

- ii) Detailed interconnection diagram identifying each component with terminal number, cable type, cable size and cable entry details. The interface details shall be clearly identified in the drawing
  - iii) Grounding detail of each item
  - iv) Power supply distribution details
  - v) Clearance space required for maintenance work
  - vi) Weight of camera and other accessories
  - vii) System Configuration diagram
- b) Installation procedure of camera and other accessories.
  - c) Maintenance procedure including replacement of its parts/ internals.
  - d) List of Software & software licenses
  - e) Any other drawings and documents specifically indicated in vendor data requirement enclosed with the Requisition.

## 2.0 DESIGN AND CONSTRUCTION

2.1 The Closed Circuit Television (CCTV) system shall consist of the following units as a minimum:

- a) Camera Unit.
- b) Video encoders
- c) Video Management Software ,Video analysis system along with active matrix TFT type LCD display unit with backlit LED monitors
- d) Network Video Recorder (NVR)
- e) CCTV System cabinet
- f) Power supply distribution board
- g) Cables, cable glands, connectors and other accessories
- h) Network switches
- i) Media Convertors (shall be IP 65)

The CCTV system shall be able to use conventional system or digital system or IP based system based on IP cameras or digital cameras with IP components.

### 2.1.1 Camera Unit

Camera unit shall consist of Video Camera, remote controlled pan, tilt and zoom unit, camera unit enclosure, remote controlled washer and wiper assembly, sun shield and thermostatically controlled heaters, receiver units, junction boxes etc.

#### 2.1.1.1 Video Camera

- a) Unless otherwise specified, the video camera shall be colour type comprising of 1/4" or 1/3" CCD/CMOS (as per image quality specified in CCTV camera datasheet) sensor with wide dynamic range & resolution of 540 TVLs (TVL: TV lines) as a minimum.
- b) The camera and lens system shall have Automatic Gain Control (AGC) facility with gain adjustment of typically up to 18dBA. The video amplifier shall ensure a signal to noise ratio of 50.
- c) The camera and lens system shall be able to operate satisfactorily under varied light intensity levels. The light sensitivity of the CCTV camera shall be 1 lux and shall be able to view objects in illumination level of 45 lux at the distance of 50 m as a minimum.
- d) Automatic lens iris control facility shall also be provided as per the background light levels.
- e) The focal length of the camera shall be based on the distance of the objects from the camera. The lens adjustment for focus control and zoom control shall be motorized and remote controllable. The lens of the field CCTV cameras shall be selected to cover a minimum object height of approximately 3.5 meter to maximum object height of approximately 35 meters at an object distance of approximately 60 meters on the full screen of the monitor.

For the CCTV cameras pertaining to Flare, the lens of the CCTV cameras shall be selected to cover a minimum object height of 15 meters to maximum object height of 150 meters at an object distance of approximately 300 meters on the full screen of the monitor.

- f) The camera shall have feature of backlight compensation.

#### 2.1.1.2 Pan, Tilt and Zoom Unit

The pan and tilt arrangement shall be able to adjust camera within an angle of 0° to 335° horizontally (i.e. pan range) and a minimum of 180° (±90°) vertical (i.e. Tilt range) with Zoom of minimum (12x digital + 35x optical). The movement of the device shall be smooth. Pan speed shall be 6 degrees /sec and tilt speed shall be 3 degree/second as a minimum. Pan, tilt and Zoom action shall be operable from video management system in control room.

#### 2.1.1.3 Wiper and Washer

- a) Whenever camera is for outdoor installation/dusty environment or if the application necessitates, the glass window shall be provided with a wiper and washer unit (as required in line with CCTV camera datasheet). Also, Cameras in field shall be suitable for 1/2" water line connection and shall be provided with Ex'd' SOV

(Solenoid valve) suitable for the specified hazardous area classification for water connection to washer and wiper system.

- b) The washer unit shall comprise of washer tank, motor & pump and associated tubing. The washer tank shall be placed in an FRP enclosure near the camera and shall be easily accessible. The tank shall have a water inlet connection, a valve along with ball float actuator, a water outlet connection, necessary tubing & connectors between the water outlet connection, water pump, and nozzle at the camera. The nozzle connection for drinking/ potable water shall be ½". The rising water level in the tank shall raise the lever which will close the valve. The pump shall either be located in the explosion proof housing of the camera or placed inside the FRP enclosure of the washer tank. Whenever the pump is placed in the FRP enclosure, it's motor shall be explosion proof certified for the area classification. Vendor shall indicate the media to be used for actual washing with requirements like flow, pressure etc. Unless otherwise specified, the washer tank shall have a capacity of 10 litres as a minimum and the minimum flow rate of the pump shall be 0.5 litres per minute.

#### 2.1.1.4 Camera and Pan, Tilt & Zoom unit enclosure

- a) The Camera unit and Pan, Tilt & Zoom unit enclosure(s) shall be suitable for the area classification indicated in the purchaser's data sheets. Unless otherwise specified, the enclosure shall conform to the following standards :

Weatherproof housing IP-65 as per IS/IEC-60529

Flameproof housing Flameproof/ Ex (d) as per IS/IEC-60079

Flameproof housing shall also be made weatherproof.

- b) For CCTV cameras required in hazardous area, shall be certified Ex'd' models of the CCTV camera manufacturers themselves and retrofitting option of the CCTV cameras in separate Ex'd' enclosure shall not be considered.

#### 2.1.1.5 Space Heater

For outdoor applications and where there is a possibility of condensation on the glass window, the camera unit shall be provided with a thermostatically controlled anti condensation heater.

#### 2.1.1.6 Junction Box

The junction boxes for housing the accessories shall be suitable for outdoor installation with minimum IP-65 weatherproof protection as per IS/IEC-60529 and shall be certified Flameproof/ Ex (d) as per IS/IEC-60079 for the hazardous area classification as per location of junction boxes. Junction box may include fibre optic transceivers depending upon network configuration.

#### 2.1.1.7 Camera Mounting

Cameras shall be provided with suitable mounting accessories like Pedestals, Stanchions etc. for mounting on Technical structures, Roofs, Building tops, Poles as indicated in the datasheets.

In case mounting is to be done on Poles, the height of the support poles shall be as per the datasheets. The pole shall have ladder for camera maintenance. The structural steel shall be painted to meet the environment. Pole material shall be GI (Galvanized iron).

## 2.1.2 Video Encoder

- a) The video encoder shall digitize and compress the video signal using MPEG-4, MJPEG & H.264 compression technique (Transmit and Receive both Video and Audio as per CCTV camera datasheet). The operator shall have the option of changing the frame rate from 1 to 25/30 frame per second (fps)/camera as per CCTV camera datasheet and also change the resolution to CIF, 2CIF and 4CIF (PAL/NTSC).
- b) The video encoder shall be capable of TCP/UDP, unicast and Multicast transmission of live video. If connected over an IP network, then each video encoder shall be IP addressable and shall be able to connect to networking devices such as switches/ routers. Encoder shall be single/ multi channel as specified in the datasheets. Multi channel encoder shall have 4 channels maximum. It shall have facility to add additional cameras in future.
- c) The video encoder shall be capable of receiving camera control commands from video management system and relay them to cameras on RS485.
- d) The encoder shall be capable of detecting the loss of video signal from the camera video output.
- e) Encoder shall be equipped with FO transceivers depending upon network configuration.
- f) The encoder shall be able to send alarm signals (e.g., on motion detection or loss of video signal) over the network to the respective video management system. The video management system at the control room shall receive the alarm signals over the network and shall drive outputs such as an audible alert or a visual indication on a monitor to alert an operator.
- g) It shall be possible to upgrade the video encoder software (video & alarm management software) remotely.
- h) The encoders mounted locally along with the cameras are also acceptable provided the same are certified flameproof Ex'd' for the specified hazardous area.

## 2.1.3 Video Management System/Video Recording/Video Analysis

2.1.3.1 The system shall support the virtual matrix capability (i.e., software based matrix) to allow the operator to assign any camera to any local or remote monitor on the network. Also it shall be possible to Control and monitor any camera on the network.

2.1.3.2 The video management system shall be able to permit online selection of :

- a) Camera Units
- b) Monitors
- c) No. of views on one monitor
- d) Recording commands
- e) Pan-tilt-zoom control

- f) Sequential switching of images on monitors
  - g) Focus, wiper, wash and zoom operating for each camera unit.
  - h) Motion detection
- 2.1.3.3 The monitors shall be coloured active matrix TFT type LCD display unit with backlit LED, with necessary controls like colour brightness, contrast adjustment and monitor ON/OFF control. These functions shall be possible from the monitor front. The monitor size shall be minimum 21" or as specified in the CCTV camera datasheet.
- 2.1.3.4 The camera views on the monitor shall be populated based on the operator request. The operator shall be able to view 1/4/9/16/25 cameras views per monitor. The operator shall be able to enlarge the views.
- 2.1.3.5 The operator shall be able to view cameras through simple drag and drop commands.
- 2.1.3.6 The system shall be equipped with the web based client software to allow users to view the cameras on the browser from any PC on the network, provided if they are given the permission and password.
- 2.1.3.7 The user interface shall present the operator with a camera tree that shall show the list of all the cameras and camera sequences that are available to the operator. The Vendor shall present the hierarchy of the camera tree together with the grouping of cameras and the way in which the user/ operator shall interact with it.
- 2.1.3.8 The NVMS user interface shall have a map to allow viewing of graphical representation of the area. The operator shall be able to place camera icons on the map. The Vendor shall present the full features and operations of the map in the way in which the user/ operator shall interact with the map.
- 2.1.3.9 The operator shall be able to perform pan/ tilt/ zoom/ washer and wiper unit control for PTZ cameras.
- 2.1.3.10 The operator shall be able to enable/ disable Motion detection feature of the CCTV system.
- 2.1.3.11 The operator shall be able to write macros/scripts for the cameras to do the following as a minimum:
- a) To define the sequence of cameras to be viewed on a given monitor
  - b) To define the period and start/ stop time for viewing a camera on a monitor
- 2.1.3.12 The viewing and control of cameras shall be controlled by use of passwords. Two levels of password shall be provided:
- a) The operator level in which the operator shall be able to perform PTZ controls, viewing, recording and playback.
  - b) The supervisor level in which the supervisor shall be able to make configuration changes in addition to the PTZ controls, viewing, recording and playback.

