भारत सरकार
अंतरिक्ष विभाग
सतीश धवन अंतरिक्ष केंद्र शार
श्रीहरिकोटा रेंज डा.घ. 524 124
श्री पोट्टि श्रीरामुलु नेल्लूर जिला, आं.प्र., भारत
दूरभाष : +91-8623 245060 (6 लं)
फैक्स : +91-8623 222099

सत्यमेव जयते

Goverment of India
Department of Space
Satish Dhawan Space Centre SHAR
Shriharikota Range P.O. 524 124
SPSR Nellore Dist., AP., India
Telephone : +91-8623 245060 (6 Lines)
Fax : +91-8623 222099

निविदा सूचना सं. TENDER NOTICE NO. SDSC SHAR/Sr.HPS/PT/RO-VALF/56/2025-2026

भारत के राष्ट्रपति की ओर से वरि. प्रधान क्रय एवं भंडार, सतीश धवन अंतरिक्ष केंद्र श्रीहरिकोटा निम्नलिखित वस्तुओं के लिए ऑनलाइन निविदाएं आमंत्रित करते हैं/On behalf of President of India, Sr. Head Purchase and Stores, SDSC SHAR, SRIHARIKOTA invites on line quotations for the following: -

क्र.सं. Sl No	संदर्भ सं. Ref. No.	विवरण Description	मात्रा Qty.
01.	**SDSC SHAR /VALF PURCHASE /VALF/ 2025001737 Design Engineering Services for Third Launch Pad Project [Public Tender - Two Part] QCBS Selection Method**	**Design Engineering services for Third Launch Pad**	**01 Lot**

निविदा दस्तावेजों को डाउनलोड करने की अंतिम तिथि Last Date for downloading of tender documents : 22.01.2026 at 16:00 hrs.
ऑनलाइन निविदा जमा करने की अंतिम तिथि Due Date for submission of bids online : 22.01.2026 at 16:30 hrs.
निविदाएं खोलने की नियत तिथि Due Date for opening of tenders : 23.01.2025 at 10:30 hrs.

निविदाकार के लिए निर्देश Instructions to Tenderers:

निविदाएं ईजीपीएस के माध्यम से ही भेजी जाएं तथा कोई निविदा शुल्क लागू नहीं होगा।
Bids shall be submitted on line through EGPS only and No tender fee shall be applicable.

01. कार्य के सम्पूर्ण विवरण/जानकारी तथा नियम व शर्तों इत्यादि के लिए संलग्न अनुलग्नक को देखें। / For full details/scope of work and terms and conditions etc., please see the enclosed annexures.

02. इच्छुक निविदाकार इसरो की ई-खरीद वेबसाइट इसरो न्यू ई-प्रोकुरमेंट www.eproc.vssc.gov.in से ई-निविदा डाउनलोड और अपनी निविदा ई-खरीद पोर्टल पर ऑनलाइन जमा कर सकते हैं। डाक / वाहक / स्वयं द्वारा प्राप्त निविदाओं पर विचार नहीं किया जाएगा। / Interested tenderers can download the e-tender from ISRO e-procurement website ISRO NEW E-PROCUREMENT www.eproc.vssc.gov.in and submit the offer on line in the e-procurement portal. Offers sent physically by post/courier/in person will not be considered.

03. निविदा दस्तावेज इसरो की वेबसाइट www.isro.gov.in इसरो न्यू ई-प्रोकुरमेंट वेबसाइट www.eproc.vssc.gov.in तथा सतीश धवन अंतरिक्ष केंद्र शार की वेबसाइट www.shar.gov.in पर भी उपलब्ध हैं। इन्हें केवल ई-खरीद पोर्टल से डाउनलोड और निविदा ऑनलाइन जमा कर सकते हैं। / Tender documents are also available on ISRO website www.isro.gov.in ISRO New e-procurement website www.eproc.vssc.gov.in and SDSC SHAR, Sriharikota website www.shar.gov.in. The same can be down loaded and offer submitted on line in the new e-procurement portal only.

04. निर्धारित तिथि/समय के पश्चात प्राप्त बोलियों पर विचार नहीं किया जाएगा। / Quotations received after the due date/time will not be considered.

05 निविदा दस्तावेज दिनांक 22.01.2026 को 16:00 बजे तक डाउनलोड करने के लिए उपलब्ध रहेंगे तथा निविदा ऑनलाइन जमा करने की अंतिम तिथि 22.01.2026 को 16:30 बजे तक है। निविदाएं दिनांक 23.01.2026 को 10:30 बजे खोली जाएंगी। / The tender documents are available for download upto 22.01.2026 at 16:00 hrs. and last date for submission of tenders on line 22.01.2026 at 16:30 hrs. and Tender Opening on 23.01.2026 at 10:30 hrs.

06.इच्छुक विक्रेता विवरण जानने के लिए निविदा खोले जाने वाले सत्र में शामिल हो सकते हैं। निविदा के मूल्यांकन पर विचार करने के लिए उनकी उपस्थिति अनिवार्य नहीं है। / Interested vendors can attend the Bid opening sessions to know the details. Presence not mandatory to consider the quote for evaluation.

07. वरि. प्रधान क्रय एवं भंडार, सतीश धवन अंतरिक्ष केंद्र श्रीहरिकोटा के पास किसी भी या सभी निविदाओं को स्वीकार / अस्वीकार करने का अधिकार है। / Sr. Head, Purchase and Stores, SDSC-SHAR, Sriharikota reserves the right to accept or reject any/or all the quotations.

08. GeM ARPTS Report ID: GEM/GARPTS/18112025/35E0SGQCWQCF

दिनांक DT: 22.12.2025

वरि. प्रधान क्रय एवं भंडार
Sr. HEAD PURCHASE AND STORES

GOVERNMENT OF INDIA
DEPARTMENT OF SPACE
SATISH DHAWAN SPACE CENTRE SHAR SRIHARIKOTA (SDSC SHAR)
NELLORE

Tender for Design Engineering Services for Third Launch Pad Project

Bids to be submitted online

Tender No.: SDSC SHAR/VALF PURCHASE/SH202500173701 dated 22-12-2025

A. Tender Details

Tender No :	**SDSC SHAR/VALF PURCHASE/SH202500173701**
Tender Date :	**22-12-2025**
Tender Classification:	**SERVICES**
Purchase Entity :	**VALF PURCHASE**
Centre :	**SATISH DHAWAN SPACE CENTRE SHAR SRIHARIKOTA (SDSC SHAR)**

Design Engineering Services for Third Launch Pad Project

As per tender documents

GEM/GARPTS/18112025/35E0SGQCWQCF

A.1 Tender Schedule

Tender Publish Date :	**22-12-2025 15:05**
Bid Clarification Due Date :	**09-01-2026 10:00**
Bid Submission Start Date :	**22-12-2025 15:05**
Bid Submission Due Date :	**22-01-2026 16:30**
Bid Opening Date :	**23-01-2026 10:30**
Price Bid Opening Date :	**10-03-2026 10:30**

A.2 Pre-bid Meeting Details

Date :	**05-01-2026 10:00**
Place :	**Satish Dhawan Space Centre, Sriharikota (SDSC-SHAR)**
Location :	**SATISH DHAWAN SPACE CENTRE SHAR SRIHARIKOTA (SDSC SHAR), NELLORE, ANDHRA PRADESH**

Centre :	**SATISH DHAWAN SPACE CENTRE SHAR SRIHARIKOTA (SDSC SHAR), NELLORE, ANDHRA PRADESH**
Details :	**Pre-bid meet shall be held on 05.01.2026 (Monday) 10:00AM vide online/offline mode, bidders are requested to send request vide mail for participation in the pre-bid meeting on psovalf@shar.gov.in , sselvan@shar.gov.in on or before 03.01.2026**

B. Tender Attachments

Technical Write-up/Drawings

Document : RFP document

Instructions To Vendors

2. INSTRUCTIONS TO TWO PART TENDER

1. We are proposing to invite Tenders in Two Parts viz., Part-I Techno and Commercial & Part-II Price. All Tenderers are requested to follow carefully the following instructions before preparing their offer.
PART- I- TECHNO COMMERCIAL BID:
(1)This part should contain detailed Specifications of the items quoted by you along with Technical Literature and Leaflets if any.
(2)All the Commercial terms and Conditions applicable also should be indicated separately under separate heads.
(3)The Commercial terms such as delivery terms, delivery period, payment terms, warranty, validity of the offer, Installation & Commissioning, Duties and Taxes etc shall come into this.
(4)Either Technical Specifications or Terms & Conditions as above should be very clearly reflected items wise with reference to the items called for in the tender.
(5)Please note that Prices should not be indicated in this part.
(6)Any deviations from the Technical Specifications and Commercial Terms shall be indicated separately.
PART II-PRICE BID:
(1)The prices applicable for the items, item wise in response to the tender shall come into this part.
(2)Tender shall indicate very clearly item wise prices with reference to their Technical Offer.

Note: 1. PLEASE NOTE THAT THE OFFERS SUBMITTED CONTRADICTORY TO ABOVE INSTRUCTIONS WILL BE LIABLE FOR REJECTION. PLEASE ENSURE OFFERS ARE SUBMITTED WITHIN THE DUE DATE.
2. BEING TWO PART TENDER, WE REQUEST YOU NOT TO DISCLOSE / INDICATE ANY OF THE PRICE VALUE WHILE SEEKING / PROVIDING CLARIFICATION. YOU SHOULD INDICATE ONLY IN PERCENTAGE. IN CASE IF YOU DISCLOSE ANY OF THE PRICE AMOUNT YOUR OFFER WILL BE REJECTED.

3. STANDARD TERMS & CONDITIONS

1. 1. OUR GST NUMBER: 37HYDF00385A1DZ- SDSC SHAR SRIHARIKOTA
2.Email for communication: psovalf(at)shar.gov.in
3.Instruction to Indigenous Suppliers:

A) Payment Terms shall be as specified in RFP. If not specifically mentioned Our Normal payment term is 100 percent within 30 days after receipt and acceptance of the item at our site. Please confirm acceptance in your quotation.
B) Purchase - Price preference to MSEs
Purchase - Price preference will be applicable to the product reservation admissible to the Micro and Small Enterprises. Purchase - Price Preference shall be extended to the MSEs under the Public Procurement Policy for MSEs formulated under the Micro, Small and Medium Enterprises Development Act, 2006. The participating MSEs in a tender, quoting price within the band of L-1 plus 15 percent may also be allowed to supply a portion of the requirement by bringing down their price to the L-1 price, in a situation where L-1 price is from someone other than an MSE. Such MSEs may be allowed to supply up to 25 percent of the total tendered value. In case of more than one such eligible MSE, the supply will be shared equally.
Micro and Small Enterprises which have technical capability to deliver the goods and Services as per prescribed technical and quality specifications and may not be able to meet the qualification criterion relating to prior experience minus prior turnover may be relaxed as per guidelines issued by Ministry of MSMEs and as amended from time to time.
Interested vendors shall specifically claim the benefit with supporting documents.
C) Purchase - Price preference to Make-in-India Products:
Preference shall be given to Class 1 local supplier as defined in public procurement (Preference to Make in India), Order 2017 as amended from time to time and its subsequent Orders - Notifications issued by concerned Nodal Ministry for specific Goods - Products. The minimum local content to qualify as a Class 1 local supplier is denoted in the bid document 50 percent. If the bidder wants to avail the Purchase preference, the bidder must upload a certificate from the OEM regarding the percentage of the local content and the details of locations at which the local value addition is made along with their bid, failing which no purchase preference shall be granted. In case the bid value is more than Rupees 10 Crore, the declaration relating to percentage of local content shall be certified by the statutory auditor or cost auditor, if the OEM is a company and by a practicing cost accountant or chartered accountant for OEMs other than companies as per the Public Procurement (preference to Make-in-India) order 2017 dated 04.06.2020 and amendments thereof. In case Buyer has selected Purchase preference to Micro and Small Enterprises clause in the bid, the same will get precedence over this clause.
D) Instruction to Foreign Suppliers-(if allowed as per RFP)
a) Payment Terms shall be as specified in RFP. If not specifically mentioned Our normal payment term is SIGHT DRAFT, Please confirm acceptance in your offer, if you insist for L - C, and all bank charges shall be to your account. Confirm acceptance.
b) Please specify whether any export clearance is required in case of an order on you.
c) Warranty - Guarantee applicable for the item shall be mentioned in your offer
d) Special Certification for packing Material : as per Plant Quarantine (Regulation of Control into India) Order 2003, Articles packed with packing material of plant origin namely, hay, straw, wood shavings, wood chips, saw dust, wood waste, wooden pallets, Dunn age Mats, wooden packages, coir pith, pear or sphagnum moss etcetera, will be allowed entry by Customs only with a Phytosanitary Certificate. In case of a Purchase Order, if you propose to us any of the above material for packing such a certificate

issued by your local Plant Quarantine Authority shall be furnished.
e) Confirm whether any Export License is required and for which End User Certificate is to be provided by us, in case of an Order on you. (Enclose format for EUC, if applicable)
f) Either Indian Agent on behalf of the foreign principals or the foreign principal directly can quote against this order, but not both. In either case an Indian agent cannot represent more than one principal against the same tender.
g) In case the quote is in INR we prefer to execute the same on HSS Basis and for which Concessional Customs duty as per Notification number 50 - 2017 Customs dated 30.06.2017, Serial Number 539(A) as amended by Notification number 05 - 2018 dated 25.01.2018 and vide Notification No.05-2025 dt.01.02.2025 and 45-2025 dtd 24.10.2025. In case the quote is on Indian Rupee (Outside High Sea Sale), the price shall include taxes and duties if any. We shall not be able to provide any duty or IGST tax exemption - concession certificates. If the item quote is of USA make, please quote for all-inclusive price since we prefer to get the item on FOR destination basis.
h) Any bidder from a country which shares a land border with India will be eligible to bid in any procurement whether of goods, services (including consultancy services and non-consultancy services) or works (including turnkey projects) only if the bidder is registered with Competent Authority as specified in Office Memorandum number F.No.6 - 18 - 2019-PPD, Ministry of Finance, Department of Expenditure, Public Procurement Division dated 23rd July 2020. All the conditions mentioned in the above OM is applicable for this tender.
E) Common terms to Indigenous and foreign suppliers:
a.Warranty
You shall provide applicable warranty for the items offered by you without fail. For the applicable period you shall provide necessary warranty certificate.
b.Performance Bank Guarantee
Towards the performance of the systems during the warranty period you shall submit a performance bank guarantee equivalent to 3 percent of the order value to cover the warranty period. This PBG shall be interest free and the same shall be returned to you on successful completion of all contractual obligations. The said PBG shall have a further claim period of 2 months.
c.Security Deposit
On acceptance of the order, you shall submit an interest free amount equivalent to 3 percent of the total contract - order value towards security deposit. This security deposit is collected towards the performance of the Contract. The said Security Deposit shall be submitted either in the form of Bank Guarantee - Demand Draft - FDR receipts duly endorsed in the name of the centre. The Security Deposit will be returned to you on successful completion of the Contractual obligations; failing which it shall be forfeited - adjusted.
4.Offer Validity
Your offer shall be valid for 180 days in case of 2 part - 90 days in case of single part from the date of tender opening. In case your offer validity is less than the mentioned above, the said offer is liable for rejection which may please be noted.
5. Liquidated Damages:
If you fail to deliver the ordered items satisfactorily within the time specified or any extension thereof, Liquidated Damage at 0.5 percent (zero point five percent) of the order value or part thereof the un-

delivered items for each calendar week of delay shall be recovered from your bill. However total Liquidated Damage shall not exceed 10 percent (ten percent) of the order value.
6.FORCE MAJEURE:
Should a part or whole work covered under this contract be delayed in delivery - completion of work due to reasons of Force majeure which shall include legal lockouts, strikes, riots, civil commotion, fire, accidents, quarantines, epidemic, acts of God and War, stoppage of deliveries by the Government, freight embargoes etcetera; the delivery period - completion of work referred to in this Contract shall be extended by a period not in excess of duration of such Force Majeure. The occurrence shall be notified by either party within reasonable time.
Note:
I.Offers received through post, courier, fax or email will not be considered.
II.Technical and commercial bid (Part-I) shall not contain any price details. Optional accessories or other price details, if any shall be uploaded in Supporting documents related to Price Bid, to be opened along with Price Bid.
III.In respect of FIM being issued, the fabricator shall submit Bank Guarantee for equivalent sum compulsorily. In case, submission of Bank Guarantee is not possible, the reasons there for shall be clearly mentioned. However, for such cases the fabricators at their cost shall secure such FIM through Insurance Policy with Director, SDSC SHAR as beneficiary. In case of PSU and Government Organization, Indemnity Bond in lieu of Bank Guarantee is acceptable. Balance FIM - Scrap, if any shall be returned along with the supply of the items. Please confirm acceptance in your quotation.
IV.SDSC SHAR shall have the right to place part order among the parties for the items for which they are the lowest.
V.TERMS AND CONDITIONS IN THE RFP SHALL PREVAIL OVER OTHER TERMS AND CONDITIONS(in case of any contradiction or ambiguity)

4. General Instructions to Vendor

1. Instructions to tenderers

TeleNo.08623-225174/225127
Fax No.08623-225170/22-5028

e-Mail ID : hps@shar.gov.in, sselvan@shar.gov.in, psovalf@shar.gov.in
1. Interested tenderers may, at their option, login to https://eproc.isro.gov.in and submit your offers.

2. TENDER FEE IS NOT APPLICABLE.

3. EARNEST MONEY DEPOSIT IS NOT APPLICABLE IF NOT MENTIONED IN THE RFP SPECIFICATION.
4. Indian agents while quoting on behalf of their principals are requested to attach Principals original quote, necessary authorization letter from their Principals, copy of agency agreement etc. in their bid.

5. TWO PART BIDS: In case of Two part tender, price details shall not be uploaded in the Technical & Commercial Bids (Part I), failing to which the bid will be treated as INVALID.
6. The offer should be valid for a minimum period of 180 days for 2 part / 90 days for single part from the date of opening.
7. Due date & time: Sufficient time has been allotted for Bid submission. Vendors are requested to complete Bid submission well in advance. Last minute requests for due date extension citing server problems etc. will not be entertained. Bids will not be entertained after the due date and time.

7 (A). Request for the extension of the due date will not be considered.

8.
(a) Bid Opening for Public Tender: In case of Public Tender-Two Part Tenders: Technical and Commercial Bids will be opened on the first day specified for Tender opening. Interested vendors can attend the tender opening session to know the bidding details (Bidders presence is not mandatory to consider the quote for evaluation). Price Bid opening of the selected vendors will be scheduled later and it will be intimated to the selected Bidder (s).

(b) For Limited Tender: Bidders participation is not allowed.

9. Prices are required to be quoted according to the units indicated.

10. Preference will be given to those tenderers offering supplies from ready stocks and on the basis of FOR destination delivery at site.

11. (a) All available technical literature, catalogues and other data in support of the specifications and detail of the items should be furnished as attachments.

(b) Samples, if called for, should be submitted free of all charges by the tenderer and the Purchaser shall not be responsible for any loss or damage thereof due to any reason whatsoever. In the event of non-acceptance of tender, the tenderer will have to remove the samples at his own expense.

(c) Approximate net and gross weight of the items offered shall be indicated in your offer. If dimensions details are available the same should be indicated in your offer.

(d) Specifications: Stores offered should strictly conform to our specifications. Deviations, if any, should be clearly indicated by the tenderer in their quotation. The tenderer should also indicate the Make/Type number of the stores offered and provide catalogues, technical literature and samples wherever necessary. Test certificates wherever necessary should be attached. Whenever options are called for in our specifications, the tenderer should address all such options. Wherever specifically mentioned by us the tenderer could suggest changes to specifications with appropriate response for the same.

12. The purchaser shall be under no obligation to accept the lowest or any tender and reserves the right of acceptance of the whole or any part of the tender or portion of quantity offered and the tenderers shall supply the same at the rates quoted.

13. All amounts shall be indicated both in words as well as in figures. Where there is difference between amounts quoted in words and figures, amount quoted in words shall prevail.

14. The tenderer will be required to furnish a document containing the name of his bankers as well as the latest income-tax clearance certificate duly counter signed by the Income-tax Officer of the Circle concerned under the Seal of his office, if required by the Purchaser.

15. The Purchaser reserves the right to place order on the successful tenderers for additional quantity up to 25% of the quantity offered by them at the rates quoted.

16. Sr. Head, Purchase and Stores, SDSC SHAR SRIHARIKOTA reserves the right to accept or reject any bid in part or full without assigning any reason thereof.

17. Any bidder from a country which shares a land border with India will be eligible to bid in any procurement whether of goods, services (including consultancy services and non-consultancy services) or works (including turnkey projects) only if the bidder is registered with Competent Authority as specified in Office Memorandum no.F.No.6/18/2019-PPD, Ministry of Finance, Department of Expenditure, Public Procurement Division dated 23rd July 2020. All the conditions mentioned in the above OM is applicable for this tender.

C. Bid Templates

C.1 Technical Bid - Design Engineering Services for Third Launch Pad Project

1. CONSULTANCY SERVICES
Design Engineering services for Third Launch Pad as per scope, specifications, services, terms & conditions mentioned in Part-A & B of the tender document.

Item specifications for CONSULTANCY SERVICES
Design Engineering services for Third Launch Pad as per scope, specifications, services, terms & conditions mentioned in Part-A & B of the tender document.

Sl No	Specification	Value	Compliance	Offered Specification	Remark
1	Design Engineering Services for Third Launch Pad as per enclosed specification document	1 lot	Yes / No / Explain		

Supporting Documents required from Vendor

1. Bidder complaince to Scope of Bidder / Design Consultant in pg:34 in RFP

2. Bidder complaince to Part-A: Instruction to Bidder / Design Consultants and General Terms & Conditions

3. 3) Duly filled, signed and stamped any other documents related to "unpriced techno-commercial part" of RFP

4. 2) Duly filled, signed and stamped any other documents related to "unpriced techno-commercial part" of RFP

5. 1) Duly filled, signed and stamped any other documents related to "unpriced techno-commercial part" of RFP

6. Duly filled, signed and stamped "Main covering letter" as mentioned in RFP

7. Duly filled, signed and stamped "Annexure –XII: Exceptions and deviations" as mentioned in RFP

8. Duly filled, signed and stamped "Annexure –XI: Confidentiality & Non-Disclosure Agreement Format" as mentioned in RFP

9. Duly filled, signed and stamped " Annexure –X: Declaration Regarding Clean Track" as mentioned in RFP

10. Duly filled, signed and stamped "Annexure –IX: Format of Curriculum Vitae (CV) of Manpower" as mentioned in RFP

11. Duly filled, signed and stamped "Annexure –VIII: Details of Softwares & Equipment available with Design consultant" as mentioned in RFP

12. Duly filled, signed and stamped "Annexure –VII: Performance Report of Works" as mentioned in RFP

13. Duly filled, signed and stamped "Annexure –VI: Details of the Works Completed" as mentioned in RFP

14. Solvency Certificate as per "Annexure –V: Solvency Certificate Format" as mentioned in RFP

15. Duly filled, signed and stamped "Annexure –IV: Financial Capacity of Design consultant" as given in RFP

16. Duly filled, signed and stamped "Annexure –III: Details of Company / Firm" as mentioned in RFP

17. 2) Documents as requested in "Annexure –II (b): Evaluation Criteria" of RFP

18. 1) Documents as requested in "Annexure –II (b): Evaluation Criteria" of RFP

19. Duly filled, signed and stamped "Annexure –II (b): Evaluation Criteria" as given in RFP

20. 2) Documents as requested in "Annexure –II (a): Minimum Qualification Criteria" of RFP

21. 1) Documents as requested in "Annexure –II (a): Minimum Qualification Criteria" of RFP

22. Duly filled, signed and stamped "Annexure –II (a): Minimum Qualification Criteria" as given in RFP

23. Duly filled, signed and stamped "Annexure –I(c): Providing Additional Design Engineering Services" as given in RFP (Price Bid Related)

24. Duly filled, signed and stamped "Annexure –I(b): Detailed Price Break-up Format" as given in RFP (Price Bid Related)

25. Duly filled, signed and stamped "Annexure – I (a): Format for Schedule of Prices" as given in RFP (Price Bid Related)

26. Bid letter along RFP document (without price) duly signed and stamped as token of acceptance

27. UDAYM Certificate if claiming MSE Purchase Preferences

5 additional documents can be uploaded by the vendor

C.2 Commercial Terms / Bid

Sl. No.	Description	Compliance	Vendor Terms
1	Please confirm here whether your quoted "UNIT PRICE" in our Price Bid is EXCLUDING GST or INCLUDING GST. ------------ NOTE: If you are not clearly stating "GST is Inclusive OR Extra in basic cost" it will be treated as "GST is included in the quoted Basic/Unit cost in the price bid". Your offer will be evaluated as INCLUSIVE OF GST.	Yes / No / Explain	
2	Delivery Schedule: As per para no. 24 of PART-A of RFP	Yes / No / Explain	
3	DELIVERY TERM: Free on site at SDSC SHAR, Sriharikota	Yes / No / Explain	
4	FORCE MAJEURE: If at any time during the continuance of the order the performance in whole or part by either party of any obligation under this order shall be prevented or delayed by reasons of any war, hostility, acts of public enemy, civil commotion, sabotage, fire, floods, lightening, epidemic, quarantine restrictions, strikes, go-slow, lockout or acts of God, notice of which is given either party to the other within 21 days from the date of occurrence thereof, neither party shall be reasons of such eventually be entitled to terminate this order nor shall either party have any claim for damages against the other in respect of such non-performance or delay in performance.	Yes / No / Explain	

5	VALIDITY OF OFFER: - Bid shall remain valid for acceptance for a period of Four months from the due date of submission of the Bid. The Bidder / Design Consultant shall not be entitled during the said period to revoke or revise his Bid or to vary the Bid except and to the extent required by SDSC SHAR in writing. Bid shall be revalidated for extended period as required by SDSC SHAR in writing. In such cases, unless otherwise specified, it is understood that validity is sought and provided without varying either the quoted price or any other terms and conditions of Bid finalized till that time.	Yes / No / Explain	
6	PAYMENT TERM : As per para no. 22 & 23 of PART-A of RFP. Please clearly indicate option of your payment. In case of Advance payment option indicated in the above para, please note the following: 1. The rate of interest shall be loaded on option of advance by the bidder for evaluation. 2. After release of advance payment, any delay attributable to the contractor in effecting the delivery schedule after prescribed delivery period, interest will be levied beyond the specified delivery period on the amount of balance advance payments as per the Prime Lending Rate of RBI. 3. In case of non-performance/poor performance, advance payment shall be recovered from contractor with interest as per the Prime Lending Rate of RBI along with 2% penal interest from the date of release of advance payment and the BG against advance payment shall be forfeited.	Yes / No / Explain	

7	Bank Guarantee Clause for Advance Payment : Before release of advance payment, You have to provide Advance Bank Guarantee for 10% of the PO value in prescribed format from a scheduled bank in Rs. 100-00 non judicial stamp paper valid till the completion of all contractual obligations plus sixty days. BG will not carry any interest and it will be returned to you once the Purchase Order / Contractual obligation is successfully executed. In case of non-performance / poor performance, the BG shall be forfeited and advance payment shall be recovered from supplier with interest as per the Prime Lending Rate of RBI along with 2% penal interest from the date of release of advance payment. Note: In case of extension of delivery period, the validity of BG shall be validated accordingly.	Yes / No / Explain	
8	Police Verification : The Contractor would be required to provide verification report from the local police authorities within one month from the date of receipt of the order, duly certifying the verification of the Character & Antecedents for each of the work force engaged by the contractor for executing the work.	Yes / No / Explain	
9	PENALTY CLAUSE/LIQUIDATED DAMAGE: Please refer the para no. 25 & 26 of PART-A of RFP	Yes / No / Explain	

10	Security Deposit (SD): Security Deposit (SD) 3% value of the order shall be deposited with SDSC on Rs.100/- Non Judicial Stamp paper in the form of bank guarantee/DD/FDR from a Scheduled/Nationalized Bank towards the satisfactory completion/successful execution of the purchase order/contract within 10 days of release of PO and shall be valid till satisfactory completion/successful execution of the purchase order/contract plus SIXTY days. SD will not carry any interest and it will be returned to you once the Purchase Order / Contractual obligation is successfully executed. In case of non-performance / poor performance, the Security Deposit shall be forfeited. If you are not submitting the SD within the stipulated period, this PO liable to be cancelled in addition to any other action against you.	Yes / No / Explain	
11	INCOME TAX: Income Tax at the prevailing rate as applicable from time to time shall be deducted from the successful Bidders bill as per the Income Tax Act, 1961 and the rules there-under or any re-enactment or Modifications thereof.	Yes / No / Explain	
12	The Contractor should comply all Labour Laws, Minimum Wages Act, Payment of Employees Provident Fund and ESI/Insurance under workmen Compensation Act and other laws applicable from time to time.	Yes / No / Explain	
13	Please provide an undertaking for the compliance of all Labour Laws as applicable from time to time including Minimum Wages Act, Payment of ESI/ EPF/ GST etc.	Yes / No / Explain	
14	The Contractor shall employ Indian Nationals above age of 18 years only.	Yes / No / Explain	

15	ARBITRATION:- The Contract shall be interpreted, construed and governed by the Laws in India. In the event of any dispute/s, difference/s or claim/s arising out of or relating to the interpretation and application of the Consultancy services contract(s), such dispute/s or difference/s or claim/s shall be settled amicably by mutual consultations of the good Office of the respective Parties and recognizing their mutual interests attempt to reach a solution satisfactory to both the parties. If such a resolution is not possible, within 30 days from the date of receipt of written notice of the existence of such dispute/s, then the unresolved dispute/s or difference/s or claim/s shall be referred to the Sole Arbitrator appointed by the Parties by mutual consent in accordance with the rules and procedures of Arbitration and Conciliation Act 1996 as amended from time to time. The arbitration shall be conducted in Bengaluru in the Arbitration and Conciliation Centre - Bengaluru (Domestic and International) as per its rules and regulations. The expenses for the Arbitration shall be shared equally or as may be determined by the Arbitrator. The considered and written decision of the Arbitrator shall be final and binding between the Parties. The applicable language for Arbitration shall be English only.	Yes / No / Explain	

16	Purchase preference to Micro and Small Enterprises (MSEs): Purchase preference will be given to MSEs as defined in Public Procurement Policy for Micro and Small Enterprises (MSEs) Order, 2012 dated 23.03.2012 issued by Ministry of Micro, Small and Medium Enterprises and its subsequent Orders/Notifications issued by concerned Ministry. If the bidder wants to avail the Purchase preference, the bidder must be the Service provider of the offered Service.Relevant documentary evidence along with UDYAM REGISTRATION in this regard shall be uploaded along with the bid in respect of the offered product or service. If L-1 is not an MSE and MSE Seller (s) has/have quoted price within L-1 plus 15% (Selected by Buyer) of margin of purchase preference/price band defined in relevant policy, such Seller shall be given opportunity to match L-1 price and shall be evaluated as per QCBS formula as mentioned in the RFP. Please note that there is no relaxation on prior experience and turnover criteria.	Yes / No / Explain	
17	Are you claiming MSME Preference for this tendered service? Note: You should have been the service provider of the offered product as per your MSME Registration. (If YES, valid Udyam Registration documents shall be uploaded. Otherwise your claim will not be considered. False declarations will be in breach of the Code of Integrity under Rule 175(1)(i)(h))	Yes / No / Explain	
18	Please provide valid/currently using E-mail Id & Contact no. for seeking further clarifications if any.	Yes / No / Explain	
19	NOTE: As the selection criteria of the bidders are based on QCBS basis, hence all the bidders have to comply with qualification criteria as mentioned in Annexure-II (a) and II (b) of RFP. There is no relaxation on prior experience / turnover criteria for any category of the bidders during techno-commercial evaluation.	Yes / No / Explain	

20	Please go through the RFP attached with the tender. Bidder shall strictly adhere to all terms and condition including scope of contract laid down in the attached RFP. Terms & Conditions mentioned in the RFP shall prevail.	Yes / No / Explain	
21	The bidder shall provide compliance to Order No. F.No.7/10/2021 PPD dated 23.02.2023 and amendments thereof by Ministry of Finance, Department of Expenditure, Public Procurement Division regarding restrictions on procurement from a bidder of a country which shares a land border with India and comply to all the provisions of the Order. In this regard, you shall certify that the bidder entity is not from such a country or, is from such a country, has been registered with the Competent Authority.	Yes / No / Explain	
22	Remarks, if any	Yes / No / Explain	

C.3 Price Bid

Sl. No.	Item	Quantity	Unit Price	Currency	Total Price	Remark
1	CONSULTANCY SERVICES Design Engineering services for Third Launch Pad as per scope, specifications, services, terms & conditions mentioned in Part-A & B of the tender document.	1.00 Lot		-		

REQUEST FOR PROPOSAL DOCUMENT

for

Design Engineering Services
for
Third Launch Pad

Third Launch Pad (TLP) Project

Satish Dhawan Space Centre (SDSC)

Indian Space Research Organization

SHAR, Sriharikota Range PO - 524 124

Tirupathi District, Andhra Pradesh

CONTENTS

Nomenclature

AC	Air Conditioning
ACB	Air Circuit Breaker
AcoSS	Acoustic Suppression System
ACS	Air Conditioning Systems
AHU	Air Handling Unit
AI/DI	Analog Input/Digital Output
ALS	Automatic Launch Sequence
APL	Advanced Physical Layer
BOQ	Bill Of Quantities
BT road	Bituminous Road
CDR	Conceptual Design Review
CFD	Computational Fluid Dynamics
CGSS	Compressed Gas Service System
DCPS	DC Power Supply
DD	Demand Draft
DDC	Distributed Discrete Control
DDR	Detailed Design Review
DG	Diesel Generator
EOT	Electrically Operated Overhead Travel
EPS	Emergency Power Supply
EVU	End Valve Units
FAT	Factory Acceptance Test
FCC	Filling Control Center
FEM	Finite Element Analysis
FFL	Finished Floor Level
FLP	Flame Proof Panel
FMECA	Failure Modes Effects And Cause Analysis
FO cable	Fibre Optical Cable
FRP	Fibre Reinforced Polymer
GA	General Arrangement
GHe	Gaseous Helium
GLR	Ground Level Reservoir
GMe	Gaseous Methane
GN2	Gaseous Nitrogen
GPS	Global Positioning System
GRP	Glass Reinforced Polymer
GSS	Gas Service System
HART	Highway Addressable Remote Transmission
HAZOP	Hazard And Operability Study
HEPA	High efficiency particulate filter
HMI	Human Machine Interface
HP/LP/OP	High Pressure/Low Pressure/Operating Pressure
HT/LT/MV	High Tension/Low Tension/Medium Voltage
HV	High Voltage
HVAC	Heating Ventilation And Air Conditioning
I/O	Input/output
ICAO	International Civil Aviation Organization
ICS	Instrumentation & Control System

IISc	Indian Institute Of Science
IIT	Indian Institute Of Technology
iMCC	Intelligent Motor Control Center
IOP	Ignition Over Pressure
JB	Junction Box
JDD	Jet Deflector Duct
LCP	Local Control Panel
LD	Liquidate Damages
LDB	Light Distribution Board
LED/LCD	Light Emitting Diode/Liquid Crystal Display
LH2	Liquid Hydrogen
LHFS	Liquid Hydrogen Filling System
LHRS	Launch Hold And Release System
LIDAR	Light Detection And Ranging
LMFS	Liquid Methane & Filling System
LN2	Liquid Nitrogen
LOFS	Liquid Oxygen Filling System
LOX	Liquid Oxygen
LPS	Lightning Protection System
LPT	Lightning Protection Tower
LV	Launch Vehicle
LV-01	Launch Vehicle-01
LV-02	Launch Vehicle-02
MCB	Miniature Circuit Breaker
MCCB	Moulded Case Circuit Breaker
MEP	Mechanical Electrical & Process
MLP	Mobile Launch Pedestal
MV&LT	Medium Voltage & Low Tension
MVP	Medium Voltage Panel
NDT	Non Destructive Testing
NGLV	Next Generation Launch Vehicle
NIF	NGLV Integration Facility
NSB	NGLV Service Building
NSB-F	NGLV Service Building - Fuel
NSB-O	NGLV Service Building - Oxidizer
NSS	Nitrogen Supply System
NTP	Network Time Protocol
OEM	Original Equipment Manufacturer
OHT	Over Head Tank
P&ID	Piping and Instrumentation Diagram
PBU	Pressure Build Up Units
PDB	Power Distribution Board
PDR	Preliminary Design Review
PLC	Programmable Logic Control
PMLP	Primary Mobile Launch Pedestal
PO	Purchase Order
QAP	Quality Audit Plan
QRA	Qualitative Risk Assessment
RCC	Reinforced Cement Concrete
RFP	Request For Proposal

RIO	Remote Input Output Panel
RPOP	Remote Power On Panels
RRU	Remote Regulation Unit
RTD	Resistance Temperature Detector
RWM	Remote Water Monitor
SAT	Site Acceptance Test
SAU	Single Action Unit
SDD	SCADA Design Document
SLD	Single Line Diagram
SMLP	Secondary Mobile Launch Pedestal
SNPS	Safety Nitrogen Purge System
SPD	Surge Protection Device
SPTA	Spares and Tools
SPU	Self-Propelled Unit
SRD	System Requirement Document
SRS	Software Requirement Specification
SS	Stainless Steel
SVAB	Second Vehicle Assembly Building
SWL	Safe Work Load
TDS	Tax Deducted At Source
TLP	Third Launch Pad
TSB	Technical Service Building
TUT	Tiltable Umbilical Tower
UPS	Uninterrupted Power Supply
URD	User Requirement Document
UT	Umbilical Tower
VCR	Valve Chamber Room
VCR-F	Valve Chamber Room - Fuel
VCR-O	Valve Chamber Room - Oxidizer
VFD	Variable Frequency Driver
VVVF	Variable Voltage Variable Frequency
2D	Two Dimensional
3D	Three Dimensional

Bid Submission Details
“Request for Proposal”

Title

“Design Engineering Services” for Third Launch Pad

Brief about “Request For Proposal”

1) Indian Space Research Organisation, Satish Dhawan Space Centre, Sriharikota proposes to establish “Third Launch Pad” at SDSC SHAR, Sriharikota.

2) The brief scope of work includes,

- ✓ Development of Conceptual design, Preliminary design, preparation of tender specification documents and detailed design of civil, electrical/electronics, AC, mechanical and control systems related to Third Launch Pad systems and technical support during realization of systems as mentioned in this document.

3) The RFP includes the following documents:

3.1) **Part-A:** Instructions to Bidder / Design consultants and General Terms & Conditions

Contains General Information and Instructions for the Bidder / Design consultants about the RFP and also Standard Conditions of RFP, which will form part of the Contract with the successful Design consultant

3.2) **Part-B:** Scope of Work and System Description

Essential details of items/ services required, such as Bidder /Design consultant scope of work, department scope of work, technical specifications

3.3) **Part-C:** Bidder Evaluation Formats

Contains Evaluation Criteria and Annexure

4) The invitation of tender is open to all firms registered in India who are interested in bidding for the project.

5) Joint ventures and consortium etc, will not be accepted.

6) This RFP is being issued with no financial commitment and the Buyer reserves the right to change or vary any part thereof at any stage. Buyer also reserves the right to withdraw the RFP, should it become necessary at any stage.

7) Proposals are invited from the interested Bidders / Design consultants for the enclosed scope of work in two-part bid. Part-1 technical and unpriced part of the work and Part-2 Priced commercial part.

8) The address and contact numbers for seeking clarifications regarding this RFP are given below –

(a)	Bids/queries to be addressed to	Purchase& Stores Officer, VALF
(b)	Postal address	Satish Dhawan Space Centre SHAR, ISRO, Dept. of Space, Govt. of India, Sriharikota – 524124, Tirupathi Dist, Andhra Pradesh
(c)	Designation of the contact personnel	Purchase& Stores Officer, VALF
(d)	Telephone numbers of the contact personnel	08623-22 6082/6274/5127
(e)	e-mail ids of contact personnel	psovalf@shar.gov.in

9) BID SUBMISSION

Bids duly filled in by the Bidder / Design Consultant should invariably be submitted in the following manner,

PART – I : UNPRICED TECHNO-COMMERCIAL PART OF THE BID FOR THE WORK

Complete Techno–commercial part of the bid shall be filled online in the "Specified Terms" form of the e-tender. Any documents related to technical literature and any other document as per the tender shall be scanned and uploaded to the e-tender under "Documents solicited from bidder" form only in ISRO e-procurement portal (https://eprocure.isro.gov.in). SDSC SHAR may open Part-I of the bid on the stipulated date. Initially vendors will be qualified based on "Minimum Qualification Criteria" (MQC) and then "MQC" qualified vendors will be evaluated based on Technical bids for further processing.

Technical and unpriced commercial bid Part-I shall comprise the attachments, specifying attachment number arranged in the order as follows:

(a) Work completion certificates of similar qualifying design engineering works.

(b) Submission of bid letter along with one set of proposal document (RFP) duly signed and stamped as token of acceptance

(c) All the annexures/forms enclosed in proposal duly filled, signed and sealed

(d) ***Unpriced copy of schedule of prices*** with all other commercial terms, taxes, duties, exemption certificates and conditions duly filled (Prices to be kept blank), signed and stamped

(e) Last three years IT returns.

(f) Any other relevant document, Bidder / Design Consultant desires to submit.

PART – II : PRICE PART OF THE BID FOR THE WORK

Price bid shall be filled in the on-line 'price bid' form of the e-tender only in ISRO e-procurement website https://eprocure.isro.gov.in.

The price schedules shall be uploaded on-line in the respective forms along with the price bid in the e-portal.

a) Price Bids (Part-II) of technically and commercially acceptable offers shall be opened at a later date.

b) The rate quoted shall be FREE ON-SITE at SDSC SHAR, Sriharikota basis.

c) If the offers submitted by the bidders are silent on taxes, it will be presumed that quoted rates are inclusive of taxes & duties and no claim in this regard will be entertained later.

d) SDSC SHAR reserves the right to reject any or all the Bids without assigning any reasons thereof.

e) ***Any bids/offers with price details in Techno-Commercial Offer (Part –I) shall be rejected.***

10) Bidder Evaluation Procedure:

a) The bidders qualifying the “Minimum Qualification criteria” (as mentioned in Annexure-II(a)) will be evaluated further in QCBS (Quality cum Cost Based Selection) method (as mentioned in Annexure-II(b)) on the basis of details furnished by bidders. The evaluation would consist of the following stages:

Stage-1: Evaluation of Technical Bids: Technical marks of bidders will be arrived in this stage. Bidders shall achieve a minimum of 60 Technical marks for proceeding to Stage-2 (i.e evaluation of financial proposal). Technical score of bidder will be computed.

Stage-2: Evaluation of Financial Bids: In this stage, bidders will be evaluated based on quoted price. Each bidder shall be ranked based on their quoted price and a Financial score will be given.

b) The Technical score (S_t) and Financial score (S_f) will be calculated for bidders as mentioned in Annexure-II (b). Based on these scores, the Combined score (Sc) of the bidder will be calculated as mentioned in Annexure-II (b) and the proposal with the highest combined core(S_c) shall be considered for issuing purchase order.

c) In case of any discrepancy in the self-assessed marks by bidder and that awarded by Department on QCBS (Quality cum Cost Based Selection) method, the marks awarded by the department will be final and binding.

PART-A

Instruction to Bidder / Design consultants and General Terms & Conditions

Part-A: Instruction to Bidder / Design Consultants and General Terms & Conditions

S.No	Description	Bidder / Design Consultant Compliance
1.	**Prices quoted should be on the basis of FREE ON-SITE at SDSC SHAR**. The Bidder / Design Consultant shall bear all costs associated with the preparation and submission of its bid and SDSC SHAR will, in no case, be responsible or liable for those costs, regardless of the conduct or outcome of the bid process	
2.	**Site Visit:** Bidder / Design Consultant may visit the site for understanding the works involved before submitting the offer. Claims and objections due to ignorance of existing conditions or inadequacy of information shall not be considered after submission of the Bid and during implementation. Request for site visit shall be made through e-mail giving the details of name of the person and ID.	
3.	**Pre-Bid Meeting:** Pre-bid meeting shall be convened at SDSC SHAR or ISRO, Chennai Guest House. Attending pre-bid meeting is not mandatory. Considering vast scope of work, Department prefers bidders to attend pre-bid meeting, for better understanding the requirements and clarification to their queries. Bidder / Design Consultants may participate in the pre-bid meeting and get any clarifications instantaneously. The Pre-Bid meeting will be held in Hybrid mode (Online mode or Offline mode). However, offline mode is preferred. Bidder / Design Consultant shall intimate the preferred mode of attending the pre bid meeting through mail at least two days in advance before the pre- bid meeting schedule. Please contact the following officer regarding the details of pre-bid meeting Purchase & Stores Officer, VALF e-mail: psovalf@shar.gov.in	
4.	**Consultancy Services:** The Contract is purely a Consultancy Service intended for carrying-out all the works enlisted under the scope of work and at no stage this should be construed as a LABOUR CONTRACT.	
5.	Submission of bid shall be deemed to have been done after careful study and examination of the bid document with full understanding of its implications	
6.	Bidder / Design Consultants are neither allowed to join hands or nor allowed to submit multiple bids. In case of detection of such cases,	

S.No	Description	Bidder / Design Consultant Compliance
	their bid (s) is/are liable to be rejected.	
7.	SDSC SHAR reserves the right to award the work, modify / cancel the award without assigning any reason	
8.	The Bidder / Design Consultant has to adhere to the time schedule of activities mentioned in the Bid and no request to change the last date or extend period/time for submission shall be entertained by SDSC-SHAR. However, SDSC SHAR reserves the right to extend the date/time for submission of the responses without assigning any reason by notifying in its website.	
9.	**Right to Termination/Cancellation**: Notwithstanding anything contained in this document, SDSC SHAR, reserves the right to cancel/terminate the bid/offer process without assigning any reason whatsoever, at anytime, prior to signing the contract and shall have no liability for above mentioned actions	
10.	**Authentication of Bid:** The Bid document should be typed and there should not be any overwriting or cutting or interpolation. Signatures and official stamp of Bidder / Design Consultant's authorized person should be put at the bottom on each page of the bid document. The Bid Document shall be signed by a person duly authorized to bind the organization to the Contract. A duly stamped and notarized Power-of-Attorney accompanying the Bid Document shall support the letter of authorization.	
11.	**Late Bids:** Any Bid received by SDSC SHAR after the deadline for submission of Bids prescribed in this document, will be summarily rejected and returned unopened to the Bidder / Design Consultant. SDSC SHAR shall not be responsible for any delay. No further correspondence on this subject will be entertained.	
12.	**Opening of Bids:** SDSC SHAR will open Technical Bids as per schedule. The Bidder / Design Consultant may depute his/their authorized representative for the event. The Bidder / Design Consultant's representative who is present shall sign the attendance roll evidencing his/her attendance. Even if no representative of the Bidder / Design Consultant is available, the Bids would be opened as per schedule. In the event of the specified date of Bids opening/presentation being declared a holiday for SDSCSHAR, the Bids shall be opened at the appointed time and location on the next working day.	
13.	**Clarification of Bids:** To assist in the examination, evaluations and comparison of bids, SDSC SHAR may, at its sole discretion, ask the	

S.No	Description	Bidder / Design Consultant Compliance
	Bidder / Design Consultant for clarification on the Bid submitted. The request for clarification shall be through EGPS or email. The response shall be submitted through EGPS or by email duly signed by authorized representative.	
14.	**Completeness of Bids:** SDSC SHAR will examine the Bids to determine whether they are complete, whether they meet all the conditions of the Tender Document and Technical Specifications, whether any computational errors have been made, whether required sureties have been furnished, whether the documents have been properly signed and whether the Bid Documents are substantially responsive to the requirements of the Bid Document. Information must be furnished in comprehensive manner against each column of Bid Document.	
15.	**Rectification of Errors:** No requests regarding correction of mistakes in the financial bids will be entertained. Arithmetic errors in bids will be considered as follows: (a) Where there is a discrepancy between the amounts in figures and in words, the amount in words shall govern. (b) Notwithstanding the above, the decision of the Evaluation Committee shall be final and binding.	
16.	**Rejection of Bids:** The Bid shall be submitted duly filled by downloading Bid document from website. Bids submitted by Fax or e-Mail would not be entertained. Bid may be rejected at any stage of the evaluation if it is found that the company has provided misleading information or has been blacklisted by a Central or any State Government or has indulged in any malpractice/ unethical practice and has not honoured contractual obligation elsewhere. If the Bidder / Design Consultant deliberately gives incorrect or misleading information in their tender or wrongfully creates circumstances for the acceptance of the tender, SDSCSHAR reserves the right to reject such a bid at any stage.	
17.	**OFFER VALIDITY:** Bid shall remain valid for acceptance for a period of ***Four months*** from the due date of submission of the Bid. The Bidder / Design Consultant shall not be entitled during the said period to revoke or revise his Bid or to vary the Bid except and to the extent required by SDSC SHAR in writing. Bid shall be revalidated for extended period as required by SDSC SHAR in writing. In such cases, unless otherwise specified, it is understood that validity is sought and provided without varying either the quoted price or any	

S.No	Description	Bidder / Design Consultant Compliance
	other terms and conditions of Bid finalized till that time.	
18.	**GST:** Applicable shall be indicated separately in schedule of prices and Bidder / Design Consultant specified terms during the submission of online bids.	
19.	**INCOME TAX:** Income tax at the prevailing rate as applicable and if applicable from time to time shall be deducted from the supplier's bills as per Income Tax Act. and a certificate issued (TDS Certificate)	
20.	**Definition of Milestone:**	

Milestone	Description of milestone
Milestone-1	Completion of **Phase-I i.e "Conceptual and Preliminary design"** as per the scope given in document "Part-B: Scope of Work & System Description"
Milestone-2	Completion of **Phase-II i.e "Critical Design/ Detailed Design/ Engineering & Fabrication Drawing Preparation"** as per the scope given in document "Part-B: Scope of Work & System Description"
Milestone-3	Completion of **Phase-III i.e "Preparation of Tender Specification Documents Based on Preliminary Design/ Critical Design"** as per the scope/specifications given in document "Part-B: Scope of Work & System Description"
Milestone-4	Completion of **Phase-IV i.e "Certification of Design Changes During Fabrication/ Manufacturing"** as per the scope/specifications given in document "Part-B: Scope of Work & System Description"

S.No	Description	Bidder / Design Consultant Compliance
21.	**TERMS OF PAYMENT:** General guideline terms of payments are as indicted below. Any deviation to these payment terms to be brought out. If the contract is terminated / delayed due to default of the Bidder / Design Consultant, the advance payment would be deemed as an interest-bearing advance at the interest rate (e.g., the interest rate of the MCLR of RBI) prevailing on the date of release of advance payment, plus 2% to be compounded quarterly.	
22.	**SCHEDULE OF PAYMENT** • The system wise milestone based payments shall be regulated/calculated based on the prices indicated in the Annexure –I(b): Detailed Price Break-up Format. • Bidder / Design Consultant may choose either Option-1 or Option-2	

S.No	Description	Bidder / Design Consultant Compliance
	• Incase advance payment is requested by Bidder / Design Consultant, interest as per MCLR of RBI shall be loaded on advance portion for arriving financial score (S_f). • All the payment shall be certified by PM-TLP, recommended by APD-TLP and approved by PD-TLP to enable the payment. **Option-1: With Advance:**	

Payment (percentage of PO value)	Value
10% (Basic value)	Advance against submission of bank guarantee for an equal amount from a reputed nationalized/scheduled bank and shall be valid till Contract completion period. Format of Bank guarantee shall be obtained from Department after award of contract
20%	Pro-rata basis against **completion of Milestone-1** of the following systems along with GST (including GST on advance): Launch Pad Systems, Process System Infra, Air Conditioning & Vehicle Cool Air system, ACOSS System, Safety Systems and Support Systems
30%	Pro-rata basis against completion of **completion of Milestone-2** of the following systems along with GST: Launch Pad Systems, Process System Infra, Air Conditioning & Vehicle Cool Air system, ACOSS System, Safety Systems and Support Systems
30%	Pro-rata basis against completion of **completion of Milestone-3** of the following systems along with GST: Launch Pad Systems, Process System Infra, Air Conditioning & Vehicle Cool Air system, ACOSS System, Safety Systems and Support Systems
10%	Lumpsum value along with GST against completion of **Milestone-4** as per the scope given in the RFP

<table>
<tr><th>S.No</th><th>Description</th><th>Bidder / Design Consultant Compliance</th></tr>
<tr><td></td><td>
Option-2: Without advance
<table>
<tr><th>Payment (percentage of PO value)</th><th>Value</th></tr>
<tr><td>30%</td><td>Pro-rata basis against completion of completion of Milestone-1 of the following systems along with GST:

Launch Pad Systems, Process System Infra, Air Conditioning & Vehicle Cool Air system, ACOSS System, Safety Systems and Support Systems</td></tr>
<tr><td>30%</td><td>Pro-rata basis against completion of completion of Milestone-2 of the following systems along with GST:

Launch Pad Systems, Process System Infra, Air Conditioning & Vehicle Cool Air system, ACOSS System, Safety Systems and Support Systems</td></tr>
<tr><td>30%</td><td>Pro-rata basis against completion of completion of Milestone-3 of the following systems along with GST:

Launch Pad Systems, Process System Infra, Air Conditioning & Vehicle Cool Air system, ACOSS System, Safety Systems and Support Systems</td></tr>
<tr><td>10%</td><td>Lumpsum value along with GST against completion of Milestone-4 as per the scope given in the RFP</td></tr>
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</td><td></td></tr>
<tr><td>23.</td><td>
Advance Payment:
a) It is to be noted that interest as per MCLR of RBI shall be loaded on advance portion for arriving financial score (S_f).
b) 10% of PO as advance after acceptance of PO and against submission of Bank Guarantee for an equivalent amount from nationalized/scheduled bank and shall be valid till Contract completion period plus 60 days. Format of Bank guarantee shall be obtained from Department after award of Contract.
c) In case of advance payments, if the Bidder / Design Consultant is not completing the milestones within the delivery schedule, the advance amount will be recovered immediately <u>after contract completion period</u> and interest will be levied as per the Marginal Cost of Lending Rate (MCLR) of RBI plus 2% penal interest.
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<tr><th>S.No</th><th>Description</th><th>Bidder / Design Consultant Compliance</th></tr>
<tr><td>24.</td><td>

DELIVERY SCHEDULE:

<table>
<tr><th>Milestone</th><th>Deliverable</th><th>Duration</th><th>Scope</th></tr>
<tr><td>T0</td><td>Release of Order</td><td>--</td><td>Department</td></tr>
<tr><td>T1</td><td>Submission of inputs</td><td>T0+10days</td><td>Department</td></tr>
<tr><td>T2</td><td>Completion of Conceptual Design under Milestone-1</td><td>T1+45days</td><td>Bidder / Design Consultant</td></tr>
<tr><td>T3</td><td>Dept. clearance for Conceptual Design</td><td>T2+10days</td><td>Department</td></tr>
<tr><td>T4</td><td>Completion of Preliminary Design under Milestone-1</td><td>T3+90days</td><td>Bidder / Design Consultant</td></tr>
<tr><td>T5</td><td>Dept. clearance for Preliminary Design</td><td>T4+15days</td><td>Department</td></tr>
<tr><td>T6</td><td>Completion of Milestone-2</td><td>T5+150days</td><td>Bidder / Design Consultant</td></tr>
<tr><td>T7</td><td>Completion of Milestone-3</td><td>T5+30days</td><td>Bidder / Design Consultant</td></tr>
<tr><td>T8</td><td>Completion of Milestone-4</td><td>T7+ 43 months</td><td>Bidder / Design Consultant</td></tr>
</table>

</td><td></td></tr>
<tr><td>25.</td><td>

Liquidated Damages:

In the event of the Bidder / Design Consultant failing to complete the work within the delivery period specified in the contract agreement or in extension agreed thereto, the Department shall reserve the right to recover from the Bidder / Design Consultant as liquidated damages, a sum of **0.5** percentage per week or part thereof of the "undelivered/uncompleted portion of work / system value in the respective milestone" subject to a maximum of **10.0** percentage of the value of "undelivered/uncompleted work / system in the respective milestone"

T2, T4, T6& T7 mentioned in the Delivery schedule shall be considered as LD reckoning dates.

System wise price break-up of PO price schedules is indicated in the Annexure –I(b): Detailed Price Break-up Format:

</td><td></td></tr>
</table>

<table>
<tr><th>S.No</th><th>Description</th><th>Bidder / Design Consultant Compliance</th></tr>
<tr><td></td><td>Following table will be referred to arrive at the system(s) wise applicable LD calculations for the undelivered or uncompleted work or respective milestones/systems. Also please be noted that LD is applicable for Milestones -1, 2 and 3.
<table>
<tr><th>Description</th><th>Value</th></tr>
<tr><td>Milestone-1</td><td>30% value of the following individual systems, as applicable

Launch Pad Systems, Process System Infra, Air Conditioning & Vehicle Cool Air system, ACOSS System, Safety Systems and Support Systems

Individual system wise price break-up is given in Annexure-I(b)</td></tr>
<tr><td>Milestone-2</td><td>30% value of the following individual systems, as applicable

Launch Pad Systems, Process System Infra, Air Conditioning & Vehicle Cool Air system, ACOSS System, Safety Systems and Support Systems

Individual system wise price break-up is given in Annexure-I(b)</td></tr>
<tr><td>Milestone-3</td><td>30% value of the following individual systems, as applicable

Launch Pad Systems, Process System Infra, Air Conditioning & Vehicle Cool Air system, ACOSS System, Safety Systems and Support Systems

Individual system wise price break-up is given in Annexure-I(b)</td></tr>
</table></td><td></td></tr>
<tr><td>26.</td><td>Penalty Clause for the services during Milestone-4:
For Milestone-4, (i.e Technical support/certification of design changes during erection and commissioning), Penalty as mentioned below because of deficiency of services will be applicable to a maximum amount of 10% of Milestone-04 value as mentioned in PO document.
Milestone-04 value: 10% of PO cost
Deficiency of Services: Deficiencies include but are not limited to the following:
a) Not certifying design changes during realization phase or</td><td></td></tr>
</table>

S.No	Description	Bidder / Design Consultant Compliance
	delayed response from Consultant during Miltestone-4: If consultant has not responded/clarified/certified to design changes by department within 7days from the date of Department's request, 0.5% per week delay of milestone-4 value for each request will applied as Penalty. b) Major impact or rework in site works/realization because of mistake in Design: If site work got effected or major rework during realization has occurred, because of improper co-ordination during design phase (between various disciplines of consultant) or mistake in detailed drawings/good for construction drawings or equipment specification, a Penalty of 0.5% of milestone-4 value for each mistake will applied. c) If Department feels that, a site visit (to SDSC SHAR) by Bidder / Design Consultant is required to have better clarity, Department will intimate to Bidder / Design Consultant accordingly. If consultant had not visited to SDSC SHAR within 1 week of Department's request, a Penalty of 0.5% per week delay of milestone-4 value will be imposed.	
27.	**Security Deposit:** Security Deposit (SD) 3% value of the order shall be deposited with SDSC within 10 days from the date of the Purchase Order towards security deposit in the form of Bank Guarantee(BG)/ FDR/DD towards performance of the Contract valid till completion of the contract period plus sixty days towards claim period. (This will be returned by SDSC immediately on execution of the order satisfactorily as per order terms. If not, the amount will be forfeited). NOT REQUIRED FOR LANDED COST BELOW RS.5 LAKHS.	
28.	**Mode of Payment:** Our Bankers are State Bank of India, SDSC SHAR, Sriharikota – 524 124. You may furnish your banker details for transferring the payments through NEFT/RTGS mode	
29.	Bidder / Design Consultant shall note that the conditional discounts would not have edge in the evaluation process of tenders.	
30.	Non-acceptance of any conditions where ever called for related to guarantee or warrantee, performance bank guarantee, liquidate damages are liable for disqualification of bids.	
31.	Where counter terms and conditions / printed or cyclostyle conditions of sale have been offered by the tenderer, the same shall not be deemed to have been accepted by the purchaser, unless the	

S.No	Description	Bidder / Design Consultant Compliance
	purchaser's specific written acceptance thereof is obtained.	
32.	The tenderer shall at all times indemnify the Purchaser against all claims which may be made in respect of the stores for infringement of any right protected by the patent Registration of design or Trade Mark and shall take all risks of accidents or damage, which may cause a failure of the supply from whatever cause arising and the entire responsibility for the sufficiency of all means used by him for the contract.	
33.	**Arbitration:** In the event of any dispute/s, difference/s or claim/s arising out of or relating to the interpretation and application of the Contract, such dispute/s or difference/s or claim/s shall be settled amicably by mutual consultations of the good Offices of the respective Parties and recognizing their mutual interests attempt to reach a solution satisfactory to both the parties. If such a resolution is not possible, within 30 days from the date of receipt of written notice of the existence of such dispute/s, then the unresolved dispute/s or difference/s or claim/s shall be referred to the Sole Arbitrator appointed by the Parties by mutual consent in accordance with the rules and procedures of Arbitration and Conciliation Act 1996 as amended from time to time. The arbitration shall be conducted in Bengaluru in the Arbitration and Conciliation Centre Bengaluru (Domestic and International) as per its rules and regulations. The expenses for the Arbitration shall be shared equally or as may be determined by the Arbitrator. The considered and written decision of the Arbitrator shall be final and binding between the Parties. The applicable language for Arbitration shall be English only. Work under the Contract shall be continued by the BIDDER / DESIGN CONSULTANT during the pendency of arbitration proceedings, without prejudice to a final adjustment in accordance with the decision of the Arbitrator unless otherwise directed in writing by the DEPARTMENT or unless the matter is such that the works cannot be possibly continued until the decision (whether final or interim) of the Arbitrator is obtained.	
34.	**Applicable Law and Jurisdiction:** The laws of India shall govern this purchase order for the time being in force. The **Courts of Andhra Pradesh**, India only shall have jurisdiction to be with and decide any legal matters or disputes what so ever arising out of the purchase order.	
35.	**Force Majeure:** Should a part or whole work covered under this	

S.No	Description	Bidder / Design Consultant Compliance
	purchase order be delayed due to reasons of Force Majeure which shall include legal lockouts, strikes, riots, civil commotion, fire accident, quarantines, epidemic, natural calamities and embargoes the completion period for work, equipment referred to in this agreement shall be extended by a period not in excess of the duration of such Force Majeure. The occurrence shall be notified within reasonable time.	
36.	**Secrecy:** The Bidder / Design Consultant or any of his persons shall not disclose any information furnished to them by Department nor any drawings, reports and any other information prepared by them without the prior written approval of Department except in so far as disclosure is necessary for the performance of work and service under this agreement. The Bidder / Design Consultant shall be subject to the provision of the official Secrets Act 1923, and amendments thereof pertaining to such information at all times.	
37.	**Copyright:** Department shall have the copy right with respect to all the design prepared by them based on the requirement furnished by Department. The Bidder / Design Consultant shall not copy or repeat the plans and designs etc., prepared by them in connection with work to which this Agreement belong without written permission from the Department. All deliverables, outputs, plans, drawings, specifications, designs, reports, and other documents and software submitted by the Consultant under this Contract shall become and remain the property of the ISRO and shall be subject to laws of copyright and must not be shared with third parties or reproduced, whether in whole or part, without the Procuring Entity's prior written consent. The Consultant shall, not later than upon termination or expiration of this Contract, deliver all such documents and software to the Procuring Entity, together with a detailed inventory thereof. The Consultant may retain a copy of such documents and software but shall not use it for commercial purposes	
38.	The Service Provider agrees that they should not use the Name/logos of the Service Receiver in any manner, including commercial advertising or as a business reference, including ID cards without the approval of the Service Receiver. Any violation will result in cancellation of the Work Package Order(s) including forfeiture of Security Deposit.	
39.	**Intellectual Property:** All intellectual property submitted to SDSC SHAR during the bid evaluation process or during subsequent phase for the successful Bidder / Design Consultant will become the	

S.No	Description	Bidder / Design Consultant Compliance
	intellectual property of SDSC SHAR.	
40.	The technical information, drawings, specifications and other related documents (which are all confidential) furnished by ISRO is the property of ISRO and shall not be disclosed or handed over to any other agency except for the purpose of execution of the contract.	
41.	Quoted price by the party is firm and fixed throughout the contract period.	
42.	Agency shall make own arrangement for accommodation, transport to site of work, medical facility, food, communication facility for their personnel	
43.	Department shall not undertake any responsibility in respect of life, health, accident, travel and any other insurance for the personnel deployed by the Agency.	
44.	Department shall not be liable for any injury/death, caused to any official employee, representative or agent of the consultant or their consultants working at the SDSC SHAR site or during travelling or damage to their properties for any reason whatsoever. Department shall not entertain any claim from any person on that behalf. It would be the responsibility of the consultant to get their officials, employees, representatives, agents or their consultants insured against the possible risks involved in the discharge of their duties.	
45.	Party shall comply with all labour laws, minimum wages act, payment of EPF and ESI, as applicable. The Bidder / Design Consultant shall indemnify and compensate SDSC SHAR, if SDSC SHAR under the Contract Labour (Regulation & Abolition) Act, 1970 becomes liable to assume any liability towards the workforce engaged by the Bidder / Design Consultant. In the event, the provisions relating to recovery as provide in the relevant clauses of the said Act shall be applicable in toto	
46.	**Submission of Forged Documents:** If any of the Service Provider submits any forged or false documents along with their Tender/Bid, such Tenders/Bids will be summarily rejected and such Service Providers will be blacklisted for all future tenders/bids	
47.	Party shall attend to physical meetings/expert committee reviews at SDSC SHAR as and when requested by Department. The quoted rate shall include all the necessary overhead, no reimbursement for travel and other incidental expenses are admissible.	

