

**VALUE Rs. 1000.00**

# **Aryabhata Research Institute of Observational Sciences (ARIES)**

**REQUEST FOR PROPOSAL (RFP)**

**FOR**

**Procurement, Manufacture, assembly, inspection, testing,  
transport and erection of 80 cm Schmidt Telescope as per  
the attached:**

- a) Assembly Drawings.**
- b) Lists of drawings & parts.**
- c) Technical specifications.**

**This document has 31 pages including this cover page except 23 assembly drawings.**

## **TABLE OF CONTENTS**

**1- Eligibility Criteria**

**2- Terms and conditions**

**Annexure A – Technical Offer**

**Annexure B – Technical Specifications of 80 cm Schmidt Telescope.**

**Annexure C – Commercial Offer**

**Annexure D – Assembly drawings.**

## **Eligibility Criteria:**

1. Vendor should have reputed background and should be established in manufacturing of high precision Opto-Mechanical equipments business in India for at least ten years.
2. The vendor must have adequate infrastructure, skilled manpower, inspection & testing equipments along with the precision working machines & tools set up. Vendor must enclose relevant information in the form of brochures, leaflets, manuals etc. to support his technical competence for this job.
3. Three years comprehensive on site warranty for the manufactured mechanical parts of the telescope should be offered by the manufacturer only in original letter head.
4. Vendor must comply with all the above mentioned criteria. Non-compliance of any of the criteria will entail rejection of the offer summarily. Photocopies of relevant documents / certificates should be submitted as proof in support of the claims made. ARIES reserves the right to verify / evaluate the claims made by the vendor independently.
5. All bids should be accompanied by a bid-security of Rs. 1,00,000/= (Rs One lakh only) in the form of a Demand Draft/Bank Guarantee issued by a scheduled commercial bank favouring Director, ARIES, payable at Nainital.
6. RFP document can be obtained against payment of Rs. 1000/- issued by a scheduled commercial bank favouring Director, ARIES, payable at Nainital.

## TERMS AND CONDITIONS

### Scope of Supply

Procurement, Manufacture, Assembly, Inspection, Testing, Transport and Erection of 80 cm Schmidt Telescope as per the drawings, lists of parts and technical specification.

As necessary requirement for the manufacture of the telescope the manufacture of the following items come under the scope of contract.

1. Dummy parts to represent the optics and other assemblies coming in telescope which cannot be given to the vendor and which are not included in the scope of supply covered under the technical specification.
2. Any jigs, fixtures, gauges and tooling necessary to complete the manufacture, assembly, inspection, testing and erection of the telescope.
3. Grouting of the foundation bolts and foundation plates on north and south piers.
4. Providing necessary facilities, instruments and tooling for the quality surveillance and inspection of components, assemblies and alignments.

### Terms of execution of work

The vendor shall deliver the equipment at the ARIES site within 10 months from the date of receiving the intimation from the ARIES, failing which the ARIES reserves its right to levy liquidated damages as prescribed hereunder.

### Two Part Offer

The offer will be in two parts; Technical & Commercial. Both the parts must be submitted at the same time but **in separate sealed covers**, giving full particulars, addressed to the ARIES and duly super-scribed "**Technical Offer for 80 cm Schmidt telescope**" and "**Commercial Offer for 80 cm Schmidt telescope**" on or before **1400 hours on 2<sup>nd</sup> July 2007**.

### Bid Security

Bid security of Rs. 1,00,000/- (Rs One lakh only) in the form of a demand draft/bank guarantee issued by a scheduled commercial bank favouring Director, ARIES, payable at Nainital must be submitted along with the offer. This amount will be forfeited if the vendor refuses to accept purchase order or having accepted the purchase order, fails to carry out his obligations mentioned therein. **No interest will be payable on the Bid Security amount.**

### Offer Validity Period

The offer should remain valid for a period of at least 90 days from the date of opening of tender.

### Technical Offer (TO)

The Technical offer (TO) should be complete in all respects and contain all information asked for in this document. Vendor should attach Annexure – A in its technical offer. ***It should not contain any price information. However TO should confirm that all required rates have been quoted in Commercial Offer (CO), without showing the actual amounts in the TO.***

**It is mandatory to understand & accept the technical specifications as per the Annexure-B, along with the offer. ARIES, at its discretion, may not evaluate a TO in case of non-submission or partial submission of technical details.**

The TO must be submitted in an organised and structured manner. No brochures/leaflets etc., should be submitted in loose form.

The TO should comprise of following:

1. Documents in support of the background of manufacturer as established in manufacturing of high precision Opto-Mechanical equipments business in India for at least ten years.
2. Documents in support of infrastructure, skilled manpower, inspection & testing equipments along with the precision working machines & tools set up in the form of brochures, leaflets, manuals etc.
3. Three years comprehensive on site warranty for the manufactured mechanical parts of the telescope by the manufacturer only in original letter head.
4. Bid security of Rs. 1,00,000/= (Rs. One lakh only) in the form of a demand draft issued by a scheduled commercial bank favouring Director, ARIES, payable at Nainital.

### **Commercial Offer (CO)**

The Commercial Offer (CO) will give all relevant price information and will quote **prices only in Indian Rupees**. The CO should not contradict the TO in any manner. This must contain all price information.

### **Erasures or Alterations**

Technical details must be completely filled up. The corrections or alterations, if any should be authenticated.

### **Price Composition**

The price quoted should be only in Indian rupees and inclusive of following

1. Cost of the item.
2. All taxes, duties and levies.
3. Transportation and Forwarding charges to respective sites, if applicable.
4. Insurance to cover from transit period till installation.

Prices which are not quoted as above will be summarily rejected.

Total cost of ownership for the items will be taken for cost comparison.

### **No Price Variations**

The commercial offer shall be on 11<sup>th</sup> July at 1500hrs at a fixed price basis. **No upward revision in the price would be considered on account of subsequent increases in, excise tax, sales tax, etc.** However, if there is any reduction on account of government levies/taxes, during the validity of offer, the same shall be passed on to the ARIES.

### **Opening of Offers and Evaluation Criteria**

Technical Offers will be opened at ARIES. No separate intimation will be given in this regard to the vendors, for deputing their representatives.

Vendors will be evaluated on various parameters details of which are given in the Annexure - A

### **No Commitment to Accept Lowest or Any Tender**

The ARIES shall be under no obligation to accept the lowest or any other offer received in response to this notice and shall be entitled to reject any or all offers without assigning any reason whatsoever.

### **Price Freezing**

The price and configuration finalised should be valid for a period up to 12 months, subject to review at quarterly intervals for downward revision of price. The vendor should pass on the benefit of any reductions in the price in the interim period.