### 2.1.3.13 Video Recorder

- a) Whenever specified the system shall also be supplied with video recorder to record video images automatically or on manual demand. The recorder shall meet the following requirements as a minimum.
- b) The video recorder shall have disk space to store on-line video storage for duration as specified in the datasheets and access to high capacity archiving mechanisms for removal of stored video to off-line storage media.
- c) The vendor shall size the video recorder hard disc space based on the number of cameras, number of days (minimum 30 days) for which the recording has been done, the resolution of recording and the number of frames per second to be recorded, as indicated in the datasheets. Vendor shall submit calculations/equations for storage requirements. Use of software without supporting calculations shall not be acceptable.
- d) The system shall mark the events with time and date stamping during monitoring and recording. The system shall allow the operator to view stored information with respect to time and date of recording with scan and search of the marked events/timing.
- e) The operator shall be able to playback the recorded events in forward, rewind, pause along with fast/slow motion with variable speed.
- f) It shall be possible for the operator to schedule recordings for each individual camera taking place in the future. The operator shall be able to configure the Start and Stop time for the scheduled recording.
- g) The operator shall be able to export previously stored video to DVD or latest storage option as specified in the datasheets.
- h) The exported video shall be able to retrieve archived video from DVD or the latest storage option as specified in the datasheets.
- i) Captured images or videos shall be easily distributed to any remote locations through the LAN/WAN environment, if required. The operator shall be able to export previously stored video from a recorder to any other network storage devices including a network drive. An exported file must be in MPEG-4/MJPEG/H.264 format and, as such, should be readable using any MPEG-4/MJPEG/H.264 compliant decoding software.
- j) Each video recorder shall be of 19" rack mountable type.
- k) Video recorder shall support RAID 5 as a minimum.

### 2.1.3.14 Video Analysis

- a) System shall generate alarm on motion detection in areas where no motion is expected.
- b) System shall generate alarm on no motion detection in areas where motion is expected.

- c) System shall generate alarm on flare flame failure.
- d) System shall generate alarm in case fire is detected.

#### 2.1.4 Alarms & Events

- a) The operator in the control room shall be able to get an indication of the faults occurring in any of the devices connected over the network. This includes faults occurring in the cameras, video encoders, computers, and video recorders. Faults occurring in each of these devices shall generate an alarm in the operator console.
- b) The operator shall be able to view the chronology of events by device, date, time and description.
- c) The system shall support logging of events for reviewing and analysis in the future.
- d) Upon detecting a fault, the system shall be able to automatically send an E-mail alert.

#### 2.1.5 Configuration

The following facilities shall be provided for configuration of the CCTV system as a minimum:

- a) Assign an ID or name to each camera.
- b) Add/delete cameras.
- c) Change the camera details (e.g. Camera location, Camera ID, Camera number, etc)
- d) Configure the camera encoding parameters in terms of number of frames per second.
- e) Configure the camera encoding resolution in terms of setting it to CIF, 2CIF, or 4CIF.
- f) Creation of schedules for recordings.
- g) Configure recording either on demand, continuous recording or based on motion detection.
- h) Add/ delete monitors to the system.
- i) Add/ delete computers to the system.
- j) Creation of a camera group, view a camera group, view a camera sequence, and view a multiple view screen.
- k) For an IP based system, assign IP addresses to video encoders, computers of video management system, video recorders, video wall controllers as applicable.
- l) Program external outputs based on certain events.

### 2.1.6 Interfacing with DCS

Wherever specified, interfacing with DCS shall be done to allow DCS operators to view live video along with DCS graphics on the DCS operator consoles. Hardware required for the same shall be provided by vendor. Software required in video management system and DCS shall be provided by vendor.

### 2.1.7 CCTV Cabinets

2.1.7.1 The CCTV cabinet(s) shall house the following components:

- (i) Computer(s)
- (ii) Video encoder(s)
- (iii) Video recorder(s)
- (iv) Control unit
- (v) Network switches
- (vi) Transceiver modules, if any
- (vii) Indoor fibre patch panel, if any
- (viii) VGA boosters, if any
- (ix) Line drivers, if any
- (x) Miniature circuit breakers etc. as applicable.

2.1.7.2 The cabinet(s) shall be fitted with lockable doors and shall have front and rear access. All system cabinets shall be completely wired.

2.1.7.3 The cabinet shall be free standing, enclosed type and shall be designed for bottom cable entry. Cabinet structure shall be rigid and shall be provided with removable lifting lugs to permit lifting of the cabinets.

2.1.7.4 Cabinets shall be fabricated from cold rolled steel sheet of minimum 1.5 mm thickness for sides and rear and 2 mm thickness for doors and suitably reinforced to prevent warping and buckling. The rack/ rail mounting plates inside the cabinets shall be of 3 mm thickness. Cabinets shall be thoroughly deburred and all sharp edges shall be grounded smooth after fabrication. Cabinet frame shall be of 9 fold profiled CRCA or of Angle iron frame using minimum section of 50 x 50 x 4 mm angle.

2.1.7.5 Each cabinet shall be maximum 2100 mm high (excluding 100 mm channel base), 800 mm wide and 800 mm deep, in general. Construction shall be modular preferably to accommodate 19" standard racks. Maximum swing out for Pivot card racks, doors and drawers shall be limited to 800 mm. Doors of the cabinet shall be equipped with lockable handles and concealed hinges with pull-pins for each door removal. All cabinets shall be of same height.



- 2.1.7.6 In order to effectively remove dissipated heat from the cabinets, vent louvers backed by wire-ply screen shall be provided on the cabinet doors. Ventilation fans shall be provided in each cabinet along with fan failure alarm contact.
- 2.1.7.7 LED lamps shall be provided in each cabinet for each cabinet for internal illumination along with door operated micro switches. All lighting shall be on 240V 50Hz normal power supply.
- 2.1.7.8 All wiring within the cabinet shall be neatly laid and shall be accessible. Clamping rails shall be provided for incoming cables to prevent excessive stress on the individual terminals. All metal parts of the cabinet including doors shall be electrically continuous and shall be provided with common grounding lug.
- 2.1.7.9 The colour of the CCTV cabinets shall RAL 7035, unless otherwise specified.
- 2.1.7.10 Cable glands shall be provided for cable entry into the CCTV cabinet. Spare cable entries shall be plugged.
- 2.1.8 Optical Fibre Cable

The Optical Fibre Cable (OFC) used for the CCTV system shall conform to the following specification as a minimum:

- a) The OFC shall have FRP strength member, loose tubes for single mode optical fibres filled with moisture resistant jelly, moisture barrier of polymer coated Aluminium tape or water swellable tape, inner sheath of HDPE, CST (Corrugated steel tape) armouring and outer sheath of HDPE for outside plant applications.

For inside plant applications, PVC shall be used as outer & inner sheaths in OFC. PVC jackets shall be rated for Flame retardant (IEC 60332).

- b) Optical fibres shall be single mode fibres compliant to ITU-T G 652 and fibres colours shall correspond to IEC 60793-2 and 60304. Optical fibres shall be coated with UV cured double acrylic resin. It should not have any reaction with cladding or core material. The coating should provide maximum resistance to micro-bending & abrasion and ensure mechanical & optical strength. The coating shall be easily stripped with mechanical tools.
- c) The number of fibres in the OFC shall be decided depending upon the requirement with 8 fibres as a minimum.
- d) The cabled fibre attenuation shall be  $\leq 0.37$  dB/km for 1310 nm wavelength range and 0.22 dB/km for 1550 nm wavelength range.
- e) The tensile performance shall be as per IEC-60794-1-21 and with tensile load of 9.81 W Newton with attenuation change  $\leq 0.05$  dB/km at 1310 nm. W is weight of OFC/km.

#### 2.1.9 Network Switch

The network switch used for the CCTV system shall conform to the following specification as a minimum:

- a) The network Switch shall be configured to provide communication paths and provide the facility for adaptive packet and message routing through any available communication link. The network Switch shall provide the facility of multiple protocol router and bridge that provides high bandwidth connections into backbone networks for remote sites.
- b) The hardware design shall be based on distributed processing architecture with packets forwarding to be performed on the network interface modules.
- c) The network Switch shall support both intra-area and inter-area routing for transporting messages between nodes and shall support the network routing/bridging services for OSI, TCP/ IP, X.25, LAT and other industry standard wide area networks/ protocols. The network switch shall be adaptive 10/100/1000 Mbps interface port, supporting pass through/ crossover adaptation of port. The network switch shall be provided with optical fibre module interface suitable for long distance transmission.
- d) Network security shall have Password Protection, IP address filtering, encryption, IEEE 802.1X network access control, user access log etc as minimum.