S.No	Description	Bidder / Design Consultant Compliance
48.	**Conflict of Interest:** The Consultant must provide professional, objective, and impartial advice, holding the Procuring Organisation's interest paramount at all times, and shall not try to get benefits beyond the legitimate payments and credentials in the contract. He should strictly avoid conflict with other assignments or their corporate interests. Consultants must disclose to the Procuring Entity Covering Letter any actual or potential conflict that impacts its capacity to serve the best interest of the Procuring Organization. Failure to disclose such situations shall be treated as a violation of the Code of Ethics (ITC-Clause 15) and shall attract penalties mentioned therein. Proposals found to have a conflict of interest shall be rejected as nonresponsive. Without limitation on the generality of the preceding, a Consultant in this Procurement Process shall be considered to have a conflict of interest if the Consultant: 1) Conflicting Associations: a) directly or indirectly controls, is controlled by or is under common control with another Consultant; or b) receives or has received any direct or indirect subsidy/ financial stake from another Consultant; or c) has the same correspondence address or same legal representative/ agent as another consultant for purposes of this proposal; or d) has a relationship with another Consultant, directly or through common third parties, that puts it in a position to have access to information about or influence the Proposal of another Consultant or influence the decisions of the Procuring Entity regarding this Procurement Process; or 2) Unfair Competitive Advantage and Conflicting Activities: had (or any of its Affiliates) been engaged by the Procuring Entity to provide goods, works, or services for a project, shall be disqualified from providing consulting services resulting from or directly related to those goods, works, or services. Conversely, a firm (or any of its Affiliates) hired to provide consulting services for the preparation or implementation of a project shall be disqualified from subsequently providing goods or works or services resulting from or directly related to the consulting services for such preparation or implementation. 3) Conflicting Assignments: would (including its Experts and Sub-consultants or any of its Affiliates) be or are providing consultancy services in another assignment for the same or another Procuring	

S.No	Description	Bidder / Design Consultant Compliance
	Entity that, by its nature, may conflict with this assignment. 4) Commissions and Gratuities: The Consultant shall disclose any commissions or fees that may have been paid or are to be paid to agents, representatives, or commission agents concerning the selection process or execution and performance of the resulting Contract. The information disclosed must include the name and address of the agent, representative, or commission agent, the amount and currency, and the purpose of the commission or fee. 5) Conflicting Relationships: has close business/ family relationship with a staff of the Procuring Organization who are/ would be directly/ indirectly involved in any of the following activities: a) preparation of the RFP document or TOR of the Procurement Process b) evaluation of Proposals or award of Contract, or c) implementation/ supervision of the resulting Contract	
49.	**Disclosure and use of Information:** Bidder / Design Consultants shall guarantee that all information and data received during execution of Purchase Order from SDSC SHAR shall be classified as "confidential" within the meaning of the Official Secrets Act and will not be divulged to any third party without prior written permission of SDSC SHAR. All drawings & documents shall be returned after execution of work. No publicity of any kind whatsoever regarding this work shall be given without prior clearance from SDSC SHAR. Bidder / Design Consultants shall submit, a "Confidentiality & Non-Disclosure Agreement" to Department when they quote for this tender. Format is enclosed in Annexure-XI	

PART-B
Scope of Work &
System Description

Part-B: Scope of Work & System Description

1. Introduction

Third Launch Pad (TLP) facilities at SDSC SHAR, Sriharikota are to be realized for servicing and launching of launch vehicle stages working on Liquid Oxygen& Liquid Methane, Liquid Oxygen & Liquid Hydrogen which will power Next Generation Launch Vehicle.

Brief scope of Design Engineering Services involves,

a) Development of Conceptual, Preliminary and Detailed design of Launch Pad facilities including civil, electrical, hydraulic, AC, mechanical, Instrumentation & control systems based on the configurations / system requirements provided by Department.

b) Development of Conceptual, Preliminary and Detailed design of Safety & Fire Fighting System, Support Systems and Acoustic Suppression System (AcoSS) & Instrumentation Control System (ICS) including civil, electrical, AC, mechanical, Instrumentation & control systems based on the configurations provided by Department.

c) Development of Conceptual, Preliminary and Detailed design of Process System infrastructure including MEP, Civil, Electrical and AC based on the drawings provided by Department.

d) Deployment of design engineering team to SDSC SHAR for coordinating with Department, obtaining design clearance, carrying out modifications to drawings as per Department's suggestion and releasing of final detailed drawings/good for construction drawings

e) Certification of design changes during realization phase etc.

f) The various systems and subsystem involved and the nature of the works/deliverables under the design engineering works and is not limited to the following list mentioned below,

S.No	System	Subsystem	Works/Service Involved
1.	Launch Pad Infrastructure	Civil/ Mechanical /Electrical/ AC systems of JDD, Rail track, LPTs & Crew Access Tower, AcoSS, civil interfaces of TUT ground anchoring and control room, Pipe trenches, and satellite & vehicle cooling system, rail track beam across JDD, MLP ground anchors and surrounding paved area	• Design, detailed engineering, preparation of drawings, schedules (BOQ) and cost estimates for tendering. • Preparation of tender document. • Providing budgetary offers and cost estimates. • Preparation and release of MEP and construction good drawings, composite drawings time to time with updates. • Interfacing of AcoSS piping at JDD and allied civil foundations.
2.	Launch Pad Mechanical	TUT&SMLP, PMLP, AcoSS, Bogie Systems	• Development of conceptual &preliminary design, detailed

S.No	System	Subsystem	Works/Service Involved
	Systems	along with Electrical, Electronics, instrumentation, control system and hydraulic systems.	design, optimization, structural analysis, hydraulics, control system & automation, computational fluid dynamic analysis, modal studies, thermal analysis. • Development of pipe routing / pipe Supports interfaces with the TUT, MLP, JDD, VCR and hydraulic systems etc. • Preparation of fabrication drawings, bill of quantities (BOQ), tender specification and documents. • Preparation of drawings. • Providing Budgetary offers for cost estimation purpose. • Consideration of the piping loads, equipment & flow components loads, for the design of structures • Preparation of composite drawings with piping, instrumentation, checkout, Electrical interfaces, etc • Routing of process pipes, checkout cables, umbilicals over TUT, SMLP and PMLP. • Routing of ACoSS pipelines in and around JDD.
3.		Twin Rail Track (NIF to TLP and SVAB to TLP)	• Development of conceptual & preliminary design, detailed design of rail track system including track beams and bridge over vagu. • Preparation of fabrication drawings, bill of quantities (BOQ), tender specifications and documents. • Preparation of drawings and cost estimates for tendering. • Providing Budgetary offers for

S.No	System	Subsystem	Works/Service Involved
			cost estimation purpose. • Development of pipe routing / pipe Supports interfaces with the Rail Track structures / humes • Providing the adequate no. of culverts for crossing the process piping from one side to another. • Preparation of composite drawings with piping, instrumentation, checkout, Electrical interfaces, etc.
4.		Lightning Protection Towers (LPTs) with FRP mast, grid connection, earthing, maintenance cradle	• Based on LPS configuration studies outcome, designs and detailed engineering is to be carried out. • Preparation of fabrication drawings, bill of quantities (BOQ), tender specification. • Preparation of drawings and cost estimates for tendering. • Preparation of tender document. • Providing Budgetary offers for cost estimation purpose.
5.		Crew access tower	• Development of conceptual &preliminary design with BOQ estimation and estimation of reaction loads on crew access tower foundation
6.	Process Systems infrastructure	LHFS, LMFS, LOFS, CGSS, NSS, VCR-O & F, NSB-O & F, Pedestals, trenches, etc	• Conceptual Design, Preliminary Design, Detailed design, tender documents and Preparation of construction drawings, schedules (BOQ) and cost estimates for tendering as per the architectural and layout drawings provided by Department including Civil, Electrical, AC, PH, etc. • Preparation of tender

S.No	System	Subsystem	Works/Service Involved
			document. • Providing Budgetary offers for cost estimation purpose. • Preparation and release of MEP, composite drawings and construction good drawings time to time with updates. • Preparation of composite drawings with piping, instrumentation, checkout, Electrical interfaces, Floor/Wall/Roof/ column embedment etc • Incorporation of pipe trenches and cable trenches as per user requirement and interfacing the same with Launch Pad Infrastructure • Equipment foundation drawings.
7.	Safety & Firefighting systems	Civil/ Mechanical , Electrical along with Electronics, Instrumentation and control system for Fire pumps, deluge systems, Foam systems, hydrant and water monitor system, compressed air & breathing air systems, Fire detection and alarm systems, Clean gas suppression systems, Flame / gas detection systems, eye wash & body showers, portable fire extinguishers, emergency Public address system, Safety signages etc.,	• Conceptual & Preliminary Design, Detailed design, tender documents and Preparation of construction drawings, schedules (BOQ) and cost estimates for tendering. • Equipment foundation drawings. • Preparation and release of MEP, composite drawings and construction good drawings time to time with updates. • Development of conceptual & preliminary design, detailed design, optimization and piping fluid analysis, gas dispersion modelling etc., • Development of pipe routing / pipe Supports interfaces with other systems. • Preparation of fabrication drawings, bill of quantities (BOQ), tender specification and documents.

S.No	System	Subsystem	Works/Service Involved
			• Preparation of drawings. • Providing Budgetary offers for cost estimation purpose. • Consideration of the piping loads, equipment & flow components loads • Preparation of composite drawings with piping, instrumentation, Electrical interfaces, etc • Routing of pipelines inside storage facilities and at launch pad.
8.	Acoustic suppression system (ACOSS) (Water based) .	AcoSS Civil/ Mechanical , Electrical along with Electronics, Instrumentation and control system	• Development of conceptual & preliminary design, detailed design, optimization, acoustic and surge analysis, required instrumentation & control system. • Design, detailed engineering, preparation of drawings, schedules (BOQ) and cost estimates for tendering. • Consideration of the updated piping loads, equipment & flow components loads, for the design of structures • Preparation of composite drawings with piping, instrumentation, checkout, Electrical interfaces, etc • Development of pipe routing / pipe supports interfaces with the TUT, MLP, JDD, VCR, pump house for OHT filling etc • Preparation of fabrication drawings, bill of quantities (BOQ), tender specification. • Preparation of drawings, tender documents and cost estimates.
9.	Support	Roads / culverts	• Development of conceptual &

S.No	System	Subsystem	Works/Service Involved
	Systems	between Process building and launch pad area, TLP Technical Service Building, Maintenance and storage building, storage yards, SPU storage building, water treatment plant with OHT & Pump house, PH, water pipeline distribution network, sewage disposal system, buildings pertaining to range systems Miscellaneous items like design of civil cable trenches/pipe trenches and pipe pedestals connecting to various facilities, RCC Pipe trenches in the project and then to substation.	preliminary design, Layout, detailed design, detailed engineering and fabrication drawings, schedules (BOQ) and cost estimates for tendering. • Preparation of tender document. • Providing budgetary offers for cost estimation. • Preparation and release of MEP and construction good drawings time to time with updates. • Preparation of composite drawings with piping, instrumentation, checkout, Electrical interfaces, Floor/Wall/Roof/ column embedment etc • Incorporation of pipe trenches and cable trenches as per user requirement. • Equipment foundation drawings.

Launch Pad Facilities = Launch Pad Mechanical Systems + Launch Pad Infrastructure

2. SCOPE OF THE WORKS

2.1 Department Scope of Works

S.No	Description	Compliance
1.	Providing configurations for the launch pad systems	
2.	“Providing configuration drawings for the process systems by department” for design of process system buildings (civil/electrical & AC)	
3.	Providing soil test report, topographical data, preliminary overall layout, soil resistivity data etc.	
4.	Providing launch vehicle configuration details, loads and load cases, factor of safety to be considered, design criterion etc	
5.	JDD loads as inputs for design, preparation of tender	

S.No	Description	Compliance
	documents etc.	
6.	Preliminary configuration of ACOSS systems will be given for designing of ACOSS System and JDD related systems.	
7.	Preliminary configurations of Safety & Firefighting systems	
8.	Results of "Lightning Protection Studies" will be given to Bidder / Design Consultant for development of configuration, design and tender documents preparation of lightning protection towers	
9.	Electrical inputs – Equipment (which are not designed by consultant) loads and design philosophy etc. Electronics inputs – Providing Process requirements & accuracy requirements for the system *Department will provide tentative inputs for design*	
10.	Process & safety system equipment/piping loads for designing of foundations/pedestals/supports (wall/column/floor) along with pipeline routing scheme /locations	
11.	Identification of area for office establishment	
12.	Providing the power and water source to the office.	
13.	Power supply will be extended on chargeable basis.	
14.	Issuing necessary entry permit based on requirement.	
15.	The SDSC will provide assistance to the Consultant wherever deemed necessary, in the form of issuing letters to concerned.	
16.	No accommodation will be provided at SDSC SHAR guest house/housing colony.	
17.	The landline telephone connections and email services will be provided by the Department during the project period.	
18.	Providing interface details related to Category-C items for preparation of composite layout and design considerations	

2.2 Scope of Bidder / Design Consultant:

S.No	Description	Bidder / Design Consultant Compliance
a)	Conceptual & preliminary design, detailed design, optimization, structural analysis, modal studies, preparation of fabrication drawings, bill of quantities (BOQ) and preparation of tender specification documents with cost estimation and estimating the bill of materials.	
b)	The brief technical requirements/specifications of TUT, PMLP, SMLP, Rail track system, JDD, LPTs, Launch Pad facilities and approach platforms, Process systems, ACoSS facilities, Safety & firefighting system, Crew Access Tower, Electrical, AC & Instrumentation system are given in this document. The Bidder / Design Consultant shall review and confirm the Department’s specifications, configuration and clearly delineate any deviation from the specifications laid down with exhaustive reasoning. Once accepted, it is the Bidder / Design Consultant’s responsibility to configure and detail out the systems meeting the functional requirements as per the specifications and conditions stipulated in this document/contract.	
c)	For meeting the system specifications for certain items, few configurations are proposed by the Department for several major systems. The Bidder / Design Consultant is required to go through the configurations proposed by the Department and adopt suitable configurations or provide alternate configurations to meet the Department’s specifications. In case, the configuration proposed by the Department is adopted, Bidder / Design Consultant shall elaborate further improvements if any and provide details, such as calculations with adequate reasoning and also assume full responsibility of the configuration to meet Department specification for its proper functioning and easy maintenance.	
d)	Each phase of work shall be presented to the expert review teams constituted by the Department and design / analysis documents to be updated as per the committee recommendations. Any change in configuration / revision of loads shall be incorporated without any additional price and shall be	

S.No	Description	Bidder / Design Consultant Compliance
	presented to the committee for clearance before proceeding further.	
e)	Configurations proposed by the Department shall be adopted or alternate configurations can be proposed to meet the technical as well as functional requirements of the systems being configured/designed.	
f)	Development of conceptual & preliminary design, detailed design, optimization, structural analysis, hydraulics, control system & automation, computational fluid dynamic analysis, modal studies, dynamic analysis, rigid body motion analysis, thermal analysis for the systems as per the requirement.	
g)	Preparation of fabrication drawings, bill of quantities (BOQ), tender specification documents.	
h)	Detailed engineering, preparation of drawings and cost estimates for tendering.	
i)	The Conceptual design, preliminary design and Detailed design(Part A) of the following systems shall be vetted by premier institutes such as IITs/IISc/Specialised Agency with the concurrence of Department. a) Jet Deflector Duct b) PMLP + Tiltable Umbilical Tower + Secondary Mobile Launch Pedestal (SMLP) c) Acoustic Suppression System (AcoSS)	
j)	Preparation and release of MEP and construction good drawings time to time with updates	
k)	Certification of design changes during realization of systems.	
l)	Carry-out corrective engineering in the event of faulty design solely attributable to the Bidder / Design Consultant without any additional cost.	
m)	Obtaining clearance from the Department at the end of each phase of scope of work as stipulated in the Contract.	
n)	Carrying out FEM analysis for critical structures for finalizing the sizes of structural members and Interfaces.	
o)	Developing animation videos for mechanisms of launch pad system after preliminary design.	

S.No	Description	Bidder / Design Consultant Compliance
p)	Delivering the services as per the stipulated terms and conditions of the Contract.	
q)	Revision/ changes in drawings due to Interface issues/ site conditions to be done at no additional cost.	
r)	Bidder / Design Consultant shall engage adequate number of technical staff to carry out the work within the time schedule.	
s)	Deployment of staff to SDSC SHAR as a part of Phase-I, II & III	
t)	Establishment of site office.	
u)	Necessary logistics for the movement of staff and accommodation to the staff.	
v)	Mobilizing required software(s), computer hardware(s), laptop, printers, scanners, telephones, project system to site for delivering the services as per the scope.	
w)	Latest police verification certificate shall be ensured for all the staff positioned at site.	
x)	Compliances to the necessary statutory requirements.	
y)	The Bidder / Design Consultant shall keep the Department informed about the progress of work in his office related to this contract.	
z)	Drawings soft copies, 3D models, analysis plots soft copies and hard copies shall be submitted after completion of all the works. 7 sets of hardcopies (A0/A1/A3 size) of Department's approved final good for construction/Detailed drawings shall be submitted.	
aa)	Bidder / Design Consultant shall follow all the applicable IS codes/ASTM codes or equivalent during all phases of design in concurrence with department.	
bb)	**Office Setup** a) Department shall only provide office space within the project sites free of charge along with electricity and water supply. The cost of construction of office space to be borne by the Consultant. b) The Consultant, at his own cost procure install, operate, maintain office equipment such as computers	

S.No	Description	Bidder / Design Consultant Compliance
	(Desktops and Laptops), Printers (A-3 and A-4 size), A0 plotter, Fax machine, UPS and other peripherals and all consumables as required for efficient discharge of duties. c) The landline telephone connections and email services will be provided by the Department during the project period.	
cc)	The Consultant shall procure, operate and maintain at its own cost necessary vehicles for the use of its members during the project period.	
dd)	Consultant shall arrange for food and accommodation for their personnel.	
ee)	Visiting SDSC SHAR during realization/erection and commissioning as per the request from Department.	
ff)	**Providing additional Design engineering services:** a) In case, Department requires Bidder / Design Consultant to perform additional design works, other than the scope of work mentioned in the tender document, Bidder / Design Consultant shall be compensated on a man day basis for different category of team members. b) Bidder / Design Consultant shall take prior approval from Department before commencement of any work other than mentioned in the scope of this Tender Document. c) Efforts assessment of the new work shall be carried out by a committee constituted by PD, TLP or Department, with members from Dept. and Consultant representative. d) The quoted man-day rate shall remain same until the force of this contract.	
gg)	Bidder / Design Consultant shall develop 3D modelling of overall layout indicating Launch pad system (with all sub-systems), Process infrastructure (including equipment with supports, process pipes, cables, AC duct routing, electrical cables/trays, instrumentation system, electrical panels etc. within the process facilities), routing of pipes (with supports) within the overall layout, Support systems, AcoSS system, AC plants, Safety and firefighting system for better visualization of all the systems. Details of process equipment along with pipe sizing and instrumentation system (which is not mentioned in the scope of Bidder / Design Consultant) will be provided as 2D	

S.No	Description	Bidder / Design Consultant Compliance
	drawings to Bidder / Design Consultant for development of 3D model of facility. 3D models and 3D walkthrough animation video shall be submitted during Phase-I (during PDR), Phase-II and during Phase-IV (as built model)	

Note:

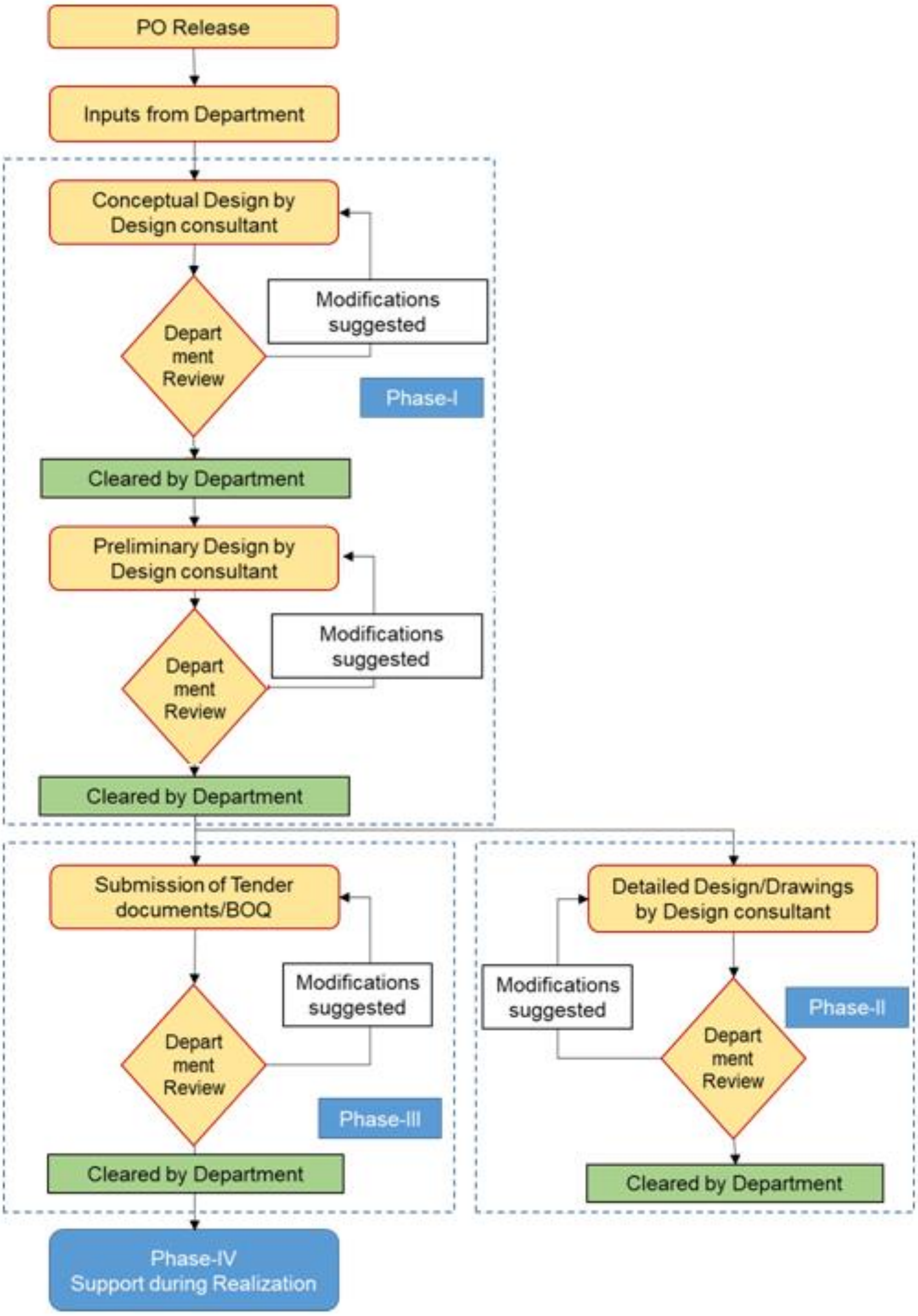
1) The dimensions and loads indicated for the designing of the various systems/sub-systems are indicative. Exact values will be provided to the qualified Bidder / Design Consultant along with purchase order.

2) During design review phases, all the changes as proposed by the Department shall be carried out without any additional price.

2.3 Phases of Design:

Considering the milestones, the services required under Design Engineering services are broadly classified into four phases as tabulated below:

Milestone	**Phase**	**Activities Description**
Milestone-1	Phase -I	Conceptual Design (CDR) and Preliminary Design (PDR)
Milestone-2	Phase -II	Detailed Design/ Critical design / engineering & preparation of fabrication drawings (DDR)
Milestone-3	Phase -III	Preparation of tender specification documents/BOQ document based on Preliminary design/ Critical design& analysis.
Milestone-4	Phase -IV	Certification of design changes during fabrication/ manufacturing



Design Engineering Services Workflow chart

2.4 Category wise scope of the works:

Systems and their scope under design engineering work are categorized as given below,

Category-A: Phase-I to Phase-IV

Category-B: Phase-I, Phase-III & Phase-IV

Category-C: Interfaces to be incorporated in Fabrication Drawings/Floor layouts (related to Category-A items) based on Department Inputs (after PDR) meeting all systems requirements/loads. Interfaces shall be shown in composite drawings / overall layout.

Facility/ Systems	Category-A	Category-B	Category-C
Launch Pad Systems	Scope involves design of mechanical, civil (including foundation & integrated infrastructure for with rail track, ACOSS, Crew access tower, PMLP), hydraulic and electrical/electronic system along with housing/enclosure for Hydraulic Powerpack and Instrumentation & control system as per the mentioned category. PMLP, SMLP, TUT, Self driven Wheel bogie system with hydraulic jacking system, X&Y alignment mechanisms for TUT alignment, Tilting Hydraulic actuator system for TUT along with Electrical and electronic & control system for equipment, LPTs and JDD, approach platforms. **Rail track system:** Overall layout, civil foundation, Rail track subsystems and anchoring systems for both PMLP, SMLP + TUT and rail track beam at JDD and bridge over vagu (stream of water).	Hauler/SPU specifications Tractive effort required for pushing and pulling of Launch vehicle +TUT+SMLP shall be computed for procurement of hauler.	Pneumatic, Checkout, CCTV and allied systems. Process piping systems on TUT, PMLP & SMLP Piping, equipment, cut outs & Cable trenches near Launch Pad & across the Rail track Preparation of composite drawings with piping, instrumentation, checkout, Electrical interfaces, Floor/Wall/Roof/ column embedment, pipe trenches, cable trenches etc.
Process System infrastructure (LHFS, LMFS, LOFS, NSS, CGSS, VCRs, NSBs etc.)	Scope involves design of Civil, Electrical, AC with control system/DDC and Sliding/swing type doors related to buildings, mono rail supported electrical chain pulley system for pump room and cooler rooms, cable trenches	EOT cranes	Pneumatic, CCTV, Firefighting, process system Equipment with electrical panel and Instrumentation & Control system

Facility/ Systems	Category-A	Category-B	Category-C
	internal as well as external. Inside facility, equipment loads will be provided for which suitable foundation & pedestals with relevant interfaces shall be designed.		Piping, instrumentation, checkout, Electrical interfaces, Floor/Wall/Roof/ column embedment, pipe trenches, cable trenches etc.
Overall layout development	Generation of overall layout (3D and 2D) indicating all the launch pad systems, rail tracks, roads, process buildings, safety and firefighting system, AcoSS, NSB, VCR etc as per the department's input. Co-ordinates shall be indicated in the 2D overall layout	--	Piping, instrumentation, checkout, Electrical interfaces, Floor/Wall/Roof/ column embedment etc.
Support System	Civil, Electrical and AC systems related to Roads / culverts between Process building and launch pad area etc as per the department's input. TLP Technical Service Building, Maintenance and storage building, storage yards, SPU storage building, water treatment plant with OHT & Pump house, water pipeline distribution network, sewage disposal system, buildings pertaining to range systems etc.) Miscellaneous items like design of civil cable trenches/pipe trenches and pipe pedestals connecting	--	--

Facility/ Systems	Category-A	Category-B	Category-C
	to various facilities, RCC Pipe trenches in the project and then to substation.		
Vehicle and Satellite cooling system Air conditioning system for Launch pad, process and safety	AC, instrumentation/control/DDC and electrical system along with AC plants. Civil, electrical and AC systems of Vehicle & Satellite cooling system, ducting system, Instrumentation & Control System, DDC etc.	--	Routing of AC ducts, pipes etc in over TUT, PMLP building etc.
Safety & Firefighting systems	Scope involves design of mechanical, civil and electrical, electronic, instrumentation and control system as per the mentioned category.	--	--
ACOSS System	AcoSS system for jet noise acoustic noise suppression, required nozzle supports and water distribution piping Scope involves design of mechanical, civil (including foundation) and electrical, electronic, instrumentation and control system as per the mentioned category.	--	--

List of Sub-systems which are to be designed is given below, but not limited to the following,

Sl.no	System Category	System	Sub-system	Design Category
1.	**Launch Pad Mechanical System**	**Primary Mobile Launch Pedestal (PMLP)**	PMLP Structure	Category-A
2.			PMLP ground anchor system	

3.			PMLP-TUT Hinges	
4.			PMLP-TUT Hinge pin assembly/disassembly mechanism (automatic) with load monitoring system on pin along with necessary electrical / electronic control system for remote operation.	
5.			PMLP-SMLP Locking / Unlocking Mechanism	
6.			PMLP cutout closure covers for corealone vehicle configuration	
7.			Retractory / Thermal Protection System	Category-B
8.			Routing of Process pipes, umbilicals, ACoSS pipes etc inside PMLP	Category-C
9.		**Secondary Mobile Launch Pedestal (SMLP)**	SMLP Structure	Category-A
10.			SMLP to TUT locking mechanism along with necessary electrical/electronics control system for remote operation.	
11.			SMLP-TUT pin assembly and disassembly mechanism (automatic remote operation) along with necessary electrical/electronics control system for remote operation.	
12.			SMLP-TUT pin load monitoring system along with necessary electrical/electronics control system for remote operation.	
13.			SMLP to PMLP locking mechanism	
14.			SMLP to Launch Vehicles Interface rings	
15.			SMLP Cutout Covers	
16.			Interface rings between Launch Vehicles and SMLP	
17.			Retractory / Thermal Protection System	Category-B

18.			Routing of Process pipes, umbilicals etc inside SMLP	Category-C
19.		**Tiltable Umbilical Tower (TUT)**	TUT Structure	Category-A
20.			TUT to SMLP locking Mechanism	
21.			TUT-SMLP pin removal mechanism (automatic remote operation) with suitable instrumentation for load monitoring on pin along with necessary electrical/electronics control system for remote operation.	
22.			TUT to PMLP hinge Mechanism	
23.			TUT-PMLP pin removal mechanism (automatic) with suitable instrumentation for load monitoring on pin along with necessary electrical/electronics control system for remote operation.	
24.			TUT Hydraulic Cylinders	
25.			Hydraulic Power Pack system for TUT tilting	
26.			Electrical, Electronics, Instrumentation & Control System for TUT Hydraulic System	
27.			TUT Hydraulic Cylinder ground anchor system	
28.			TUT Hydraulic cylinder to TUT assembly/disassembly (automatic) mechanisms along with necessary electrical/electronics control system for remote operation.	
29.			Launch vehicle foreend support saddle with holding arm on TUT and holding mechanism along with necessary electrical/electronics control system for remote operation.	
30.			Launch vehicle support saddles on TUT along with necessary electrical/electronics control	

			system for remote operation.	
31.			Launch Vehicle deflection correction mechanism (if required)	
32.			TUT to Wheel bogie system/road transporter interface with alignment mechanism	
33.			Retractory / Thermal Protection System	Category-B
34.			Routing of Process pipes, AC ducts, umbilical etc inside TUT	Category-C
35.		**TUT Horizontal Transportation System (Wheel bogie / Road Transporter / self-propelling system)**	Wheel bogie system / Road Transporter	Category-A
36.			Hydraulic jacking system for Lifting/lowering along with necessary electrical/electronics control system for remote operation.	
37.			TUT hinge to PMLP hinge automatic alignment mechanism along with necessary hydraulic/electrical/electronics control system for remote operation.	
38.			Wheel bogie system / Road Transporter to TUT locking mechanism	
39.			Propelling system for transportation of wheel bogie/road transporter	
40.			Prime mover for road transporter (if required)	Category-B
41.		**Lightning Protection System (LPTs)**	LPT structure	Category-A
42.			Cradles for LPT	
43.			Pill boxes	
44.			FRP Masts	
45.			Catenary conductor with terminations and end fittings	
46.			Civil Foundation	
47.			Electrical system	
48.			Grid at Launch Pad area	Category-C

49.		**Rail Track System**	Rail track components like rails, resilient pads, fish plates, bolts, sole plates, expansion joints etc	Category-A
50.			Rail track beams across JDD	
51.			Bridge across vagu and culverts	
52.			Track Changeover Mechanism at loop track	
53.	**Launch Pad Infra**	**Crew Access Tower**	Tower structure (scope is only upto Phase-1 and BOQ estimation) (PDR results shall be used for civil foundation design)	Category-A
54.			Civil Foundation	
55.		**PMLP**	Civil Foundation	Category-A
56.		**Jet Deflector Duct (JDD)**	Civil Foundation	Category-A
57.			Transpiration cooling system or equivalent system	
58.			JDD metallic structure	
59.			Provision for supporting ACOSS pipes	
60.			JDD de-watering system	
61.			Refractory / thermal Protection System	Category-B
62.			Routing of ACOSS pipes, umbilicals, process pipes, firefighting pipes etc	Category-C
63.		**Lightning Protection System (LPTs)**	Civil Foundation	Category-A
64.			Panel rooms	
			Electrical systems	
65.		**TUT**	Civil Foundation	Category-A
66.		**Rail Track System**	Civil Foundation	Category-A
67.	**Process Infra**	**LMFS, LOFS, LHFS, CGSS, NSS, NSB, VCR**	Civil / Mechanical/Electrical / AC	Category-A
68.			Elevators / EOT crane	Category-B
69.			Routing of Process Pipes, Electrical cables, AC ducts, trays and instrumentation system 3D model of Process facility indicating routing of process pipes, equipment, electrical cables, AC ducts, instrumentation system etc	Category-C

70.	**AC System** (including civil, electrical, AC & automation)	Satellite &Vehicle Cool air System	Category-A
71.		AC System for Process & Infra	
72.	**Electrical System**	Launch Pad Mechanical	Category-A
73.			
74.		Launch Pad Infra	
75.		Process system Infra	
76.		ACOSS, Safety System, AC system& Support systems	
77.	**Instrumentation & Control System**	Launch Pad Systems	Category-A
78.			
79.		ACOSS, Safety System, AC system& Support systems	
80.	**Support Systems** (including civil, electrical, AC & automation)	Overall layout and design of roads, Culverts, Pedestals, Trenches, PH, external & pad lighting, Technical service building, Shelter for TUT, Storage Yards, Maintenance and Service building, water treatment plant with OHT & Pump house, water pipeline distribution network, sewage disposal system, buildings pertaining to range systems	Category-A
81.	**Safety & Firefighting systems**	Design of civil, mechanical, Equipment, Instrumentation and control system , routing of Pipes, Electrical cables, AC ducts, trays and instrumentation system	Category-A
82.	**ACOSS System**	Design of civil, mechanical, process, water distribution system, Instrumentation and control system, civil routing of Process Pipes, Electrical cables, AC ducts, trays and instrumentation system	Category-A

2.5 Details of Services:

a) Phase –I: Scope of the Services

Conceptual (CDR) and Preliminary Design (PDR)

Phase-I commences immediately after 10 days of the issue of Letter of Intent (LOI) or date of signing of the contract as per the terms given in purchase order. In this phase, the Bidder / Design Consultant shall present conceptual and preliminary design of all the systems. This phase of work shall be divided into two parts. The **Part-A is the conceptual design** which is followed by **Part-B, the preliminary design**.

1) **In Part-A**, all the options which have direct influence on the finalization of configuration, shall be studied in detail and proceed on the meritorious one, for which preliminary design can be taken up. Consultant shall present the conceptual design to department for further approval. To proceed further to preliminary design, consultant shall incorporate all the changes proposed by Department without any additional cost.
2) **In Part-B**, Preliminary design has to be carried out by consultant. Preliminary design phase ends with the successful completion of Preliminary Design Review (PDR) by the Department and submission of documents, 2D / 3D / FEM models as envisaged in the following section after incorporating Department's recommendations by the Bidder / Design Consultant without any additional cost.
3) Changes/modifications/improvements over the technical input, if any, at this stage are to be presented to the Department with full justification and Department's approval shall be obtained for such changes.
4) The Bidder / Design Consultant shall note that, Phase-I is an iterative process, which sometimes involves changes to load values/dimensions/parameters, additional loads/load cases or modifications are to be considered. Bidder / Design Consultant shall carry out the changes or analysis for additional loads/load cases and modified inputs as suggested by Department without any additional cost.
5) The Bidder / Design Consultant shall prepare the following details during Phase-I and submit the documents for review by the Department for finalization.

Part-A: Conceptual Design

1) As part of Conceptual Designs, the configuration document for all items/subsystems/systems shall be prepared by the Bidder / Design Consultant. The configuration document shall contain the following:
    a. Title
    b. Design inputs/Users' requirements
    c. Configurations studied
    d. Material selection
    e. Trade off studies on configuration giving merits and demerits and comparison of Configurations
    f. Preliminary specifications of major subsystems/ bought out items
    g. Schematic diagrams layout, plans and cross sections at various locations
    h. Details of long lead items
    i. Configuration management plan
    j. Erection aspects
    k. Compliance / deviations to user specification
2) The Design Review Team/ Committee will review the configuration of the items/ subsystems/systems. Any suggestions/modifications recommended by Review team shall be incorporated in the final configuration studies report.
3) Bidder / Design Consultant shall prepare 3D models and assemblies of the launch pad systems and submit the same to department.

Part-B: Preliminary Design

The Bidder / Design Consultant shall carryout preliminary design of items/subsystems/systems after conceptual design approved by Department and bring out design report along with the interface details. The salient features covered under this phase of design are to be brought out for major facilities. Loads and load cases considered for design of system shall be properly documented in PDR report. The Bidder / Design Consultant shall consider all the features but not limited to as specified by Department.

1) The design drawings shall be prepared using 3D solid model and 2D drawings. Mechanical drawings in preliminary design stage shall show line diagrams of mechanical assemblies with specifications of bought out items.
2) PDR document comprising of all the above shall be submitted for review and approval.
3) Upon completion of PDR, and incorporation of all recommendations therein, the final PDR document shall be submitted.
4) Bidder / Design Consultant shall develop 3D model of overall layout indicating Launch pad system (with all sub-systems), Process infrastructure (including equipment with supports, process pipes, cables, AC duct routing, electrical cables/trays, instrumentation system, electrical panels etc. within the process facilities), routing of pipes (with supports) within the overall layout, Support systems, AcoSS system, AC plants, Safety and firefighting system for better visualization of all the systems and to avoid interfacing issues.

   Details of process equipment along with pipe sizing and instrumentation system (which is not mentioned in the scope of Bidder / Design Consultant) will be provided as 2D drawings to Bidder / Design Consultant for development of 3D model of facility.

Preliminary Design Deliverables –Civil Systems

a. Preliminary configuration and design of launch pad systems, process facilities and architectural drawings
b. Composite layout drawing indicating all the interfacing element
c. Overall layout of Third launch pad.
d. 3D model of all the process facilities by incorporating all the essential details shall be provided.
e. Design reports and FEM analysis models of all the relevant systems.
f. Bill of quantities for tendering purpose.
g. Finalization of building foundation indicating type, trade off studies, if any.
h. Typical foundation design calculation.
i. Structural scheme showing beams, columns/frames, slabs and reinforcement in the form of line diagrams.
j. Generation of equipment foundation drawings for process Equipment
k. Lightning Protection Towers for Process buildings
l. Sandwiched Merlon for Process Facilities
m. AcoSS nozzle supports, water distribution piping and OHT design.

n. Preparation of composite drawings with piping, instrumentation, checkout, Electrical interfaces, Floor/Wall/Roof/ column embedment etc
o. Typical joint details showing beam column junction.
p. Details of plinth beam connection.
q. Structural static analysis with foundation to arrive at stress levels, deflected shapes for cyclonic winds and dynamic analysis. Earthquakes design checks as per relevant IS Codes.
r. Analysis to meet thermal loads, buckling etc. shall be carried out.
s. Analysis to meet the equipment loads on columns/ beams.
t. Design of sealing joints to avoid entry of rain water.
u. Grade of concrete, cover shall be considered for saline atmosphere as per latest IS 456-2000.
v. Schedule of doors and windows.
w. Finish details including painting of facilities.
x. Testing requirements, if any.
y. Construction philosophy with equipment and materials to be mobilized.
z. Interfaces with electrical, A/C and other disciplines.
aa. Interfaces with TUT, wheel bogie system, process system equipment & Pipelines, rail track system, track beam, ground anchors, ACOSS system, safety and firefighting system etc.
bb. Soft copies of all the drawings & models shall be provided. (i.e. .dwg, model files)

Preliminary Design Deliverables – Mechanical / Structural System

a. Preliminary sizing of structural members for all structures like PMLP, SMLP, TUT, CAT etc.
b. Structural analysis of the systems with proper boundary conditions.
c. Arriving at the deflections in the structures for all loading conditions and load combinations and ensuring these within acceptable limits.
d. Estimation of natural frequency for certain critical systems which are identified. The other modes of excitation less than this frequency also shall be listed.
e. Sensitivity analysis shall be carried out to study the effect of failure of a few structural members.
f. Dynamic response of the overall structure shall be carried out for the operating conditions likely to be encountered.
g. Estimation of local stresses at openings and cut outs and providing stiffeners to the structure.
h. Rigid body motion analysis / dynamic analysis to be carried out for systems like TUT, alignment mechanisms etc.
i. Design details related to Hydraulic actuator system for tilting and alignment mechanisms.
j. Estimation of Hydraulic actuator load vs tilting angle data.
k. Hydraulic circuit simulation for TUT Hydraulic actuator system.

l. Failure modes, Effects and Criticality Analysis of various systems like Hydraulic actuator system (including control system), ACOSS system and any other alignment mechanisms etc.
m. Sizing of the Equipment, flow component & piping
n. Revision of Process P&IDs and Equipment layouts
o. Specification of the equipment's, flow components etc.,
p. Schedule of the piping & flow components and instruments
q. Pressure drop calculations, Process flow analysis (both steady and transient-water hammer effects), flexibility analysis, deriving of support loads, water distribution pattern etc.
r. Selection of the equipment, Flow components etc.
s. Composite drawings with piping, instrumentation, checkout, Electrical interfaces, Floor/Wall/Roof/ column embedment etc
t. EOT Crane, Mono Rail Crane, etc

Preliminary Design Deliverables – Electrical Systems

a) Estimation of Electrical Load requirements of a building or system.
b) Detailed Engineering calculations to support the design, such as load calculations, voltage drop calculations, short circuit calculations, Arc flash studies and circuit protection coordination for each feeder and equipment etc.
c) Determine appropriate size and specifications for various electrical components and systems and detailed technical drawings.
d) Single line diagram for overall electrical system from sub-station to various facilities and also within the facilities from MV panel.
e) Electrical load summary for individual facilities i.e. Equipment loads, lightning load, A/C loads etc. Electrical equipment layout drawing for the entire facility including distribution drawings, schemes.
f) Design of electrical system and specifications of major electrical Equipment, components like TUT Hydraulic actuator system and Hydraulic jacking system for wheel bogie system and any other system as per the scope mentioned in this document.
g) Sizing of electrical equipment, cables, transformers etc.
h) Electrical cable layout and cable schedule.
i) Testing requirements.
j) Interfaces with civil, AC and other disciplines.
k) Voltage drop studies and analysis, fault level calculation
l) Redundancy design, protection and study of single point failures

Preliminary Design Deliverables – Electronics & Instrumentation System

a) Preliminary P&ID diagram for each system
b) Layout of panels in each location
c) List of field elements for each facility & system

d) PLC/SCADA Configuration drawing for all systems
e) Specification for all elements
f) Sizing of cables, cable layout and schedules
g) Interfacing with electrical systems
h) Surge protection scheme
i) Redundancy & Fail- safe consideration (ICS System & equipment)
j) Cable connectivity drawing among systems/ facilities
k) Network connectivity drawings
l) Network/ Checkout cable routing & CCTV mounting scheme

Preliminary Design Deliverables – AC System:

a) Heat load calculations.
b) Quantities and major specifications of all the items like compressors, chillers, condensers, Air Handling Units, Ducting arrangement, pipes, fittings, instruments; considering sizing, material compatibility, pressure rating, dimensions/ design standards etc.
c) Conversion of finalized schematic diagram into a process & instrument diagram, consisting of all equipment, flow components instruments etc., and their inter-connecting pipeline for air conditioning system.
d) Sizing of all pipelines and ducting arrangement based on pressure drop calculations and piping design.
e) Finalization of insulation scheme for air conditioning system.
f) Design of support, expansion joints for equipment, ducting, pipelines etc.
g) Equipment general arrangement details of AC Plant along with equipment Layout and routing of pipe lines, ducting and its connection, P&ID diagrams, interfaces with civil and foundation for equipment, supports arrangement, trenches for duct and pipe lines routing etc.,
h) AC plant shall be interfaced for remote operation, monitoring and control from AC plant with active feedback sensors.
i) Ducting of satellite and vehicle cooling and ducting inside TUT shall be designed for a mass flow rate of 20,000Kg/hr.
j) Detailed specification of controller, I/O units and operator programming station. Redundancy requirements at controllers, I/O units and at network level including the power supplies.
k) Actual hardware and I/O requirements based on process requirements and their distribution with adequate spares.
l) Procurement specifications of all equipment, flow components, instruments etc.
m) Testing requirements.
n) Interfaces with Civil, Electrical and other disciplines
o) AC plant shall be interfaced for remote operation, monitoring and control from TSB/Integration building or through DDC network

Preliminary Design Deliverables – Safety & Firefighting systems and AcoSS system

a) Sizing of the Equipment, flow component & piping
b) Process P&IDs and Equipment layouts
c) Specification of the equipment's, flow components etc.,
d) Schedule of the piping & flow components and instruments
e) Pressure drop calculations, Process flow analysis (both steady and transient- water hammer effects), flexibility analysis, deriving of support loads, water distribution pattern etc.
f) Arriving the civil buildings sizes based on water storage capacity, pumping capacity, equipment arrangement, and Piping layout in the Facility towards meeting the completeness of the systems, etc.
g) Overhead tank shall be designed for the wind loads, seismic loads, hydraulic loads, acoustic loads and other water flow induced loads as per the prevailing structural codes and standards.
h) Water distribution piping shall be designed as per the system requirements for water flow distribution from OHT to launch pad at various locations/ elevations. The water flow shall be controlled in a staggered manner by operating the control valves in a sequence towards mitigating the surge/ water hammer effects in the system.
i) Architectural drawing and inter connection/interfaces with pipe, support bracings, staircases, approaches for maintenance and to meet the necessary functional objectives etc.The adequate number of valves along with instruments for status and pressure parameters during the operation.
j) Structural analysis and preparation of final design drawings.
k) Firming up of sizes of RCC members (like piles, pile cap, shafts, bowl, cover slabs etc.
l) Sizing of inlet and outlet pipelines based on pressure drop calculations and piping design.
m) Standard analysis shall be used for the design and analysis of structures.
n) Based on the Water injection quantities the required water throw length and spread has to be designed.
o) Envelope of water sheet for a given nozzle has to be designed in CFD similar to rain birds.
p) Loads shall be arrived on the OHT due to withdrawal of water at rate of 72 cu.m/s (indicative) by conducting Transient analysis. Hydraulic analysis/simulation packages shall be used during the design.
q) Out let and inlet piping layout in the OHT and their anchoring scheme requirements, handling provisions. Requirements of Special features like static earthing, water overflow scheme and embedment plates on walls of OHT etc.
r) All the drawings shall be developed by using standard symbols for all structural columns and beams etc., and by adopting CAD system/equivalent software packages.
s) Interfaces with the launch pad systems like JDD, MLP etc.,

t) Preparation of final design drawings, firming up of sizes of RCC members, piping design.

u) Transient analysis, Hydraulic analysis/simulation packages shall be used during the design.

v) Conversion of finalized schematic diagram into a Process & Instrumentation (P & I) diagram, consisting of all equipment, flow components, instruments etc., and their inter connecting pipelines.

w) Command supply circuit shall be configured critically and designed to meet the system functional requirement.

x) Tagging of all equipment, flow components and instruments and incorporation of same in the P & I diagram.

y) Design and detailing of structures like pipe support towers, handling equipment, pipe supports, cable trays, trenches, pedestals etc.

z) Structural, thermal stress and flow analysis, including water hammer.

aa) Manual & EP valves procurement plan, identifying make and source of supply, modality of supply and scope of supply etc.

bb) Generation of civil architectural drawings considering the features like water drainage provision, removable slabs, pipe embedment plates, structural supports, slopes required for pipe line routing and pipes handling during erection/maintenance etc.

cc) Preliminary design report for all safety & Firefighting systems and AcoSS system

Preliminary Design Deliverables – Equipment

The Bidder / Design Consultant shall provide the specifications for the special bought-out items/ mechanical systems which are to be procured by the Party / Department. Such systems include Linear bearings, hydraulic cylinders / jacks, Control system etc.,

1) The PDR document shall contain following for each system / sub-system:
    a. Back ground information
    b. Department's requirements
    c. Configuration studies
    d. Review committee suggestion
    e. Design inputs/specifications
    f. Design criteria
    g. Tests
    h. Load combinations
    i. Basic sizing of members

2) Typical **structural analysis shall include**
    a. Detailed analytical model with discretizing nodes, element numbers, etc.
    b. Analysis using Software viz. FEM, etc for static and dynamic conditions.
    c. Loading conditions considered with gross magnitude of individual load cases

d. Deflections and stresses in critical zones in tabular forms for various conditions
e. Support reactions
f. Stress contour plots
g. IS code checks wherever relevant
h. Mode shapes
i. Natural frequencies
j. Stiffeners Analysis (P-Delta analysis)
k. Schematic diagrams
l. Layout
m. Plans
n. Cross sectional details
o. Configuration management plan
p. Reliability and Quality Assurance plan
q. Bought out items' specifications
r. Interface details between items/subsystem/system Compliance of design specifications,
s. Fabrication criticalities
t. Erection sequence
u. Method of testing the system for its specifications

3) The documents shall be supplied in soft copies and Five sets of hard copies for the purpose of review. 3D models and FEM models/codes shall be submitted to department for review.

b) Phase –II: Scope of the Services

Detailed Design/ Critical design / engineering & preparation of fabrication drawings (DDR)

- Phase-II commences immediately after the completion of Preliminary Design Review.
- In this phase, the Bidder / Design Consultant shall present detailed design/development details of the system, sub-systems, major equipment including all external and internal interfaces. Specific handling procedures during installation and special fixtures, if any, shall also be identified.
- Further detailing of each system shall be carried out in this phase.
- The Manufacturing/ installation /Erection sequence is also to be frozen in this phase.
- Phase-II, Part-A is the detailed design/engineering which ends with the successful completion of the final design review by the Department.
- Phase-II, Part-B: Civil/ Mechanical /Electrical/ AC system related Fabrication/ Manufacturing/ construction Drawings preparation

Part- A Detailed Design/ Engineering

- Detailed design reports (DDR) and FEM models, 3D models shall be submitted to Department.
- Based on review and suggestions by Department, consultant shall update the detailed design and submit final reports. FMECA analysis wherever required, has to be carried out & details are to be submitted to Department.
- The documents shall be supplied in soft copies and Five sets of hard copies for the purpose of review. 3D models and FEM models/codes shall be submitted to department for review.

Detailed Design/Engineering Deliverables – Civil System

a) Detailed design reports, FEM models.

b) Indicating the realization tolerances for verticality and the location tolerances of embedment.

c) Design of roof slabs, RCC walls, beams, RCC columns/ brackets, footing etc., of the buildings / structures.

d) Design of equipment foundations, RCC pedestal cable trench etc., based on dead load and live load, cyclonic load, vibration load, acoustic load, seismic load, etc, wherever applicable.

e) Ductile detailing of RCC elements as per IS 13920, to minimize seismic damage.

f) Design of pits, collection tanks (underground), overhead tanks etc. by considering appropriate treatment to avoid dampness, seepage, leakage etc.

g) Design of embedment plates/ pipe supports/ structural support considering respective loads.

h) Design of cable trench with supporting arrangement for cables including cover slab.

i) Design of public health system for individual buildings.

j) Design of water line for drinking water and other user as per requirement.

k) Sizing and distribution network for process and drinking water needs at different buildings with independent lines from supply source.

l) Details of toilet pits and piping connections.

m) Composite layout drawings with piping, instrumentation, checkout, Electrical interfaces, Floor/Wall/Roof/ column embedment etc

Detailed Design/Engineering Deliverables – Mechanical/ Structural System

a) During the final design phase, the joint details shall be worked out for all structural systems. Member details, welding details, Weld qualifications, surface preparation for corrosion prevention, painting schemes shall also be worked out.

b) For machined components, the design drawing shall indicate clearly the dimensional tolerance, Geometrical Tolerances. Heat treatment/stress relieving requirements, surface finishes to be achieved, surface protection by applying anti corrosive varnish shall be worked out.

c) Procurement plan for indigenous items identifying source of supply, modality of supply, scope of supply etc.
d) Assembly tolerances for control assembly / Total assembly, Alignment accuracies, Trial run specification, performance under load specification, Type Test of items shall be worked out.
e) Major sub- system interface details.
f) Erection plan and procedures along with required material handling equipment including special equipment, if any. Pre-requisites at site for erection purpose shall be submitted.
g) List of recommended spares for two years of trouble-free operation.
h) Identification of applicable standards and codes.
i) Reliability and quality assurance plan.
j) Safety implementation and control plan.
k) Preparation of detailed design report for each sub-system and presentation of the same to Department for approval.
l) Composite layout drawings with piping, instrumentation, checkout, Electrical interfaces, Floor/Wall/Roof/ column embedment etc

Detailed Design/Engineering Deliverables – AC, Satellite & Vehicle Cooling along with Instrumentation System

a) Design of Air Conditioning system and clean rooms considering heat load.
b) Structural, thermal, flows and stresses analysis of Air Conditioning piping.
c) Selection and procedure for Air Conditioning pipeline insulation.
d) Air Conditioning duct design with insulation and routing within and outside the building.
e) Preparation of piping loop drawing for hydro test.
f) Erection plan, procedure and sequence along with required material handling equipment for electrical and A/C Equipment.
g) Dimensions and actual numbers of racks and consoles for control system.

Detailed Design/Engineering Deliverables – Electrical Systems

a) Estimation of Electrical Load requirements of a building or system.
b) Switch gear single line diagram.
c) Short circuit calculations and voltage drop calculations.
d) Preparation of logic diagram and interlock diagrams.
e) Inter panel connection diagram.
f) Electrical cable tray and trenches layout.
g) Emergency power layout.
h) Grounding system design and drawings.
i) Electrical loop sketches.
j) Cabling and inter connection schemes between various facilities.

k) Selection of painting scheme and application procedure.
l) Energy efficient solutions for optimizing the energy consumption and reliable power with high MTBF.
m) Ensuring the safety & compliances designs adhere to relevant electrical codes and standards.

Detailed Design/Engineering Deliverables – Electronics & Instrumentation

a) Erection plan
b) Detailed P&ID drawings
c) User requirement flow diagram
d) Panel drawings/ Console drawings & its positioning details
e) Final IO list
f) Final cable routing – Trays/ trench, etc.
g) Final field elements list & erection
h) PLC/SCADA configuration/ BOM & development
i) Interlock & wiring drawings
j) Cable layout & routing drawings
k) Earthing/ grounding schemes
l) Interfacing all sub systems
m) Spares list for each system
n) Deliverable documents/ drawings for all systems
o) Finalizing the specification of items in each system in consultation with department. (Document shall be submitted for each facility/ systems)
p) Quality Audit Plan (QAP) for each element and as whole system shall be submitted
q) Documents:
    - QAP
    - FMECA studies for all systems,
    - FAT & SAT procedure document
    - User requirement document - URD (In terms of flow chart) by consultancy
    - Following Documents shall be provided by executer which is to be mentioned in specification document
        - Software requirement specification (SRS)
        - System requirement document (SRD)
        - Data flow diagram & State transition diagram document
        - Detailed design document (DDD)
        - DACS SCADA Design document (SDD)
        - Traceability Matrix Document (TMD)
        - Black box test document
        - White box test document

- PLC Code document
- Console document
- Operation document
- Checklist document
- Calibration & Test certificates of all ICS elements as a document
- Panel HV Test reports, Panel material certificates
- T&E document with all test cases as a document
- Final consolidated QAP, FAT & SAT document

Detailed Design/Engineering Deliverables – Equipment:

a) Procurement plan for indigenous items identifying source of supply, modality of supply, scope of supply etc.

b) Assembly Tolerances for control assembly/Total assembly, Alignment accuracies, Trial run specification, performance under load specification, Type Test of items shall be worked out.

c) Major sub- system interface details.

d) Erection plan and procedures along with required material handling equipment including special equipment, if any.

e) List of recommended spares for two years of trouble-free operation.

f) Identification of applicable standards and codes.

g) Reliability and quality assurance plan.

h) Safety implementation and control plan.

i) Preparation of detailed design report for each sub-system and presentation of the same to Department for approval.

j) The applicable IS standards, regulations for design, Manufacturing, fabrication, erection and testing shall be followed. In case any particular aspect of the work is not specifically covered by any Indian standard, international standards or any other standard practice may be followed after obtaining approval.

k) A final design report shall be brought out with the following:

- ✓ Background information
- ✓ Review committee suggestions
- ✓ Compliance of review committee suggestion
- ✓ Finer analysis details of stress, Thermal and FMECA etc.,
- ✓ Unresolved specifications, if any
- ✓ Critical fabrication requirements
- ✓ Critical assembly requirements
- ✓ Supply standards incorporated in design
- ✓ Handling provisions for erection
- ✓ System integration plan
- ✓ Design margins available
- ✓ Operational and maintenance details

- ✓ List of wearing out components
- ✓ Test and evaluation procedure
- ✓ System acceptance standard
- ✓ Fabrication drawings
- ✓ Additional works suggested by Design review committee, if any

l) At the conclusion of this phase, the Bidder / Design Consultant shall submit the final design document to the Department in soft copies and five sets of hard copies.