## **Inspection**

As a part of evaluation criteria, the ARIES will inspect the works of the manufacturer before placing the purchase order through its staff / consultant for authentication of the various technical parameters being claimed by the vendor. Inspection will be carried out by the ARIES through its staff / consultant at vendor's factory / site. However, not allowing full cooperation in this regard will disqualify the vendor and his offer will be rejected summarily. Manufacturer will furnish the inspection reports of all the materials, parts, subassemblies & assemblies to ARIES during the course of manufacture. The manufactured parts will be inspected & approved by the third party inspection team along with ARIES staff before transport & erection at ARIES site.

## **Payment Terms**

The terms of payment will be as follows:

1. No advance payment against purchase order.
2. 10 % advance will be given against the purchase of raw materials on submission of bills for the same.
3. 40% of the value of the equipment will be paid after inspection & approval of the total telescope at the works of the vendor. The payment will be made only against inspection & approval reports along with the invoice.
4. 25% of the value of the equipment will be paid after transport & erection of the telescope at ARIES site.
5. The balance 25% will be paid after performance evaluation of the telescope against a performance Bank Guarantee of 5 % of total order value, valid for the warranty period.

## **Liquidated Damages**

Notwithstanding the ARIES's right to cancel the order, 0.5% of the order value per week per system would be payable to the ARIES for every week's delay in the execution of this purchase order beyond the specified delivery/installation schedule subject to a maximum of 5% of the value of the systems ordered. ARIES reserves its right to recover these amounts by any mode such as adjusting from any payments to be made by the ARIES to the firm. Part of week will be treated as a week for this purpose. However liquidated damages may be exempted depending upon the reasons of delay on mutually agreed basis between Vendor & ARIES.

## **Order Cancellation**

If the vendor fails to deliver the equipment within the stipulated time schedule or the extended date communicated by the ARIES, it will be a breach of contract and will result in forfeiture of bid security money along with cancellation of his tender.

The ARIES reserves its right to cancel the order in the event of delay in delivery / installation / commissioning of the items.

## **Guarantees**

Vendor should guarantee that the items delivered to the ARIES are of required quality. The manufacturer should also guarantee that all the equipments supplied by the manufacturer are legally obtained. The equipment should be delivered in proper packed condition.

## **Warranty**

The offer must include comprehensive on-site three years warranty from the date of installation and commissioning of the equipment. Warranty should be from supplier only (Letter in this respect should be enclosed in technical bid). Failing which the bank guarantee may be forfeited.

Vendor shall be fully responsible for the manufacturer's warranty in respect of manufacturing, quality and functioning of all equipment covered by the offer. Vendor must warrant all equipment, against any manufacturing defects during the warranty period. During the warranty period vendor shall maintain & replace all the defective good at the installed site, at no additional charge to the ARIES. Vendor should be in a position to supply all necessary spares for telescope for next five years after the warranty period.

**Annexure – A**  
**Technical Offer**  
**(Letter to the ARIES on the vendor's letterhead)**

To  
The Director  
ARIES , Manora Peak  
Nainital-263129

Dear Sir,

Sub: RFP for 80 cm Schmidt Telescope.

With reference to the above RFP, having examined and understood the instructions, terms and conditions forming part of the RFP, we hereby enclose our offer for the supply of the Telescope as detailed in your above referred RFP. We also submit required information in following format:

<b>Parameter</b>	<b>Vendor's response</b>
Details of infrastructure, skilled manpower, inspection & testing equipments along with the precision working machines & tools set up .(Enclose relevant information in the form of brochures, leaflets, manuals etc. to support technical competence for this job)	
Year of establishment for manufacturing business in India	
Acceptance of technical specifications as per Annexure 'B', list of parts & assembly drawings	
Acceptance of the responsibility of the manufacturer to take the Procurement, manufacture, assembly, inspection, testing, transport and erection of 80 cm Schmidt Telescope at ARIES as a complete Job without any extra claims.	
Acceptance of three years on site warranty of the mechanical parts of the telescope after successful erection of 80 cm Schmidt Telescope at ARIES	

We further confirm that the offer is in conformity with the terms and conditions as mentioned in your above referred letter and enclosures.

We also confirm that the offer shall remain valid for ninety days from the date of the opening.

We also understand that the ARIES is not bound to accept the offer either in part or in full and that the ARIES has right to reject the offer in full or in part without assigning any reasons whatsoever.

We enclose Demand Draft/BG for Rs. 1,00,000/- (Rs. One lakh only) favoring Director, ARIES and payable at Nainital, towards bid security, details of the same are as under:

1. Demand Draft/BG no. :
2. Date of Demand Draft/BG :
3. Name of Issuing Bank :

Yours faithfully,

Authorised Signatories  
(Name & Designation, seal of the firm)

Date:

**ANNEXURE - B**

**Technical Specifications of 80 cm Schmidt Telescope**

**CONTENTS**

- 1. Description**
- 2. Drawings**
- 3. Manufacture**
- 4. Surface Treatment**
- 5. Transport**
- 6. Erection**
- 7. Quality Surveillance**

**ANNEXURE I**

**List of drawings and lists of parts**

## 1. Description

80 cm Schmidt Telescope is an optical telescope having a spherical primary mirror, which is 80 cm in diameter (nominal). A CCD is placed at focal length (521.77 mm) of the primary. The beam of light reflected by the primary passes through a meniscus located at 345 mm from the primary. Incoming light passes through a Baker Nunn corrector lens system located at 1110.57 mm from the primary. A prism assembly is located at 170.75 mm from the Nunn corrector. These optical components are housed in a tube assembly. Mount assembly supports the tube. Mount contains the declination and polar axes about which the telescope rotates to locate and track the object in the sky.

Telescope consist the following main assemblies.

1. Tube Assembly
2. Mount Assembly
3. Absolute Encoder Assembly 1.
4. Absolute Encoder Assembly 2.
5. Incremental Encoder Assembly
6. RA/Dec. Motor Assembly

### 1.1. Tube Assembly (Drg. No. 32101-200003)

Tube assembly holds optics and instrumentation necessary for observations. It consists of the following sub assemblies.

1. Primary Mirror Cell Assembly
2. CCD Assembly
3. Meniscus Assembly
4. Declination Counter weight Assembly

Baker Nunn corrector and the prisms are mounted in the front (top end) of the tube. They can be adjusted to align with the axis of the primary.

Two guide telescopes are mounted outside the tube in diametrically opposite locations. These are mounted on adjustable mounts for aligning their axes with the axis of the tube (primary).

#### 1.1.1. Primary Mirror Cell Assembly (Drg. No. 32101-210004)

Mirror Cell contains the following sub assemblies.

1. Axial Support
2. Radial Support
3. Defining axial Support
4. Defining radial Support

One end of the tube carries the mirror cell, which houses the primary mirror. Axial and radial supports hold the mirror in position.

Primary mirror is supported by axial supports and radial supports which are balanced to support exactly the proportion of weight of the mirror coming on them at any position of the primary. Three axial supports balance each other without any counterweights.

Each radial support is fitted with an adjustable counterweight to take exactly the proportion of weight coming on it.