#### 2.1.10 Power Supply

- 2.1.10.1 The system shall operate on 110 VAC/ 240VAC UPS (as specified in the datasheets) with the following specifications. However Space heater (if applicable) shall not be on UPS:

Voltage variation	± 10%
Frequency	50 Hz ± 3 Hz

Any other power supply required shall be derived from this power supply by the vendor.

- 2.1.10.2 Power Supply distribution for all items related to closed circuit television system shall be carried out from the system cabinet itself. Vendor shall supply any hardware required for conversion/ distribution. Power supply for each item shall be provided with a separate switch and fuse for isolation and protection of the system.

The system may use composite cables (consisting of power cable and video & signal cables) from junction box to camera. Cables from junction box to encoder shall be as per network requirement.

- 2.1.10.3 The CCTV camera unit shall be capable of withstanding plant vibration level of 2.1 G (within the frequency range of 5 Hz to 200 Hz) and sudden shocks of level 5 G (with frequency of 2 Hz). Any vibration pads required to meet this requirement shall be in vendor's scope of supply.

- 2.1.10.4 The CCTV system shall have the capability for future expansion to add cameras and additional storage in video recorders.

- 2.1.10.5 All cable glands, as required, for camera enclosure, pan/ tilt unit, junction boxes, CCTV cabinet etc. shall be Nickel plated brass, dual compression type, suitable for armoured cables & area classification specified in datasheets. Slipper type PVC sleeves (cable shrouds) shall be used over cable glands.

### 3.0 NAMEPLATE

- 3.1 Each camera shall have a SS label name plate attached firmly to it at a visible place furnishing the following information:

- a) Manufacturer's model no. and serial no.

- b) Manufacturer's name/ trademark.
- c) Type and Resolution of Camera
- d) Lens Focus Length
- e) Pan, Tilt and Zoom Range
- f) Type of explosion protection and certificate number
- g) Power Requirement.

3.2 Each item of Close Circuit Television and its accessory shall have SS labels attached firmly to it at a visible place, furnishing the following information:

- a) Manufacturer's model no. and serial no.
- b) Manufacturer's name/ trademark.
- c) Type of explosion protection and certificate number
- d) Power Requirement.

#### 4.0 INSPECTION AND TESTING

4.1 Vendor shall submit the following test certificates and test reports for purchaser's review:

- a) Dimensional verification certificate
- b) Manufacturer's test reports as per Type 3.1 of EN 10204
- c) Minimum light intensity testing
- d) Power supply variation check
- e) Certificate from Statutory authority for flame proof and weather proof enclosure, as applicable

#### 4.2 Witness Inspection

4.2.1 All items shall be offered for pre-dispatch inspection for following, as a minimum, unless otherwise specified:

- a) Physical dimensional verification and workmanship, verification of recording rack, display resolution, configurations (software),
- b) Bill of material check, check for Layout such as viewing station, multiple display, windows, etc.
- c) Effect of variations in power supply, voltage and frequency
- d) Performance testing and verification of integrated CCTV system (recording & retrieve video quality, alarms, etc.).

- e) Review of all certificates and test reports.
  - f) Complete system integration check with all the accessories (including printer), system diagnostic check and reports generation check.
- 4.2.2 Purchaser reserves the right to inspect and witness testing at vendor's works as per approved Inspection Test Plan and quality documents. In case the purchaser does not witness the tests, all the tests shall anyway be completed by the vendor and test reports shall be submitted to purchaser for scrutiny.
- 5.0 SHIPPING**
- 5.1 All threaded openings and cable entries shall be suitably protected to prevent entry of foreign material.
  - 5.2 Any glass item shall be protected with foam sheet to protect against damage during transportation.
  - 5.3 Each panel/cabinet and accessory shall be suitably packed and protected from damage due to transportation, unloading and loading.
  - 5.4 Each component part requiring identification for proper assembly at site shall be piecewise marked.

## 1.0 GENERAL

- 1.1 The CONTRACTOR shall construct Plant/Facilities in accordance with the requirements of the Technical Standards/ Specifications, with proven/good engineering practices and procedures. Such Facilities shall be safe, reliable and suitable for their intended purpose.
- 1.2 The CONTRACTOR shall provide all supervision, labour, construction equipments, tools & tackles, materials and consumables, temporary facilities, Construction utilities etc. and render all support services necessary for the construction. Provision of construction power and water shall be as per Special Conditions of Contract (SCC)/ General Conditions of Contract (GCC).
- 1.3 The CONTRACTOR shall plan, execute, manage and control all the construction activities for the facilities forming a part of this contract.
- 1.4 The CONTRACTOR shall arrange insurance coverage for all the personnel engaged by him for the work as per statutory rules, regulations and local laws.
- 1.5 The CONTRACTOR shall insure all the materials and equipments against fire, flood, earthquake, theft, etc. as per SCC/ GCC brought for the job till the Plant/Facilities are commissioned and handed over to the OWNER.
- 1.6 The CONTRACTOR to ensure mechanizing the construction activities to a great extent.
- 1.7 The CONTRACTOR is deemed to have full knowledge of the applicable laws and regulations, conditions of labour, local conditions, the site conditions, environmental aspects and shall comply with the requirements thereof.
- 1.8 The CONTRACTOR is required to organize and mobilize Construction Management Services in a systematic and sequential manner to ensure that the Plant installation is carried out in accordance with the approved engineering drawings, specifications, standards, QA/QC procedures etc. and its mechanical completion is achieved within targeted time schedule. Construction Management and Supervision is to be carried out by the CONTRACTOR himself by deploying persons on his rolls and this activity is not to be sub-contracted in any case.  
For this purpose, the Contractor shall deploy a Construction Management Team headed by a qualified & experienced person at site. The Construction Management team shall include engineers/ specialists in QA/QC, Project Control (Planning, scheduling, monitoring), contracts, construction supervision, progress measurement/billing, safety, warehousing, purchasing etc. Key personnel including the Head should have sufficient qualification/experience and should not be changed without concurrence from Owner/PMC.  
Curriculum vitae of all key Construction Personnel shall be submitted to Owner/PMC at least 3 months before deployment. Owner/PMC reserves the right to interview these personnel before their mobilization.
- 1.9 The CONTRACTOR shall ensure delegation of adequate and sufficient powers (including financial) to the Head of his Construction Team for effective and smooth functioning of the construction management. HO support shall be provided to the Head of Construction Team at site during construction on all matters of project execution including the following:
- Field engineering.
  - Vendor specialists required during construction.
  - Rectification/replacement of defective supplies, if any, noticed during construction.
  - Expediting replacement of imported items found short/damaged.
  - Required documentation for the material inspection at site
  - Compilation and submission of Field Inspection documents in requisite copies as per contract
  - Documentation to meet Statutory requirements.

- 1.10 The construction supervision, co-ordination and management activities shall be carried out by the CONTRACTOR in accordance with the construction procedures developed and submitted by the CONTRACTOR and approved by Owner/PMC. CONTRACTOR shall prepare construction schedules within the framework of overall contract schedule and submit to Owner/PMC for approval. CONTRACTOR shall plan, execute, monitor and control construction activities as per the approved construction schedule. The schedule so prepared shall be reviewed periodically and backlog if any related to availability of work front/ materials shall be brought to the notice of Engineer-in-Charge and corrective actions to be taken to meet the monthly/ overall Construction targets. CONTRACTOR shall depute a project team at site during construction phase under a project coordinator for providing above-mentioned support to the Head of Construction Team.
- 1.11 The CONTRACTOR shall procure material like cement, reinforcement bars and structural steel from approved vendors only. The CONTRACTOR shall establish and maintain a material testing laboratory for carrying on field tests during execution of contracts under different disciplines by sub-contractor's, at no extra cost to Owner. The entire test equipments deployed shall have valid test/calibration certificates traceable to relevant national/ international standards. Such material tests, for which testing facility at site is not established, shall be carried out by CONTRACTOR at testing laboratories approved by Owner/PMC at no extra cost. CONTRACTOR shall maintain the test records and the same shall be made available for review/ inspection of Owner/PMC. Further, Owner/PMC reserve the right to witness/ inspect testing at the laboratory at no extra cost to Owner/PMC.
- 1.12 Construction supervision and management functions to be performed by the CONTRACTOR shall include the following as key functions for effective execution, monitoring and control:
- Planning, scheduling, monitoring & reporting.
  - Construction supervision, discipline wise.
  - Quality assurance and quality control, discipline wise.
  - Shipping, custom clearances, inland transportation
  - Warehouse management and material control.
  - Field engineering/Purchase.
  - Health, Safety and Environment (HSE) Management
  - Enforcement of statutory rules/ regulations and Labour Laws
  - Personnel/administration/Industrial Relations
  - Billing and invoicing
  - Finance and Accounts
  - Security
- 1.13 Whenever the hookup is to be done with the facilities under operation, efforts shall be made by the CONTRACTOR to complete the work and restore the system expeditiously. If required the work shall be continued round the clock.

## 2.0 EXECUTION OF WORKS

The CONTRACTOR'S work during construction shall include but not be limited to the following:

- i. Prepare and submit all the Plans, Procedures and documents to Owner/PMC as specified in the contract.
- ii. Establish requisite site organization staffed by competent and experienced specialists, supervisors and inspectors.