Detailed Design/Engineering Deliverables –Safety & Firefighting systems and AcoSS system:

a) Procurement plan for indigenous items identifying source of supply, modality of supply, scope of supply etc.

b) Major sub- system interface details.

c) Erection plan and procedures along with required material handling equipment including special equipment, if any.

d) Sizing & selection of equipment's for safety & firefighting systems

e) Sizing & Selection of Foam system for Liquid Methane & launch pad Facilities

f) Selection & Finalization of Piping and Flow components

g) Generation of inputs for designing civil foundations for Fire Water Pumps, Foam concentrate Pumps, Foam Concentrate storage tank, air receivers, cooling water towers, filter housings etc.

h) Design of civil pedestals for various pipeline sizes supports in the yard and propellant storage facilities.

i) Stress and Flexibility Analysis of piping system

j) Isometric Drawings of piping

k) Water distribution pattern drawings

l) Detailed structural stress analysis including water hammer. The suitable CAD packages results also shall be submitted.

m) Selection and finalization of all field instruments based on the process requirement and approved specifications

n) Preparation of instrument / equipment layout diagram

o) Detailed design of nozzles and surge protection system etc.

p) Detailed construction drawings for civil works and fabrication drawings for structures and piping.

q) Design and detailing of structural like pipe support in the towers, handling equipment/structure etc.

r) Procedure for qualification and commissioning. Preparation of piping loop drawing for hydro test/pneumatic test purpose.

s) Specific handling procedures during installation and special fixtures, if any, shall also be identified.

t) Design of support structures for accommodating nozzles, accumulators and flow components etc.

u) Flow components layout in the proposed trenches with details of civil, electrical and utility related interfaces.

v) Quality control plan for scope of work

w) Conducting of FMECA analysis and troubleshooting of identified problems.

x) Piping flexibility analysis

y) Preparation of impulse / pneumatic line layout diagram

z) HAZOP Study & QRA of all systems as per the preliminary configuration

aa) List of recommended spares for two years of trouble-free operation.

bb) Identification of applicable standards and codes.

cc) Reliability and quality assurance plan.

dd) Safety implementation and control plan.

ee) Preparation of detailed design report for each sub-system and presentation of the same to Department for approval.

ff) The applicable IS standards, regulations for design, Manufacturing, fabrication, erection and testing shall be followed. In case any particular aspect of the work is not specifically covered by any Indian standard, international standards or any other standard practice may be followed after obtaining approval.

gg) A final design report shall be brought out with the following:

- ✓ Background information
- ✓ Review committee suggestions
- ✓ Compliance of review committee suggestion
- ✓ Finer analysis details of stress, Thermal and HAZOP, FMECA etc.,
- ✓ Unresolved specifications, if any
- ✓ Critical fabrication requirements
- ✓ Supply standards incorporated in design
- ✓ Handling provisions for erection
- ✓ System integration plan
- ✓ Design margins available
- ✓ Operational and maintenance details
- ✓ List of wearing out components
- ✓ Test and evaluation procedure
- ✓ System acceptance standard
- ✓ Fabrication drawings
- ✓ Additional works suggested by Design review committee, if any

hh) At the conclusion of this phase, the Bidder / Design Consultant shall submit the final design document to the Department in soft copies and five sets of hard copies.

Part-B: Preparation of Fabrication/ Manufacturing/Construction Drawings

Bidder / Design Consultant shall adhere the following guidelines in preparing and submitting fabrication / Manufacturing drawings.

a) Regarding civil works, Consultant shall prepare Architectural drawings, composite drawings, overall layout concrete and reinforcement details, columns and pile foundation details, MEP drawings, Good for construction drawings and any other drawing/document required for carrying out civil works. 3D models of process facilities shall also be provided.

b) Regarding mechanical/fabrication works, Consultant shall prepare and submit, General assembly drawings, detailed design drawings of all the mechanical systems, specifications/datasheets of bought out items, FMECA documents related to Hydraulic actuator systems and alignment mechanisms and any other drawing/document which are required for realization of system.

c) Regarding electrical system,

- Technical specifications which includes BOM and procedure for QAP, FAT & SAT for various electrical components.
- Assistance with cost estimation, procurement, Bidder / Design Consultants list and Bidder / Design Consultant's coordination.
- Electrical Single Line Diagram and schematics for various electrical equipment and mechanisms like crane and pumps etc with interlock and fail safe circuits.
- HT&LT panel and distribution network
- Electrical Load estimations
- Calculation of sizing of Transformers, DG sets, UPS, battery sizing, switchgears and other electrical equipment.
- Cable sizing calculations and cable schedule
- Interface drawings like panel layouts, terminal details
- Cable tray and routing layouts
- Bus trucking system
- Illumination layouts for indoor and outdoor
- Earthing Systems
- Lightning Protection Layouts
- Bill of materials
- Erection and installation drawings
- Electrical site plan and layouts
- Testing and commissioning procedures

d) Regarding electronics and control system & HVAC System

- Panel GA with all elements
- Field JB GA
- Field elements assembly drawings
- End to end Cable scheduling drawings
- Details PLC/SCADA drawings

- detailed drawings/ configuration
- AC and cool air duct routing drawings etc.
- Equipment specifications

e) General Specifications:

- Party shall submit P0 version of drawings for Department's review and discussion. Based on Department's suggestions, consultant shall update the drawings and release for "Good for construction drawings". All the revisions of the drawings shall be indicating properly with revision numbers.
- The Bidder / Design Consultant shall start to submit progressively for approval, the fabrication/Manufacturing drawings based on the approved design drawings to form part of tender documents. Timelines for submission of drawings shall be followed strictly.
- All the drawings prepared and submitted shall have compatibility with AutoCAD 2010 or latest version and documents shall have compatibility with Windows operating system.
- Isometric 3D drawings in assemblies are also required to be submitted for interface checks.
- The detail fabrication drawings shall be drawn out in a neat and sequential manner with the details in appropriate scale so as to facilitate cross checking and shall preferably be according to the erection modules.
- The sequence of submission of fabrication drawings for approval shall match with the approved fabrication and erection schedule. The approval of the drawings will be accorded only towards the general conformity with the design requirements and ensure the correctness of functional requirements as well as specifications. Also, to ensure the correctness of general arrangement for centre line dimensions, levels, section sizes and adequacy of connections including splice joints, the number of bolts, weld length, size of gusset/ end plates, etc., the correctness of all other details like cutting lengths, matching of holes, notch dimensions, match markings, bill of materials, bolt list etc., will be entirely the Bidder / Design Consultant's responsibility. The approval of the drawings however shall not relieve the Bidder / Design Consultant of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of contract documents.

The fabrication drawings preparation shall consider but not be limited to the following requirements,

a) Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections.
b) Dimensional drawings of base plates, additional members, mounting details of equipment shall be shown in the drawings.
c) Provide the next higher available section in case the specified section is not available and submit comparison sheets to show that the proposed alternative sections are as strong as the original sections shown on the design drawings.
d) Complete Bill of Materials and detailed drawings of all sections and also their weights.

e) Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof.
f) The drawings shall indicate the items of steel work that require pre/post heating including sequence of welding stress relieving and test required to be carried out on welds identified as per this specification
g) The preparation of fabrication drawings shall not be sublet without prior approval of the Department.
h) The drawings shall give all the necessary information for the fabrication, erection and painting of the steel work in accordance with the provisions of this Specification.
i) The drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection.
j) The drawings shall give complete information necessary for fabrication of the various components of the steel work, including the location, type, size and extent of welds.
k) These shall also clearly distinguish between shop and field bolts and welds and specify the class of bolts and nuts.
l) The drawings shall be drawn to scale large enough to convey all the necessary information adequately.
m) Notes on the drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked up stresses and distortion.
n) Edge preparation details, welding and weld testing (NDT) shall be identified, requirements for preheating, inter pass heating, stress relieving and heat treatment procedure, wherever required, shall be clearly indicated in the drawings.
o) Wherever required backing strip at weld joints shall be in accordance with requirements of IS: 813 schemes of symbols for welding and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length.
p) Controlling dimensional tolerances and geometrical tolerances required as per design shall be bought out in fabrication drawing with proper details for inspecting the same.

The Bidder / Design Consultant shall be responsible for any alternations of the work due to discrepancies, errors or omissions on the drawings or specifications given by him, (even though such drawings or specifications have been duly approved), provided that such discrepancies, errors or omissions are not due to inaccurate information on the inputs furnished to the him by Department.

The Bidder / Design Consultant shall prepare process flow charts for all the fabricated and machined items sub assembly wise indicating process sequence, stages of inspection and care to be taken at different stages of process and shall be submitted to Department for approval.

At the conclusion of this phase, the Bidder / Design Consultant shall submit documents in soft copies and Five sets of hard copies for the purpose of review. 2D drawings, 3D models and FEM models/codes shall be submitted to department for review. Bidder / Design Consultant shall arrange for 7 copies (A0 or A1 or A3) of each drawing (department approved drawing) for realization of systems.

As a part of Phase-III, Bidder / Design Consultant needs to submit tender documents, Bill of Quantities and boughtout items specifications for tendering by Department. These are based on PDR phase estimation. Hence, after completion of Detailed design, Bidder / Design Consultant shall re-verify the Bill of Quantities and bring out the change w.r.to the quantities submitted after PDR phase. Detailed justification regarding the change in Bill of Quantities shall be submitted to Department.

c) Phase-III: Preparation of Tender Specification Documents as per Scope

a) On completion of Phase-I, the Bidder / Design Consultant shall generate the Tender Specification Documents / Bill of Quantities (BOQ) with detailed tender schedules based on which the Department can float tenders for the realization of systems for Civil/Electrical/AC/Mechanical systems / Safety & Firefighting systems/ Acoustic suppression system etc. Phase II and Phase III shall be carried out in parallel by the Bidder / Design Consultant.

b) Bidder / Design Consultant shall carryout market survey (regarding each system/equipment) and shall submit budgetary offers obtained from various suppliers/vendors for cost estimation by Department.

c) This phase will complete with submission of all the documents by the Bidder / Design Consultant after incorporating the comments, suggestions and recommendations by the Department.

d) For civil/electrical/AC works, cost estimation is to be carried out as per the latest SOR rates, which will be provided by Department.

d) Phase-IV: Certification of Design changes during realization

The contract shall remain active during the realization of systems. In this phase, the Bidder / Design Consultant shall be responsible to provide clarifications if a design change is envisaged in fabrication/ Manufacturing/civil/electrical/AC work due to unexpected reasons. Design verification is to be carried out for the changes proposed by Department. Bidder / Design Consultant shall give clearance to proceed with the modifications.

During realization of systems, if any additional drawings are required or additional sub-system is to be designed for the realization of systems (system which is listed this document), the same will be intimated to Bidder / Design Consultant by Department. Bidder / Design Consultant shall prepare the drawings/carry out design and submit the same to Department.

As per site requirement, if Department feels that, a site visit (to SDSC SHAR) by Bidder / Design Consultant is required for obtaining clarification or resolution of site issue, Department will request Bidder / Design Consultant for a site visit.

Consultant shall visit SDSC SHAR as per Department's request. No additional payment will be made for site visit.

B.6 Deployment Design Consultancy Team to SDSC SHAR:

For ensuring proper coordination with Department, Bidder / Design Consultant shall deploy following team to SDSC SHAR during "Preliminary Design Stage" and upto completion of Phase-II & III. This is in-addition to the workforce available at their office for carrying out major design works as per the scope mentioned in this document. Department will give prior intimation to Design Consultant after completion of Conceptual Design, for deployment of their team to SDSC SHAR.

Cost incurred for deployment of manpower and office-setup shall also be included in quotation as mentioned in Annexure – I (a) & I (b) itself. No separate quotation is acceptable.

Note: The number of personnel to be deployed (as mentioned in the below table) are indicative and are minimum number to be deployed. If required, Bidder / Design Consultant shall deploy additional manpower as per the workload and to complete the work within the delivery schedule. If Bidder / Design Consultant feel that deploying additional / other category manpower helps in better co-ordination and smooth progress of work, he shall take prior approval of Department before deploying the manpower. No additional cost will be payable to Bidder / Design Consultant.

S.No	Particulars	Number	Minimum Qualification	Minimum Experience& Knowledge
1.	Engineer	2	Bachelor's Degree in Civil Engineering	• Minimum experience: 5years • Basic knowledge in engineering and specifications generation of fasteners, lubricants, structural items, bearings, etc. • Knowledge in AUTOCAD and STAADs &ETABS for drawings generation, interface studies for modification/ improvement works and for design verification. • Should have knowledge in MS office for preparation of Design reports presentations etc.
2.	Engineer	2	Bachelor's Degree in Mechanical Engineering	• Minimum experience: 5years • Basic knowledge in engineering and specifications generation of fasteners, lubricants, structural items, bearings, etc. • Knowledge in AUTOCAD and 3D modelling software like Solidworks/ Ansys/STAADs &ETABS / fluid

S.No	Particulars	Number	Minimum Qualification	Minimum Experience& Knowledge
				analysis softwares for drawings generation, interface studies for modification/ improvement works and for design verification. Should have knowledge in FEM concepts. • Knowledge in specification of various Fasteners and Mechanical Elements/ consumables/spares, etc. • Should have knowledge in MS office for preparation of Design reports presentations etc.
3.	Engineer	2	Electrical &electronics engineer	• Minimum 5years experience • Hands on experience in 11/0.415kV operating voltage levels for various electrical equipment like MV&LT panels, Distribution Boards, illumination system, Earthing system, Lightning protection system and automation like Building management system. • Electrical, Instrumentation & control systems. It is required to have experience in handling Motors/ Pumps, IMCC, Sensors, PLC/ SCADA based control systems, Power/ Signal & Control cables
4.	Draftsman	4	ITI draftsman (Civil)	• Minimum experience: 5years • Knowledge in AUTOCAD for drawings generation for modification/ improvement works. • Should have knowledge in MS office for preparation of reports, minutes of meetings and office maintenance.
5.	Draftsman	3	ITI draftsman (Mechanical)	
6.	Draftsman	2	ITI draftsman (Electrical & Electronics)	

Following are the responsibilities of Design consultancy team deployed to SDSC SHAR during Phase-I (PDR), II & III

S.No	Responsibility	Bidder / Design Consultant Compliance
1)	Once the preliminary design (Phase-1) stage is completed, it is the responsibility of Bidder / Design Consultant to ensure that all the deliverables related to PDR are submitted by Bidder / Design Consultant to Department.	
2)	Obtaining clearance from Department during Phase-I to Phase-III stages of Design work.	
3)	Bidder / Design Consultant shall arrange for Hard copies of design reports, drawings etc and obtain clearance from Department. Accordingly, A0/A1 plotter, A3/A4 colour printer and computers (with required softwares) shall be arranged in their office.	
4)	Bidder / Design Consultant shall arrange for 7 copies (A0 or A1 or A3) of each drawing (department approved drawing)	
5)	Maintain proper configuration control of design reports and drawings.	

3. Launch Pad Systems:

3.1 Introduction:

A) The major Launch Pad Systems envisaged as a part of TLP project are,

- ✓ Single wedge Jet Deflector Duct (JDD).
- ✓ Tiltable Umblical Tower (TUT) with Secondary Mobile Launch Pedestal (SMLP)
- ✓ Primary Mobile Launch Pedestal (PMLP)
- ✓ Lightning Protection Towers (LPTs)
- ✓ Rail Track system connecting existing SVAB to TLP and NIF to TLP
- ✓ Crew Access Tower foundation
- ✓ Satellite & Vehicle Cool Air System

B) Launch Pad facilities for two different launch vehicle configurations are considered,

- ✓ Launch Vehicle-01 (LV-01 - *Core alone*) of 105m height and Ø6.5m
- ✓ Launch Vehicle-02 (LV-02 – *with 2 strapons*) of 105m height and Ø6.5m

Vehicle dimensions are subjected to change.

C) By considering, 2 different launch vehicle, following table gives the list of launch pad facilities to be designed,

S.No	System
1.	Primary Mobile Launch Pedestal
2.	Tiltable Umbilical Tower
3.	Secondary Mobile Launch Pedestal
4.	Hydraulic actuators system for tilting of TUT
5.	Wheel bogie system
6.	Lightning Protection Towers
7.	Jet Deflector Duct
8.	Rail track system
9.	Crew access tower
10.	Interface adapters for Static Testing of Stages

Note: For design of elements like JDD, LPTs, rail track system, hydraulic actuator system, PMLP ground anchors etc., worst case loads from PMLP, TUT & SMLP are to be considered.

D) Apart from systems for launch, static test of stages is also planned at launch pad. To meet this requirement, fixtures / adapters interfacing with PMLP/SMLP to test stage shall be designed.

E) At NGLV Integration Facility (NIF), the fully integrated and tested launch vehicle will be assembled on Tiltable Umbilical Tower (TUT). All the fluid umbilicals of the respective stages will be mated and leak checked at the Integration facility itself to minimize the pad occupancy time. The fully integrated launch vehicle will be transported to the launch pad on rail track using wheel bogie system over a rail track system with proper guiding. NIF building is connected to TLP using a rail track system of approximately 1.2km. The launch pad is configured for receipt of integrated vehicle in horizontal condition. After fixing and aligning the TUT hinges with brackets on PMLP, Launch Vehicle +TUT+SMLP will be tilted from horizontal to vertical position and locked with Primary Mobile Launch Pedestal (PMLP) which is positioned at launch pad.

F) TUT with SMLP is basically a structure which is provided to support the launch vehicle during horizontal assembly with SMLP, for transportation from NIF to TLP followed by tilting and anchoring of launch vehicle over PMLP at TLP.

All the umbilical connections are made from TUT to vehicle at NGLV Horizontal Integration Facility (NIF) when it is in horizontal condition. TUT facilitates the tilting of Launch Vehicle from horizontal to vertical at Third Launch Pad. When it is tilted to vertical, TUT acts as a support structure for last minute umbilical retraction.

G) PMLP & SMLP are fabricated steel structures used for supporting integration, transfer and launch activities.

H) Two type of rail track system are planned to be realized.

- ✓ Twin rail track system, similar to existing SVAB track: This will connect SVAB to TLP.
- ✓ NIF to TLP Rail track system: This will connect NIF building to TLP. The proposed configuration is twin rail track or as per design requirement.

I) A Single wedge J type Jet Deflector Duct (JDD) is proposed to be realized. This is meant for proper diverting of rocket exhaust.

ACOSS system will be interfaced with JDD through Piping system along with adequate support scheme and this system shall be protected from Launch Jet environment. A suitable civil foundation has to designed for realization of JDD. JDD shall also interface with rail track beam and ground anchors.

J) A Lightning Protection system (LPT), preferably of 4 tower configuration is planned to be realized around TLP. Each tower height is approximately 190m. This system is meant for protection Launch vehicle from lightning strikes and also to support auxiliary requirements like photography/CCTV requirements etc. LPTs shall have a maintenance cradle/lift to meet the approach requirements.

3.2 Operational Philosophy

A) <u>Operation Philosophy for launch vehicle:</u>

i. Sub-systems / stages of launch vehicle (LV-01 / LV-02) will be integrated horizontally in NIF building.

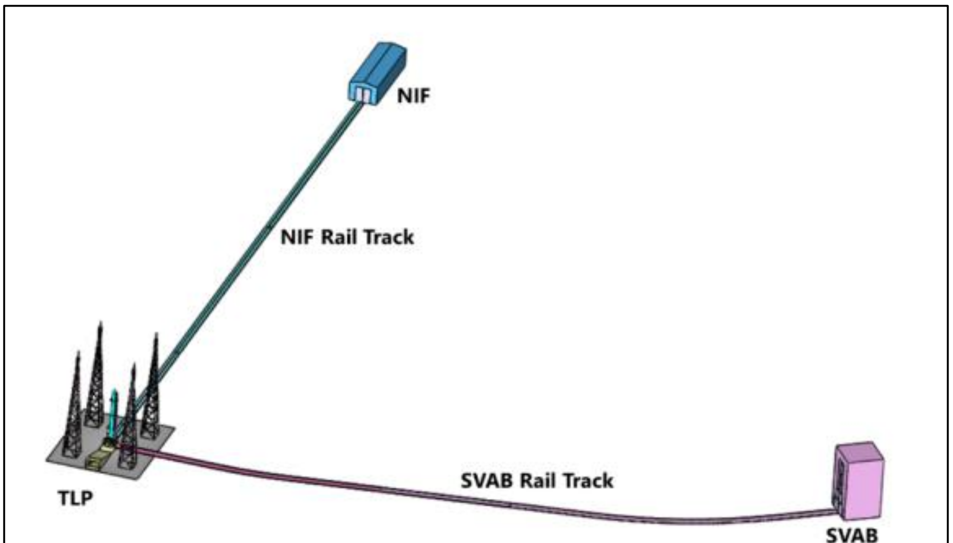
ii. It is proposed to lift entire vehicle and position it over TUT + SMLP.

iii. LV-01/LV-02 + TUT + SMLP will be moved to TLP over rail track system using Wheel bogie system

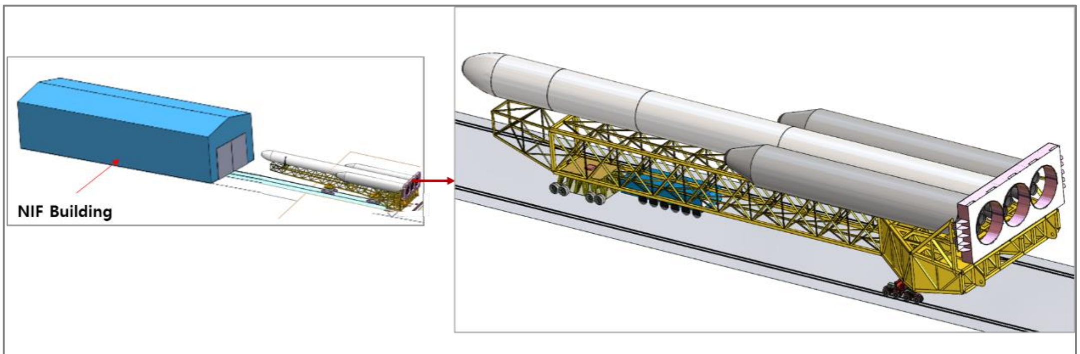
iv. TUT to PMLP hinge and TUT to Hydraulic actuators connection will be carried out at TLP.

v. Launch vehicle with TUT + SMLP will be tilted to vertical condition using hydraulic actuators. SMLP will be fixed to PMLP

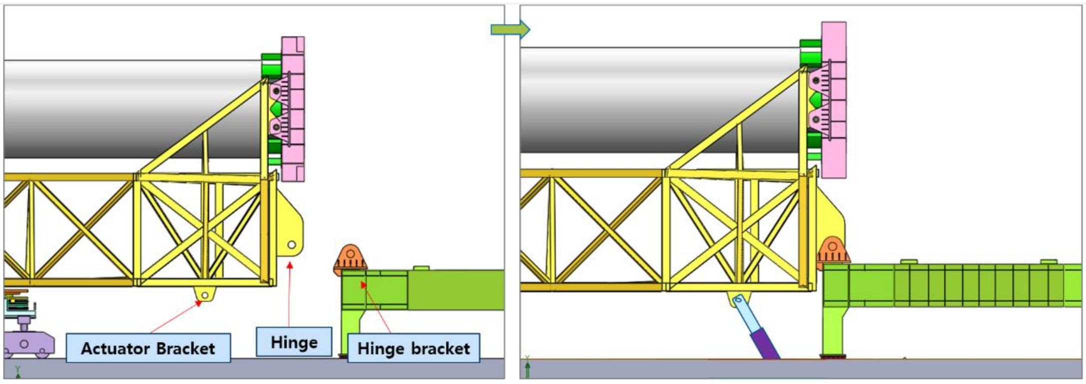
vi. Anchoring mechanism shall be provided over PMLP to ensure load of LV+ SMLP + TUT is transferred to PMLP uniformly.



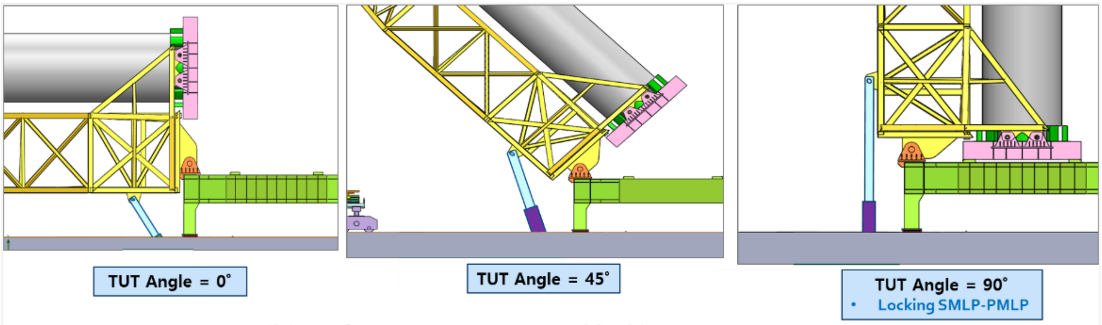
TLP overall Layout



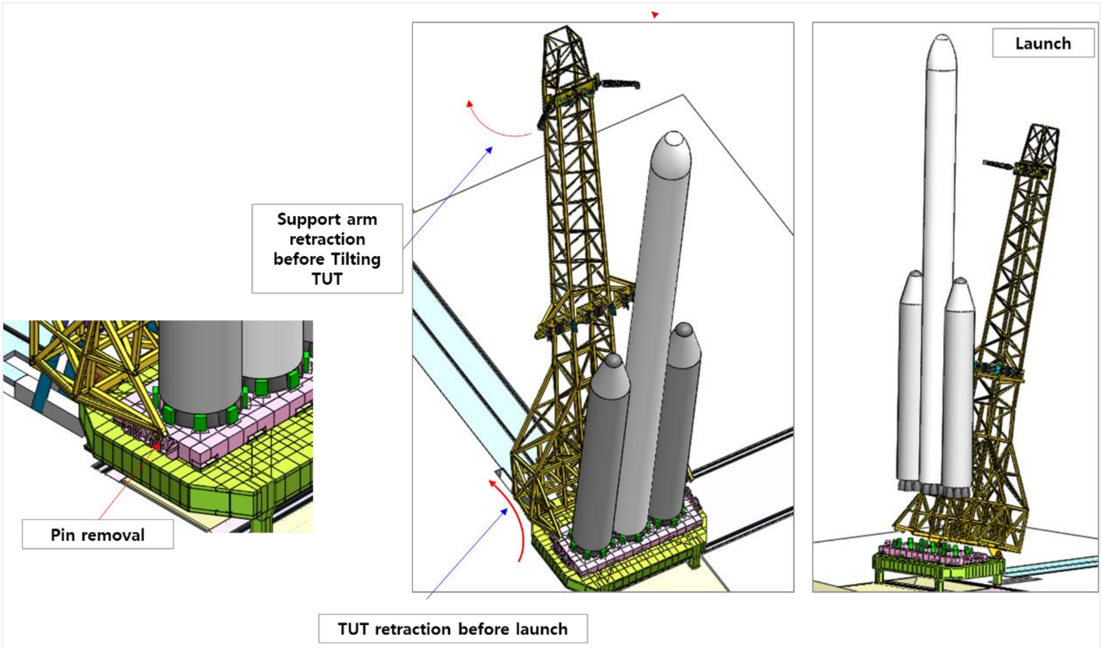
Movement of LV-02 from NIF Building



Alignment of TUT+SMLP w.r.t. PMLP, assembly of TUT-PMLP hinge & TUT-Tilting actuator connection



Tilting of LV + TUT + SMLP and locking to PMLP



B) Operation before launch: There is a requirement to tilt TUT by approximately 10^o-45^o away from vehicle just before launch. Hence, a suitable mechanism shall be provided in TUT configuration. Hydraulic system shall be designed to tilt the TUT in two steps, by 3^o to 5^o before launch and 10^o to 45^o at the launch time.

TUT movement from NIF to TLP: The proposed configuration for movement of TUT + SMLP + LV is using Wheel bogie system which will move over a rail track system. There is a requirement of aligning TUT with PMLP before the tilting of Launch vehicle. Hence, in the proposed configuration of Wheel bogie system, mechanisms for TUT rotation and Y direction movement are proposed.

Design Consultant shall study various options for TUT transportation and submit the configuration along with merits and demerits to Department for review and clearance.

3.3 System Description:

a. Primary Mobile Launch Pedestal (PMLP)

Sizes of the systems mentioned in this document are indicative only. Dimensions may vary as per department's requirement (or) by design consultant during system design.

A) Description

A) PMLP is a fabricated steel structure to support:

- Fully integrated Launch Vehicle with TUT/SMLP after tilting from horizontal to vertical.
- Routing of pneumatic, hydraulic, propellant servicing lines, electrical / checkout cables, cooling hoses etc., by user agency.

B) PMLP is made of thick steel plates and is totally a welded structure.

C) PMLP shall have a provision for transportation using existing bogie system + Hauler from SVAB building to TLP and Vice-versa.

D) PMLP is configured in a way that the PMLP legs and associated ground anchors are similar to that of existing Launch Pedestals.

E) The PMLP structure is positioned and anchored to the ground anchors at launch pad.

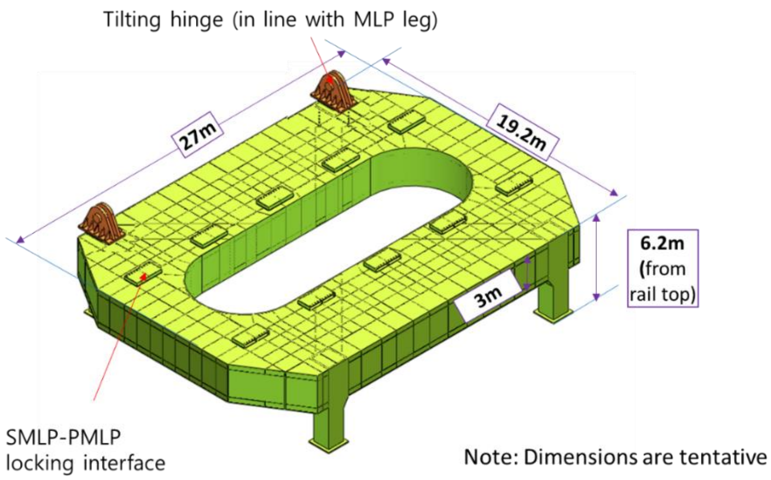
B) System Configuration

The proposed configuration of PMLP structure shall consists of the following:

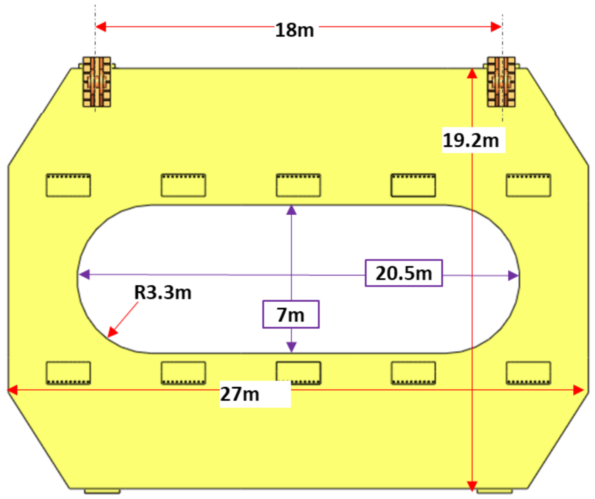
Dimensional Details:

- Overall Dimension: 27m*(W)X19.2m(L)X6.2m* (H)
- MLP leg c/c distance = 18mX18m
- MLP-Bogie mating interface c/c distance = 14m x 14m
- MLP deck bottom elevation: 3.2m

* Width and height are tentative and shall be finalized along with design of TUT and SMLP.



PMLP configuration



PMLP plan view

a) **Pedestal Deck**

The Pedestal Deck is made of structural steel plates arranged in the form of grid of multiple flanges and webs. The deck is designed to transfer the different loads from LV+SMLP+TUT and other applicable loads during the final tilting and positioning at launch pad. This shall also withstand static test loads also, i.e firing of launch vehicle stages for 20 seconds (tentative).

- The bottom of the deck is at EL 3200 and the top of the deck is at EL 6200 from rail top. There shall be two intermediate levels. Between the intermediate levels, a 2m x 2m passage / walkway shall be provided for accommodating Propellant & Pneumatic pipelines for servicing of liquid stages, safety equipment, etc. in the interior of the pedestal deck structure. Suitable cut-outs at the front & top faces of the MLP shall be provided, towards interfacing of MLP pipelines, instrumentation interfaces with the ground system as well as liquid stages. Suitable entry and exit openings shall be provided with doors for preventing entry of exhaust gases into the compartments. Staircases shall be provided for access from the floor level to the passage inside PMLP.

- Suitable cut outs shall be provided on top of the PMLP for allowing the strap-on jet and the core jet to flow.
- This overall size is split into smaller modules to facilitate fabrication, transportation, handling and erection of pedestal deck at site. Thus, PMLP is split into modules which will be transported separately and subsequently welded together at site.
- Pedestal deck shall have at least 4 nos of anchor legs / pin brackets (pin assembly shall be carried out using hydraulic mechanism) for supporting and locking SMLP. These are meant for uniform load distribution from SMLP to PMLP and anchoring LV + SMLP + TUT after tilting.
- PMLP deck shall have TUT hinge brackets which are aligned w.r.to 4 nos. anchor bracket meant for locking SMLP.

b) Anchor Legs and Bogie Interfaces:

- The PMLP structure is provided with four supporting anchor legs at its corners at 18 m square. These legs are intended for supporting the PMLP when it is anchored to the ground. PMLP anchors are fixed at the bottom of these support legs to suit the ground anchors provided at other integration buildings and Second Launch Pad. Bearing plates of suitable thickness are mounted between the ground anchors and the anchor legs. The anchor legs are also provided with a handling system for handling the bearing plates.

c) TUT-PMLP Hinge Brackets:

- After receipt of TUT + SMLP + LV-01/LV-02 at TLP, hinge on TUT will be aligned and locked with respective to hinge brackets on PMLP.
- Hinge brackets on PMLP will be perfectly aligned and positioned on PMLP deck top, so that once TUT is locked to these hinges, misalignment of vehicle axis w.r.to PMLP cut-out axis will be minimum.
- TUT-PMLP hinge pin assembly/disassembly shall be automated using hydraulic actuators or equivalent mechanism. It shall also be equipped with pin load monitoring system along with necessary electrical/electronics control system for remote operation.

d) SMLP to PMLP Anchoring System:

After tilting of TUT + SMLP + Launch vehicle, SMLP is to be anchored securely to PMLP. Necessary interface and anchoring provision shall be provided over PMLP. Suitable mechanism to uniformly transfer the load from SMLP to PMLP shall be designed.

This anchoring interface shall be capable of transferring self-weight load of SMLP+TUT + Launch vehicle (with propellant filled) and uplift load because of functioning of LHRS (launch hold and release system) during launch. Also, it has to withstand static test loads also.

e) **PMLP Anchoring System & Associated Civil Foundation:**

Anchoring system is to be provided for enabling assembly of PMLP to ground anchors. It involves fixing of PMLP to Ground interfaces at TLP. Anchoring points at TLP shall be designed considering the TLP JDD, rail track system and also launch jet loads. All anchors shall be at same level to meet the MLP levelling accuracy.

System is meant to carry the loads of PMLP, SMLP & TUT and LV-01/LV-02 and also static test loads.

Surface level of ground anchors should be +/- 1mm (tentative).

Suitable civil foundation shall be designed.

C) Functional Requirements

- PMLP structure is intended for providing support for the launch vehicle during tilting of vehicle and anchoring to launch pad.
- The PMLP structure must be stiff enough and shall support the vehicle loads, equipment loads, live loads, wind loads, launch jet loads, thermal loads and loads caused due to structural interactions at a maximum wind velocity of 30 m/s acting from any direction.
- Operating wind during PMLP movement shall be 18m/s.
- The PMLP shall have sufficient height so as to have enough stand-off distance from the jet deflector wedge.
- The PMLP shall have enough working space on it for the movement of personnel and material during the vehicle integration.
- The PMLP shall have required size of openings for the free escape of exhaust gases
- Suitable refractory lining/thermal protection is to be provided at areas impacted by jet on PMLP.
- Differential thermal expansion due to solar heating shall be taken care.
- PMLP is supported on anchor legs for anchoring to the ground anchors at pad.
- Suitable hand rails (removable type) are provided all along the edge of PMLP platform for safety of personnel (removable type) working on it.
- Staircase shall be provided as part of PMLP for men and material to access the PMLP platform.
- The PMLP shall have provision to accommodate all Sub-systems such as filling, Safety, compressed air, breathing air, hydraulic, electrical & checkout systems, etc. inside the box girders.
- PMLP shall have support brackets/blocks for supporting and anchoring LV + TUT + SMLP.
- PMLP shall have 4nos of bearing plates at the bottom of deck at four corners of 14m square. These plates will be used for resting over existing bogie system and Hydraulic jacks.

- Based on inputs from department, routing scheme for Propellant, checkout lines routing inside PMLP shall be developed by the design consultant.
- Shall have provision for strap-on cut outs with closures with a provision to easy assembling and disassembling with suitable arrangement.
- Shall have foldable stair cases from ground level to top surface of PMLP and a fixed stair case from top level to 3.8m level on the other side.
- In the box girders 2 x 2 m square duct is to be provided with suitable approaches to accommodate service lines, safety equipment, electrical & checkout lining inside the structure. Suitable doors are to be provided.
- Lighting and ventilation system suitable to Class IIC environment to be provided inside the box girders.

D) Design Inputs:

The design criterion, loads and load cases mentioned in the below section shall be considered. However, if required, as suggested by Department, party shall also consider additional loads and cases for design.

a) The PMLP shall be designed for static, modal & buckling cases.
b) PMLP ground anchor foundation shall be designed for worst case vehicle load, i.e LV-02 + PMLP
c) Top surface (interfacing with vehicle) accuracy shall be 30 arc seconds. The top face shall lie within 2 parallel planes, which are 0.5 mm apart, and the mean plane shall make an angle not more than 30 arc seconds with a reference horizontal plane under full load.
d) The top surface shall lie within +/- 0.5 mm maximum from the mean position.
e) Acceleration / deceleration during movement of PMLP shall be 0.03 m/sec^2.
f) Vertical spring mode frequency shall not be less than 10 Hz (tentative).
g) Maximum allowable deflection at center of PMLP shall be of the order of 6mm (tentative)and the stiffness of the system shall be of the order of 1.7 x 10^6 kg/cm. (tentative)
h) PMLP shall be designed for the conditions when it is moving on the bogie and when it is anchored to ground.
i) CFD analysis is to be carried out to understand the interaction of nozzle exhaust jet with TUT + SMLP + PMLP interfaces and subsystems. Nozzle exit parameters will be given by Department. This data shall be used for designing of protective hoods on launch pad systems, arriving jet loads etc.

Type of loads (tentative) to be considered:
The loads mentioned are below are indicative.

S. No	Type of Load	Abbreviation	Load data (tentative) *Exact details will be provided to qualified Design Consultant along with PO*
1.	Vehicle load	VLcg	Dry mass of the LV-01 vehicle is 200t & with propellant filled condition is 1500t approx.

S. No	Type of Load	Abbreviation	Load data (tentative) *Exact details will be provided to qualified Design Consultant along with PO*
			(This is a sub-set) Dry mass of LV-02 vehicle is 400t & with propellant filled condition is 3100t approx. (This shall be the design load) The effect of vehicle weight due to the CG offset is also to be considered. The effect of CG offset along 'X' axis, 'Y' axis and 'Z' axis is considered.
2.	Dead Load	DL	Self-weight of PMLP structure including weight of refractory cement. Weight of refractory will be intimated by department.
3.	Live load	LL	250 kg/m^2 for PMLP top surface.
4.	Wind Load	WL	Operational wind loads to be considered as 30m/s and launch wind load to be considered as 18m/s in different directions as per IS 875.
5.	Temperature Load (Solar heating)	TL	Ambient temperature to be considered is 37^oC. Temperature gradient shall be in the range of $\pm 8^oC$ from the ambient.
6.	Acoustic load	SDP	Acoustic load corresponding to sound pressure of 172 dB.
7.	Jet load	JL	Jet load of 1.5 Kg/cm^2 acting on the top during lift off.
8.	Acceleration load	AL	Acceleration of 0.03 m/sec^2 during movement on track.
9.	Support settlement load	SSL	Two supports resting on one of the jet deflector duct walls will be considered to sink simultaneously. The loading effect due to differential support settlement of 1.5mm will be considered
10.	LV-01 maximum thrust	Nth	To be considered for SMLP-PMLP interface/PMLP design. Tentative thrust – 1600t. Input will be provided along with PO.
11.	LV-02 maximum thrust	Lth	To be considered for SMLP-PMLP interface/PMLP design. Tentative thrust – 5000t. Input will be provided along with PO.

S. No	Type of Load	Abbreviation	Load data (tentative) *Exact details will be provided to qualified Design Consultant along with PO*
12.	Static test thrust	Mth	Tentative thrust – 1600t. Input will be provided along with PO.
13.	SMLP + TUT + LV-01/LV-02	Tilting	SMLP + TUT + LV-01/LV-02 will be tilted from horizontal to vertical. Loads because of tilting and positioning is to be considered
14.	SMLP + TUT + LV-01/LV-02	Vertical	SMLP + TUT + LV-01/LV-02 positioned over PMLP in vertical condition

Type of load combinations (tentative) considered:

Various load combinations are to be considered during design. Details will be provided to qualified Design Consultant along with PO. Typical Load combinations (LC) are listed below:

Case No.	Loading combination	Boundary conditions
PMLP during transportation		
1	DL + LL + WL + AL	PMLP on rail
Loads on PMLP because of Tilting and positioning/anchoring of TUT + SMLP + LV-01/LV-02		
2	DL + LL + VLcg + Tilting + WL	Fixed to anchor Tilting loads because of LV+TUT+SMLP and last minute reverse tilting of TUT load cases to be considered.
PMLP at launch pad		
3	DL + LL + VLcg + WL	Fixed to ground anchors
4	DL + LL + VLcg + WL + TL	Fixed to ground anchors
Loads on PMLP due to Static Test firing		
5	DL + VLcg + SDP + Nth+JL+WL	Fixed to ground anchors (LV-01 launch / static testing)
6	DL + VLcg + SDP + Lth+JL+WL	Fixed to ground anchors (LV-02 launch / static testing)

Case No.	Loading combination	Boundary conditions
PMLP at launch pad (During launch)		
7	DL + JL + SDP	Fixed to ground anchors
Modal analysis		
8	Modal analysis	Vertical spring mode Fixed to ground anchors
Wheel load analysis (PMLP on rail track)		
9	DL + LL + VLcg + WL	PMLP on rail, stiffness of rail track & subsoil
Analysis for permissible skew		
10	DL + LL + VLcg	PMLP on rail and it is guided by transporter
Stability analysis		
11	0.9 DL + 0.9 of vehicle weight + WL	PMLP on rail

** Loads and load cases are tentative. Exact details will be provided to qualified Design Consultant along with Purchase order*

b. Tiltable Umbilical Tower + Secondary Mobile Launch Pedestal:

Sizes of the systems mentioned in this document are indicative only. Dimensions may vary as per department's requirement (or) by design consultant during system design.

A) Description:

TUT with SMLP is basically a structure which is provided to give support to the vehicle at the bottom as well as sideways during horizontal assembly and transportation. All the umbilical connections are also routed along TUT to vehicle at NIF when it is in horizontal condition. TUT facilitates the tilting of LV from horizontal to vertical at launch pad. When it is tilted to vertical, TUT acts as a support structure for last minute umbilical retraction.

TUT + SMLP is a fabricated steel structure used for:

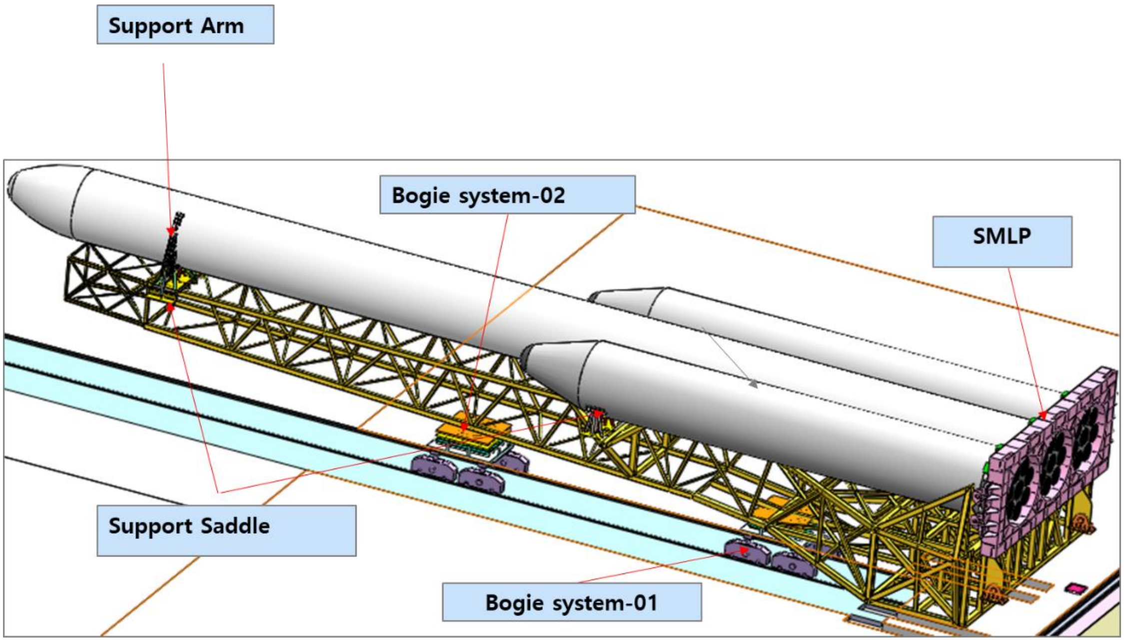
- Horizontal positioning and transportation of fully integrated LV-01/LV-02 from NIF to TLP.
- Tilting of LV-01 or LV-02 at TLP and followed by positioning and anchoring over PMLP.
- Routing of pneumatic, hydraulic, propellant servicing lines, safety, electrical / checkout/ instrumentation cables, cooling hoses. etc.
- LHRS and LV-01/LV-02 sit-on umbilical system are located over SMLP. Suitable routing scheme for propellant hoses for the proposed core-alone version sit-on system will be provided in SMLP.

- ➢ SMLP will be fixed to TUT structure using pin/bearing/hinge.
- ➢ TUT will also have interface for connecting to tilting hinges available on PMLP.
- ➢ Tilting of TUT + SMLP + Launch vehicle is proposed using Hydraulic actuator system.
- ➢ Openings on SMLP for interfacing of pipelines shall be provided.

B) Sequence of Activities Proposed for Tilting of Launch Vehicle:

SMLP along with TUT will be positioned at NGLV Horizontal Integration Building (NIF). After completion of integration, the TUT with SMLP along with Launch vehicle is moved to launch pad horizontally using Bogie System + Hauler. After fixing and aligning the TUT hinges with ground anchor brackets, Hydraulic actuators will be attached to TUT structure and then, LV +TUT+SMLP will be tilted from horizontal to vertical position. Anchoring of SMLP+LV+TUT over PMLP will be carried out using Hydraulic pin insertion/locking system and anchor blocks provided on PMLP. After tilting of TUT and SMLP, locking of SMLP with primary MLP with the help of fasteners/suitable mechanism will be carried out.

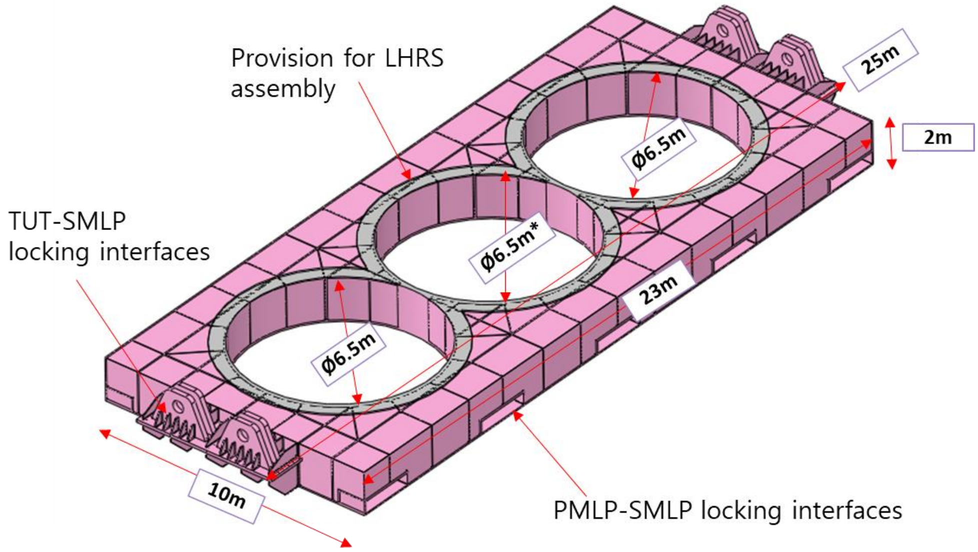
As a part of launch countdown, TUT structure will be tilted back by approximately 6^{o} to 45^{o}(tentative) before lift-off of Launch vehicle.



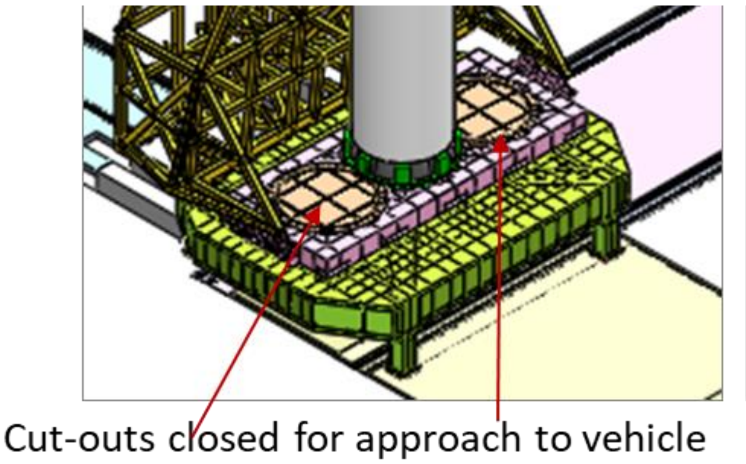
TUT-02 with SMLP-02

C) Secondary Mobile Launch Pedestal - System Configuration

Dimensional Details: • Overall Dimension: 10m(W)X23m(L)*X2m* * Width and height are tentative and shall be finalized along with design of TUT and SMLP.



SMLP configuration (LV-02)



SMLP configuration (LV-01)

a) **Pedestal deck:**

The Pedestal Deck shall be made of structural steel plates arranged in the form of grid of multiple flanges and webs. The deck is designed to transfer the different loads from LV-01/LV-02 and other applicable loads during the integration, transportation and final positioning at launch pad.

Bottom of pedestal deck shall have supports for anchoring of SMLP + TUT + LV to PMLP. Suitable cut outs shall be provided on top of the PMLP or SMLP for allowing the strap-on jet and the core jet to flow. Cutout covers shall be provided for strapon cutouts on SMLP to enable approach during LV-01 servicing activities. Suitable cut outs shall be provided for routing of Process pipelines, instrumentation interfaces.

SMLP shall be split into smaller modules to facilitate fabrication, transportation, handling and erection of pedestal deck at site. It shall be ensured that the maximum size of a single module is decided based on the transportation requirement. An interface ring/Pedestals shall be realized between Vehicle to SMLP.

b) **SMLP to PMLP Anchoring System:**

After tilting of TUT + SMLP + Launch vehicle, SMLP is to be anchored securely to PMLP. Necessary interface and anchoring provision shall be provided over PMLP.

This anchoring interface shall be capable of transferring self-weight load of SMLP+TUT + Launch vehicle (with propellant filled) and uplift load because of functioning of LHRS (launch hold and release system).

c) **Vehicle Interfaces rings:** LHRS supports are planned for LV-01& LV-02. Hence, suitable interface rings have to be designed between SMLP and LV-01/LV-02.

d) **SIT-ON umbilical interfaces:** SIT-ON umbilical system is proposed for launch vehicle propellant filling. Hence, vehicle interface rings shall have provision to accommodate SIT-ON umbilical system.

e) **Hinge pin interface for connecting Tiltable UT:** TUT will be connected to SMLP using hinge pins. Before final tilting of TUT, all hinge pins will be removed. Scheme for automatic remote operation for assembly/disassembly of pin along with necessary electrical/electronic control system is in the scope of Design Consultancy.

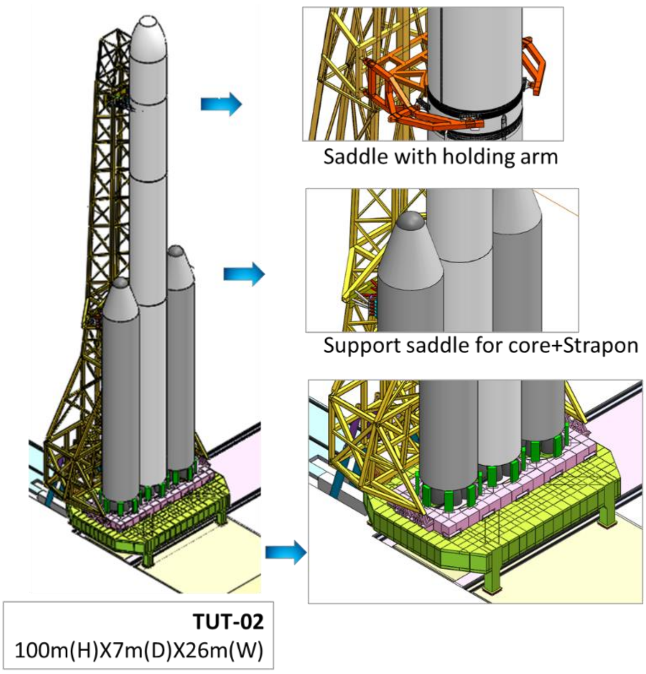
D) Tiltable Umbilical Tower – System Configuration:

a) TUT Structure:

TUT is a steel structure of dimension of approximately 100m(L) X26m(W) X7m(D). Based on increase in launch vehicle height, TUT height shall also be increased to support the vehicle. It serves as a supporting member for LV-01/ LV-02 in horizontal condition. TUT structure will be fixed to hinge brackets and also to SMLP hinges. TUT will have interfaces for connecting Hydraulic actuator system.

Process & safety system pipelines, Satellite cooling ducts, electrical, instrumentation and checkout umbilical will be routed through TUT and then connected to launch vehicle.

Suitable refractory lining/thermal protection is to be provided at areas impacted by jet on TUT



TUT configuration (Dimensions are indicative)

b) Vehicle Support Saddles:

The TUT shall have two kinds of LV support system.

i) Support Saddles: These support saddles provide support to the LV (simply supported condition) during the horizontal transportation of the LV. The saddles can be adjustable along the length of the TUT upto a certain extent (TBD). Suitable mechanisms are required for retraction of support saddle along with necessary electrical/electronics control system for remote operation.

ii) Holding Arms: These arms are the anchoring points of the LV on the TUT and hold the LV in vertical condition. 1no. or max 2 nos. shall be provided on the LV for grabbing / anchoring the LV. These arms shall be retracted before the TUT is being retracted back.

Both these supports shall provide freedom for axial movement of the LV.

Exact number of support saddles and holding arms will be given to qualified design consultant along with PO.

c) TUT tilting hinges: These are the hinge brackets about which TUT tilting is proposed. Hinges brackets will be anchored to ground anchors/PMLP before tilting of TUT + SMLP + Launch vehicle. Since, the size of lock pin is heavy, automatic pin assembly mechanism with feedback and control system shall be planned.

d) Hydraulic actuators: Four number of actuators are proposed for tilting of LV + TUT + SMLP. One end of actuators will be fixed to ground and other end will be connected to TUT. Suitable spherical bearing + pin arrangement shall be planned at the ends of hydraulic actuators to adjust for misalignments. Pin assembly with ground anchors/hinge brackets shall be automated, so that the human intervention is minimized. Hydraulic cylinders shall be properly supported/stored when they are not connected to TUT. Accordingly, suitable mechanism shall be planned to support them.

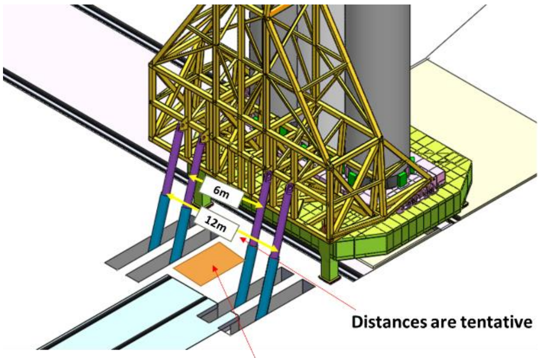
Since, the weight of Hydraulic actuators is high, suitable lifting mechanism shall be provided to lift the actuator, so that piston end of actuator can be connected to TUT.

Provision for handling Hydraulic actuators at site shall be available in case of any maintenance / repair is called for.

Hydraulic cylinder, powerpack, circuit, control system shall be enclosed with protective enclosure or an RCC room (Civil, Electrical & AC) near to launch pad. This is meant to protect the system from launch environment.

Piston of hydraulic cylinders will be exposed to launch environment, hence, suitable thermal protection of hydraulic cylinders shall be planned.

Optimum configuration of hydraulic actuator comprising no. of actuators, extended length, retracted length, capacity, connection points on ground and TUT shall be studied and presented to department.



TUT Hydraulic actuator configuration

Operation of Hydraulic actuators shall be controlled using a Hydraulic powerpack system and PLC based control system etc, as per the requirement.

Two modes of operation of Hydraulic actuators are planned:

- Mode-1: For tilting of LV-01/LV-02+TUT+SMLP from horizontal to vertical condition and positioning over PMLP.

  In this mode, LV-01/LV-02+ TUT + SMLP will be received in horizontal condition.

  Hydraulic actuator system shall be lifted and then connected to TUT. This system will be used for tilting of LV-01/LV-02+ TUT + SMLP.

  Approximate time for operation considered is 2hours. Tilting operation is divided into 3 categories,

  1) Tilting from 0^o to 20^o: In this range, tilting operation shall be carried out in creep speed.
  2) Tilting from 20^o to 70^o: In this range, tilting operation shall be carried out in normal speed.
  3) Tilting from 70^o to 90^o: In this range, tilting operation shall be carried out in creep speed.

     Creep speed shall be tentatively $1/10^{th}$ of normal speed.

     Normal speed and Creep speed values will be provided to qualified Design Consultant along with PO. There shall be a provision to control speed of tilting by user.

  At a particular angle of TUT, there will be a CG (center of gravity) shift from one side to other side of the hinge, leading to change in load direction on hydraulic actuators (push to pull). Hence, suitable care shall be taken in configuration of system, so that the entire tilting activity will be smooth.

- Mode-2: Last minute tilt of TUT away from launch vehicle

  In this mode, the activities will be scheduled as a part of ALS (automatic launch sequence) phase, where in the activity is scheduled by vehicle on-board computer. Also, TUT to SMLP lock pin shall be removed remotely. Hence, the proposed control system of hydraulic actuator shall be compatible with Department's system.

  Retraction-1: TUT will be tilted slowly away from launch vehicle by around 3^oat around To-3 minutes (To – Launch time)

  Retraction-2: During launch, TUT will be tilted further away from 3^o to upto certain angle (less than 45^o). This shall happen at slightly higher speed.

Since, Retraction-2 operation is carried out at higher speeds, a buffer system or mechanical lock of TUT is required to slow down the TUT retraction and stop at certain angle.

Details will be furnished by Department.

- Mode-3: TUT operation in case of launch calloff.

  In this mode, if there is a launch calloff, TUT which is at retracted condition has to brought back to vertical condition and pin between SMLP to TUT shall be engaged remotely.

  Foreend support arm shall be connected to launch vehicle.

  Once clearance is received from Launch Vehicle teams, the empty vehicle shall be tilted back from 90^o to 0^o in creep and normal speed as similar to Mode-1.

- It may be noted that, two different speeds of tilting are proposed in Mode-1 & 2. Also, in mode-1, TUT+SMLP+LV will be tilting, whereas in mode-2, only TUT needs to be tilted back.

Note:

- Based on the size of Hydraulic actuator with associated hydraulic circuit/powerpack and control system, design consultant may configure the entire system (i.e Hydraulic actuator, power pack and control system).
- Suitable ground anchors with civil foundation has to be realized to transfer TUT + SMLP + LV-01/LV-02 tilting loads to ground.

e) TUT shall provide support saddles for carrying out the stage – wise assembly on the TUT or full LV assembly on TUT.

f) **Approach Platforms:** Suitable approach platform fixed, emergency ladders or movable over TUT shall be designed based on requirement

g) **Routing:** Routing of pneumatic, hydraulic, propellant servicing lines, safety, electrical / checkout/ instrumentation cables, cooling hoses. etc. through TUT and SMLP shall be developed by design consultant based on inputs from the department.

h) **TUT Shelter:** To carry out maintenance of TUT and to protect it from adverse weather conditions, TUT shelter is to be designed.

i) **Actuator and associated civil foundation:**

- Anchoring system is to be provided for enabling fixing of TUT tilting actuator brackets to Ground interfaces. Ground anchors has to be designed considering the hydraulic actuator loads.
- All anchors shall be at same level to meet the PMLP levelling accuracy.
- System shall be designed for tilting actuator loads during tilting and final positioning.
- Positional accuracy of ground anchors should be +/- 1mm.
- Suitable civil foundation shall be designed.
- Hydraulic cylinder, powerpack, circuit, control system shall be enclosed with protective enclosure or an RCC room (Civil, Electrical & AC) near to launch pad.

