ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES), MANORA PEAK, NAINITAL-263 129 (INDIA)

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TENDER NOTICE

Notice No- AO/3060/3-3(4)/08-09

Director, ARIES invites sealed offers from established company for Design, Manufacturing, Installation, Testing and Commissioning of Aluminium Coating Plant for 3.7m Optical Telescope Mirror at Devasthal-Nainital as per details given in the Tender Specification. Tender document can be purchased from Purchase Section, ARIES, Nainital on any working day (Mon-Friday), between 1400-1700 hrs after depositing Rs. 500/- in cash or DD drawn in favour of Director, ARIES, Nainital or can be downloaded from website **http://aries.ernet.in/ARIES tender.html** . Suppliers downloading the form from the website will have to send the tender amount of Rs. 500/- in the form of DD in favour of Director, ARIES, Nainital along with the tender failing which the tender will be summarily rejected. The tender should be submitted in two parts i.e. Technical and Commercial bid in separate envelopes. Both the sealed bid should be put up in a bigger envelope addressed to "Director, ARIES, Manora Peak, Nainital, Uttarakhand, India-263129". Sealed tenders dispatched by registered post/ speed post/ courier will only be accepted.

Date of commencement of issue of Tender : 22 December 2008

Date of submission of Tender : 16 February 2009

Registrar, ARIES

TENDER SPECIFICATIONS FOR

DESIGN, MANUFACTURING, INSTALLATION, TESTING AND COMMISSIONING OF ALUMINIUM COATING PLANT FOR 3.7m OPTICAL TELESCOPE MIRROR AT DEVASTHAL – NAINITAL

Aryabhatta Research Institute of

Observational Sciences (ARIES)

Manora Peak,

Nainital – 263 129

Uttarakhand

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PART-I

SECTION - I

INSTRUCTION TO BIDDERS

1.0 GENERAL

1.1 Sealed Tenders are invited by Aryabhatta Research Institute of Observational Sciences (ARIES) for Design, Manufacturing, Installation, Testing and Commissioning of Aluminium Coating Plant for 3.7 m Optical Telescope Mirror at Devasthal, Nainital – 263129, Uttarakhand. Tenders shall be received up to 14:00 hrs on 16/02/09 at the office of ARIES at the address given below. Technical Part i.e. Part-I will be opened on the same day at 15:30 hrs. After scrutiny and ensuring that mandatory requirements are fulfilled as per Annexure-E, bidders shall be informed for oral presentation and the date of opening of Price Bid i.e. Part – II.

1.2 Preparation of Proposal

Bidder (Company) shall examine and study carefully General Conditions of Contract, Scope of Work, Preliminary Concept Report, and Schedule for Design and Engineering Activities and confirm their acceptance to the same in their offer.

Scope of work provides a general overview of the required supply and services.

1.3 The nature of work involved is explained in detail in scope of work.

1.4 The Commercial Terms and Conditions are as mentioned in the General Conditions of Contract. Any deviation shall be specifically mentioned in the Tender.

1.5 Technical and Financial Proposals must be submitted simultaneously but in separate sealed envelopes by the date and time stipulated in **Section 1.1.** Both the inner envelopes shall indicate the name and address of the Bidder. The first inner envelope shall contain the Bidders Technical Bid / Proposal with copies duly marked “Original” and “Copy”. The second inner envelope shall include the Financial Proposal duly identified as such. If the envelopes are not sealed and marked as instructed, the ARIES will assume no responsibility for the misplacement or premature opening of the proposals submitted.

Technical Bid / Proposal must be submitted in one original, clearly marked as such, with five (5) additional copies and soft copy (C.D). Technical Proposals (both original and copies) must be sealed in a specially marked envelope/package labeled ***TENDER NO.AO/3060/3-3(4)/08-09 TECHNICAL PROPOSAL"***

Financial Bid / Proposal must be submitted in one (1) original only on the form prescribed in Part II – Section VII. Financial Proposals must be sealed separately in a specially marked envelope labeled ***TENDER NO. AO/3060//3-3(4)/08-09*** **FINANCIAL PROPOSAL – DO NOT OPEN".**
All proposals for delivery shall be addressed as follows.

Director
Aryabhatta Research Institute of Observational Sciences (ARIES)
Manora Peak,
Nainital – 263 129
Uttarakhand, India
Email: sagar@aries.ernet.in

1.6 Earnest Money Deposit

Bidders shall pay Earnest Money Deposit of **INR 10,00000 (Rs Ten lacs only)** in the form of Bank Demand Draft from any Nationalized Bank drawn in favour of Director, ARIES payable at Nainital. This Earnest Money Deposit will be refunded to the Bidder if their tender is not accepted. No interest will be paid on EMD.

1.7 Validity

Tenders duly filled shall remain valid for 90 days from the last date of opening of Financial Bid / Proposal.

2.0 The cost of preparing a proposal, attendance for any oral presentation shall be borne by the bidder, regardless of the conduct or outcome of the solicitation process. Bidder may visit site and collect any data prior to submission of Bid. Representative of ARIES will provide clarification to queries raised by the bidder during their visit. Bidders must offer services for the total requirement.

3.0 Bidders may submit requests for clarification to this Tender Specifications by sending an email to the Project Engineer identified in Clause No. 6.0 below. Responses will be provided to all Bidders via email.

4.0 The ARIES may, whether at its own initiative, or in response to a clarification requested by an invited bidder, modify the solicitation documents by addendum. The ARIES may, at its discretion, extend the deadline for submission of proposals or cancel the requirement in part or in whole.

5.0 A bid may be withdrawn after submission provided that written notice of withdrawal is received by ARIES prior to the deadline prescribed for submission.

6.0 All communication must be directed to:

Shri Vishal Shukla (Engg. - B)
Project Engineer (3.6m Coating Plant)
ARIES, Manora Peak
Nainital-263129
Uttarakhand, India
Email: vishal@aries.ernet.in

7.0 Evaluation of Technical and Financial Bid

PHASE I

7.1 **Technical Bid**

Only those bidders meeting the mandatory criteria will be advanced to the technical evaluation. An evaluation committee appointed by ARIES will carry out the technical evaluation/oral presentation on various parameters given in requirement matrix Annexure-F.

7.2 Oral Presentations

Oral Presentation: Those bidders in the competitive range will be required to make an oral presentation. Information from the oral presentation will also be used as part of the technical evaluation process. ARIES reserves the right to incorporate elements from oral presentations in the final Contract. The oral presentation will not encompass price proposals.

Oral Presentation Ground Rules: The selected bidders as specified above must make an oral presentation to ARIES's evaluation panel and participate in a question and answer session. The purpose of the oral presentation and question and answer session is to validate the information provided by the bidder in their

proposal and to test the bidder's understanding of the work that will be performed as per the Scope of Work under the prospective contract, which will be a factor in the overall technical evaluation of the proposals. Each bidder shall be allowed around 60 minutes to make their oral presentation.

ARIES will fix the date and time for each Bidder's oral presentation. The Project Engineer will notify Bidder of the scheduled date and time, as well as the agenda for their presentation. At its sole discretion, the ARIES reserves the right to reschedule any bidder's presentation. Bidders must confirm their availability on that date should they be invited.

The presentation must be made by one or more of the personnel whom the bidder will employ to manage or supervise contract performance. The proposed Senior Executive must be present. The bidder should be prepared to answer detailed technical questions from ARIES.

During the presentation, interaction between the evaluation team and the bidder will be limited. The chairman of the meeting/presentation ensure compliance with the ground rules. ARIES will not inform bidders of their strengths, deficiencies or weaknesses during the presentation and ARIES will not engage in bargaining during the presentations.

ARIES reserves the right to make video or audio recordings of oral presentations for its own internal use; these will not be released or made public except where required by law.

7.3 Reference Checks

The Technical Evaluation Team will perform either telephonic or e-mail reference checks.

PHASE II

7.4 Financial Proposal

7.4.1 Only those financial proposals will be evaluated whose technical bid qualify in the technical evaluation, oral presentations and Reference Checks.

7.4.2 ARIES reserves the right to conduct BAFO (Best and Final Offer). However, ARIES's right of BAFO as herein reserved should not be interpreted to allow negotiations on mandatory criteria. Bidders are forewarned that they must make their best offer at the time of their Proposal.

8.0 NO COMMITMENT TO ACCEPT LOWEST OR ANY TENDER

ARIES shall be under no obligation to accept the lowest or any other bid / proposal received in response to this tender and shall be entitled to reject any or all bids without assigning any reason what so ever. The decision of Director, ARIES, shall be final.

9.0 INSPECTION OF BIDDERS SET-UP

As a part of evaluation criteria, ARIES may inspect the office and total set up of the organization before placing the order, through its staff for authentication of various technical parameters being claimed by the Bidder.

10.0 AWARD

Bidder's bid/proposal shall include all of the following labeled Annexure:

Annexure : E	Completed Mandatory Requirements
Annexure : F	Completed Requirements Matrix
Annexure : G	Completed Resume of persons executing this project
Annexure : H	Certificate of Authority to Sign proposal

10.1 Award will be made to the successful bidder, following negotiation of an acceptable contract. The award will be in effect only after acceptance by the selected Bidder of the terms and conditions and final Scope of work.

10.2 Upon completion of negotiations ARIES will promptly notify the unsuccessful Bidders.

SECTION - II

INTRODUCTION

1.1 Aryabhatta Research Institute of Observational Sciences (ARIES) is an autonomous institute devoted to research and development in Astronomy & Astrophysics and Atmospheric Sciences. The Institute is under the Department of Science and Technology (DST), Government of India.

1.2 The proposed 3.6 m telescope will be optimized for the spectroscopic observations. ARIES made serious efforts to involve international community for technical and financial support in this project. The success came as Russian Academy of Sciences and Belgium astronomers decided to participate in this project. National Institutes like IIA, TIFR are also participating in this project. It is also proposed that (I) A high resolution (~ 50,000) stellar spectrograph (II) Faint object spectrograph camera and (iii) Near IR camera are to be developed as the first generation instruments.

1.3 A contract for design, manufacturing, integration, testing, supply and installation of the telescope has been entered between ARIES and AMOS, Belgium on 29th March 2007. The Telescope design is in advanced stage. Telescope components are expected to arrive at Mumbai Port by Nov-2011.

1.4 The Aluminium Coating Plant at ARIES Nainital is for upcoming 3.7m and 1.313m telescope mirrors. The frequent coating of these mirrors becomes necessary because they are exposed to the atmosphere and reflectivity decreases with time. Although a preliminary concept report of coating plant is enclosed with this tender, it is only for guideline and clarification to the bidder as to which basic amenities / facilities are required in this Coating Plant Project.

SECTION - III
GENERAL CONDITIONS OF CONTRACT

1.0 Definition of Terms

2.0 Pre-qualifying Requirements

3.0 Site Information

4.0 Scope of Services

5.0 Co-ordination with ARIES and Methodology for execution of works

6.0 Meetings

7.0 Submission of Reports and Drawings

8.0 Time – The Essence of Contract

9.0 Delay in Design and Engineering Activity by Company

10.0 Penalty for delay in completion of design and engineering activity

11.0 Contract Price

12.0 Service Tax

13.0 Performance bank Guarantee

14.0 Terms of Payment for Design and Engineering Services

15.0 Invoice

16.0 Force Majeure

17.0 Jurisdiction

1.0 DEFINITION OF TERMS

i) ARIES:	Aryabhatta Research Institute of Observational Sciences, Nainital – 263129
ii) Company:	Name of the Successful Bidder
iii) AMOS:	Advanced Mechanical and Optical Systems, Belgium (Telescope Manufacturer)
iv) Inspector:	Representative of ARIES
v) Project:	Aluminium Coating Plant at Devasthal
vi) Site:	Actual place of Project where plant is to be installed.
vii) QAP:	Quality Assurance Plan.
viii) Contract price:	The total price towards the Design,Manufacturing, Installation and commissioning Activities as mentioned in the Scope of Work.
ix) PerformanceTest:	Shall mean the performance of the Coating Unit Manufactured by Company as per the agreed specifications and terms.
x)) Commissioning:	Means complete installation and testing and to coat a dummy mirror in the last.
xi) Contract Document:	The term contract document shall mean and include the following, which shall be deemed to form an integral part of the Contract. a) Contract Agreement signed on Stamp Paper. b) General Conditions of Contract, Scope of Work, Schedule of Design and Engineering Activities, Basic data from ARIES, Annexures enclosed with the Contract. c) Any mutually agreed variations to the conditions and specifications of the contract.

xii)Guarantee Period: Shall mean the period of 12months after successful commissioning of the coating plant.

2.0 PRE-QUALIFYING REQUIRMENTS

2.1 A company should be design and manufacturing organization.

2.2 The Engineers proposed to be engaged for execution of this contract should have designed at least one coating plant for greater than 1meter mirror. Proof of successful completion of such works to be furnished in the technical bid.

3.0 SITE INFORMATION

Nainital is located at a distance of about of 320 km North- East from Delhi. The nearest railway station called Kathgodam is located at a distance of about 35 km. From Kathgodam one can reach Nainital by Taxi.

The site called Devasthal is 62 km from Nainital. There is no public transport from Nainital to Devasthal. One has to arrange his own vehicle to reach site.

4.0 SCOPE OF SERVICES

As explained in the introduction preliminary works of Telescope Project are in advanced stage and ARIES expects to complete coating plant activities in a scheduled time. The scope of services for Company broadly includes:-

1) Concept Design and engineering of Aluminium Coating Plant.

3) Calculation and detailed drawing of the Plant.

4) Manufacturing of the complete plant.

5) Installation, testing and commissioning of the Plant.

The detail scope of work is described in Section – IV.

5.0 CO-ORDINATION WITH ARIES AND METHODOLOGY FOR EXECUTION OF WORKS

Execution and completion of this project will require frequent meetings with ARIES to get clarified various technical and scientific requirements. Similarly requirements / suggestions of Telescope manufacturer will also need to be incorporated during the concept stage itself. Operation and maintenance aspects will need approval of both ARIES and Company. In view of the above it is proposed to execute this project in following stages.

5.1 Stage - I

• Concept Design.

• Preliminary concept report with G. A. drawing of Coating Plant.

• Drawing of Support Structure, mirror rotating system, substrate holder etc.

5.2 Stage – II

• Detail engineering, analysis and calculations of Coating Plant.

• Design of Electrical System

5.3 Stage - III

• Design of Pumping Systems, valves, plumbing lines, pneumatic supply.

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5.4 Stage - IV

- Design of Control Console Unit for manual and automatic operation.

5.5 Stage – V

- Manufacturing, installation, testing and commissioning of the whole system.

6.0 MEETINGS

ARIES will conduct regular meeting with company personnel and other concerned authorities as the case may be in every month to review the progress of work and discuss critical areas at various stages. Company will have to attend these meetings. Frequency of such meetings will be decided by ARIES.

7.0 SUBMISSION OF REPORTS AND DRAWINGS

7.1 Company shall submit two hard copies of various reports such as Concept Report, Sizing Data, Operation Philosophy, Design calculations, Vacuum calculations, pump selection etc. along with two copies of related drawings, catalogue etc. for review and concurrence of ARIES. ARIES will return one copy to Company with their approval / concurrence and comments.

7.2 Company shall submit four copies of finally approved reports / calculations and any other technical data which need to be preserved as record for future use. Similarly four sets of final drawings shall be issued prior to commissioning activity. A soft copy of final instruction, maintenance manuals and drawings shall also be submitted at the end of the project.

8.0 TIME – THE ESSENCE OF CONTRACT

The period of completion of design and engineering activity as stipulated in Section – VI (which is 18 months that includes Design, Manufacturing, Installation, Testing and Commissioning of the Coating Plant) shall be deemed to be essence of contract. The company has to ensure that it will organize his resources and perform his works so as to complete it not later than the period agreed to. The time for the completion of works will be reckoned from the date of signing the Contract Agreement.