- iii. Supervise, Coordinate and manage the activities performed at site by him and by his sub-contractors for execution of work and render all technical/specialist services.
- iv. Plan and schedule the construction work, monitor and take timely corrective action when required to adhere to approved execution schedule.
- v. Plan, allocate and mobilize required resources, manpower, and construction equipment/materials, commensurate with construction plan/schedule.
- vi. Provide all temporary facilities required for Construction including drinking water, lighting, office space, electronic transmission of drawings & documents, printing facilities, rest rooms, crèches, first-aid, fire protection system, toilets, canteen facilities, labour hutments, transport facilities for the workers and staff.
- vii. Prepare & implement Quality Control and Quality Assurance plan.
- viii. Prepare & implement Health, Safety & Environment (HSE) plan.
- ix. Report beforehand and take approval from Owner/PMC regarding use of any equipment and/or material not conforming to the contract, drawings and specifications.
- x. Execute and supervise all additional works and modification works as required or suggested by Owner/PMC as a part of approved change orders.
- xi. Erect and install the equipments and materials according to the approved specifications and procedures.
- xii. Establish required Field Inspection and Testing Laboratories at site to carryout tests as specified in the standards/specifications of the contract.
- xiii. To organize and obtain all applicable clearances/approvals from statutory bodies/authorities, as required by the laws of land for the work executed at site shall be the responsibility of the Contractor under the contract.
- xiv. Obtain approval of Owner/ PMC for Welding Procedure Specifications (WPS)/ Procedure Qualification Records (PQR) as required. Carry out inspection, non-destructive tests and analyze and certify acceptability of all welds and materials in accordance with specified Technical Standards. Carry out inspection and testing of incoming materials as per agreed procedures.
- xv. Organize and conduct Weekly Project Review meeting related to site construction activities.
- xvi. Provide daily work progress reports and detailed weekly and monthly progress reports summarizing percentage completion of the work including status of drawings, materials and effects on approved schedule, areas of concern and corrective actions required thereof. Contractor shall also identify any foreseeable delays in any aspect of the WORK and take corrective actions to eliminate/minimize the effect on Overall Completion Schedule. All progress shall be quantified.
- xvii. Take photographs and video recording of Project Construction Progress on regular basis and submit the same to Owner/PMC on monthly basis along with the Monthly Progress Report.
- xviii. Prepare and submit safety and labour relation procedures in line with all applicable codes, regulations and OWNER'S requirements.
- xix. Supervise and monitor all safety and labour relation functions as per agreed procedures and applicable laws of the land and report to Owner immediately for any violations and injuries.
- xx. If any part of the facilities is completed and is under operation, while other parts of the facilities are under construction, or work is to be carried in running Plant, it is essential that rigid safety rules be prepared and maintained for all works in accordance with the requirements of Owner/PMC.
- xxi. Maintaining all the records generated during project execution up-to-date and made available to Owner/PMC whenever requested. These records shall be handed over to Owner on completion of the work at no extra cost to Owner.

- xxii. Carryout warehouse management and material control in accordance with approved procedure.
- xxiii. Take all necessary precautions and required actions to protect construction work and materials from damage by local weather conditions and ongoing construction activities in the vicinity, theft and pilferage etc. till handing over of the plant to Owner.
- xxiv. Damages, if any, occurred to the existing facilities at the site during execution of the job shall be intimated to Owner / PMC immediately and the damages shall be rectified promptly.
- xxv. Take insurance policies for materials in transit and storage-cum-erection risk and other insurance covers required for men and materials at site as per SCC/ GCC in consultation with Owner.
- xxvi. Undertake housekeeping including sweeping, clean up to maintain cleanliness, sanitation, removing excess materials, temporary facilities, scaffolding, etc. on regular basis till handed over to Owner.
- xxvii. Prepare and submit to Owner/PMC the following daily reports for construction activities covering the following:
- Weather
  - Manpower deployment category wise
  - Construction Equipments
  - Work Progress
- xxviii. Ensure the control of all works with regard to its impact on the surrounding environment.
- xxix. Ensure all hot works are performed outside hazardous areas and in compliance with OWNER'S Safety Permit System requirements wherever applicable.
- xxx. Arrange and coordinate the visits of suppliers representatives/specialists at site.
- xxxi. All material handling equipment, tools, tackles, hoisting and lifting equipments/ machineries should be subjected to required load test initially and then periodically, to ensure safe/stable operation.
- xxxii. Organize field engineering work, wherever required and ensure timely resolution of interface problems / site constraints in consultation with Owner/PMC.
- xxxiii. Prepare and certify material reconciliation statement on completion of work to enable Owner to take over the surplus materials, as applicable.
- xxxiv. Organize the codification and handing-over of surplus materials (as applicable) and spares/ tools and tackles to the Owner on completion of work.
- xxxv. Provide weekly/daily activity plan for site inspection.
- xxxvi. Develop a phased mechanical completion program to facilitate sequential Pre-commissioning/Commissioning activities in a logical manner to meet the Overall Project Schedule.
- xxxvii. Remove / demolish all temporary structures/ establishments/ facilities created by the Contractor / his sub-contractors during the execution of the work and restore the site to its original condition.
- xxxviii. Carry out tightening of flange joints by using hydraulic tensioner/ torque wrench as per specifications. Contractor shall ensure that stud bolts are ordered extra long to facilitate tensioning.
- xxxix. Organize safety induction programme for their manpower before deployment on work and at regular intervals thereafter.

CONTRACTOR shall draw up a detailed activity list of pre shutdown activities and shutdown activities (wherever applicable) and submit the same for the approval of the Owner/PMC. All endeavors shall be made to maximize the pre-fabrication before the planned shut down and to minimize the work during shutdown period. All such activities shall be identified and appropriately planned for temporary supports, scaffolding,



clamping arrangements, enabling works, etc. so that the quantum of the work during the shutdown can be minimized.

### 3.0 EXECUTION PLANS

CONTRACTOR shall submit Construction Execution Plan to Owner/PMC for review/approval during kick-off meeting. The Plan shall detail the execution methodology of the CONTRACTOR during construction phase of the PROJECT covering following aspects as minimum –

#### 3.1 Construction Management Plan

CONTRACTOR shall submit Construction Management Plan to Owner/PMC for approval during kick-off meeting. The Plan shall detail the management methodology to be applied during the construction phase of the PROJECT, along with a list of procedures to be utilized in undertaking the work.

All reference procedures and detail work plans referred to in this document must be submitted for review and approval by Owner/PMC at least (4) four weeks in advance of actual commencement of the activity concerned.

#### 3.2 Construction Execution Plan:

It shall include the following as minimum:

3.2.1 Contractor's manpower and man-hour histogram by major section and discipline and their manpower deployment schedule on monthly basis.

3.2.2 Major equipment mobilization plan on monthly basis with short description. CONTRACTOR to develop this plan with due consideration to maximize the mechanization of construction activities.

Other plans of Contractor and procedures to be submitted at least four (4) weeks prior to start of respective activity at site, include the following as a minimum:

- a. Develop/ prepare pre-shut down/ shut down and post shut down plan including resource mobilization plan and submit to Owner/PMC for approval (where applicable).
- b. Develop/ prepare construction/erection plan/procedures and submit to Owner/PMC for approval.
- c. Temporary facilities, etc.
- d. Piling plan (if applicable)
- e. Barricading Plan (if applicable)
- f. Scaffolding plan
- g. Excavation and underground work plan
- h. Heavy transport and heavy lifting plan (Rigging Plan), If applicable
- i. Pre-fabrication plan
- j. Other activity plans e.g. piping, equipment and steel structure erection plan etc.
- k. Monsoon counter measures and preparation
- l. Emergency Evacuation Procedure
- m. Storm Management Plan
- n. Schemes to carry out works in inclement weather

Contractor shall ensure that lay down area (as applicable) given to him shall be utilized optimally.

#### 3.3 Sub-Contracting Plan

A minimum of the following activities shall be performed by the CONTRACTOR directly and shall not be subcontracted:

- a) Project Management
- b) Planning
- c) Procurement
- d) Construction Management
- e) Commissioning

If CONTRACTOR proposes to engage sub-contractor(s) for the execution of some of the activities at site, a preliminary sub-contracting plan along with the identified scope of work for each sub-contract shall be furnished by the CONTRACTOR to the Owner/PMC at the time of bid submission. However, the credentials of proposed Sub-contractor(s)'s shall be submitted by the CONTRACTOR on award of work, which shall be evaluated by Owner/PMC at SITE for acceptance. CONTRACTOR shall not be permitted to change the sub-contractor under any circumstances without prior approval of Owner/PMC. Non-compliance of the above shall be strictly dealt within relevant provision(s) of the contract.

The sub-contracting plan shall cover

- i) Sub-contracting philosophy and plan
- ii) List and scope of work of each subcontract
- iii) Subcontract administration plan
- iv) Organization chart of each sub-contractor.

The list and major scope of each subcontract shall not be changed from those of the CONTRACTOR'S plan unless specially approved by OWNER.