- TUT + SMLP + LV shall be anchored inside NIF, near launch pad and inside TUT shelter. Hence, suitable ground anchor system shall be provided.

E) Specifications of Instrumentation and Control System:

LV + TUT + SMLP will be tilted near the launch pad with a hydraulic system. Suitable instrumentation and control systems must be selected and configured for precise tilting. The requirements for maintaining an overall tilt accuracy of 0.1° for the control system are given subsequently. The TUT is proposed to tilt using a hydraulic system of suitable capacity, driven by suitable pumps. For details please refer Section- 9.

F) FUNCTIONAL REQUIREMENTS OF SMLP & TUT

- SMLP + TUT structure is intended for providing support for the launch vehicle during integration, transportation of the vehicle to launch pad, tilting of launch vehicle at TLP and vice versa.
- SMLP / TUT structure shall be stiff enough and shall support the vehicle loads, equipment loads, live loads, wind loads, launch jet loads, static test loads, thermal loads and loads caused due to structural interactions at a maximum wind velocity of 30 m/s acting from any direction. SMLP shall be capable of moving the vehicle at controlled speed at a wind velocity of 18 m/s acting from any direction.
- SMLP shall have enough working space on it for the movement of personnel and material during the vehicle integration.
- SMLP shall have required size of openings for the free escape of exhaust gases.
- It shall have suitable thermal protection (refractory lining).
- Differential thermal expansion due to solar heating of TUT and SMLP shall be taken care.
- After tilting of LV + TUT + SMLP to vertical condition, SMLP is supported on anchor legs/pin arrangement for anchoring to the PMLP deck ground anchors. Hence, suitable support blocks/interfaces shall be provided on the bottom of SMLP.
- TUT + SMLP shall have tilting interfaces (or hinge brackets) on PMLP.
- Suitable hand rails (removable type) are provided all along the edge of SMLP platform for safety of personnel (removable type) working on it.
- Hinge pin locking mechanism, TUT hydraulic actuators, control system and hydraulic powerpack system may be exposed to hot gas environment, hence suitable protection hoods shall be considered during design phase itself.
- **Alignment of PMLP and TUT+SMLP:** PMLP will be moved from SVAB to TLP using Wheel bogie system over a rail track. TUT will be moved from NIF to TLP using wheel bogie system over a rail track. Hence, before commencement of tilting, alignment of PMLP to TUT+SMLP at launch pad shall be ensured for assembly of pins to tilting hinges before tilting of TUT+SMLP. Hence, suitable alignment mechanisms are to be provided on Wheel bogie system.

G) Design Inputs:

The design criterion, loads and load cases mentioned in the below section are tentative. If required, as suggested by Department, party shall also consider additional loads and cases for design.

a) The SMLP shall be designed for static, modal, dynamic& buckling analysis.

b) Top surface (interfacing with vehicle) accuracy shall be 30 arc seconds. The top face shall lie within 2 parallel planes, which are 0.5 mm apart, and the mean plane shall make an angle not more than 30 arc seconds with a reference horizontal plane under full load.

c) The bottom surface of SMLP deck anchor blocks shall be within +/- 0.5 mm maximum from the mean position.

d) TUT + SMLP + LV Acceleration / deceleration during movement shall be 0.03 m/sec^2.

e) SMLP Vertical spring mode frequency shall not be less than 10 Hz (tentative).

f) SMLP Stiffness of structure shall not be less than 1.7 x 10^6 kg/cm (tentative).

g) Maximum permissible deflection of TUT at tip shall be of the order of 50mm to 100mm (tentative). However, exact permissible deflection will be provided to qualified Design consultant along with PO.

h) If structural deflection of TUT exceeds permissible deflection during tilting of vehicle, design consultant may propose active hydraulic/ equivalent mechanism to limit deflection at vehicle supports.

i) The differential deflection of SMLP LHRS support location shall be less than 0.5mm.

j) Jerk free tilting of TUT + LV + SMLP followed by precise and slow positioning over PMLP.

k) Anchoring of SMLP with PMLP and ensuring load of SMLP+TUT+LV transferred properly to PMLP.

l) Hydraulic actuator system and civil foundation shall be designed for worst case weight/loads, i.e SMLP-02 + TUT-02 + LV-02

m) CFD analysis is to be carried out to understand the interaction of nozzle exhaust jet with TUT + SMLP + PMLP interfaces and subsystems. Nozzle exit parameters will be given by Department.

Type of loads to be considered:

The loads mentioned are below are indicative.

S.No	Type of Load	Abbreviation	Load data (tentative) *Exact details will be provided to qualified Design consultant along with PO*
1	Vehicle load	VLcg	Dry mass of the LV-01 vehicle is 200t & with propellant filled condition is 1500t approx. (This is a sub-set) Dry mass of LV-02 vehicle is 400t & with propellant filled condition is 3100t approx. (This shall be the design load) The effect of vehicle weight due to the CG offset is also to be considered.

S.No	Type of Load	Abbreviation	Load data (tentative) *Exact details will be provided to qualified Design consultant along with PO*
			The effect of CG offset along 'X' axis, 'Y' axis and 'Z' axis is considered.
2	Tilting load	Vtilt	LV-01/LV-02 + TUT + SMLP tilting from horizontal to vertical. TUT + SMLP tilting. Tilting back of TUT.
3	SMLP + TUT	Vsm+tut	Self-weight of SMLP and TUT shall be considered.
4	Dead Load	DL	Self-weight of TUT + SMLP structure including weight of refractory cement. Self-weight of PMLP structure including weight of refractory cement. Weight of refractory will be intimated by department. It shall also include propellant and gas servicing pipe line weight, electrical umbilical weight and AC duct weight.
5	Live load	LL	250 kg/m^2 for SMLP top surface.
6	Wind Load	WL	Operational wind loads to be considered as 30m/s and launch wind load to be considered as 18m/s in different directions as per IS 875.
7	Temperature Load (Solar heating)	TL	Ambient temperature to be considered is 37^{o}C. Temperature gradient shall be in the range of ±8^{o}C from the ambient.
8	Acoustic load	SDP	Acoustic load corresponding to sound pressure of 172 dB.
9	Jet load	JL	Jet load of 1.5 Kg/cm^2 acting on the top during lift off.
10	Acceleration load	AL	Acceleration of 0.03 m/sec^2 during movement on track.
11	Load because of LHRS	LHRS	LV-01/LV-02 will be supported over SMLP using Launch Hold and Release System (LHRS). LHRS hold the vehicle to SMLP and inturn to PMLP until required pressure is achieved in Launch Vehicle engine firing. Hence, this load shall be considered. Max load per LHRS for

S.No	Type of Load	Abbreviation	Load data (tentative) *Exact details will be provided to qualified Design consultant along with PO*
			LV-01: 1550 kN LV-02: TBD
12	LV-01 maximum thrust	Nth	To be considered for SMLP-PMLP interface/PMLP design. Tentative thrust – 17402 kN Input will be provided along with PO.
13	LV-02 maximum thrust	Lth	To be considered for SMLP-PMLP interface/PMLP design. Tentative thrust – 52206 kN Input will be provided along with PO.
14	SMLP + TUT + LV anchoring over PMLP	Anc	After tilting of LV +TUT + SMLP, it will be anchored to PMLP. These loads are to be considered. Suitable adapter may be planned.
15	Approach platform and maintenance cradle with winch (capacity 500kg)	APS	If approach platform is proposed to be connected to TUT, loads because of this shall be considered.
16	Hydraulic actuators load	HA	Tilting loads on TUT because of Hydraulic actuators

Load Cases:

Various load combinations are to be considered during design. Details will be provided to qualified Design Consultant along with PO / during CDR and PDR.

Typical Load combinations (LC) are listed below:

Case No.	Loading combination	Boundary conditions
TUT + SMLP in NIF building		
1	DL + LL	TUT on Bogie system / anchors
2	DL + LL + VLcg	Loading of LV-01/LV-02 over TUT and connecting to SMLP TUT on Bogie system / anchors
TUT+SMLP movement to TLP		
3	DL + LL + WL + AL + VLcg	TUT + SMLP on rail

Case No.	Loading combination	Boundary conditions
Tilting of TUT+SMLP+LV-01/LV-02 at TLP		
4	DL + WL + AL + VLcg + HA + WL	During Tilting Worst case load during tilting has to be brought out by design consultant.
5	DL + WL + AL + VLcg + HA + WL	During positioning of SMLP over PMLP (after tilting)
During static test firing/launch of LV-01/LV-02		
6	DL + VLcg + SDP + Nth+JL+WL	Fixed to PMLP (LV-01 launch / static testing)
7	DL + VLcg + SDP + Lth+JL+WL	Fixed to PMLP (LV-02 launch / static testing)
Retraction of TUT		
8	DL (TUT) + HA + Acc + WL	TUT connected to Hydraulic actuator SMLP is fixed to PMLP

c. Wheel Bogie System

A) Description

Wheel Bogie System is meant for transportation of Tiltable UT (TUT) or TUT + SMLP + LV-01/LV-02 vehicle from NIF to TLP and vice versa. Bogie system shall be designed for LV-02 loads and dimensions as a determining case.

The launch vehicle transportation system shall be planned with the following alternatives:

a) Wheel bogies on aft end to support the TUT at two locations and wheel bogies at fore end moving on the same rail track

b) Wheel bogies on aft end and single road moving unit at fore end.
Design Consultant shall study the above two options and transportation via road and bring out a comparison report indicating technical details and cost comparison.

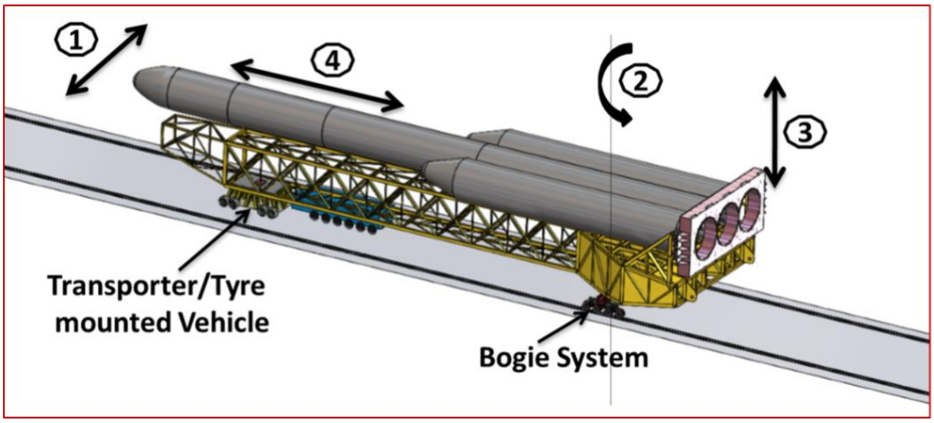
Option-a

- ✓ **TUT aft end support:** Two units of Bogie (Bogie-1 & 2) are proposed to support LV-01/LV-02 + TUT + SMLP, one each on either side of TUT on aft end. Number of wheels required can be decided as per the design.
- ✓ **TUT fore end support:** TUT frame on the fore end will also be supported over two bogie units. Bogie system will be propelled using a road moving tow tractor/ Hauler. The above details are preliminary and shall be as per design requirement.
- ✓ Empty bogies shall be self-propelled either hydraulically or electrically with suitable gear mechanism

Option-b

- ✓ **TUT aft end support:** Two units of Bogie (Bogie-1 & 2) are proposed to support LV-01/LV-02 + TUT + SMLP, one each on either side of TUT on aft end. Number of wheels required can be decided as per the design.
- ✓ Empty bogies shall be self-propelled either hydraulically or electrically with suitable gear mechanism
- ✓ **TUT fore end support:** Support of TUT + SMLP +LV at fore end is through Tyre mounted custom-built vehicle or SPU/SPMT. Since the axle load will determine the design of rigid pavement between the rail track, overall optimization shall be carried out for number of axles and type of tyres.

- Hydraulic jacks with associated power pack system shall be planned over each bogie. This is meant for lifting TUT+SMLP+LV-01/LV-02 for alignment with hinge-eyes on PMLP and hydraulic tilt cylinders. However, final configuration of hydraulic system shall be as per design.
- **Alignment of PMLP and TUT+SMLP:** TUT will be moved from NIF to TLP using wheel bogie system over a rail track. Hence, before commencement of tilting, alignment of PMLP to TUT+SMLP at launch pad shall be ensured for assembly of pins to tilting hinges before tilting of TUT+SMLP. Hence, suitable alignment mechanisms are to be provided on both the Wheel bogie + TUT + SMLP



1. TUT + SMLP Linear movement across track
2. TUT + SMLP rotation
3. Hydraulic jacks in wheel bogie system for vertical adjustment
4. Along the track adjustment using Hauler

Degrees of freedom on bogie system

- Real time assessment of misalignment between PMLP and SMLP+TUT+ LV-01/LV-02 shall be available on a HMI screen. This can be realized by measuring the misalignment using laser guided system or equivalent sensors/ micro controller with graphical display of misalignment in a display panel.
- Design consultant may develop mechanism for correcting misalignment between TUT and PMLP along with online monitoring & correction mechanism.
- All the specifications and configurations of bogie system are indicative only.

Description	**Parameter**
Location of Bogie system below TUT	To be decided (Based on Combined C.G of TUT + SMLP + Vehicle after finalizing their design)

Description	Parameter
Width of the track	18 m C/C (To be arrived as per design)
Tread diameter of wheels	To be arrived as per design
Wheel specification	Forged wheel
No. of wheels in each bogie	8nos. or as per design

A) Functional Requirement:

a) The bogie system shall support the total dead load of the TUT+SMLP+LV, equipment loads, vehicle loads, live loads, Acceleration Loads, loads due to gradient and wind loads caused due to structural interactions and support settlement.

b) Bogie system shall suit to the interface of TUT /Suitable interface.

c) The bogie shall be capable of carrying and moving TUT +SMLP+ LV at controlled speed at a wind velocity of 30 m/s. The wind may be acting from any direction.

d) Hydraulic jacking system shall be capable of lifting and lowering TUT +SMLP + LV vehicle.

e) Bogie system shall be provided with alignment mechanism required for aligning TUT with PMLP.

f) Provision for connecting tow hitch of hauler shall be available in the bogie system.

g) Bogie systems shall be provided with parking brakes / mechanical brakes.

B) Design Inputs(Tentative):

a) Self-weight of bogie system.

b) Loads from TUT + SMLP (when supported with LV-01/LV-02).

c) Operating wind load at 18m/sec

d) Acceleration and Gradient

e) Hauling force

f) Reaction loads from Hydraulic jacking system and X/Y & Z positioning system.

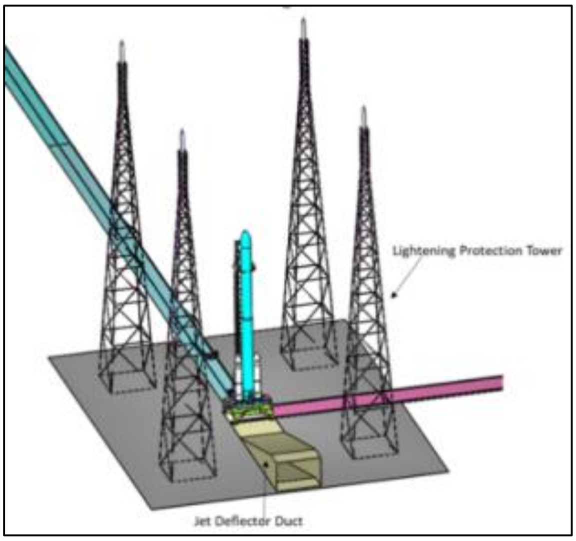
g) Equipment loads on maintenance platform – 250kg/m2.

h) Loads because of Wheel to Track interaction.

d. Jet Deflector Duct

A) Description

Third launch pad shall be capable of launching various variants of launch vehicles. The Jet Deflector Duct (JDD) which is a permanent structure has to be designed to suit the requirements of multiple launch vehicles. JDD is one of the most important elements of the new launch pad which plays a vital role during lift-off of launch vehicle. It directs the exhaust jet effectively avoiding the hot gas interaction with launch vehicle and dictates the magnitude of many unsteady parameters such as lift-off acoustics and ignition over pressure. Heaviest configuration of the above mentioned launch vehicles is LV-02. Proposed JDD is a fully closed JDD with cover slab over the entire length of the JDD. Cover-slab shall also be designed movement of trailers considering a wheel load of 7.5t. This will aid as a passive acoustic suppression system during the lift-off of the launch vehicle. Approximate size of JDD is 113m (L) x 25m (W) x 18m (D). Refractory cement will be applied over exposed surface of JDD for protection from hot rocket exhaust. Details of sub-systems interfacing at JDD will be provided by Department.

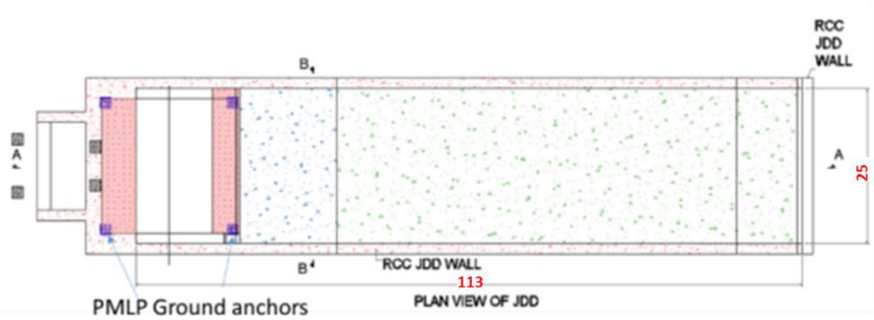


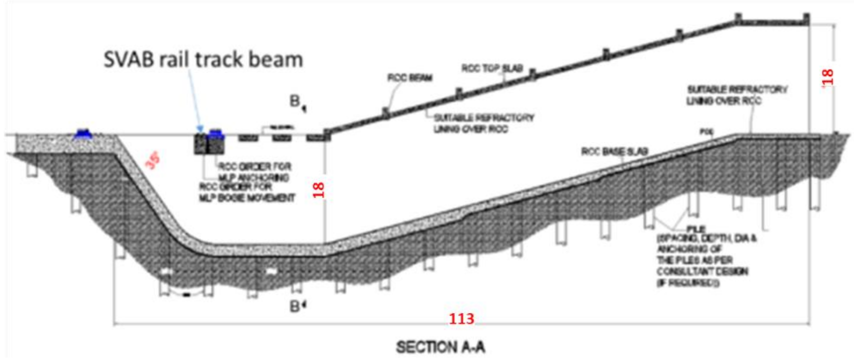
Various options for thermal protection during static test of stages/ during Launch, like transpiration cooling, replaceable sacrificial plates etc. of JDD, shall be studied and report shall be submitted to department.

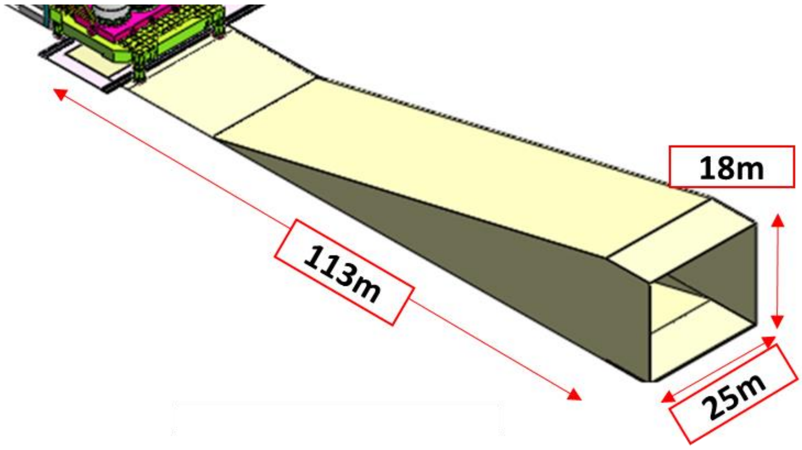
Launch pad elevation will be above the natural ground level (NGL). Accordingly, all other systems (like rail track etc) elevations shall be updated. Value of elevation will be given by Department to qualified design consultant along with PO.

B) **Sub-Systems Interfacing with JDD:** JDD civil foundations shall be designed to accommodate the following major systems along with auxiliary cable trenches, pipeline trenches etc.

- **PMLP ground anchors:** 4 nos of PMLP ground anchor along with their foundation needs will be interfacing with JDD.
- **Track beam for supporting SVAB rail track:** One track beam girder needs to be integrated with JDD top wall for supporting SVAB rail. This will enable movement of launch vehicles from SVAB to TLP using existing SVAB Bogie. Wheel load of 100t per wheel shall be considered for design. Detailed configuration of SVAB bogie will be furnished along with PO.







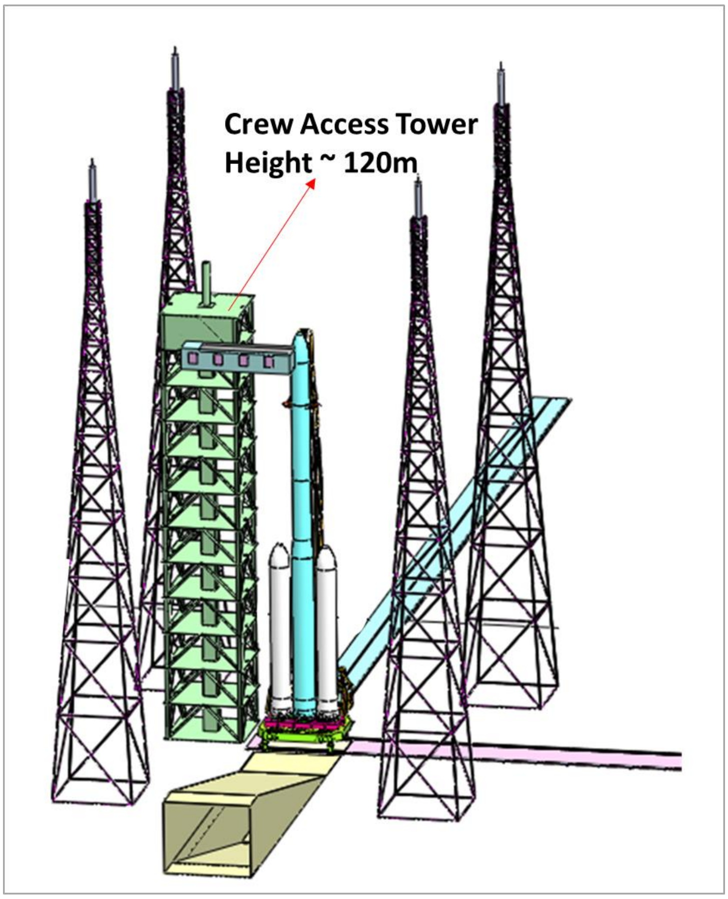
- **AcoSS system:** Lift-off acoustics encompass a wide range of phenomena, from the initial ignition to the moment of liftoff and till the launch vehicle clears the launch pad. At ignition, the sudden release of energy creates a shockwave known as Ignition over pressure (IOP), that propagates upward towards the launch vehicle base and also through the deflector duct and then impinges on launch vehicle. As the engines reach full thrust, intense noise is generated, reaching very high levels of even 200 dB, loud enough to cause structural/ avionics failure in launch vehicle stages and physical damage to vulnerable ground systems in the vicinity. Hence, an Acoustic Suppression System is proposed to be realized.

  Because of impingement of exhaust gas onto JDD, erosion of JDD refractory is possible. To reduce the erosion of refractory, transpiration cooling system or equivalent system shall be designed.

  Pipe lines of AcoSS and Transpiration cooling shall be routed around JDD and water will be injected during launch.

- **JDD De-watering system:** JDD will be filled with water during the operation of AcoSS system or because of rain. Hence, a suitable JDD De-watering system shall be designed.

- **Crew Access Tower and foundation:** The proposed Third Launch Pad is configured keeping in view of the augmentation requirements of Human Space Programme in future. Hence, a Crew Access Tower (with approximate size of 16m (L) x 16m (W) x 120m (H) with necessary approach platforms, 2nos. Of elevators and crew ingress arm is required. Civil foundation of Crew Access Tower shall be an integral part of the launch pad. Hence, Design consultant shall carryout design the Crew access tower (preliminary design) and then design the civil foundation of Crew Access Tower as per the inputs given by Department. Dimensions, equipment details and location of tower will be provided by Department.



Crew access tower

C) Design Criteria / Inputs (Tentative)

1) Jet loads (static test and launch)
2) Hydrostatic loads
3) Acoustic loads
4) Surcharge load
5) Reaction loads from different sub-systems on JDD
6) Soil pressure
7) Analysis of individual diaphragm wall, configuration of braced excavation, critical failure surface for finalized configuration, study on slope stability analysis for ramp portion of JDD, soil structure interaction for full structure (non-linear and damping effects) shall be carried out using Plaxis or equivalent software.

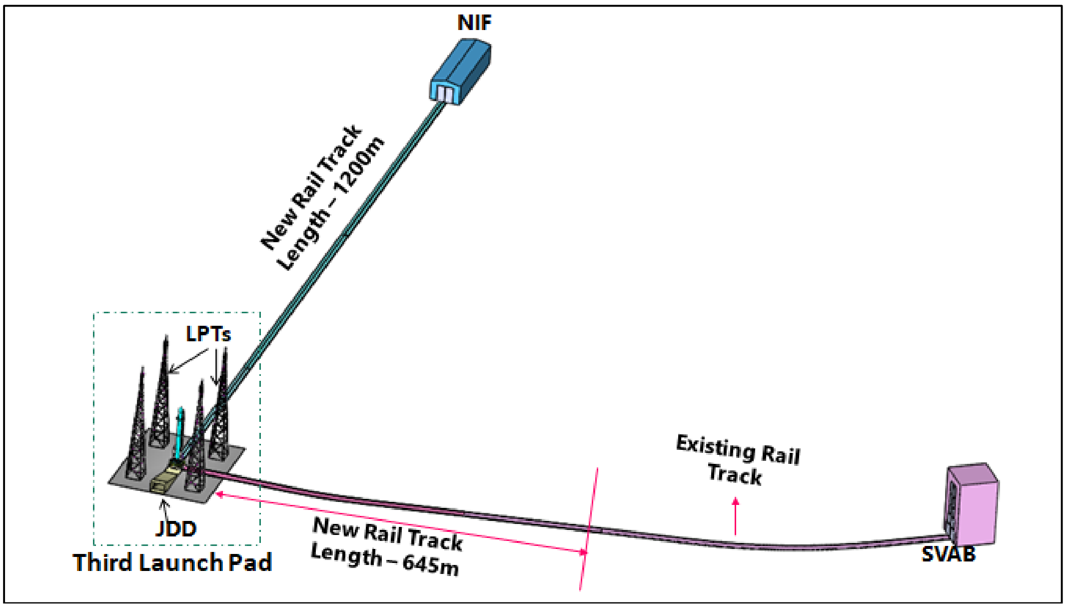
e. Rail Track System

A) Description

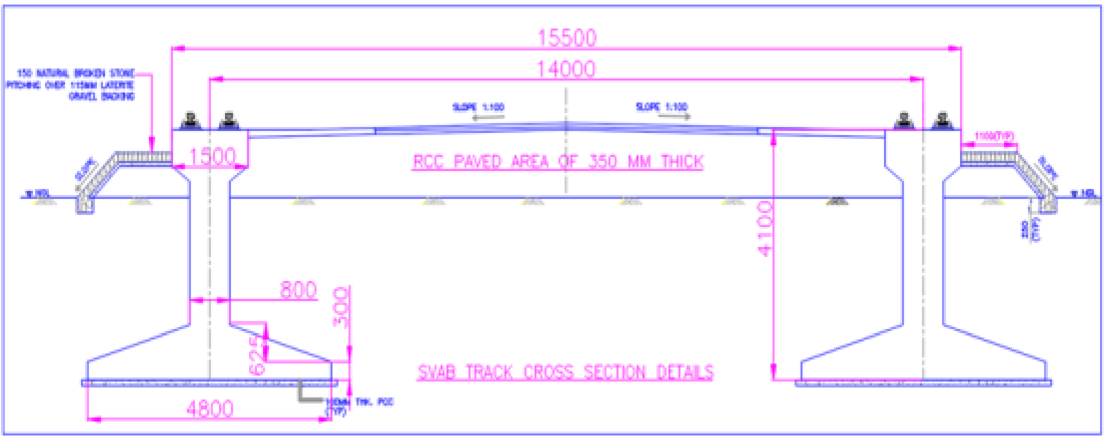
Two types of rail track systems are envisaged.

A. Twin Rail Track Connecting SVAB and TLP:

- The length of track is approximately 645 meters.
- The existing 14m span(C/C) twin rail track system from SVAB need to be extended up to TLP. The gauge of twin rails is 750mm on each side.
- The track shall be designed for a bogie wheel load of 100t.
- This track shall be suitably interfaced with JDD.



TLP Rail Track Layout

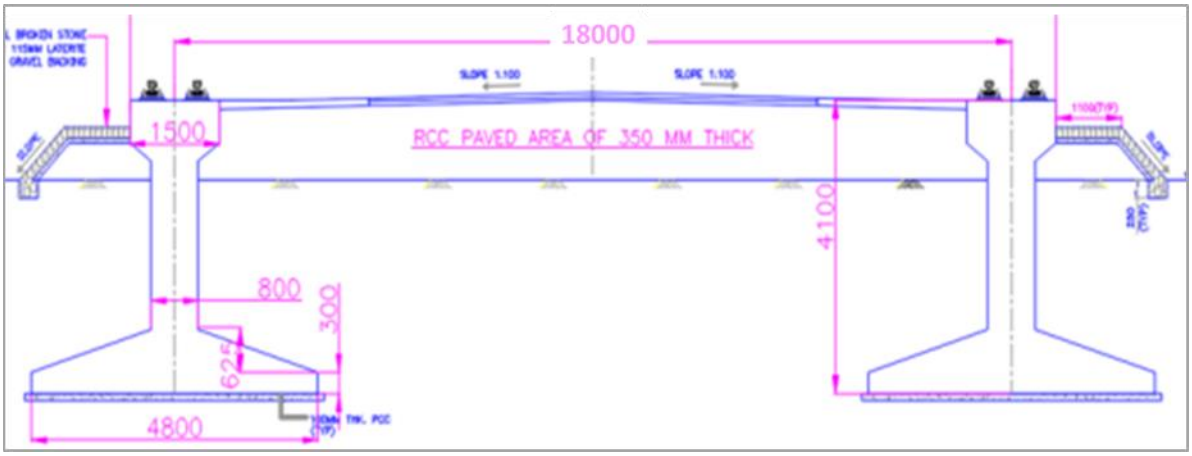


B. Rail Track connecting NGLV Integration Facility to TLP:

- The length of track is 1200 m.
- A twin rail track 18 m C/C (this can be changed as per design) system is proposed up to TLP. Gauge of twin rails is 750mm or may be finalized as per design.
- Wheel load shall be limited to 100 t.

C. **General requirements of Rail Track:**

- The track shall be designed to provide levelled top surface for smooth movement of MLP.
- Level difference across tracks between rail tops at any location is to be limited within ±1 mm.
- The track foundation shall have culverts/ hume pipes for crossing of cables or pipelines at required locations based on functional requirements.
- The area between the rail tracks will be paved with RCC road to enable movement of the SPU used for MLP traction. RCC road with camber and drainage provision shall be planned between the rail tracks.
- RCC road with drainage provision shall be planned between the rail tracks
- Across water bodies and Hume pipe locations, necessary bridging is to be provided.
- The difference in levels of top surface of track due to deflection under load shall be minimum to maintain the stability of vehicle. Wheel load shall be decided based on TUT+LV+SMLP+Bogie weight.
- Provisions are to be made along the track for suitable lighting during vehicle movement
- To enable the movement of safety vans/equipment during the movement of launch vehicle and also to meet any contingency requirement to approach the vehicle/TUT during movement, suitable BT roads are to be planned on one side of the rail track.



B) **System Configuration**

Civil Foundation

- Civil foundation shall withstand the loads during the movement of launch vehicle with ground system over rail track. The foundation provides a platform for laying rail track. It is provided for supporting rail track.
- Expansion joints shall be provided in the rail track foundation at reasonable intervals based on length or topography.
- Rail track SVAB has to cross JDD for positioning PMLP at TLP ground anchors. Hence, a beam is proposed for rail track across the JDD with suitable integration of pad area foundation

- Bridge has to be designed wherever vagu/lake is available. Culverts/equivalent system shall be provided for smooth flow of water.

Rail Track Sub-Systems

Rail track elements like soleplate, rail clips etc. will be assembled to the civil foundation. Once the sub-systems are assembled, they will become integral part of the foundation and will provide rigid support for launch vehicle or MLP movements.

The following will form the track sub system:

Sole Plate:

Sole plate disperses the load acting on the rail to the foundation over a larger area.

Sole plate is an interface structural member between the rail bottom and concrete foundation. It is held in position using foundation fasteners embedded along with reinforcement bars. The top of sole plate shall be levelled and secured by non-shrink grout. The rail top level is determined by the levelling of sole plate.

Resilient Pad:

Resilient pad is provided between the rail bottom and soleplate to provide smooth load transfer to the track foundation. The resilient pad shall have long life to withstand for environmental conditions of Sriharikota.

Rail Clips:

Rail clips shall be provided to hold the rail track with sole plate. The pitch and pattern of rail clips shall be optimized as per design load conditions suitable for straight and curved track.

Rail:

MRS-85 / CR 171 rails for connecting SVAB to TLP and NIF to TLP for unification purpose. Fish plates suitable for the above rails

Loop Track with Track Changeover system:

It is proposed to realize another integration building (NIF-2) adjacent to NIF-1 building. NIF to TLP rail track, connecting to NIF building shall also be connected to NIF-2 building.

Hence, a Loop Track with Track Changeover system has to be realized. Loop track shall connect to main NIF to TLP.

C) Functional Requirements/ Specifications

- The track shall be designed to provide levelled top surface for smooth movement of PMLP and TUT+SMLP+LV
- The difference in levels of top surface of track due to deflection under load shall be minimum to maintain the stability of vehicle.
- The track shall be designed for a bogie wheel load based on design of wheel bogie system.
- Level difference across tracks between rail tops at any location to be limited to ±1 mm.

- The SVAB track has to extend beyond Jet Deflector Duct (JDD) at TLP for a length of 3m approx. and shall be suitably interfaced with JDD.
- The track foundation shall have culverts/ hume pipes for crossing of cables or pipelines at required locations based on functional requirements.
- At water bodies and hume pipes locations, necessary bridging (of approximately 200m of bridge is required along NIF track) is to be provided.
- Allowable deflection of rail track beam across the duct at JDD will be provided by Department.
- The width between the rail track will have RCC pavement for the movement of hauler. The top level of the pavement will be same as the top of rail.
- Camber in pavement and collection pits along with drainage shall be provided for disposing rain water away from the rail track.
- Suitable provision/expansion joint shall be given to avoid shrinkage and temperature stresses in rail track foundation.

D) Design Inputs/loads(tentative):

- Rail track foundation shall be designed to withstand vertical wheel load of 100 t for SVAB to TLP rail track and TLP to NGLV building. 10% & 5% of vertical wheel load shall be considered for lateral wheel load and longitudinal wheel load respectively.
- Self-weight of rail track.
- Overburden soil pressure.
- Surcharge due to bogie movement.
- Uplift pressure.
- The difference in levels of top surface of track due to deflection under load shall be minimum to maintain the stability of vehicle.
- Level difference across tracks between rail tops at any location to be limited to ±1 mm and along the rail track

f. Lightning Protection System:

A) Purpose:

The fully integrated Launch Vehicle at launch Pad is exposed to environment, prior to launch during final checks and propellant filling activities. During that time, if there is lightning activity on the cloud, there will be possibility of direct lightning strike on the launch vehicle. Lightning Protection System is needed for protection of Launch vehicle and Launch Pad area.

B) Description:

- 4 nos. of Lightning protection towers along with FRP Lightning mast and down conductor systems are proposed. The towers are located at four corners of rectangle 95m X 130m from launch vehicle as centroid.

- The tower is of approximately 190 m tall with self-supported steel lattice type structure. It supports 12.5m tall FRP insulating mast at top along with conductor network, inter connecting all the towers at top.
- Steel structures consist of Tower members e.g. main chords, diagonals, vertical and plan bracings, Platforms, hand rails, ladders, Lightning mast,
- Supports for lights, CCTV rooms and Cable trays. Approach platforms are provided at 10m intervals up to 120m level and subsequently at 6m intervals (max.) till the top.
- Access ladders with safety cage are provided for approach to all the platforms. Alternative approach to any level of the tower is provided by means of a maintenance cradle located at center of the tower. One number of maintenance cradle fitted with electrically operated rope crawler mechanism is provided inside each Lightning tower for movement of men and materials from ground to various landings inside the tower, up to 150m level.
- All the four towers will be interconnected by 12mm dia. SS steel ropes of steel core construction at two levels i.e., at 190m & 150m levels. Conductors will be tightened for a pre-calculated tension so as to allow maximum sag of 6 meters.
- The orientation of the tower is such that the CCTV Cameras have a clear view of the vehicle at the launch pad. To meet the above requirements, the lightning protection system consists of (a) basic structure along with access ladder, platforms, pill box for cameras, etc., (b) Maintenance cradle and (c) Down conductor and its earthing.

C) Scope of Design Consultant:

S.No.	Category	Sub-system	Scope of Design Engineering
1.	Structural	LPT tower structure	• Configuration, design and estimation of structural member sizes for the tower. • Design of terminations and end fixing scheme for catenary conductors and down conductors. • 3D model generation of LPT indicating all subsystems like pill boxes, cradles, FRP mast, catenary conductors etc. • Preliminary design of Maintenance Cradle • Generation of Design report, structural drawings and interface details with civil foundation.
2.	Civil	Foundation	• Location of LPT foundation with respect to common and verifiable structures in launch pad layout. (coordinates) • Subsurface foundation design based on the geotechnical data given by Department. • Electrical panel room of size 8m x 5m. • Generation of BOQ • Generating Design reports and drawings.

S.No.	Category	Sub-system	Scope of Design Engineering
3.	Electrical system	Electrical interfaces and cables	• Providing light fittings for recommended illumination level of 400lux cumulatively • Aviation lamps • Routing scheme of cables for light fittings • Identification of Electrical interfaces for instruments mounted the tower

D) Design Inputs to Consultant by Department:

- Department is entering a separate consultancy for theoretical and experimental expertise to develop the Lightning Protection Scheme for Launch Pad. Based on the outcome and recommendations of this study, location of LPTs and height will be provided.
- Location, sizes and loads from instrumentation systems.
- Preliminary geotechnical Investigation Report and Topography survey of the site.

E) Design Requirements:

- The tower design shall consider the static & dynamic analysis.
- The design of the tower shall consider CCTV camera rooms (2 x 3m) at specified levels.
- Design of tower should consider cable tension arrived from wind spectrum analysis. Stock bridge dampers design and locations shall be finalised to take care of galloping of wire ropes interconnecting the tower.
- All the four towers shall be interconnected by 12mm dia. SS steel ropes of steel core construction at two levels. (At 190m & 150m levels). Conductors will be tightened for a pre-calculated tension so as to allow maximum sag of 6 meters.
- The top of the each FRP mast is connected to distant grounding point which is located approximately 160m away from the Lightning protection lattice tower.
- A maintenance cradle of 200 kg SWL with all relevant safety features shall be provided to reach different levels in the tower. Suitable guide column for maintenance cradle shall be designed.
- Towers shall be designed for a wind load of 230kmph at 10m level as per IS 875 Part-3 latest revision.
- Electrical system design will be given by Department. These equipment loads also to be considered.
- Integrated analysis of all four towers are to be carried out.
- The allowable deflection and stresses shall be as per latest IS codes.
- If required, the LPTs foundation shall be suitably merged/designed with JDD foundation.

g. Static test requirements

Static testing of individual stages namely 1st stage, 2nd stage and 3rd stage of launch vehicle is planned at Launch Pad. During static testing, stage is to be rigidly clamped to PMLP/SMLP using intermediate fixtures. These fixtures shall be rigid enough to withstand static test loads and transfer the thrust loads from stage to ground anchors.

If required, department will intimate design consultancy to carry out design of necessary fixtures for handling/transportation of stages for carrying out static test. However, further details will be furnished along with PO.

Adequacy of PMLP, SMLP for carrying out static test shall also be studied and a report shall be submitted to department.

S.No	Type of Load	Details	Load data
1.	Stage-01	Dimensions: Ø6.5m X40m Weight: 100t	1600t thrust (appx.)
2.	Stage-02	Dimensions: Ø6.5m X24m Weight: 50t	700t thrust
3.	Stage-03	Dimensions: Ø6.5m X18m Weight: 13t	50t thrust

The details mentioned in the above table are tentative.

4. Process Systems:

Scope of design engineering involves design of civil, electrical & AC along with mechanical system like EOT crane, Monorail crane, doors, cable trays, embedment plates etc, for “Process System” facilities as per the scope mentioned this document

4.1 Introduction:

Cryo Propellant Servicing systems for servicing of launch vehicle shall include the following facilities. All the propellant servicing systems are configured to carry out simultaneous filling of all Cryo stages. The stage servicing requirements include filling of Liquid Methane & Liquid Oxygen (LOX) and LOX & Liquid Hydrogen in to liquid stages and charging of gas bottles with GN2/GHe/GOX/GMe. Accordingly, Process systems have been configured for servicing of Liquid stages of Launch vehicle at Third launch pad. The systems are operated remotely from Filling Control centre which is located at 5 – 8 km from the TLP.

(i) Liquid Methane Filling System (LMFS)
(ii) Liquid Oxygen Filling System (LOFS)
(iii) Liquid Hydrogen Filling System (LHFS)
(iv) Compressed Gas Service System (CGSS)

(v) Nitrogen Supply System (NSS)
(vi) NGLV Service Buildings (NSB-O & NSB-F)
(vii) Valve Chamber Rooms (VCR-O & VCR-F)

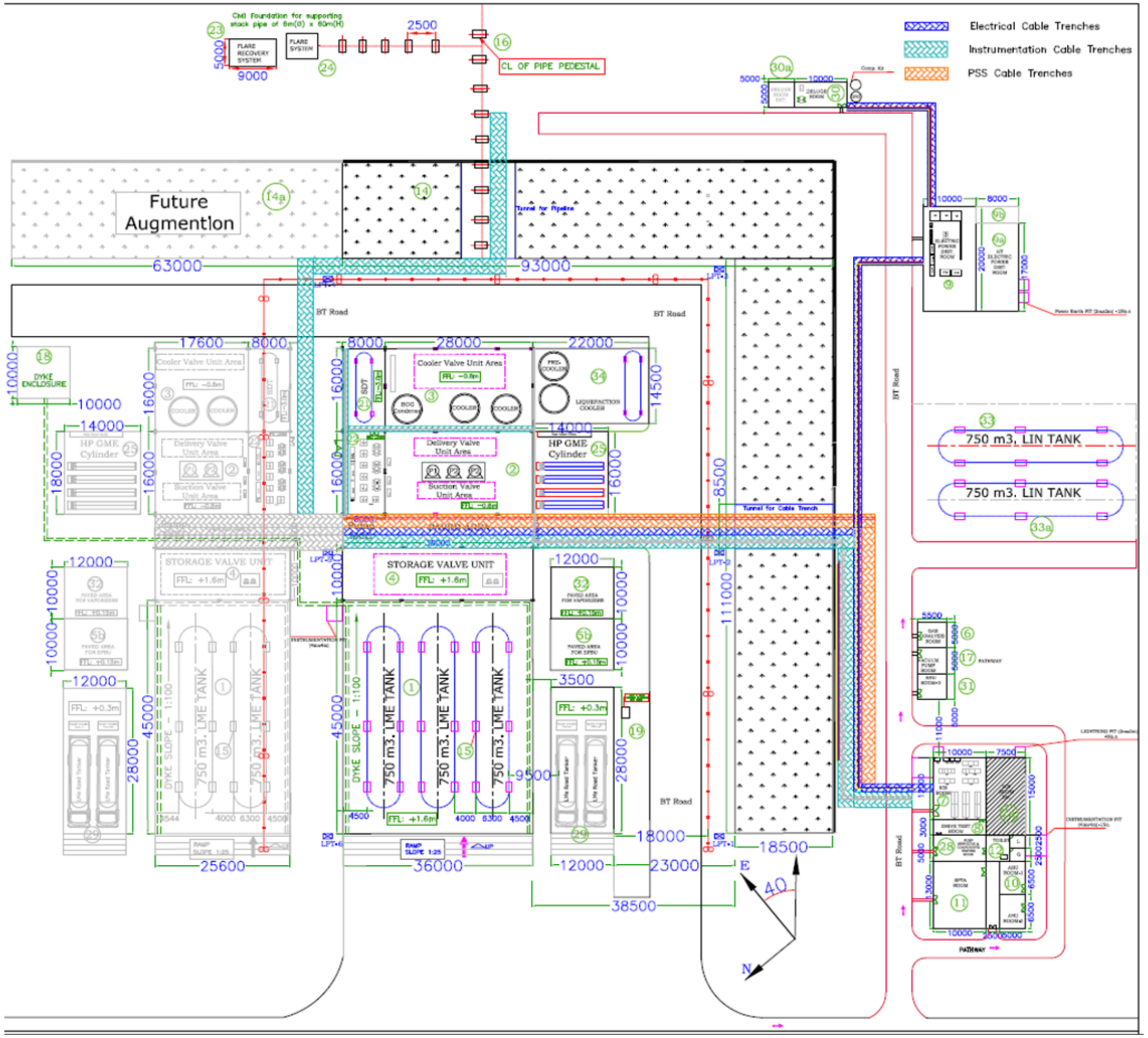
These systems are located at a safe distance from the launch pad based on safety criteria.

4.2 Liquid Methane & Filling System (LMFS):

S. No.	Description	Details
1	Purpose:	Liquid Methane Filling system comprises of Liquid Methane storage & High-Pressure Gaseous Methane system. It is envisaged for Liquid Methane filling to various stages of Next Generation Launch Vehicle and also, high pressure charging of Gaseous Methane to Start-up gas bottles of NGLV stages.
2	Civil structure	
2.1	Description:	Facility houses storage tanks, pumps, coolers, valve units, vaporizers, External Pressure Build-up units, high pressure gas cylinders & drain tank, etc. Flare stacks of suitable height (~30 mtr), for flaring of unused methane vapours. A Sandwiched merlon with blast wall will protect the facility from overpressure. Instrumentation & control room, Electrical panel room, Vacuum pump room & Gas analyzers room, Deluge shed & Foam pump room, HT room located separately and are outside the merlon.
2.2	Functional requirement:	• Roofless storage bay for housing Storage tanks • **RCC roofed open structure** gas cylinders, Methane gas recovery system, etc. • RCC closed room for Methane pumps & coolers, Valve units, High pressure gaseous methane pumps. • RCC Pits: For drain tanks & Spill collection • **Auxiliary buildings:** Vacuum pump, gas analyzer, Control system, SPTA, Instrumentation, Electrical panel, Pneumatic, along with Air Handling Units and Public Health. • RCC paved area for Mobile tanker Parking Bay, PBUs, vaporizers, external PBUs, approach road. • Lightning protection system for the facility

S. No.	Description	Details
		• Sandwiched Merlon protection for the storage • Foundation for equipment: Storage tanks, Methane pumps, Methane coolers, Methane gas cylinders, Drain tanks, Accumulators, Flare stack, PBUs, etc. • Tunnels / Trenches for pipe and internal & external cable routing. Pipe pedestals for indoor and outdoor piping. • Suitable ramp for connecting the parking area with the road. • Pipeline pedestals • Antistatic false floor of depth 500 mm in Instrumentation and control room & Drive test room
2.3	Load details:	Design inputs shall be as per drawings: • Lightning protection system to be suitably designed. • Foundations for Storage tanks, coolers, pumps, drain tanks, Equipment's, Pipelines pedestals, and flare stack. • Blast wall for merlon to be suitably designed. • Wind (230kmph) and seismic loads to be considered as per IS latest 1893. **Impermeable flooring to be considered for propellant handling areas.** Design inputs will be updated by Dept. at the time of award of contract.
3	Electrical system: Refer Section-8 in this document	
4.	AC system:	Refer Section-7
5.	Specific equipment which is under design engineering scope (like EOT crane, doors etc.)	Doors shall be designed to withstand Launch environment and size to be selected to envisage easy equipment transport. • Adequate windows shall be planned in the pump room and cooler room to facilitate ventilation and sun light. • Pump room, cooler room and gas cylinder storage shall be provided with cranes with mono rail system of 2t capacity (Tentative).
6.	Equipment which is not under the scope of design	Equipment: a) Cryogenic storage tanks

S. No.	Description	Details
	engineering Load because of Equipment are to be considered for design of Civil, Electrical and AC systems	b) Centrifugal pumps c) Sub cooling equipment d) Accumulator e) Vaporizers f) Pressure Build up units (PBUs) g) Drain tanks h) Gas cylinders i) Reciprocating pumps j) Valve units
7.	Design loads and load cases to be considered.	
7.1	Civil system design	Load details shall be as per approved drawings.
7.2	Mechanical system design	1. Roof, wall, & floor Embedment plates for routing of pipelines, cable trays, AC ducts. 3D arrangement of AC duct, Instrumentation cable tray, power tray for electrical fitting, AC duct routing, pipeline to be provided by the designer. 2. Internal and external cable trenches with appropriate covers 3. Opening of 0.5 m x 0.5 m in the wall with metal embedment for cable entry between Cooler room and Pump room, between pump room and Instrumentation and control room, between pump room and storage bay is required. The exact location will be provided in due course. Provision to close/adjust the opening after cable routing is required.
7.3	Electrical system design	Yes As per Section-8
7.4	AC system design	Yes As per Section-7



Description	Dimensions
Storage Area	36mx55m, 25.6mx55m -Augmentation
Pump Area	28mx16m, 17.6mx16m-Augmentation
Cooler Area	28mx16m, 17.6mx16m-Augmentation
Pump MCC Area	8mx16m, 8mx16m-Augmentation
Drain Tank Area	8mx16m, 8mx16m-Augmentation
Liquefaction Area	22mx14.5m
HP Methane Cylinder Area	14mx16m, 14mx16m-Augmentation

4.3 Liquid Oxygen Filling System (LOFS):

System	Liquid Oxygen Filling System	
S. No.	**Description**	**Details**
1	Purpose:	Liquid Oxygen Filling system comprises of Liquid Oxygen storage & High-Pressure Gaseous Oxygen system.It is envisaged for Liquid Oxygen filling to various stages of Next Generation Launch Vehicle (NGLV) and also, high pressure charging of Gaseous Oxygen to Start-up gas bottles of NGLV stages.
2	Civil structure	
2.1	Description:	Facility houses storage tanks, pumps, coolers, valve units, vaporizers, External Pressure Build-up units, high pressure gas cylinders & drain tank, etc. A Sandwiched merlon with blast wall will protect the facility from overpressure. Instrumentation and control, Electrical panel room, Vacuum pump room located separately, however, are inside the merlon.
2.2	Functional requirement:	• Roofless Storage for housing storage tanks • RCC roofed open structure for housing gas cylinders, deluge system. • RCC closed room for Oxygen pumps & coolers, Valve units, High pressure gaseous Oxygen pumps. • RCC Paved area for vent stack and for drain tanks • RCC column for vent stack and structure supports. • Auxiliary buildings: Vacuum pump room, Control system, SPTA, Instrumentation, Electrical panel, Pneumatic, along with Air Handling Units and Public Health. • RCC paved area for Mobile Tanker Parking Bay, PBUs, vaporizers, external PBUs, approach road. • Lightning protection • Merlon protection for the storage • Foundation for equipment: Storage tanks, Oxygen pumps, Oxygen coolers, Oxygen gas cylinders, Drain tanks, Accumulators, Flare stack, PBUs, etc. • Tunnels / Trenches for pipe and internal

		and external cable routing. Pipe pedestals for indoor and outdoor piping. • Suitable ramp for connecting the parking area with the road. • Pipeline pedestals • Antistatic false floor of depth 500 mm in Instrumentation and control room & Drive test room
2.3	Load details:	Design inputs shall be as per drawings: • Lightning protection system to be suitably designed. • Foundations for Storage tanks, coolers, pumps, drain tanks, Equipment's, Pipelines pedestals and vent stack • Blast wall for merlon to be suitably designed. • Wind (230kmph) and seismic loads to be considered as per latest IS 1893.
3	Electrical system: Refer Section-8 in this document	
4.	AC system:	Refer Section-7
5.	Specific equipment which is under design consultancy scope (like EOT crane, doors etc.)	Doors shall be designed to withstand Launch environment. Door size to be selected to envisage easy equipment transport. • Adequate windows shall be planned in the pump room and cooler room to facilitate ventilation and sun light. • Pump room and cooler room shall be provided with mono rail system of 2t load bearing capacity.
6.	Equipment which is not under the scope of design consultancy. Load because of Equipment are to be considered for design of Civil, Electrical and AC systems.	Equipment: 1. Cryogenic storage tanks 2. Centrifugal pumps 3. Sub cooling equipment 4. Accumulator 5. Vaporizers 6. Pressure Build up units (PBUs) 7. Drain tanks 8. Gas cylinders 9. Reciprocating pumps 10. Valve units
7.	Design loads and load cases to be considered.	
7.1	Civil system design	Load details shall be as per approved drawings
7.2	Mechanical system design	1. Roof, wall, & floor Embedment plates for routing of pipelines, cable trays, AC ducts. 3D arrangement of AC duct, Instrumentation cable tray, power tray

		for electrical fitting, AC duct routing, pipeline to be provided by the designer. 2. Internal and external cable trenches with appropriate covers 3. Opening of 0.5 m x 0.5 m in the wall with metal embedment for cable entry between Cooler room and Pump room, between pump room and Instrumentation and control room, between pump room and storage bay is required. The exact location will be provided in due course. Provision to close/adjust the opening after cable routing is required.
7.3	Electrical system design	Yes As per Section-8
7.4	AC system design	Yes As per Section-7

4.4 Nitrogen Supply System (NSS):

S. No.	Description	Details
1	Purpose:	Nitrogen supply system comprises of Liquid Nitrogen storage is envisaged for propellant filling related activities of various stages of Next Generation Launch Vehicle (NGLV). The major operation of NSS is SNPS Purging of NGLV stages, GN2 supply to LHFS storage and UT, LOX Coolers filling and replenishment with LN2, Sub cooling of Liquid Methane, GN2 supply for Ejector Operations of LOX & LH2.
2	Civil structure	
2.1	Description:	Facility houses storage tanks, valve units, vaporizers, External Pressure Build-up units etc. A Sandwiched merlon with blast wall will protect the facility from overpressure.
2.2	Functional requirement:	• Roofless Storage for housing storage tanks • **RCC roofed open structure** for housing Valve units.

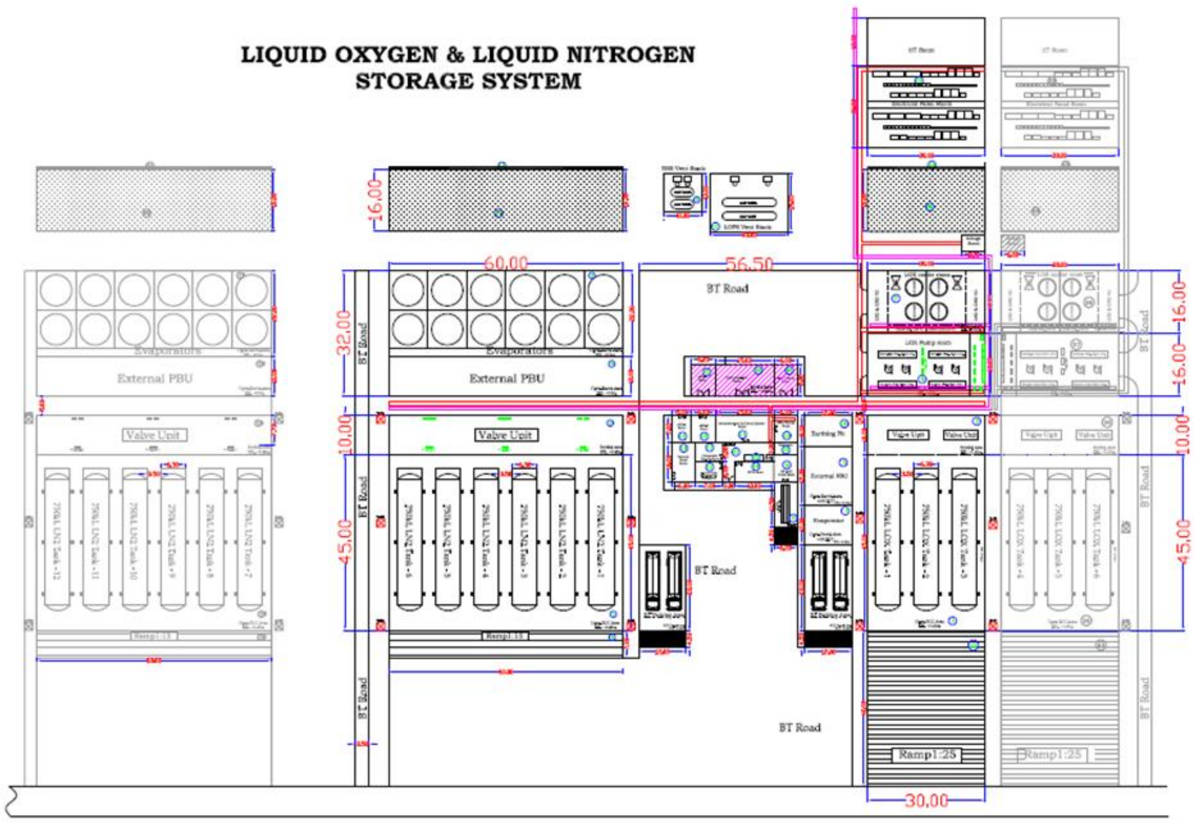
S. No.	Description	Details
		• **Auxiliary buildings:** RCC paved area for Mobile Tanker Parking Bay, PBUs, vaporizers, external PBUs, approach road. • Lightning protection • Merlon protection for the storage • Foundation for equipment: Storage tanks, Vent stack, PBUs, etc. • Tunnels / Trenches for pipe and internal and external cable routing. Pipe pedestals for indoor and outdoor piping. • De-watering system for RCC trenches/collection pits. • Suitable ramp for connecting the parking area with the road. • Pipeline pedestals • Antistatic false floor of depth 500 mm in Instrumentation and control room (Room common for LOX and NSS)
2.3	Load details:	Design inputs shall be as per drawings: • Lightning protection system to be suitably designed. • Foundations for Storage tanks, drain tanks, Equipment's, Pipelines pedestals and vent stack • Blast wall for merlon to be suitably designed. • Wind (230kmph) and seismic loads to be considered as per latest IS 1893.
3	Electrical system: Refer Section-8 in this document	
4.	AC system:	As per Section-7
5.	Specific equipment which is under design engineering scope (like EOT crane, doors etc.)	Doors shall be designed to withstand Launch environment. Door size to be selected to envisage easy equipment transport
6.	Equipment which is not under the scope of design engineering Load because of	Equipment: 1. Cryogenic storage tanks 2. Vaporizers 3. Pressure Build up units (PBUs) 4. Valve units

S. No.	Description	Details
	Equipment are to be considered for design of Civil, Electrical and AC systems	
7.	Design loads and load cases to be considered.	
7.1	Civil system design	Load details shall be as per approved drawings
7.2	Mechanical system design	1. Roof, wall, & floor Embedment plates for routing of pipelines, cable trays, AC ducts. 3D arrangement of AC duct, Instrumentation cable tray, power tray for electrical fitting, AC duct routing, pipeline to be provided by the designer. 2. Internal and external cable trenches with appropriate covers.
7.3	Electrical system design	Yes As per Section-8
7.4	AC system design	Yes As per Section-7

Sl. No.	Major Areas	NGLV	Augmentation for LMLV	Remarks
1	LOX Storage Tanker bay	1350 sq.m	1350 sq.m	Open Bay without roof
2	Lox Pump Room	480 sq.m	480 sq.m	5.5 m Roof
3	Lox Cooler Room	480 sq.m	480 sq.m	5.5 m Roof
4	LOX Evaporator & PBU area	1320 sq.m	300 sq.m	Open paved area
5	NSS Storage tanker Bay	2700 sq.m	2700 sq.m	Open Bay without roof
6	NSS Evaporator & PBU area	1320 sq.m	1320 sq.m	Open paved area

Sl. No.	Major Areas	NGLV	Augmentation for LMLV	Remarks
1	LOX Storage Tanker bay	1350 sq.m	1350 sq.m	Open Bay without roof
2	Lox Pump Room	480 sq.m	480 sq.m	5.5 m Roof
3	Lox Cooler Room	480 sq.m	480 sq.m	5.5 m Roof
4	LOX Evaporator &	1320 sq.m	300 sq.m	Open paved

	PBU area			area
5	NSS Storage tanker Bay	2700 sq.m	2700 sq.m	Open Bay without roof
6	NSS Evaporator & PBU area	1320 sq.m	1320 sq.m	Open paved area



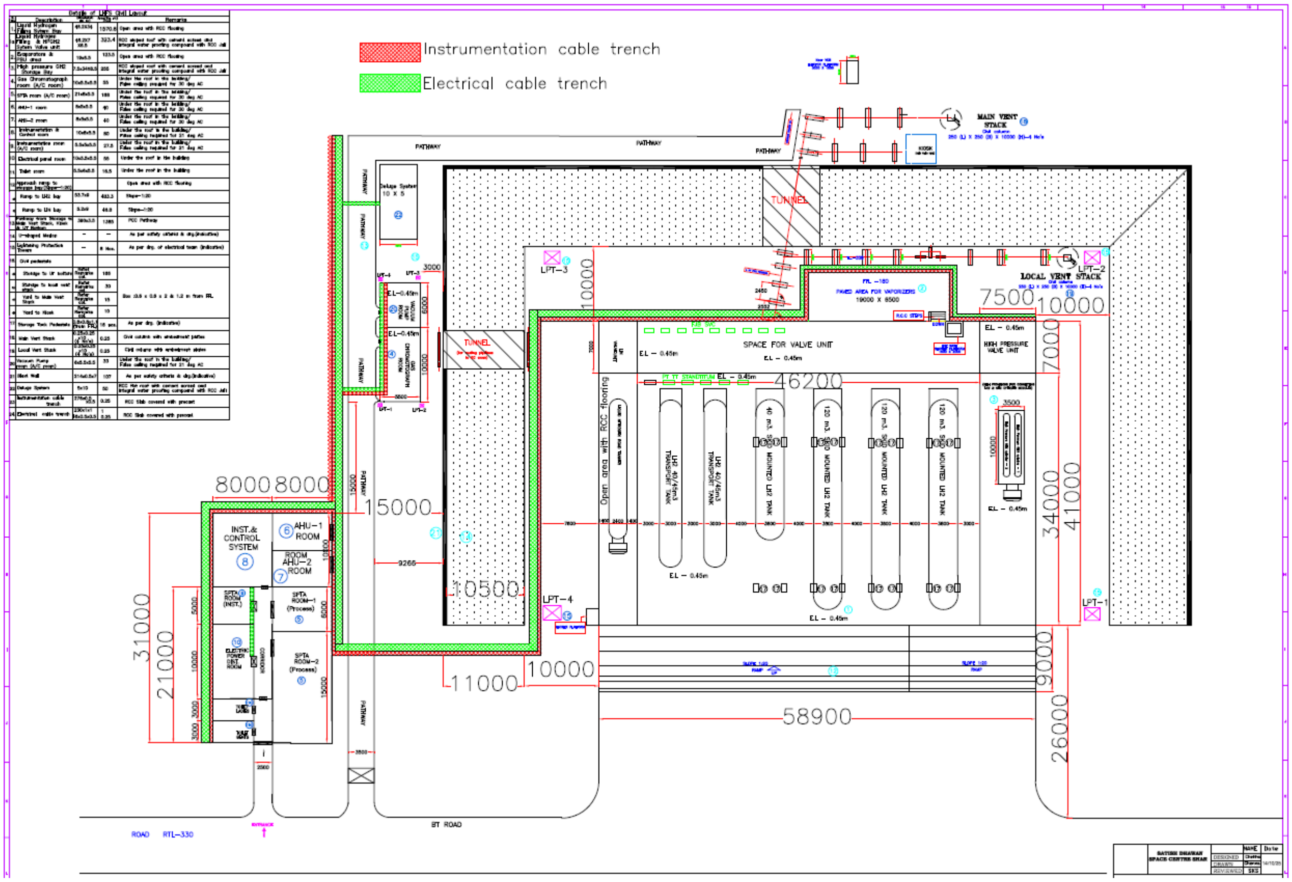
4.5 Liquid Hydrogen Filling System (LHFS):

System	Liquid Hydrogen Filling System	
S. No.	**Description**	**Details**
1	Purpose:	Liquid Hydrogen Filling system comprises of Liquid Hydrogen storage & High-Pressure Gaseous Hydrogen system. It is envisaged for Liquid Hydrogen filling to upper stage of Next Generation Launch Vehicle (NGLV) and also, high pressure charging of Gaseous Hydrogen to Start-up gas bottles of NGLV stages.
2	Civil structure	
2.1	Description:	Facility houses storage tanks, coolers, valve units, vaporizers, External Pressure Build-up units, high pressure gas cylinders etc.