9.0 DELAY IN DESIGN AND ENGINEERING WORKS

In case if delay in design and engineering works has occurred due to reasons solely attributable to Company, ARIES will levy penalty for delay in completion of company's design and engineering work on his uncompleted portion of work, as per Clause No.10 of this Section.

10.0 PENALTY FOR DESIGN AND ENGINEERING ACTIVITIES

Company shall be liable to pay penalty at the rate of 0.5% of the uncompleted portion of design and engineering price for every week of delay or part thereof, in submission of requisite documents for issue of tenders for various equipments. This penalty will be maximum 5% of the contract price of uncompleted portion of work. Percentage allocation for various design and engineering works for the purpose of this clause only, will be mutually decided after award of contract.

11.0 CONTRACT PRICE

The selected company price becomes contract price which shall cover:

- Price for design, manufacturing, installation, testing and commissioning of the coating plant.

For the purpose of penalty, bank guarantee, retention etc., price quoted above shall be considered.
Contract price shall be inclusive of service tax prevailing on the day of submission of bid. Any variation in Services Tax or inclusion of new tax shall be paid as per the revised rates.
The price above shall remain firm till completion of the whole work.

12.0 SERVICE TAX

Service tax will be paid at actual wherever required.

13.0 PERFORMANCE BANK GUARANTEE

Selected company will submit 10% amount of total contract price as performance bank guarantee within seven days of issue of work order i. e. acceptance of tender and before signing of agreement. Valid till completion/performance of project i.e guarantee period (12 months from the date of commissioning). EMD will be released within fifteen days after receiving performance bank guarantee.

14.0 TERMS OF PAYMENT FOR DESIGN AND ENGINEERING SERVICES

In the beginning stage of the project, the company should provide basic system calculations, concept report and G.A. drawings of the Coating Plant. After that the payment will be made by ARIES under the following heads:

14.1 20% of the total contract price against submission of detail design, drawings and calculations of the Aluminium Coating Plant that includes the following components:

(i) Coating Chamber, Support Structure, Mirror Rotating System, Substrate Holder, Pumping Systems, Valves, Plumbing Lines, and Pneumatic Lines.

(ii) Detail design of Control Console Unit for Manual and Automatic operation.

(iii) Detail design of Electrical System.

(iv) Submission of Final Concept Report with Engineering Drawings.

14.2 60% of the total contract price after Manufacturing and Installation of the Coating Plant which is the total sum of the following:

(i) 15% of the total contract price after the procurement of the Pumping Systems by the company.

(ii) 10% of the total contract price after procurement of raw material for coating plant by the company.

(iii) 15% of the total contract price after manufacturing of the Coating Chamber.

(iv) 20% of the total contract price after complete installation of the Coating Plant.

14.3 20% of the total contract price after successful commissioning of project and coating of a dummy mirror.

14.4 Amount against performance bank guarantee will be released after 12 months from the date of Commissioning.

15.0 INVOICE

Following documents shall be submitted to ARIES for claiming payment against various stages.

15.1 Payment against Clause No. 14.1

i) Invoice
ii)Submission of detail design and calculations of the components of the Aluminium Coating Plant as mentioned in **14.1** and Final Concept Report.
iii) Approval of ARIES.

15.2 Payment against Clause No. 14.2

i) Invoice
ii) Submission of procurement, Manufacturing, Installation Report
(iii) Approval of ARIES.

15.3 Payment against Clause No. 14.3

(i)Invoice
(ii) Submission of Testing and Commissioning Report
iii) Approval from ARIES.

15.4 Payment against Clause No. 14.4

i) Invoice
ii)After successful functioning of the Coating Plant for one year after commissioning.

16.0 FORCE MAJEURE

i) Force Majeure is defined as unforeseen incidents / circumstances beyond the control of bidder and affecting the bidder's works, which partially or totally hinder the total fulfillment of the contract, such as but not limited to:

a) War, rebellion or invasion

b) Natural phenomena such as floods, earthquakes or any other act of God.

c) Riots, Civil commotion

ii) Strikes, lockouts, power shut downs, load shedding, power cuts etc. on any account at the bidders office will not constitute Force Majeure condition.

iii) Notice of force majeure conditions should be given to ARIES within 15 days from the date of occurrence with all backup documents. The bidders work shall resume as soon as practicable after such eventuality has come to an end or ceased to exist.

iv) No extra claim due to escalation, statutory variation, new levies or any other reason on this account will be entertained.

v) If the force majeure conditions hindering the performance or obligations under the contract in part or whole continue for a period exceeding 60 days, the ARIES may terminate the Contract.

17.0 JURISDICTION

Any dispute or differences including those considered as such by only one of the parties arising out of or in connection with this project shall be, to the extent possible, settled amicably between the parties. If amicable settlement cannot be reached, then all disputes shall be settled by an Arbitrator. The Director of ARIES or any officer nominated by him will be the sole arbitrator and his/ her award shall be final and binding upon the parties without appeal and shall be in writing and set forth the findings of fact and the conclusions of Law.

In case of any proceedings/ Suits, Indian Law shall govern the contract and the Hon'ble Court at Nainital shall only have the jurisdiction to hear such matters.

SECTION – IV

SCOPE OF WORK

The Aluminium Coating Plant at ARIES Nainital is required for upcoming 3.75m and 1.313m telescope mirrors. The frequent coating of these mirrors becomes necessary because they are exposed to the atmosphere and reflectivity decreases with time .The best coatings for optical telescopes are aluminium, silver, and gold, which have good reflectance in the visible and infrared region.

Aluminium is the reflective coating of choice for general- purpose, ground based telescope mirrors because of its very good reflectance from the ultraviolet to the infrared and because it can easily be deposited and removed. In the country no aluminizing facility is available for 3.75m mirror. The common Coating plant is required primarily for coating the primary and secondary mirrors of 3.75m and 1.313m telescopes.

The following details regarding the scope of work are provided to the bidder (company) for the Coating Plant:

1. Requirement:

• An aluminizing plant to be set up at ARIES, Nainital for aluminizing the 3.75m and 1.313m Telescope Mirrors. In 3.75m coating chamber a is separate substrate holder for 1.313m mirror is required so that same chamber can be used for coating 1.313m mirror.
• The technical details of the mirrors, their diagrams and handling tools are given in Annexure A, B, C and D.
• The plant should also have arrangements for coating single or multiple mirrors of smaller dimensions.

2. Location and Environment:

• The above plant is to be installed and commissioned at the observatory located at Devasthal, nearly 60km away from Nainital, India at an altitude of about 2500m above MSL.
• The outdoor temperature at the location can vary between -10°C and 35°C and the relative humidity can be as high as 100%. Pressure at the site is 810mb (±10mb).
• The space available at the site for Coating Plant is 9m (Length) x 5m (Width) x 4.5m (Height). The exact layout of the plant should be finalized only after due consultation with ARIES.

3. Mirror Pre-Cleaning:

• The mirror should always be placed with its surface to be cleaned/coated facing upwards. All supports should act only on the bottom surface, while handling as well as when placed in the cleaning/coating chambers.

• A pre-cleaning chamber should be provided to allow removal of the previous aluminium coating without damaging the substrate. The cleaning chamber should be able to withstand without corroding, the chemicals used, for pre-cleaning. Normally CuSO4, HCl, HNO3, distilled water is used for mirror cleaning.

4. Vacuum Chamber and Evacuation System:

• The vacuum chamber is to be fabricated from Stainless Steel SS 304L and all material used inside the chamber should be vacuum compatible. Adequate ports and fittings should be provided for meeting the requirements of inert gas atmosphere, evacuation, purging, cooling etc.

• Enough number of view ports should be provided for inspection of the chamber interior during the evacuation and coating process.

The company should keep in view the following components regarding Vacuum Chamber and Evacuation System:

4.1 Vacuum Chamber:

(i) Concept Design, Approval by ARIES
(ii) Structural Design including Stress analysis
(iii) Support Structure
(iv) Substrate Holder
(v) Telescope Mirror Rotating System
(vi) Magnetron Source, Ion Cleaning and Coating System

4.2 Evacuation System:

(i) Roughing and High Vacuum Pumps (For high vacuum only Turbomolecular or Cryo pump to be used)
(ii) Valves and Gauges from Varian, Pfeiffer, Alcatel etc.
(iii) All the plumbing, Cold Traps etc.
(iv) Chiller for water cooling

• The pumps should be able to reach the required vacuum in six hours. The makes and models of the pumping system components along with their

specification details should be provided. An estimate of the vacuum degradation rate (leaks, degassing etc.) should also be provided. The leak rate should be less than 10^{-2}mbar per day.

• The system should allow preparing the surface to be coated with gas discharge techniques.

• Company must design Coating plant component in such a fashion that it can be transported to the site see road survey report (Annexure I).

5. Coating System:

• Magnetron sputtering technique is to be used for coating. The make and model of the magnetron system and its power supply should be provided.

• The coating characteristics should be as follows:

- Coating Thickness: 1000 Angstroms ± 50 Angstroms.
- Coating Thickness uniformity: ±10% of Coating Thickness.
- Reflectivity >92% at all location.

Incidence angle should be limited to within 45° over any area of the mirror being coated. Total time of coating including evacuation should be approximately 12 hours.

6. Gauges and Meters

• Adequate number of gauges and meters should be provided to check the pressure and temperature at all the necessary parts of the evacuation, coating and pumping systems. The makes and models as well as specification sheets of the gauges and meters to be used in the system should be provided.

• Provision should be made for monitoring the thickness and rate of coating of the substrate at a number of different radial locations, with an accuracy better than 5%.

7. Power:

• A realistic estimate of the power required (both starting and running) by the different subsystems (evacuation, coating, cooling, monitoring, control) should be provided. If required, provision should be made for soft starts and sequential start up procedures.

• If power failure occurs during the operation of the plant, it may be restored within five to ten minutes. Any critical subsystems of the plant should have arrangements to take power independently from a UPS system, which will be available at the observatory.

8. Control Console:

This unit should contain the following:

(i) Auto Vacuum Controller with mimic diagram, push button switches for manual over ride, selector switch for auto/manual/standby mode, utility failure indication with alarms.

(ii) Microprocessor based Pirani and penning gauge control unit

(iii) Ion Bombardment control

(iv) Magnetron source control.

9. Operation and Safety:

• The entire plant should have adequate safety interlocks and alarms to prevent accidental damage to the equipment or injury to personnel.

• Manual overrides should be provided for any automatic operational controls.

10. Manuals, Maintenance & Spares:

• Detailed manuals should be provided with the following information:

a. Subsystem descriptions including detailed electrical and mechanical drawings, circuit diagrams, interconnection & layout details etc.
b. Operational procedures for handling the substrate, cleaning, evacuation, coating, purging, testing etc.
c. Safety precautions and interlock/alarm recovery procedures.
d. Instruction and maintenance manuals, trouble shooting and Fault finding procedures and recovery methods.

- After sales warranty- 3 years.
- Supply of spares for 3 years.

11. Miscellaneous:

11.1 Clear specifications (quality, quantity, fitting or piping specification, rate of supply, pressure etc.) should be given of any other auxiliary requirements which are necessary for the operation of the plant such as coolant, inert gas, liquid nitrogen etc.

11.2 Any other requirements such as ventilation, drainage, structural support etc. should be clearly specified.

11.3 The company should also provide the training about the operation of the plant, coating of the mirror and precautions related to the plant.

11.4. Testing at factory for all details, including a test coating- Min size of test glass to be 1mx2m to cover the full radial values from 0 to 1.8m. Test to be performed are Thickness uniformity, Adhesivity and reflectivity.
Supplier should have thickness measuring instrument (Stylus toll based) and also a reflectometer for above testing at factory.

11.5. The leak rate should be less than 10^{-2}mbar per day.

11.6. Rotation with correct max load to be checked at factory.

11.7. Packing and transport of all components.

11.8. Installation and Commissioning.

Section-V

Preliminary Concept Report Indicating Requirements of Aluminium Coating Plant at Devasthal Nainital

This document describes the functional specifications of the coating plant.

Introduction

The need for establishing aluminizing facility at ARIES Nainital is for upcoming 3.7m and 1.3m telescope mirrors. Astronomical reflectors have mirrors, which are exposed to the outside atmosphere during observations and due to weather thin layer of coating on these mirrors gradually looses its reflectivity thus leading to a reduction in light gathering power. Therefore frequent coating of these mirrors becomes necessary .The best coatings for optical telescopes are aluminum, silver, and gold, which have good reflectance in the visible and infrared.

Aluminium is the reflective coating of choice for general- purpose, ground based telescope mirrors because of its very good reflectance from the ultraviolet to the infrared and because it can easily be deposited and removed. In the country no aluminizing facility is available for 3.7m mirror. Even if such facility had existed the risk of transporting such precise and costly mirrors was considered undesirable. The Coating plant will be used primarily for coating the primary and secondary mirrors of 3.7m and 1.3m telescopes.

Coating Processes

There are three major physical vapor deposition (PVD) processes that could be used for coating 3.75m and 1.313m mirrors: Thermal evaporation, electron and sputtering. However sputtering is preferred over other techniques because of the following reasons:

- Sputter targets can have much larger surfaces than evaporative sources. This simplifies problems of coating uniformity.
- Since the target is large, a relatively small distance to the substrate is required this results in a smaller, cheaper coating plant.

- The solidity of sputtering targets permits, theoretically, operation at any angle.
- Since the distance between the targets and the substrate is reduced, a high degree of control can be maintained over grain diameter, and consequently reflectance.
- Multicoat deposits are possible.
- The adhesion of the coating to the substrate is better.
- Reactive processes can be easily done by sputtering a metallic target while reactive gases are introduced into the chamber, to enable oxides, nitrides, etc., to be deposited.

Sputtering has been universally applied in the semiconductor production area, and in producing low emissivity coated architectural glass.

So due to advantages of coating uniformity, smaller plant size, more flexibility of operation at any angle etc, we are planning magnetron based coating facilities capable of depositing high quality aluminum (Al).

Sputtering Based Coating Processes

In the sputtering process, the source material is mobilized not by heating, but by ion impact on a large solid plate of source material, known as the target. The incident ions impact surface atoms in the target, which then produce further collisions within the target until target atoms are ejected. Ions are then generated in a discharge that fills much of the chamber. In the country a 2.2m aluminizing plant at Inter –University Centre for Astronomy and Astrophysics (IUCAA), Pune is available based on Sputtering Principle.

Factors affecting Sputtering:

1. The sputter current **I** determines mainly the rate of the deposition process and hence the time which remains for the arriving particles during the growth process for either surface diffusion or agglomeration on existing growth centers or nucleation with other adatoms. The applied voltage determines the maximum energy, with which sputtered particles can escape from the target (reduced by the binding energy). Energies of the sputtered particles show a broad distribution with a maximum of the distribution between 1 eV and 10 eV. The applied voltage determines also the sputter yield, which is the number of sputtered particles per incoming ion.

2. The pressure **p** in the sputter chamber determines the mean free path λ for the sputtered material, which is proportional to **1/p**. Together with the target substrate distance (TS) the pressure controls, how many collisions occur for the particles on their way from the target to the substrate. This can influence the porosity of the films. But also the crystallinity and texture can be affected.

3. Via the gas mixture one can control the stoichiometry of films, which are sputtered from a metallic target. The oxygen flow **q (O_2)** is the parameter varied, whereas the desired total pressure is kept constant by regulation of the Ar-flow **q (Ar)**.