Three defining axial supports locate the primary in the exact position. These are specially designed to define the axial location (in the direction of the axis of the primary) without taking any significant weight of the same. Each support is provided with a micrometer-controlled movement to exactly position the mirror when it is supported by the balancing axial supports.

A radial defining support located in the bore of the primary locates the primary in the radial direction.

No restraining force is applied from the front of the mirror allowing it float freely on its supports. Three stopper plates located in front of the primary only prevent tilting of the mirror in any eventuality.

Four fixed counter weights mounted at the back of the mirror cell symmetric to the axis balance the tube assembly about the declination axis when the prisms are kept in position. These weights shall be removed if the prisms are removed from the tube.

A fixed counterweight located off axis compensates partially imbalance due to off axis location of the moving counter weight.

#### **1.1.2. Meniscus Assembly (Drg. No. 32102-240011)**

The meniscus assembly is provided with the adjustments to align the meniscus with the optic axis of the primary. It is supported by four spider arms, which are bolted to the stiffener plates in the tube.

#### **1.1.3. CCD Assembly (Drg. No. 32101-230010)**

CCD is mounted on a focusing unit driven by a stepper motor. A precision ball screw and nut mechanism moves a drum carrying the CCD assembly. It is supported by four spider arms, which are bolted to the stiffener plates in the tube. The CCD can be aligned with the axis of the primary.

Spider arms supporting meniscus and focusing unit should be aligned with each other and cause minimum obstruction to the incoming light.

The ball-screw nut is bolted to the traversing drum. The ball-screw is mounted on bearings at one end is driven by a stepper motor through a timer belt and pulleys.

#### **1.1.4. Declination Counter Weights (Drg. No. 32101-260019)**

The telescope is balanced about the declination axis due to any imbalance in weights located on either side of the axis. Imbalances due to weights located on the axis of the tube and off the axis are to be completely eliminated. Fixed counter weights are fixed behind the back of the primary mirror cell and outside the tube on the declination axis away from the mount.

The fixed counter weights located symmetric about the axis of the tube balance the prism assembly. These weights need to be removed if the prism assembly along with the mounting plate is dismantled from the tube. In addition a balancing ring is bolted on the top of the tube in place of prism assembly.

The fixed counter weights located off the axis of the tube behind the primary and on the outer surface of the tube balance the tube for weights located away from the axis.

A moving counter weight is located outside the tube, which moves nearly parallel to the axis of the tube. A hand driven screw and nut mechanism provides the necessary movement. This weight helps in exactly balancing the tube about declination axis and

in providing any adjustments required due to changes in weights during the usage of the telescope.

## **1.2. Mount Assembly (Drg. No. 32101-100002)**

The tube assembly is fixed to the declination trunnion, which rotates in the central section of the mount.

The mount consists of the following subassemblies.

1. Declination Axis Assembly
2. South Bearing Assembly
3. North Bearing Assembly
4. Declination Drive Assembly
5. R.A. Counterweight Assembly
6. R.A. Drive Assembly

### **1.2.1. Declination Axis Assembly (Drg. No. 32102-140017)**

The tube assembly is mounted on a trunnion. The trunnion rotates on two angular contact bearings located in the mount for the telescope. These bearings form the declination axis of the telescope about which the tube rotates.

### **1.2.2. South Bearing Assembly (Drg. No. 32102-120008)**

North and South ends of the mount are supported by spherical roller bearings. The south bearing housing is fixed on the top of a bracket, which is fixed with screws to foundation plate. The foundation plate is grouted to the top of the pier after aligning and levelling with the help of foundation bolts.

### **1.2.3. North Bearing Assembly (Drg. No. 32102-110007)**

The bearing housing at north is fixed to a mounting plate. The bearing housing can be moved in east west direction to align the axis of the mount with North-South at site. A guide and push-pull screws fitted on the mounting plate assist in providing precise motion. Mounting plate below the north bearing housing is fitted with levelling screws for adjusting the elevation of the north bearing with respect to the south to align the axis of the mount at angle corresponding to the latitude at site.

The foundation plate is grouted to the north pier after levelling and aligning the polar axis at the time of erection of the telescope.

### **1.2.4. RA Counterweight Assembly (Drg. No. 32101-150020)**

RA counterweight is mounted on the central section of the mount. The declination gearbox and the RA counter weights compensate the weight of the tube assembly and balance the telescope about the polar axis. Two sets of counterweights are fitted in the assembly. One set of weights fitted on the cylindrical surface outside the housing compensates the imbalance due to prism assembly. These weights shall be removed if the prisms are to be removed from the tube.

Weights inside the housing are distributed above and below the axis of the mount to compensate any off axis imbalance.

### **1.2.5. R.A/Dec. Gear Box Assembly (Drg. No. 32101-130005)**

The telescope about polar axis and the tube assembly about the declination axis are rotated by identical gearboxes. The gearboxes are shaft mounted and fitted with torque arms to provide torsional rigidity. The gear drive consists of three-stage step down from the input shaft. Two pinions drive the

bull gear mounted on the driven trunnion. Back to back drive provides completely backlash free motion. Gearbox is mounted on the bearings fitted on the bull gear.

The gearbox assembly also consists of the following subassemblies.

1. Gear Pick-up Assembly
2. Friction Roller Assemblies (2 nos.)

Gear pick-up assembly picks up motion from the bull gear through an anti-backlash pinion pair for rotating an incremental encoder.

Friction roller assembly picks up motion from a roller driven by a ground track on the bull gear by friction for rotating an incremental encoder/absolute encoder.

### **1.3. Absolute Encoder Assembly 1 (Drg. No. 32103-600021)**

Absolute encoder is coupled to declination trunnion/south end of the mount through a bellows type flexible coupling to read the absolute position of the telescope.

### **1.4. Absolute Encoder Assembly 2 (Drg. No. 32104-800024)**

Absolute encoder (as an alternative to the encoder on the shaft) is coupled to the roller driven by the bull gear in the RA/Dec. gearbox assemblies.

### **1.5. Incremental Encoder Assembly (Drg. No. 32103-700023)**

Incremental encoder is used to measure and monitor the speed of rotation of the telescope about both the axes. It is coupled to the gear pick up assembly in the RA/Dec. gearbox assemblies. Identical encoder is also coupled to the friction roller in the RA/Dec. gearbox assemblies.

### **1.6. RA/Dec Motor Assembly (Drg. No. 32103-400018)**

Pinion 3 shafts in each gearbox are extended to receive the stator of motor driving the pinion. The pinion shaft and housing are manufactured to suit the rotor and stator of the motor. The motor assemblies are identical to both RA and Dec gear drives.

All care shall be taken while handling the motors. Guideline and procedure for the assembly of motors, issued by the manufacturers, shall be obtained from the purchaser.

## **2. Drawings**

Annexure I lists the drawings covering the assemblies described in **1.** and the components comprising the assemblies. Lists of parts specifying manufactured components, bought outs, proprietary and hardware parts are also listed.

Apart from dimensions and tolerances drawings specify guide lines/instructions to be followed during welding, heat treatment, machining, storage, assembly and surface treatment operations.