		A Sandwiched merlon with blast wall will protect the facility from overpressure. Instrumentation and control room, Electrical panel room, Vacuum pump room & Gas analyzer room located separately and are outside the merlon.
2.2	Functional requirement:	• Roofless Storage for housing storage tanks & mobile tankers • **RCC roofed open structure** for housing Valve units, Coolers & gas cylinders, deluge system. • **Auxiliary buildings:** Vacuum pump, gas analyzer, Control system, SPTA, Instrumentation, Electrical panel, Pneumatic, along with Air Handling Units and Public Health. • RCC paved area for PBUs, vaporizers, external PBUs, approach road. • RCC collection pit and de-watering system • Lightning protection systemfor the facility • Merlon protection for the storage • Foundation for equipment: Storage tanks, Hydrogen coolers, Hydrogen gas cylinders, Vent stack, PBUs, etc. • RCC column for vent stack and structure supports. • Tunnels / Trenches for pipe and internal and external cable routing. Pipe pedestals for indoor and outdoor piping. • Suitable ramp for connecting the parking area with the road. • Pipeline pedestals • Antistatic false floor of depth 500 mm in Instrumentation and control room and instrumentation test room
2.3	Load details:	Design inputs shall be as per drawings: • Lightning protection system to be suitably designed. • Foundations for Storage tanks, drain tanks, Equipment's, Pipelines pedestals and vent stack • Blast wall for merlon to be suitably designed. • Wind (230kmph) and seismic loads to

		be considered as per latest IS 1893.
3	Electrical system: Refer Section-8 in this document	
4.	AC system:	Refer Section-7
5.	Specific equipment which is under design consultancy scope (like EOT crane, doors etc.)	Doors shall be designed to withstand Launch environment. Door size to be selected to envisage easy equipment transport
6.	Equipment which is not under the scope of design consultancy Load because of Equipment are to be considered for design of Civil, Electrical and AC systems	Equipment: 1. Cryogenic storage tanks 2. Sub cooling equipment 3. Vaporizers 4. Pressure Build up units (PBUs) 5. Gas cylinders 6. Reciprocating pumps 7. Valve units
7.	Design loads and load cases to be considered.	
7.1	Civil system design	Load details shall be as per approved drawings
7.2	Mechanical system design	1. Roof, wall, & floor Embedment plates for routing of pipelines, cable trays, AC ducts. 3D arrangement of AC duct, Instrumentation cable tray, power tray for electrical fitting, AC duct routing, pipeline to be provided by the designer. 2. Internal and external cable trenches with appropriate covers
7.3	Electrical system design	Yes As per Section-8
7.4	AC system design	Yes As per Section-7

Sl. No.	Major Areas	NGLV	Remarks
1	LH2 Storage Tanker bay	1570 sq.m	Open Bay without roof
2	LH2 filling & HP GH2 Valve unit	323 sq.m	5.5 m Roof
3	High pressure GH2 storage bay	255 sq.m	5.5 m Roof
4	LH2 Evaporator & PBU area	124 sq.m	Open paved area



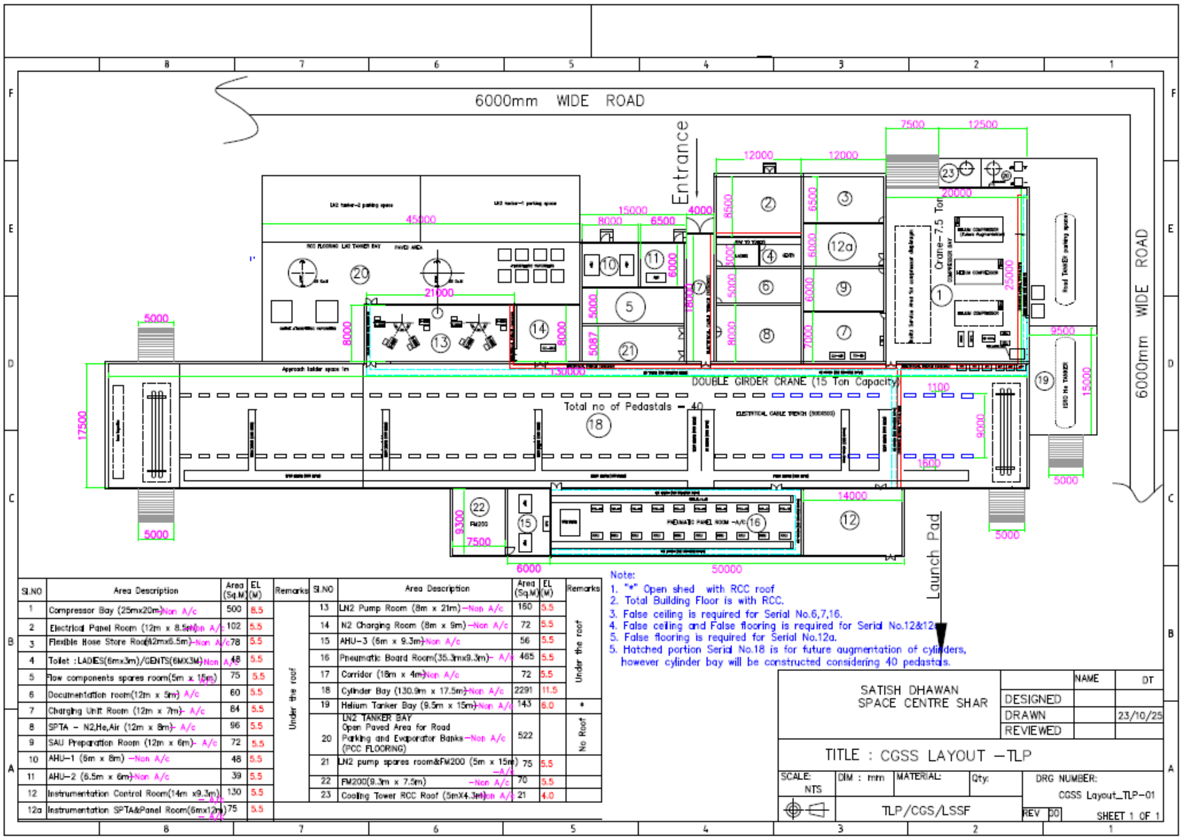
4.6 Compressed Gas Service System (CGSS):

S. No.	Description	Details
1	Purpose:	Compressed Gas System (CGS) receives Liquid Nitrogen(LN2) and Liquid Helium (LHe) from manufacturers using mobile cryogenic tankers. LN2 is converted into gaseous form using cryogenic pumps and evaporators. LHe is converted into gaseous form using evaporators and high pressure diaphragm compressors. These gases are stored in multiple gas cylinders at 400bar pressure at storage facility. The gas supply from storage cylinders to liquid stages of New Generation Launch Vehicle(NGLV) using suitable pressure regulation and control scheme.
2	Civil structure	
2.1	Description:	Facility houses High pressure gas cylinders, vertical LN2 storage tanks, pumps, compressors, coolers, valve units, vaporizers, Remote Valve Units, Regulation units

S. No.	Description	Details
		and associated instrumentation and control & electrical system etc.
2.2	Functional requirement:	▪ **RCC roofed open structure** for housing gas cylinders with 15 EOT crane double girder. ▪ **RCC roofed closed room** for GHe compressors, LN2 pumps, charging units and pneumatic board room. ▪ **Auxiliary buildings:** Electrical panel room, flexible hose store room, SAU preparation room, Documentation room, control panel room, SPTA, pneumatic board room, ASU, and FM200. ▪ RCC paved area for LN2 tanks,evaporators,Mobile tanker Parking Bay, vaporizers, approach road. ▪ **Foundation for equipment:** LN2 & LHe Storage tanks, Nitrogen pumps, coolers, Helium compressors, High pressure gas cylinders, Accumulators, double girder crane-15 tons, Crane-7.5 tons etc. ▪ Tunnels / Trenches for pipe and internal & external cable routing. Pipe pedestals for indoor and outdoor piping. ▪ Suitable ramp for connecting the parking area with the road. ▪ Pipeline pedestals ▪ Antistatic false floor of depth 500 mm in Instrumentation and control room
2.3	Load details:	Design inputs shall be as per drawings: ▪ Foundations for Storage tanks, Gas cylinders, Equipment, Pipelines pedestals, Compressors & pumps. ▪ Blast wall for merlon to be suitably designed. ▪ Wind (230kmph) and seismic loads to be considered as per latest IS 1893.
3	Electrical system: Refer Section-8 in this document	
4.	AC system:	Refer Section-7
5.	Specific equipment which is under design	15 Ton EOT crane Doors shall be designed to withstand Launch environment. Door size to be selected to envisage easy

S. No.	Description	Details
	engineering scope (like EOT crane, doors etc.)	equipment transport
6.	Equipment which is not under the scope of design engineering Load because of Equipment are to be considered for design of Civil, Electrical and AC systems	Equipment: 1. LN2 Cryogenic storage tanks 2. LN2 pumps 3. GHe compressor 4. Vaporizers 5. High pressure Gas cylinders
7.	Design loads and load cases to be considered.	
7.1	Civil system design	Load details shall be as per approved drawings
7.2	Mechanical system design	1. Roof, wall, & floor Embedment plates for routing of pipelines, cable trays, AC ducts. 3D arrangement of AC duct, Instrumentation cable tray, power tray for electrical fitting, AC duct routing, pipeline to be provided by the designer. 2. Internal and external cable trenches with appropriate covers 3. Opening of 0.5 m x 0.5 m in the wall with metal embedment for cable entry between pneumatic board room and Instrumentation control room and 1.5m x1.0m openings in the wall with metals embedment plates for pipe line entry and exit from the pneumatic rooms. The exact location will be provided in due course. Provision to close/adjust the opening after cable routing is required. 4. 3D modelling of the building, equipment, piping, and along with related support structures with walk through and clash detection features
7.3	Electrical system design	Yes As per Section-8

S. No.	Description	Details
7.4	AC system design	Yes As per Section-7



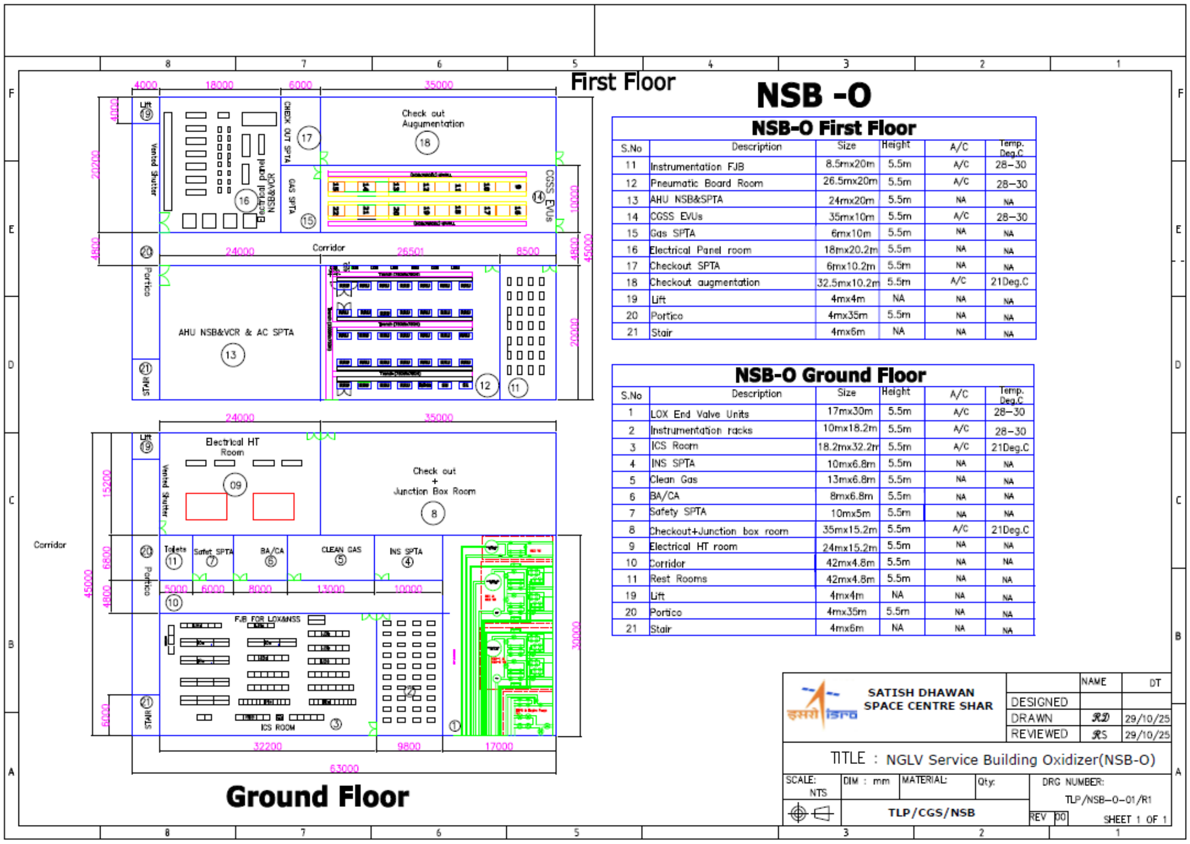
4.7 NGLV Service Building Oxygen Side (NSB-O):

S. No.	Description	Details
1	Purpose:	**i. Ground Floor:** • LOX system valve units for stage filing, pressurization and venting • Instrumentation & Control System equipment for measuring & monitoring of servicing parameters. • Checkout system for vehicle data acquisition and control • Clean gas /Breathing and compressed air supply • Electrical HT room to power requirements of AHU and other power demanding elements • Air-conditioning system is also equipped for NSB that requires 21℃ for instrumentation & control room & check

S. No.	Description	Details
		out room and 25℃ for Equipment rooms. **ii. First Floor:** • Remote Regulation Units (RRUs), are housed in the Pneumatic Board Room towards meeting system response as per the Liquid stage requirements. The gases are supplied through suitable piping network from gas cylinders at storage to respective RRUs and then to EVUs located at Valve Chamber Room (VCR) and first floor of NSB -O • EVUs for gas servicing launch vehicle • Electrical LT for the general electrical requirements of the NSB-O • AHU room for supply of cool air to the NSB first and second floor • Industrial lift for (min, 3ton) equipment lifting • Checkout room to facilitate the future augmentation.
2	Civil structure	
2.1	Description:	Facility houses valve units Liquid oxygen system, High pressure Pneumatic equipment, Checkout system related equipment, Instrumentation & Control systems panels & racks, electrical (HT&LT) Air conditioning equipment, etc.
2.2	Functional requirement:	• Closed room with RCC roof with False ceiling & False flooring for Instrumentation & Control system and Checkout system. False ceiling for Pneumatic system. • Trenches for internal and external cable routing • Antistatic false floor of depth 500 mm in Instrumentation and control room • Modular vertical augmentation of building shall be considered for design
2.3	Load details:	Design inputs shall be as per drawings
3	Electrical system: Refer Section-8 in this document	
4.	AC system:	Refer Section-7
5.	Specific equipment which is under design engineeringscope	Doors shall be designed to withstand Launch environment. Door size to be selected to envisage easy equipment transport.

S. No.	Description	Details
	(like EOT crane, doors etc.)	Two doors shall be provided for Instrumentation room
6.	Equipment which is not under the scope of design engineering. Load because of Equipment are to be considered for design of Civil, Electrical and AC systems.	Equipment: 1. Valve Units LOX system 2. Pneumatic Regulation units 3. End Valve Units 4. Instrumentation junction boxes 5. Electrical panels of HT/LT 6. Instrumentation racks, etc
7.	Design loads and load cases to be considered.	
7.1	Civil system design	Load details shall be as per approved drawings Modular vertical augmentation of building shall be considered for design withstanding launch loads
7.2	Mechanical system design	1. Roof, wall, & floor Embedment plates for routing of pipelines, cable trays, AC ducts. 3D arrangement of AC duct, Instrumentation cable tray, power tray for electrical fitting, AC duct routing, pipeline to be provided by the designer. 2. Internal and external cable trenches with appropriate covers 3. Opening of 0.5 m x 0.5 m in the wall with metal embedment for cable entry and between pneumatic board room and Instrumentation control room. The exact location will be provided in due course. Provision to close/adjust the opening after cable routing is required. 4. Opening of 1.0mx1.0 in the wall with metal embedment for pipe line entry and exit and between pneumatic board room. The exact location will be provided in due course. Provision to close/adjust the opening after cable routing is required. 5. Industrial lift for equipment mobilization 6. 3D modelling of the building, equipment, piping, and along with related support structures with walk through

S. No.	Description	Details
		and clash detection features.
7.3	Electrical system design	Yes As per Section-8
7.4	AC system design	Yes As per Section-7

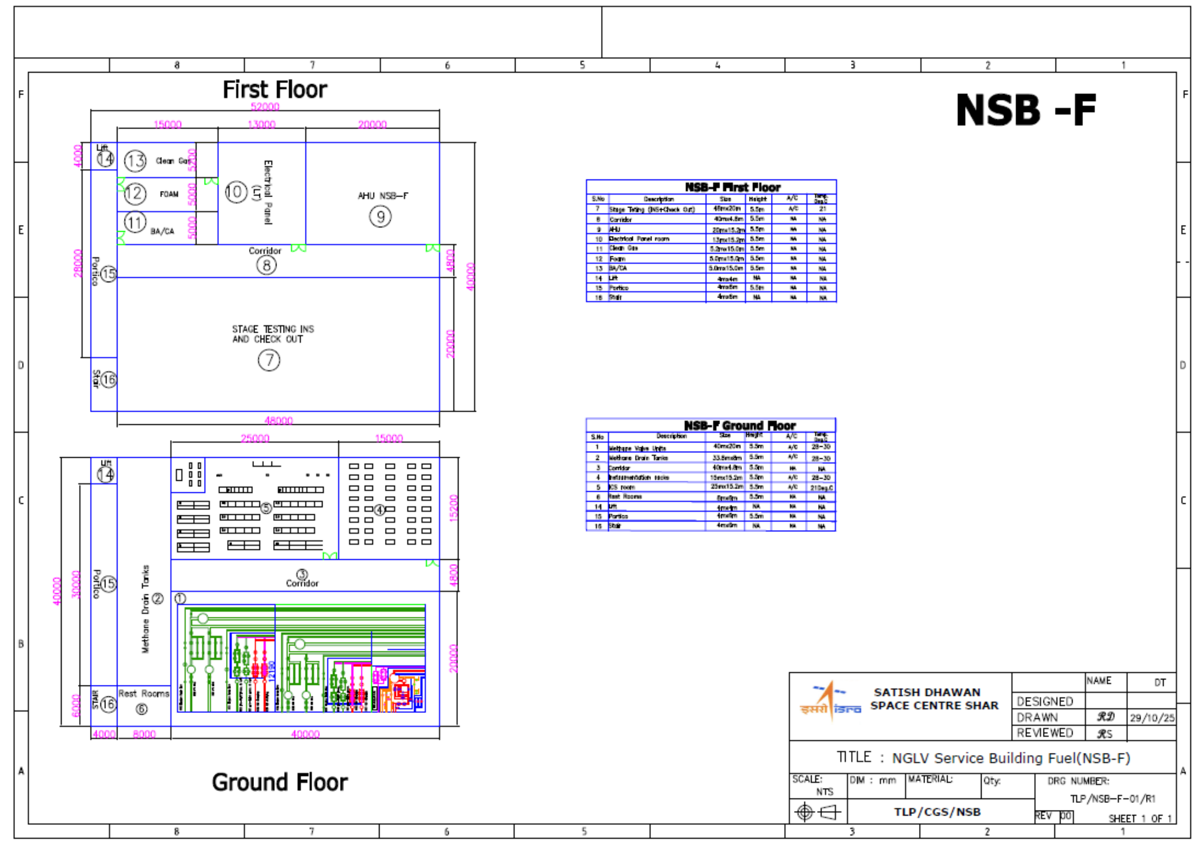


4.8 NGLV Service Building Fuel Side (NSB-F):

S. No.	Description	Details
1	Purpose:	**i. Ground Floor:** • Methane and LH2 system valve units for stage filing, pressurization and venting • Instrumentation & Control System equipment for measuring & monitoring of servicing parameters **ii. First Floor:** • Electrical LT for the general electrical requirements of

S. No.	Description	Details
		the NSB-F • AHU room for supply of cool air to the NSB first and second floor • Foam system for methane system fire fighting • Compressed air and breathing air system • Industrial lift for (min, 3ton) equipment lifting • Checkout room to facilitate the stage hot related instrumentation and checkout
2	Civil structure	
2.1	Description:	Facility houses valve Units of Liquid hydrogen ,Liquid Hydrogen ,High pressure Pneumatic equipment, Checkout system related equipment, Instrumentation & Control systems panels & racks, Air conditioning equipment, etc.
2.2	Functional requirement:	• Closed room with RCC roof with False ceiling & False flooring for Instrumentation & Control system and Checkout system. False ceiling for Pneumatic system. • Trenches for internal and external cable routing • Antistatic false floor of depth 500 mm in Instrumentation and control room • Modular vertical augmentation of building shall be considered for design
2.3	Load details:	Design inputs shall be as per drawings
3	Electrical system: Refer Section-8 in this document	
4.	AC system:	Refer Section-7
5.	Specific equipment which is under design engineering scope (like EOT crane, doors etc.)	Doors shall be designed to withstand Launch environment. Door size to be selected to envisage easy equipment transport. Two doors shall be provided for Instrumentation room
6.	Equipment which is not under the scope of design engineering.	Equipment: 1. Valve Units of Liquid Methane and hydrogen system 2. Instrumentation junction boxes

S. No.	Description	Details
	Load because of Equipment are to be considered for design of Civil, Electrical and AC systems.	3. Electrical panels of LT 4. Instrumentation racks, etc
7.	Design loads and load cases to be considered.	
7.1	Civil system design	Load details shall be as per approved drawings Modular vertical augmentation of building shall be considered for design withstanding launch loads
7.2	Mechanical system design	1. Roof, wall, & floor Embedment plates for routing of pipelines, cable trays, AC ducts. 3D arrangement of AC duct, Instrumentation cable tray, power tray for electrical fitting, AC duct routing, pipeline to be provided by the designer. 2. Internal and external cable trenches with appropriate covers 3. Opening of 0.5 m x 0.5 min the wall with metal embedment for cable entry and between pneumatic board room and Instrumentation control room. The exact location will be provided in due course. Provision to close/adjust the opening after cable routing is required. 4. Opening of 1.0mx1.0 in the wall with metal embedment for pipe line entry and exit and between pneumatic board room. The exact location will be provided in due course. Provision to close/adjust the opening after cable routing is required. 5. Industrial lift for equipment mobilization 6. 3D modelling of the building, equipment, piping, and along with related support structures with walk through and clash detection features.
7.3	Electrical system design	Yes As per Section-8
7.4	AC system design	Yes As per Section-7

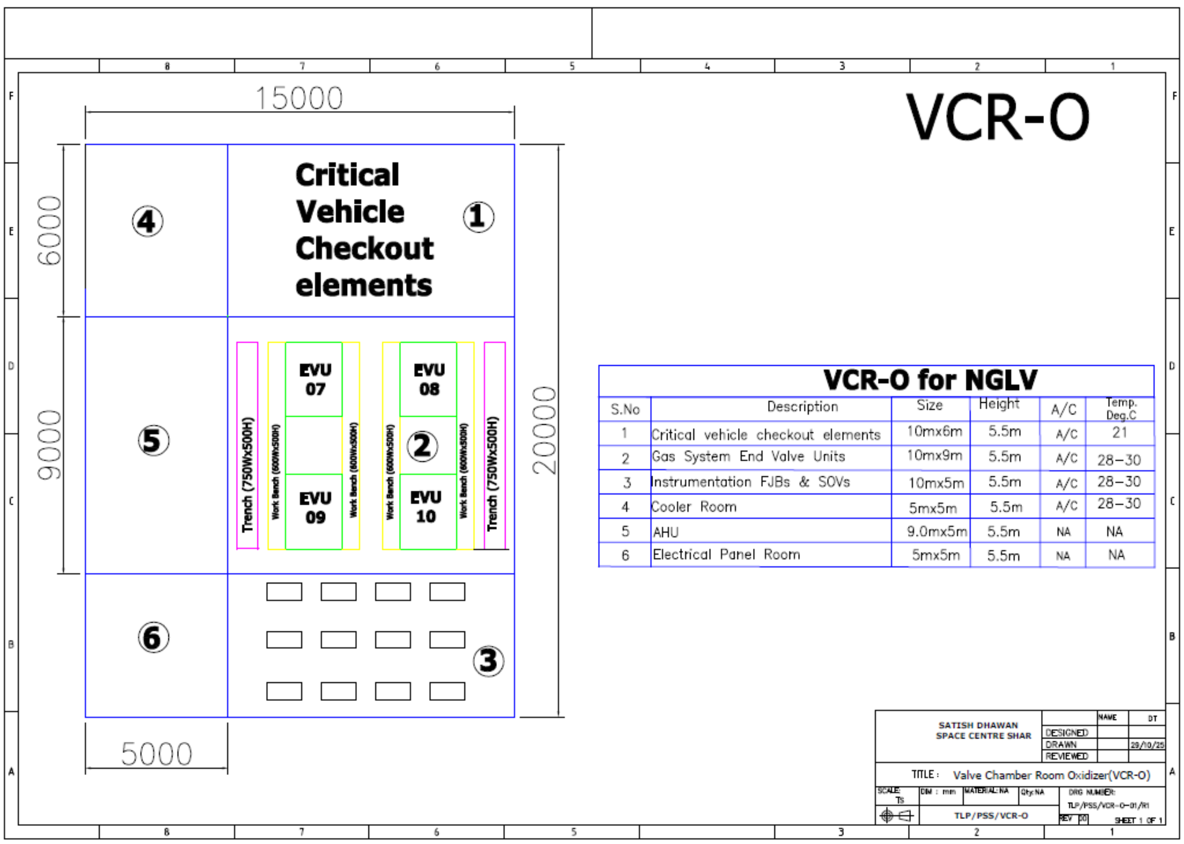


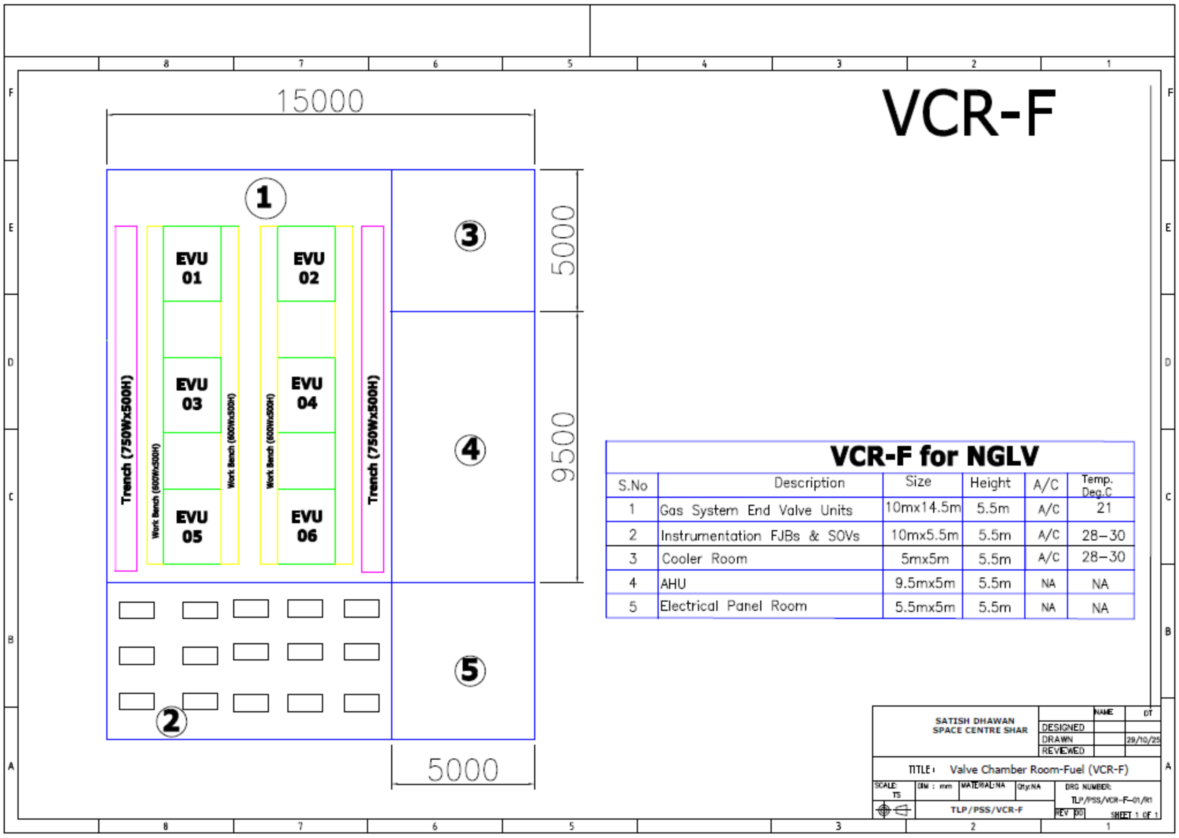
4.9 Valve Chamber Room (VCR-O&F):

S. No.	Description	Details
1	Purpose:	• Critical End valve units and associated instrumentation meant for meeting the Liquid stage requirements i.e command and stage purge. These fluids are supplied through suitable piping network to stages from End Valve Units located at Valve Chamber Room (VCR-O&F). • VCR-O houses check out junction boxes to interface with vehicle
2	Civil structure	
2.1	Description:	Facility houses End valve units, of gas system, Instrumentation racks, respective helium gas coolers ,AHU, and electrical panels
2.2	Functional requirement:	• Closed room with RCC roof along with partly false floor & False ceiling for ICS.

S. No.	Description	Details
		• Trenches for internal and external cable routing with appropriate covers
2.3	Load details:	• Design inputs shall be as per drawings
3	Electrical system: Refer Section-8 in this document	
4.	AC system:	Temperature to be maintained as 25℃ at Process equipment rooms and instrumentation. Refer Section-7
5.	Specific equipment which is under design engineering scope (like EOT crane, doors etc.)	Suitable mechanical system for the movement of equipment's within the Valve chamber Room, shall be considered. Doors shall be designed to withstand Launch environment. Door size to be selected to envisage easy equipment transport. Two doors shall be provided for Instrumentation room
6.	Equipment which is not under the scope of design engineering	Equipment's: 1. End valve units 2. Instrumentation junction boxes and Electrical panels 3.AHU 4.Cooler Room(Helium cooler Units) 5.Check out junction boxes in VCR-O
7.	Design loads and load cases to be considered.	
7.1	Civil system design	Load details shall be as per approved drawings
7.2	Mechanical system design	1. Roof, wall & floor Embedment plates for routing of pipelines cable trays, AC ducts. 3D arrangement of AC duct, Instrumentation cable tray, power tray for electrical fitting, AC duct routing, pipeline to be provided by the designer. 2. Internal and external cable trenches with appropriate covers 3. Opening of 0.5 m x 0.5 m in the wall with metal embedment for cable entry between end valve unit and instrumentation room The exact location will be provided in due course. Provision to close/adjust the opening after cable routing is required.

S. No.	Description	Details
		4. Opening of 1 m x 1 m in the wall with metal embedment for pipe line entry and exit between end valve unit and NSB and VCR exit 5. 3D modelling of the building, equipment, piping, and along with related support structures with walk through and clash detection features.
7.3	Electrical system design	Yes As per Section-8
7.4	AC system design	Yes As per Section-7





5. Safety &Firefighting Systems

5.1 Introduction:

Safety & Firefighting systems for Third Launch Pad (TLP) are intended to protect all launch complex ground facilities, launch vehicle and operational personnel from fire hazards arising due to storage and handling of propellants like Liquid Hydrogen (LHFS), Liquid Methane (LMFS), Liquid oxygen (LOX), Liquid nitrogen (LN2) and other High pressure compressed gasses used for servicing of Launch vehicle. Following are the systems planned,

1. **Water Based Fire Fighting Systems:**
   - **Deluge System:** Automatic-cum-remote operated deluge system for fire suppression in propellant storages to be planned as per statutory norms.
   - **Spray Nozzles:** Remote operated spray nozzles for MLP cooling and for dilution of propellant spills/fires shall be planned.
   - **Water monitors:** Remote operated and manoeuvrable water monitors around MLP and at propellant storages shall be planned.
   - **Fire Hydrant System:** Fire hydrants are required to be provided for all propellant storages and other facilities in the launch complex as per statutory norms.

2. **Foam Based Fire Fighting system:**
   - **Foam System:** Remote operated foam system for fire suppression in propellant storages to be planned as per statutory norms.
   - **Foam Spray Nozzles:** Remote operated spray nozzles for MLP cooling and for dilution of propellant spills/fires shall be planned.
   - **Foam Water Monitor:** Remote operated and manoeuvrable foam monitors are to planned at Methane storage, around MLP and at required location as per statutory norms.

3. **Clean Gas Based Fire Fighting system:**
   - **Modular System for Electrical Panels:** Modular type fire extinguishers can be provided with powder and gas based extinguishing agents. This system will be connected in UPS power supply to indicate the activation of system if any in case of power failure.
   - **Total Flooding System for Control Rooms/Checkout Rooms:** Clean agent fire suppression systems are waterless and deploy immediately without leaving behind oily residue or water that can damage irreplaceable assets. These systems will be planned at required locations as per statutory norms. This system will be connected in UPS power supply to indicate the activation of system if any in case of power failure.

4. **Fire Detection & Alarm system:** Heat and smoke, multi-criteria. UV/IR detectors, are to be planned in select rooms and passage ways of all facilities to ensure round the clock fire safety even during non-campaign periods. Hooters, Remote Indicators, Manual call points and fire alarm panels shall be suitable for respective location (explosion proof housing wherever required). Fire alarm panels are supplied with dual redundant power sources (normal and UPS Power Supply). The system to be designed as per IS 2189.

5. **Gas Monitoring System (HC, H2, O2):** Explosion proof Electrochemical type HC, oxygen, hydrogen leak detectors are proposed to be planned in critical locations. The purpose of oxygen detector is to detect both, the enriched oxygen level and depleted oxygen level in the atmosphere. HC and Hydrogen sensors detects the presence of its concentration in the atmosphere.

6. **Flame detection systems:** UV/IR flame detection systems to be designed to detect the fire condition at propellant storages and launch pad area.

7. **First aid Fire Extinguishers:** Portable fire extinguishers are not meant to deal with large fires. They are very valuable in the early stages of fire. As per IS 2190/ NFPA-10, Facilities proposed for TLP can be categorized as extra hazard occupancies where high amounts of Class B flammables are present and rapidly

developing fires with high rates of heat release are expected. Fire extinguishers shall be provided for the protection of both the building structure and the occupancy hazards contained therein regardless of the presence of any fixed fire suppression systems as per statutory norms.

8. **Eye wash showers:** Eye/body wash showers are meant to use in case of any spill or splash of hazardous chemical by operation personnel. Require number of eye was showers are to be planned at all storage facilities and integration facilities handling chemicals.

9. **Compressed air & Breathing Air System:** Compressed air & Breathing air system is to be provided at all propellant storage servicing facilities/storages for hazardous/emergency operations. The system to be worked out based on EN/BIS standards.
10. **Emergency public address system:** Emergency PA system is to be provided for all facilities and launch pad area to alert the people in case of any emergency.

5.2 Details:

The design of the Safety & Firefighting systems involves in design of Civil, Mechanical, Equipment, Electrical, Instrumentation & control systems and AC systems. Safety & Fire Protection system includes deluge system, foam-water system, remote operated water cum foam monitors, fixed water powered oscillating monitors, fire hydrants, fire detection and alarm systems, gas detection and suppression system, first-aid fire hose reels & fire extinguishers and eye wash body showers and compressed and breathing air systems. The fire water is catered from a Ground Level Reservoir (GLR). The fire water would be available in fixed points at Process Facilities for tapping to fire protection system.

The fire protection system circuits involve carbon steel pipes of sizes from DN15 to DN1200, flow components namely deluge valves, EP valves, manual valves, filters, water cum foam monitors, fixed water powered oscillating monitors, medium & high velocity water spray nozzles, fire hydrant valves, equipment such as foam skid and structural steel access platforms. The detection & fire protection system includes instruments namely pressure gauge, pressure transmitter, flow switch, joy sticks and necessary electrical, measurement, command cabling & tubing.

The details of the systems for design consideration is given in the table.

S. No.	Description	Details
1	Purpose:	Hydrants, deluge system, Pumps, foam system, compressed air & breathing air system and Clean gas suppression systems, gas detection, gas suppression system, emergency PA system are

S. No.	Description	Details
		required to be realised to meet Facility safety requirements. Safety systems proposed are water based system for propellant storage & launch pad areas and clean gas suppression system for control room & electrical panel rooms. Required Fire water will be stored in Ground Level Reservoir (GLR) & Over head tank (OHT) at 45 metres staging.
2	Systems / Equipment to be designed	1. Fire pumps 2. Compressors 3. Air Receivers 4. Cooling water pumps & towers 5. Electrical panels 6. Foam system 7. Deluge systems 8. Hydrant system & Remote water monitors 9. Breathing air system 10. Fire detection and alarm system 11. Gas detection systems 12. Gas suppression systems 13. Flame detection systems 14. Electrical systems 15. Instrumentation and control systems 16. Piping system 17. Eye wash and body showers 18. Portable fire extinguishers 19. Emergency PA system 20. EOT crane for pump handling in the pump bay. 21. GLR & OHT filling system from water treatment plant
3	Civil structure	
3.1	Description:	a) Fire pump house b) Ground level Reservoir c) Overhead Tank d) Safety systems Auxiliary buildings and pedestals for supporting fire hydrant pipelines e) Associated Instrumentation, control and electrical systems

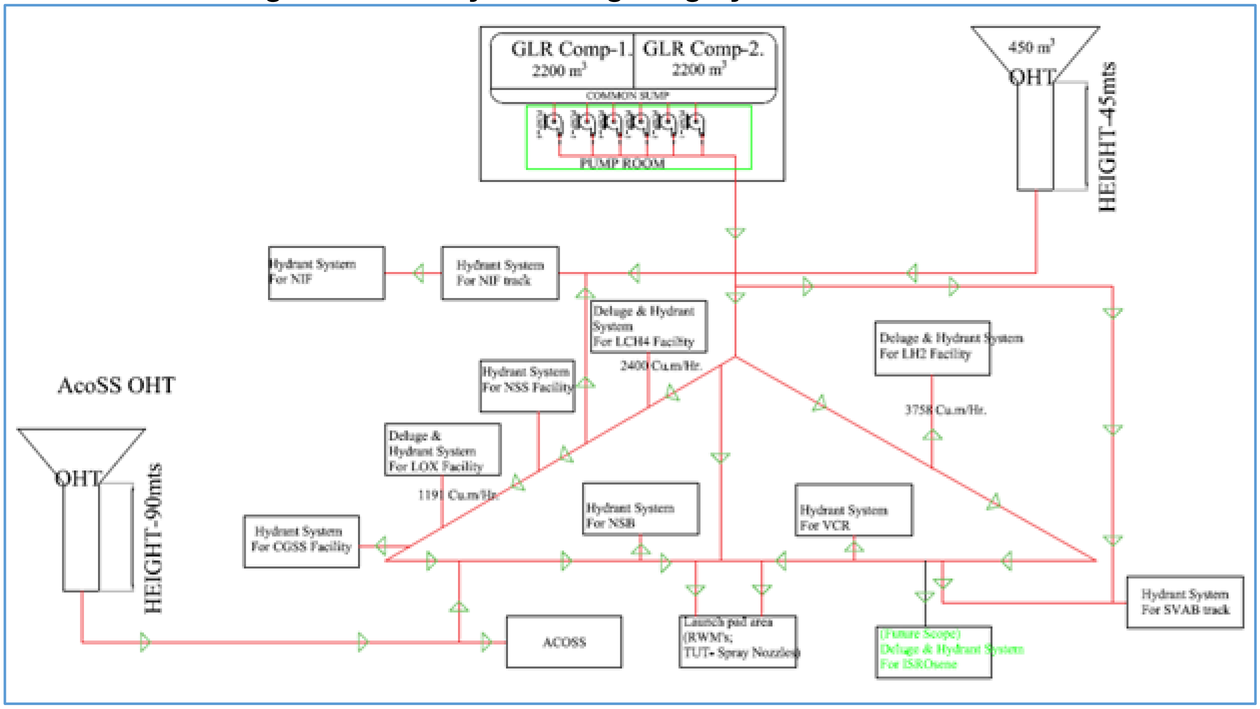
S. No.	Description	Details
3.2	Functional requirement:	**Fire pump house** • **RCC roof with brick wall rooms** for pumps, compressors, electrical panels and control console. • EOT crane girder and EP plates. • **Equipment foundations** for Fire pumps, Compressors, cooling water pumps, Cooling water towers, filters and air receivers. • **Auxiliary buildings:** Electrical panel room, cooling water pump room, control console room, pollution monitoring calibration room, Instrumentation & calibration room, A/C package unit room, Mechanical SPTA room, Tool room, Site engineers room and toilets. • **RCC paved area** for Cooling water towers, air receivers, filters, diesel storage tank area, storage yard. • Civil pedestals for pipe supports for various dia of pipe • **Cable trench** for internal and external cable routing with covers. • Antistatic false floor of depth 500 mm in Instrumentation and control room • **Approach staircase** to reach top of pump house **Ground level Reservoir** Impermeable RCC structure for storage capacity of 5400 cu.m • Provision for filling GLR from the water treatment plant • Provision for periodical maintenance of GLR • Provision of level indicator to know the level locally & remotely and auto filling &cut-off • Provision for connecting pipeline to fire water pumps • Provision for filling the tanks • Installation of sluice valve as per the drawing • Provision for Strainer at the inlet piping to Pumps.

S. No.	Description	Details
		• RCC Stairs provision to reach the GLR top. **Overhead Tank** • Impermeable RCC structure for storage capacity of 450 cu.m of fire water at 45-meter staging. (tentative) • Provision for filling OHT from the water treatment plant • Provision for periodical maintenance of OHT • Provision of level indicator to know the level locally & remotely and auto filling &cut-off • Pipeline connection the OHT staging at 45 meters to fire water network at ground level. • RCC Stairs provision to reach the OHT top from zero meter. **Safety systems Auxiliary buildings** (Deluge room, Foam concentrate pump room & RMV Valve housing room) • **RCC roof with brick wall rooms** for housing deluge valves, RWM's, pumps for foam concentrate preparation. • **Civil foundation / beds** for Foam concentrate pumps, tanks. • **Civil foundation / beds** for booster pump in RWM valve houses. • **Approach staircase** to reach top of RWM valve housing.
3.3	Load details:	**Fire pump house** Design inputs shall be as per drawings: - Civil Foundations for Fire pumps, compressors, receivers, cooling water pumps, filters and towers. **Ground level Reservoir** Design inputs shall be as per drawings: - Foundations for GLR - **Cable trench** for internal and external cable routing with appropriate covers. **Overhead Tank** Design inputs shall be as per drawings:

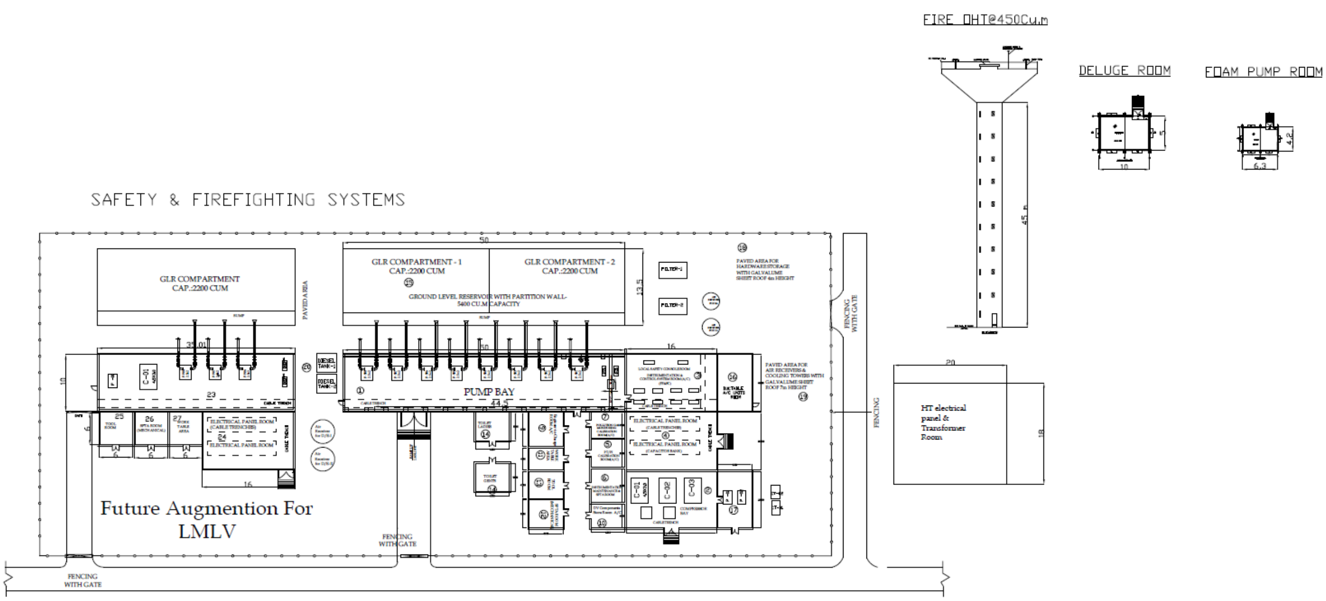
S. No.	Description	Details
		- Pile/ raft Foundations for OHT. **<u>Safety systems Auxiliary buildings</u>** Design inputs shall be as per drawings: - Civil Foundations for Foam concentrate pumps. - Civil Foundations for Foam concentrate tanks. - Civil pedestals design for pipe and cable tray supports
4	Electrical system: Refer electrical specification in this document	
5.	AC system:	**A. Fire pump house** Temperature to be maintained at 21℃ in instrumentation & Control console room.
6.	Design loads and load cases to be considered.	
6.1	Civil system design	Load details shall be as per approved drawings for the following A. Safety systems Auxiliary buildings B. Fire pump house C. Ground level Reservoir D. Overhead Tank E. Pedestals for pipe supports
6.2	Mechanical system design	**A. <u>Fire pump house</u>** - Column Embedment plates - -EOT crane **B. <u>Pump house &Ground level Reservoir</u>** 1. Roof and wall Embedment plates for routing of pipelines cable trays, AC ducts. 3D arrangement of AC duct, Instrumentation cable tray, power tray for electrical fitting, AC duct routing, pipeline to be provided by the designer. 2. Internal and external cable trenches with appropriate covers 3. Opening of 0.5 m x 0.5 m in the wall with metal embedment for cable entry between instrumentation and control room and compressor room. The exact location will be provided in due course. Provision to close/adjust the opening after cable routing is required.

S. No.	Description	Details
		C. <u>Overhead Tank</u> - Wall Embedment plates for routing of pipelines. - Platforms at various levels to approach pipeline in the OHT Shaft for the periodical maintenance & inspection.
6.3	Electrical system design	**A. Safety systems Auxiliary buildings** Yes **B. Fire pump house** Yes **C. Overhead Tank** Yes As per specification given in this document
6.4	AC system design	A. Fire pump house Yes As per specification given in this document
6.5	Design Standards and codes to be followed	Consultant shall follow relevant IS codes / NFPA / OISD / NBC code for design of Safety & Fire fighting system

Process Flow diagram of Safety & Firefighting systems



Fire pump house, Reservoir, OHT and Auxiliary buildings layout:



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Sl.No	Description	Dimension(LxB)	Area(Sq.m)	Height(m)
1	Pump Bay	50.0 x 10.0	500	6.5
2	Air Compressor Bay	16.0 x 10.0	160	6.5
3	Local safety control room & Instrumentation & Control system room (FF&FC)(A/C)	16.0 x 10.0	160	5.5
4	Electrical Panel Room	16.0 x 10.0	160	5.5
5	PT/PI Calibration Room	6.0 x 5.0	30	4
6	ICS maint. & SPTA room	6.0 x 6.0	36	4
7	Pollution Gas Monitoring Calibration room (A/C)	6.0 x 4.5	27	4
8	Site Engineers Room (A/C)	6.0 x 6.0	24	4
9	Staff Room (A/C)	6.0 x 4.0	24	4
10	Work Table Area	6.0 x 4.0	24	4
11	SPTA Mechanical Room	6.0 x 6.0	36	4

Sl.No	Description	Dimension(LxB)	Area(Sq.m)	Height(m)
12	Tool Room	6.0 x 5.0	30	4
13	Toilet	10.0 x 6.0	60	4
14	Ground level reservoir 5400 Cu.m capacity	48.3 x 13.5	652.05	6.5
15	Ductable A/C units room	Dimensions will be provided by CAMS - TLP		
16	Cooling Tower Pump Room	10.0 x 6.0	36	4
17	Paved area-HW storage	11.0 x 16.0	176	-
18	Paved area for Air Receivers & CTs	11.0 x 16.0	176	-
19	Paved area for Filter	11.0 x 16.0	176	-
20	OHT	45 m height 450 Cu.m		
21	Deluge Room	\pt5443.2;10.0 x 5.0	54	3
22	Foam Pump Room	6.0 x 4.0	24	3

LMLV

Sl.No	Description	Dimension(LxB)	Area(Sq.m)	Height(m)
23	Pump Bay	35 x 10.0	350	6.5
24	Electrical Panel Room	16.0 x 10.0	160	6.5
25	Tool room	16.0 x 10.0	160	5.5
26	SPTA Mechanical Room		36	4
27	Work Table Area	6.0 x 4.0	24	4

Note: Flow diagram and details mentioned in the above figures are indicative. Exact details will be given to qualified party along with PO.

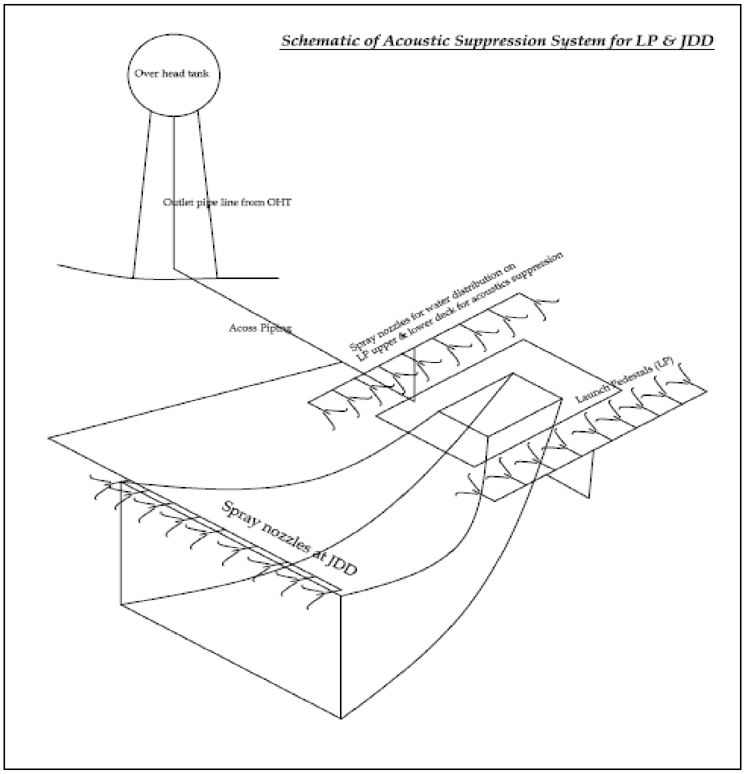
6. Acoustic Suppression System (ACoSS):

The vibro-acoustic environment induced by acoustic energy released from a launch vehicle propulsion system during lift off, is of great concern for the integrity of the launch complex, control electronics in the vehicle and payload. Acoustic suppression system is essential to attenuate the intense noise generated at launch pad. Water based Acoustic Suppression System is proposed during lift off.

The following major systems are required to be designed:

1. RCC Over Head Tank (OHT) with water storage capacity of around 2600 cu.m and staging height of around 85 mtr. OHT along with the water filling system shall be designed, as per the prevailing codes & standards. All the necessary features like vortex breaker, outlet pipe, fill pipe, score pipe, tank ventilation, illumination, approach staircase etc., shall be incorporated suitably.
2. Distribution-piping and water spray system shall also be designed. The distribution piping system shall be extended from OHT for water injection at specified locations in and around JDD & MLP at launch pad.
3. Design of water filling system to the overhead tank along with suitable capacity of ground level reservoir and pumping system.
4. Design of Instrumentation & Control System for remote operation
5. Design of Transpiration Water Cooling System for JDD with suitable pressurization system connected to distribution piping and spray system with minimum injection pressure requirement of 8 bar (tentative) at JDD spray location.

** Indicative capacity of OHT is 2600 cu.m. However, the exact details will be provided to qualified Design Consultant along with PO.*



Schematic diagram of acoustic suppression system

The scope shall include the following but not limited to:

1. Overhead Tank:
    a) Configuration & design of Over Head Tank of around 2600 cu.m water capacity in addition to freeboard volume at around 85mtr staging height.
    b) Configuration & design of down runner pipe (water withdrawing pipe) of suitable diameter.
    c) Design of integrated thrust block for down runner pipe support along with tank foundation.
    d) Configuration & design of Water supply system to fill OHT from water treatment plant
2. Design of water distribution piping System:
    a) Development of P&ID, Piping layout and detail engineering
    b) Sizing and selection of piping& flow components viz Electro pneumatic & manual valves, water injection nozzles at the specified locations of the system
    c) The pipes shall be routed in the suitable RCC trenches near launch pad as per site conditions. The distribution system shall be designed for a peak

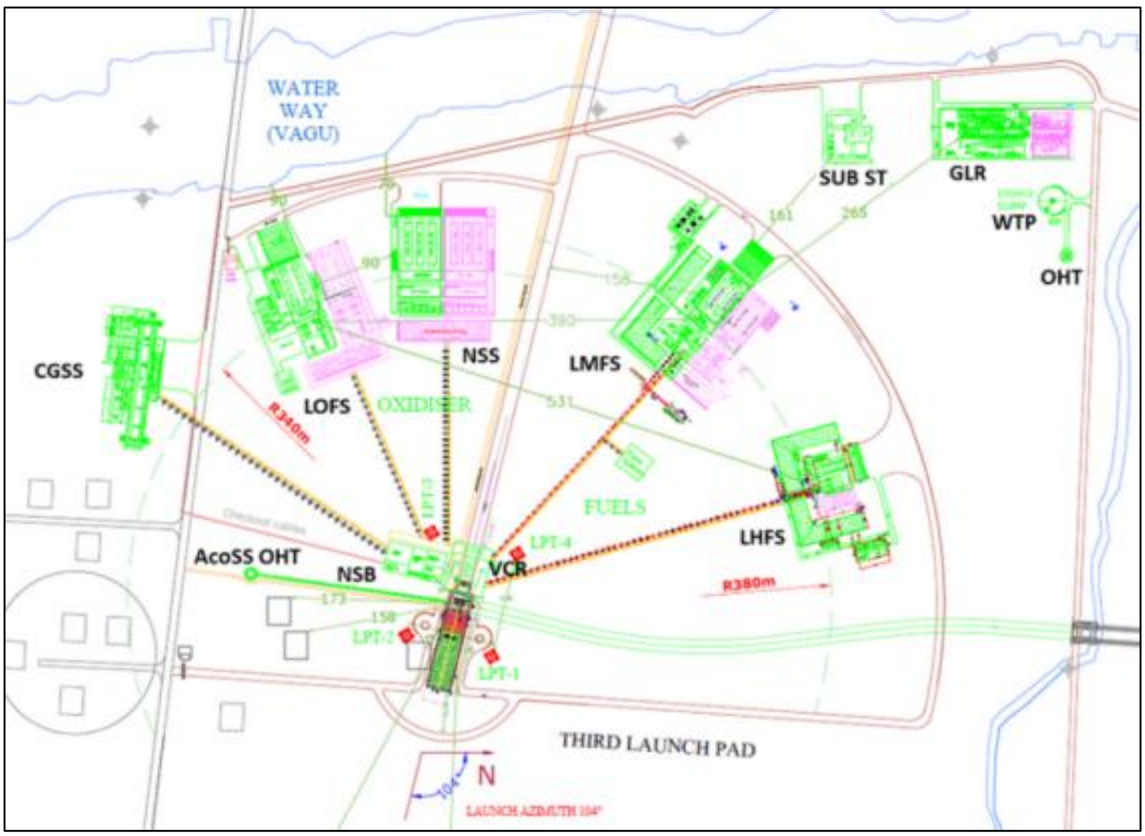
indicative flow rate of 75 cu.m/s. Further distribution at launch pad in the ratio of 2:2:1.

3. Instrumentation & Control system:

   Proposed Configuration of Instrumentation and control systems shall be as per Section:9.

4. Transpiration water cooling system for JDD:

   a) Configuration and design of storage tanks, piping system and spray system.
   b) Development of P&ID, piping layout and detailed engineering.
   c) Sizing and selection of storage tanks, pressurization system, piping and flow components, water injection nozzles etc, at specified locations at JDD.
   d) Interfacing with JDD.