4. The substrate temperature can have a strong impact on the growth behavior with respect to crystallinity or density of the samples. It can be adjusted between room temperature and 500^0C. But even during sputtering without external heating the substrate temperature may rise considerably, especially during long sputtering times for the deposition of thick films

5. In principle a bias-voltage can be applied to the substrate up to ±100V, which has the effect of accelerating electrons or ions towards the substrate or keeping them away. Both may have an influence on the layer growth as reported in the literature.

6. Usually substrate and target surface are parallel to each other. A variation of the deposition angle (also: sputtering under oblique incidence) can be achieved by tilting the substrate. Thereby a new preferential direction for the film growth and potentially anisotropic films can be produced.

Coating Plant

Primary Mirror Considerations:

The mirror(s) will be coated with the primary optical surface horizontal and looking up .
The primary mirror will be between 3.7m to 3.8m diameter. The Coating Plant(s) must be capable of coating a SCHOTT meniscus mirror.
Mirror handling arrangements during washing and coating will be specified and designed by the Telescope Manufacturer.

Low Emissivity/Protected Coatings

Requirement: "The fully optimized IR configuration will have a telescope emissivity, including scattering and diffraction, of 4% with a goal of 2% immediately after coating or recoating optics, with 0.5% maximum degradation during operations, at any single wavelength beyond 2.2 μm. [...This] leads to the need for low emissivity coatings on the primary mirror."

The Coating Unit

The Coating Unit consists of the following main components.

- The vacuum chamber with a support structure.
- The roughing pump system and the high vacuum pumping system.
- The mirror support system with lateral and axial pads to support the glass mirror during coating
- The mirror rotary drive mechanism.
- The vacuum chamber after mirror loading
- The magnetrons sputter source with a water-cooled shutter system and water cooled shields.
- The glow discharge cleaning device, to heat up and clean the mirror surface prior to coating.
- Control console & control instrumentation.

Thin Film Deposition Equipment

The main components of thin film deposition equipment unit comprising the following components:

- Sputter source for aluminum including power supply
- Shields to trim the aluminum coating deposited.
- Shutter panels
- Glow Discharge Cleaning Device (GDCD) including power supplies.
- The DC Planar Magnetron Source consists of the target 99.995% pure aluminum cathode bonded to a water-cooled backing plate to reduce the heat radiated to the mirror. The discharge is produced by the use of an inert gas (Argon) to support the flow of current between cathode and anode. The planar magnetron source uses magnetic fields to focus electrons in the region of the sputtering target.

- Stainless steel trim shields, which are placed below the cathode to trim the deposition of the sputtered aluminum, ensure that the mirror is evenly coated with a uniform thickness of aluminum.
- The shutter panels are stainless steel sheet box constructions, which are cooled by water, fed through the panels under pressure. There are two shutters, one to form the leading edge of the coating, and one to form the trailing edge. Both shutters are pivoted about the centre of the mirror, and at the beginning of a coating run both shutters are closed together along the line of the joint band.
- Below the shutter panels, copper panels are suspended filled with liquid nitrogen. Their purpose is to provide an area of high purity and homogeneity between the shutter opening below the magnetron and hence aid and improve the quality of the reflectance of the aluminum deposited onto the mirror.
- The GDCD consists of two aluminum electrodes, shaped to give the required profile. The glow discharge electrodes are water-cooled and are suspended from a dark space shield, which is also made of aluminum. The purpose of the GDCD is to reduce adsorbed water molecules from the mirror, the inner surfaces of the chamber and all components mounted inside the chamber. The glow discharge also heats the mirror surface, which improves film adhesion and film purity.

Process Description

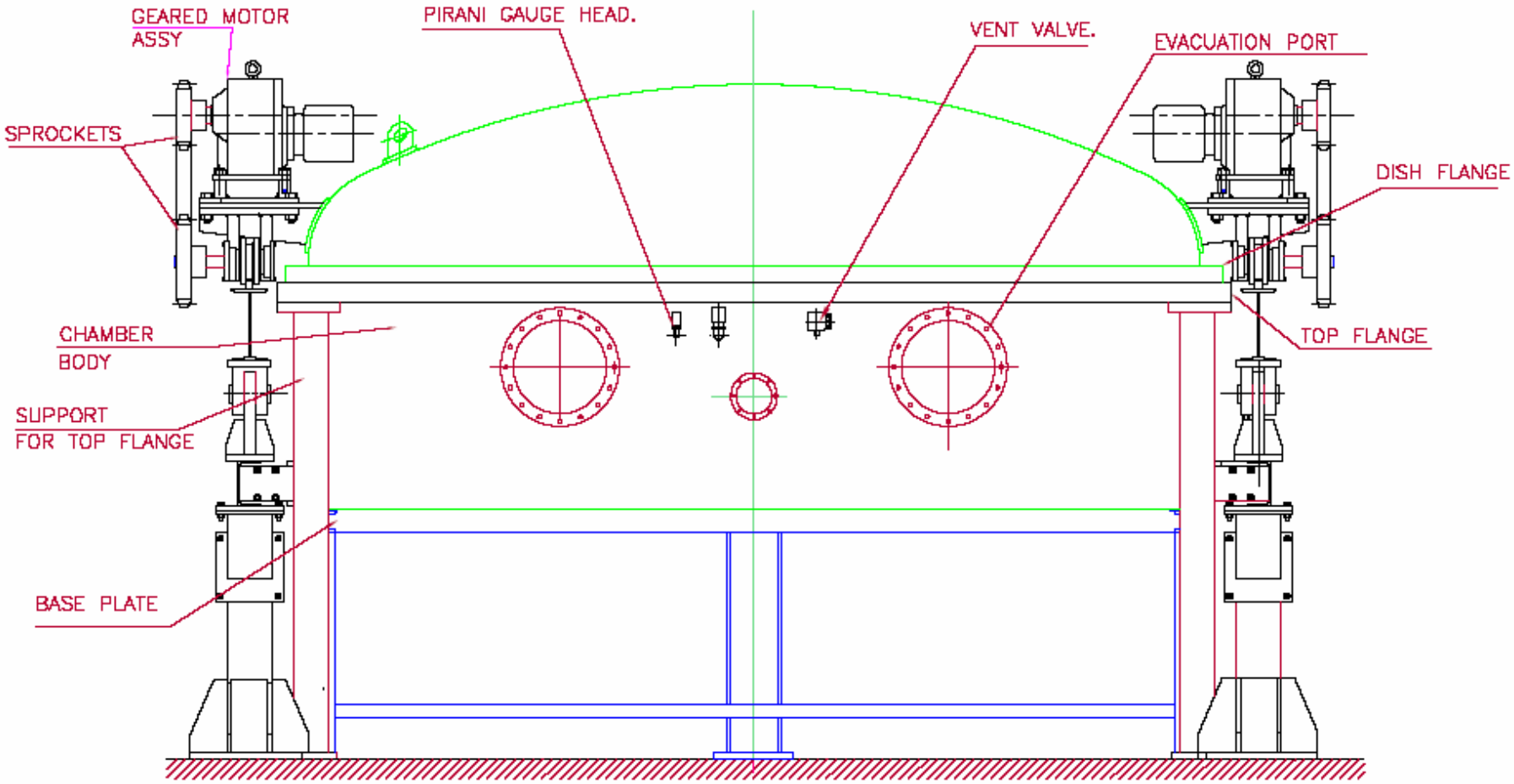
- The method selected to deposit a thin aluminum film on the mirror is the sputtering process.
- The sputter coating process is done by inserting a mirror into a vacuum chamber, which contains a specially designed cathode and an inert process gas. A negative voltage is applied to the cathode (target) and a glow discharge (plasma) ignites within the vacuum chamber when the appropriate environment (or conditions) is achieved.
- At this point, positively charged atoms of the gas (ions) are attracted to the surface of the target which is negatively charged. The positive atoms strike the negatively charged target with such force that atoms of the target are ejected and deposited on the mirror surface, building up a thin layer atom by atom.
- What differentiates a magnetron cathode (used here) from a conventional diode cathode is the presence of a magnetic field which confines electrons in the region of the sputtering target. A magnetic field is supplied from below the cathode target, which is arranged so that free electrons are captured in the

crossed magnetic and electric fields in the region. The captured electrons enhance the ionization in the inert gas atmosphere. Overall, the effect is to lower the operating voltage required, from several kilovolts to less than 1000 volts. The most striking gain of the magnetron design, however, is an order-of-magnitude increase in coating deposition rates per unit area of target.

Coating Procedure

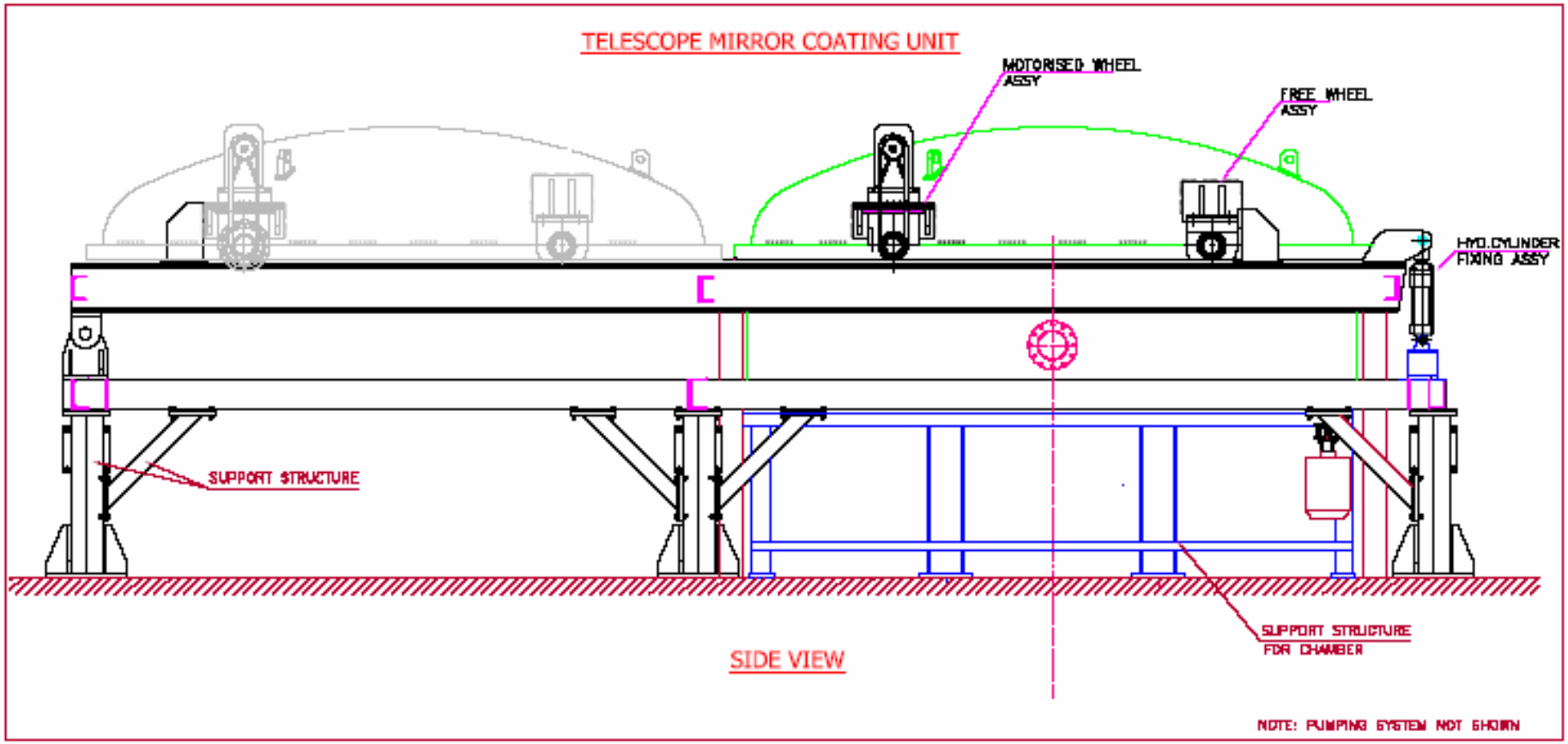
- The mirror is loaded into the lower half of the coating unit. The two halves of the vacuum chamber are brought together, sealing the coating unit. Then the chamber is pumped down to achieve the required vacuum level.
- The mirror is rotated beneath the sputter source and GDCD so that it can first receive a surface treatment and then its coating of Aluminium.
- After the surface treatment via the GDCD has been completed the magnetron is powered up to pre-sputter until the cathode's surface is clean.
- The mirror is rotated at a pre-determined speed calculated to give the intended coating thickness at the intended sputtering rate. The leading edge shutter is opened as the intended position of the joint band passes underneath. Thereby, the rotational speed of the shutter exactly matches that of the mirror.
- After the mirror has completed one revolution, the trailing edge shutter is closed by rotating it at the same rotational speed as the mirror, as the film joint passes underneath. This produces sharply stepped edges to the coating, the trailing edge lying on top of the leading edge. Shadowing of the coating by the shutter edges prevents them from being perfect steps.
- Because both shutters are pivoted about the centre of the mirror, all points along the joint band take the same time to cross the mirror opening.
- Prior to glow discharge cleaning, the chamber is pumped down to less than 0.001 Pa. Then air is fed in and at a pressure of 2 Pa (cryo pumps throttled) the GDC process is started. After the mirror has completed one revolution, the glow discharge cleaning is finished and the chamber is pumped down to less than 0.0002 Pa, which demonstrates the high pumping speed of the high-vacuum pumping system. Finally, argon is fed in and sputtering is started at an argon pressure of 0.08 Pa.

TELESCOPE MIRROR COATING UNIT



FRONT VIEW

NOTE: PUMPING SYSTEM NOT SHOWN


TELESCOPE MIRROR COATING UNIT
MOTORISED WHEEL ASSY
FREE WHEEL ASSY
HYD.CYLINDER FIXING ASSY
SUPPORT STRUCTURE
SUPPORT STRUCTURE FOR CHAMBER
SIDE VIEW
NOTE: PUMPING SYSTEM NOT SHOWN

TECHNICAL SPECIFICATIONS OF THE UNIT:

1.0. VACUUM CHAMBER:

1.1.	**CONFIGURATION**	**:**	Cylindrical construction with Top dished Lid.
1.2.	**MATERIAL OF CONSTRUCTION**	**:**	Stainless Steel SS 304 material.
1.3.	**DIMENSION OF THE CHAMBER**	**:**	4500mm diameter x 900mm (Ht.) (Approx.)
1.4.	**TOP SIDE**	**:**	Topside will have a circular flange with 'O' ring groove and 'O' ring to achieve vacuum sealing with Top dished lid.
1.5.	**BOTTOM SIDE**	**:**	Bottom side will have a welded thick base plate.
1.6.	**TOP DISHED LID**	**:**	Topside of the chamber will have a dished end Lid with a flange achieving vacuum sealing with chamber top flange. Suitable hooks are provided on the topside of the dish.

2.0. LID MOVING MECHANISM:

Top lid is moved horizontally by means of AC geared motor with AC drive with chain and sprocket arrangement. The wheels are provided in the dished end, which are located on railings. These railings are supported by means of number of vertical pillars to the ground.

Initially the lid is lifted up by means of 2 Nos. of pneumatic cylinders to clear the 'O' rings before it horizontally moves on the railings.

3.0. SUPPORT STRUCTURE:

Support structure is to be fabricated out of Mild Steel.

4.0. SUBSTRATE HOLDER:

It is to be designed and fabricated so as to follow the configuration, details and accuracies given by Telescope manufacturer.

5.0. TELESCOPE MIRROR ROTATING MECHANISM:

To achieve uniform deposition of Aluminium on the Telescope Mirror, the mirror is rotated inside the chamber with support and rotary drive mechanism. The Telescope Mirror with its support is placed on the rotary support system consisting of a Central Rotary Vacuum shaft seal provided at the bottom plate of the chamber with lateral and axial support pads to support the telescope mirror having weight of 4.5 Tons.