The drawings as well as this specification form composite technical specifications for the 80 Cm Optical Schmidt Telescope. In case of conflict between specifications the vendor shall obtain the clarification from the Purchaser.

## **3. Manufacture and Assembly**

### **3.1. Raw Materials**

Raw materials used for manufacture shall confirm to the specification given in the drawings. Use of materials other than specified would be permitted only if prior approval for the same is obtained from the purchaser.

In cases of plates undergoing machining, the drawings specify only the thickness required (even where plate or bar sizes are given) to be maintained after machining. Plates/bars having adequate size to accommodate required machining allowance, errors in weld fit up, and distortion during welding and heat treatment shall be used.

Invar material is specified for the manufacture of some of the components in the axial defining supports. Specification for the same shall be finalised in consultation with the purchaser after establishing the availability in the market.

### **3.2. Manufacture**

It is essential that the processes and machines used for manufacture would be of appropriate type and precision necessary to meet the dimensional and geometric tolerances specified in the drawing. Manufacturer shall permit access to the purchaser or his representative to assess the machines on which the components would be manufactured. Manufacturer shall adopt processes and methods appropriate for meeting specifications of the drawings/documents and ensuring quality of the components.

Noted below are some important aspects of manufacture.

1. All gas cut surfaces shall be ground or machined minimum 1 mm below the cut surface.
2. Necessary land/root gap shall be maintained between the mating edges/surfaces for the butt and fillet welds.
3. Stress relief or heat treatment shall be carried out leaving sufficient allowance for machining after the heat treatment to maintain the dimensional and geometric tolerances.

Precision components, which are not welded but undergo extensive machining, shall undergo stress relief at 600° C for 1 hour per 25 mm of thickness after rough machining to remove major portion of material.

4. Machines and manufacturing processes used shall be such that specified accuracies shall be easily achievable.

The gears/pinions in the gear boxes for polar and declination axes shall be made to precision category DIN Class 6 that calls for grinding the teeth. Also the track used to drive the friction roller needs to be ground to high accuracy.

5. Where drawings call for certain machining operations to be done at assembly they shall be carried out only at assembly following notes given in the component/assembly drawings. Purchaser shall be contacted for guidance if no specific instructions are provided in the drawings for such an operation.
6. Some of the operations can only be completed while aligning the telescope optically with reference to stars and these shall be kept for completion at site only.
7. For critical and large components position tolerance has been specified for the location of boltholes. In place of maintaining the position tolerance use of jigs taking reference of the specified feature (dimension) for drilling both the mating components is permitted. Enlargement of holes at the time of assembly is prohibited.

8. The following components/assemblies are available with purchaser. The manufacturer shall exactly verify dimensions before taking up manufacture of components or assemblies connected with these components.
  - 1) Baker Nunn Corrector
  - 2) Prism Assembly
  - 3) Meniscus
  - 4) CCD
  - 5) Defining axial supports
  - 6) Defining radial support
  - 7) Couplings for encoders
  - 8) Absolute and incremental encoders
  - 9) Motors for RA/declination drives

Flexible ring of radial defining support shall be used as it is for the assembly as mentioned in the drawing.

9. Fixed counter weights in the tube and mount assemblies shall be taken up only after the completion of all the components in the assembly. Counter weights are likely to change with the actual weight of the manufactured components and the imbalance about the axis.

### **3.3. Assembly**

While assembling the components guide lines/instructions given in the assembly drawings shall be implemented using appropriate assembly methods and techniques. Telescope shall be completely assembled at works and operated with the motors to check performance of the mechanical systems.

Noted below are some important aspects for assembly.

1. All components shall be cleaned completely free of rust preventive, oil, grease etc and wiped dry of any cleaning agent used before assembling the components.
2. Wherever holes are to be drilled or tapped to match with mating components at the time of assembly the requirement of alignment and fit of the mating components shall be ensured while marking/transferring holes for drilling.
3. Spacers and bearing covers locating bearings shall be ground after trial assembly to determine the exact extent of machining. When these components are reassembled the bearings shall rotate free and smooth with no axial play.
4. Big bearings, which have interference fit with shafts, shall be heated and installed in position. Proper method of heating using appropriate oil bath shall be used for heating. Any discolouration or damage to the bearings during heating or handling shall be avoided. The shafts or components mounted on the bearing shall rotate free and smooth with minimum torque (appropriate for the assembly) with no play in the bearings when the screws or locknuts are fully tightened.
5. Only specified grease (will be specified) shall be used in the bearings wherever required.
6. Trial/proof assembly of the components in subassemblies shall be completed and offered for inspection before giving surface treatments viz. phosphate coating, painting etc. Components, which have undergone surface treatment, shall be thoroughly cleaned dry and reassembled.

7. Screws shall be tightened to the specified torque at the time of final assembly (for some of the assemblies at site only).
8. Pedestals made of steel structure shall be manufactured and erected at works to simulate the north and south piers at site. Top of the pedestals shall have machined plates, which are 25 mm in thickness. They shall have tapped holes matching with the holes in the foundation plates. The height and the distance between the pedestals shall be maintained as per the drawing for piers.
9. Dummy primary mirror and dummy weights to represent the optical assemblies shall be manufactured and assembled at the specified locations to simulate the load on the structure and drives.
10. While assembling the telescope geometric relations ship between the optic, declination and polar axis shall be verified. Optic axis of the primary mirror (dummy mirror) and declination axis shall be coplanar and perpendicular to each other.
11. Sensitivity of the axial and radial supports for the primary mirror shall be verified as specified in the assembly drawings.
12. Movement of the CCD assembly with stepper motor driving the focusing mechanism shall be tested. Movement shall be smooth and free from any vibrations or jerks. Alignment of ball screw and nut mechanism with the traverse axis of the guide drum shall be precisely maintained. The torque required to traverse CCD assembly in the horizontal position is negligible and excess torque indicates the degree of misalignment.
13. For the purpose of verifying the performance of drives the telescope shall be balanced about the declination and polar axes at works. Balancing at the works is only a preliminary requirement and final and exact balancing can be done only at site. Adjustment of fixed and moving counter weights as necessary shall be done to achieve complete balance. Any imbalance is measured by monitoring the torque required to rotate the telescope (current drawn by the motor) in clockwise and anti clockwise rotation.

For balancing tube assembly about the declination axis the following procedure shall be followed.

- i. The tube assembly shall be kept pointing horizon with polar axis in 12 O' clock position. Motor current to rotate the tube in clockwise and anti-clockwise directions about declination through a small angle shall be monitored. The imbalance indicates imbalance due to on axis (axis of tube) weights.
- ii. The tube assembly shall be kept pointing zenith with polar axis in 12 O' clock position. Motor current to rotate the tube in clockwise and anti-clockwise directions through a small angle shall be monitored. The imbalance indicates imbalance due to off axis weights.

Balancing the telescope about the polar axis shall be taken only after balancing the tube assembly completely about the declination axis.

