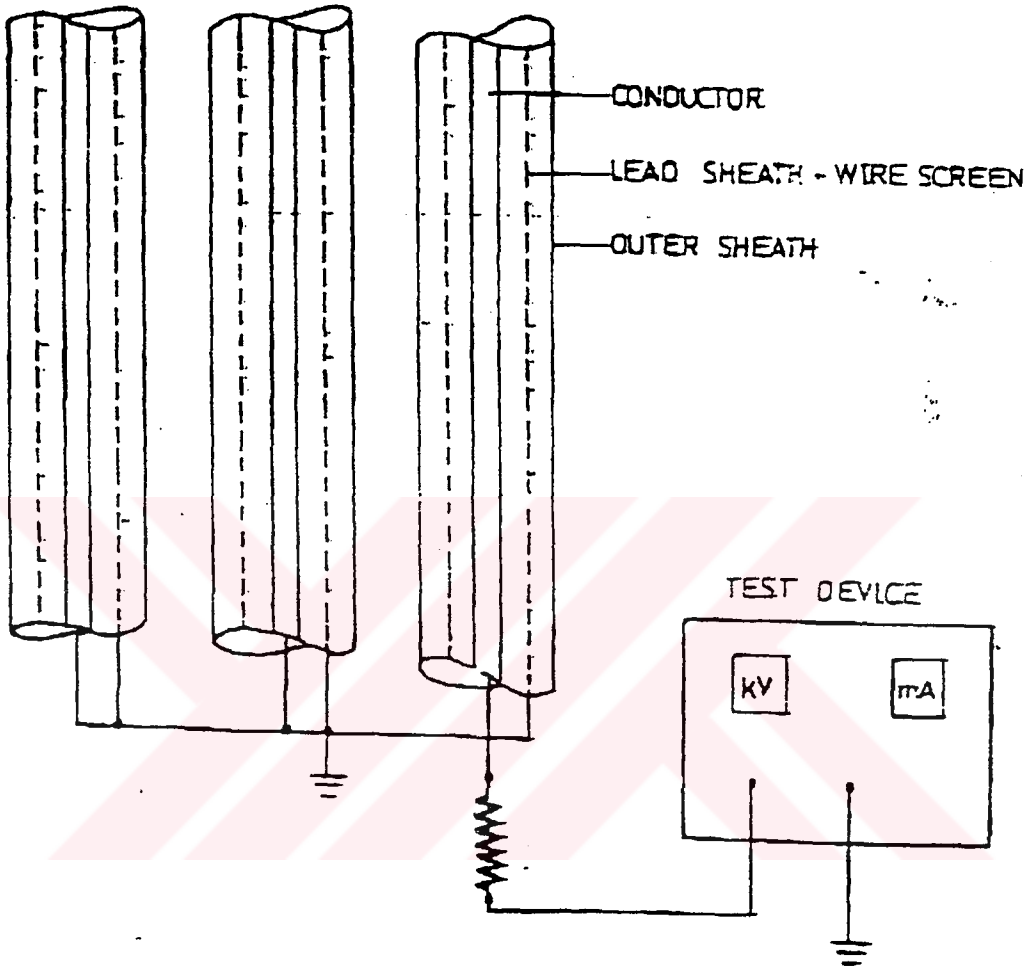
COMMENTS

DATE

Executed by

Witnessed by

ELV - D.C. TEST



CUBICLE

Customer:

Tesis:

F.B.No:

Production Year:

Protokol Nr:

External FB Nr (Project):

Date:

Rated Insulation Voltage:

Rated Voltage:

Control Voltage:

Signal Voltage:

Heater's Voltage:

Auxiliary Voltage:

1-Cubicle Lay-out checking:

☐

2-Main Busbar Checking:

☐

3-Earthing Checking:

☐

4-Mechanical Interlocking Checking:

5-Circuit Breaker Truck Mec.Function Checking:

☐

6-Earthing Switch Mec.Function Checking:

☐

7-Load Breaker Switch Mec.Function Checking:

☐

8-Circuit Breaker Mec.Function Checking:

☐

9-Current Transformer Checking:

☐

10-Voltage Transformer Checking:

☐

11-N/A:

☐

12-Internal Cable Connection Check:

☐

13-External Connections Check:

☐

14-Open-Close Function Tests:

☐

15-Control and Protection Systems Check:

☐

16-Measurement Devices Checking:

☐

17-Insulation Resistance Measurement:

☐

18-

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20-

NOTES:

DATE

TESTED BY

APPROVED BY

Drawing Necessary

Material Location	SNF 3504-3
	SNF 3501-4
	SNF 3502-3
	SNF 3503-3
	SNF 3903-4
	SNF 3012-A

CUBICLE	333 053/000
	333 055/000
	333 052/000
	333 054/000