The telescope mirror rotation is achieved by means of AC motor with drive mechanism which is connected to rotary vacuum shaft seal by means of Gear and Gear Wheel Mechanism.

6.0. MAGNETRON SOURCE:

A magnetron source which can hold the Aluminium Target should be provided and supported on the inner side of the Top lid with suitable supports for Aluminium sputtering.

7.0. DC POWER SUPPLY:

Reputed Make DC power supply should be provided to energize the magnetron source.

8.0. ION BOMBARDMENT GADGET WITH POWER SUPPLY:

Ion bombardment gadget fabricated out of Aluminium should be provided by the side of the magnetron source. A suitable rating HT power supply also should be provided to energize the ion bombardment gadget.

9.0. HIGH VACUUM PUMPING SYSTEM:

High Vacuum pumping system is required to evacuate the vacuum chamber to an ultimate vacuum level of better than 1 x 10^{-6} Torr. Detailed specifications of the High Vacuum Pumping System are provided hereunder:

9.1. ROUGHING PUMP:

Roughing Pump is needed to evacuate the vacuum chamber to a vacuum level of 10-2 Torr.

9.2. HIGH VACUUM PUMP:

High Vacuum Pump is necessary for High Vacuum Operation upto 10-6 Torr.

9.3. LIQUID NITROGEN TRAP:

Between Roughing Pump and Chamber Liquid Nitrogen Trap with Body and Flanges made of stainless steel should be provided.

9.4. HIGH VACUUM VALVE:

Electropneumatically operated Viton sealed high vacuum valve right angle type is connected between the Turbomolecular/Cryo Pump and the chamber. It isolates the chamber from the Turbomolecular/Cryo Pump whenever required. This should be totally fabricated out of non-magnetic stainless steel AISI- 304.

Limit switches should be fitted to valve actuation mechanism such that without closing the valve fully, the chamber cannot be pressurized with Argon or vented to atmosphere. The valve operations are also interlocked with roughing and vent valves.

9.5. ROUGHING VALVE:

Electro pneumatically operated Right angle type roughing valve Viton sealed should be provided in the Vacuum Line connecting the Roots Pump

and the Chamber for Roughing Operation. Roughing valve should be suitably interlocked with high vacuum valve and vent valve.

9.6. BACKING VALVE:

Electro pneumatically operated backing valve right angle type should be provided in the Backing Line for Backing Operations.

9.7. HOLDING VACUUM PUMP (ROTARY, ROOTS PUMP):

Direct Drive, Double Stage Rotary Vacuum Pump with Roots Pump should be provided as a holding pump for Turbomolecular/Cryo Pump.

9.8. HOLDING VALVE:

Electro pneumatically operated Holding Valve of Right Angle Valve is needed at the exhaust of the turbo molecular Pump for Holding the Vacuum When chamber roughing operation is on.

9.9. VACUUM PLUMBING LINES:

Vacuum Plumbing lines should be fabricated out of non-magnetic stainless steel AISI-304. Suitable size bellow adopter is to be introduced in the roughing line and backing lines to arrest the vibration. The plumbing line will be so designed such that it will have maximum conductance and shortest path.

9.10. VENT VALVE:

Electropneumatically operated vent valve of should be fitted to the chamber to vent the chamber at the end of the cycle to expose the chamber to atmosphere. There should be a facility to connect to a dry nitrogen source instead of exposing to atmosphere. This Valve ports should be interlocked with high vacuum valve such that when the vent valve is opened the other valve cannot be energised.

9.11. MICROPROCESSOR BASED PIRANI-PENNING GAUGE:

Microprocessor based Controller Pirani Sensor and Penning Sensor with necessary Sensor Cables, Power Cables with set point controller should be provided.

10.0. CONTROL CONSOLE AND CONTROL INSTRUMENTAION:

Control Console provided in the system should be fabricated out of MS sheet metal with powder coating to mount the control instruments and the electrical gadgets. This control console houses the following:

1. Auto Vacuum Controller with mimic diagram, push button switches for manual over ride, selector switch for auto/manual/standby mode, utility failure indication with alarms.

2. Microprocessor based Pirani and penning gauge control unit

3. Ion Bombardment control

4. Magnetron source control.

5. Digital thickness monitor.

6. All the electrical switchgear like control transformers, relays, timers, fuses are mounted on a plate and fitted vertically inside the control console at the bottom position for convenience of maintenance.

A separate power panel is a part of the control console which houses voltmeters, ammeter with RYB indications, fuses etc.

10.1. INSTRUMENTATION:

10.1.1. AUTO VACUUM CONTROLLER:

Auto Vacuum Controller should be provided in the system which houses mimic diagram with manually operated push button switches. It is a process controller to control the sequence of operations in vacuum system. Manual or auto selection of sequence of operation is provided. In addition a stand by mode is provided to enable the basic pumping to be carried on

during the exposure of chamber to atmosphere for loading or unloading. Timers are to adjust the delay for the opening of the valves.

Auto vacuum controller is assembled in a 19" rack size control unit. The front panel contains the flow chart of the vacuum system and all the controls. The pressure monitor i.e., Microprocessor based pirani-penning gauge is provided on the front panel. All the outgoing terminals are provided on the back side of the panel.

AVC is designed using a logic control relays. The major operation is controlled by Microprocessor based Pirani-Penning gauge and its controllers. In addition signals are taken for indicating the status of water, air, temperature of the Turbomolecular/Cryo Pump heater. Precaution is to be taken to sense the physical location of actuators by providing magnetically operated proximity switches for the pneumatically operated valves.

Microprocessor based Pirani-Penning gauge is to be used to integrate with auto/manual vacuum controller. Microprocessor gauge has set point control and other features. The vacuum reading is digital display.

10.1.2. SPECIFICATIONS CONTROLS:

- **Auto:** In the auto mode it facilitates starting of the vacuum system from cold start. Complete cycle of operation till the high vacuum is created is done automatically.

- **Standby mode**: In this mode pumping system is automatically switches on and Turbomolecular pump is kept ready waiting in standby mode for chamber evacuation. And the high vacuum valve is closed. This operation has to be selected to vent the chamber to atmosphere for unloading the work after completion of the process.

- **Auto stop:** It takes care to switching off the system automatically.

- **Manual:** In this mode different components can be operated by the selection of manual switches. It will still have important interlocks to safeguard the equipment.

- **Failure Indications:** Water, air and vacuum fail indications as well as audio alarm are provided on the front panel.

- **Status Indications:** Status indication is provided with a flow chart diagram and LED display on the front panel.

10.1.3. SEQUENCE OF AUTO AND MANUAL OPERATION OF VACUUM SYSTEM:

After switching on the mains providing all the utilities required, press the auto pump mode in case automatic pumping is required. As soon as the auto pump mode is selected the Rotary vacuum pump, roots pump pirani controllers and roughing valve simultaneously switched on.

As soon the vacuum in the chamber reaches the preset vacuum of 0.05 m.bar the roughing valve closes through pirani (2) controller and opens backing valve high vacuum valve. Once the high vacuum valve is opened penning gauge interlock is cleared and the Penning gauge is switched on automatically. Now penning gauge indicates the chamber pressure and after attaining the preset vacuum in the chamber the penning controller indicates VACUUM READY.

In case the roughing vacuum does not build up due to any leaks, the roughing operation continues until a pre set time, which is normally set higher than the normal roughing time when this time is energised because of leak, the roughing valve is closed and the alarm comes on indicating roughing defect and alerting the operator. This situation continues until fault is rectified.

At the end of the cycle, the air can be admitted into the chamber through a electropneumatically operated air admittance valve which is interlocked with high vacuum valve and roughing valve Unless these valves are closed the air admittance valve cannot be energised. This interlocking holds well in manual operation also.

To stop the unit by auto stop selects the auto stop position from mode select switch. This closes immediately the high vacuum valve. The high vacuum valve in turn closes the Penning gauge and Penning controller and disconnects the interlock to the manifold gadgetries. The Turbomolecular/Cryo Pump also switches off along with the high vacuum valve.

10.1.4. MANUAL MODE OF OPERATION:

When the manual mode is selected all the operations are transferred to manual control. Now all the push button switches are effective with necessary interlocks. The rotary roots vacuum pump can be started by pressing rotary vacuum pump, roots pump start switch.
By using the push button switch, open the roughing valve and create rough vacuum in the vacuum chamber to a set value which is measured by pirani gauge head. After reaching the set value of 50 microns, close the roughing valve and open the high vacuum valve to read high vacuum using a penning gauge.

These interlocks are made operational even in manual mode to protect the system. After opening high vacuum valve, the interlock for penning gauge is cleared and the penning can be switched on. For shutting down unit the procedure is same as in auto except the switches should be operated manually.

10.1.5. PROGRAMMABLE LOGIC CONTROLLER:

Microprocessor based programmable logic controller of reputed make like Siemens with required number of inputs and outputs will be provided in the system for the complete automation of Vacuum cycle and evaporation cycle. The detailed catalogue of programmable logic controller is enclosed for your reference.

10.1.6. SUPERVISORY CONTROL AND DATA ACQUISITION SOFTWARE FOR LARGE AREA VACUUM COATING UNIT:

It is an extremely flexible, user friendly and generic Supervisory Control and Data Acquisition [SCADA] Software System. It interfaces to front end devices to offer real time Graphic Operator interface. It also provides facilities of Data Collection, Reporting and supervisory Control.

Complex requirements of batch semi continuous, continuous processes in various industries like Engineering, discrete manufacturing and process can be easily.

Some of the important features of SCADA Software:

1. Monitor:

a. Monitor is used to monitor various predefined formats. Command line facility enhances the flexibility of software. Multilevel access control for operational security purpose.

b. Analog I/O groups displayed in tabular or Bar graph format.

c. Controller monitoring groups are displayed in Bar graph format containing set point and process variables.

d. Discrete I/O monitoring groups in panel style status display.

e. Alarm monitoring is provided through an alarm line display which displays most recent, most severe active and acknowledged alarm.

2. Logger:

a. Field data acquired is logged according to the intervals specified, multilevel logging is provided to handle different critical levels of parameters.

b. The data is logged in files which reside on hard disk. These files can be accessed by Reporter and Historian for the purpose of historical review.

c. Off line conversion utility allows the user to convert the data files to ASCII file which can be imported by various popular packages e.g. Lotus.

3. Reporter:

a. Reporter is used for selective extraction of Information.

b. Calculation can be performed on the extracted data.

c. Report format can be specified by the user.

d. Report can be generated on EVENT, DEMAND OR TIME according to requirement.

4. Historian:

a. Historian is used to retrieve the data stored upto 365 days.

5. Calculator

a. Calculator is used to execute the desired calculation, based on any of the I/O point and process data variable.

b. Calculator supports Mathematical, logical and special operator specific to Process, Indexing, and Table lookup.

c. Calculation specification is simple and Menu driven.

6. Supervisor:

a. Supervisor is used to take actions based on certain condition.

b. Event processing allows you to specify process constraints and executes Emergency feed back actions.

c. Supervisor provides Audible Alarm, Report generation.

10.1.7. PC WITH MONITOR:

A reputed make latest version PC with fastest memory, 19" TFT LCD Colour monitor, Floppy drive with laser printer etc., is provided.

10.1.8. AIR COMPRESSOR:

Suitable capacity Air Compressor with Filter, Regulator and Lubricator is to be provided for operation of all electro-pneumatic valves.

11.0. SAFETY DEVICES & INTERLOCKS:

The coating unit is provided with number of safety devices to protect the system and the operator from mal-function and possible operator's errors.

11.1. THERMAL OVERLOAD SWITCH:

The motors are fitted with Thermal Overload Switch to protect the pump motor rotary from drawing excessive current due to overload. The starters will trip in case of excessive current and should be manually reset button after identifying the fault conditions.

The rotary and roots pump will be protected against phase reversal and voltage imbalance and also for single-phase protection.

11.2. COOLING WATER LINES:

Water lines for different system of the coating unit are taken from a central manifold distributing them into various circuits providing each with a control valve for independent operation.

Similarly the outlet water from different systems of the coating unit is connected to a common outlet manifold. Water flow switches are provided on the outlet of each system so that the water flow rate of each of the system can be sensed and OK signal is given to operate respective power controls.

In case of water supply failure are reduced rate of water flow those switches de-energize the electrical circuit and give alarm showing the status of the system through LED indicators.

11.3. PRESSURE SWITCHES :

Pressure switches one in pneumatic line is connected to alert the operator by alarm in case pneumatic supply drop below the required operating pressure.

11.4. MICRO SWITCH :

The high vacuum valve is fitted with micro switches which provide the signal on the valve fully closed position so that even if the electrical signal gives any wrong status the micro switches will not allow other operation to be carried out.

11.5. PIRANI CONTROLLER:

Pirani vacuum controllers are incorporated operating in the range of 0.5 to 1×10^{-3} mbar through a roughing pirani gauge head and backing pirani gauge head. These vacuum controllers sense the vacuum of respective places and energies the relay when the preset vacuum is reached. This pirani controller is a part of the microprocessor based gauge.

11.6. PENNING GAUGE CONTROLLER :

Penning gauge controller which operates in the range of 5×10^{-4} m.bar to $5x\ 10^{-6}$ m.bar is inter connected with coating unit power controls such that if vacuum falls beyond the set value the controls and respective power supply will be de-energised.

View ports with window glasses are provided with protective shield to avoid implosion.

All high voltage power cables and power lines are shielded to prevent even remote chance of personnel getting contact with it during operation of the equipment.

The equipment is protected with relay and circuit breakers for sudden voltage fluctuation, power failures and high current surges.

This penning controller is a part of the microprocessor based gauge.

11.7. SAFETY INTERLOCKS:

1) The interlock should be provided in the PLC programme such that it is not possible to start the roots pump if the backing pump is not ON. Similarly if the backing pump stops, roots pumps automatically stop.

2) High vacuum valve should not be opened unless the required roughing pressure is obtained in the chamber. This will be achieved through roughing pirani head through its set point controller.

3) All the valves should attain closed position when there is a sudden power failure. This will be achieved by provided single acting cylinder with spring return solenoids.

4) Both roughing valve and backing valve should not remain open at the same time. Only one valve will remain open. Suitable time delay will be provided between closing and opening of the valve. This can be achieved by programming through Process Logic Controller.

5) An interlock should be provided for HT power supply and electron beam gun power supply by means of vacuum switch such that the above power supplies cannot be energised if vacuum chamber is in open condition to safeguard operator against high voltage hazards.

12.0. FABRICATION:

a) All the SS components should be fabricated using argon arc welding for leak tight joints.

b) All the components, sub-assemblies and fully assembled should leak tested using mass spectrometer leak detector having sensitivity to detect minimum leak rate of the order of 10^{-9} std.cc/sec.

c) All the materials used in the fabrication of pipelines, flanges and hardwares should be of non-magnetic material AISI-304.

d) All the Stainless steel surfaces exposed to vacuum should be electrochemically polished for low outgassing rates.

e) All the materials used in the fabrication should bel be tested in a reputed testing agency and necessary test certificates will be produced.

f) All the butt welds are radiography tested including the root welds.

13.0. INSPECTION :

Following tests are required:

a) Leak testing of the whole unit with Mass Spectrometer Leak Detector.

b) Testing of complete assembled coating unit for ultimate vacuum of 1×10^{-6} m.bar under clean, cold, empty and degassed condition.

c) Testing of automatic operation of vacuum system from cold start to vacuum ready indication using single switch operation.

d) Testing of the complete coating unit with its accessories for their specified performances.

e) Testing of glow discharge cleaning system for 15 - 25 mins.

g) Testing of vacuum during deposition of metal.

h) Checking of coating thickness uniformity for metallic coatings

k) Checking the results of the system parameters with respect to operation of all safety interlocks and demonstration of the safety aspects of the entire coating plant.