#### 4.0 TEMPORARY FACILITIES

The CONTRACTOR shall arrange the following temporary facilities as the minimum (including for his sub-contractors also):

- i) Exact location of temporary work area, access and general layout inside the area.
- ii) Planning and description of the temporary facilities such as:
  - a. Identification of borrow earth area (if required)/excess earth dumping yards
  - b. Site office and Fabrication yards, Open storage area and Warehouse
  - c. Miscellaneous workshops including maintenance area for construction equipments.
  - d. Temporary roads including access road to Plant, fencing and gates
  - e. Security, watch & ward, security gates, etc.
  - f. Utility supply systems viz. Construction power with DG Sets, construction water, drinking water etc.
  - g. Area lighting
  - h. Fire fighting equipments
  - i. Drainage and Sanitation
  - j. Camp Accommodation
  - k. Field Testing Laboratory
  - l. Radiography Source Pit as per BARC Guidelines
  - m. Film processing and viewing labs



- Material Appropriation and Handing Over of all items to OWNER with Owner's codification system as per terms of contract.
- Security.
- Taking up with suppliers on short supplied items and placing replacement orders for lost/damaged items.
- Intimating to there HO regarding short/lost/damaged items received at site and further replacement action, as applicable.

CONTRACTOR shall generate and issue following reports:

- Fortnightly statement of consignments in transit.
- Daily report of material received.
- Material receipt status and inventory status w.r.t. material delivery schedule
- Material Inspection Report with respect to materials received at site
- Report on Over/Short/Reject/Damage (OSRD) receipts against each consignment on receipt at warehouse.
- Weekly status of consignments, Material Receipt Report (MRRs)
- Monthly status of field purchase.
- Monthly status of over, short, reject & damage (OSRD) settlement.
- Monthly status of piping material MTO V/s Actual receipt.
- Log Register of Rotating Equipments maintenance
- Daily Stock Position of Cement
- Any other report as desired by Owner/PMC.

#### 8.0 FIELD ENGINEERING

CONTRACTOR shall be responsible for controlling and issue of technical drawings and documents, preparation of field sketches, field modifications, checking/preparation of as-built drawings, etc. CONTRACTOR should have adequate facilities for incorporating field changes, preparation of As-built drawings, Printing machines and Drawing & Document Control System.

#### 9.0 FIELD TENDERING

CONTRACTOR shall be responsible for carrying out field tendering activities, as required from the site itself.

#### 10.0 FIELD PURCHASE

CONTRACTOR shall be responsible for carrying out field purchase activities, as required.

Field Purchase items are restricted to those required for running and maintenance of the field offices, items required to expedite construction work and items found short, missing or damaged against the main order when received at the site. Any material purchased from field for usage in the plant should have proper inspection certificate and should be purchased from Owner/PMC approved suppliers. If required by OWNER/ PMC, check testing of the material samples selected by Owner/PMC shall be carried out by CONTRACTOR without any extra commercial implication.

#### 11.0 HEALTH, SAFETY AND ENVIRONMENT (HSE) MANAGEMENT

The CONTRACTOR shall be responsible for Health, Safety and Environment (HSE) Management at construction site for the construction activities to be carried out by the

him/his approved sub-contractors in accordance with the requirements mentioned in Appendix-B for Health, Safety and Environment Management during construction.

CONTRACTOR shall be working in an operating refinery. All measures required for safe construction are to be ensured. Besides all personnel employed in the job to follow safety requirements of Owner/PMC, the movement of CONTRACTOR's personnel will be restricted to their workplace only.

## 12.0 HOUSE KEEPING

It is the responsibility of the CONTRACTOR to maintain general cleanliness and proper housekeeping at work site. CONTRACTOR shall organize disposal of excavated earth /garbage/ rubbish/scrap, etc. on day to day basis to identified disposal areas/safe areas and forward daily report for the same indicating the details of men and machinery deployed for the purpose; if asked by Owner/PMC.

Wastage and serviceable/ unserviceable scrap generated during dismantling and regular works shall be segregated and dumped in designated locations in consultation with Owner/PMC. Earth and landfill materials shall be dumped at locations identified by Owner/PMC, otherwise outside the Project Site and the required fees charged by the local authorities shall be borne by the CONTRACTOR without any extra cost to OWNER.

## 13.0 INDUSTRIAL LABOUR RELATIONS

CONTRACTOR shall be responsible for industrial relation functions and implementation of labour laws at site. CONTRACTOR'S staff shall be suitably trained and experienced in Labour Relation functions so as to ensure a good relationship with labour and to prevent the occurrence of industrial disputes resulting in subsequent delays or work stoppages. In particular, CONTRACTOR shall maintain close liaison with Owner/PMC.

CONTRACTOR shall maintain proper liaison with Statutory Authorities and local bodies and shall be responsible to implement and observe all statutory laws at site. CONTRACTOR must have in his staff; a well experienced Labour Relation Officer, preferably from local area.

CONTRACTOR shall maintain the records of wages paid in a wage register, PF, etc. as per statutory regulations.

CONTRACTOR shall report immediately to Owner/PMC any problems including labour disputes, fight, and work stoppages. A written report shall be submitted to Owner/PMC within 24 hours of the incident.

CONTRACTOR must submit a Labour Relation Plan including their sub-contractor(s) prior to the start of the work/within one month of award of the contract, whichever is earlier, mentioning as a minimum:

- A detailed estimate of the number of labour, both indirect and direct, sorted by craft.
- Outline recruiting plans for all manpower requirements.
- Identify personnel involved with labour relations and outline procedures to mitigate labour disputes & problems.
- Labour welfare plan

CONTRACTOR shall hold labour relations meeting twice a month with their work force as well as a separate meeting with the Owner.

#### 14.0 CONSTRUCTION EQUIPMENTS

The Contractor is required to organize and mobilize the construction equipments and other tools/tackles in a sequential manner and ensure that plant installation is carried out in a mechanized manner to the extent possible and its mechanical completion is achieved within targeted time schedule.

Contractor shall ensure deployment of the following construction equipment as a minimum as per requirement to the maximum extent –

- i. Cranes of different capacities
- ii. Tower crane, as required
- iii. Hydraulic crane with audio-visual signaling devices and limit switches
- iv. Portable Alloy Analyzers with print out facility
- v. X-ray and Radiography sources
- vi. Stress Relieving Equipments with Recording facility
- vii. All weather fabrication sheds
- viii. Blast cleaning and Painting Shop, as required.
- ix. Welding machines
- x. DG sets
- xi. Electrical and Instrumentation equipments/measuring devices etc.
- xii. Bevel Cutting Machines
- xiii. Test Pumps
- xiv. Compressors
- xv. Gas and Mechanical cutting devices
- xvi. Various inspection / measuring devices

The Contractor shall, without prejudice to his responsibility to execute and complete the work strictly as per the specifications and other laid down procedures, execute all the work by mechanizing the construction activities to the maximum extent by deploying all necessary construction equipments/machinery of adequate capacities and numbers.

Contractor shall be responsible for arranging all facilities for torque tightening/tensioning of bolts/fasteners as specified. Contractor shall ensure that stud bolts are ordered extra long by one diameter to facilitate tensioning. Guidelines for torque tightening/tensioning are specified in specifications for boxing up of flanged joints, as referred in APPENDIX-A.

In order to minimize fabrication at site, Contractor to fabricate all (major) fabricated items at their vendor works to the maximum extent possible due to limitation of space at site and transported to site with maximum length of consignment transportable by sea and road. Contractor shall carry out the route survey/ study for transportation of 'Over Dimensioned Consignments' including waterways from source of manufacture/supply to site well in advance of placement of order to ensure unhindered transportation of the same to construction site. Contractor shall arrange Cranes of suitable capacities to match with the erection requirements. Crane movement roads are to be clearly identified and marked on the plot plan before planning of such movement. Construction of hard stands for positioning of crane in the fabrication yard and at erection site/locations including approach roads to the hard stands from the plant roads shall be Contractor's responsibility. The hard stands shall be suitable for the crane loads (self load + equipment load) to facilitate erection works and to be tested for any settlement.

For the purpose of Equipment/ Structural steel Erection, the Contractor shall deploy a Rigging team headed by a Rigging Foreman/Engineer reporting to concerned Area Engineer. Area Engineer should be well conversant with various erection techniques and shall be responsible for preparing erection schemes in accordance with the approved procedures and based on crane manuals and suiting to plant layout. Area Engineer shall have to foresee various other construction activities in the surroundings areas while planning erection schemes including safety aspects of man and machinery also.

Contractor shall prepare erection schedule in line with the overall project schedule of the Plant in phased manner with erection schemes of various equipments, vessels and submit to Owner/PMC for approval, Monitoring and control of erection schedule and erection activities shall be carried out by the contractor as per the approved construction procedures.

For efficient working and maintenance of construction aids, Contractor shall establish and maintain crane yard / workshop equipped with regular maintenance facilities for various construction aids for carrying out routine field maintenance during performance of the contract. Temporary approach road and hard stands, wherever required for the movement of the Cranes and other vehicles for equipment erection and transportation of material shall be properly planned and made by the Contractor. Weekly/fortnightly maintenance shall be planned in such a way that the same does not hamper the erection schedule.

During performances of the work, Contractor must ensure that structures, materials and equipments are adequately braced with Guys, Struts or any other means as deemed fit & approved by Owner/PMC. Such means shall be supplied and installed by the Contractor as required till the erection works is satisfactorily completed. Such guys, shoring, bracing, strutting, planking supports etc. shall not interfere with the work of other agencies and shall not damage or cause distortion to works executed by other agencies. All lifting tools, tackles and cranes shall be tested periodically by statutory/competent authorities for their load carrying capacity. Such relevant valid/test certificates shall be submitted to Owner/PMC for review before actual use of the tools, tackles and cranes.