For balancing telescope about the polar axis the following procedure shall be followed.

- i. The tube assembly shall be kept pointing zenith with polar axis in 12 O' clock position. Motor current to rotate the telescope in clockwise and anti-clockwise directions through a small angle shall be monitored. The imbalance indicates imbalance due to weights along the declination axis.

- ii. The telescope shall be rotated through 90° about polar axis to 6 O' clock position making the tube horizontal and pointing horizon. Rotate the telescope through small angles in clockwise and anti-clockwise directions through a small angle for balancing the telescope due to weights located asymmetric to the plane containing declination and polar axes.

#### **4. Surface Treatment**

Surface treatment to be given to each component is specified in the drawing. Noted below are the general guidelines to be followed.

##### **4.1. General Instructions**

1. All machined surfaces of components shall be protected by applying rust preventive or grease to clean dry surface after completion of machining till they are taken up for assembly. All the traces of rust preventive or grease shall be completely removed before placing the component in assembly.
2. Chemicals, paints etc used for the surface treatment shall be from reputed manufacturers.
3. Surfaces shall be ground free of weld spatter, tack welds and burrs before giving any surface treatment.
4. Surface treated components shall be well protected from damage to the surface during storage, handling, transport and erection.
5. Instruments, electrical or electronic components, bearing etc shall be protected from paint or any damage during.
6. Precision screws used for fastening motors, encoders and couplings shall be cadmium plated.
7. No bright and shining surfaces are permitted in the telescope. The finish of all surface treated components shall be dull.
8. All the un-machined surfaces of the big components shall be painted. Colour of the paint used on the components and surfaces inside the telescope tube shall be black. Purchaser would specify the colours of paint to be used on the components, which are exposed.

##### **4.2. Manganese Phosphate Coating**

Most of the machined components and some un-machined components shall be given a coat manganese phosphate. This is a chemical treatment process involving surface preparation like degreasing, phosphate coating, rinsing and finishing. All the machined components that can be immersed in the processing tanks (components which are not very big) shall be given this treatment. All hardware items viz. bolts, screws, nuts, washers etc. shall be given manganese phosphate coating.

Noted below are the guidelines, which shall be followed.

1. The manganese coating shall be of Class 1 of IS: 3618. Cleaning, degreasing, coating and sealing process shall be as per IS: 6005.
2. Petroleum solvent degreasing is not acceptable. Alkaline degreasing shall not be used on components having surface finish of 0.8 microns or better. Traces of chemicals used for degreasing shall be completely removed before phosphating.
3. After phosphating and rinsing in water rinsing in dichromate solution is recommended.

4. The manganese-coated components shall be immersed in black stain (spirit stain) and rust preventive oil to seal the coating.

### 4.3. Painting

The drawings specify the components and surfaces, which are to be painted. Noted below are the important guidelines for the components.

1. Projections on the surfaces to be painted viz. weld spatter, tack welds, burrs etc, shall be removed by grinding. The surfaces shall be cleaned completely free of oil, grease, scale.
2. When specified in the drawings components requiring blast cleaning shall be blast cleaned after cleaning as per 1. above. All machined surfaces shall be coated with grease or rust preventive and well protected from any possible damage during blast cleaning. The surface shall be blast cleaned to white metal. Shot or grit blasting method shall be used (no sand blasting).

Any area left due to covers protecting the machined surface shall be inspected and cleaned to white metal by hand grinding/buffing.

3. Surfaces cleaned as per 1. and 2. above shall be taken up immediately for painting. **No cleaned surface shall remain unpainted more than 4 hours after cleaning.**
4. The surface shall be given first coat of primer. The coat of primer shall be applied by brush followed by pressing with a roller. Spray painting of primer is not permitted.
5. The primer coat shall be followed by application of putty, which shall be applied by a trowel or a putty applicator to fill the dents and crevices if any.
6. Large components, which are dismantled and transported to site for reassembly at site, shall be transported to site with one coat of primer and putty. No further painting shall be carried out at works.
7. Components, which are assembled at works and transported to site as parts of an assembly, shall be finish painted before transport to site.

8. Only Zinc chromate primer shall be used. Putty shall be of the same manufacturer as primer. Finish coat shall be of synthetic enamel of the same manufacturer as primer. Instructions of the manufacturer for painting shall be strictly followed.

Vendor shall obtain the approval of the purchaser for the make of the paint before procurement.

Two coats of synthetic enamel finish coat shall follow primer and putty coats. Finish coating shall be by spray. The second coat shall be applied after the first coat is hard dried and its gloss is knocked off by scuffing.

9. If there is any gap between the primer/putty application and finish coat any grease/oil/dust that might have gathered shall be completely wiped off (if necessary using soft soap solution) and dried before finish coating. Any damage to primer shall be rectified by applying primer to the damaged area and allowed to dry before spraying finish coat.

Accumulation of moisture, dust, oil etc. on surfaces, which received primer, or first coat of enamel, would lead to peeling of paint applied subsequently.

10. The components, which receive only primer coat at works before despatch to site, shall be inspected for any damage to primer coat after erection at site. All painting at site shall be done after completion of erection and assembly except of surfaces that become inaccessible after erection. The surfaces shall be cleaned to remove oil, grease, soil, rust, dust, moisture etc. Locally damaged primer coating and rusted areas shall be painted locally with primer by brush.

**Then the whole surface shall be given a second coat of primer by spray.** If found necessary putty shall be applied on damaged surfaces before coating with primer.

Two coats of synthetic enamel as described earlier shall follow the primer coat.

11. Surfaces sliding and rolling against another, surfaces mating with others and threads shall not be painted.

## 5. Transportation

After assembly and testing the telescope shall be dismantled into transportable subassemblies or units, to ensure their safety during transportation. Each unit shall be put in wooden crates with appropriate packing material/restraints to prevent movement inside the crate. Each crate shall be secured to the body of the truck. Contractor undertaking the transport shall be familiar with roads leading to Manora Peak near Nainital in Uttarakhand.

**Machined surfaces of components, which are dismantled from assembly, shall be given a protective coating before packing and despatch to prevent rusting during transport and storage.**

## 6. Erection

The following procedure shall be followed for the purpose of erecting the telescope at site.

1. The telescope shall be erected on the piers constructed in the observatory building at Manora Peak, Nainital. The piers before erection would be unfinished leaving holes for placing the foundation bolts and 50 mm short for grouting the bolts after levelling and aligning the north bearing housing.
2. Both the north and south bearing housings shall be levelled and aligned to align the axis of the mount to an accuracy of one minute of arc by adjusting the foundation plates before assembling bearings and the mount. Cross wires shall be fixed in the bearing housings (without bearings) for the purpose of alignment.

Approval for the alignment and level of bearing housings to match with the latitude and north-south axis shall be obtained.

3. All the foundation bolts shall be grouted in their holes leaving the 50 mm gap below the foundation plates.

Alignment and level of bearing housings shall again be verified. If necessary, adjustments can be made before filling the 50 mm gap below the foundation plate with grout.