SECTION-VI

SCHEDULE OF DESIGN AND ENGINEERING ACTIVITIES

Time Frame / Activities	Apr-Jun'09	Jul-Sep'09	Oct-Dec'09	Jan-Mar'10	Apr-Jun'10	Jul-Sep'10
Preliminary Concept Report with G. A. Drawing of the Coating Plant						
Detail Engineering and calculations of the Coating Plant with Finite Element Analysis (FEA).						
Drawing of Support Structure, Mirror Rotating System, Substrate Holder etc.						
Detail Design of Pumping Systems, Valves, Plumbing Lines, Pneumatic Lines						
Detail Design of Control Console Unit for Manual and Automatic Operation						
Detail Design of Electrical System						
Final Concept Report with Engg. drawings and Approval of ARIES						
Manufacturing and Installation of the Coating Plant						
Testing and Coating of a dummy Mirror						

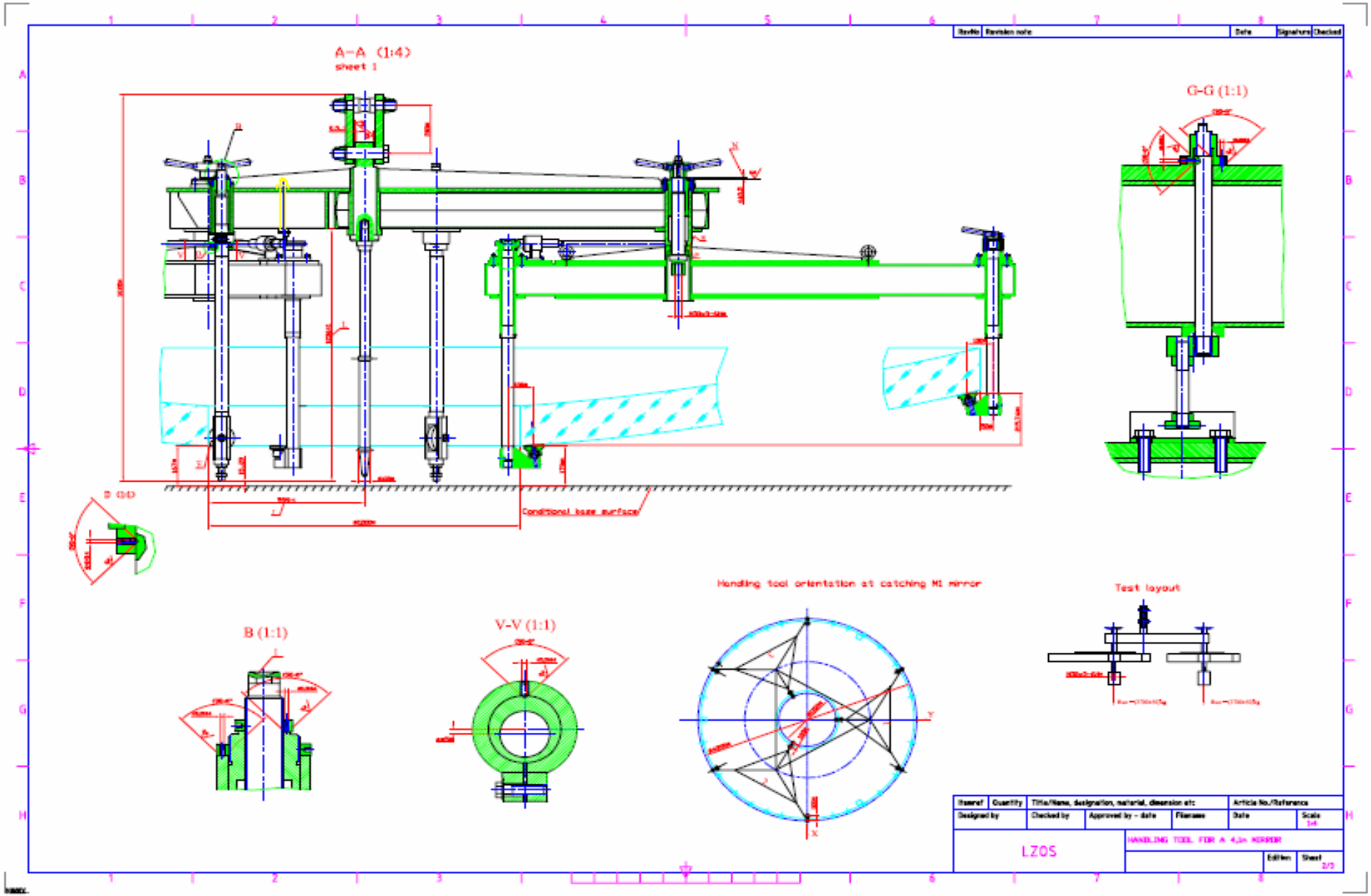
Annexure-A

Technical Specifications of the Mirrors:

	1.3m Telescope	**3.6m Telescope**
Mirror Dimension	1.313m	3.7m
Surface	Concave Hyperbolic	Concave Hyperbolic
Mirror Thickness	147.32mm at edge	165mm
Mirror Material	Corning TSG	Schott
Center Hole Diameter	457.2mm	750mm
Radius of Curvature	15m	6.06m

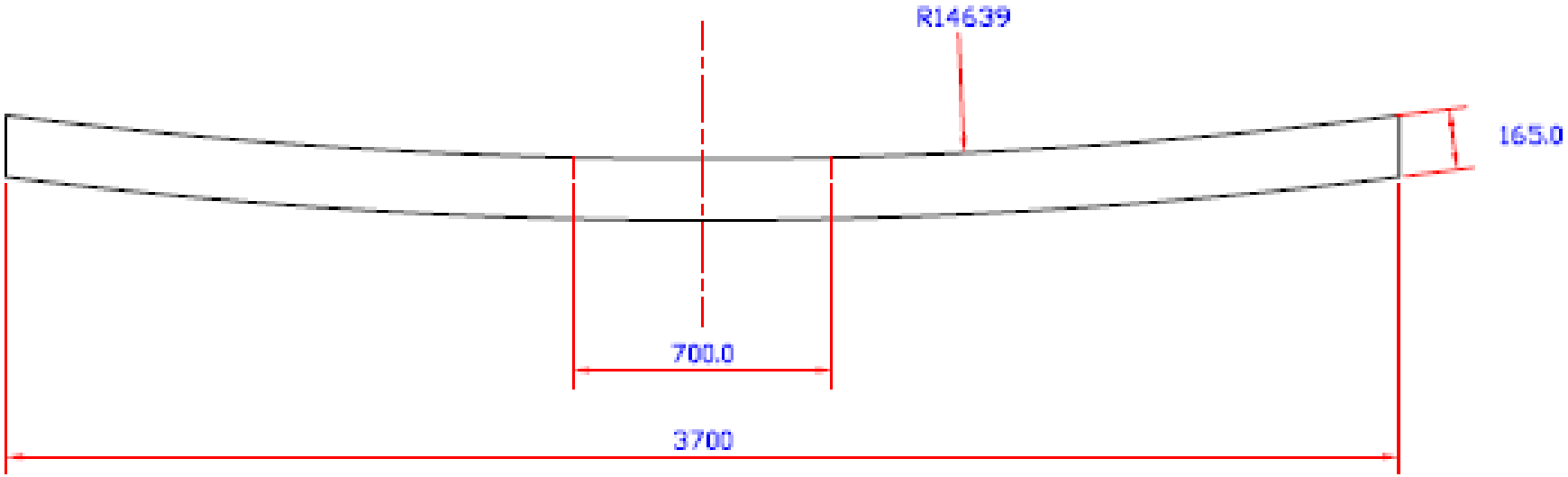
Design of 3.7m mirror handling tool is similar to 4.2m Mirror Handling Tool (below Drg.)

Annexure- B



3.7m Mirror Drawing:

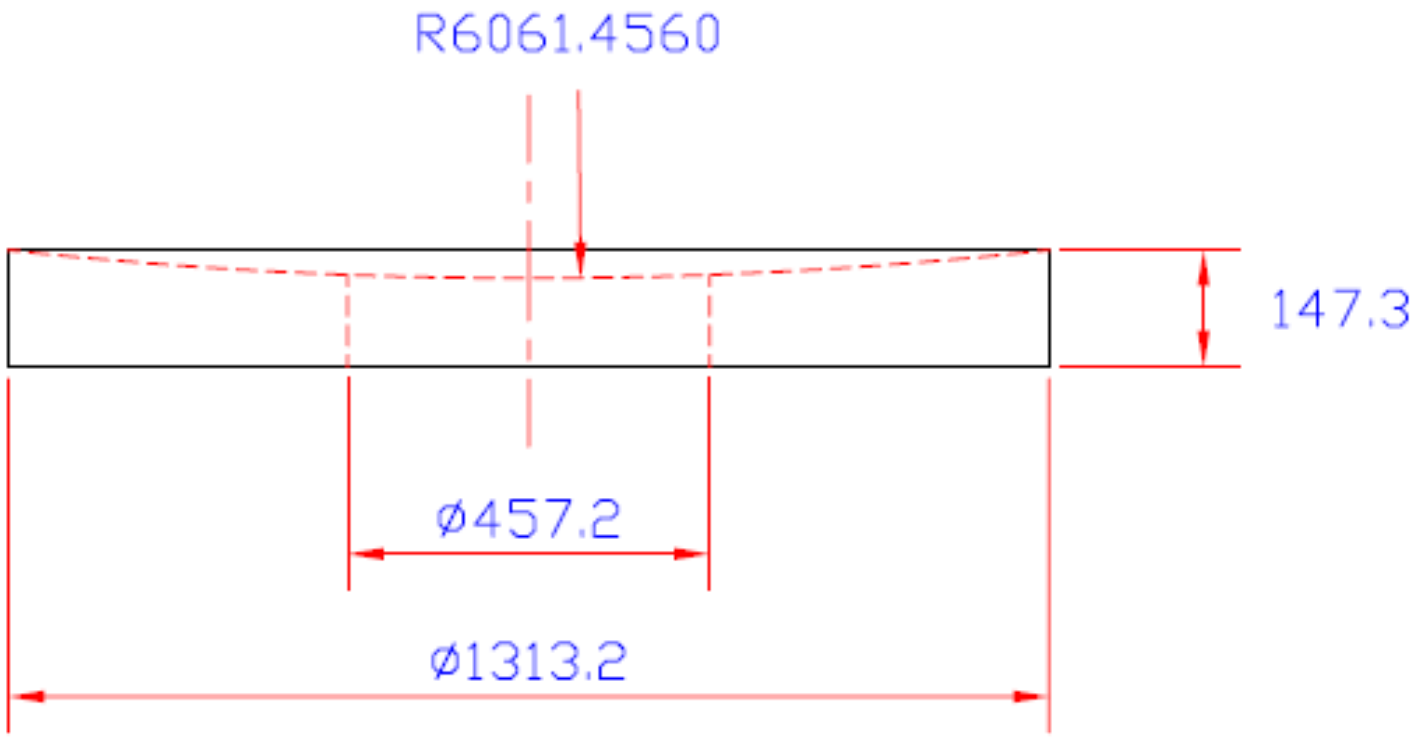
Annexure- C



- **All dimensions are in mm.**

Annexure- D

1.313m Mirror Drawing:



- **All dimensions are in mm.**

ANNEXURE - E

MANDATORY CRITERIA

Bidders will receive a Pass/Fail rating on this section. In order to be considered for Phase-I, Bidder must meet all the mandatory criteria described below. All questions should be answered on this form or an exact duplicate thereof. The ARIES reserves the right to verify any information contained in Bidder's response or to request additional information after the proposal is received. Incomplete or inadequate responses, lack of response or misrepresentation in responding to any questions will affect your evaluation.

MANDATORY CRITERIA	**BIDDER'S RESPONSE**
1.1 Bidders must have five or more staff with prior experience in providing appropriate and cost-effective design of Thin film Coating Plant. (name of previous customer, party)	Reference #1: Reference #2: Reference #3: Reference #4: Reference #5:
1.2 Bidders must have experienced staff in vibration, structural, finite element analysis.	Yes/No Provide names and Describe experience
1.3 Bidders must have one or more staff with demonstrated experience in design of complex vacuum products	Yes/No Provide name(s) and Describe experience
1.4 Bidders must submit a complete set of audited financials for the previous three (3) fiscal years that demonstrates it has been operating in a positive position.	Yes/No

Place: Signature
Name of the Bidder _____
Date:

Company Seal

ANNEXURE – F

REQUIREMENTS MATRIX

Bidders's proposal must be organized to follow the format of this Bid. Each Bidder must respond to every stated request or requirement and indicate that Bidder confirms acceptance of and understands the ARIES requirements. The Bidder should identify any substantive assumption made in preparing its proposal. The deferral of a response to a question or issue to the contract negotiation stage is not acceptable. Any item not specifically addressed in the Bidder's proposal will be deemed as accepted by the Bidder. The terms "Bidder" refer to those companies that submit a Bid / Proposal pursuant to this Tender Specifications.

Where the Bidder is presented with a requirement or asked to use a specific approach, the Bidder must not only state its acceptance, but also describe, where appropriate, how it intends to comply. Failure to provide an answer to an item will be considered an acceptance of the item. Where a descriptive response is requested, failure to provide the same will be viewed as non-responsive. Where a statement of non-compliance is provided, the Bidder must indicate its reasons and explain its proposed alternative, if applicable, and the advantages and disadvantages to the ARIES of such proposal.

Section	BIDDERS RESPONSE
1.0	Explain your experience in working on similar projects with other organizations.
1.1	Explain your experience of team (to be deployed) in providing appropriate and cost-effective design, development and commissioning of highly specialized projects.
2.0	Make available 5 resumes of staff with experience in design, analysis of special areas like vacuum coating, pumping systems, vacuum technology etc.. These should be standard resumes, not biographical information only. Provide a chart with information on Experience in Strategy , Design and manufacturing.
2.1	Provide information on your specific strengths in design and development, and innovation (supported by specific examples of past work done)

2.2	Provide evidence of previous customers satisfaction with your work on similar projects.
2.3	Provide information on how you keep your staff up to date on innovative uses latest design tools, technology etc.
3.0	Describe how you will allocate staff to all aspects of this assignment, and how you will assure that appropriate staff members are always available for critical and time-urgent tasks and for prompt response to requests from the client.
4.0	Provide general information on how you evaluate and measure your effectiveness, timeliness, completeness and innovation in responding to ARIES needs for design, manufacturing, commissioning and maintenance.
4.1	Provide specific information on how you will monitor and evaluate your technical performance under this contract.
5.0	Provide information on how you will monitor and assess the quality of your work (including relevance to the ARIES specific needs, technical excellence, and responsiveness.)
5.1	Explain your strategy and mechanisms for assuring a "seamless" relationship and response for the ARIES even when different members of your team are working on this project.

Explain how you use technology to serve your clients better and to embody and demonstrate to your clients the innovative uses of technology that you are advocating in their own projects.

Place: Signature
Name of the Bidder _____
Date:

Company Seal

ANNEXURE – G

RESUME

Name of Staff: _____

Title / Designation: _____

Years with Firm: _____ Nationality: _____

Certifications: _____

Education/Qualifications: (Summarize college/university and other specialized education of staff member, giving names of schools, dates attended and degrees-professional qualifications obtained.

Employment Record/Experience

1. Relevant training taken that is applicable to the requirements of this Tender Specifications.
2. Relevant experience that is applicable to the requirements of this Tender Specifications.