Contractor shall submit the construction equipment deployment schedule at the time of kick off meeting. Daily construction equipment deployment report will also be submitted by the Contractor to Owner/PMC in the performa approved by Engineer In charge.

Contractor shall ensure the timely augmentation of the men, equipments and machinery depending upon the exigencies of the work to meet the overall project schedule and as per instructions of Owner/PMC.

## 15.0 CONSTRUCTION MANPOWER

The Contractor is required to organize and mobilize construction staff/ manpower in a sequential manner to ensure that the work is carried out in accordance with the construction schedule. Mobilization of construction staff should be such that the progress achieved in phased manner should match with the overall Project Schedule. Key Personnel i.e. Resident Construction Manager, Site In-charge, Lead QA/QC Engineer, Lead Planning Engineer, Safety officer, Discipline Engineer for execution of job shall be deployed meeting the qualification and experience requirement of Document No. 7-82-0003.

For this purpose, the Contractor shall clearly indicate in his construction methodology whether work shall be done departmentally or by engaging sub-contractor or the combination of both. Contractor shall prepare detailed methodology for the work to be carried out departmentally as well as through sub-contractors clearly, defining the scope and responsibility of Contractor and his sub-contractors.

The works of all sub-contractors shall be managed by the construction staff of the main Contractor who shall perform the duties of construction management and shall administer, coordinate, and inspect the works of the sub-contractor(s) and be responsible for the Quality and timely completion of respective works. The Contractor shall establish the pre-requisites for successful completion of sub-contractor (s) work. However, by deploying the sub-contractor (s), as approved by Owner/PMC for any discipline, does not absolve the Contractor of his total responsibility under the subject contract.

The Contractor must note that in case of any sub-contractors' failure to execute the works as per standards/specifications/drawings and/or negligence & disobedience in carrying out any order or instruction of Owner/PMC, the same shall be viewed very seriously and any action as deemed fit in accordance with provision(s) of the contract shall be taken by Owner/PMC.

Contractor shall submit the construction manpower deployment schedule at the time of kick off meeting. Daily construction manpower deployment report shall also be submitted by the Contractor to Owner/PMC on approved format. Any additional manpower of any category required to be deployed during the actual execution of the work to meet the Project time schedule and as instructed by Owner/PMC, shall be mobilized by the Contractor within a reasonable time. Mobilization of such additional manpower by the Contractor shall not entitle him for any additional compensation at all.

All construction supervision, coordination and management activities shall be carried out by the Contractor in accordance with the construction procedures approved by Owner/PMC. Contractor shall prepare construction schedules based on the Overall Project Schedule and submit the same to Owner/PMC for approval. Monitoring and control of the construction activities shall be carried out as per the approved construction schedule & procedures.

During the execution of works at site, if the Contractor engages sub-contractor (s) for execution of works at site as per approval obtained from Owner/PMC in line with contract provision(s) and in the event sub-contractor complains in writing to the Owner with regard to the non-payment of their dues from the Contractor for the works executed by them (excluding final payments and payments due after termination of sub-contractors' services by the main Contractor), Owner/PMC reserves the right to make such payment to the sub-contractors directly based on approved measurements with due notice to the Contractor. Owner/PMC shall release such payments to sub-contractor at the cost and risk of the Contractor in order to ensure smooth execution of work at site. All such payments made by Owner/PMC to the sub-contractor(s) shall be deducted from the running account bills or any other payments due to the Contractor.

The above provisions shall also be applicable in case of construction materials procured at site by the Contractor from the suppliers.

## 16.0 INTERFACE WITH OTHER CONTRACTORS

CONTRACTOR shall ensure that his interface with other CONTRACTORS is smooth and cordial. In case of any dispute, Owner/PMC decision shall be binding.



Owner/PMC may arrange weekly/fortnightly/monthly interface meetings. The CONTRACTOR shall depute concerned personnel to attend these meetings. Generally, the following interfaces may be present:

- CONTRACTOR shall allow movement of persons/ material/ equipment/ vehicles belonging to other CONTRACTORS or Owner/PMC through the roads constructed by him.
- CONTRACTOR shall coordinate with 'neighboring' contractors for maintaining elevations/levels of various interconnecting services.
- CONTRACTOR shall not dump his earth, scrap or any material in other Contractors' area. He shall cooperate with Owner/PMC in maintaining good housekeeping throughout the complex.
- CONTRACTOR shall ensure proper drainage and no water logging in his area/other areas.
- If requested by the Owner/PMC, CONTRACTOR shall allow testing of materials of other Contractors in his laboratory, in case of emergency.
- CONTRACTOR shall clearly define in the interface meeting with other contractors their erection / construction interface at their Battery limits.

#### 17.0 CHECKLIST FOR INSPECTION OF FLANGED JOINTS

Requirements specified in standard specification for application of torque and hydraulic bolt tension for flange joints No. 6-76-0002 shall be followed by the CONTRACTOR.

## 1.0 SCOPE

This document shall be applicable to all construction works to be executed by CONTRACTOR.

## 2.0 RESPONSIBILITY

It is Contractor's prime responsibility to arrange/produce the product conforming to contract specifications and inspect all equipment, materials and works at various stages of execution as per the approved QA Plans. In addition, they have to coordinate all efforts in this regard directly with the Owner/PMC and other involved agencies to give adequate confidence that the activities are performed as per agreed ITPs and necessary documentation is available. Contractor shall deploy an exclusive team of Quality control Engineers and Supervisors for ensuring the quality of works executed at site on day to day basis. Verification by Owner/PMC or his representative at any stage shall not relieve CONTRACTOR of his responsibility towards quality of the product.

The CONTRACTOR shall comply with all statutory rules & regulations in force during execution of work and interface with such authorities as required.

## 3.0 METHODOLOGY

The management of construction quality control is divided into the following categories:-

- (1) Procurement of materials required for the construction work.
- (2) Execution of work
- (3) QA/QC Audits

### 3.1 PROCUREMENT OF MATERIALS REQUIRED FOR THE CONSTRUCTION WORK

The CONTRACTOR shall develop list(s) defining the items to be procured along with proposed Vendors for approval of the Owner/PMC. The list shall comprise of all items except vessels, equipments, pumps, electrical/ instrumentation panels etc. which may be available directly ready for installation or requiring small fabrication as per requirement. The vendor list shall be in line with the contract document. In case, no vendor list exists in the contract for a particular item, the CONTRACTOR shall propose a list of Vendors to Owner/PMC. CONTRACTOR has to satisfy himself with the capability of the vendor to deliver the product in time with quality before proposing him as a prospective vendor. CONTRACTOR shall submit the QA/QC plans for all major items and carry out their procurement in line with the approved plans. The categorization plan shall be submitted by contractor in line with the contract requirement/ bid package. The CONTRACTOR can either provide his own adequate qualified staff for inspection or employ a separate third- party inspection agency with prior approval to carry out these functions. Involvement of Owner/PMC in the quality control plan, if required, shall be defined during approval of the same.

### 3.2 EXECUTION OF WORK

- (i) The QA plans for execution shall be developed by the CONTRACTOR. OWNER/ PMC's approval for the same shall be taken well before start of the work. The final Inspection & Test Plans (ITPs) and formats, based on the indicative ITPs (enclosed elsewhere in package), shall be developed by the CONTRACTOR as per contract specifications for approval by Owner/PMC. For the activities which are identified as Witness or Hold Point, specific inspection call shall be raised by the CONTRACTOR with Owner/PMC in the requisite format well in advance.

The indicative ITPs enclosed in the bid package are for guidance to the CONTRACTOR and may not cover some of the activities to be performed during execution of works under the scope of this contract. The CONTRACTOR shall develop Inspection & Test Plans and Formats for all such activities also and submit the same to Owner/PMC for approval, before actually undertaking such activities

CONTRACTOR shall be completely responsible for management of approved quality plans and Owner/PMC involvement will be only of Surveillance in nature to randomly check the works at selective/critical junctures. Their role shall be to monitor that the CONTRACTOR is executing the quality plans as per the approved drawings, employing adequately qualified staff and other resources for various items of works. Any deviation to the specifications shall be brought to the notice of Owner/PMC in prescribed formats by CONTRACTOR for approval.

- (ii) It is likely that the CONTRACTOR may engage sub-contractor(s)/vendors for performance of the work. CONTRACTOR shall be responsible for ensuring the implementation of approved QA plan, contract specifications and contract conditions through their sub-contractors to achieve the quality during all stages of construction. It shall be the responsibility of the CONTRACTOR to ensure proper coordination between his sub-contractor(s) and other agencies working at site.

The sub-contractor(s)/vendors selection shall be done after evaluation by the CONTRACTOR in line with contract requirements and shall be got approved by Owner/PMC before engaging them for the works.

- (iii) Storage

All the materials procured shall be stored/stacked as per the standard norms and as recommended in various clauses of relevant codes and contract document. The storage of material shall be such as to avoid damage to life/properties (physical and chemical) of the materials. The storage shall not cause deterioration, rusting, mix-up etc. and hamper the other related works in any way. CONTRACTOR shall submit his detailed warehouse plan for Owner/PMC approval to manage the above in open/covered areas.

The materials susceptible to fire shall be kept away in a separate protected place.

In general, the materials shall be kept systematically in order of their class, batch number and identification number, so that they are accessible for the inspection by Owner/PMC whenever required and to avoid the mix up in those materials.