Overall layout of Process, Safety & Acoustic Suppression systems

7. Air Conditioning systems of Satellite & Launch Vehicle Cool Air System and Process and safety systems facilities:

7.1 Introduction:

Overall Third Launch Pad (TLP) Air conditioning systems are mainly categorized into two streams:

a) **Satellite and Launch Vehicle Cool Air systems:** To meet the conditioning requirements of Satellite and Launch vehicle, each chain with a mass flow rate of 10,000kg/Hr of air (requirement for one stream) as per details in the functional requirements shall be designed. This stream of satellite cool air requirements is purely ***"once through systems"*** which shall be designed to meet the conditioning requirements of satellite and Launch Vehicle in two separate streams of flow requirements individually.

b) **AC system for Process & Safety Systems:** Air conditioning systems required for Process and Safety Systems Facilities (PSS) near launch pad area and in D-area of Third Launch Pad shall be designed with ***Re-circulation type AC systems*** unless otherwise specified.

c) The scope involves plant design, ducting design and routing scheme finalization along with necessary QCDC systems etc.,

- Air-conditioning systems for Satellite and launch vehicle cooling during the pre-launch and launch activities shall be designed to maintain cool air/Conditioned air at a temperature from 10°C (minimum) to 15°C (maximum) with an operating accuracy/in steps of ±0.5°C and with a Variable Relative humidity of 30-50% (Range: 30% (Min) to 60% (Max)) for Satellite and with a variable Relative Humidity of 50±5% for Launch Vehicle. The conditions mentioned to be achieved towards at end at discharge ports of TUT provided for satellite and vehicle cool air requirements.
- Air conditioning systems for Process and Safety systems facilities (PSS) shall be designed to meet requirements of conditioning temperature of 21±2°C (Range: 19°C to 23°C), with a Relative humidity of 55±5% for instrumentation and control rooms (ICS) and Checkout rooms & with a temperature of less than 30°C (Range: 25°C to 30°C) and Relative humidity of Comfort RH of TLP.
- Air Conditioning processes involved are filtering, conditioning, dehumidifying, filtering and supply the treated air through round aluminium duct of adequate thickness including insulation to supply to the payload fairing/satellite and to launch vehicle at different elevations from AC plant. The Satellite and vehicle cool air systems and its associated elements shall be routed and interfaced through TUT to meet the launch requirements from TLP.

Sl No	Description of Air Conditioning systems	Basic requirements
1	ACS for Launch Pad Facilities (once-through type AC systems)	Space craft and Launch Vehicle cooling air systems (Once through systems with Conditioned air) as per details given in table provided in Functional Requirements/ Specifications of Satellite and Vehicle Cool Air Systems. Design Consultant shall design AC system and plant (including civil, electrical, AC, equipment, instrumentation and control system), routing of AC duct and instrumentation system inside building, near to launch pad and over TUT.
2	ACS for Launch Pad for Process and Safety system facilities (Re-circulation/Once through systems based on process requirements)	Individual process facilities and safety systems facilities of Third Launch pad (TLP) shall be provided with both recirculation type and once through systems based on the requirement of process need. NSB-O, NSB-F & VCR-O & VCR-F, FCC-2 or 3 facilities which are under Launch pad infrastructure also shall be configured with suitable air conditioning systems under this category. Design Consultant shall design AC system and plant (including civil, electrical, AC, equipment, instrumentation and control system), routing of AC duct and instrumentation system inside building etc. AC infrastructure for each building shall be located adjacent to the building.

7.2 Brief Description of Satellite and Launch Vehicle cooling purpose:

- Satellite and launch vehicle require conditioned air cooling during the pre-launch and during launch preparedness/readiness activities to maintain cool air at temperature from 10°C (minimum) to 15°C (maximum) with a variable relative humidity of 30-60% for satellite and variable relative humidity of 55±5% (50% to 60%) for Launch vehicle. Chemical Dehumidifiers/Dynamic chemical dehumidification systems shall be designed for conditioning of the supply air.

Cool air requirements	Temperature (in °C)	Settable Temperature (in °C)	Relative Humidity (%)
For Satellite	10-15°C	±0.5 °C	30-60%** (With an operational accuracy of ±5%)
For Launch Vehicle (LV)	10-15°C	±1 °C	55±5% (With an operational accuracy of ±5%)

- For satellite and vehicle cool air systems, brine shall be taken as the medium for conditioning and supply of chilled air.
- Plenum and duct design are to be done such that pressure drop and heat loss is as minimum as possible with suitable material with supports, stiffeners, 2-way valves, 3-way mixing valves, insulation, guide vanes etc.
- Total 4 Numbers of Dehumidifiers (2Nos Working and 2Nos stand by) with each 10000Kg/Hr or 6 Nos of Dehumidifiers with 7500Kg/Hr capacity shall be connected to the Two independent mixing plenums i.e., one plenum for satellite cooling purpose and other plenum for vehicle cooling system. The stream of satellite cool air systems along with 2 Nos/3 Nos of dehumidifiers along with independent duct systems shall be planned to meet the satellite and launch vehicle conditioned air requirements.
- Satellite cooling duct must be designed to carry 10,000Kg/hr of conditioned air from plant outlet to Satellite port elevation level of approximately 120m. (Details provided in drawing below)
- Vehicle cooling duct must be able to carry 10,000Kg/Hr of conditioned air from Plant outlet to multiple adaptors available in different elevations in TUT.
- Round Aluminium duct with adequate thickness including insulation shall be designed for the above mass flow rate of 10,000Kg/Hr (for satellite) + 10,000 Kg/Hr (for launch vehicle) to transport the conditioned air from two different mixing plenums which enable the total flow as two independent streams to the final destination points of satellite cooling systems & Vehicle cooling systems separately.
- The round aluminium duct from the exit of plenum shall be routed through trenches located in and out of the AC Plant and shall be taken near TUT foundation and terminated. The round aluminium duct shall be designed in such a way that the interconnection between AC plant duct and TUT duct shall have minimum interconnecting gap and the duct shall not foul with any other interface of TUT and pipe lines, structures, etc of any other structure near TUT.

- Both ducting systems of satellite and vehicle cool air shall be designed with one number of emergency vent port at the top most possible elevation of duct with remote control valve mechanism. The remote control provision shall be considered in Control room of AC Plant/DDC room.
- Satellite and vehicle cooling plant must have flexibility to operate all Dehumidifiers for both Satellite cooling purpose and Vehicle cooling purpose. Air/Filter plenum, associated ducting, remote controlled Butterfly valves, Interlocks etc., and shall be configured accordingly.
- Trenches are to be designed with slope for rain water to get collected in one feasible end. Soak pit to be prepared at that end to collect the water, Pump set up along with flexible hose to remove the water is to be designed. Supports in the trench that carry Ducts to be positioned at half of the depth of the trench.
- Quick connection and Disconnection provision shall be incorporated with flexible ducting/corrugated hose arrangements for the aluminium ducts (Round aluminium duct from AC plant and fixed round aluminium duct in the TUT) carrying chemically dehumidified air so that connection can be established after movement of TUT to the launch pad.
- In-built dummy arrangement shall be incorporated within the fixed ducts in addition to the flexible ducts in order to avoid entry of dust or water inside the duct during idle period. After inter-connection of AC plant round aluminium duct & fixed round aluminium duct inside TUT, passage of conditioned/chemically dehumidified air supply shall be ensured to various ports.
- Necessary isolation valves and 3-way control valves shall be configured where ever required based on the requirement of Conditioned air/Chilled brine for control systems of TUT tilting actuator/Modules and will be decided during realization of the hydraulic actuation systems of TUT.
- The control systems of TUT (TUT Control and operation room of 60 Sq.m area approximately- TUT Control Systems Building (TCSB)) which consists control systems and its associated instrumentation systems near TUT shall be designed with a conditioned air at 21±2°C, RH of 50±5% for reliable operation. Actual layout of TCSB with internal room wise dimensional details will be provided at the time of preliminary design phase.
- All Dehumidifiers and other necessary brine chillers, primary and secondary pumps, cold and hot brine tank, brine top up tank and its sump, Brine charging Pump and shall be designed similar to existing available system (similar to SVAB/SLP)AC plants of SDSC-SHAR.
- Effective height of 120m shall considered(equal to height of TUT) for design of AC plant equipment like Dehumidifiers, brine tanks, brine pumps, brine

chillers to achieve required end conditioning temperature of 10-15°C (±0.5°C) & RH of 30-60% (±5%) and 10-15°C (±0.5°C) & RH of 55±5% for satellite and vehicle cool air requirement respectively.

- Total approximate Distance from dehumidifier to the Satellite port will be 250Mtr. Horizontal -100m to 120m, Vertical 120-130mts. Accordingly, dehumidifier unit capacity with required static pressure may be designed to ensure a positive pressure of 650-700mm of water column pressure inside the payload fairing or satellite cabin).

7.3 Brief details of Air Conditioning Systems for Process and Safety system facilities:

- TLP also consists of process systems facilities for propellant storage and fuel circuit purpose and safety system facilities for the purpose of pre-launch and post-launch operations.
- Facility wise specific temperature and RH requirements is provided in this document.
- All the Instrumentation and Control Systems (ICS) facilities and MCC/FCC facilities including launch pad infrastructure facilities NSB-O, NSB-F and TUT Control systems Building (TCSB) of process and safety systems(PSS) facilities shall be designed with re-circulation type air conditioning systems with conditioning parameters of 21°C temperature && 55±5% RH unless otherwise specifically mentioned.
- All the equipment rooms of process and safety systems facilities shall be designed with a temperature & RH requirement of Less than 30°C (Range: from 25°C to 30°C)&Comfort RH.
- Some of the facilities located within the D-Area of Launch pad shall be designed with Non-flame proof systems and flameproof. Most of AC systems shall be configured for of Non-flame proof type only. Any specific flame proof systems requirement shall be designed based on the requirement of safety considerations which will be intimated later during conceptual design phase.
- Facility wise inputs were mentioned with Temperatures &RH for each facility shall be designed considering suitable size of AHU Rooms/Packaged AC Units room adjacent to each facility itself.
- Vendor shall consider suitable AC plant according to the requirement of each facility wise air conditioning requirements mentioned, in case AHU rooms are not indicated in the layout, if required shall be incorporated.

7.4 Detailed specifications of Satellite &Launch Vehicle Cool Air Systems:

SYSTEM DESCRIPTION:

- Satellite and Launch vehicle AC plant **(Once through type Air conditioning system** - A dedicated system designed for satellite and launch vehicle cooling streams) shall be configured nearest to the Launch pad(less than 100mts distance on the unaffected zone of flammable/discharge plumes) with i.e., multiple air cooled screw chillers circulating with brine solution operating temperature with (-)1.1Deg C outlet of chiller & double skinned chemical dehumidifiers of each systems with 10,000Kg/Hr mass flow rate Capacity.
- **Total mass flow rate requirements= 20,000kg/hr (10,000kg/Hr for satellite cool air requirements + 10,000 Kg/hr for Launch vehicle cool air requirements) with 100% stand by.**
- Even though it is proposed to have 2nos of 10,000 kg/hr cool air supply plants, based on need, it may be divided to 3nos. Exact details will be given along with PO.

DESCRIPTION OFBRINECHILLING SYSTEM FOR SATELLITE AND LAUNCH VEHICLE COOLING:

- Brine chilling systems mainly consists of 4 Nos of (2W +2S) air cooled screw chillers 4Nos (2W+2S) insulated primary chilled brine pumps, 4 Nos (2W+2S) insulated secondary chilled brine pumps, 4 Nos of Dehumidifiers (2W +2S), 1 Number of Insulated hot and cold well, brine top up tank and top up pumps, Brine charging Pump, insulated chilled brine piping, connected valves and different control and monitoring elements. They are indicative, systems shall be designed to meet the end value.
- Primary chilled brine pumps draw brine from hot well and pump through the chillers, where it is cooled to required temperature and to the cold well.
- From cold well secondary chilled brine pump draws chilled brine and pumped through the primary and secondary cooling coils, where it picks up heat in the dehumidifier and return to the hot well.
- Tanks are to be designed such that Chilled brine quantity in Cold well tank should be capable to deliver the requirement satisfactorily for half an hour minimum without Chiller running condition. This is essential to meet the demand during change over and power failure or any unexpected breakdown. Tank shall be designed to meet this demand.
- **COOL AIR DISTRIBUTION SYSTEMS:** The outlet round aluminium ducts for satellite cool air systems and vehicle cool air systems shall be separately designed with two separate individual mixing Filter Plenums. Duct shall be preferably seamless without any major joints and vehicle cooling duct shall be tapped to have cool air requirement at different elevations. Temperature and

RH measuring and monitoring in remote mode(DDC) shall be provided at Satellite port and EB port end termination. Static pressure shall be monitored with U tube manometer in Main duct at Satellite port elevation and EB port elevation (Manometer shall be intact even during Tilted position of UT) and shall be displayed. Necessary arrangements shall be considered during design of the duct for both satellite and vehicle cooling system.

- The mixing plenum outlet shall be provided with two different isolation valves (operated in remote and Manual), at the plenum exit in order to have control on each system separately, isolating valves shall have provision with fine/precise adjustment to control the flow rate precisely. Cool air systems shall be designed in such a way that, it can be operated independently based on the requirements of satellite cooling and vehicle cooling system individually. Locking or Wheel/stem removal mechanism after adjustment in these isolation valves to avoid accidental operation is to be provided.
- Both satellite and vehicle cool air duct shall ensure similar conditioning systems for cooling purpose.
- Each Dehumidifier outlet shall be provided with remote mode operated isolation valve. This valve shall have provision for ON/OFF only through local & Remote.
- Each Dehumidifier outlet, before connecting to the plenum, shall be provided with another tapping with round Aluminium seamless ducting and its own isolation valve (Manual) in order to vent out the Conditioned air outside the plant to the ambience. This valve is essential for testing of the Dehumidifier independently without disturbing to the operations.
- Cool air systems of satellite and Launch vehicle systems shall consist of Pre-Filters, primary cooling coil, High static blower, Absorption type dehumidifier bed, secondary cooling coil, heaters, 5µ, HEPA filter units and re-heaters wherever required to achieve the design conditions of both launch vehicle cooling & Satellite cooling requirements. This unit shall serve & achieve the design parameters in all extreme conditions of Sriharikota ambient in all the seasons.
- All the working and standby dehumidifiers shall be considered with individual mixing plenums (for each stream) with HEPA filters for supply of clean air.
- Multiple screw chillers & Dehumidifier units shall be connected with primary chilled brine pumps & Secondary chilled brine pumps including insulated stainless steel Hot & Cold well tank with schedule 40 seamless pipeline & Pipe fittings shall be covered with phenolic foam or suitable insulation & finished as per the detailed specification.
- Calculated total cooling load (Sensible &latent) from envelope, internal gains, ventilation with a safety factor of 15% for uncertainties (like higher equipment load) shall be considered during configuration of overall systems.

- The insulated brine storage tank (SS-316Construction) shall be partitioned into cold well and hot well.
- The chilled brine from chiller units will be transported to cold well for storage. From the cold well, chilled brine solution is circulated to both primary & secondary cooling coil of adsorption type chemical dehumidifiers and N2 cooling heat exchanger. Treated air after conditioning in the adsorption type chemical dehumidifiers transported through permanently routed insulated aluminium ducts with fully covered condition, QCDC flexible hoses, through TUT (Tillable Umbilical Tower) to meet the designed conditions of air at different locations of launch vehicle as well as satellite.
- Air flow analysis report generated by conventional software's like CFD to the finalised Vehicle and Satellite cool air configurations, shall be submitted for depicting the temperature rise, pressure drop across various elements of ducting, flow rate etc., of Dehumidified air throughout its path from Dehumidifier outlet to TUT outlets at different elevations and also at satellite discharge points.
- Dehumidifier shall have provision to allow operator to change the required process flow rate setting through DDC in remote mode.
- All Dehumidified air outlet ports available in TUT shall have Flow rate measurement sensor, Static pressure measuring sensor. These values are to be displayed in SCADA page too.

FUNCTIONAL REQUIREMENTS/ SPECIFICATIONS OF SATELLITE AND VEHICLE COOL AIR SYSTEM:

S.No.	Parameter of air	Required at termination point
1	Temperature (°C) at Satellite port and EB port in TUT	From 10°C to 15°C (Variable), with operational accuracy of ± 0.5°C
2	Relative Humidity % at Satellite port and EB port of TUT	Satellite RH Requirements: (conditions to be measured at EB port) Range: 30%(Minimum) to 60% (Maximum), with operational accuracy of ± 5%
		Launch Vehicle RH Requirements: (conditions to be measured at EB port) Range: 50%(Minimum) to 60% (Maximum), 55±5%
3	Cleanliness Class	10,000 Class
4	Static Pressure (mm) of water column	Min: 625mm (lower bound limit) to 700mm (Upper bound limit) of water

		column at the Satellite port elevation and EB Port elevation.
5	Mass flow rate in Kg/Hr (total : 20,000Kg/Hr) (However, the final quantity requirements will be confirmed at the time of PO, i.e 2 x 10000 kg/hr or 3 x 7000 kg/hr or 10000 + 5000 + 5000 kg/hr	Satellite cooling requirements: 10,000 Kg/hr (indicated)
		Launch Vehicle Cooling requirements: 10,000 Kg/hr (indicative)
6	Stand-by units	100% for entire system
7	Cooling capacity of brine chiller& De-humidifiers, primary pumps, secondary pumps, brine storage tanks/hot & cold brine well/AC ducting)	Capacity of each De-humidifier: 10,000Kg/hr (pre-defined capacity), Chillers, pumps, tanks, Number of ducts, duct sizing and routing through TUT etc shall be designed (TBD)
8	Overall horizontal and vertical distances of air travel (approximately)	Horizontal travel distance of less than 120m and vertical travel distance of 130m (Total distance in meters: 250)
9	Duct with insulation	Round Aluminium duct with necessary insulation and aluminium cladding shall be designed to meet the above requirements and shall be routed through the TUT to the required elevations.
Note: The philosophy of having 4 Nos (2W + 2S) of chemical dehumidifiers of 10,000kg/Hr capacity each is tentative. The provision to split the number of De-humidifiers in order to meet the actual requirement to be considered while designing. Any implications arise due to splitting in electrical, civil etc to be bought out. **Option-1:** Design of 8 Nos of 5000kg/hr dehumidifiers in place of 4 Nos of 10000kg/hr capacity dehumidifiers (inclusive of standby) **Option-2:** Design of 6Nos of 7500kg/hr Capacity (dehumidifiers in place of 4 Nos of 10000kg/hr capacity dehumidifiers (inclusive of standby) Such options also shall be explored during the design phase based on the final coo air flow requirements from the NGLV/LMLV project.		

- **AC PLANT FOR SATELLITE AND LAUNCH VEHICLE COOLING:** Chilled brine units of air-cooled screw type brine chiller packaged units shall be used (One set working and One set standby) shall be as follows:

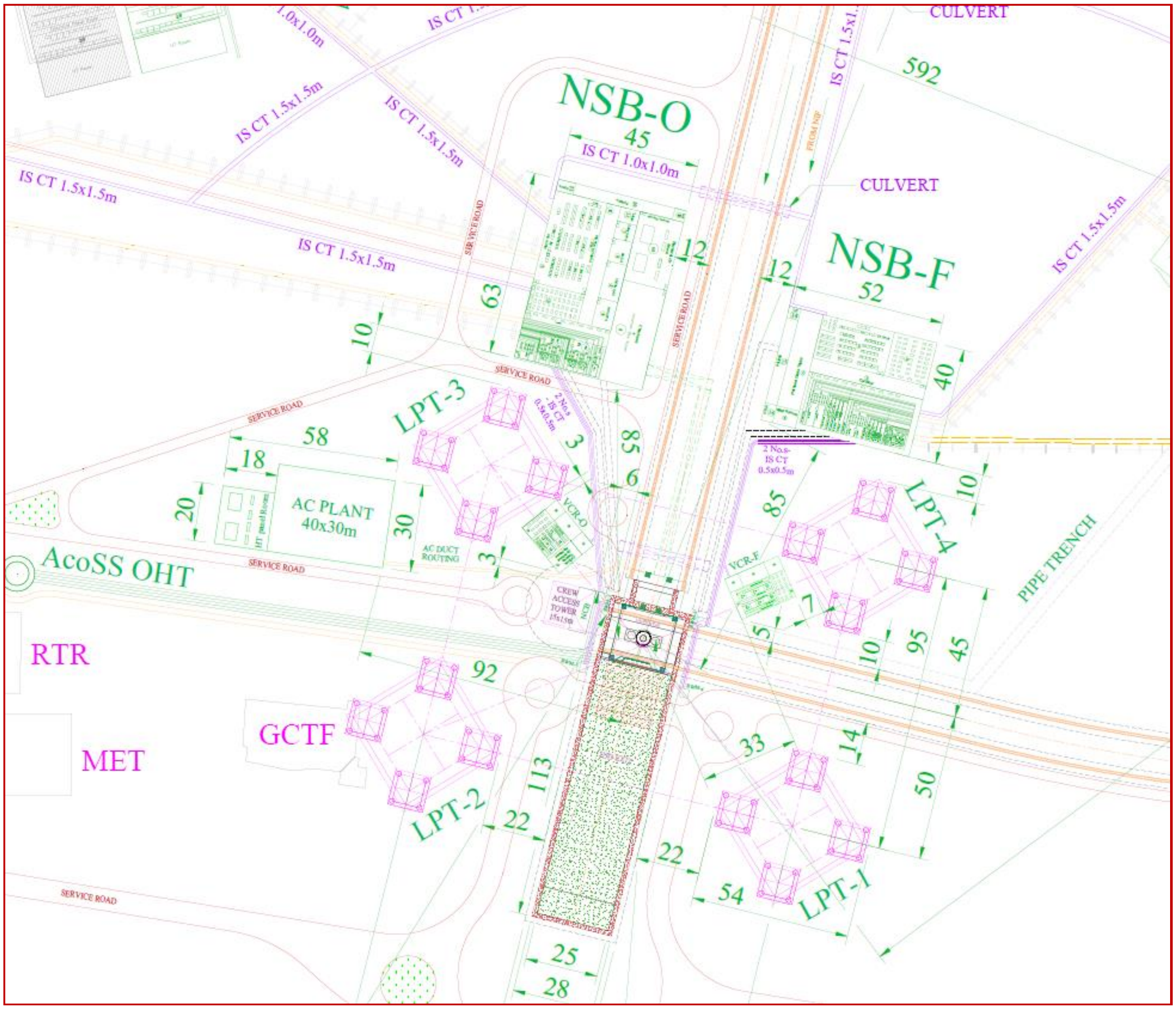
- **Brine Chiller Units**: Air cooled screw type brine chiller package unit connected with adsorption dehumidifiers, primary brine circulation pump between hot well and chiller and secondary brine circulation pump between cold well and adsorption dehumidifiers of nominal capacity (one set of multiple units as working and one set of multiple units are standby). All the brine chillers shall be designed with suitable capacity to meet the flow rate requirements. Mono ethylene glycol (water with borax powder) shall be used as circulating medium in the chillers and dehumidifier. Automatic compressor step less Loading from 15% to 100% to be provided.
- **Chemical/Desiccant type adsorption Dehumidifier** (one set of working and one set standby) (100% stand by as chain mode operation): - Chemical/adsorption type dehumidifiers using silica gel desiccant fully automatic digitally controlled dehumidifier equipped with control panel for continuous monitor and regulates precisely all relevant parameters. The LED/LCD shall display reactivation temperature, operating status of the reactivation heater, blower fans and bed motors, fault and operation status same shall reflect in remote desktop. Remote control along with remote RESET is also to be incorporated. Physical status (Excluding from PLC) of Blower motor status, Valve status, Desiccant bed status, Reactivation heater status to be obtained in remote. (All the parameters monitoring in the chemical dehumidifier shall be able to monitor through the DDC/BMS remotely)
- Design must consider U traps for condensate drain from Dehumidifiers and if trenches are required for the U traps then same must be reflected in layout diagram. Suitable natural condensate disposal mechanism or Mechanical disposal also shall be mentioned in the layout. Condensate drains of Primary coil & Secondary coil of each dehumidifier must be independently laid.
- There shall be two separate round aluminium insulated round duct of adequate size from filter plenum to TUT top with interface termination at different levels for launch vehicle cooling and round aluminium (seamless preferably) duct from filter plenum to Payload Fairing housing inside a TUT till Payload fairing of satellite shall be designed (130Mtrs Horizontal distance from Dehumidifier unit to the UT & 120Mtrs Vertical distance in the UT, Total distance is approximately 250Mtrs) and accordingly static blower of dehumidifier shall be designed to achieve required temperature of from 10 to 15°C with Minimum RH of 30% at the destination points of satellite.
- Satellite cooling and vehicle cooling system requires to be designed to operate 24Hrs per day at extreme ambient conditions of SDSC SHAR Sriharikota in all the seasons.
- Insulated hot &cold well shall be located inside the AC Plant room and required brine top up pump and top up tanks shall be considered on the top

floor of AC Plant.

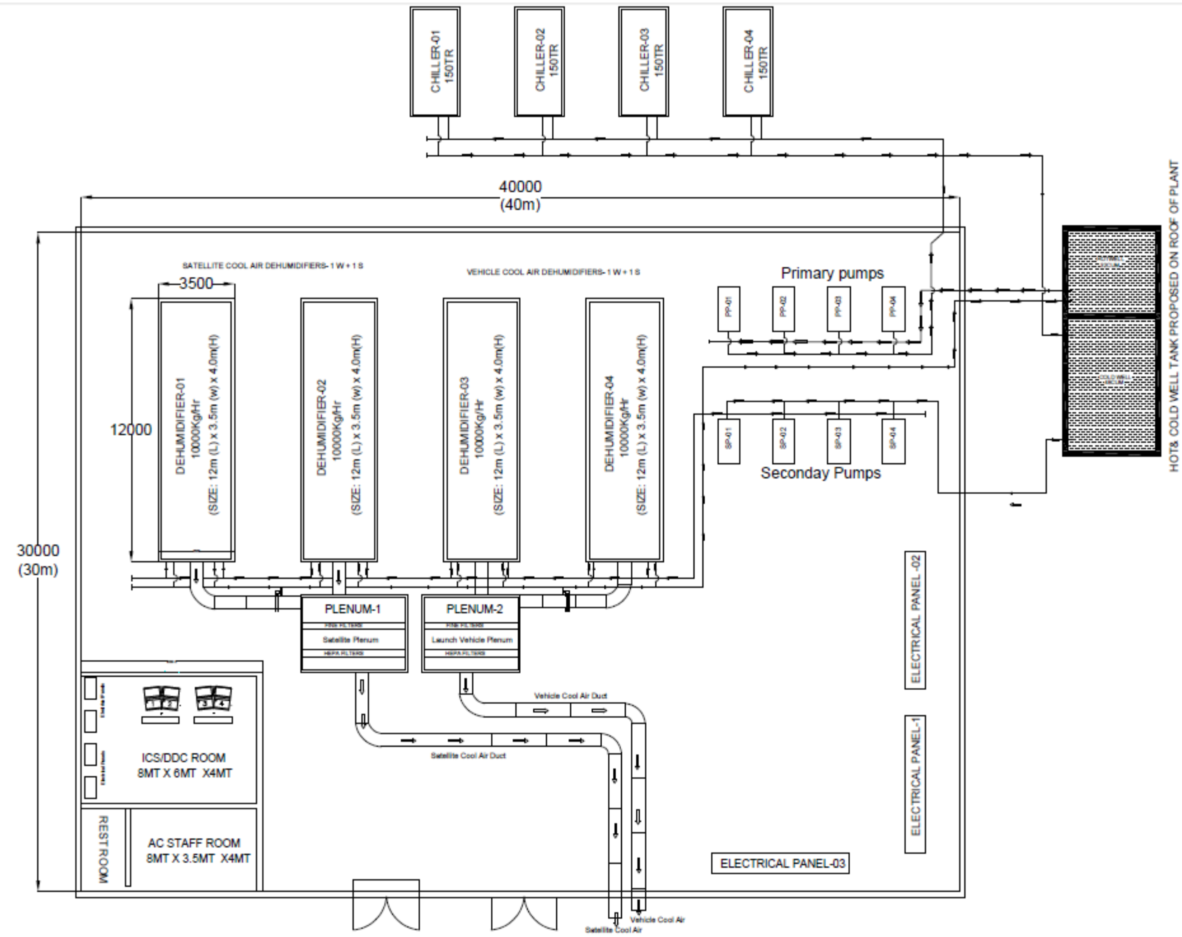
- Air distribution system mainly comprises of round aluminium supply air ducting and dampers of adequate thickness to withstand the high static pressure. Remotely operated three-way valve is provided at the outlet of cooling coils which will control the flow of chilled brine towards the cooling coil based on the load. Three way modulating valve shall have provision to regulate precisely to meet the required temperatures as per the setting.
- Fresh air is drawing through pre-filters and passes through the primary cooling coil and Dehumidifier. The dehumidified air is then passed through secondary cooling coil and filter bank to achieve 10,000 Class air standards. The filtered cooled dehumidified air is supplied through aluminium ducts to various vehicle discharge/cooling points. Interface details for satellite and vehicle cooling system ducting will be detailed out during detail engineering stage.
- Vehicle cool air requirements: Cool air is also required for the avionic packages local cooling in the following sub-assemblies: (all the elevations are with reference to the Top most point of Payload fairing – which is a zero reference where elevation zero is considered for cooling requirements). All the elevations mentioned below are indicative only. It may changed based on the latest vehicle configuration. The above individual sub-assemblies shall be supplied with a minimum cool air of 500 kg/hr (indicative)

  1. NS1BS - NS1 Base Shroud @ 83mts Elevation
  2. NS1F - NS1 stage Fore End Sub-assembly @ 50.9m
  3. NS2TF - NS2 Engine Thrust Frame Sub-assembly @45.6m
  4. NS2F - NS2 Fore End Sub-assembly @ 33.8m
  5. NS3F - NS3 Fore End Sub-assembly @21.2m

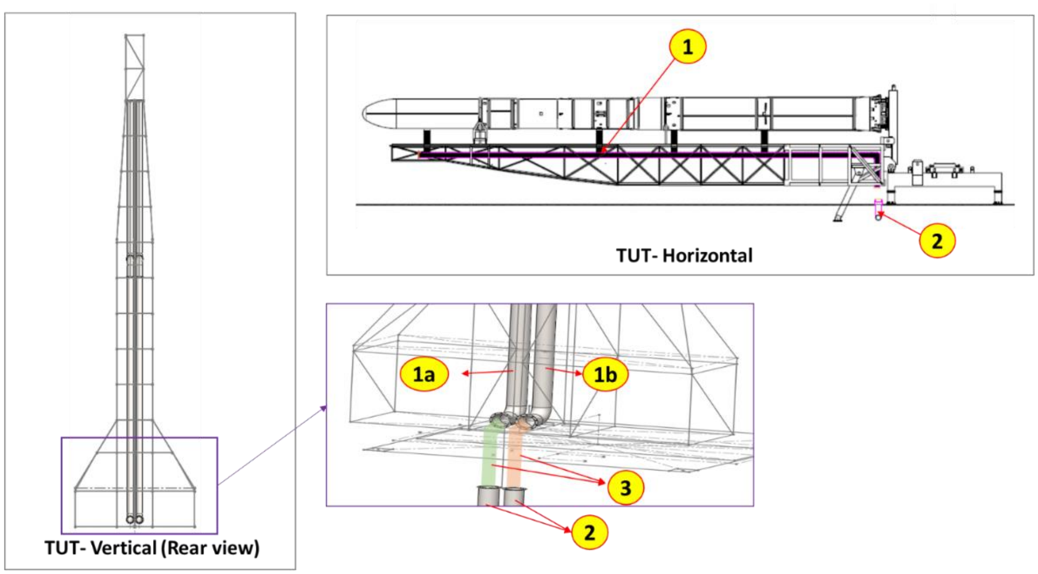
Exact values of Mass flow rate required at various elevations for design of duct will be provided after finalisation at later stages.



Location of Satellite and Vehicle cool air AC Plant



Configuration (indicative) of Equipment layout of Satellite and Vehicle cool air AC Plant



1. Round Aluminum Satellite and Vehicle cool air duct inside TUT (Vertical duct Height – 130m)
1a. Satellite cool air duct (seamless – No joints)
1b. Vehicle cool air duct (with extended duct at different elevations) – for vehicle cooling purpose
2. Satellite and Vehicle cool air Ducts from AC plant – Routed from common Mixing Plenum exit point to near TUT(Horizontal duct length – 120m)
3. Flexible Duct (Connection at launch pad in TUT Vertical Condition)

AC duct routing scheme over TUT

- **OUTSIDE DESIGN CONDITIONS:**

Outside design data (tentative) is taken as per ISRO input for Sriharikota:

Particulars	Units	Summer	Monsoon	Winter
Dry Bulb Temperature(DBT)	°C	42.2	28.3	18.3
Wet Bulb Temperature(DBT)	°C	28.3	26.7	13.9
Relative Humidity	%	36	88.5	62.1
Latitude	°		13.7° (North)	
Altitude above MSL	m		20	

- Cooled, dehumidified and filtered air from chemical dehumidifier shall be circulated through double wall insulated aluminium construction filter plenum of adequate thickness with suitable SS stiffeners & Frame outside with pre-filter and fine filter & HEPA Filters (with fixing frames) insulated aluminium duct at different terminals at various elevations on the launch pad for vehicle cooling and also to the terminal at the duct termination point for satellite cooling. Plenum shall be fabricated in such a manner that 100% leak proof& Leak test shall be carried out with 1.5 times of working pressure.
- Extreme care shall be taken during designto ensure that there are no possible leak paths around the filters and suitable sealant shall be used to arrest the leaks (if any) and sealant shall withstand to the designed static pressure.
- Monitoring and control of satellite cooling systems and vehicle cooling systems will be form the main PLC and SCADA provided in the control room located in the AC plant. The main PLC is common for both air conditioning systems of satellite and vehicle cooling systems. Common redundant processes will be considered for satellite and vehicle cooling systems.
- Chiller packages shall be provided with independent microprocessor-based PLC for the control and operations of the chillers.
- Each de-humidifier unit will be supplied with a package local control panel (LCP). This LCP will be provided with remote IO.
- Chiller PLC and RIO of the LCP supplied with the dehumidifier will communicate with main PLC in the control room.
- All the interlocks and monitoring will be executed in the PLC provided in the control room.
- Operation& Monitoring of those valves shall be provided in remote mode
- Satellite &Vehicle cooling systems redundancy will be considered in the IO level, power supply and communication of the PLC.

- For satellite cooling system sensor level redundancy at the distribution tap off is considered, in addition to IO level redundancy.
- Satellite and vehicle cooling system will be provided with normal/DG power supply from Sub-station, 415V Normal/DG switch gear will be located in the AC Plant room, which will be fed from sub-station.
- Three-way mixing / modulating valve operation shall be through remote mode and % of opening of valve can be decided by the operator and set through DDC. Also, Automatic operation of three-way valve shall be based on required set temperature with thermostat control to be provided at the outlet of cooling coils (Both Primary & Secondary) which will control the flow of chilled brine towards the cooling coil based on the load.
- All duct terminations shall be provided with flow control/adjustment manual wheel operated valve/damper with locking arrangement, with provision to operate in remote mode shall be provided for fine adjustment & control.
- P & ID diagrams for overall satellite and vehicle cooling systems shall be generated prior to realization at each design phase with complete set of detail specifications and electrical loads. After realization modified P&ID, Layout depicting Diameter and Length of the pipeline and Ducts etc., to be submitted.
- The limiting air velocity in duct shall be maintained within 10m/sec for designing the round duct.
- Hot & Cold well tank shall be of Stainless-steel (SS-316) material construction of minimum 5mm thick including suitable stiffeners and shall be insulated with Phenotherm insulation of adequate thickness and finished with sand cement plastering finally covered with 0.8mm thick aluminium cladding to accommodate the chilled brine at -1° C.
- Insulated hot and cold well tank shall be located at suitable elevated location on the concrete pedestal.
- Motors rating shall be 30% above the BKW de-rated for the ambient condition of 45°C.
- Automatic capacity control of compressors with variation of cooling load in the chillers.
- Low differential pressure switch (at chiller inlet and outlet connection line) to switch off the compressor and local indication for the same.
- Chilled brine pipe line shall be insulated with phenolic foam or equivalent fire-retardant type.
- Horizontal centrifugal pump with back pull out design shall be provided for both primary & secondary pumps. Pump shall be coupled with motor by spacer type coupling and shall confirm to the latest edition of the relevant standard. Coupling of the pump & Motor shall be able to replace without disturbing of the pump & Motor Alignment.

- Pump shall be fitted with mechanical seal instead of gland to avoid any leakage. The pump shall be heavy duty suitable for continuous duty and shall be standard product of manufacturer proven for satisfactory and reliable performance.
- Ducting construction shall conform to: IS-655, 2006and SMACNA. Ducting of satellite and vehicle cooling near launch pad area and ducting inside TUT shall be aluminium sheet of adequate thickness and shall be designed properly.
- Chilled brine pipeline with fittings shall be of Carbon Steel seamless type Sch-40 meeting ASTM & ANSI standards.
- Extended stem butterfly type manual valve shall be provided at brine pipe line for various isolation in the chillers, pumps, hot& Cold well and dehumidifiers. Also extended stem type manually operated butterfly valves with locking arrangement shall be used for isolation and fine control of air flow in the dehumidifier and Umbilical tower wherever suitable.
- In order to facilitate remote mode operation and changeover of the systems, required valves shall be motorized operation of control and valve operating provision shall be configured in remote mode.
- Ducting of vehicle cooling shall be insulated with 'Phenotherm in the molded section or Rockwool/Class-0 Nitrile Rubber insulation based on indentations on duct'. The insulation shall be covered with vapour barrier GI wire mesh. Insulation joints shall be sealed with aluminium tape of adequate width. Wire mesh shall be covered with Aluminium cladding of suitable thickness and wherever the duct is exposed to ambient, Aluminium foiling is to be done over the surface with suitable clamping.
- The pump shall be heavy duty suitable for continuous duty and shall be standard product of the manufacturer for satisfactory & reliable performance as per the design flow rate to satisfy the chillers and dehumidifier requirement.
- Satellite & Vehicle cooling system needs to operate 24/7 operation for approximately 15days minimum with changeover once in 24Hours.
- AC plant shall be interfaced for remote operation, monitoring and control from TLP to FCC & Control center AC control room facility building through the existing AC Control Network.
- Power supply: Satellite & Vehicle cool air system will be provided with a provision for DG power supply from substation along with the EB power. Change over from EB power to DG switch gear shall be considered for hassle free changeover. Double incomer provision shall be considered in the main incoming panel.
- Serial port with BAC-net compatible protocol and RS-485 for PLC

communications hall be provided.

7.5 Specifications of AC System for Process System & Safety Facilities:

- TLP D-areas are envisaged with Re-circulation type air conditioning systems. The AHUs or Packaged AC units (PAC's) shall be located in the various locations in D-areas within each process and safety system facility for air distribution purpose. Individual facilities shall be configured with floor mounting PAC's of similar brand/Make/as per CEPO Approved brands only. Return air from the AHU/PAC shall be collected back to the AHU room through louvers in the respective floors of facilities. In case of chillers configured for any facility, return water from the AHU shall be transported back to the chiller for cooling through the pumps.
- The air distribution systems mainly comprise of Galvanized steel sheet (GSS) construction double skin type AHU and air distribution systems. AHU/PAC houses pre-filters, cooling coil, supply air centrifugal fan DIDW type and supply air dampers. The gravimetric efficiency shall be 90% down to the particle size of 10 microns. For double skin type AHU, the air distribution system mainly comprises of GSS rectangular supply air ducting, duct volume control dampers (VCD),silencer/sound attenuation, fire damper, supply air powder coated extruded aluminium diffusers/grilles with VCD, return air grilles or Diffusers, Differential pressure switches, Safety/Geyser thermostat, Exhaust air powder coated extruded aluminium grilles without VCD, tie rods, angles etc. Three-way valve is provided at the outlet of cooling coils which will control the flow of chilled water/air towards the cooling coil based on the temperature.
- Areas like VCR (Valve Chamber Room) facilities shall be provided with PACs (Packaged AC units) in the areas which are not served by AHU's. Number of units in each area and capacity of each unit shall be based on the internal layout and air-conditioning load for each area. Outdoor condensing units shall be installed adjacent to facility or on the terrace of ground floor/first floor of respective process and safety system facility based on the user requirements input.
- NGLV Service Building (NSB-0, NSB-F) shall be configured with chilled water systems with AHU's located inside the facilities. Chilled water system mainly comprises of chillers, insulated chilled water pumps, insulated chilled water piping, valves and fittings, insulated chilled water expansion tanks, electrical switch gears and cabling. Chilled water pumps draw chilled water from chilled water return header and pump it through chillers, where it is cooled to the required temperature. Further it is supplied to the AHUs where it is picks up heat and return it to the chilled water return header. The insulated chilled

water expansion tanks shall be provided on the terrace or first floor of the respective facility.

- Chilled water pipeline with fittings shall be of Carbon Steel seamless type Sch-40 meeting ASTM & ANSI standards or suitable one.
- In addition to the above Launch pad satellite and vehicle cool air systems; TLP also consists of process systems facilities for propellant storage and service purpose and safety system facilities for the purpose of safe operations prior and during launch. These process and safety system facilities are as follows;
    - Liquid Methane Filling System (LMFS)
    - Liquid Oxygen Filling System (LOFS)
    - Liquid Hydrogen Filling System (LHFS)
    - Compressed Gas Storage Systems (CGSS)
    - Nitrogen Supply System (NSS)
    - Valve Chamber Room (VCR)- VCR-F & VCR-O
    - NGLV Service Building (NSB) – NSB-O & NSB-F
    - Safety GLR Facility
    - FCC facility
- All the above facilities include associated safety, Process Instrumentation & automation systems and checkout interfaces.
- Each facility shall be designed with suitable recirculation / once through air conditioning system with flame proof or Non-flame proof type including exhaust system wherever required based on the facility requirement to ensure safety in operation.
- Design of air conditioning system shall be planned with floor mounted Package type AC Units of multiples may be considered to meet the demand including stand by requirement. Air conditioning systems for conference halls / meeting halls and comfort requirement split type AC units AC units may be considered. Selection of AC system is based on the capacity, environment and requirement.
- A/C distribution systems are to be designed to supply cool air to the required areas by providing suitable dampers that can be regulated in the ducting to optimize the power consumption, considering the fact that large areas of the building are not used and requirement is process need air conditioning only.
- Toilets shall be provided with wall mounted propeller exhaust fans with human sensors.
- Chillers, packaged AC units, cooling towers and associated pumps shall be located in the AC plant room adjacent to each facility. Piping and

instrumentation diagram shall be submitted for each process and safety facility prior to detail design.

- Procurement specifications data sheets shall be submitted after configuration design with cost estimations for tendering purpose.
- Cabling and earthing shall be provided for the loads of air conditioning systems of each facility.
- Monitoring and control of theeach facility air conditioning and ventilations systems shall be from the Main PLC and SCADA provided in the control room located in the AC plant. The Main PLC shall be common for all the process and safety building and satellite and vehicle cool air systems. Common redundant processor shall be considered for all the facilities and satellite and vehicle cool air systems.
- Remote I/O Panels shall be provided in the field and these remote I/O panels shall communicate with the main PLC in the control room.
- Chiller packages shall be provided with independent Microprocessor based PLC for the control and operation of chillers. The micro PLC shall communicate with the main PLC in the control room.
- Main PLC in the control rooms shall have an interface with the Fire Alarm systems.
- All the interlocks shall be executed through PLC provided in the control room.
- For each building ACV systems, redundancy shall be considered in the power supply and communication of the PLC.
- Split type air conditioning units of various capacities shall be provided in areas which are not served by AHU’s only after obtaining clearance from the department. The number of units in each area and capacity of each unit shall be based on the interior layout and conditioning load for each area.
- Air flow analysis report generated by conventional software like CFD, to be submitted depicting the temperature rise, pressure drop etc., of conditioned air throughout its path.
- All PAC rooms and AHU rooms shall include thermal insulation under roofs inside the rooms.
- In facilities like VCR etc., which are very close to Launch pad, outdoor units and Refrigerant pipelines are to be provided with additional covering, and aluminum cladding with nut bolt set up.
- Common inputs for all process facilities are as follows:

S.No	DESCRIPTION	INPUTS /SPECIFICATION
01	Facility dimension L x W x H (Mtr)	Refer attachment for room-wise dimensions and no. of personnel.
02	Number of persons inside the AC area	

S.No	DESCRIPTION	INPUTS /SPECIFICATION
03	Lighting Load	5KW (Indicative)
04	Equipment Load	10KW (Indicative)
05	Above the Air-conditioned area room is available or directly exposed to solar radiation.	Directly exposed.
06	Walls are with brick construction / any partition material	Brick (to be decided during design)
07	Any Specific Exhaust system is required for exhausting in case of fire/ Smoke	Based on the process need and user requirements, it shall be designed.
08	Type of AC / Class of Conditioned area	Recirculation type AC with Air conditioning parameters of non-flame proof/ Flame proof based on the user requirement
09	Class of Cleanliness if any specific Conditioned room application	Normal filtration level , Normal filtration level with 5-20 micron filtration level. Based on the ISO-15644-1 Standard.
10	Application / purpose of AC room.	Conditioning of equipment, human comfort, Conditioning of equipment and driving out of volatile vapours
11	Design conditions of Conditioned Room/AC room	Indicative values provided below facility wise individually
12	Static pressure of the Conditioned room to be maintained,	Not applicable
13	Number of air changes required.	0.5 to 1.0 (may consider suitable number according to user inputs)
15	Air Conditioning Requirement height	Full Height as per room specifications
15	Is AC room single area / multiple areas?	Both single areas & Multiple areas
16	Effective utilization of AC/conditioned room	Not applicable
17	False ceiling height of AC room	5 m from FFL
18	Any specific air flow pattern required.	Recirculation type Unless specifically mentioned.
19	Operating hours of AC room	24 Hours (round the clock operations
20	Stand by AC system i.e. chillers & AHU's, Pumps.	100% for instrumentation systems, 50% for others
21	Air shower for AC room individual /	Not applicable

S.No	DESCRIPTION	INPUTS /SPECIFICATION
	common	
22	Air shower cleanliness class.	Not applicable
23	Ante room to Air shower entry area	Not applicable
24	Independent Treated Fresh Air AHU for each Conditioned room	Not applicable
25	AC room is FLP/ Normal	Normal AC for all the equipment rooms and instrumentation control rooms. Flame proof AC shall be taken based on the specific input from safety during realization.
26	Return air duct should be connected to AHU with return air ducting.	Yes Return air duct shall be connected to AHU
27	Conditioned space should be operated independently without mixing with other Conditioned room air.	N/A
28	AC room flooring type	Hardenite flooring
29	AC room walls type	Brick wall
30	Conditioned room ducting type	Aluminium
31	Both supply air, return air shall be connected to the AHU.	Yes
32	Individual AHU room for independent Conditioned room required or common AHU room.	To be designed considering the feasibility.
33	Hazardous fumes / material handling in the Conditioned rooms.	No
34	Emergency Exhaust system is required	Required for few Rooms
35	DDC Operation is required	Yes
36	DDC Operation with stand-alone or connection with existing DDC	Both Local (facility push button) and Remote operations (PLC based)
37	AC Operator Room at AC plant.	Based on the process requirement, shall be configured.

The following are the details of each Process and Safety Facility Wise Air Conditioning Inputs/Requirements:

1. **Liquid Methane Facility Systems (LMFS):**

In Liquid Methane Facility, Instrumentation and control room requires 21±2°C

(Range: 19-23°C) and equipment rooms (pump room, SPTA room & vacuum pump room) requires less than 30°C (Range: 25-30°C). For instrumentation & control room, the estimated cooling capacity shall be considered with 100% standby whereas for equipment rooms, the estimated cooling capacity shall be configured with 50% stand by.

The detailed design inputs, estimated capacities are as follows: (However, based on final design of facilities, the area to be arrived at.)

Instrumentation & Control room	Documentation & Equipment Rooms
• **Design Conditions (indicative)** Area of the building : 320m^2 Height of the building : 5.5 m Temperature : 21°C • **EstimatedCapacity** **:**To be designed (Working & standby)	• **Design Conditions (indicative)** Area of the building : 500m^2 Height of the building : 7.0 m Temperature : 30°C • **EstimatedCapacity** **:**To be designed (Working & standby)

INPUTS FOR AC REQUIREMENTS OF LMFS

S. No.	Facility with Room Number	LMFS Area Dimensions			Type of AC system (Re-circulation type AC)	DBT (in °C)	RH (%)	Emergency ventilation (Yes/No)	Equipment Load (kW)	Personnel
		Size of Rooms (mxm)	Area (m2)	Height of blg. (m)						
1.	Pump MCC Room, 22	8x16	108	5.5	Non Flame proof	≤ 30 (25-30)	Comfort RH	No	1100	05
2.	Pump Servicing and Component testing room - 28	10x5	50	5.5	Non flame proof AC	≤ 30 (25-30)	Comfort RH	No	1	05
3.	SPTA Room-11	10x13	130	5.5	Non flame proof AC	≤ 30 (25-30)	Comfort RH	No	2	05
4.	Drive testing room -7a	10x3	30	5.5	Non flame proof AC	21 ± 2 (19-23)	55 ± 5	No	5	05
5.	ICS -7	10x12	120	5.5	Non flame proof AC	21 ± 2 (19-23)	55 ± 5	No	25	05
6.	Gas Analysis Room-6	5.5x5	27.5		Non Flame proof	≤ 30 (25-30)	Comfort RH	Yes		
7.	Vacuum Pump room -17	5.5x5	27.5	5.5	Non Flame proof	≤ 30 (25-30)	Comfort RH	No	2	05

2. LIQUID OXYGEN FACILITY (LOFS)

Liquid Oxygen Facility requires 21°C for instrumentation and control room and 30°C for equipment room (pump room, SPTA room & Vacuum pump room). Capacity of Instrumentation shall be considered with 100% standby whereas for equipment room, the estimated cooling capacity shall be with 50% stand by. The detailed design inputs, estimated capacities are as follows:

Instrumentation & Control room	Documentation & Equipment Rooms
• **Design Conditions (indicative)**	• **Design Conditions (indicative)** Area of the building : 812m^2

Area of the building : $126m^2$ Height of the building : 5.5 m Temperature : 21°C • **Estimated Capacity** : To be designed (working & Standby)	Height of the building : 6.0 m Temperature : 30°C • **Estimated Capacity:** To be designed (Working& standby)

INPUTS FOR AC REQUIREMENTS OF LIQUID OXYGEN FACILITY

S. No.	Facility, room No.	LOFS Area Dimensions			Type of AC system	DBT (in °C)	RH (%)	Emergency ventilation (Yes/No)	Equipment Load (kW)	Personnel
		Size of Room (mxm)	Area (m2)	Height of blg. (m)						
1.	LOX Pump room	30x16	480	6.5	**Once through or recirculation**	Less than 30°C (Range: 25-30)	Comfort RH	Yes	TBD	05
2.	Component testing room, 13	7x5	35	5.5	Recirculation		Comfort RH	No	1	05
3.	Vacuum Pump maintenance & testing room, 12	7x5	35	5.5	Recirculation		Comfort RH	No	2	05
4.	Vacuum Pump room,11	10x6	60	5.5	Recirculation		Comfort RH	Yes	2	05
5.	SPTA, 15	7x7	49	5.5	Recirculation		Comfort RH	No	2	05
6.	Drive testing room, 18	7x6	42	5.5	Recirculation	21 ± 2 (Range: 19-23)	55 ± 5	No	5	05
7	ICS, 17	15x7	105	5.5	Recirculation	21 ± 2 (Range: 19-23)	55 ± 5	No	25	05

3. LIQUID HYDROGEN FACILITY (LHFS)

Liquid Hydrogen Facility requires 21°C for instrumentation and control room and at 30°C for equipment room (Pump room, SPTA room, and Vacuum pump room &analyzer station). For instrumentation & control room, the estimated cooling capacity shall be worked out with 100% stand by. For equipment room, the estimated cooling capacity shall be worked out with 50% stand by. The detailed design inputs, estimated capacities are as follows:

Instrumentation & control room	Equipment Rooms
• **Design Conditions (indicative)** Area of the building : $135m^2$ Height of the building : 5.5 m Temperature : 21°C • **Estimated Capacity** : To be designed. (Working& Standby)	• **Design Conditions (indicative)** Area of the building : $235.5m^2$ Height of the building : 5.0 m Temperature : less than30°C (Range: 25-30°C) • **Estimated Capacity:** To be designed. (Working& standby)

ROOM WISE INPUTS FOR AC REQUIREMENTS OF LHFS FACILITY

S. No.	Facility	LHFS Area Dimensions			FFL w.r.t FRL (m)	Type of AC system	DBT (in °C)	RH (%)	Emergency ventilation (Yes/No)	Equipment Load (kW)	Personnel
		Size of Rooms (mxm)	Area (m2)	Height of blg. (m)							
1.	Gas Chromatograph Room,4	10x5.5	55	5.5	0.3	RECIRCULATION TYPE AC SYSTEMS	≤30 (25-30)	Comfort RH	No	2	05
2.	Vacuum pump room, 20	6x5.5	33				≤30 (25-30)	Comfort RH	No	2	05
3.	SPTA Room-1 Process,5	15x8	120				≤30 (25-30)	Comfort RH	No	2	05
4.	SPTA Room-2 Process,5a	8x6	48				≤30 (25-30)	Comfort RH	No	1	05
5.	SPTA Room-Inst.	5.5x5	27.5				≤30 (25-30)	Comfort RH	No	2	05
6.	Instrumentation & Control room	10x8	80				21 ± 2 (19-23)	55 ± 5	No	5	05

4. COMPRESSED GAS STORAGE SYSTEM (CGSS):

Compressed Gas Storage System requires 21°C for instrumentation and control room and 30°C for documentation room and equipment room (Compressor maintenance room, charging unit room, SPTA room, SAU preparation room, pneumatic board room & pump spares room). To meet these requirements, direct expansion type air-conditioning system is proposed. For instrumentation & control room, the estimated cooling capacity is with 100% stand by. For Engineers room &calibration rooms, the estimated cooling capacity is with 100% stand by.The detailed design inputs, estimated capacities are as follows:

Instrumentation control room	Documentation & Equipment Rooms
• **Design Conditions (indicative)** Area of the building : $130m^2$ Height of the building : 5.5 m Temperature : 21°C • **EstimatedCapacity** **:**To be designed (Working & standby)	▪ **Design Conditions (indicative)** Area of the building : $894m^2$ Height of the building : 5.5 m Temperature : 25°C ▪ **EstimatedCapacity** **:**To be designed (Working & standby)

AC Requirements of Compressed Gas Storage System

CGSS FACILITY DETAILS - RECIRCULATION TYPE AC					
S.No	**Description**	**Area**	**Elevation**	**Temperature**	**RH**
1.	ICS, 12	15m x 9.3m	5.5m	21°C	55%
2.	Flow Components spares room, 5	12m x 6m	5.5m	30°C	Comfort RH
3.	Documentation room,6	12m x 5m	5.5m	30°C	

CGSS FACILITY DETAILS - RECIRCULATION TYPE AC					
S.No	**Description**	**Area**	**Elevation**	**Temperature**	**RH**
4.	SPTA- N2, He, Air,8	12m x 8m	5.5m	30°C	
5.	Instrumentation SPTA & Compressor panel room, 12a	5m x 15m	5.5m	30°C	

5. SAFETY GLR:

Safety GLR building requires 21°C for instrumentation and control room and 30°C for Engineers room & Calibration rooms (pollution monitors sensors calibration room, calibration lab, instruments maintenance and service room). For instrumentation & control room, the estimated cooling capacity is with 100% stand by. For Engineers room &calibration rooms, the estimated cooling capacity is with 50% stand by. Split type or Tower type ACs can be considered in utility rooms in this facility for design purpose. The detailed design inputs, estimated capacities are as follows:

Instrumentation control room	Engineers rooms &calibration rooms
• **Design Conditions (indicative)** Area of the building : 165m^2 Height of the building : 5.5 m Temperature : 21°C • **EstimatedCapacity :**To be designed (Working & standby)	• **Design Conditions (indicative)** Area of the building 151m^2 Height of the building : 4 m Temperature : 25±2°C • **EstimatedCapacity :**To be designed (Working & standby)

AC Requirements for safety rooms of GLR

Safety GLR DETAILS - RECIRCULATION TYPE AC					
S.No	**Description**	**Area**	**Elevation**	**Temperature**	**RH**
1.	ICS, 03	16m x 10m	5.5m	21°C	55%
2.	PT/PI Calibration, 05	5m x 6m	5.5m	25±2°C	Process/ instruments Required temperature and RH
3.	Inst. MaintenanceSPTA Room,6	6m x 6m	5.5m	25±2°C	
4.	Pollution gas MonitoringCalibration Room, 7	6m x 4.5m	5.5m	25±2°C	
5.	Discussions room, 8	6m x 6m	5.5m	30°C	
6.	Head room, 9	6m x 4m	5.5m	30°C	
7.	SPTA Mechanical room, 11	6m x 6m	5.5m	30°C	

6. NGLV SERVICE BUILDING (NSB):

NGLV Service Building (NSB) has been made into two layouts each one on either side of NIF-TLP Rail track. One is NSB-0 (Towards Oxidizer side) and other one is NSB-F (towards Fuel side).Overall NGLV Service Buildings (NSB-0 & NSB-F) requires 21°C for instrumentation control room, check out room, pneumatic board room & SPTA PIC room etc. The estimated cooling capacity shall be worked out for both working and standby systems of NSB. The detailed design inputs, estimated capacities are as follows:

<table>
<tr><th colspan="2">NSB-0 FACILITY DETAILS (GROUND FLOOR + FIRST FLOOR)- 4917 m²</th></tr>
<tr><th>Instrumentation & control room</th><th>Equipment Rooms</th></tr>
<tr><td>• Design Conditions (indicative)
Area of the building : 1172m²
Height of the building : 5.5 m
Temperature: 21°C (19-23)&55±5%
• Estimated Capacity : To be designed (Working+ Standby)</td><td>• Design Conditions (indicative)
Area of the building :3745m²
Height of the building : 5.5 m
Temperature: Less than 30°C(25-30)& 65%
• Estimated Capacity: To be designed (Working+ Standby)</td></tr>
<tr><th colspan="2">NSB-F FACILITY DETAILS- 1500m²</th></tr>
<tr><th>Instrumentation & control room</th><th>Equipment Rooms</th></tr>
<tr><td>• Design Conditions (indicative)
Area of the building : 368m²
Height of the building : 5.5 m
Temperature : 21°C (19-23) &55±5%
• Estimated Capacity : To be designed (Working+ Standby)</td><td>• Design Conditions (indicative)
Area of the building :1032m²
Height of the building : 5.5 m
Temperature : Less than30°C (25-30°C)& 65±5%
• Estimated Capacity: To be designed (Working+ Standby)</td></tr>
</table>

Inputs for AC Requirements NGLV Service Buildings (NSB-F & NSB-O)

<table>
<tr><th colspan="6">NSB-0– LAYOUT DETAILS (Re-circulation type)</th></tr>
<tr><th colspan="6">GROUND FLOOR</th></tr>
<tr><th>S.No</th><th>Description</th><th>Area</th><th>Elevation</th><th>Temperature</th><th>RH</th></tr>
<tr><td>1.</td><td>LOX End Valve Units, 1</td><td>17m x 30m</td><td>5.5m</td><td rowspan="2">Less than 30⁰C (25-30⁰C)</td><td rowspan="2">Comfort level</td></tr>
<tr><td>2.</td><td>Instrumentation Racks, 2</td><td>10m x 18.2m</td><td>5.5m</td></tr>
<tr><td>3.</td><td>Checkout+ Junction box Room, 8</td><td>35m x 15.2m</td><td>5.5m</td><td rowspan="2">21⁰C (19-23⁰C)</td><td>55±5%</td></tr>
<tr><td>4</td><td>ICS Room, 3</td><td>32.2m x 18.2m</td><td>5.5m</td><td>55±5%</td></tr>
<tr><th colspan="6">FIRST FLOOR</th></tr>
<tr><td>5</td><td>Instrumentation FJB, 11</td><td>8.5m x 20m</td><td>5.5m</td><td></td><td>Comfort</td></tr>
</table>

NSB-0– LAYOUT DETAILS (Re-circulation type)					
GROUND FLOOR					
S.No	**Description**	**Area**	**Elevation**	**Temperature**	**RH**
6	Pneumatic Board room, 12	26.5m x 20m	5.5m	Less than 30^{0}C ($25\text{-}30^{0}$C)	level
7	AHU, NSB, VCR & AC SPTA, 13	24m x 20m	5.5m		
8	CGSS EVU'S	35m x 10m	5.5m		
9	Check out augmentation	32.5m x 10.2m	5.5m	21^{0}C ($19\text{-}23^{0}$C)	55±5%

NSB-F LAYOUT DETAILS (Re-circulation type)					
NSB-F Ground Floor					
S.No	**Description**	**Area**	**Elevation**	**Temperature**	**RH**
1	Methane Valve unit, 1	40m x 20m	5.5m	<30^{0}C ($25\text{-}30^{0}$C)	Comfort level
2.	ICS Room, 5	26.5m x 20m	5.5m	21^{0}C ($19\text{-}23^{0}$C)	55±5%
3	Methane Drain tank	33.8mX8m	5.5	Less than 30^{0}C ($25\text{-}30^{0}$C)	Comfort level
3	INS Racks	15m x 15.2m	5.5m	Less than 30^{0}C ($25\text{-}30^{0}$C)	Comfort level
NSB-F First Floor					
1	Stage testing, 7	48m*20m	5.5	21^{0}C ($19\text{-}23^{0}$C)	55±5%

7. FCC-3:

FCC requires 21°C (Range: 19-23°C) air conditioning. To meet the requirement, direct expansion type air-conditioning system is proposed. For instrumentation & control room, the estimated cooling capacity is with 100% stand by. For Engineers room &calibration rooms, the estimated cooling capacity is with 100% stand by.