(Starting with present position, list in reverse order, every employment held. List all positions held by staff member since graduation, giving dates, names of employing organization, title of positions held and location of employment. For experience in last five years, detail the types of activities performed, degree of responsibilities, location of assignments and any other information or professional experience considered applicable to the requirements of this Tender Specifications.)

I, the undersigned, certify to the best of my knowledge and belief, this bio-data is accurate.

Signature of Staff Member or Bidders Representative

Date (Day/Month/Year)

ANNEXURE - H

CERTIFICATE OF AUTHORITY TO SIGN PROPOSAL

I/We, _____, certify that I am

_____of_____; that I have

signed this Proposal for and on behalf of _____and that the

signing of this Proposal is within the scope of my/our powers.

_____ Seal

Signature

Printed Name and Title

Date

ANNEXURE - I

ROUTE SURVEY REPORT

Ex.
RAMPUR N.H24+SH JN

TO
ARIES 3.6M TELESCOPE PROJECT SITE.
(DEVASTHAL-UTTARAKAND)

By
KUEHNE + NAGEL PRIVATE LIMITED
(PROJECTS)

1) Introduction:

Detailed route survey from Rampur N.H+S.H Junction to ARIES Devastal 3.6 m Telescope Erection site was carried out by, through various routes to assess the possibility of the transportation of AMOS Consignments.

Max. Weight

Azimuth Table	: 6000MM Dia X 1400 mm – Wt.30 tons.	
Base of the Fork	: 8000x4000x1500mm	- Wt. 32 tons
Fork Columns	: 4000x4600x2200mm	- Wt.10 tons
Bearing Housing	: 2000x2000x1300mm	- Wt. 10 tons
Centre Piece	: 4800x4800x1200mm	- Wt.14 tons
Intermediate and Top Rings	: 4800x4800x2500mm	- Wt.2.5 tons x 2 nos.
MI Cell	: 4300x4500x600mm	- Wt.3.5 tons
MI Mirror	: 3700mmDia x250mm	-Wt 4.2 tons
ARIES Structure	: 4800x4800x1500mm	- Wt 6 tons.

During the course of survey, Physical inspection of all enroutes structures mentioned below were carried out and recorded. Discussions held with enroute concerned Official to find out the weak structures, and their planning in future for survey record.

2 Routes with additional were inspected to check the dimensional clearance and obtained the geometric details such as Gradients, Curves and Turnings, Super elevations, etc.

Mechanical Trailers such as Tarus-Open truck/High Bed and Semi-bed Trailers and Low bed trailers combination, considered for Route survey and all the Turning radiuses were checked for trouble free movement of such trailers axles on curves and radius.

Observations:

a. Culverts, Bridges, Causeways and its details.
b. H.T and L.T Lines crossing.
c. Traction lines and Level crossings on Haldwani Bypass.
d. RUB-Railway under bridges and other overhead structures-If any on Haldwani Bypass.
e. Hut, Shops, Islands located on curves and turning circles.
f. Turning radius on curves and examining the possibilities to increase the same on Ghat section.
g. Villages and thickly inhabited areas.
h. Rivers and nallahs and their nature.
i. Gradient and dips on road.

The following information on bridge/culverts also noted:

a. State/National /MDR/ODR highway.
b. Type of bridge and its Numbers
c. Height and Traffic lane of the bridge.
d. Details of span, length, and beams
e. Classification of bridges and its conditions.
f. Possibilities of support or bypass for the weak and
   Other bridges, which cannot withstand/bear the proposed axle loading, or heavy equipment weight.

   Survey carried out to establish a least constraints route to ensure safe and timely transportation of the AMOS's equipments to reach ARIES-Devastal site.

2. ACKNOWLEDGEMENTS

Survey Team acknowledges the Guidance and Valuable support provided by ARIES.

1. Prof. Ram Sagar- Director/ ARIES
2. Dr.B.B.Sanwal - Scientist-E/ Project Manager
3. Dr.S.B.Pandey - Scientist-D

4. Survey Team acknowledges the Key notes provided by AMOS-ARI-TRE-AMO-0000-032 Prepared by Mr.C.Jamar, Checked and released by Mr.F.Frusin,ARIES Project Manager

5. Survey Team Acknowledge the support and Approval given by Our K+N India Managing Director-Mr.Volkmar Muller and our Finance Director Mr.Dilip Kohli.
6. Survey Team Acknowledge the help from Mr.Roeland Lambrechts, sales Manager and Mr.Gert Mattheussen/Industrial Project Manager, K+N Antwerpen.

Ref:

1. I.R.C Loading specification 2-2000
2. Design of Steel Bridge Structures-Volume II by Ram Chandra
3. Essential of R.C.C Bridges by John Victor
4. A seismic Design of Bridges by J.C.Sarkar
5. Highway Engineering.

3. Discussion Held at ARIES, Manora Peak, Nainital

Prior to start of the Joint survey with ARIES, discussions were held at ARIES office with Dr. B.B. Sanwal and Dr.S.B Panday and various issues were discussed on 02.06.2008

1. As per ARIES, the weight of the cargo was reduced to 15 tons max. and width is 4.1 m.
2. Based on the previous survey reports, they had a plan of movement of Mirror via Bhimtal Route due to restriction at Bhowali.
3. Also to move the Heavy duty Crane to Devastal for erection and possibility of Air Transport asked by AMOS.
4. All the bridges in State Highway were declared IRC Class 'B' loading and possibilities of support or Bypass.
5. Selection of Final route with recommendation after the Joint study with K+N.
6. Movement of 2.6 Telescopic consignments.
7. Inspection of site roads which is under construction.
8. Other suggestion and remarks.

After discussion, decided to study 2 possible routes, which are leading to Devastal site from N.H 74(Kathgodam)

4. ROUTES SELECTED, SURVEYED AND ROUTE MAP

Routes surveyed:

Route No:-1

Rampur N.H+ S.H Jn- Bilaspur- Rudarpur- Haldwani-Kathgodam- Jeolikot-Bhowali-Ramgarh-Bhataliea- Dhanachuli bend-Jalapani- Devastal ARIES Site.

KM: Total 153 KM

Ghat Section: 69 KM,

High Ways ; N.H.74/N.H.74E & S.H

Route No:-2 – Optional only, not recommended

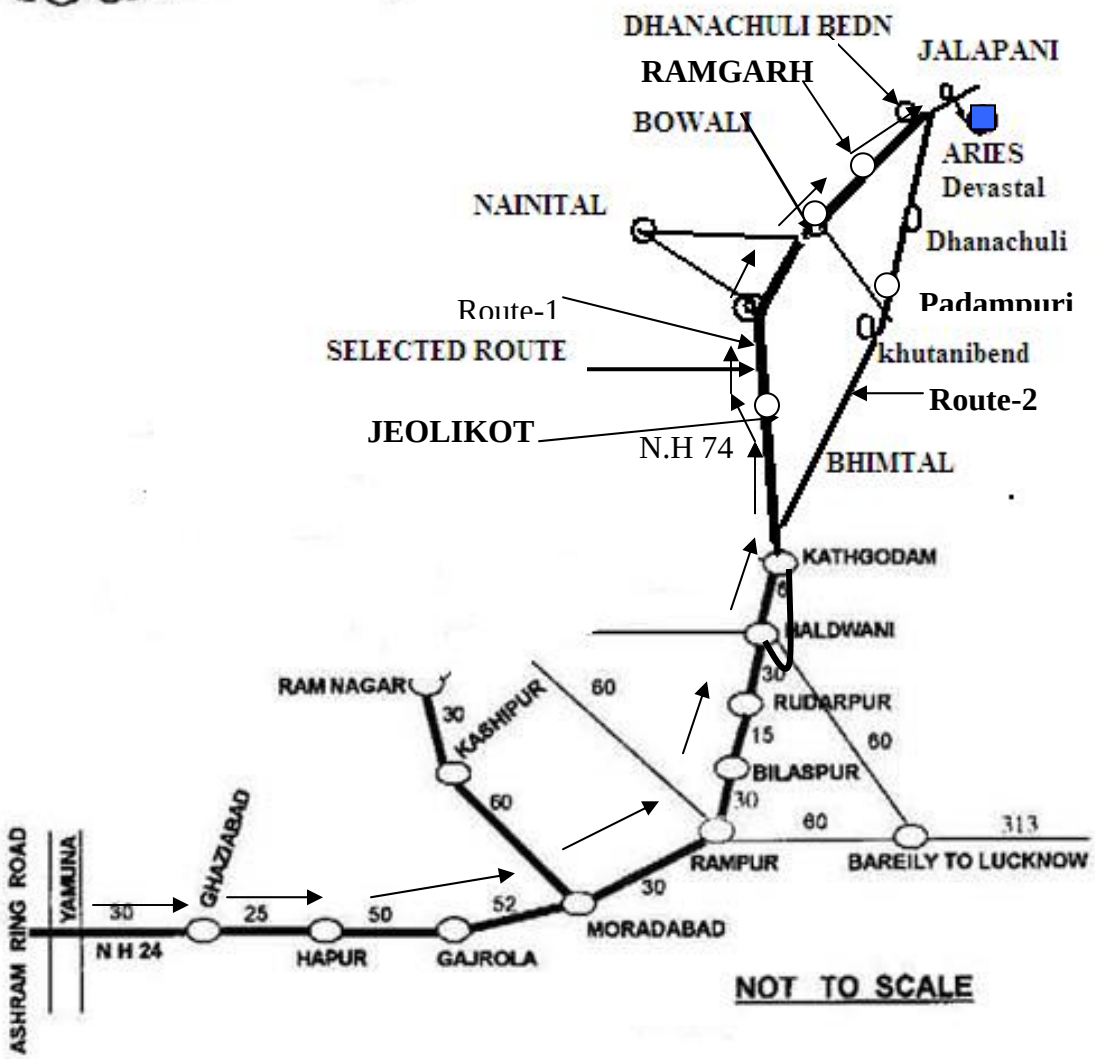
Kathkodam-Bhimtall- Khutani bend-Dhanachuli village -Dhanuchuli bend-Jalapani-Devastal ARIES Site.

K.M: Total: 142KM

Ghat Section: 56KM

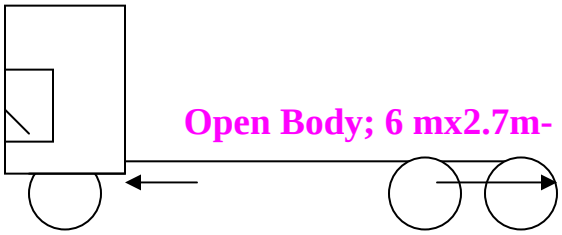
High Ways: N.H 74- S.H/MDR

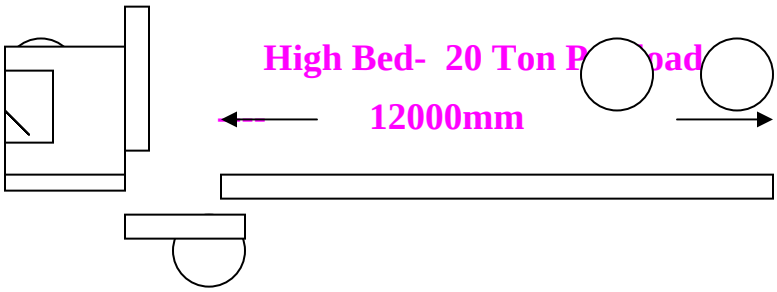
Route Map

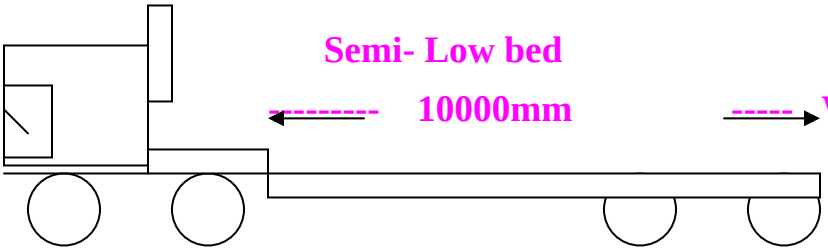

DHANACHULI BEDN
JALAPANI
RAMGARH
BOWALI
ARIES
Devastal
NAINITAL
Dhanachuli
Padampuri
Route-1
SELECTED ROUTE
khutanibend
Route-2
JEOLIKOT
N.H 74
BHIMTAL
KATHGODAM
HALDWANI
RAM NAGAR
30
KASHIPUR
60
30
RUDARPUR
15
60
BILASPUR
30
60
313
60
RAMPUR
BAREILY TO LUCKNOW
30
MORADABAD
52
50
25
30
GHAZIABAD
YAMUNA
ASHRAM RING ROAD
N H 24
HAPUR
GAJROLA
NOT TO SCALE

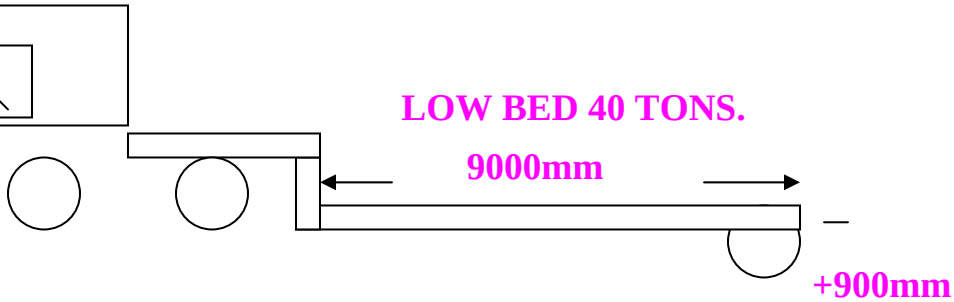
5. TRAILERS CONSIDERED FOR SURVEY WITH DETAILS

1. **Mechanical Tarus – Double Axles.**
2. **High Bed Trailer - Double Axles**
3. **Semi-Low bed - Double Axles**
4. **Low Bed - Single Axle**

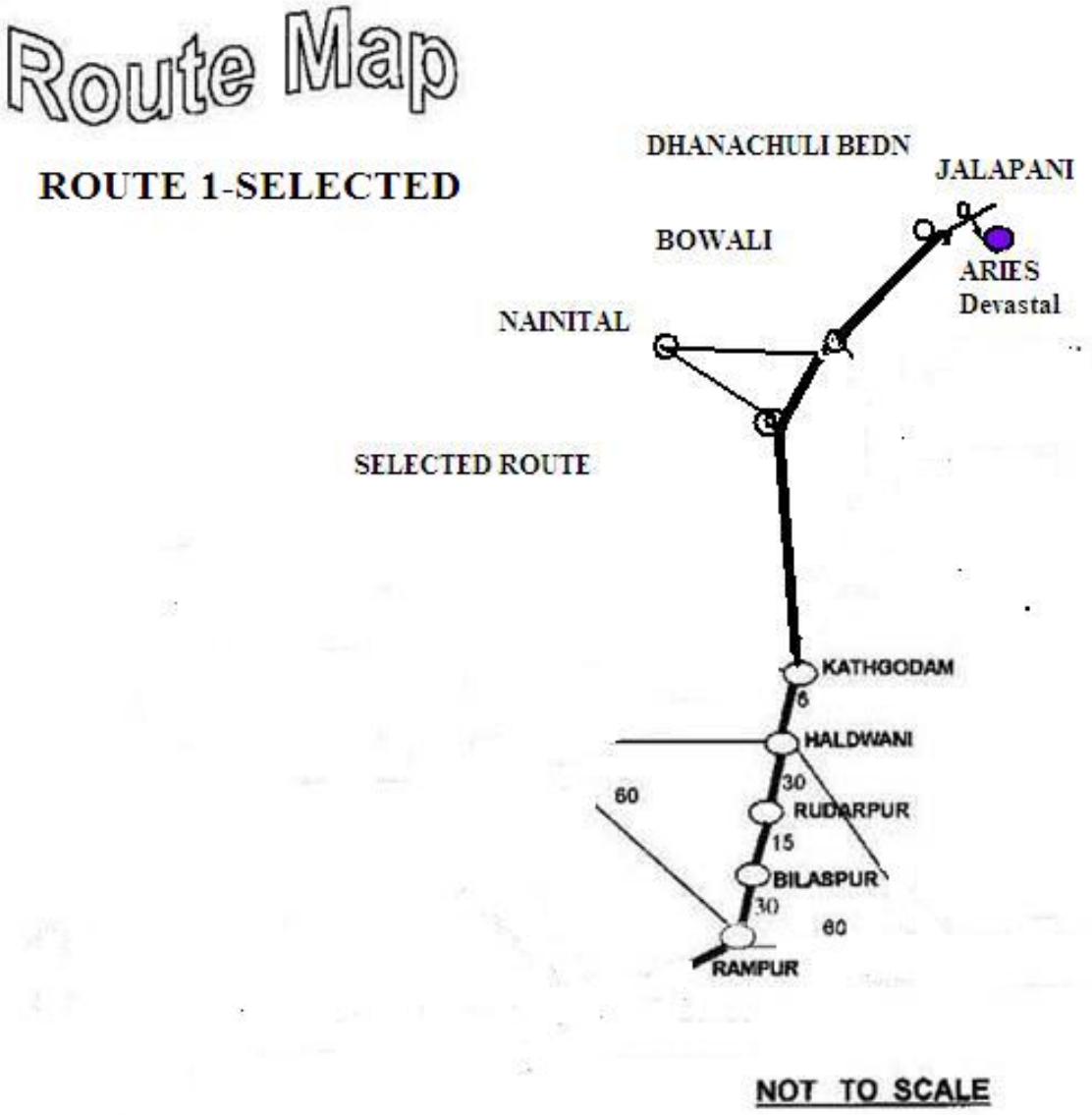
1. 