- (iv) Use

The materials shall be stacked in such a way that the lot, which is procured first, will be consumed first. For materials which are having specific expiry date/ shelf life shall not be used beyond that date and shall be removed from site. Wherever there is any doubt about the change in properties of the materials, such materials shall be sent to reputed approved laboratory for testing and acceptance.

- (v) Inspection

The CONTRACTOR shall be responsible for carrying out inspection of the materials brought at site and conducting tests/ checks (at site or in approved laboratories) at

predefined frequencies as per contract. It is the responsibility of the CONTRACTOR to ensure that the materials used at site shall conform to relevant codes/ standards and Manufacturer Test Certificates are available for correlation as and when required. The CONTRACTOR shall maintain the records of all materials brought at site and tests conducted on them.

(vi) In process and final Inspection

CONTRACTOR shall be responsible to arrange verification of products during in-process and final inspection. Relevant checks and tests shall be arranged for the works performed and records maintained. Tolerances achieved with respect to contract specification and execution drawings for various activities/processes shall be ascertained and submitted to Owner/PMC for approval. Efforts shall be made to keep checks and controls in such a way that a non-conforming product is avoided. However, if in an isolated case, the tolerances are beyond the acceptable values given in the contract/execution drawings/codes, non-conformance resolution/Deviation permit need to be raised by the CONTRACTOR and got approved/resolved from Owner/PMC.

The CONTRACTOR shall arrange verification of ingredients used and validation of the software used at the batching plant(s). Owner/PMC reserve the right to inspect the working of batching plant including validation of the software used and calibration of measuring & monitoring devices any time. The CONTRACTOR shall ensure the quality of the concrete delivered by the transit mixers, as applicable and maintain verifiable records.

CONTRACTOR will carryout Inspection, Non-destructive Tests and analyze and certify acceptability of all welds, materials and works in accordance with specified technical standards/International standards and carryout inspection and testing of incoming materials as per agreed procedures.

- v) Any Observation on quality aspects , Owner/PMC shall raise observation in attached OQA format which has to be acknowledged & compliance to be done by the contractor within the agreed time period.
- vi) The CONTRACTOR shall follow the requirements given for control of monitoring and measuring devices (Refer Document no. 7-82-0002).

### 3.3 QA/QC AUDITS

During the execution of the works, CONTRACTOR shall carry out periodical Quality Audits at least quarterly in all areas of work. These audits will be conducted by a team of specialists in the respective areas. The auditors shall not be directly involved in the jobs being audited.

The CONTRACTOR shall prepare an Audit Plan and Procedure and submit the same to Owner/PMC for approval.

A copy of the Audit Report containing the findings of the Audit team will be submitted to Owner/PMC. After completion of rectification/modifications/corrective actions on the issues indicated in Audit Report, Compliance Report shall be submitted by the CONTRACTOR to Owner/PMC for review.

Over and above the Contractor's Internal QA/QC Audits outlined above, Owner/PMC shall also reserve the right to conduct QA/QC audits at the frequency decided by them.

CONTRACTOR shall participate and provide full support to the Audit Team and furnish all documents/reports/records as desired by the Audit Team. The CONTRACTOR shall take all actions required to comply with the findings of the Audit Report and issue regular Compliance Reports for the same to Owner/PMC till all the findings of the Audit Report are fully complied.

In case major Non conformities are observed during execution of the works Owner/PMC reserve the right to appoint an independent person/Third Party Agency to conduct QA/QC Systems Audit for full/part of the facilities being executed by the CONTRACTOR. This audit will be in addition to the audits described above and may be carried out intermittently/continuously for all or part of the facilities being executed by the CONTRACTOR. CONTRACTOR shall bear the total cost of such audits and shall participate & provide full support to the Audit Team and ensure compliance of the audit observations.

#### 4.0 DOCUMENTATION AND RECORDS

All the necessary documentation & records shall be maintained by CONTRACTOR till completion of project and handed over to Owner/PMC in requisite copies as a part of completion documents. Wherever Owner/PMC personnel were directly involved particularly in witness and hold point, the copies of the records shall also be provided to personnel on completing inspection of those activities. The documentation & records shall include the following as a minimum but not limited to:

- i) Approved Quality Assurance Plan
- ii) Approved Inspection and Test Plans
- iii) Inspection and test documents covering
  - a) Manufacturer Test Certificate
  - b) Material Receipt Report including Inspection Release Note, if applicable and Site Inspection and acceptance Report on quality and quantity of material
  - c) Site test/laboratory test Report reviewed by CONTRACTOR for acceptance vis-à-vis to contract/code requirements for materials/including PMI report at warehouse.
  - d) In process Verification reports of CONTRACTOR representative and OWNER/ PMC as applicable
  - e) Final verification report including any test checks done for compliance
  - f) As-built vis-à-vis to contract/drawings including tolerances
  - g) As-built for erection
  - h) Non conformance resolution raised by CONTRACTOR/OWNER/ PMC
  - i) Concession/Deviation approval by Owner/PMC
  - j) Change order approval by Owner/PMC incase there is variation from contract
  - k) QA/QC Audit Reports and compliance Reports thereof
  - l) Mechanical Completion formats

## GENERAL REQUIREMENTS

- 1.0 Specification for Health, Safety and Environment (HSE) Management (Spec. No. 6-82-0001), is required to be followed by CONTRACTOR during Construction Phase at site.
- 2.0 CONTRACTOR shall have a documented HSE policy to cover commitment of the organization to ensure Health, Safety and Environment aspects in the line of operation.
- 3.0 It is the responsibility of the CONTRACTOR to ensure that safe construction procedures are complied with. CONTRACTOR will also ensure that adequate First Aid medical facilities are available for emergency purpose and that safety practices as per the approved safety procedure are followed by his sub-contractors also.

CONTRACTOR to ensure safety measures at the minimum like:

- a) The use of safety gadgets, viz. safety goggles, helmets, safety shoes, full body harness, provision of safety net for construction at higher elevations and provision of toe boards in scaffolding platforms, etc.
- b) All hot works must be performed by ensuring compliance to the requirements as specified by the Owner from time to time.
- c) Barricading of crane movement areas / Radiography areas
- d) Proper earthing of equipments.
- e) Proper shoring / strutting of Excavated Areas, as applicable.
- f) Cylinders of inflammable gases to be stacked upright.

To assist in the development of an effective safety program, a safety checklist for various jobs shall be developed by the CONTRACTOR and the same shall be adhered to by the Contractor's Site-In-charge.

The responsibilities of the CONTRACTOR will include but not limited to:

- Coordination and supervision of the details of the job safety programme.
- Initiation of accident reporting, investigation and follow-up actions.
- Preparation of periodic accident summaries.
- Periodic Accident Analysis Reports
- Tallying safety inspection of the job and submission of summary inspection report to OWNER/PMC.
- Obtaining work permits from the OWNER, wherever applicable.
- Check the fitness of cranes and other hoisting equipments on periodic basis/before all major lifts and submit to Owner/PMC valid/latest test certificates of tackles used for lifting.
- Submission of any other report required by Owner/ PMC.
- Conduct HSE Audit at predefined frequencies and assist OWNER/CONSULTANT/TPI during conductance of their HSE Audits.
- Ensure closure of NCs observed during the above audits.

- 4.0 Any Observation on Safety aspects, Owner/PMC shall raise observation in attached OSA format, which has to be acknowledged & compliance to be done by the contractor within the agreed time period.

ITP NO: 2501

PAINTING WORKS

SL. NO.	ACTIVITY	CONTRACTOR	EIL
<b>A.</b>	<b>BEFORE FABRICATION</b>		
1.	Availability of Valid calibration certificates of instruments/ testing equipment's	WC	RW
2.	a) Approved supplier, product and supplier's materials test certificate	WC	Note 1
	b) Check manufacturing date, expiry period and shelf life	WC	Note 1
3.	a) Physical condition of materials; original manufacturers packing/ containers	WC	Note 1
	b) Confirm identification/ Transfer of identification of materials before painting	WC	Note 1
4.	a) Adequacy of blasting machine capacity for blast cleaning	WC	--
	b) Type and quality of abrasive being used for blast cleaning	WC	--
	c) Adequacy of Airless spray equipment, air spray equipment and paint brushes	WC	--
5.	Check quality of dry air for blast cleaning and spray application	WC	--
6.	Inspection of blast cleaning operation		
	- Inspect for surface cleanliness by visual stds. of ISO 8501	WC	--
	- Measurement of surface profile by Micrometer/Elkometer/Stylus instrument	WC	--
7.	Wet film thickness ( including primer) and over coating interval for each coat of paint during application	WC	--
8.	Dry film thickness after final coat (wherever applicable)	WC	S
9.	Inspection of final curing/ drying, adhesion, hardness, surface finish, sagging, hiding and pinhole detection	WC	--
10.	Painting identification band/ code, etc.	WC	--
11.	Acceptance prior to shifting to fabrication shop, if applicable	WC	Rw

Note: 1) For incoming material inspection please refer ITP no: 6-82-1010.