The detailed design inputs, estimated capacities are as follows:

i. Design Conditions

- Area of the building: 375m^2
- Height of the building: 5.5m
- Temperature: 21°C(Range: 19-23°C) & with RH of 55±5%
- Estimated Capacity: To be designed. (Working + 100% standby)

Details of the room sizes and its AC requirements of FCC3 shall be provided during the detailed design of air conditioning systems.

8. VALVE CHAMBER ROOM (VCR):

For servicing the NGLV Stages, the critical End Valve Units are located along with

Instrumentation FJB's located in respective Valve Chamber Rooms (VCR-0 & VCR-F) on either side of rail track to meet the launch pad requirements. In order to ensure smooth loading and servicing of stages prior to launch, The Overall Valve Control Room Process Facility has been configured in to two parts: one is Valve ChamberRoom-F (VCR-F) & Valve Chamber room (VCR-O) based on the requirements of launch pad. Since the AHU/Packaged unit rooms are not indicated in the drawings, AC plant rooms shall be designed to suit the air conditioning equipment during the preliminary design of VCR facility layouts.

VCR–F & VCR-O Facility wise AC Requirements

VCR-F INTERNAL DETAILS OF FACILITY					
S.No	**Description**	**Area**	**Elevation**	**Temperature**	**RH**
1.	End Valve Unit Room	15.5m x 10m	5.5m	≤30^{0}C (25-30^{0}C)	-
2.	Instrumentation FJB's room	5.5m x 10m	5.5m	≤30^{0}C (25-30^{0}C)	-

VCR-O INTERNAL DETAILS OF FACILITY					
Sl. No	**Description**	**Area**	**Elevation**	**Temperature**	**RH**
1.	Critical check out elements room, 1	6m x 10m	5.5m	≤30^{0}C (25-30^{0}C)	Comfort
2.	Instrumentation FJB's room,3	5m X 10m	5.5m	≤30^{0}C (25-30^{0}C)	Comfort
3.	End Valve Unit Room	9m X 10m	5.5m	≤30^{0}C (25-30^{0}C)	Comfort

7.6 General Specifications:

- Centralized Chilled brine AC plant for Satellite and vehicle cool air systems shall be configured and designed by the party based on the inputs provided and AC Plant shall be considered as a separate facility for 24/7 round the clock operations. Shall not be clubbed with any other facility. This is to be designed as once-through system.
- Centralized chilled brine AC plant shall be located nearer to Third Launch Pad within 100m distance and shall be of "once through type" system.
- The cool air systems for process and safety facilities of TLP shall be designed for both "recirculation type" and once through based on the requirement specified with minimum one air change per hour.
- The Central chilled brine solution AC plant for satellite and vehicle cooling requirements shall comprise of air-cooled screw type Chilled brine solution plant shall have minimum 100% standby.
- AHU shall be Double skin With DIDW Centrifugal fan. Duct silencer/sound

attenuation shall be provided at out let of AHU to reduce sound.

- Refrigerant-134A/407C/R-410a or Eco-friendly refrigerant shall be used for air – conditioning systems.
- Reverse return piping shall be considered for designing the chilled brine piping inside AC Plant (Satellite and vehicle cooling systems).
- A/C ducting construction shall conform to IS: 655-2006and SMACNA.
- Refrigerant pipeline shall be of Copper pipe with adequate thickness to withstand the latest refrigerant pressures.
- Where ever feasible, packaged chiller AC units with re-circulation type, GSS ducting arrangements shall be considered for process and safety facility for optimization purpose. Process facilities.
- The Chilled water pipe lines will be routed inside the TLP wherever AHUs requirement will be there for cool air distribution purpose (based on the requirement, AHU will be considered to avoid pressure loss inside the ducts) There shall be 100% standby for AHU if are considered for vehicle cool air purpose.
- The facility layout architectural drawings shall be incorporated with provision to accommodate the Package units/Chillers/AHUs/AC Systems.
- In case process facilities shall requires, once through type air conditioning system cool air requirements, design shall be carried out accordingly
- Each and every facility shall be located with AHU Room or Packaged AC Units (PACs) plus electrical panels shall be located adjacent to the conditioning requirements rooms.
- Packaged AC units(PAC) along with electrical panels shall be considered in the same room/AHU room of each process facility and accordingly civil drawings of layouts shall be shown with a provision.
- Return piping/ GSS ducting shall be considered for designing the chilled water piping/Packaged units ducting inside process and safety facilities of TLP.
- Duct inside process and safety system facilities shall be insulated and covered with aluminium cladding to avoid condensation.
- Cast iron butterfly type valve shall be provided at water pipe line for isolation and flow adjustment.
- Motors rating shall be 10 to 20% above the BKW de-rated for the ambient condition of 45°C.
- Chiller shall be horizontal shell and tube type construction with water/brine to flow in the shell and the refrigerant inside the tube.
- Chilled water pipeline shall be of Carbon Steel seamless type Sch. 40 meeting ASTM & ANSI standards.

- Chilled water pipe line shall be cold insulated with phenolic foam. The insulation material shall be in two halves of annual cylindrical shape to match the pipe size.
- Horizontal centrifugal pump with back pull out design shall be planned. Pump shall be coupled with motor by spacer type coupling and shall conform to the latest edition of the relevant standard.
- The pump shall be heavy duty suitable for continuous duty and shall be standard product of the manufacture proven for satisfactory & reliable performance.
- Satellite AC plant shall be designed for remote operation, monitoring, Recording and control with active feedback sensors and suitable interlocks. During pre-launch operations and launch time, satellite and vehicle cool air plant shall be configured in such a way that all the conditioning parameters of cool air shall be displayed remotely in FCC facility.
- All the equipment shall be fully compatible with each other and capable of operating as a fully integrated system to deliver the specified output under design conditions
- FDA System for AHU's: The AHUs inside TLP shall be interfaced with dedicated AHU Fire Detection and Alarm system to trip the AHUs on receipt of signal and same time audio and visual indication shall be available for operational personnel. FDA for AHU's shall be suitably located during detail engineering phase.
- The monitoring and control of the TLP air conditioning and ventilation systems shall be planned from the Main PLC & SCADA provided in the control room located in satellite AC plant. The main PLC shall be common for Satellite and vehicle cool air systems &process and safety facilities of TLP. Common redundant processor shall be considered for TLP ACS and satellite and vehicle cool air systems.
- Remote I/O panels shall be provided in the field near the AHUs. These remote I/O panels shall communicate with the main PLC in the control room.
- Chiller package shall be provided with independent Microprocessor based PLC for the control and operations of chillers. The Micro PLC shall communicate the Main PLC in the control room.
- Main PLC in the control room shall have interface with the fire alarm systems.
- All the interlocks shall be executed through the PLC provided in the control room.
- For TLP AC systems, redundancy shall be considered in the power supply and communication of the PLC.
- Chillers, cooling towers (if any) and associated pumps shall be located in the respective plant room / AHU rooms provided in each process and safety

facilities.

- Instrumentation and control rooms and check out room shall be considered with dedicated Packaged AC units or dedicated chiller with AHU's with100% standby.
- AC distribution systems are to be designed to supply cool air to the required areas by providing suitable dampers in the ducting to optimize the power consumption, considering the fact that the large areas of the building are not used and requirement is comfort air conditioning for operating personal.
- Packaged Air conditioning units (PAC's) of various capacities shall be provided in the areas which are not served by the AHU's. No of units in each area and capacity of each Packaged AC unit shall be based on the interior layout Details and air conditioning load for each area. Outdoor condensing units shall be planned accordingly.
- 230V AC UPS power supply with battery backup of 1 hour is provided in the instrumentation and control system.
- Design and Detailed engineering of Interface details for satellite cooling system ducting and it interconnection to permanent ducting and vehicle pay load fairing shall be carried out for future implementation.
- The reliability and quality assurance plan(QAP) with P&ID diagrams shall prepared by the vendor in consultation with design engineering at each and every stage of design and the same will be approved by department/consultant.
- The number of round aluminium insulated required size ducts for satellite and vehicle cooling systems from the filter plenum of de-humidifier to Launch pad TUT with interface termination at different levels shall be designed by design engineering with details to realize the same.
- All the duct terminations shall be provided with flow control/adjustment manual/Automatic wheel operated damper with locking arrangement.
- The air velocity in duct shall be maintained within 10 m/sec for designing the round duct of vehicle & Satellite cooling system and all other comfort AC system shall be as per the HVAC standard.
- The air-cooled condenser shall be constructed of copper tube, mechanically expanded into aluminium fins.
- All the pumps shall be heavy duty suitable for continuous duty and shall be standard product of the manufacturer proven for satisfactory and reliable performance.
- FMECA study on Satellite and Vehicle cool air system shall be carried out.

7.7 Guidelines for Electrical Panels:

- All electrical panels which are related to AC system shall meet latest IEC 61439 Standards in fully type tested design and starter shall be selected based on the OEM TYPE-II charts.
- Hardwired interlocks and operational interlocks related to safety, operational requirements shall be carried out in the electrical panels along with software/PLC based interlocks.
- All electrical starts shall have plug in relays for status and command as required. Necessary corrections will be asked during drawing approval.
- All safety distances from electrical panels to AC equipment shall be considered based on the latest IS Standards/CEA guidelines.
- All electrical panels shall have digital multi-function meter with RS485/Ethernet communication and required earth leakage protection for all feeders.
- All starter feeders shall be MCCB based only.
- All incoming and outgoing feeders shall be MCCB/ACB. Above 800 amps, shall be considered with ACB. Below 800 amps shall be considered with MCCB.
- Required cable trench and cable trays from panel to AC Equipment shall be considered during design stage.
- Required dual earthing shall be considered for all panels.
- Any other points/parameters required for electrical systems of the AC units shall be finalized during the design stage.
- All MCCBs shall be with microprocessor release compatible for integration with SCADA/BMS.
- All the exposed cables laid in trench/wall/ceiling/floor/truss shall be provided with silicon based fire resistant coating compatible for PVC cables.
- All the components, panels, cables etc and panel fabrication shall conform to relevant IS specifications and shall also be got approved by engineer in charge.
- Erection, testing and commissioning of the system and various components shall be done as per the relevant IS specifications.
- The electrical panel shall be got fabricated/ considered from approved manufactures only. The list of approved panel manufacturers shall be provided at the time of configuration.
- Vendor shall configure and submit the detailed SLD (single line diagram), General arrangement drawings (GA) for approval of engineer-in-charge.
- Minor civil works like foundations, pedestals for air handling units and

packaged ac units, opening in the walls/ceiling etc for passage of pipes, ducts, cables etc shall be configured accordingly.

- All the panels shall be suitable for operation of 415V, 3 phase, 4 wire, 50Hz AC supply complete with all interconnections and consisting of main Incoming MCCB of rating as indicated in SLD with power (KA) Symmetrical breaking capacity, earth leakage protection, microprocessor based release and having indoor interlocking facility.
- The panel shall have necessary interfaces like 24V DC/230V AC relays, air break contactors etc to trip the MCCB controlling he incoming supply on receiving signal from smoke detection and fire alarm control panel with operations on 24V DC supply. Required no. of NO/NC contacts with the LED shall be provide for visual (actuation/off) indication of this trip signal along with a by-pas key type actuator.
- Supply, installation, testing and commissioning of capacitors of suitable to improve and maintain a power factor of not less than 0.95 at any time for AHU motors.
- Necessary cabling/wiring is to be provided for all control circuits in between panels, all equipment and remote control.
- CODES AND STANDARDS: The configuration, design, manufacture, fabrication, installation and testing of equipment covered by these specifications shall comply with latest edition of the appropriate equivalent international standards, all currently applicable statutes, regulations and safety codes in the locality where the equipment shall be installed. Minimum following standards or equivalent Indian/international standards shall be followed are given below:

IS-660	Safety code for mechanical refrigeration.
IS-5111	Testing of refrigerant compressors
ANSI-B9.1	Safety code for mechanical refrigeration
ARI-520	Standard for positive displacement refrigeration compressor and condensing units
IS-2494	Endless V-belts for industrial purposes
IS-3142	V-Grooved pulleys for Endless V-belts specifications
ASGRAE-23-67	Method of testing for rating positive displacement refrigerant compressor and condenser units
ARI-480	Standard for refrigerant cooled liquid coolers remote type
ASHRAE-26	Method of testing for rating liquid coolers

ASME-SEC-VIII,Div,1	Unfired pressure vessels code
ANSI-B-31.5	Specification for shell and tube type heat exchanger
IS-659	Safety code for air conditioning
ASHRAE-33	Methods of testing for rating forced circulation air-cooling and air heating coils
IS-5120	Technical requirements for rotodynamic special purpose pumps
IS-5639	Specification for pumps handling chemicals and corrosive liquids
IS-5659	specifications for pumps for process water
API -610	Centrifugal pumps for general safety services
IS-655	Specification for metal air duct
IS-277	Galvanized steel sheets-specification
IS-737	Wrought aluminium and aluminium for sheet and strip for general engineering purposes
ARI-210	Standard for unitary air conditioning equipment
ASHRAE-37	Standard methods of testing for rating unitary air conditioning and heat pump equipment
BS-848	Methods of performance test of fans
BS-2831	Methods of test for air filters used in air conditioning
IS-4671	Expanded polystyrene for thermal insulation purpose
IS-4894	Centrifugal fans
IS-1239	steel tubes, tubular and other wrought steel fitting
ASHRAE-23	Standard method of testing and rating-67 standard air conditioner-67 standards
ARI-450-6	Standard for air cooled refrigerant condensers
ARI-410	Standard for air cooling and air heating coils
IS-3588	Specifications for electrical axial flow fans
IS-2062	Specifications for steel for general structural purpose
ASME SEC IX	Welder, welding & Brazing qualification procedure
AHRI 430	Central station air handling units

ASHRAE-52.5-1992	Method of testing General ventilation air cleaning devices for removal efficiency particle size

7.8 Instrumentation and control systems:

DDC System for satellite and vehicle cooling systems:

- Chilled brine air conditioning plant shall be remotely monitored/operated/controlled from centralized control room located in AC plant control room and FCC control room. This shall be configured with man/machine interface.
- DDC system of satellite and vehicle cooling system shall be designed with the following functions:
    - Remote operation (start/stop/reset) of Equipment like compressors, pumps, AHU Blowers and condenser fans.
    - Remote start/stop/status of reactivation heaters
    - Remote start/stop/status of black strip heater (If designed) located in SA path.
    - Remote status indication of equipment like compressors, pumps, AHU/Blowers, dampers and condenser fans.
    - Remote monitoring of chilled brine temperature at common outlet header of chillers, Inlets and outlets of primary coils and Secondary coils.
    - Automatic operations of chemical dehumidifier for humidity control of supply of processed air.
    - Automatic capacity control of compressors with variation of cooling load.
    - Remote control and monitoring of temperature and RH at various levels.
    - Remote monitoring of static pressure at the end point.
    - Manual cum motorized ON-OFF type butterfly type damper at inlet brine line to each chiller.
    - Motorized ON-OFF type butterfly type damper at outlet duct to each blower of satellite cooling AHU/Dehumidifier/blower of satellite cooling AHU.
    - Automatic operation of 3 way motorized mixing valve at AHU/heat exchanger outlet line to control supply air/N2 temperature.
    - Pressure and temperature values in brine line and air duct wherever required.

8. Electrical systems

8.1 Introduction

- The purpose of this section is to define the overall framework, philosophy and scope for the Electrical systems design and engineering of all facilities under the Third Launch Pad Complex which are defined under this RFP.
- System design shall meet all electrical requirements of the Launch Pad, Process Infrastructure and all associated auxiliary facilities — ensuring safe, reliable, and continuous operation of mission-critical systems during all operational modes of the launch cycle (normal days, critical launch / process activities and countdown days).
- The design shall consider the latest trends, advanced systems and proven industrial practices adopted in modern spaceports and process installations. The Consultant shall ensure that the electrical systems are designed for high reliability, operational safety, maintainability, and energy efficiency, functional requirements and also meeting the aesthetic of the overall launch complex.
- Design shall consider site-specific environmental conditions, saline atmosphere, high humidity and ambient temperature up to 50°C, ensuring long-term performance and corrosion resistance of all electrical systems and materials.
- The overall objective is to deliver a robust, modular and intelligent power distribution architecture that ensures continuous availability of power, optimal energy utilization, and complete integration with the automation and SCADA systems for remote monitoring, control and diagnostics.
- Electrical design shall include two types of the works
    a) *External electrification – involving main TLP substation feeding power to entire TLP.*
    b) *Internal electrification – involving sub distribution at each facility*

8.2 Scope under department

- The **external electrification** including the **TLP Substation** with Normal Power, DG sources, UPS systems, and all associated substation equipment will be realized by the **department.**
- **Feeders from the substation to each facility** will be provided by the department covering
    a) **Two / Three HT/MV feeders** for each of the five facilities – NSB (near Launch Pad), LOFS, LMFS, GLR, and Satellite AC Plant.
    b) **One / Two LT feeders** from substation to all facilities for non-critical loads & AC systems
    c) **Three / Four chains of UPS feeders** for critical, non-critical, and emergency lighting loads.
- **HT/MV incoming panels and HT/MV/LT transformers** located at the above five HT facilities shall also be under **department scope**. (refer tentative layout for HT rooms)
- **Study related to Lightning Protection towers for launch pad to find out** distances from the rocket, height of the towers, number of towers and etc details

will be carried out by the department. These detailed study report will be shared to the design consultant during initial level design. Further earthing scheme and design of towers and etc as defined under this RFP shall be part of consultant's scope.

- Soil resistivity details at various locations of the third launch pad site will be provided by the department and shall be used to design earthing scheme.
- Scope of the design consultant under electrical systems
- The scope covers complete electrical design and detailed engineering services for all the launch pad infrastructure, process facilities, and auxiliary / support facilities under the third launch complex as defined under this RFP.
- The Consultant shall carry out complete internal electrification design starting from the termination points of department-provided feeders and up to the end utilization equipment of each facility indicated in this RFP.
- The scope includes design and engineering of the following but not limited to:
  a) HT / MV / LT distribution networks including panels, MCCs, iMCCs, PCCs and related systems.
  b) Cabling (power, control, instrumentation), cable trays, and cable routing systems.
  c) Internal wiring and design of lighting systems: indoor, outdoor, process, area, street lighting and special illumination scheme for pad lighting.
  d) Earthing and lightning protection systems at all facilities.
  e) Automation systems for all the electrical network (Control, monitoring and SCADA) and automation integration with substation systems.
  f) Critical and non-critical UPS distribution and Emergency power distribution.
  g) Auto changeover schemes for all the mission critical systems and others as required
  h) Selection of all process and launch pad electrical equipment such as motors, variable frequency drives, solenoid valves, actuators, process heaters, local control panels, field junction boxes, earthing interconnections, and all associated power and control accessories required for the functional realization of the systems.
  i) Harmonic mitigation, power factor correction, surge protection, and power quality studies and selection of suitable mitigation techniques.
  j) Any other electrical design works which are required to complete the scope of this RFP.

  The design shall incorporate latest technologies, energy-efficient and advanced systems, ensuring long-term reliability, maintainability, and aesthetics suitable for launch pad environments by considering latest IS, IEC, IEEE standards, CEA regulations and department's safety guidelines.
- The Consultant shall carry out the study and design of electrical systems in hazardous areas as per IEC 60079 standard. Suitable flameproof or intrinsically safe equipment shall be selected based on area classification. All electrical works in hazardous zones shall comply with applicable safety codes and departmental requirements.

- The Consultant shall carry out comprehensive load analysis and system studies covering load flow, short-circuit, voltage drop, protection coordination, harmonics, and reliability assessment using approved softwares.
- The Consultant shall develop the complete power distribution architecture, single-line diagrams, equipment sizing, layouts, earthing and lighting, protection schemes and prepare detailed BOQs, cost estimates and technical specifications for all facilities.
- The consultant shall study the details related to substation scope and various systems, feeder distribution schemes from substation to each facility and design the additional requirements if required towards completion of electrical systems for TLP project. Necessary fault coordination, feeder discrimination and other requirements shall be also considered / designed as per the department requirement even though it is not specifically mentioned in this RFP.
- All design documents shall be tender-ready by incorporating departmental requirements, relevant standards and statutory approvals from various agencies and integration requirements with civil, process, and automation systems.
- The scope shall include preparation of all reports, drawings, specifications, datasheets, and GTPs for transformers, panels, cables, lighting, UPS, earthing, and related electrical items.
- The Consultant shall coordinate with Civil, Mechanical, HVAC, Process, and Instrumentation disciplines to ensure integrated and clash-free design.
- Scope also covers civil infrastructure for HT rooms at locations which are envisaged under this RFP (Launch Pad HT Distribution Room, Satellite AC Plant, LMFS, LOFS, and GLR). The department shall provide preliminary inputs such as sizes and scheme layouts of HT panels and transformers at these locations, which shall be considered to finalize the civil layouts by the consultant.
- The Consultant shall provide all deliverables for Phase I (Preliminary Design) and Phase II (Detailed Design) as defined in other sections of this RFP.
- The Consultant shall prepare tender specification documents, BOQs, and technical schedules for electrical systems to enable department to float tenders for system realization, along with market survey and budgetary cost inputs from approved vendors. (Phase III).
- The Consultant shall provide design clarifications, verification of design changes during realization, and preparation of any additional drawings or modifications as required by the department. (Phase IV)
- The Consultant shall execute all relevant design, documentation, and coordination works necessary to ensure complete and functional realization of all electrical systems under this RFP without any financial implication to the Department.

  Note: The above scope is indicative. Consultant shall perform all additional works necessary to ensure completeness and compliance with department requirements and functional realization of all electrical systems."

8.3 Power Supply and Power Network details:

- The HT Power supplies are broadly classified as:
  a) Normal power supply (33kV, 3 phase AC system)
  b) Normal power supply (11kV / 6.6 KV / 3.3 KV, 3 phase AC system)
- Standby power supply through DG sets (11kV / 6.6 KV, 3 phase AC system)

- The LT Power supplies are broadly classified as:
    a) Normal power supply (415 V, 3 phase AC system)
    b) Standby power supply through DG sets (415V, 3 phase AC system)
    c) Un-interruptible power supply (400V, 3 phase AC system)
    d) Emergency power supply (400V, 3 phase AC system)
- The Electrical Systems for normal and emergency power at the facility level shall be designed for satisfactory operation for 415 V +/- 10%, 3 phase, 50 Hz +/- 5% solidly grounded system. The combined voltage and frequency variation up to 10% maximum (absolute sum).

8.4 Applicable Standards, Regulations and References

- The electrical design, engineering, and documentation for all facilities under this project shall **strictly adhere to the latest revisions** of all relevant **IS/IEC/IEEE standards and CEA regulations**, in conjunction with **departmental requirements, safety guidelines, and best international l practices**.
  Wherever a conflict arises between the requirements of IS, IEC, or departmental specifications, the **more stringent requirement** shall be considered for design in **consultation with the department**.
- All standards, regulations and codes listed herein shall be treated as **minimum requirements**; the consultant shall identify and apply any additional standards necessary to ensure safety, reliability, maintainability, and compatibility of the electrical systems with the **launch pad operational environment**.

#	Description	Standard Code / Reference	Remarks / Application Area
1	Earthing systems and grounding design	IS 3043 / IEEE 80	Design, installation and testing of power and instrumentation earthing grids.
2	Low-voltage electrical installations	IEC 60364 series / IS 732	Wiring rules, clearances, circuit protection and safety provisions.
3	High-voltage installations (> 1 kV AC)	IEC 61936 / IS 8160	Design basis for HV/MV networks, insulation coordination and clearances.
4	Power transformers	IEC 60076 series / IS 2026	Rating, temperature rise, loss limits, routine and type tests.
5	Rotating electrical machines (motors)	IEC 60034 series / IS 325 / IS 4722	Motor selection, efficiency class and testing requirements.
6	LV switchgear and control gear assemblies	IEC 61439	Design and type-testing for PCC/MCC/DB panels.
7	HV/MV switchgear and control gear	IEC 62271	Design and testing for 11 kV / 33 kV panels and breakers.
8	Cables – XLPE / PVC insulated	IS 7098 / IS 1554 / IEC 60502	Power and control cable construction, ampacity and testing.
9	Cable accessories, lugs and terminations	IS 8130 / IS 5499	Terminations and connectors for LV/MV systems.

10	Illumination and lighting design	IS 10322 / IEC 60598	Luminaires and illumination level design criteria.
11	Lighting calculation tools (reference practice)	DIALux / AGI-32	Lighting design software for indoor and outdoor lux analysis.
12	Lightning protection system design	IEC 62305 / IS 2309	Protection against direct and induced lightning effects.
13	Surge protective devices (SPDs)	IEC 61643 / IS 2834	Coordination of SPDs at service entrance and distribution levels.
14	Hazardous area classification	IS 5572	Basis for identifying Zone 0/1/2 areas for flammable gases and vapours.
15	Flameproof and Ex-proof equipment	IEC 60079 series	Design and testing of electrical equipment for explosive atmospheres.
16	Intrinsic safety and IS circuits	IEC 60079-25 / IS 60079-11	Design rules for intrinsically safe instrument circuits.
17	Protection against electric shock	IS/IEC 61140	Insulation coordination and human safety provisions.
18	Power quality and harmonic limits	IEEE 519 / IEC 61000 series	Harmonics, voltage fluctuation and flicker control.
19	Electromagnetic compatibility (EMC)	IEC 61000 series	Emission and immunity requirements for control & SCADA equipment.
20	Programmable controllers (PLC)	IEC 61131 series	PLC hardware and software standards for automation systems.
21	Substation automation communication	IEC 61850 / IEC 60870-5-104	Protocols and data models for SCADA integration.
22	Cyber security for automation systems	IEC 62351 / IEC 62443	Security architecture and communication protection.
23	Functional safety of E/E/PE systems	IEC 61508 / IEC 61511	Safety integrity levels (SIL) and FMEA/FMECA requirements.
24	Electrical equipment of machines	IEC 60204-1	Electrical safety for machines, jacks and actuator systems.
25	Environmental testing of equipment	IEC 60068 series	Qualification under temperature, humidity, vibration and salt spray.
26	High-voltage testing & insulation coordination	IEC 60060 / IEC 60071	Impulse withstand and insulation coordination for HV gear.
27	Concrete and embedment interfaces	IS 456 / IS 13920	For equipment foundations and electrical embedment.
28	Variable speed drives (VFD systems)	IEC 61800 series	Design and testing for power electronic drive systems.
30	Power installations in explosive atmospheres	IEC 60364-7-707	Wiring requirements for hazardous locations.
31	Gas detection and safety interfaces	IEC 60079-29 / IEC 60079-30	Electrical interface with gas detection and safety systems.
32	Testing and inspection of Ex equipment	IEC 60079-17	Inspection and maintenance procedures for hazardous areas.
33	Quality management systems	ISO 9001	Design and documentation quality control requirements.
34	Environmental &	ISO 14001 /	EHS management framework for

	occupational safety	ISO 45001	design and installation.
35	Terminology and symbols	IEC 60050 / IS 8130	Consistent electrical terminology and drawing symbols for documentation.

8.5 System Study and Input Collection

- Department will provide the initial level launch pad and process electrical loads which were assumed as part of initial level project studies.
- The Consultant shall initiate the electrical design activities by conducting a comprehensive study of all systems, facilities, and process operations defined under the scope of the Third Launch Complex Project. The study shall aim to understand overall electrical requirements, system interdependencies, and critical load characteristics.
- The Consultant shall collect and review all design basis inputs, process flow diagrams, equipment data sheets, operational sequences, and load details.
- Consultant shall collect the inputs from process and safety teams to identify all electrically driven systems—motors, solenoid valves, actuators, heaters, instrumentation, and auxiliary equipment etc —and classify them into mission-critical, critical or non-critical / support categories.
- Facility-level input sheets shall be prepared by the Consultant to record details such as equipment type, power ratings, operating voltage, duty cycle, control mode (local/remote), safety classification, and redundancy needs.
- Each facility's operational mode (normal, standby, launch, servicing, emergency, maintenance) shall be analysed to identify electrical power dependency, switching logic, and load priority.
- Consultant shall identify the operational hierarchy of loads and prepare a **Criticality Matrix** for each facility.
    a) **Mission-Critical Systems** – No failure tolerated during launch or propellent filling operations.
    b) **Critical Systems** – Short interruptions acceptable, but operation must resume automatically through auto changeover logic.
    c) **Support/Non-Critical Systems** – Failure manageable through manual restoration or standby backup.
- Based on the criticality assessment, Consultant shall identify the required redundancy (2N, N+1, or N) for each system and determine its power source (Normal, DG, UPS, or EPS) in consultation with department.
- System configuration study shall include identification of single-point failures and formulation of schemes to eliminate them through feeder duplication, auto-transfer, or load redistribution.
- Consultant shall review and finalize system voltage levels (11 kV / 6.6 kV / 3.3 KV / 415 V / 230 V) for each facility in coordination with department to ensure compatibility with the main substation and process interfaces.
- Study of standby and emergency power sources shall be carried out to define Normal–DG–UPS–EPS interfaces, auto changeover logics, and delay tolerances for each load category.

- Consultant shall map inter-facility power flows between launch pad infra facilities like NSB to pad lighting, NSB to TUT and etc to define feeder routing distances, cable sizing criteria, and voltage drop considerations and routing of the cables.
- Study shall cover operational environment parameters—temperature, humidity, salinity, hazardous classification, and EMI exposure—to determine equipment derating factors and protective measures.
- Consultant shall identify and list all applicable standards, codes, and departmental guidelines relevant to the system design to ensure uniform design compliance from the beginning.
- Preliminary system configuration diagrams shall be prepared showing all feeders, sources, and interconnections among launch pad, process, and auxiliary facilities.
- Consultant shall prepare a **System Study Input Report** summarizing:
    a) Facility-wise system descriptions and power sources.
    b) Electrical loads and maximum demands for each facility
    c) Classification of all loads (mission-critical / critical / non critical).
    d) Identified redundancy levels (2N / N+1 / N).
    e) Identified DG, UPS, and EPS dependencies.
    f) Initial feeder interconnection philosophy.
    g) Environmental and operational constraints.
    h) Preliminary design assumptions and input requirements pending from Department.
- The System Study Input Report shall be submitted as part of design deliverables under phase I to the department for review and approval before proceeding with detailed load analysis and configuration design.

8.6 Electrical systems requirements: Scope matrix

- This Matrix provided herein outlines the facility-wise applicability of all electrical systems, equipment, and sub-systems under the scope of this electrical portion of the Design Engineering RFP. It is intended to define the responsibilities between the Department and the Design Consultant for all internal electrification works across Launch Pad, Process, and Auxiliary facilities as indicated the below table. Even though some of the electrical systems like substation and etc. are defined under department scope, if any part of the work or additional requirements which are arising due to the design engineering of the electrical systems under this RFP, those additional works / requirements design shall also be carried out without any additional cost.
- **Launch Pad Infrastructure Facilities**: Tiltable Umbilical Tower (TUT), Mobile Launch Pedestals (MLP), Valve chamber room (VCR-O & F), VCB, NGLV Service Building (NSB-O & F), JDD, Bogie System, Rail Track, Lightning Protection Towers (LPT), Crew Access tower (CAT), Cable trenches, AC systems/ plants of all these facilities including Sat and vehicle cooling AC plants and all launch pad associated structures as indicated in this RFP.
- **Process Infrastructure Facilities:** Liquid Methane Filling System (LMFS), Liquid Oxygen Filling System (LOFS), Liquid Hydrogen System (LH_2), Liquid Nitrogen System (LN_2), Compressed gas storage facility (CGSS), GLR (Safety

systems), AC systems of all these facilities and associated process support buildings.

- **Auxiliary / Support Facilities:** Pump Houses, Bore Well and Overhead Tank Areas, CISF Security facilities, Control Rooms, Utility Buildings, Fire Fighting Pump House, AcoSS, Maintenance & Storage Facilities, RO Plant, WTP, and other auxiliary service structures.

#	Electrical System / Item	Launch Pad Infra Facilities	Process Facilities	Auxiliary / Support Facilities	Remarks / Design Notes
1	Main TLP substation having Normal, DGs, UPS Sources	Dept scope.			Main substation will be executed by separate turnkey project and which is not in the scope of this RFP. However, if anything additional required towards meeting this RFP requirements, that shall be considered.
2	Incoming Power Feeders from main TLP substation to each facility (11kV / 6.6kV /3.3 kV/0.433 KV). Normal / DG feeders, UPS/EPS feeders	Dept scope			Power supply to each facility shall be provided by Department through dedicated feeders from main substation; design beyond termination point is consultant's scope.
3	Incoming Facility Panels (HT / MV /LT Incoming panels)	D	D	N	Facility level HT panels will come at locations namely Launch pad distribution HT room, Sat AC plant, LMFS, LOFS and GLR. HT panels are considered based on the preliminary data, if any additional breakers / transformers required, that shall be designed to meet dept. requirements and further distribution is in the scope of design services.
4	Civil infra for HT rooms at locations of launch pad and process infra as per the layout and initial	Y	Y	Y	HT rooms civil requirements design shall be carried out to accommodate HT/MV panels as per the

	level inputs.				requirements of department.
5	Transformers (Power transformers, distribution transformers at HT rooms)	D	D	N	Ratings to be finalized based on load analysis. Dry type preferred
6	Bus Ducts / Main Bus Connections to PCCs from transformers.	D	D	N	Interconnection between transformers and PCC/MCCs.
7	All other PCC Panels / Sub PCCs including AC systems.	Y	Y	Y	Shall be designed in accordance with the requirements of IEC 61439.
8	Process MCC panels / iMCCs.	Y	Y	Y	Feed process and mechanical drives. Include redundancy and auto changeover logic.
9	VFD Drives / Motor Starters, its panels and selection of all electrical Equipmentunder this RFP	Y	Y	Y	To control hydraulic pumps/ motors, process motors. Process related MCC panels will be designed as a part of process package.
10	Auto Changeover panels, design of redundant philosophy at process / launch pad level	Y	Y	Y	Cables other than from substation to each facility is completely under this design RFP scope only.
11	Power & Control Cables from PCCs or HT panels to till to the end equipment.	Y	Y	Y	Voltage drop calculations, cable schedules, BOM and all associated works included in the scope.
12	Earthing System (Power, Instrumentation, Static, Neutral, etc)	Y	Y	Y	Shall be designed to meet IS/IEC and as per department standards and RFP specifications
13	Lightning protection Study for Launch Pad (Height, Strike Zone, Electronics and Electrical equipment)	Dept & Y	—	—	Study conducted by Department; Consultant to use data for further design.

14	Lightning Protection Towers and its earthing and all associated works as per the requirements.	Y	—	—	Dept. will give the study report. Further design for execution and required earthing scheme etc is included in this scope.
15	Lightning Protection (Facility-Level)	Y	Y	Y	Consultant to design isolated and non-isolated systems per IEC 62305 / IS 3043 and as per the dept. requirements.
16	Flame proof considerations and selection of the Equipment.	Y	Y	Y	Shall be designed and selected as per the specifications of this RFP and requirements.
17	Illumination – Indoor & Outdoor	Y	Y	Y	Illumination as per IS 3646. Use LED fixtures; perform DIALux simulations with 50% margin
18	Emergency Lighting / UPS-Backed Circuits	Y	Y	Y	UPS-based emergency luminaires to provide ≥ 90 minutes autonomy.
19	Arial & aviation lighting, high mast lighting, track lighting and Street lights for entire launch pad as required	Y	Y	Y	Shall be prepared based on the overall layout and as per the dept requirements.
20	Power Outlets – Single & Three Phase	Y	Y	Y	Single phase (5/16/20 A) and 3 phase (32/63 A) sockets distributed as per functional needs and as per the department guidelines.
21	Ventilation Systems (Fans, Air Circulators, Exhausts)	Y	Y	Y	To maintain ambient below 40 °C in rooms; as per dept environmental norms.
22	Incoming UPS isolation transformers, with protection and earthing	Y	Y	Y	As required and design shall consider all nonlinear loads and de-rating accordingly
23	Incoming UPS Distribution panels with auto change	Y	Y	Y	Shall be designed based on the load study and various requirements at

	over as required				all the facilities
24	Distribution Boards (LDBs, PDBs, UPS DBs etc junction boxes and etc)	Y	Y	Y	Panel design as per IEC 61439; segregate circuits and label per IS 2032.
25	Cable Trays / Supports / Raceways	Y	Y	Y	SS or FRP trays in outdoor areas; bonding continuity to be ensured.
26	Control & Instrumentation Power Panels	Y	Y	Y	Provide clean, isolated supply for sensitive I&C / PLC / DCS loads.
27	SCADA / Remote Monitoring Integration	Y	Y	Y	All panels and UPS to interface via IEC 61850 / Modbus TCP; health/status feedback to central SCADA.
28	APFC and Harmonic filter circuits and panels	Y	Y	Y	Maintain THD < 5% per IEEE 519. Include passive/active filters as needed.
29	Surge Protection Devices (SPD Class I / II / III)	Y	Y	Y	Install SPDs at main incomers and DBs per IEC 61643and as required.
30	Fire Alarm & Fire Fighting System electrical requirements	Y	Y	Y	Dedicated circuits from UPS / EPS; comply with IS 2189 & NFPA 72.
31	CCTV / Access Control / Security Systems Power requirements	Y	Y	Y	Separate UPS-fed DBs with EMI shielding and isolation.
32	Communication & Network Equipment Power requirements	Y	Y	Y	Power sockets & UPS outlets for racks, switches. Provide clean power and grounding.
33	Power Monitoring & Energy Management System	Y	Y	Y	Energy meters with communication; load logging & analytics as per dept requirement.
34	Lighting Control System and dedicated lighting control SCADA and remote monitoring	Y	Y	Y	For energy management & remote control integration.

35	Special Illumination for Launch Pad / Rocket Servicing	Y	—	—	Special design shall be carried out to meet vertical and horizontal illumination through studies and shall be considered along with lightning towers as required for the department
36	Civil Adequacy & Layout Verification for every panel room and process locations and design of HT, MV & LT rooms.	Y	Y	Y	Consultant to coordinate with civil discipline for panel rooms, trenches, foundations, etc as required.
37	Remote Control and Monitoring Systems for all the electrical systems as required	Y	Y	Y	Control/monitoring through central SCADA; include status, alarm, and command loops and shall be designed to link substation automation network.
38	Aviation Warning Lights / Beacon Systems	Y	Y	Y	For tall structures > 45 m as per ICAO Annex 14 standards.
39	Temporary Construction Power Network specifications	Y	Y	Y	Required specifications shall be incorporated and shall be added in all the civil package tenders
40	Testing / Calibration Outlets for Maintenance	Y	Y	Y	Dedicated test sockets in panels for voltage, current, frequency and power quality measurements.
41	QAP / Inspection / FAT–SAT Requirements	Y	Y	Y	Consultant to prepare QAPs, FAT, SAT test procedures for all electrical equipment including performance tests.
42	Documents control procedure and approval of documents requirements	Y	Y	Y	As required and shall be maintained till the end of the project as per this RFP specifications

43	Energy Efficiency & Load Optimization Study	Y	Y	Y	Consultant shall conduct an energy efficiency and load optimization study at detailed design stage to ensure compliance with ECBC / ISO 50001.
44	EMC / EMI Compliance for Sensitive Systems	Y	Y	Y	Consultant to ensure all electrical and control systems meet electromagnetic compatibility requirements.
45	Future Expansion / Spare Feeders	Y	Y	Y	Minimum **30%** spare capacity to be incorporated in panels and cable trays for future expansion.

Y : Under the scope of this Design consultancy RFP
N: Not required or will be designed by the other agency
D : Under the Department's scope and data shall be utilized for further subsystem design.

Note:
The above list of facilities and systems is indicative and provided to facilitate an understanding of the overall scope under electrical systems. However, Department reserves the right to include additional electrical systems or facilities as required for ensuring the completeness and integrity of the overall electrical infrastructure of the TLP project. The Consultant shall carry out all relevant electrical design works, documentation, and coordination activities necessary to fulfil the intent of this Design Engineering RFP, without any additional cost to the Department.

8.7 Design philosophy for Electrical systems

- **General Electrical Design Philosophy**
    1. The Consultant shall adopt a holistic and integrated approach to the electrical design, ensuring reliability, safety, maintainability, and energy efficiency for all systems under the Third Launch Pad Complex.
    2. The design shall ensure continuous and fail-safe operation of all mission-critical, process-critical, and support systems during all operational modes — launch, fueling, servicing, standby, and maintenance.
    3. All systems shall be designed in compliance with CEA regulations, relevant IS/IEC/IEEE standards, and departmental safety and operational guidelines.
    4. The overall objective is to realize a robust, modular, and intelligent power distribution network integrated with SCADA and automation systems for centralized monitoring, commanding, and diagnostics.
    5. The Consultant shall ensure zero single-point failure design by providing redundant power paths, independent feeders, and alternate control logic

wherever applicable.

6. All equipment, panels, and cabling shall be designed for tropical marine environment, ambient temperature up to 50°C, humidity up to 99%, and saline conditions ensuring long service life and corrosion resistance.
7. The design shall ensure compatibility and coordination between electrical, civil, mechanical, HVAC, and process systems for complete functional integration.
8. The Consultant shall maintain uniform design standards, nomenclature, and documentation across all facilities to simplify operation and maintenance.
9. Ease of operation, accessibility, and maintainability shall be considered in the design of all electrical rooms, trenches, and routing layouts.
10. Spare switchgear at least one in each rating have to be incorporated in the distribution panels.
11. All electrical systems shall be designed with provisions for **future expansion (minimum 30% spare capacity)** in panels, cable routes, and rooms to meet future facility needs.
12. The Power change over should not affect to the other loads.
13. Future augmentation provisions shall be incorporated in the electrical design to accommodate additional loads, panels, or equipment that may arise from future facility expansions or new building additions. Panel rooms, trenches, cable routes, and switchgear layouts shall be planned with adequate space and spare capacity to enable seamless extension without major rework or shutdown of existing systems.

- **Power Distribution Philosophy**

  a) The Consultant shall design the complete power distribution network from the substation feeder termination points up to the end-use equipment of each facility.

14. The overall system shall follow a three-tier supply architecture ensuring continuity under all operating modes:
    i. Normal Supply (from TLP substation)
    ii. Captive DG Supply (standby source / launch operations from substation)
    iii. UPS Supply (control, safety, and mission related instrumentations in redundant philosophy)
    iv. Emergency Power Supply (EPS) (for life-safety and evacuation loads)
15. The Consultant shall adopt parallel and redundant feeder arrangements for all mission-critical systems to ensure no interruption under feeder or equipment failure.
16. The power system shall provide selectivity and sectionalization with bus couplers, dual incomers, and auto-changeover logic between Normal /DG, UPS I / UPS II, and UPS III/ EPS sources as required to meet redundancy philosophy.

17. Distribution hierarchy shall follow a structured path — Substation Incomers → HT/LT Panels → MCC/iMCC → Distribution Boards → End Loads.
18. Load classification and segregation shall be clearly defined:
    i. Category A: Mission-Critical (2N redundancy)
    ii. Category B: Essential Process / Safety Systems (N+1 redundancy)
    iii. Category C: General Utility Loads / AC plants (Single supply)
19. The design shall ensure selective fault isolation — downstream devices shall clear faults first, without affecting upstream continuity.
20. Voltage regulation and drop shall be maintained within ±5% at equipment terminals under all operating conditions.
21. The Consultant shall ensure harmonic limits, power factor, and transient response meet IEEE 519 and IEC 61000 requirements.
22. All switchgear and panels shall be compartmentalized, draw-out, and type-tested as per IEC 61439 / IEC 62271 standards.
23. The Consultant shall maintain feeder diversity, spare capacity, and inter-facility flexibility to support alternate power routing during maintenance or emergencies.
24. Power distribution layouts shall include SCADA monitoring, metering, and communication interfaces for real-time status and diagnostics.

- **Mission-Critical, Reliability and Safety Design Philosophy**

a) The Consultant shall identify and classify all systems as Mission-Critical, Process-Critical, or Support to ensure redundancy and reliability are applied appropriately.

25. A Criticality Matrix shall be developed for all facilities — categorizing loads based on operational impact, recovery time, and redundancy requirement.
26. All mission-critical systems shall be designed to achieve zero single-point failure, ensuring continuity during loss of any feeder, transformer, UPS, DG, or control system.
27. Redundancy levels shall be defined as required 2N/ N+1/ N.
28. Redundant power and control feeders shall be physically segregated and routed through separate paths or trenches to avoid common mode failure.
29. Auto changeover systems (ATS/ATC) shall ensure instantaneous switching between supply sources (<300 ms for UPS loads, <5s for DG loads) during any outage.
30. The Consultant shall perform FMECA and reliability simulations (ETAP or equivalent) to validate availability targets (≥99.99% during mission operations).
31. Fail-safe logic shall be adopted — all safety-critical systems shall default to a safe state on power or control loss.
32. Protection and interlocking schemes shall isolate faulty sections while ensuring continued operation of healthy sections.
33. Control power redundancy shall be provided for PLCs, relays, and interlocks through dual UPS sources.

34. SCADA and automation systems shall be designed with redundant controllers, communication networks, and power feeds for uninterrupted monitoring and control.
35. The Consultant shall prepare a Redundancy and Reliability Study Report covering source, distribution, equipment, and control levels with quantitative reliability metrics.

- **Electrical Safety and Protection Design Philosophy**

a) The Consultant shall ensure that all electrical systems are designed with comprehensive protection coordination and safety principles, conforming to the NFPA guidelines and relevant IS/IEC/IEEE standards.

36. The protection system shall provide selective fault isolation — ensuring that the nearest downstream protective device operates first, minimizing outage area and maintaining continuity of healthy feeders.
37. Protection coordination studies shall be carried out using approved software (ETAP / DigSILENT or equivalent) covering short-circuit, load flow, and relay grading analysis.
Results shall include time–current curves, discrimination margins, and relay setting charts.
38. All protective relays for HT and LT panels shall be microprocessor-based numerical type, supporting event recording, communication (IEC 61850 / Modbus / As required), and self-diagnostic features.
39. Arc-flash protection schemes shall be implemented for all HT/LT switchgear and MCCs using arc sensors, light detection, or fast tripping relays to reduce arc energy and enhance personnel safety.
40. Earth fault, residual current and differential protection shall be incorporated as per voltage level and system configuration.
41. HT systems: overcurrent, earth fault, differential, restricted earth fault and etc.
42. LT systems: LSING protections for system protection and earth leakage protection where ever human safety required.
43. Busbar, incomer, and feeder protections shall be coordinated to ensure selectivity, avoiding nuisance trips during transient faults or inrush conditions.
44. Mechanical and electrical interlocks shall be considered on all switchgear to prevent maloperation — racking, closing on live bus, or paralleling incomers.
45. Emergency stop (E-Stop) push buttons shall be considered at accessible locations in process and launch pad areas for immediate isolation of power during emergencies.
46. All interlocks for process systems (fueling, deluge, venting, etc.) shall be hardwired fail-safe type and PLC/SCADA interlocks shall act as supervisory control only.
47. Lockout–Tagout (LOTO) provisions shall be incorporated in panel and field

design to ensure maintenance safety. All control and interlock circuits shall be designed for safe restoration post-isolation.

48. Arc-flash hazard analysis shall be carried out for all HT/LT panels. Calculated incident energy levels and protection boundaries shall be documented if required.
49. Protection grading and discrimination between Normal, DG, UPS, and EPS systems shall be ensured to maintain selectivity under all source combinations.
50. Insulation monitoring devices (IMDs) and ground fault annunciation shall be considered in UPS and control power circuits to detect insulation deterioration proactively.
51. Shock protection and personnel safety shall be ensured through double insulation, touch-safe terminals, and non-conductive flooring mats complying with IS 15652.
52. Fire retardant and halogen-free materials shall be considered for all cables, ducts and panel wiring to minimize smoke and toxicity in case of fire.
53. Panel earthing shall include dual earthing connections, separate for body and neutral systems, in line with the overall earthing design philosophy.
54. Overvoltage, undervoltage, surge, and transient protections shall be incorporated at all distribution levels to safeguard sensitive electronic and control equipment.
55. The Consultant shall prepare a Protection Coordination and Safety Report covering:
    i. Protection scheme and device selection philosophy
    ii. Relay setting and discrimination analysis,
    iii. Arc-flash and insulation monitoring studies,
    iv. Safety compliance checklists as per CEA and departmental standards.

- **Maintainability, Accessibility, and Future Expansion Philosophy**
    1. The Consultant shall ensure that all electrical systems are designed for ease of operation, inspection, testing, and maintenance without disturbing adjacent live equipment or disrupting facility operations.
    2. Operating clearances and working distances shall conform to IS/IEC 62271 (for HT systems) and IS 10118 / IS 732 (for LT systems). Minimum 1.2 / 1.5 m front and 1 m rear clearance shall be maintained unless otherwise specified or as per OEM requirements, whichever is higher.
    3. Electrical panels shall be installed on raised plinths with adequate access for bottom cable entry, termination, and future cable addition. Panel doors shall open freely to ≥ 120°, with sufficient corridor space for removal of ACB/MCCB units.
    4. Maintenance aisles and access routes shall be unobstructed, illuminated, and ventilated, with anti-slip flooring, rubber mats (IS 15652), and safety signage.

5. Design shall provide segregated and clearly identified power and control cable routes to facilitate maintenance, fault tracing, and replacement without shutdown of critical systems.
6. Each facility shall incorporate dedicated maintenance isolation points—including incomer isolators, bypass arrangements, and test links—to enable safe isolation of equipment during service activities.
7. Spare capacity of at least **30%** shall be provided in all major panels, cable trays, and raceways for future augmentation of loads and new facilities.
8. Electrical rooms shall also have space provisions for one additional panel section or transformer bay for ease of upgradation to additional new requirements in the future.
9. Equipment and cabling shall be arranged such that individual components can be replaced or upgraded without modifying structural layouts or disturbing operational feeders.
   Modular construction and plug-in or draw-out modules shall be preferred for switchgear and UPS systems.
10. Each building shall have independent earthing pits, lighting feeders, and DBs for ease of maintenance and to isolate faults locally. All earthing pits shall be accessible for periodic testing without excavation.
11. Identification and documentation shall be integral to the design—each feeder, cable, junction box, and termination shall be permanently labelled, and as-built cable schedules shall be maintained in digital format.
12. The Consultant shall consider environmental and ergonomic aspects for maintainability—adequate lighting, natural ventilation, temperature control, and clear access to all equipment, especially in coastal and saline conditions.
13. The electrical layouts and routing drawings shall be developed with provision for future expansion and interface with upcoming systems or facilities. No rework or shutdown of existing critical feeders shall be required during future additions.

- **Energy Efficiency and Sustainability Philosophy**

a) The electrical design shall ensure optimum energy utilization and sustainability across all facilities of the Third Launch Pad Complex, without compromising reliability, safety, or mission continuity.

14. The Consultant shall adopt energy-efficient system design principles covering transformers, motors, lighting, UPS systems, HVAC power distribution, and auxiliary loads, ensuring minimum losses and high power factor.
15. All major electrical equipment — including transformers, motors, and lighting systems — shall conform to the latest Bureau of Energy Efficiency (BEE) guidelines and carry highest efficiency ratings as per IS 1180 (for transformers) and IS 12615 (for motors).
16. Transformers shall be selected with low-loss cores and high-efficiency windings meeting Level-2 energy performance or better as per latest BEE

norms.

17. Motors used in all process and utility applications shall be of IE3 / IE4 efficiency class, designed for continuous operation at rated voltage and frequency, with proper derating for site conditions.
18. Lighting systems shall be entirely LED-based, with a minimum system efficacy of 120 lm/W and life expectancy exceeding 50,000 hours. Intelligent lighting controls using occupancy sensors and daylight sensors shall be implemented wherever feasible.
19. Power factor correction systems shall maintain an overall facility power factor of not less than 0.98 lag, using automatic capacitor banks with detuned reactors to avoid resonance with harmonics.
20. Harmonic mitigation shall be incorporated in design using active or passive filters, K-rated transformers, and isolation transformers to maintain voltage THD < 5% and current TDD < 8% at point of common coupling (PCC).
21. Load optimization studies shall be conducted during design to identify load diversity, eliminate over-sizing, and improve equipment utilization factors. Demand-side management provisions shall be included to minimize idle power consumption.
22. The Consultant shall evaluate life-cycle energy cost of all major systems and adopt configurations that achieve minimum total cost of ownership over a 25-year service life.
23. Wherever technically feasible, renewable or green power options (e.g., solar PV integration, daylight harvesting, or heat recovery systems) shall be studied and their implementation potential documented in the design report.
24. The Consultant shall ensure use of environmentally responsible materials, preferring recyclable, non-halogen, and low-toxicity insulation and cable materials complying with RoHS standards.
25. Energy monitoring and reporting provisions shall be integrated into SCADA and power management systems to enable real-time monitoring of energy usage, efficiency, and power factor trends for each facility.
26. All tender specifications and datasheets prepared by the Consultant shall include minimum energy performance benchmarks and manufacturer data comparison tables for departmental approval prior to equipment finalization.
27. The Consultant shall submit an Energy Efficiency and Sustainability Report summarizing all measures adopted in design, estimated annual energy savings, and compliance with BEE and departmental sustainability objectives.

- **Illumination and Lighting System Design Philosophy**

a) The Consultant shall design complete illumination systems for all Launch Pad support facilities, process areas, auxiliary buildings, internal roads, and open yards, ensuring adequate visibility, operational safety, and energy efficiency during all operating modes.

28. Lighting design shall comply with IS 3646 (Illumination Levels), IS 10322 / IEC 60598 (Luminaires), and BEE energy efficiency guidelines. All lighting calculations shall be performed using DIALux or equivalent software to verify required lux levels, uniformity, and glare control.
29. The illumination scheme shall enhance the aesthetic appeal of each facility while maintaining the required functional lighting levels. Lighting layouts shall ensure uniform illumination, visual balance, and avoidance of glare or shadow zones.
30. The Consultant shall conduct a market survey of reputed lighting OEMs (domestic and international) to identify suitable fittings for each area—indoor, outdoor, process, MCC rooms, and auxiliary spaces—based on lumen output, beam angle, optics, and room usage.
31. Lighting fittings shall be energy-efficient LED type, with minimum efficacy of 120 lm/W and a service life ≥ 50,000 hours (L70). Fittings shall have ingress protection of IP66 (outdoor) and IP54 (indoor) or higher, with corrosion-resistant housings (die-cast aluminium or SS 316).
32. The Consultant shall prepare comparative data sheets and evaluation of various OEMs and models for each lighting category, highlighting lumen performance, optical control, mounting suitability, energy efficiency, and maintainability.
33. Selection of lighting fixtures for each facility shall be carried out in consultation with the Department, based on performance, durability, availability, and aesthetic integration with the facility architecture.
34. Minimum maintained illumination levels shall meet or exceed IS 3646 recommendations:
    i. Control Rooms / operational rooms – 300 lux
    ii. Equipment Rooms / Panels – 250 lux
    iii. Process Platforms / equipment bays – 300–350 lux
    iv. Roads / Open Yards – 70–100 lux
35. Lighting circuits shall be segregated into Normal and EPS sources. Essential and emergency lighting shall be on EPS source. Flameproof fittings shall be used in hazardous areas as per IS/IEC 60079 classification.
36. Lighting controls shall include group switching, occupancy sensors, timers, and SCADA interface for essential circuits, ensuring energy-efficient operation and remote supervision capability.
37. High-mast and street lighting poles shall be hot-dip galvanized or stainless steel, designed for 180 km/h wind speed or as required, with integral earthing, surge protection, and corrosion resistance suitable for the coastal environment.
38. The Consultant shall submit lighting design reports, lux calculation sheets, vendor comparison matrices, layout drawings, datasheets, and BOQs. Final verification shall include lux testing, SPD performance, and

compliance to approved specifications.

- **Special Illumination for Launch Pad lighting**
    1. A dedicated illumination system shall be designed for the Launch Pad to provide both vertical (up to 120 m) and horizontal (up to 100 m) illumination, ensuring adequate visibility during vehicle servicing, surveillance, media coverage, and night operations while maintaining an aesthetic appearance of the pad complex.
    2. The illumination system shall achieve the required lux levels uniformly across the vehicle surface and surrounding working zones, with emphasis on minimizing glare, shadow zones, and reflection interference with optical or camera systems.
    3. Lighting calculations and simulations shall be performed using DIALux / AGI-32, or equivalent softwares to determine optimal luminaire positions, tower heights, aiming angles, and beam distribution ensuring uniform vertical and horizontal luminance.
    4. The illumination fittings shall be high-intensity LED floodlights designed for installation on lightning protection towers or dedicated pad structures (As per the design). Each fitting shall be designed / selected with mounting brackets, aiming devices, and anti-vibration accessories suitable for high-wind (≥ 180 km/h) and lift off vibrations.
    5. The design of each fitting's wattage, optics, and beam spread shall be finalized in consultation with reputed OEMs based on performance, thermal management, ingress protection (minimum IP66), and glare control requirements.
    6. The Consultant shall conduct a market survey and technical benchmarking of similar illumination systems used in stadiums, aerospace launch complexes, and large outdoor industrial installations, and propose suitable configurations for departmental review.
    7. The system shall use asymmetric precision optics to achieve directional illumination of the rocket and pad structures, maintaining visual uniformity while preventing spill light on adjacent process areas.
    8. Color temperature of the luminaires shall be maintained between 4000 K and 6000 K, with CRI ≥ 80, ensuring accurate colour reproduction for surveillance and high-definition media capture.
    9. The Consultant shall perform a location optimization study to determine the most suitable positions and number of lighting towers, considering shadow casting, vehicle geometry, and safety clearances. The study shall include aesthetic renderings of nighttime views of the pad complex.
    10. The illumination system shall include individual and group dimming control, enabling separate operational modes — "Servicing," "Stand-by," and "Launch/Media Coverage" — with control integrated into the pad electrical SCADA system.
    11. All luminaires shall be industrial grade, corrosion-resistant, vibration-tested, and compliant with relevant IS/IEC lighting standards. Aviation obstruction

lighting shall be provided on all tall towers as per DGCA/ICAO requirements.

12. The Consultant shall submit illumination study reports, Dialux/AGI32 simulation results, OEM data sheets, and layout drawings indicating tower positions, luminaire aiming angles, and expected lux contours for departmental review and approval prior to finalization for tender.

- **Earthing and Lightning Protection Design**
  1. The Consultant shall design comprehensive earthing and lightning protection systems for all Launch Pad, Process, and Auxiliary facilities ensuring equipment safety, personnel protection, and effective dissipation of fault and lightning currents.
  2. All earthing systems shall be **dual** redundant — providing two independent, low-resistance paths to earth to ensure continuity of grounding under all operating and fault conditions.
  3. Separate and dedicated earthing networks shall be provided for each type of system and for each facility, including:
     - i. Neutral Earthing (NE): For transformers, UPS isolation transformers, DG/UPS systems as required.
     - ii. Body / Equipment Earthing (BE): For all electrical panels, motors, structures, metallic bodies, and enclosures.
     - iii. Instrument Earthing (IE): For control, instrumentation, and PLC/SCADA reference networks.
     - iv. Dedicated Earthing (DE): For sensitive electronics, communication, and monitoring systems.
     - v. Lightning Protection Earthing (LPE): For all lightning towers, down conductors, and surge protection systems.
     - vi. Static earthing: For static discharges at hazardous environment and as required.
  4. Each earthing network shall be interconnected through equipotential bonding at designated nodes to ensure uniform potential distribution and eliminate step and touch voltage hazards.
  5. Earthing materials shall be selected based on function and durability:
     - i. Copper (tinned) for Neutral and Instrument Earths.
     - ii. Galvanized Iron (GI) for Body and Lightning Earths.
     - iii. Mixed copper–GI interconnections may be used where technically justified, ensuring no dissimilar metal corrosion.
  6. Earthing conductors shall be sized based on fault current calculations, permissible temperature rise, and mechanical strength. Minimum conductor cross-section shall comply with IS 3043 and IEEE 80 standards.
  7. The type of earth electrode system—plate, pipe, or maintenance-free chemical/copper rod—shall be selected during the preliminary design stage based on soil resistivity, corrosion environment, and maintenance considerations.

8. Target earth resistance values shall be:
   i. Power / Body Earth: ≤ 5 Ω
   ii. Instrument / Control / Neutral Earth: ≤ 1 Ω
   iii. Lightning Earth: ≤ 10 Ω or more stringent as required by the Department.
9. The Consultant shall design multi-grid earthing systems for major facilities (e.g., Launch Pad, LOFS, LMFS, NSB, Satellite AC Plant), integrating equipment, structures, and towers to achieve equipotential grounding.
10. Lightning Protection System (LPS) design shall comply with IS/IEC 62305 and IS 2309, considering Department-provided lightning tower parameters. All towers and structures shall be bonded to the main earth grid through dedicated radial conductors.
11. Surge Protection Devices (SPDs) of Class I, II, and III shall be coordinated with the earthing system to ensure low-impedance discharge paths and consistent potential reference for electronic equipment.
12. All earthing risers, pits, and bonds shall be accessible for testing. Identification tags and earthing pit indices shall be provided in the drawings and on-site labels for maintenance traceability.
13. The Consultant shall prepare earthing layout drawings, loop and riser diagrams, typical installation details, and resistance calculation sheets for each facility.
    Design deliverables shall include earthing grid configuration, fault current withstand verification, and lightning protection bonding scheme.
14. All earthing systems shall be designed for long-term reliability, corrosion resistance, and maintainability under high-humidity, saline coastal environmental conditions.