2. 

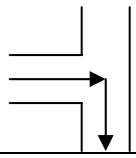
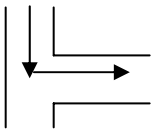
3. 

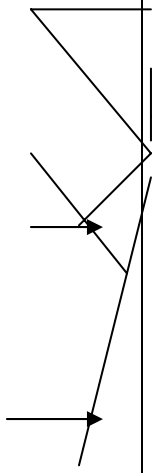
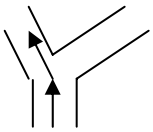
4. 

6. SELECTED ROUTE-1 WITH DETAILED SURVEY REPORT

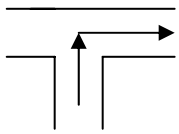
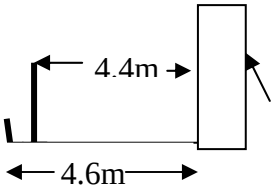
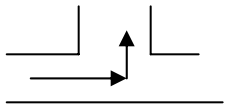


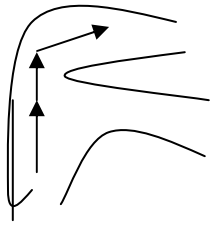
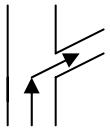
	DETAILED	SURVEY	REPORT-	ROUTE 1
K.M	LOCATION	STRUCTURES		REMARKS
00	RAMPUR N.H.24+ S.H Jn-	Road Junction N.H--- National Highway S.H --- State Highway	'T' Junction	Suitable Turning radius available for trailer movements.
10	S.H	Intermediate Road	Bitumen width 5.75m Shoulders 1 to 2 m	Observed on good conditions
18	Ballarpur	City	Congested City	Frequent over head domestic wires needs to be lift for the cargo having height over 3m.
21	S.H	31/1-- Bridge	Steel truss Plate Girder Bridge— Deck Type. IO Panels 5m. Girders Placed on Rocker bearings. Span 1x	New 70R Bridge under construction and it will be ready for Telescopic movement. However, alternate route available via Bariely.
21	S.H	31/2-- Bridge	R.C.C Slab Span 1x6m Slab : 350mm	Class "A'
31	S.H	Railway Level Crossing	Non Electrified-B.G Lane	Normal Pass
33	S.H	Rudrapur Road Jn	Square Junction	Go straight. Left for Kashipur and Right for Kitcha
67	Haldwani	Road Junction	'T' Junction	Turn Right. Straight goes to Haldwani city. Can be crossed during night.

67.90	Haldwani	Road Junction	‘T” Junction 	Turn right towards Bypass
KM	Location	Structures	Observation	Remarks
68.80	Haldwani	Road Junction	‘T’ Junction 	Turn Left to meet Haldwani Bypass. Straight goes to Delhi via Kitcha
72.30	Bypass	Railway Level Crossing	No.-Electrified.B.G Crossing	Normal Pass.
75.70	Bypass	4/1 Bridge	R.C.C T-Beam bridge. 2-Girders System Span 13x28.25m	Class” A’-Single lane withextented cantilever.
76.80	Bypass	6/1-Bridge	R.C.C Slab. Span 1x6m	2lane of Class ‘A’/AA
77.90	Bypass	Road Junction	Inverted ‘Y’ Jn 	Turn Left. Right for Bariely to meet Delhi road.
81.70	Bypass	Bridge	R.C.C Slab Span 1x6m	2lane of Class ‘A’/AA
83.70	Bypass	Bridge	R.C.C’T’ Beam 2-Girders System Span 3 x36.25m	Class” A’-Single lane withextented cantilever
84.10	Bypass	Road Junction	‘T’ Junction	Haldiwani Bypass Ends. N.H.74 and To meet Kathgodam
84.20	Kathgodam	90/1 Bridge	2 Steel Bridges. 1. Steel Through Bridge for Up vehicles. Span 1x24 m. 2. Steel Plate Girder	1. Steel Through bridge is new Class ‘A’ Bridge and Steel.Diemsions restriction is there.Ref.the Diagram for the same.

			Bridge on Rocker. Span 1x24 m. 	2. For Steel-Plate Girder bridge no-classification is mentioned and it is open with 4.4m and side panels of 700.The side key stone is 1000mm and the distance in between both bridge is 2.2m. Consider Class 'B' loading and heavy cargo, this can be easily supported to convert Class 'A'
84.70	N.H 74	Rani Bagh		Main Ghat road starts from this point.
84.70	N.H.74	90/3- culvert	R.C.C Slab Span 1x5m	Class 'A;
87.20	N.H.74	Road Junction	'Y' Junction 	Continue on N.H 74 towards Left. Right for Alternative route via Bhimtall.Ref.the route Map. Road with Up-Gradient and good turning radius on 'U'Curves.
99.30	N.H.74	Bridge	R.C.C Slab with Steel girder . Span 1x9m	Class 'A'
100.40	N.H.74	Jeyolikote	Village	No free. Over head wires.
101.40	N.H.74	Bridge	R.C.C Slab with Steel Girder. Span 1x6m	Class 'A'
102.40	N.H.74	Road Junction	'T' Junction 	Go straight to meet N.HH74E.Left for Nainital
103.2	N.H.74E	Bridge	R.C.C Slab with	Class 'A'

			Steel girder. Span 1x8 m	
103.60	N.H.74E	Bridge	R.C.C Slab with Steel girder. Span 1x9.5 m	Class 'A'
104.00	N.H.74E	2/4 Bridge	Steel –Baily Bridge. Span 1x39m. Width 4.65 M. Side Panel: 1.2m.	No classification and very Old bridge. Rating Looks 24 R/30R. Bridge can be supported and it is possible for Heavy loads.
110.10	N.H.74E	8/2 Bridge	R.C.C Slab with Steel Girder. Span 1x6m	Class 'A'
111.10	N.H.74E	Culvert	Stone Arch Span 1x3m	No classification for Arch and the safe axle load is applicable for crossing as per IRC Ratings
111.20	N.H.74E	Culvert	Stone Arch Span 1x3m	No classification for Arch and the safe axle load is applicable for crossing as per IRC Ratings
112.20	N.H.74E	11/1-Bridge	Stone Arch Span 1x18m. Spandrel; 2.5. Width : 5.5m	No classification for Arch and the safe axle load is applicable for crossing as per IRC Ratings. Marked as class 'B' and it can be supported or use baily over the bridge for heavy loads and it is possible.
113.10	N.H.74E	Culvert	Span 1x3m	
K.M	Location	Structures	Observation	Remarks
114.20	N.H.74E	Bridge	Stone Arch Span 1x8m. Spandrel; 2.5. Width : 5.5m	No classification for Arch and the safe axle load is applicable for crossing as per IRC

				Ratings. .
116.20	N.H.74E	Road Junction	'Y' Junction	Continue to N.H towards Bhowali.
118.20	Bhowali	Road Junction	'T' Junction 	Turn Right and leave N.H.74 E. Move towards Bhowali town
119.00	Bhowali Wall and Un-used Telephone poll to be removed for 4.6 m width.	Congested Area	Width clearance 	Sweet shop
119.70	Bhowali	Road Junction	'T' Junction over a Slab bridge 	Turn Left to meet S.H.25
120.70	S.H. 25	Bhowali Outer		Bhowali Ends
124.10	S.H.25	2/1-Bridge	R.C.C T-Beam Span 1x 8m	Class ,A' 2-Lane
130.10	S.H.24	Width Congesstion	Clear width available in between a Temple wall and side rock/shop is 5.5.m	Width if required can be extended.
KM	Location	Structures	Observation	Remarks

132.20	S.H 24	Ramgarh	Village	
134.60	S.H.24	Road Junction	'Y' Junction	Turn right and continue on S.H
136.00	S.H.24	Kashia lake jn	'Y' Jn	Turn Right
137.20	S.H.24	Road Junction	'Y' Jn	Turn right
138.20	S.H.24	Bhatalia Jn	'Y' Jn	Turn right
139.80	S.H.24	Latipughat	'Y' Jn	Turn right
141.50	S.H.24	Village JN	'Y' Jn	Turn right
145.20	Dhanachuli Mode	Road Junction	Junction on 'U' curve and 'Y' Junction 	1.Go on as per the drawing-on Left-hand side. Right hand for Alternate road via Bhimtal.
149.20	S.H	Jalapani	Road Junction-'T' Junction. 	Turn right to meet ARIES Road, which under construction.
149.20 To 153.00	ARIES Road	Road under construction uoto 3.6 m Telescope-site	Needs 3-4 bends widening and increasing its outer radius.	
153	3.6M Telescope erection site.			Observed the area is limited and the extension possibility is very difficult.

Notes :

1. The Turning radius in between KM 132.20 From Ramgarh to Dhanasuli Bend is suitable for Tarus Truck and 30ft Trailers. For Normal Trailers of 40ft and low bed trailers needs a Trail run.

2. Outer Turnings radius required for 40ft High bed/Semi Low bed is Min.of 14 MT.

Optional route section surveyed
Via Bhimtal/Padampuri

Route Map


DHANACHULI BEDN
JALAPANI
ARIES
Devastal
Dhanachuli
khutanibend
BHIMTAL
KATHGODAM
6
HALDWANI
30
RUDARPUR
15
60
BILASPUR
30
60
313
RAMPUR
BAREILY TO LUCKNOW

DETAILED ROUTE SURVEY REPORT

KM	Location	Structures	Observation	Remarks
00	Kathgodam	Steel Bridge	Explained in First report	
03	N.H.74	Road Junction	'Y' Jn	Turn right to meet S.H.10 Towards Bhimtal
04	S.H.10	bridge	Steel Through Bridge Span 1x47m. Width 4.7m Clear Height 4.3m at 4.7M Width. Max.Height 5M	Class 'B' or 18R Bailey. Support possible, Expensive but dimensions are limited due to Through type.
18	Thalitall	Tourist area		
19.6	S.H.10	bridge	R.C.C 'T' Beam Span 1x18.7m Single lane Width-4.8m Height 1.3m	Class 'A'
19.9	S.H.10	Road Junction	'T' Jn	Turn left.
20.40	Bhimtal	Congested Area	Available width clearance-5.65m	
22.40	S.H.10	Khutanibend Junction	Road Junction on 'U'Curve	Turn right to meet MDR and leave S.H.10. Upto this point,the free turning radius available is for Tarus and not for trailers.
23.10	MDR	Road clearance	Width 5.3m.	Up gradients starts.
25.10	MDR	Road clearance	Width 4.3m	Only Tarus is suitable for trouble free turning.
25.60	MDR	Bridge	R.C.C 'T' Beam Span 1x16m	Class' A'

			Single lane Width ;4.6m Parapet : 1m	
25.80	MDR	Road width	Bitumen 3.3 and shoulders 0.5m	Up/down Gradients.
25.80	MDR	5/2-Bridge over river Rivera	Steel through bridge Span1x68.30 Width 4.6m Clear Height 4.3m at 4.7M Width. Max.Height 5M	Class 'B' Support is possible, but expensive as the Gauge is very deep and to limited dimensions.
35.80	MDR	15/1Bridge	Steel Truss/Bailey Span 1x30m. Width;4.7m Side panels:2.25m	Class 'A' Very deep Gauge.
39.80	MDR	Dhari	Village	
45.80	MDR	Dhanachuli Village		
47.30	MDR	Dhanachuli bend	Critical turning on 'U' Curve	No direct turn. Need to move in multiple turn to meet S.H
51.30	S.H	Jalapani	T-Jn	Turn right to meet site road
55.10	Site Road	ARIES 3.6 Telescopic site.		

Bridges and Its design criteria

In India the bridges are classified in to 4 catagoteries by Indian Road Congress.

They are,

1. IRC Class 70R(or) A/AA
2. IRC Class AA
3. IRC Class A
4. IRC Class B

Most of the bridges in National Highways are constructed under 70R/A/AA System and in state Highways, all bridges are under conversion to 70 R.

However, based on the survey report, we observed many bridges in this Ghat section falls under Class A and Class B or equivalent to 18R.

Both class A and Class B/18R are explained under as details:

Class A:

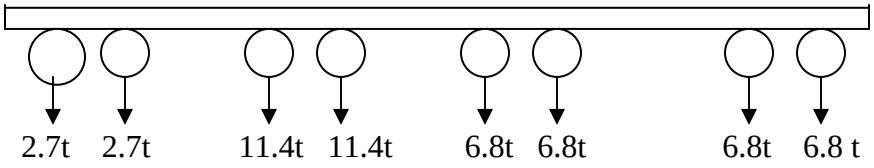
This loading is normally adopted on all roads on which permanent bridges and culverts are constructed.It consists of one driving vehicle unit and two trailers.The trailers attached to the driving unit are not detachable.The ground contact area of the the wheels are as per the under;

Axle Load	Ground contact Area	
	B-mm	W-mm
11.4 tons	250	500
6.8 tons	200	380
2.7 tons	150	200

The Minimum clearance carriage way width 5.5m to 7.5m.

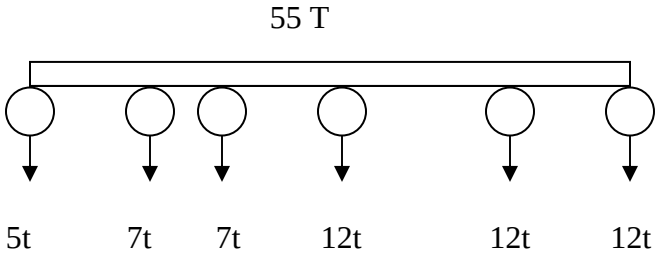
The below diagram shown the position of Class A Vehicle. This Class A is also reffered to 40R.That means a payload of 40 tons can be moved safely on class A Bridges.

Class A Loading –Vehicle.



IRC Class A Train of Vehicle.