ITP NO: 2501

PAINTING WORKS

SL. NO.	ACTIVITY	CONTRACTOR	EIL
<b>B.</b>	<b>AFTER INSTALLATION</b>		
1.	a) Approved supplier product : Suppliers materials test certificate	WC	Note 1
	b) Manufacturing date, expiry period and shelf life	WC	Note 1
2.	Physical condition of materials; original manufacturers packing/ containers	WC	Note 1
3.	Confirm completion of		
	a) Hydrostatic testing of piping	WC	--
	b) Mechanical clearance of structure & equipment's	WC	--
4.	a) Adequacy of surface preparation tools and tackles	WC	--
	b) Check the quality of surface preparation	WC	--
5.	a) Performance test for paint applicator for spray application	WC	--
	b) Adequacy of airless spray equipment and air spray equipment and paint brushes and quality of dry air for paint application	WC	--
6.	Wet film thickness and over coating interval for each coat of application	WC	--
7.	Dry film thickness after final coat	WC	S
8.	Identification of color bands, direction marking	WC	--
9.	Identification of color bands, direction marking	WC	--
10.	Final Acceptance	WC	HP
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

Note: 1) For incoming material inspection please refer ITP no: 6-82-1010.



ITP NO: 2603

**CALIBRATION OF INSTRUMENTS**

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Availability of approved standard calibrated testing equipment having test certificates from approved lab and validity of calibration.	WC	HP
2.	Dust free environment	WC	S
3.	Availability of approved data sheets, calibration procedures, standards, vendor's manuals	WC	Rw
4.	Usage of appropriate tools and tackles	WC	S
5.	Usage of qualified/ trained personnel	WC	S
6.	Mounting of instruments, instrument tag & model	WC	S
7.	Checking of instrument ranges, supply & output for proper connections	WC	S
8.	Calibration of local gauges	WC	Rw
9.	Calibration of electronic instruments	WC	S
10.	Calibration/ stroke checking of Control Valves	WC	W
11.	Calibration of safety valves, shut down valves and trip switches or transmitters	WC	W
12.	Calibration of special level instruments i.e. Radar type/ float type instruments	WC	W
13.	Ensuring procedure & record	WC	Rw
14.	Plugging of spare entries	WC	S
15.	Stamping of calibration date on instruments	WC	S
<b>INSPECTION &amp; TEST DOCUMENTS</b>			
	Review Test and Inspection documents	WC	Rw

ITP NO: 2604

**FABRICATION AND ERECTION OF CABLE DUCTS**

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Incoming material Inspection	WC	Note 1
2.	Usage of proper tools and tackles	WC	S
3.	Use of approved consumables	WC	S
4.	Correctness of dimensions of duct	WC	S
5.	Welding as per standards/ specifications	WC	S
6.	Installation & alignment of support as per structural drawings and documents	WC	S
7.	Painting of cable duct and support	WC	Note-2
8.	Grinding of sharp edges before erection	WC	S
9.	Alignment of cable duct	WC	S
10.	Covering of duct after completion of cable laying/ dressing	WC	S
11.	Usage of appropriate clamp & fasteners	WC	S
12.	Installation of guide supports	WC	S
<b>INSPECTION &amp; TEST DOCUMENTS</b>			
	Review Test and Inspection Document .	WC	Rw

Note :1)

For incoming material inspection please refer ITP no: 6-82-1010.

2)

For cleaning & painting, please refer ITP No. 2501 (Standard no 6-82-2500)

ITP NO: 2605

**FABRICATION, ERECTION OF CABLE TRAYS, ANGLE TRAYS FOR CABLE AND TUBE LAYING.**

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Incoming material Inspection	WC	Note 1
2.	Correct size and routing of tray/ angle	WC	S/Rw
3.	Ensure separation of cable trays for power & signal/ Thermocouple cables	WC	S
4.	Supports as per standards/ specifications	WC	S
5.	Removal of sharp edges and sharp bends	WC	--
6.	Fastening/ welding of trays/ angles	WC	S
7.	Check for fouling with piping & structures	WC	S
8.	Check for any obstruction/ free access for maintenance	WC	S
<b>INSPECTION &amp; TEST DOCUMENTS</b>			
	Review Test and Inspection Document	WC	Rw

Note :1) For incoming material inspection please refer ITP no: 6-82-1010.

ITP NO: 2606

**FABRICATION, INSTALLATION OF INSTRUMENT SUPPORT/  
STANCHIONS, PANEL SUPPORTS, CANOPIES, JB SUPPORTS**

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Incoming material Inspection	WC	Note 1
2.	Usage of proper tools and tackles	WC	--
3.	Availability of approved junction box layout and Instrument location plan	WC	Rw
4.	Location of Junction Box & Instrument Stanchions (from access point of view & installation standards)	WC	S
5.	Correctness of dimensions, height, etc.	WC	--
6.	Approved welder, consumables, standards	WC	Rw
7.	Check for installation, hole to hole dimension & alignment/ fit-up	WC	S
8.	Removal of sharp edges	WC	--
9.	Painting	WC	Note-2
10.	Physical walk through the line	WC	--
11.	Easy access for maintenance	WC	S
<b>INSPECTION &amp; TEST DOCUMENTS</b>			
	Review Test and Inspection Document	WC	Rw

Note :1)

For incoming material inspection please refer ITP no: 6-82-1010.

2)

For cleaning & painting, please refer ITP No. 2501(Standard no 6-82-2500)

ITP NO: 2609

**CABLE LAYING, GLANDING AND TERMINATION**

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Incoming Material Inspection for Cables, Glands etc.	WC	Note 1
2.	Correctness of cable type as per schedule	WC	S
3.	Measurement & routing	WC	--
4.	Check cable for continuity, insulation resistance, megger values	WC	Rw
5.	Identification tags/ tag plates and proper dressing & clamping	WC	--
6.	Separation of signal/ thermocouple and power cables	WC	S
7.	Proper glands as per area classification, size of cable, JB entry, etc.	WC	S
8.	Identification/ ferrule and dressing inside junction boxes and instrument	WC	--
9.	Crimpable type lugs and proper crimping	WC	--
10.	Telephone wire connection inside JB	WC	--
11.	Shield wire dressing/ sleeving and termination	WC	--
12.	Insulation of shield wire on instrument end	WC	--
<b>INSPECTION &amp; TEST DOCUMENTS</b>			
	Review Test and Inspection Document	WC	Rw

Note : 1) For incoming material inspection please refer ITP no: 6-82-1010.

ITP NO: 2610

INSTALLATION OF JUNCTION BOXES, LOCAL CONTROL PANEL

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Incoming Material Inspection	WC	Note 1
2.	Check suitability as per specified hazardous area classification	WC	Rw
3.	Check Correctness of cable entries	WC	--
4.	Alignment	WC	--
5.	Tightening of fasteners	WC	--
6.	Tightening & numbering of terminal blocks	WC	--
7.	Availability of telephone sockets (for JB's) & earthing point	WC	--
8.	Earthing of JB/ LCP	WC	S
9.	Plugging of spare entries with correct plugs	WC	S
10.	Wiring of various hardware in LCP as per approved wiring drawings	WC	S
11.	Protection of JB and LCP (Canopy, weather shed)	WC	S
<b>INSPECTION &amp; TEST DOCUMENTS</b>			
	Review Test and Inspection Document	WC	Rw

Note : 1) For incoming material inspection please refer ITP no: 6-82-1010.

ITP NO: 2633

LAYING, GLANDING & TERMINATION OF INTERCONNECTION  
CABLES, PREFABRICATED CABLES, SYSTEM CABLES, POWER  
CABLES AND FIELD CABLES – CONTROL ROOM

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Correct size & type of cables as per cable schedule	WC	Note 1
2.	Testing of cable before laying as per specification (continuity, megger, etc.), as applicable	WC	Rw
3.	Check for exact distance and cables cutting accordingly	WC	Rw
4.	Tag on cables as per specification	WC	--
5.	Availability of proper cable gland size, type of specified thread	WC	Rw
6.	Tightening of check nut (after termination)	WC	--
7.	Cable continuity & insulation resistance, as applicable	WC	--
8.	Dressing of cables inside PVC Duct and covering of PVC Duct after complete cabling.	WC	--
9.	Ferruling of cables	WC	--
10.	Usage of sleeved crimpable type lugs	WC	--
11.	Crimping of lugs	WC	--
12.	Tightness of cables in the terminal block	WC	S
13.	Numbering of terminal blocks	WC	--
14.	Continuity of fuses in terminal blocks	WC	S
<b>INSPECTION &amp; TEST DOCUMENTS</b>			
	Review Test and Inspection Documents	WC	Rw

Note: 1) For incoming material inspection please refer ITP no: 6-82-1010.

ITP NO: 2634

**POWER 'ON' OF PANELS AND PRE-COMMISSIONING OF THE SYSTEM -  
CONTROL ROOM**

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Check for earth pit resistance	WC	HP
2.	Earth connection to system earth, panel earth etc.	WC	HP
3.	Ensure proper interconnectivity of panel earth bus	WC	W
4.	Incoming power supply and termination of the power cables	WC	W
5.	Power 'ON' the system and observe system booting and self diagnostic check.	WC	W
6.	Reload the software's, if necessary	WC	S
7.	Check for alarms by switching 'ON'/'OFF' the sub systems	WC	S
8.	Start simulation of individual loops from respective 'Field Terminal Blocks' (FTBs)	WC	S
9.	Observe the response and tune the controllers	WC	S
10.	Interlocks as per P&ID	WC	S
11.	Record the input & outputs	WC	Rw
12.	Trend reports, logging reports/shift reports & alarm, sequence and functioning of all peripheral units.	WC	Rw
13.	Back-up operation of PLC cards, system memory & power supply switch over	WC	W
14.	Lighting and ventilation fan operation	WC	S
15.	Functioning of complex loops	WC	W
<b>INSPECTION &amp; TEST DOCUMENTS</b>			
	Review Test and Inspection Documents	WC	Rw