Quick cure grout mix, viz. made by M/s Fosroc Chemicals, shall be used for grouting.

Nuts on the foundation bolts shall be tightened to specified torque.

Position of the housings on the foundation plates shall be clearly identified and marked.

Adjusting arrangement at north bearing shall be used only for the final alignment with the help of star after completion of telescope assembly.

4. The assembly of the bearing housings with the mount, which has the bearings already fitted, shall be completed. Then bearing housings shall be placed in positions already identified and bolted to the foundation plates permanently.
5. After securely locking the bearings housings the balance subassemblies can be assembled on the mount.

The mount and tube shall be suitably supported during the erection/assembly to prevent rotation.

6. After completion of the assembly and installation of RA and dec. motors and encoders the telescope shall be exactly balanced about polar and declination axes. The balancing shall ensure equal currents for rotation of tube assembly about declination axis and the complete telescope about the polar axis in clockwise and anticlockwise rotations.
7. Exact alignment of the telescope at the angle of latitude and along north south axis shall be undertaken under guidance of Purchaser using pole star for guidance.
8. All the screws/bolts shall be tightened to specified torque after applying loctite or equivalent locking compound on the threads.
9. The vendor shall study conditions at site and make necessary arrangements including handling systems and devices for proper handling and erection of components in the observatory building.

The vendor is responsible for proper storage at site for all the components and assemblies till the time of erection/assembly. Vendor shall discuss with the purchaser the available facilities and the need to augment any requirements.

## **7. Quality Surveillance**

An optical telescope is a high precision instrument demanding high degree of accuracy. The polar and declination axes shall be precisely aligned to an accuracy of 1 second of arc with the angle of latitude and north south axis of earth at site. The telescope and other moving optical elements shall rotate free and smooth completely free from any backlash and play. The assemblies attain different orientations and positions due to rotation about the declination and polar axes. All the components in the telescope shall be held in position with no play. No vibrations or jerks are permitted while the telescope is rotated.

Ultimate accuracy of positioning the telescope in any orientation is 1 second of arc for both axes. The accuracy is achieved by positioning the telescope with help of close loop servo system taking feed back of position and speed from the encoders and rotating the input shaft of gear box through precision motors. It is necessary to limit the errors due to mechanical systems to minimum possible to get stable and accurate

position of the telescope in the shortest time. The gearboxes shall be made to high accuracy to minimise the positioning errors due to errors in the gear train. The manufacture of the mechanical systems shall be to the high precision possible. Hence the accuracies specified for various components and assemblies are the basic requirement to obtain the desired performance of the telescope.

As a specific requirement of telescope the sensitivity of the supports for the primary mirror shall be maintained. The supports system shall make the mirror float freely in all its positions. The precision and surface finish of the components making up the mirror supports determine the sensitivity of the supports.

The telescope is designed to minimise the flexures in the components. Defective raw materials, improper welding and unrelieved stresses are likely to develop deformations after finish machining and with the passage of time during the life of the telescope.

In view of the above the quality surveillance adopted shall ensure that the specifications for the components and assemblies contained in the drawings and the technical specifications are met. While some of the important surveillance aspects are noted below they may not comprise all the requirements and the vendor shall adopt whatever quality checks are necessary to ensure compliance with the specifications.

The vendor shall carry out inspection of the components and assemblies at various stages of manufacture and assembly and maintain record of inspections. Test reports, inspection records etc. shall contain reference to the drawing, identification to each and every unit of the part and the actually recorded results/dimensions etc. Any deviations from the specifications shall be noted.

Purchaser or his representatives shall be allowed to inspect the components or inspection records of the vendor at any stage of manufacture.

A third party quality surveyor would indicate his programme of surveillance and stages of inspection for the entire period of manufacture, assembly, testing, erection and commissioning.

### **7.1. Raw Materials**

All raw materials shall be free from any visible and metallurgical defects.

1. Plates, whether they undergo machining or not, shall be free from scale, pitting, dents etc.
2. Plates having thickness of more than 25 mm thickness and used for critical components shall be grid ultrasonic tested for metallurgical/rolling defects.
3. Bars of alloy steel procured shall be in annealed condition. They shall be inspected for hardness. Any bars showing significant hardness shall be rejected.

Bars shall be inspected for chemical composition to meet relevant standard for the material.

4. Vendor shall maintain a record of all the raw materials inspected for chemical composition with references to the parts for which the same would be used.
5. Ring forgings (for bull gears in RA/dec. gear boxes) shall be inspected for chemical composition and any metallurgical defects during forging.

### **7.2. Fabrication**

1. The vendor shall inspect all welded components at the weld-fit up stage recording the locating dimensions of the machined surfaces and the

available machining allowance on the plates forming the surface. Inspection record of the weld-fit ups shall be maintained. Gaps for the root of the welds and the lands maintained on the edges of the groove welds shall be inspected.

2. Welds shall be ground and blended smooth and subjected to checks as specified in the drawing viz. dye penetrant, radiography etc.
3. The welded components shall be inspected again after clearance of welds to verify the available machining allowance on the plates. If necessary any corrections shall be made to ensure minimum plate thickness specified after machining while maintaining the locating dimensions. Then only the components shall be taken up for stress relieving wherever applicable.
4. Stress relieved components shall be thoroughly cleaned before taking up for further processing like machining. They shall be inspected to ensure that no deformation have taken place during stress relief by checking critical dimensions.

### **7.3. Machining**

1. Components requiring heat treatment viz. hardening, stress relief shall be rough machined leaving adequate allowance for finish machining before heat treatment.
2. Ring forgings in bull gears of the RA/Dec. gearboxes shall be offered for inspection in proof machined/hardened and tempered stage before taking up for finish machining.
3. All finish machined components shall be inspected immediately and as measured dimensions shall be recorded for each piece before storage for assembly.

Components shall be inspected for the removal for burrs and sharp corners.

### **7.4. Heat Treatment**

Time-temperature chart for all the heat treatment operations viz. stress relief, hardening and tempering shall be maintained from the time of loading the components to the time of taking them out.

All the components taken out of the furnace shall be visually inspected after cleaning if necessary. Components shall be inspected for distortion, quench cracks, damage to surfaces etc. after heat treatment before taking up for finish machining. A record of any defects noticed shall be maintained before rectifying if necessary. The components shall be taken up for machining only after ensuring that the defects would be eliminated during machining without compromising on the dimensions.

The components subjected to hardening and tempering shall be tested/inspected for the properties to be achieved. Each and every piece shall be inspected and record measured properties maintained.

### **7.5. Surface Treatment**

Components, which have undergone manganese phosphate coating, shall be inspected for the following.

- i. All surfaces requiring coating have received coating over the complete area. Any surfaces exempted from coating are not coated. The coating is uniform. The coating is followed by oil and black stain rinsing.
- ii. Components undergoing painting shall be inspected at every stage viz. cleaning before primer coat, primer coat, application of putty, first finish coat and second

finish coat. Any defects at every stage shall be rectified before proceeding further with painting.