Total Load: 2.7+2.7+11.8+11.8+6.8+6.8+6.8+6.8 = **56.20 tons**.



40 R Loading, equivalent to Class A Loading

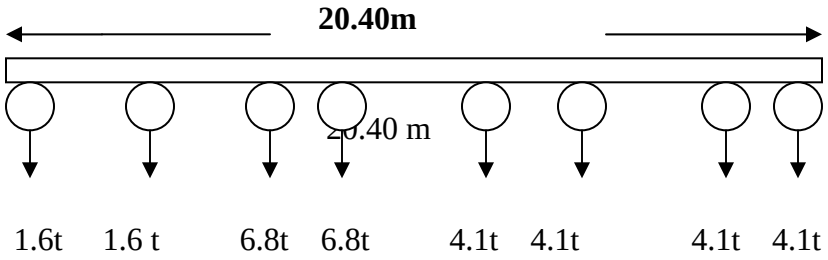
Inpractical,no such vehicles are available in market and theses vehicle will produce more shear and bending effects. These are only Hypothetical Vehicles for classification of vehicles and bridges.

Below given are Vehicles' details for Class B Loading and its details.

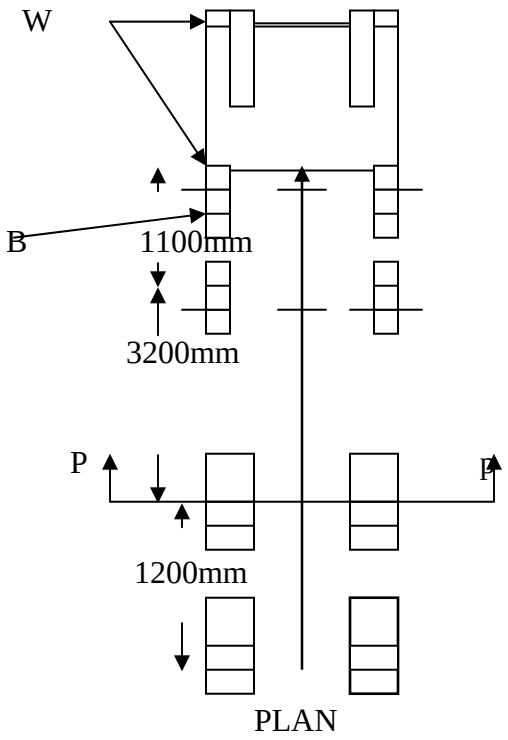
IRC Class ‘B’ Loading

IRC Class B Loading is intended to be adopted for Temporary structures,tibmber bridges and for the bridges in specified area.

The standard loads are to be arranged in such a manner as to produce the severest bending moment or shear at any section considered. The loading vehicles are to be aligned so as to travel parallel to the length of the bridge. When these vehicles are on the span, no other live load needs to be considered as acting over the un-occupied area. Vehicles in Adjacent lanes are to be assumed to be moving in a direction producing max.stress.



Total Load : 1.6+1.6+6.8+6.8+4.1+4.1+4.1+4.1 = 33.20 Tons



IRC: Indian Road Congress:

There was no uniform code in India, prior to the formulation of I. R. C. Each state or province had its own rules about the standard loadings and stress. When IRC Formed, as centralized code formed and applied to all states. In addition, seismic effects also considered by IRC.

IRC Bridge codes as available now of the below section:

1. Section I –General feature of design
2. Section II – Loads and Stress (IRC6-2000)
3. Section III- Cement Concrete
4. Section IV- Bricks, Stone and block masonry
5. Section V – Steel Road Bridges.

Impact Effects:

Live load trains produce higher stress than those which would be caused if the loading vehicles were stationary. In order to take into account the increase in stress due to dynamic action and still proceed with the simpler statistical analysis, an impact allowance is made.

For class A or Class B Loading,

It will be $I = A/ B+L$

Where,

I= Impact Factor Fraction
A= Constant of value 4.5 for R.C.C Bridges and 9 for steel bridges
B= Constant of value 6 for R.C.C and 13.5 for steel bridges
L= Span in Meter.

For spans less than 3 m, the impact factor is 0.5 for R.C.C Bridges and 0.545 for Steel bridges. When span exceeds, the impact factor is taken as 0.154 for steel bridges and 0.088 for reinforced concrete bridges.

Example:
Span 1 x39 m at 104 KM as per the survey report-Selected route.

$I = 9/13.5+39 == 0.17\%$

The safe load of the bridge is 33.20 tons on Class B as per the above vehicle. Then the total load including the impact allowance is 0.17

This benefit can be avail only when the vehicle is moving with 5KM per hour over the bridge and no other live load to cross at the same. However the calculations determining the safe load carrying capacity shall not allow for the effects due to Impact/Wind pressure, longitudinal forces etc. as described in IRC Manual

The Bending and Shear calculations for IRC Vehicles' and proposed cargo movement vehicle needs to be calculated to ascertain the factor. The spacing between the successive vehicles will be 30m.The classification of bridges will be determined by the safe load carrying capacity of the weakest of the all structural members.

Major Hurdles and solutions

As per the Cargo details provided by AMOS:

Max. Width: 6 m -- Azimuth Table
Max. Length: 8m -- Base of Fork
Max. Height: 2.5m-- Rings
Weight : 32 tons.-- Base of Fork

As per Survey Report:-- On Ghat Road- N.H 74/74E and S.H

KM	Hurdles	Solutions
84.20	90/1 Steel Bridge	To convert the open bridge into Class 'A' needs support and it is possible. When cargo arrives in dismantle conditions and 15 tons, can cross the bridge safely.
104.00	2/4 Steel Bailey Bridge-1x39m	To convert the open bridge into Class 'A' needs support and it is possible. When cargo arrives in dismantle conditions and 15 tons, can cross the bridge safely
112.20	11/1- Stone Arch Bridge Span 1x18m	Can be supported as ring support to convert into Class A or can use bailey over the bridge to cross heavy loads. In dismantled condition, cargo can cross the bridge safely.
114.20	Stone Arch 1x8m	Use Steel plate or support for heavy as per list. In dismantled condition, normal pass.
119.00	Bhowali. The Existing clearance is 4.4m.	Remove the telephone poll which is now in no use and increase width to 4.6m. Again to increase the width, to break the compound wall which is under MES through ARIES on reconstruct basis and it is possible.
130.10	Width in between Temple and Shops barrier -5.5 m.	Can be extended with required permission
149.20-153	ARIES-Site Road	Needs to improve on turnings

Queries raised by ARIES for Erection of Materials

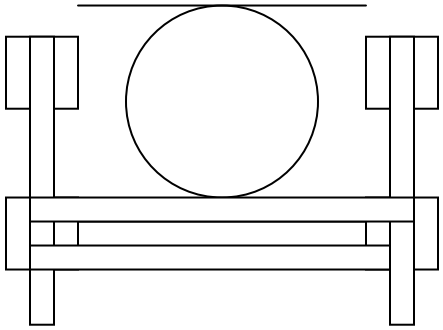
ARIES asked us to explore the possibilities of erection of AMOS Consignments at a Height of 27 m and we studied accordingly. Joint survey carried out and find out the possibility of bringing the crane to site.

To erect this cargo need Heavy cranes over150-200 tons capacity and subject to its lifting capacity and its operational area required of 20m. At an operating height of 30m with 30m radius, the lifting is possible for 125-150T cranes are 14 tons. The ratings of heavy line are limited by factors other than stability,

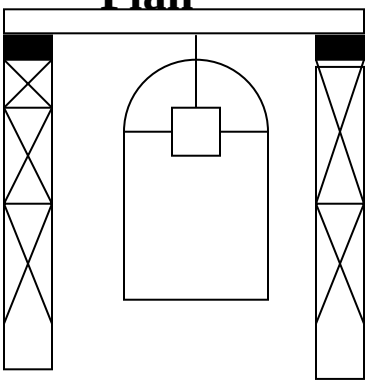
Based on the route survey and its bridges conditions, this type of crane cannot be bring to site on its own or dismantle conditions due to self weights. In dismantled conditions, the heaviest item will be app. 40-50 tons. Transit move is possible but, this ghat section will not allow for the same due to the weak bridges.

In such situation, Tower crane and derrick can be used. Such type can be designed suitable to site location. Derrick is the best solution as the boom and mast butts are mounted on a turn table and the stifflegs pin into foundation.

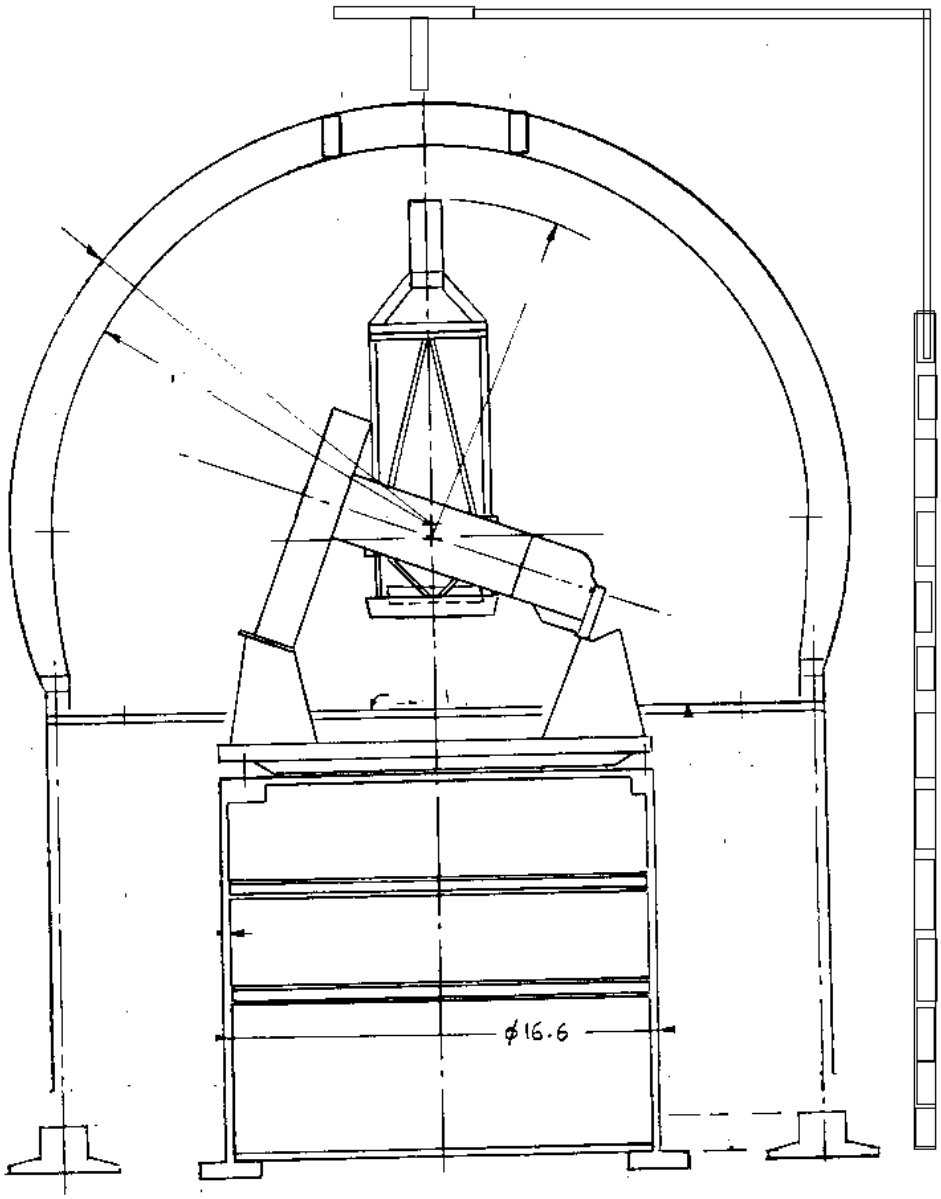
However another design is movable Gantry on Mast as per the below diagram. Need complete details such as Buildings, height etc



Plan



Section



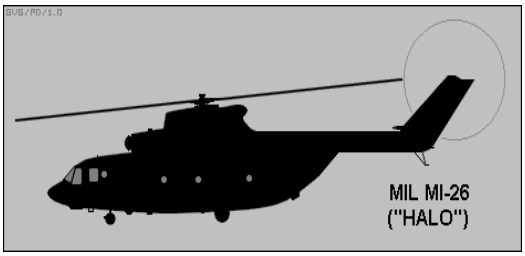
Typical Derrick view. Design needs to be checked

Transportation by AIR

Transportation by AIR is not advisable as the nearest Airport is Pant Nagar below Haldwani and it is not a Major Airport and the reasons as follows.

Only Helicopter mode is possible and it is available with Army. Such Ghat section and the wind effects, such as **density of air, wind direction and wind exposure** area needs to keep in mind for the same. Air at sea level has uniform pressure of 14.7 psi and after, it changes its velocity

The landing area is another issue at ARIES site at 3.6m Telescopic site. At least **700 sqm** landing area is required for the same as per Army requirements, which is practically not possible.



MI-26 Model is required

Specification:		
Main rotor diameter	32 meters	105 feet
Tail rotor diameter	7.61 meters	25 feet
Footprint length	40 meters	131 feet 4 inches
Fuselage length	33.73 meters	110 feet 8 inches
Height to rotor head	8.145 meters	26 feet 9 inches
Empty weight	28,100 kilograms	62,000 pounds
Max loaded weight	56,000 kilograms	123,500 pounds
Maximum speed	295 KPH	185 MPH / 160 KT
Service ceiling	4,600 meters	15,100 feet
Range, fully loaded	800 kilometers	500 MI / 435 NMI

The basic Mi-26 is intended for military transport and available only with Army.

Recommendation:

Hence, considering all aspects and safety of the cargo, recommended by road than By Air mode.

CONCLUSION

Transportation:

1. Cargo as per the dimension given AMOS can be transported with all required civil works in the form of Support/ Breaking of wall etc. However width limitation is upto 5m only, even after doing necessary civil works.

2. Cargo on dismantled conditions will reach site safely. At Bhowali, needs removal of telephone poll and breaking of wall is necessary for cargo having width over 4.1m

3. Route via Bhowali is recommended due to the gradients and up-gradients on the alternate section surveyed via Bhimtal. Critical turnings on 'U' Curve and 'S' Bend will only allow normal open truck and even a trail run is very difficult on this section.

4. Air Transport is not recommended due to the reasons as explained, mainly the landing area at ARIES site and approval from Army.

5. Also recommend a trail run of the maximum width cargo after dismantled condition especially for Mirror.

Erection:

1. Movement of heavy crane and its operation is very difficult considering the Area and bridges enroute**.**

2. Needs to study and derrick system, but limited for 15 Tons lifting or based on the Final packing list.

Documents Required:

1. Final Packing list
2. Dom plan and other relevant drawings for design.

SECTION - VII

PRICE BID

Tender Specification No. AO/3060 / 3-3(4)/08-09

Attention : **The Director**
ARIES, Manora Peak,
Nainital – 263 129
Uttarakhand
Email: sagar@aries.ernet.in

The Financial Proposal is herewith submitted in accordance with the instruction given in Instructions to the Bidder and taking into consideration all terms and conditions in the Tender Specification No. AO/3060/3-3(4)/08-09. I commit my bid / proposal to be bound by this Financial Proposal for carrying out the scope of services as specified in the Tender Specifications.

Sr. No.	Description	Price in Rs.	Service Tax In Rs.
1.	Design, Manufacturing, Installation, Testing and Commissioning of Aluminium Coating Plant for 3.7m Optical Telescope Mirror at Devasthal-Nainital as per scope of work details given in the Tender Specification.		

Place :

Signature of the Bidder

Date : Name of the Bidder _____

Company Seal