RELIABILITY CONTROL

AIM OF RELIABILITY CONTROL
The aim of reliability control is to eliminate unreliable plant operation and delays in plant start-up caused by malfunction of plant equipment. The importance of this aim cannot be overemphasized. All efforts of design, procurement, planning, scheduling, cost control and construction can be wasted if equipment fails to function properly when required.

Loss of production, market position, sales advantage and company prestige can all be caused by delays in start-up. In addition, the effect on product quality, the cost of repairs or replacement and the cost of consequential damage must be considered when establishing a reliability control program for each project. The procedures developed in this chapter are designed to assist the Project Manager in achieving the necessary control.

PHILOSOPHY OF RELIABILITY CONTROL
The control of plant reliability cannot be set aside as a separate entity that can ignore or be ignored by other project operations. It is involved in all phases of the project from its inception through its continuous successful operation. For example, at the appropriation stage it is essential that reliability guidelines are established so that:

1. A basis can be established for plant quality and performance. It is obvious that the cost of the new facility will vary with the required life and quality that is required from the plant.
2. The Architect-Engineer and the Task Force can make sound decisions based on a firm statement of the desired plant reliability.
3. A realistic estimate of the cost of reliability control can be made.

During the preparation of the control estimate consideration must be given to the total cost of reliability control. Without the allocation of sufficient funds, there will be a tendency to bypass the reliability function and run the risk of losses far in excess of the cost of control. It is essential to realize that the vendor’s warranty seldom provides sufficient protection for the Owner. The vendor will not accept responsibility for consequential damage, loss of production or any other costs beyond the repair or replacement of defective equipment.

The Architect-Engineer plays a key role in achieving the desired plant reliability. Reliability must be designed into a plant. It can only be added to a plant later at a prohibitively high cost and a great deal of inconvenience. The quality of drawings and specifications produced by the Architect-Engineer must be studied. The caliber and depth of the Architect-Engineer’s design team and management group, the working conditions, the
reproduction methods and systems as well as the communications lines within the organization are all areas that can affect the quality of the output of the Architect-Engineer. He must acknowledge our philosophy of reliability control and prepare his drawings and specifications accordingly.

Purchasing plays a major part in reliability control through a variety of safeguards common to professional purchasing procedures. Such safeguards include:

1. Establishing a proper flow of information between vendor, Architect-Engineer and purchaser so that the vendor recognizes only one authority.
2. Establishing systematic procedures for processing changes to drawings and specifications to eliminate the possibility of a vendor or an inspector working with superseded documents.
3. Including guarantee requirements in the purchase order which leave no doubt regarding the vendor's responsibility.
4. Including clauses in the purchase order which grant Task Force inspectors access to the vendor's plant to witness tests and manufacturing processes and to review quality control methods and procedures.
5. Requiring certification of materials, manufacturing processes, and test procedures necessary to assure that the equipment meets specifications.

These procedures are not difficult to apply or enforce at the outset of procurement operations but become almost impossible to institute once orders have been placed.

The construction force is the next link in the chain of reliability and must perform satisfactorily if all the preceding effort is to be of value. Not only must the construction methods and procedures be critically reviewed but proper supervision and inspection are essential if equipment is to be handled, erected, installed and tested in accordance with Task Force requirements.

The construction of a reliable plant is the responsibility of the Project Manager.

**STEPS IN ACHIEVING RELIABILITY CONTROL**

At the outset it is essential that the Project Manager has a clear understanding of the guidelines for the reliability requirements set forth at the appropriation stage. He should know what life the plant is expected to have, what degree of automation is planned, and how versatile the plant should be.

He should satisfy himself that sufficient funds have been allocated in the estimate to permit him to provide effective reliability control.

No estimate should be accepted as complete unless consideration has been given to the various cost aspects of reliability control and appropriate allowances have been included. The cost of reliability control will have a wide variation, dependent on the size of the plant, the complexity of the process and equipment and the return on investment.
With this background, the Project Manager is in a position to make certain that the following steps are being carried out:

1. Preparation of the Inspection List. Identifies areas or equipment which must be controlled from the reliability standpoint.
2. Preparation of Inspection Plan. Determines who will inspect each item on the inspection list, as well as how, when, where and how often inspections must be made. From this inspection plan a close estimate of cost can be made and this should be compared with the original estimate.
3. Specification Review. Ensures that specifications for items on the inspection list reflect all reliability control requirements.
4. Selection of Vendors. Establishes that the vendor is competent to supply the equipment as specified. This includes investigation of:
   a. Vendor manufacturing facilities
   b. Vendor quality assurance program
   c. Vendor scheduling procedures
   d. Conditions imposed on the vendor
5. Inspection and Reporting. Verifies that the completed equipment meets specifications. Only qualified inspectors should be used and each inspector should set up a program for each item including:
   a. Specification review
   b. Inspection plan
   c. Inspection
   d. Inspection report and recommendations
6. Corrective Action. Ensures effective follow-up of the results of inspection.

In addition, the Project Manager must ensure that adequate inspection is being performed during field erection and assembly operations.

RECEIVING, ERECTION, INSTALLATION AND ASSEMBLY
Reliability control of manufactured items does not end with vendor inspection. Proper receiving procedures must be in operation to determine that only the material received is actually signed for. At this time the receiver must review the inspector's acceptance report to see if final corrections were made and if special shipping procedures were followed. Any sign of damage, improper handling or failure to take precautions should be investigated immediately. If there is any doubt regarding the extent of damage, field tests and site inspection must be performed as soon as possible.

Field erection or installation requires the same careful surveillance as vendor fabrication. If the installation of equipment is being undertaken by site contractors, such contractors
must have the ability, know-how and equipment to provide a proper installation. The vendor is often engaged to install or supervise the installation of his own equipment. In either case the Project Manager should not be lulled into a false sense of security by the fact that Owner supervisors are on the project. It may well be that the supervisor is fully occupied in other areas and is unaware of the importance of specific items from the reliability standpoint. Equipment which has offered enough potential risk to be included on the inspection list warrants careful consideration during installation. Individual equipment items should be started up as soon as possible to provide time for adjustment or repairs in the event of malfunctions. The Project Manager must ensure that proper installation and start-up procedures are employed on plant components if a successful plant start-up is to be achieved.

FOLLOW-UP
Effective reliability control does not end with the successful start-up of a plant. The specification of reliability not only indicates what performance is required but also how long this performance is expected to continue under given environmental conditions.

Feedback of information within the Owner’s organization regarding the malfunction of equipment is necessary if reliability control is to perform its function fully in future projects.

COST OF INSPECTION PERSONNEL
The major portion of the cost of reliability control is in the inspection of equipment at the vendors’ plants. Not all equipment is subjected to source inspection so that a cost estimate for inspection will have no fixed ratio when compared to the total cost of the project. Typical figures indicate that ten to fifteen percent of the project value usually represents the dollar value of the equipment being inspected. Inspection costs are usually two or three percent of the dollar value of such equipment. This means an inspection cost of one quarter to one half of one percent of the project cost.

This must be weighed against the risk of losses that would occur if the equipment failed to function either at the time of start-up or during manufacturing operations. These costs must be given consideration in the initial stages of any project to make certain that they are included in the budget.