Only approved paints and chemicals shall be used. Paints from the same manufacturer shall be used at all stages and for the complete project.

#### **7.6. Proprietary Components and Hardware**

Proprietary and hardware parts of the telescope, which the vendor would procure, shall be from reputed manufacturers made to the specifications given. The following guidelines shall be followed. All such item shall be offered to Quality surveyor for approval well before they are required for use in assembly. Any rejections of the procured items shall not be a cause for the delay in assembling the components.

1. The bearings used in the telescope shall be of SKF or FAG make.
2. Ball screw and nut (of CCD assembly) shall be of THK make.
3. Lock nut and lock washers used for locating the bearings shall be inspected completely for dimensions and quality of material used.
4. Sample of felt to be used in the telescope shall be offered to quality surveyor for approval before procurement.

#### **7.7. Assembly**

Components and assemblies shall be inspected for the following.

1. Vendor shall keep record of the weights of all components entering the assembly.
2. All components entering the assembly shall be clean and dry. They shall be inspected for the presence of rust preventive, oil, or grease if required shall be sent for cleaning and drying. Superior kerosene shall be used for cleaning all machined surfaces.
3. All the components shall have inspection records showing clearance for assembly including acceptance of the surface treatment they have undergone. For the components, which require machining, to suit at assembly surface treatment would be done only after the trial assembly.
4. Components shall be free from burrs and sharp corners.
5. Where assembly involves use of bearings the bearings shall be thoroughly cleaned with superior kerosene if the bearings are not shielded bearings. Shielded bearings shall be cleaned with a clean, dry and lint free cloth.
6. Components rotating on bearings shall be inspected for free and smooth rotation with no axial or radial play. If the assembly is final and the components do not require dismantling for transport to site the locknuts locating the bearings shall be tightened fully and locked with lock washer in position.
7. If the assembly is final and the component do not require dismantling for transport to site screws/bolts shall be tightened with locking compound and tightened to specified torque after the approval of the assembly by quality surveyor. Approval of the assembly by the quality surveyor shall be in writing.
8. Mirror supports shall be inspected for sensitivity.
9. Alignment of various subassemblies and components in the telescope shall be checked and approved by the quality surveyor.

10. Movement of the CCD, rotation of tube assembly about declination axis and rotation of telescope about polar axis shall be checked and approved by the quality surveyor at works before dismantling for despatch to site. The quality surveyor shall undertake verification of the balancing of the telescope at works and record of counter weights used in the telescope.

Approval of the assembly of telescope is only for the purpose of clearance for transportation to site and to avoid any reworks or repairs, which would be time consuming. The telescope would be approved on the basis of clearance of performance of the mechanical system after assembly at site.

### 7.8. Erection

During and after the erection of the telescope at site checks as outlined in 7.7 would be repeated.

## ANNEXURE I

Sl.no.	Drawing no.		Revisions
		<b>AXIAL SUPPORT ASSEMBLY</b>	
1	32103-211012	ASSEMBLY	
2	32113-211031	Arm	R1
3	32114-211032	Pad	
4	32114-211033	Support	
5	32114-211034	Cover	
6	32114-211035	Ball stem	
7	32114-211036	Liner	
8	32114-211037	Spacer	
9	32114-211038	Thrust pad	
		<b>RADIAL SUPPORT ASSEMBLY</b>	
10	32102-212013	RADIAL SUPPORT ASSEMBLY	
11	32114-212039	Counter weight	
12	32113-212040	Bracket	R1
13	32113-212041	Swivel	R1
14	32114-212042	Pad	
15	32114-212043	Retainer	
16	32114-212044	Lever	
17	32114-212045	Ball stem	
18	32114-212046	Pivot pin	
19	32114-212047	Liner	
		<b>DEF.AXIAL SUPPORT ASSY</b>	
20	32103-213014	DEF.AXIAL SUPPORT ASSY	
21	32114-213048	Mirror holder	
22	32114-213049	Support rod	
23	32114-213050	Micrometer support	

24	32113-213051	Guide sleeve	
25	32114-213052	Spring holder	
26	32114-213053	Sleeve	
27	32114-213054	Spring	
		DEF.RADIAL SUPPORT	
28	32102-214015	ASSY	
29	32113-214055	Housing	
30	32113-214056	Support	
31	32114-214057	Flexible ring	
32	32114-214058	Ball cage	
33	32114-214059	Wedge	
34	32114-214060	Pin	
35	32114-214061	Spring	
36	32101-210004	PRIMARY MIRROR CELL ASSY.	R1
37	32111-210062	Primary mirror cell	
38	32114-210063	Fixed Dec. Counter weight	
39	32113-210064	Bottom cover	
40	32114-210066	Stopper plate	
41	32114-210067	Radial cover	
42	32114-210068	Cover plate	
43	32114-210069	Stopper pin	
44	32101-230010	CCD ASSEMBLY	
45	32113-230070	Support	R1
46	32113-230071	Slide	
47	32112-230072	CCD Housing	
48	32112-230073	Guide Drum	
49	32113-230074	Aligning plate	
50	32113-230075	Bearing housing 1	
51	32114-230076	Bearing cover	
52	32114-230077	Retainer	R1
54	32113-230079	Bearing housing 2	
56	32113-230081	Ball Screw	
57	32114-230082	Clamp plate	
58	32114-230083	Bearing cover	
59	32114-230084	Lock pin	
60	32114-230085	Cam	
61	32114-230086	Guide pin	
62	32114-230087	Spacer	
63	32114-230088	Pulley	
64	32113-230089	Adaptor	
65	32114-230090	Disc spring	
66	32102-240011	MENISCUS ASSEMBLY	

67	32112-240091	Holder	
68	32113-240092	Support	
69	32113-240093	Aligning plate	
70	32114-240094	Retainer	
71	32114-240095	Spacer (Rear)	
72	32114-240096	Sleeve 1	
73	32114-240097	Spacer (Front)	
74	32114-240098	Sleeve 2	
75	32114-240099	Nut	
76	32114-240100	Clamp	
77	32114-240101	Retainer	
78	32114-240102	Spring	
79	32114-240103	Pin	
80	32114-240104	Threaded pin	
81	32102-110007	NORTH BEARING ASSEMBLY	
82	32113-110105	Foundation Plate	
83	32113-110106	Bearing Housing	
84	32113-110107	Mounting Plate	
85	32113-110108	Bearing cover	
86	32114-110109	Guide	
87	32114-110110	Spacer	R1
88	32102-120008	SOUTH BEARING ASSEMBLY	R1
89	32113-120111	Foundation Plate	R1
90	32113-120112	Mounting Bracket	R1
91	32112-120113	Bearing Housing	R1
92	32114-120114	Bearing Cover	R1
93	32114-120200	Spacer	
94	32101-200003	TUBE ASSEMBLY	
95	32111-200115	Tube	R1
96	32113-200116	Prism Support	
97	32114-200117	Mounting plate(prism)	
98	32113-200118	Mounting plate	R1
99	32114-200119	Plate	
100	32114-200120	Spider Arm(CCD)	
101	32113-200121	Cover (CCD opening)	R1
102	32114-200122	Spider Arm(Meniscus)	
103	32114-200123	Sleeve cover	
104	32114-200124	Pin	
105	32114-200184	Balancing Ring	
106	32114-200065	Offset Dec Weight #1	

107	32101-260019	DEC. COUNTER WEIGHT ASSY.	
108	32112-260125	Support Frame	
109	32113-260126	Moving Weight	
110	32113-260127	Screw Rod	
111	32114-260128	Cover	
112	32114-260129	Guide Rod	
113	32114-260130	Bearing Housing	
114	32114-260131	ScrewRod Nut	
115	32114-260132	Bush	
116	32114-260133	Bearing Cover	
117	32114-260134	Spacer	
118	32114-260135	Hand Wheel	
119	32114-260182	Scale	
120	32114-260183	Pointer	
121	32102-140017	DEC. AXIS ASSEMBLY	R1
122	32112-140136	Dec Trunion	R1
123	32114-140137	Spacer	
124	32114-140138	Bearing Cover	
125	32114-140139	Spacer	
126	32114-140140	Locknut	
127	32103-131006	GEAR PICK UP ASSEMBLY	
128	32114-131141	Bearing Housing	
129	32114-131142	Support	
130	32113-131143	Shaft	
131	32112-131144	Pinion A	
132	32113-131145	Pinion B	
133	32114-131146	Outer Spacer	
134	32114-131147	Inner Spacer	
135	32114-131148	Spacer	
136	32114-131149	Spring	
137	32103-132009	FRICITION ROLLER ASSEMBLY	
138	32113-132151	Housing	
139	32113-132152	Swivel Support	
140	32114-132153	Plate	
141	32114-132154	Support	
142	32113-132155	Shaft	
143	32114-132156	Pin	
144	32114-132157	Cover	
145	32114-132158	Spacer	
146	32114-132159	Spring	
147	32114-132196	Support	
148	32102-133016	TORQUE ARM ASSEMBLY	R1

149	32113-133160	Long Pin	R1
150	32114-133161	Threaded Sleeve	
151	32113-133162	Threaded Holder	
152	32114-133163	Short Pin	
153	32114-133164	Spacer	
154	32101-130005	RA/DEC. GEAR BOX ASSEMBLY	
155	32111-130165	Gear Box	R1
156	32112-130166	Gear Box (Bot)	
157	32112-130167	Gear Box (Top)	
158	32112-130168	Gear Box 1	
159	32112-130169	Bull Gear	
160	32113-130170	Bull Gear Cover	
161	32113-130171	Gear 2	
162	32113-130172	Gear 3	
163	32114-130173	Retainer	
164	32113-130174	Pinion 3 Shaft	R1
165	32113-130175	Pinion 1 Shaft	
166	32113-130176	Pinion 2 Shaft	R1
167	32114-130177	Spacer	R1
168	32114-130178	Cover 1	
169	32114-130179	Cover 2	
170	32114-130180	Cover 3	
171	32114-130181	Cover	
172	32114-130080	Side Cover	
173	32114-130190	Top Cover	
174	32103-600021	ABSOLUTE ENCODER ASSEMBLY 1	
175	32114-600185	Encoder Support	
176	32114-600186	Plate	
177	32114-600187	Stub Shaft	
180	32103-400018	RA/DEC MOTOR ASSEMBLY	
181	32114-400193	Motor Housing	
182	32114-400194	Cover	
183	32114-400195	Locator	
184	32114-400199	Coupler	
185	32114-400206	Spacer	
186	32101-150020	RA COUNTER WT. ASSEMBLY	
187	32112-150201	Housing	
188	32113-150202	Cover Plate	
189	32114-150203	RA Counter Weight #1	
190	32114-150204	RA Counter Weight #2	
191	32114-150205	Stud	

192	32114-150078	Spacer
193	32113-150192	Cover
194	32103-700023	INCREMENTAL ENCODER ASSY.
195	32114-700197	Mounting Plate
196	32114-700150	Adaptor
197	32104-800024	ABSOLUTE ENCODER ASSEMBLY 2
198	32114-800198	Mounting Plate
199	32101-100002	MOUNT ASSEMBLY
200	32111-100189	Mount
201	32101-000001	TELESCOPE ASSEMBLY
202	32113-000191	Bracket
203	32114-000207	Plate

**List of Parts**

1	32124-000001	TELESCOPE ASSEMBLY	
2	32124-100002	MOUNT ASSEMBLY	
3	32124-200003	TUBE ASSEMBLY	
		RA/DEC MOTOR	
4	32124-400018	ASSEMBLY	
5	32124-600021	ABSOLUTE ENCODER ASSEMBLY 1	
6	32124-700023	INCREMENTAL ENCODER ASSY.	
7	32124-800024	ABSOLUTE ENCODER ASSEMBLY 2	
8	32124-110007	NORTH BEARING ASSY	R1
9	32124-120008	SOUTH BEARING ASSY	R1
10	32124-130005	RA/DEC. GEAR BOX ASSEMBLY	R1
11	32124-131006	GEAR PICKUP ASSEMBLY	
12	32124-132009	FRICTION ROLLER ASSEMBLY	
13	32124-133016	TORQUE ARM ASSEMBLY	
14	32124-140017	DEC. AXIS ASSEMBLY	
15	32124-150020	RA COUNTER WT. ASSEMBLY	
16	32124-210004	PRIMARY MIRROR CELL ASSY.	R1
		AXIAL SUPPORT	
17	32124-211012	ASSEMBLY	
18	32124-212013	RADIAL SUPPORT ASSEMBLY	
19	32124-213014	DEF.AXIAL SUPPORT ASSY	
		DEF.RADIAL SUPPORT	
20	32124-214015	ASSY	

21	32124-230010	CCD ASSEMBLY
22	32124-240011	MENISCUS ASSEMBLY
23	32124-260019	DEC. COUNTER WEIGHT ASSY.

**Note: Only 23 assembly drawings are attached in the tender document for the costing purpose by manufacturer. However manufacturer/his representative can see/discuss the remaining drawings, site of installation and other details if required from the ARIES engineering staff during the working hours.**

**ANNEXURE - C**  
**Commercial Offer**

**Items to be considered for total cost of ownership**

<b>Items</b>	<b>Price</b>
Total cost of Procurement, manufacture, assembly, inspection, testing, transport and erection of 80 cm Schmidt Telescope at ARIES	
Taxes, duties & levies.	
Transport & forwarding charges.	
Insurance to cover from transit period till installation	
<b>Total</b>	

**Annexure - D**  
**(Assembly drawings)**

**Note: These AUTO-CAD drawings will be provided by hand or by post with tender document.**