- **Cabling and Routing Design Philosophy**
  1. The Consultant shall design complete power, control, instrumentation, and communication cabling systems for all Launch Pad, Process, and Auxiliary facilities, ensuring safety, reliability, and maintainability under all operational conditions.
  2. The cabling design shall comply with IS 7098 (Part 1/2/3), IS 694, IEC 60502, and relevant IS/IEC/IEEE standards. Cable types, insulation, and installation methods shall be selected based on voltage level, environmental exposure, and functional criticality.
  3. The overall routing shall be planned to achieve logical segregation, ease of maintenance, and clear identification. Cable systems shall be designed to minimize interference, overheating, and mechanical damage.
  4. Segregation of Cables:
     i. Power cables shall be laid separately from control and instrumentation cables.
     ii. Normal, DG, UPS, and EPS supply routes shall be physically segregated.

    iii. Flameproof and non-flameproof circuits shall have separate conduits/trays.
    iv. AC and DC circuits shall not share the same containment.
5. Cables shall be selected as per functional application and as required for the department:
    i. XLPE-insulated, armoured, FRLS type for power circuits.
    ii. HFFR / LSZH type for indoor and occupied spaces.
    iii. Fire-resistant (FR) mica-taped cables for flameproof or hazardous areas.
    iv. Flexible copper cables for motors, vibrating, or movable equipment.
    v. Shielded twisted pair / screened cables for instrumentation and communication lines.
6. The maximum permissible voltage drop shall not exceed:
    i. 3% for lighting circuits,
    ii. 5% for power circuits,
    iii. 1% for control/instrumentation circuits.
7. Cable sizing shall consider derating factors for ambient temperature (up to 50°C), grouping, soil thermal resistivity (approx. up to 250 Ω·m), and installation depth. Current-carrying capacity shall be verified as per IS/IEC guidelines.
8. All redundant feeders (A & B chains) for mission-critical systems shall follow independent physical paths with separate trenches or trays to eliminate simultaneous failure due to fire, flood, or mechanical impact.
9. Underground (UG) cables shall be laid in coordinated trenches with civil layouts. Sand bedding, protective tiles, and route markers shall be provided. Trench drawings shall define cable spacing, separation barriers, and identification markings.
10. Above-ground routing shall use cable trays (HDG steel / SS 316 / FRP as applicable). Tray design shall ensure 30% spare capacity for future expansion and be properly supported with corrosion-resistant fittings and earthing continuity bonds.
11. Cable entries into buildings or panels shall be sealed using fire-rated cable entry systems (as per IS 12459 / IEC 60332) to prevent smoke and gas ingress between compartments or hazardous zones.
12. Hazardous area cabling shall use double compression flameproof glands, barrier seals, and explosion-proof junction boxes in compliance with IS/IEC 60079-14 and departmental safety requirements.
13. Optical Fiber Cables (OFCs) for SCADA and communication networks shall be laid in HDPE conduits or ducts with minimum bending radius, proper spacing, and pull-boxes at defined intervals.
14. Cable routing and support systems shall be designed considering aesthetic and operational requirements, ensuring concealed or neatly arranged runs in visitor and control areas without obstructing movement or equipment

access.

15. Cable identification and tagging shall follow IS 5578 / IS 11353, using permanent ferrules and stainless-steel tags at both ends and all junctions. Each cable shall be traceable in the cable schedule and route drawings.
16. Cable glands, lugs, and terminations shall conform to IS 12943 / IS 8309 and be of appropriate material (brass, SS, or tinned copper) as per installation location and fault level.
17. The Consultant shall prepare and issue detailed design documentation, including:
    i. Cable schedules and interconnection diagrams.
    ii. Route layout drawings with trench/tray cross-sections.
    iii. Termination details and gland/conduit schedules.
    iv. Voltage drop, short-circuit, and ampacity calculation reports.
18. Cable routing near the Launch Pad shall be planned to avoid blast zones, heat radiation areas, or mechanical stress points and shall incorporate suitable thermal and fire protection measures.
19. Cable earthing and screening shall be designed as per system configuration—single-end or both-end earthing for control cables—to minimize induced noise and circulating currents.
20. All cable networks shall be designed for 25 years of service life in coastal, saline, and high-humidity environments, ensuring long-term reliability and minimal maintenance.

- **Power Quality, Harmonics, and Surge Protection Philosophy**

1. As the most of modern electrical systems like VFD drives, LED based lights and etc are nonlinear in nature, the consultant shall ensure that all electrical systems are designed to maintain stable voltage, frequency and harmonic levels suitable for the sensitive control, process, and launch-pad equipment under all loading and supply conditions.
2. The electrical network shall comply with IEEE 519 limits for total harmonic distortion (THD ≤ 5 % for voltage, TDD ≤ 8 % for current at PCC) or stricter limits as specified by the department.
3. A comprehensive power quality study shall be conducted using approved software (ETAP / DIgSILENT / equivalent) to analyze voltage regulation, harmonic distortion, flicker, transients, and unbalance under normal, DG, and UPS modes.
4. The Consultant shall identify all non-linear loads (VFDs, UPS systems, converters, SMPS, DC supplies, servo drives, etc.) and evaluate their individual and combined impact on network power quality.
5. Appropriate harmonic mitigation techniques shall be adopted, including:
    i. 12-pulse or 18-pulse rectifier configurations for UPS/VFD systems.
    ii. Active or passive harmonic filters (tuned or broadband).
    iii. K-rated / isolation transformers for sensitive loads.
    iv. Line reactors or DC link chokes as required.

6. Separate feeders and busbars shall be designated for “clean power” (instrumentation / SCADA) and “raw power” (VFD / heavy mechanical loads) to limit harmonic propagation across systems.
7. The overall system power factor shall not fall below 0.98 (lag) under normal operation. Automatic Power Factor Correction (APFC) systems shall be provided at LT/MV levels with detuned reactors to avoid resonance with prevailing harmonics.
8. The Consultant shall design and specify voltage stabilization and regulation systems (AVRs / servo stabilizers / static VAR compensators) where critical loads demand tight voltage tolerance (± 2 %).
9. A three-stage Surge Protection Coordination shall be adopted in compliance with IEC 61643 and IS 15086:
    i. Class I SPD at incomer / main panels (lightning discharge).
    ii. Class II SPD at distribution and sub-distribution boards.
    iii. Class III SPD at equipment and control level for fine protection.
10. SPDs shall be metal-oxide varistor type or hybrid protection class, capable of handling expected impulse currents, with status indication and replaceable cartridges.
11. Surge and lightning protection systems shall be bonded to the earthing network through short, low-inductance paths to ensure a common reference potential and safe dissipation of transient energy.
12. Sensitive electronic and communication equipment shall be protected through Transient Voltage Surge Suppression units and isolation transformers at local distribution points.
13. The Consultant shall perform transient and harmonic simulations to verify system behavior during source changeover (Normal↔DG↔UPS), motor starting, and lightning events, ensuring no adverse impact on sensitive electronics.
14. Continuous power quality monitoring shall be integrated through multifunction meters and SCADA data points at key distribution nodes to record parameters such as THD, voltage flicker, PF, and transient events.
15. The Consultant shall prepare a Power Quality and surge protection report, summarizing the harmonic analysis, mitigation strategy, SPD coordination levels, and compliance verification plan for departmental review and approval.

- **SCADA, Automation, and Remote Operation Philosophy**
    1. The Consultant shall design a comprehensive SCADA and Automation system for all electrical networks under this RFP, ensuring centralized monitoring, control, and diagnostics for Launch Pad, Process, and Auxiliary facilities as required for the department.
    2. The system shall be fully compatible to integrate with the department’s existing and upcoming Central SCADA implemented under the Substation scope, following the same communication standards, protocols, and OEM

platform.

3. The automation architecture shall be organized in three layers:
    i. Field Level: Intelligent devices (IEDs), smart relays, and field sensors.
    ii. Control Level: PLCs, RTUs, and remote I/O modules.
    iii. Supervisory Level: SCADA servers, HMI stations, engineering consoles, and historian nodes (if required other than available servers / consoles at substation).
4. All PLCs, IEDs, and communication devices shall be industrial grade, supporting open protocols (IEC 61850, IEC 60870-5-104, Modbus TCP/IP) and be compatible with the substation automation framework.
5. The SCADA network shall employ dual redundant architecture — dual LANs (PRP/HSR or RSTP), redundant switches, dual servers, and redundant PLC processors to ensure no single-point communication or control failure.
6. Fiber-optic backbone communication shall be used between facilities and the central control complex through substation SCADA network designed for redundant ring/ radial topology
7. All electrical switchgear, ACBs, MCCBs, UPS systems, and PCC/ MCC panels shall have communication-ready interfaces for data exchange with the local and central SCADA systems.
8. SCADA shall monitor and control major electrical equipment and parameters including:
    i. Breaker status, command, load current, voltage, PF, energy, and frequency.
    ii. Transformer parameters and RTD inputs.
    iii. UPS distribution system health monitoring
    iv. Lighting control, exhaust, and emergency system controls where ever applicable.
    v. The control hierarchy shall follow three levels of command authorization:
        1. Local manual control at field panels.
        2. Remote facility-level SCADA control.
9. The system shall support time-synchronized event recording and sequence-of-events (SOE) with accuracy better than 1s using NTP/GPS-based time synchronization across all devices (where ever feasible and required).
10. All logic, interlocks, and sequencing for auto-transfer, protection, safety shutdowns, and emergency switching shall be implemented in PLC/RTU hardware with software interlocks in SCADA as supervisory control only.
11. Alarm and Event Management shall be structured with criticality levels (Critical, Major, Minor) and allow grouping, filtering, and historical logging for easy fault analysis.
12. The Consultant shall develop functional logic diagrams, cause-and-effect

matrices, and interlock schedules for all power transfer, UPS changeover, and safety shutdown sequences.

13. Cybersecurity provisions shall be incorporated at all network levels, complying with IEC 62443 and IEC 62351, including VLAN segregation, firewall protection, role-based user access.
14. All SCADA servers, switches, and panels shall have dual power supplies fed from UPS-backed circuits to maintain availability during grid or DG transitions.
15. The Consultant shall prepare the following design deliverables as part of SCADA documentation:
    i. SCADA architecture and communication topology diagrams.
    ii. I/O allocation sheets and data point lists.
    iii. Communication interface requirement details.
    iv. Cybersecurity and redundancy philosophy documents.
    v. Alarm and event matrix with tag definitions.
16. The system design shall ensure scalability for future addition of new process or electrical loads, allowing new PLC nodes and communication devices without major reconfiguration.
17. All designs, protocols, and I/O mapping shall be reviewed and approved by the department to ensure full compatibility with the central control infrastructure before inclusion in tender documents.
18. The SCADA system shall ensure continuous visibility, commandability, and data integrity of all mission-critical electrical systems, enabling safe and coordinated operation during all phases of launch and process activities.

- **Flameproof and Hazardous Area Electrical Design Philosophy**
    1. The Consultant shall design all electrical systems in hazardous and explosive atmospheres in compliance with IS/IEC 60079 series ensuring complete safety and integrity of electrical installations in propellant and gas-handling areas.
    2. The Consultant shall prepare a Hazardous Area Classification report identifying all hazardous zones (Zone 0, Zone 1, Zone 2) based on the process, gas types (e.g., LH_2, LOX, LN_2, CH_4), gas group (IIB/IIC), and temperature class (T3/T4) as required and recommended industrial practices.
    3. Tentative area classification

       Various facilities are classified as below in order to facilitate selection of equipment in these areas. The classifications are hazard zone as per IEC 60079, BIS – 5572, Flame proof group as per BIS – 2148, temperature classification as per BIS 8239

Sl.no	Facility	Area Classification
1	**Launch Pad infrastructures and mechanical systems**	
1.1	Tiltable UT (TUT)	Flameproof, Exd Zone 1 IIC

1.2	Mobile Launch Pad(MLP)	Flameproof, Exd Zone 1 IIC
1.3	Bogie System	Flameproof, Exd Zone 1 IIC
1.4	Lightning Protection Tower	Non-Flameproof
1.5	JDD	Flameproof, Exd Zone 1 IIC
1.6	Rail Track	Non-Flameproof
1.7	NSB	Non-Flameproof
1.8	VCR	Flameproof, Exd Zone 1 IIC
1.9	VCB	Flameproof, Exd Zone 1 IIC
2	**Process facilities**	
2.1	Liquid Hydrogen Filling System (LHFS)	Flameproof, Exd Zone 1 IIC
2.2	Liquid Methane Filling System (LMFS)	Flameproof, Exd Zone 1 IIB
2.3a	Liquid Oxygen Filling System (LOFS)	Vapour Tight
2.3b	Vacuum Systems	Non-Flameproof
2.3c	Nitrogen Supply System	Non-Flameproof
2.4	Gas Storage and Servicing Facility (CGSS)	Non-Flameproof
2.5	Air separation unit (ASU)	Non-Flameproof
3	**Safety facilities**	
3.1	GLR	Non-Flameproof
3.2	Acoustic suppression system	Non-Flameproof
4	**Auxiliary or support systems**	Non-Flameproof
4.1	AC Plants	Non-Flameproof
4.2	Substation	Non-Flameproof
4.3	Overhead tank and Bore wells	Non-Flameproof
4.4	Water Treatment Plant	Non-Flameproof
4.5	RO and Safety facility	Non-Flameproof
4.6	Security facilities	Non-Flameproof
4.7	Maintenance and storage (if any)	Non-Flameproof
4.8	Calibration lab (if any)	Non-Flameproof
5	**Control Center**	
5.1	FCC	Non-Flameproof
6	**Future**	
6.1	ISROSENE	Flameproof, Exd Zone 1 IIB
6.2	Crew Access Tower**	Non-Flameproof

Note: The above list is tentative only.

4. All electrical equipment located within hazardous zones shall be selected with appropriate flameproof (Ex-d), increased safety (Ex-e), pressurized (Ex-p), or intrinsically safe (Ex-i) protection type as per area classification and process requirement and department safety guidelines.
5. The Consultant shall conduct a market survey of approved OEMs for Ex-rated equipment (lighting, junction boxes, motors, control stations, cable glands, fittings, and panels) and finalize models in consultation with the

Department.

6. Each selected equipment shall have valid PESO / ATEX / IECEx certification and comply with applicable protection class, ingress protection (minimum IP66), and corrosion-resistant construction (SS316 / epoxy-coated aluminium).
7. Cable glands, junction boxes, and fittings in hazardous areas shall be of double compression type with flameproof certification and brass or stainless-steel hardware.
8. Cables in hazardous zones shall be FRLS type, armoured, and sealed with barrier-type glands at equipment terminations to prevent gas migration through cable cores.
9. Segregation shall be maintained between hazardous and non-hazardous area circuits using isolating barriers, intrinsically safe relays, and independent cable trays or conduits.
10. The earthing system in hazardous zones shall ensure equal potential bonding between all conductive parts, including equipment bodies, trays, pipelines, and structures — with separate earthing networks for power and instrumentation.
11. Flameproof lighting, switches, and sockets shall be designed for the ambient environment (50°C, high humidity, saline conditions) and shall have corrosion-resistant mounting accessories.
12. Purged/pressurized enclosures (Ex-p) may be adopted for large electrical panels installed near semi-hazardous areas, designed as per IEC 60079-2.
13. The Consultant shall design hazardous area cabling and containment systems with proper segregation, sealed entries, and mechanical protection to ensure maintainability without reclassification of zones.
14. A hazardous area equipment list shall be prepared listing each electrical item with tag number, zone classification, gas group, temperature class, protection type, and certification details.
15. The Consultant shall define and document an Inspection, Testing, and Maintenance Plan (ITP) for hazardous installations as per IEC 60079, covering type tests, routine and acceptance tests at OEM premises and at site as required.
16. Interface coordination shall be ensured with process, mechanical, and safety teams to integrate electrical design with gas detection, ventilation, and fire protection systems.
17. The Consultant shall ensure that no non-certified equipment is proposed in hazardous zones and that all transition boundaries are clearly marked in layout and drawings.
18. Documentation deliverables shall include hazardous area classification report, Zone Drawings, Ex-equipment datasheets, selection of items criteria's, ITP, and compliance certificates requirements for all Ex-rated equipment.

- **Design Implementation, Quality and Documentation Philosophy**
    1. The Consultant shall establish and maintain a comprehensive Quality Management System (QMS) in line with ISO 9001, ensuring complete traceability, verification, and approval control for all design deliverables related to electrical systems.
    2. A Design Basis Report (DBR) shall be submitted at the beginning of the assignment, summarizing standards, assumptions, philosophies, and inputs forming the foundation of all electrical design activities.
    3. All designs shall comply with CEA Regulations and internal departmental approval frameworks for safety, reliability, and maintainability of electrical systems.
    4. The Consultant shall carry out system-level design studies (load flow, short-circuit, voltage drop, reliability, protection, harmonics, arc-hazard) and submit detailed analysis reports.
    5. Interdisciplinary design coordination shall be ensured at every stage through consolidated 3D/CAD layouts and model reviews, avoiding any civil, process, or mechanical clashes.
    6. A structured Quality Assurance Plan (QAP) and Inspection & Test Plan (ITP) shall be prepared for all major and minor electrical equipment, specifying witness points, FAT/SAT requirements, and acceptance criteria.
    7. Vendor documentation review shall include technical datasheets, type test certificates, material certificates, and compliance checklists to ensure conformity with tender specifications.
    8. The consultant shall maintain a design review and change control register, capturing all departmental comments, revisions, and approvals with full traceability to drawing/document numbers.
    9. A Compliance Matrix shall be maintained throughout the design stages to ensure conformance with IS, IEC, IEEE, and CEA standards referenced in this RFP.
    10. Safety verification shall be a part of every review milestone, ensuring that clearances, interlocks, fail-safes, and protective systems comply with design intent and statutory safety norms.
    11. Cybersecurity design validation shall be carried out for all SCADA and communication-linked electrical systems as per IEC 62443, including role-based access and network isolation principles.
    12. The Consultant shall prepare Commissioning and Test Procedures defining checks, verifications, and energization sequences for various systems, including Normal, DG, UPS, and EPS networks.
    13. Upon project completion, the Consultant shall deliver a full As-Built Documentation Package — including drawings, test reports, operation and maintenance manuals, cable schedules, relay settings, and asset tagging.
    14. All design documents shall include a traceability statement, linking them to DBR (Design Basis Report) sections, departmental comments, and QAP

reference points for easy audit and verification.

15. The consultant shall prepare all required documents towards approval of CEA and central level department for charging all the electrical systems.
16. Prepare and submit operation and maintenance procedure documents shall be submitted.
17. Provide list of critical spares and commissioning spares.
18. The Consultant shall ensure that all the document are submitted for ready to documents for department.

8.8 Electrical Design Deliverables

- All electrical design deliverables shall be prepared and submitted in a systematic and uniform manner ensuring accuracy, clarity, and compliance with applicable IS, IEC, IEEE standards and CEA regulations along with department guidelines.
- The Consultant shall be fully responsible for the technical adequacy, completeness, and interdisciplinary coordination of all electrical design drawings, documents, and studies prepared under this RFP.
- The design shall meet all functional requirements of the launch pad, process, and auxiliary facilities, ensuring reliability, redundancy, maintainability, energy efficiency, and aesthetics suitable for the mission environment.
- All designs shall include provision for integration of electrical systems with department's SCADA, DDC, and automation systems to ensure interoperability and centralized monitoring.
- Only licensed and recognized engineering software such as ETAP, DIgSILENT, AutoCAD, ePLAN, DIALux, or equivalent shall be used for all studies, calculations, and drawings. Software versions and licenses shall be valid and available for department verification if required.
- All drawings shall be prepared in AutoCAD or equivalent format using standard title blocks with drawing number, revision, facility name, designer, checker, and approval fields. Symbols, scaling, and notations shall follow IS and IEC drafting standards.
- All reports and calculations shall clearly state input data, design assumptions, methodology, formulae, references, and conclusions. Supporting data and intermediate results shall be retained for verification.
- Electrical design documentation for each facility shall include, as applicable:
    1. *Power system architecture and feeder configurations.*
    2. *Load estimation and equipment sizing.*
    3. *Cable and earthing system design.*
    4. *Illumination system design for indoor, outdoor, and process areas.*
    5. *Lightning and surge protection design.*
    6. *Electrical room and cable routing layouts.*
    7. *Interface drawings with HVAC, process, and safety systems.*
    8. *Hazardous area classification and selection of explosion-proof equipment.*
    9. *Single-line diagrams, protection coordination, and interlocking schemes.*
    10. *Redundancy, power-quality and energy-efficiency provisions.*

11. *Safety, environmental, and statutory compliance.*
12. *System studies including load flow, short-circuit, voltage-drop, harmonics, and reliability analysis.*

- All deliverables shall be issued progressively for each design phase and reviewed by the department before proceeding to subsequent stages. Review comments shall be incorporated promptly and resubmitted with a clear revision index and document transmittal sheet.
- All submissions shall maintain proper revision control, version management, and document traceability throughout the project duration. Consultant shall maintain a Deliverable Register updated at each submission.
- All drawings, reports, BOQs, and studies shall undergo internal quality checks and peer review by the Consultant before submission to the department. Quality records of such checks shall be maintained.
- Deliverables shall be submitted both in editable soft copies and five sets of hard copies. Reports, BOQs, and calculations shall be in MS Office or PDF format, while drawings and studies shall be in AutoCAD, ETAP, DIALux, or equivalent formats as applicable.
- Consultant shall conduct regular interface reviews with other disciplines to ensure that electrical layouts, cable routes, trenches, foundations, and sleeves are properly coordinated with civil and mechanical drawings.
- All electrical design documents and drawings shall be prepared in full compliance with the latest CEA Regulations, statutory requirements, and departmental guidelines. The documentation shall be structured to support internal review, verification, and approval processes of the Department and other statutory authorities as applicable.
- All deliverables shall meet department’s standards of quality and completeness; incomplete or non-compliant submissions shall be returned for correction without affecting delivery milestones.
- **Under Phase I of design**
    1. Consultancy team shall study and understand all Launch Pad infrastructure systems, Process Systems, and Auxiliary Facilities, including their operational philosophy, sequence of operations, and interlocks as defined in other sections of this RFP.
    2. The electrical design team shall coordinate closely with Process, Civil, Mechanical, HVAC, and Instrumentation teams within the consultancy to understand all system requirements, equipment locations, and load classifications before initiating electrical design activities.
    3. After obtaining the operational philosophy and configuration of each facility from the concerned discipline teams and Department inputs, the consultant shall initiate the conceptual and preliminary electrical design ensuring reliability, maintainability, safety, and compatibility with process operations.
    4. The consultant shall perform market study of latest available products and technologies (for switchgear, transformers, UPS, cables, fittings, etc.) suitable for process and hazardous environments and propose preliminary equipment concepts for Department’s approval.
    5. Study of HVAC loads, process equipment loads, and mechanical drive

systems shall be carried out to determine total power demand, diversity factors, and redundancy requirements for each facility.

6. Completion of Phase–I shall be considered upon approval of the Final PDR documentation package by the Department, which will form the base for commencement of Phase–II (Detailed Design).

- **Under Phase II of design**
  - a) Phase II shall commence after approval of the Preliminary Design (PDR) and shall focus on detailed design, equipment sizing, and preparation of tender-ready engineering documents for all Launch Pad, Process, and Auxiliary Facilities.
  - b) Consultant shall develop the complete detailed design package incorporating all approved PDR concepts, departmental review comments, and inter-disciplinary coordination with Civil, Mechanical, HVAC, Instrumentation, and Automation teams.
  - c) All designs shall strictly comply with the finalized redundancy, segregation, and fail-safe philosophies ensuring uninterrupted power to all mission-critical systems.
  - d) All designs shall ensure full compliance with the mission-critical redundancy philosophy finalized in Phase I, including physical segregation, fail-safe operation, and continuity of power to all critical systems during launch or process activities.
  - e) Electrical design consultant shall verify the required room layouts, clearances, and dimensional requirements to the Civil and Structural design teams to ensure that all necessary provisions—such as equipment footprints, trenches, routings and maintenance spaces—are incorporated in the civil and architectural drawings.

<u>Phase I: Preliminary Design Deliverables</u>

The following documents / deliverables shall be prepared and submitted in accordance with the specifications of electrical portion of this RFP

- **System Study Input Report** summarizing all facilities, load assumptions and inputs from various process and launch pad infra facilities
- **Preliminary Design Basis Report** covering scope, philosophies, assumptions and applicable standards.
- **Facility-wise load list** with connected, demand, and diversity factors.
- **Criticality Matrix and critical load identification report** identifying mission critical, critical and non-critical loads to identify the redundancy philosophy.
- **Preliminary Single-Line Diagrams (SLDs)** for all facilities and interconnections.
- **Conceptual level power system studies** (load flow, short-circuit, voltage-drop).
- **Redundancy and auto-changeover concept** eliminating single-point failures based on criticality matrix.
- **Preliminary Hazardous Area Classification Report** and selection of electrical Equipment.
- **Preliminary Earthing schematics** with dual earthing for all Equipment.

- **Preliminary design report on Lightning** and Surge Protection coordination.
- **Preliminary Cable selection criteria and voltage drop calculation** for all the facilities and Routing & Segregation Concept including trench/tray strategy.
- **Preliminary layouts** of all the Equipment, PCC/MCC panels and etc. to arrive room dimensions and safety margins.
- **Preliminary Equipment Room & Panel Layouts** for all the facilities and HT rooms at facilities as specified.
- **Preliminary Lighting and Illumination design report**
- **Special illumination study report for pad lighting** as per the specifications.
- **Identification of non-linear loads and preliminary harmonic mitigation options.**
- **Initial protection and coordination philosophy** with relay types and grading intent.
- **Preliminary SCADA/automation interface** list and communication protocol outline.
- **Preliminary BOQ and Cost estimates** as required.
- **Market survey and OEM comparison sheet** for all major Equipment
- **Preliminary reliability/FMECA analysis** for mission-critical systems.
- **QAP and ITP plans** to incorporate in the tenders
- **Preliminary Design Package (PDR) – reports, drawings, studies, and presentation and shall consist minimum of**
  a) Estimation of Electrical Load requirements of a building or system.
  b) Detailed Engineering calculations to support the design, such as load calculations, voltage drop calculations, short circuit calculations, Arc flash studies and circuit protection coordination for each feeder and equipment etc.
  c) Determine appropriate size and specifications for various electrical components and systems and Detailed technical drawings.
  d) Single line diagram for overall electrical system from sub-station to various facilities and also within the facilities from MV panel.
  e) Electrical load summary for individual facilities i.e. Equipment loads, lighting load, A/C loads etc. Electrical equipment layout drawing for the entire facility including distribution drawings, schemes.
  f) Design of electrical system and specifications of major electrical Equipment, components like TUT Hydraulic actuator system and Hydraulic jacking system for wheel bogie system and any other system as per the scope mentioned in this document.
  g) Sizing of electrical equipment, cables, transformers etc.
  h) Electrical cable layout and cable schedule.
  i) Testing requirements.
  j) Interfaces with civil, A/C and other disciplines.
  k) Voltage drop studies and analysis, fault level calculation
  l) Redundancy design, protection and study of single point failures

Phase II: Detailed Design Deliverables

The following documents and drawings shall form the Detailed Design Deliverables to be submitted for department review comments.

- **Final Design Basis Report** incorporating approved philosophies, standards, and assumptions.
- Detailed **power system study reports** – load flow, short-circuit, voltage drop, motor starting, and fault analysis.
- **Protection coordination and relay grading** report ensuring selectivity and discrimination.
- **Reliability and FMECA verification** report achieving ≥ 99.99 % availability for mission critical systems.
- **Equipment sizing and rating sheet** for transformers, switchgear, MCCs, UPS, batteries, and earthing conductors.
- **Cable sizing, ampacity, and voltage-drop calculation** report with thermal and derating considerations.
- **Detailed earthing and lightning protection layouts** with pit indexing, conductor sizing, and equipotential bonding.
- **Final illumination design report** with DIALux / AGI32 analysis and lux-level verification for all areas.
- **Special launch-pad illumination study** with lighting placement and fitting wattage optimization.
- **Hazardous-area classification drawings** and equipment selection schedule with Ex-certification details.
- **Electrical room, HT / LT panel room, and cable trench general-arrangement drawings** for all facilities.
- **Final Single-Line Diagrams** with protection settings, interlocks, and redundancy configurations.
- **Control and power schematic diagrams**, wiring terminations, and interlocking logic drawings.
- **Cable routing, tray schedules, trench sections**, and inter-facility connectivity layouts.
- **Distribution-board schedules** with load balancing, feeder numbering, and circuit segregation.
- **Power, UPS, and EPS segregation drawings** with dual-feeder and changeover arrangements.
- **Earthing and bonding layouts** for hazardous and non-hazardous zones.
- **Lightning protection integration drawings** coordinated with earthing grid.
- **SCADA and automation network topology diagrams** with I/O allocation, signal list, and protocol matrix.
- **Functional logic diagrams and cause-and-effect charts** for auto-transfer and interlock sequencing.
- **Interface drawings** with civil, mechanical, HVAC, and instrumentation disciplines
- Final BOQ covering equipment, cables, earthing, and lighting systems for tendering.

- Equipment data sheets, material specifications, and Guaranteed Technical Particulars (GTPs).
- Quality Assurance Plan (QAP) and Inspection / Test Plan (ITP) including FAT / SAT formats.
- Complete tender specifications, scope of supply, and technical conditions for all electrical packages involved in the various tenders under this design RFP.
- **Price schedule templates** and technical evaluation criteria for procurement stage.
- Compliance verification report against IS / IEC / CEA standards and Departmental safety norms.
- **Energy-efficiency and power-quality compliance report** including harmonic and PF correction validation.
- Earthing-grid potential-rise and step-/-touch potential analysis report as per IEEE 80.
- **Design-validation checklist** for maintainability, clearances, and accessibility of all installations.
- Detailed Design Review presentation package for Departmental evaluation.
- “Ready for Tender” drawings and documents.
- Final tender-ready detailed electrical design package including all reports, drawings, BOQs, and specifications.
- Cost summary and item wise technical documentation forming the Electrical Section of the Project Tender documents as required.
- As-built electrical design database in editable format for record and future reference.
    a) Estimation of Electrical Load requirements of a building or system.
    b) Switch gear single line diagram.
    c) Short circuit calculations and voltage drop calculations.
    d) Preparation of logic diagram and interlock diagrams.
    e) Inter panel connection diagram.
    f) Electrical cable tray and trenches layout.
    g) Emergency power layout.
    h) Grounding system design and drawings.
    i) Electrical loop sketches.
    j) Cabling and inter connection schemes between various facilities.
    k) Selection of painting scheme and application procedure.
    l) Energy efficient solutions for optimizing the energy consumption and reliable power with high MTBF.
    m) Ensuring the safety & compliances designs adhere to relevant electrical codes and standards.

8.9 System Studies, Analysis, and Design Verification

- The Consultant shall carry out comprehensive electrical system studies and analyses using licensed professional software tools (ETAP, DIgSILENT Power Factory, MATLAB, or equivalent) to validate the adequacy, reliability, and safety of all electrical designs.
- The studies shall include, but not be limited to, the following:

Sl.no	System Study / Analysis	Purpose / Outcome
1	Load Flow Analysis	Determine voltage profiles, power factor, and system losses under steady-state and contingency conditions.
2	Short-Circuit Studies	Establish maximum and minimum fault levels at all buses; define breaker and relay ratings.
3	Voltage Drop Calculations	Verify compliance with voltage regulation limits for all feeders and distribution circuits.
4	Motor Starting Analysis	Assess voltage dips and starting transients for large induction motors and synchronous drives.
5	Protection Coordination Study	Ensure discrimination and selectivity among protective devices; prepare relay coordination curves.
6	Arc Flash Energy Analysis	Evaluate incident energy and define PPE categories, arc labels, and safety distances as per IEEE 1584.
7	Harmonic Analysis	Quantify total harmonic distortion (THD) and validate the effectiveness of harmonic filters.
8	Transient and Switching Surge Study	Evaluate surge levels during DG synchronization, UPS transfer, and large load switching.
9	Reliability and FMECA Analysis	Quantify system availability and mean time between failures (MTBF) for critical power paths.
10	Earthing Grid Potential Rise & Step/Touch Analysis	Simulate ground potential distribution during faults using IEEE 80 methodology.

- All study results shall be documented in standalone reports with clear input data, model assumptions, case simulations, results, and design recommendations.
- Consultant shall update studies as the design evolves, ensuring that final ratings and relay settings are validated during the detailed design stage.
- All study reports shall be submitted to the Department for review and approval before finalizing the tender specifications.

8.10 Other design philosophy considerations

- Substation to cater the high demand arising out of air-conditioning, lighting and equipment load with parallel redundant scheme for each facility.
- Adequate redundancy shall be incorporated throughout the power distribution. One feeder fails/one transformer fails/one DG fails / one UPS fails then other

feeder should take over the loads within a stipulated change over time. For critical applications, loss of power is not acceptable.

- Electrical safety and Protections need to be incorporated in the design and implemented in the circuits for personnel and equipment safety as per standards. The protection grading need to be studied using software simulations and then arrive at the selection of relay and its setting so as to trip the downstream panel first near to the load end.
- All electrical equipment should have safety interlocks both mechanical & electrical with fail-safe operations to be followed in the circuits.
- All electrical equipment and items need to withstand for saline atmosphere/ Sea shore environment and ambient temperature of 50 deg Centigrade with 99%of RH.
- All cables / wires shall be minimum flame retardant and halogen free or better type cables to be considered to meet the usage of each facility as per the safety norms.
- The UG cables are XLPE insulated or special cables with multi stranded aluminium and copper conductors (armored & unarmored). All cables which are used inside the facility are copper only and the insulation and sheaths shall be suitable to various applications in each facility.
- Cable trench/ cable vertical shaft/ cable trays/ cable tray in the false floor /cable tray in the false roof/ cable entry to the facility/Hume pipes with manhole provision for cable crossings/ cable entry in the hazardous area / steel infill access floor in the panel rooms are envisaged.
- Insert plates and embedment plates shall be considered for light fittings, cable trays, cable trenches, exhaust fans with louvers, air-circulators, Power outlets etc.
- Civil foundations for panel floors, trenches, high mast and earth pit skirts etc to be considered.
- Panel room entry shall be outside of the facility only and the height shall be minimum three-meter height.
- The size of the rooms for Transformers/ Isolation transformers, HT panels, LT/MV panels, bus ducts to be arrived based on the capacity of the panels, heat dissipation, sufficient space for maintenance, easy replacement & expansion. Equipment & personnel safety and future expansion of the Equipment etc shall be followed as per IE rules, CEA norms and latest standards.
- Minimum two times the rating of arrived full load for the feeder’s, switchgears and other power components to be considered.
- Dedicated iMCC and VVVF drive panels for various mechanisms and process equipment are envisaged if required.
- All motors shall be class F insulation and temperature rise shall be limited to class B or better. Special coating like non-hygroscopic coatings, suitable for operation near sea shore environment.
- For all motor are to be selected for VVVF dual drive applications with protective panel if required.
- Special equipment’s like isolation transformer, active and passive filters are required for harmonics suppression at load end and substation level. Maintain the Power quality for entire plant as per standards.

- Surge protection devices to be incorporated in the circuit for utility and sub secondary levels.
- Isolated barriers to be incorporated by bifurcating hazardous and non-hazardous locations if required.
- All electrical equipment used in the hazardous area should be explosion proof / flame proof equipment or intrinsic safe circuits for control.
- All light fittings shall be of high energy efficient and aesthetic. The building management shall be considering for saving energy.
- Unique illumination system for Launch pad area and the system shall have both vertical (~120m) and horizontal (~110m) illumination to maintain the proper LUX level during servicing of the vehicle for meeting the requirement of surveillance, media coverage and aesthetic. The illumination system calculation shall be carried out by using latest software's like DIALUX and AGI32.
- Facilities having storage tank bay, evaporator's, Gas analyzer, over flow pressurization tank bay and storage tank pit, cylinder bay, pipe line yard and vent, control rooms, electrical panel rooms, bunker, road & track, high raised structures and security facilities etc requires sufficient Illumination design and selection is based on the software calculations/ simulations. Based on the results, suitable fittings are to be used for various environment (hazardous&non-hazardous) and applications.
- Aviation illumination system for high raised facilities like lightning protection (4 towers with 180m height) and where ever applicable as per latest ICAO regulations. Power distribution for electronics equipment and aviation light fittings in different levels of lightning protection towers to be carried out. And also considered for high raised facilities in the project.
- Power outlets shall be considered for different capacities and different locations in each facility for various equipment and along the pipe lines, rail track and high raised towers etc. The selection of the Power outlets shall be suitable for various applications.
- Automation for both external and internal electrification is envisaged with suitable SCADA. Remote commanding, monitoring & logging provision to be provided. The control, monitoring and data logging of substation & facility level parameters need to be extended to remote location (12km away from the launch pad site).
- Isolated and non-isolated/integral/mesh/cone of protection lightning protection system for each facility to be considered.
- Grid Earthing, grounding and shielding to be followed for various equipment used in substation and facility are:
- Separate Earth Pit for Body /power, Static Earth Pit for Storage Tanks & pipes / personnel, Instrumentation pit for low-power instrumentation, safety pit for pyro equipment, lightning pit for lightning Protection, neutral pit for transformers and isolation transformers. The Transient Earth Clamp shall have connected to each earth pit with reference earth pit.
- Substation earthing equipment and its associated systems to be considered for personnel and equipment protection.
- Special earthing to maintain equipotential for entire Launchpad area using counterpoise have ring and radial type earthing with double layer strip interconnections with exothermic bonding and especially for lightning protection for launch pad.

- Preparation of technical reports such as single/one-line diagrams, schematic diagrams, GA drawings, power flow analysis, ampacity calculations, short circuit & Arc studies, voltage drop calculations, reliability analysis (FMECA), protection coordination and grounding analysis etc using different software's like CAD, ePLAN, ETAP, MATLAB etc. Maintenance manuals, procedures and check list for the electrical equipment in substation and facility levels.
- Generation of factory & site acceptance test reports and QA plans as per relevant standards with latest amendments, as built documents, selection of the equipment, procedures for execution of electrical equipment and CEA approval documents.
- Preparation of substation layouts, SLDs, equipment layouts, GA drawings, schematic drawings, auto changeover schemes, Automation architecture for Power control, monitoring and logging, Illumination drawing layouts, Cable routing drawing layouts, Cable tray drawing layouts, earthing drawing layouts, lightning protection drawing layouts, maintenance procedures for various equipment in substation and each facility.
- For all the sub-systems of the door, suitable approaches need to be provided both for operation and maintenance.
- Effective guards shall be provided for all the rotating parts. All electrical equipment should be properly guarded for protection against accidental contact.

8.11 Electrical loads and tentative requirements at each facility

- The Load details requirements indicated for each facility in the following tables are tentative and represent the minimum anticipated quantities. During detailed engineering, the Consultant shall assess and incorporate any additional electrical systems, equipment, or quantities necessary to meet the complete functional, operational, and safety requirements of the project. All such additions, whether explicitly mentioned or not in this RFP, shall be duly included in the design documents, BOQs, and tender specifications to ensure full compliance with the overall project scope defined herein.

Tiltable Umbilical Tower

#	Description	Specification
1.	MVP	Power Distribution for the equipment
	UPS Panels	Power Distribution for the instrumentation and control system
	Distribution Boards	Power Distribution for illumination Power outlets
2.	iMCCs Drives	Suitable for hydraulic systems
3.	Machine/Equipment	Hydraulic System
4.	Illumination	200 lux or better
	Emergency lighting	Sufficient illumination
	Area Lighting	Not applicable
5	Power Sockets	Distribution Power through power sockets

#	Description	Specification
	Single phase 5/16/20A Power outlet / plug and sockets	Four numbers of Power sockets
	3 Phase,32A Power outlet / plug and sockets	Two numbers power sockets
	3 Phase,63A Power outlet / plug and sockets	Two numbers of power sockets
6	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	Single phase 5/16/20A Power outlets/plug sockets points: 6 points for Automation/DDC
7.	EPS (Single Chain Configuration with Isolation Transformer)	Single phase 5/16/20A Power outlets/plug sockets points: 2 points for CCTV 2 points for FDA 2 points for Communication
8.	Ventilation	
	wall mounted Air circulators	Not required
	Exhaust fans	Not required
9.	Type of Cabling / Wiring	Armoured/Flexible copper cables are routed through suitable SS cable trays.
10.	EARTHING (Power / Instrumentation)	Independent earthing scheme for Instrumentation / static<1 ohm and power <5 ohm. Copper interconnecting strips for static and instrumentation. And GI for all other interconnections.
11.	Lightning Protection	Standard lightning protection as per IEC/BIS shall be provided.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	Tilting Mechanism 160kWx2+1st	480	304	480	304								
2	Hoist 30kWx2 +1 st	180	114	180	114								
3	support clamp 2kWx6+1st	84	11.4	84	11.4								
4	Switch cum Sockets	30	28.5	30	28.5								
5	Data aquazation					2	1.2	2	1.2				
6	LSSF					2	1.2	2	1.2				
7	***Total Connected Load***	774		774		4		4		0		0	
8	***Maximum Demand in KW***		**457.9**		**457.9**		**2.4**		**2.4**		0		
9	***Maximum Demand in kVA***		**572.375**		**572.375**		**3**		**3**		**0**		**0**

NOTE: All above loads are tentative.

PMLP

#	Description	Specification
1.	MVP	Power Distribution for the equipment
	UPS Panels	Power Distribution for the instrumentation and control system
	Distribution Boards	Power Distribution for illumination Power outlets

#	Description	Specification
2.	iMCCs Drives	Suitable for hydraulic systems
3.	Machine/Equipment	Hydraulic System
4.	Illumination	250 lux
	Emergency lighting	Sufficient illumination
	Area Lighting	Not applicable
5	Power Sockets	Distribution Power through power sockets
	Single phase 5/16/20A Power outlet / plug and sockets	Four numbers of Power sockets
	3 Phase,32A Power outlet / plug and sockets	Two numbers power sockets
	3 Phase,63A Power outlet / plug and sockets	Two numbers of power sockets
6	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	Not required
7.	EPS (Single Chain Configuration with Isolation Transformer)	Not required
8.	Ventilation	
	wall mounted Air circulators	Twelve numbers
	Exhaust fans	Ten numbers
9.	Type of Cabling / Wiring	Armoured/Flexible copper cables are routed through suitable SS cable trays.
10.	EARTHING (Power / Instrumentation)	Independent earthing scheme for Instrumentation / static<1 ohm and power <5 ohm. Copper interconnecting strips for static and instrumentation. And GI for all other interconnections.
11.	Lightning Protection	Standard lightning protection as per IEC/BIS shall be provided.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	Pumps 5.5x4+2	33	20.9	33	20.9								
2	Illumination	0.5	0.475	0.5	0.475								
3	Switch cum Sockets	3	2.85	0									
4	***Total Connected Load***	36.5		33		0	1			0			
5	***Maximum Demand in KW***		**24.225**		21.375		0		0		0		
6	***Maximum Demand in kVA***		**30.28125**		**26.7188**		**0**		**0**		**0**		**0**

NOTE: All above loads are tentative.

Bogie System

S.No.	Description	Specification
1.	MVP	Power Distribution for the equipment
	UPS Panels	Power Distribution for the instrumentation and control system
	Distribution Boards	Power Distribution for illumination Power outlets

S.No.	Description	Specification
2.	iMCCs Drives	Suitable for hydraulic systems
3.	Machine/Equipment	Hydraulic System
4.	Illumination	250 lux
	Emergency lighting	Sufficient illumination
	Area Lighting	Not applicable
5	Power Sockets	Distribution Power through power sockets
	Single phase 5/16/20A Power outlet / plug and sockets	Four numbers of Power sockets
	3 Phase,32A Power outlet / plug and sockets	Two numbers power sockets
	3 Phase,63A Power outlet / plug and sockets	Two numbers of power sockets
6	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	Single phase 5/16/20A Power outlets/plug sockets points: 6 points for Automation/DDC
7.	EPS (Single Chain Configuration with Isolation Transformer)	Single phase 5/16/20A Power outlets/plug sockets points: 2 points for CCTV 2 points for FDA 2 points for Communication
8.	Ventilation	
	wall mounted Air circulators	Not Required
	Exhaust fans	Not Required
9.	Type of Cabling / Wiring	Armoured/Flexible copper cables are routed through suitable SS cable trays.
10.	EARTHING (Power / Instrumentation)	Independent earthing scheme for Instrumentation / static<1 ohm and power <5 ohm. ergfbnwCopper interconnecting strips for static and instrumentation. And GI for all other interconnections.
11.	Lightning Protection	Standard lightning protection as per IEC/BIS shall be provided.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	Jack 5.5kw x4	33	20.9	33	20.9								
2	Illumination	3	2.85	3	2.85					3	2.85		
3	SMP&ETF		0	0	0					2	1.9		
4	***Total Connected Load***	36		33		0							
5	***Maximum Demand in KW***		**23.75**		**23.75**		0		0	5	4.75		
6	***Maximum Demand in kVA***		**29.6875**		**29.6875**		**0**		**0**		**5.9375**		

NOTE: All above loads are tentative.

LPTs (in Each LPT requirement)

Sl.no.	Description	Specification
1.	MVP	Power Distribution for the equipment. Auto changeover for main power and ring

Sl.no.	Description	Specification
		configuration for all LPTs. Auto changeover for electronic equipment.
	UPS Panels	Power Distribution for the Electronics, instrumentation and control system
	Distribution Boards	Power Distribution for illumination Power outlets
2.	iMCCs Drives	Suitable for maintenance cradle
3.	Machine/Equipment	maintenance cradle
4.	Illumination	250 lux in Panel rooms, minimum 400 lux throughout the vehicle, TUT, top &front side of MLP and sufficient illumination Launch pad activities. Aviation lighting as per ICAO regulations. 150 Lux in front of maintenance cradle& pillboxes in different levels. 200Lux in pill boxes.
	Emergency lighting	Sufficient illumination
	Area Lighting	Sufficient illumination
5	Power Sockets	Distribution Power through power sockets
	Single phase 5/16/20A Power outlet / plug and sockets	Four numbers of Power sockets
	3 Phase,32A Power outlet / plug and sockets	Two numbers power sockets
	3 Phase,63A Power outlet / plug and sockets	Two numbers of power sockets
6	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	Single phase 5/16/20A Power outlets/plug sockets points: 6 points for Automation/DDC
7.	EPS (Single Chain Configuration with Isolation Transformer)	Single phase 5/16/20A Power outlets/plug sockets points: 2 points for CCTV 2 points for High speed cameras 2 points for FDA 2 points for Communication 2 points for timing 2 for electrical systems The above requirements for each pill box.
8.	Ventilation	
	wall mounted Air circulators	Required
	Exhaust fans	Required
9.	Type of Cabling / Wiring	Armoured/Flexible copper cables are routed through suitable SS cable trays.
10.	EARTHING (Power / Instrumentation)	Independent earthing scheme for Instrumentation / static<1 ohm and power

Sl.no.	Description	Specification
		<5 ohm. Copper interconnecting strips for static and instrumentation. And GI for all other interconnections. Special Earthing: ring and radial counterpoise earthing to be provided for all LPT interconnections. Distinct earthing 110m away from the each LPT.
11.	Lightning Protection	Standard lightning protection as per IEC/BIS shall be provided.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	Maintenance Cradle 5 kWx4+1st	25	4.5	25	4.5								
2	Illumination 135 kWx1	135	128.25	135	128.25								
3	Switch cum Sockets 5 kWx2	10	4.75	10	4.75								
4	Aviation 2 kWx1+1st	4	1.9	4	1.9								
5	RO Equipment									5	4.75		
6	***Total Connected Load***	174		174		0	0	0	0	5			
7	***Maximum Demand in KW***		**139.4**		139.4		0		0		**4.75**		
8	***Maximum Demand in kVA***		**174.25**		**174.25**		**0**		**0**		**5.9375**		**0**

NOTE: All above loads are tentative

Jet Deflector Duct

#	Description	Specification
1.	MVP	Power Distribution for the equipment
	UPS Panels	Not required
	Distribution Boards	Power Distribution for illumination and Power outlets
2.	iMCCs Drives	Suitable for Pumps
3.	Machine/Equipment	Pump equipment
4.	Illumination	200 lux in inside JDD
	Emergency lighting	Not required
	Area Lighting	Not applicable
5	Power Sockets	Distribution Power through power sockets
	Single phase 5/16/20A Power outlet / plug and sockets	Two numbers of Power sockets
	3 Phase,32A Power outlet / plug and sockets	Two numbers of Power sockets
	3 Phase,63A Power outlet / plug and sockets	Two numbers of Power sockets
6	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	Not Required
7.	EPS (Single Chain Configuration with Isolation Transformer)	Not Required

#	Description	Specification
8.	Ventilation	
	wall mounted Air circulators	Not Required
	Exhaust fans	Not Required
9.	Type of Cabling / Wiring	Armoured/Flexible copper cables are routed through suitable SS cable trays with proper sealant or cable conduit because of High JET application.
10.	EARTHING (Power / Instrumentation)	Independent earthing scheme for Instrumentation <1 ohm and power <5 ohm. Copper interconnecting strips for static and instrumentation. And GI for all other interconnections.
11.	Lightning Protection	Standard lightning protection as per IEC/BIS shall be provided.

NOTE: All above loads are tentative

Rail Track

S.No.	Description	Specification
1.	MVP	Power Distribution for the equipment
	UPS Panels	Power distribution for AGV
	Distribution Boards	Power distribution for track maintenance , illumination
2.	iMCCs Drives	Not applicable
3.	Machine/Equipment	Not applicable
4.	Illumination	70 lux or better
	Emergency lighting	Not applicable
	Area Lighting	Not applicable
5	Power Sockets	Distribution Power through power sockets
	Single phase 5/16/20A Power outlet / plug and sockets	Every 100m
	3 Phase,32A Power outlet / plug and sockets	Every 150m
	3 Phase,63A Power outlet / plug and sockets	Every 200m
6	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	Not required

S.No.	Description	Specification
7.	EPS (Single Chain Configuration with Isolation Transformer)	Not required
8.	Ventilation	
	wall mounted Air circulators	Not required
	Exhaust fans	Not required
9.	Type of Cabling / Wiring	Armoured/Flexible copper cables are routed through suitable SS cable trays.
10.	EARTHING (Power / Instrumentation)	Independent earthing scheme for Instrumentation / static/ Track <1 ohm and power <5 ohm. Interconnection of two rails with Earth pit connections. Copper interconnecting strips for static and instrumentation. And GI for all other interconnections.
11.	Lightning Protection	Standard lightning protection as per IEC/BIS shall be provided.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	Illumination	20	9.5	10	9.5								
2	MAHAN		0	0	0								
3	***Total Connected Load***	20		10		0				2	1		
4	***Maximum Demand in KW***		**9.5**		9.5		0		0		1		
5	***Maximum Demand in kVA***		**11.875**		**11.875**		**0**		**0**		**1.25**		

NOTE: All above loads are tentative

NSB-O&F

#	Description	Specification
1.	MVP	Power Distribution for entire facility. Dual redundant feeder for process equipment alone and separate feeder for Air-Conditioning System and another non critical loads).
	UPS Panels	Power Distribution for entire facility Special equipment (remote power operate panels) for vehicle electronics , crew electronics, spacecraft electronics and environmental instrumentation electronics etc.
	Distribution Boards	Secondary Power Distribution for entire facilities
2.	iMCCs Drives	Hydraulic equipment for TUT , Hoist equipment and Lift equipment etc
3.	Machine/Equipment	Hydraulic equipment , Hoist equipment and Lift equipment etc

#	Description	Specification
4.	Illumination	Bay and valve area : 350 lux at a distance of 1m from ground. Control room: 300 lux at a distance of 1m from ground. All other areas: 250 lux.In and around: 150 Lux
	Emergency lighting	Throughout facility including control room, panel rooms, etc. with lamps.
	Street/Garden/ Pipe yard/Track/ Area Lighting	Adequate Illumination with suitable aesthetic light fixtures (with 1. High mast, outside Lightings, 2. Street Lightings, 3. Garden Lightings 4. Warning Lighting etc.)
5	Power Sockets	Distribution Power through power sockets
	Single phase 5/16/20A Power outlet / plug and sockets	Ten numbers of Power sockets in each room and on either side of the bay
	3 Phase,32A Power outlet / plug and sockets	Six numbers of power sockets required in every room.
	3 Phase,63A Power outlet / plug and sockets	Four number of power sockets required near to valve area.
6a.	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	3 Phase&Single phase 16A Power outlets/plug sockets points: 10 points for AC automation 20 points for Process I&CS 10 points for safety 6 points for Electrical 20 points Vehicle electronics 30 points Crew electronics 20 Points Spacecraft electronics
6b.	UPS Power requirement (3^{rd} Chain Configuration with Isolation Transformer)	3 Phase&Single phase 16A Power outlets/plug sockets points: 10 points for AC automation 20 points for Process I&CS 10 points for safety 6 points for Electrical 20 points Vehicle electronics 30 points Crew electronics 20 Points Spacecraft electronics
7.	EPS (Single Chain Configuration with Isolation Transformer)	3 Phase&Single phase 16A Power outlets/plug sockets points: 4 points Power 4 points I&CS 4 points for AC Automation 6 points for CCTV 3 points for timing

#	Description	Specification
		6 points for intranet 4 points for intercom 4 points for FDA 2 points for Communication 2 points for High Speed Camera 4 points for Technical Documentation
8.	Ventilation	
	wall mounted Air circulators	Where ever required
	Exhaust fans	Four rest rooms and where ever required
9.	Type of Cabling / Wiring	Armoured/Flexible copper cables are routed through suitable SS cable trays.
10.	EARTHING (Power / Instrumentation)	Independent earthing scheme for Instrumentation / static/ Tack <1 ohm and power <5 ohm and lightning protection <10 Interconnection of Earth pit connections. Copper interconnecting strips for static and instrumentation. And GI for all other interconnections.
11.	Lightning Protection	Standard lightning protection as per IEC/BIS shall be provided. Transient earth clamps / potential equalizing clamps shall be provided between lightning earth pits and other pits.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW	C-Load (KW)	MD (KW)
1	Form Pump 22kwx3 +1 st	88	62.7	88	62.7								
2	Remote Water Monitor 19kw+1st	57	18.05	57	18.05								
3	Illumination	23	21.85	23	21.85					3	2.4		
4	Switch cum Sockets	35	33.25	35	33.25								
5	Emergency Shower pump	22	20.9	22	20.9								
6	Checkout System VSSC					75	50	75	50	10	10	100	95
7	Checkout System URSC					10	4	10	4				
8	RPOP-LOX- CS					7	3.5	7	3.5				
9	RPOP-LH2- CS					7	3.5	7	3.5				
10	RPOP- LCH4-CS					7	3.5	7	3.5				
11	RPOP-NSS- CS					7	3.5	7	3.5				
12	RPOP-GSSF- CS					7	3.5	7	3.5				
13	RPOP-LOX- IS					5	3	5	3				
14	RPOP-LH2- IS					15	8	15	8				
15	RPOP-NSS- IS					6	3	6	3				
16	RPOP-GSSF- IS					20	12	20	12				
17	RPOP-LHC4-IS					5	3	5	3				
18	LSSF-ACCOSS					2	1	2	1				
19	Safety- Gas Check & PMU					5	2	5	2				
20	FDA					1	0.5	1	0.5				
21	Breathing Air purifier					1	0.5	1	0.5				
22	RO Equipment									4	2		
23	Automation					10	8	10	8				
24	***Total Connected Load***	225		225		190		190		17			
25	***Maximum Demand in KW***		156.75		156.75		112.5		112.5		14.4		95
26	***Maximum Demand in kVA***		**195.938**		**195.938**		**140.625**		**140.625**		**18**		**118.75**

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	Compressor for Chilling 115.2kW*4+1St	576	437.76										
2	Compressor for Chilling 115.2W*4+1St	576	437.76										
3	Compressor for Chilling 115.2W*2+1St	345.6	218.88										
4	Condensor Fans	15	9.5										
5	Primary Pump	11.1	7.03										
6	Secondary Pump	6.6	4.18										
7	AHU-1 7.5 kWx2+1St	22.5	14.25										
8	AHU-1 5.5 kWx2+1St	16.5	10.45										
9	AHU-2 3.7kWx1+1St	7.4	3.515										
10	Heater	40	19										
11	Chemical De-Humidifier	10	4.75										
13	APU 115.2W*6+1St	806.4	656.64										
14	***Total Connected Load***	2433.1		0		0		0		0			
15	***Maximum Demand in KW***		**1823.72**		**0**		**0**		**0**		**0**		
16	***Maximum Demand in kVA***		**2279.64**		**0**		**0**		**0**		**0**		

NOTE: All above loads are tentative and separate feeder shall be considered for Air-Condition systems and base loads.

VCR-O & F

S.No.	Description	Specification
1.	MVP	Power Distribution for entire facility. Dual redundant feeder for process equipment alone and separate feeder for Air-Conditioning System and another non critical loads).
	UPS Panels	Power Distribution for entire facility
	Distribution Boards	Secondary Power Distribution for entire facilities.
2.	iMCCs Drives	Hydraulic equipment and pumps etc
3.	Machine/Equipment	Hydraulic equipment and pumps etc
4.	Illumination	Pump Bay and valve area : 350 lux at a distance of 1m from ground.
	Emergency lighting	Throughout facility including with lamps.
	Street/Garden/ Pipe yard/Track/ Area Lighting	Not required
5	Power Sockets	Distribution Power through power sockets
	Single phase 5/16/20A Power outlet / plug and sockets	Six numbers of Power sockets in each room
	3 Phase,32A Power outlet / plug and sockets	Six numbers of power sockets required on near to valve and pumps.
	3 Phase,63A Power outlet / plug and sockets	Four number of power sockets required on near to valve and pumps.
6.	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	3 Phase&Single phase 16A Power outlets/plug sockets points: 2 points for AC automation 4 points for Process I&CS 4 points for safety

S.No.	Description	Specification
7.	EPS (Single Chain Configuration with Isolation Transformer)	3 Phase&Single phase 16A Power outlets/plug sockets points: 2 points Power 2 points I&CS 2 points for AC Automation 2 points for CCTV 1 points for timing 1 points for intranet 2 points for intercom 2 points for FDA 1 points for Communication
8.	Ventilation	
	wall mounted Air circulators	Where ever required
	Exhaust fans	Where ever required
9.	Type of Cabling / Wiring	Armoured/Flexible copper cables are routed through suitable SS cable trays.
10.	EARTHING (Power / Instrumentation)	Independent earthing scheme for Instrumentation / static/ Tack <1 ohm and power <5 ohm and lightning protection <10 Interconnection of Earth pit connections. Copper interconnecting strips for static and instrumentation. And GI for all other interconnections.
11.	Lightning Protection	Standard lightning protection as per IEC/BIS shall be provided. Transient earth clamps / potential equalizing clamps shall be provided between lightning earth pits and other pits.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	SAFETY booster pump360kW2+1st	1050	665	1050	665								
3	Illumination	4	2.85	3	2.85								
4	Switch cum Sockets	5	4.75	5	4.75								
5	RPOP-LSSF					2	1	2	1				
6	FDA					2	0.5	2	0.5				
7	Breathing Air purifier					2	0.5	2	0.5				
8	RO Equipment												
9	Automation					0	0	0	0				
10	***Total Connected Loa***	1059		1058		6		6		0			
11	***Maximum Demand in KW***		**672.6**		**672.6**		**2**		**2**		**0**		
12	***Maximum Demand in kVA***		**840.75**		**840.75**		**2.5**		**2.5**		**0**		

Load Estimations for AC System													
Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	Compressor for Chilling 105.6kW*5+5St	1056	501.6										
2	Condensor Fans	15	9.5										
3	Primary Pump	11.1	7.03										
4	Secondary Pump	6.6	4.18										
6	AHU-2 3.7kW*1+1St	7.4	3.515										
7	Heater	40	19										
8	Chemical De-Humidifier	10	4.75										
9	Exhaust blower	3	2.85										
10	***Total Connected Load***	1149.1		0		0		0		0			
11	***Maximum Demand in KW***		**552.425**		**0**		**0**		0		0		
13	***Maximum Demand in kVA***		**690.531**		**0**		**0**		**0**		**0**		

NOTE: All above loads are tentative and separate feeder shall be considered for Air-Condition systems and base loads.

VCB

Sl.no.	Description	Specification
1.	MVP	Power Distribution for entire facility. Dual redundant feeder for process equipment alone and separate feeder for Air-Conditioning System and another non critical loads).
	UPS Panels	Power Distribution for entire facility
	Distribution Boards	Secondary Power Distribution for entire facilities.
2.	iMCCs Drives	Hydraulic equipment and pumps etc
3.	Machine/Equipment	Hydraulic equipment and pumps etc
4.	Illumination	Pump Bay and valve area : 350 lux at a distance of 1m from ground.
	Emergency lighting	Throughout facility including with lamps.
	Street/Garden/ Pipe yard/Track/ Area Lighting	Not required
5	Power Sockets	Distribution Power through power sockets
	Single phase 5/16/20A Power outlet / plug and sockets	Six numbers of Power sockets in each room
	3 Phase,32A Power outlet / plug and sockets	Six numbers of power sockets required on near to valve and pumps.
	3 Phase,63A Power outlet / plug and sockets	Four number of power sockets required on near to valve and pumps.

Sl.no.	Description	Specification
6.	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	3 Phase&Single phase 16A Power outlets/plug sockets points: 2 points for AC automation 4 points for Process I&CS 4 points for safety
7.	EPS (Single Chain Configuration with Isolation Transformer)	3 Phase&Single phase 16A Power outlets/plug sockets points: 2 points Power 2 points I&CS 2 points for AC Automation 2 points for CCTV 1 points for timing 1 points for intranet 2 points for intercom 2 points for FDA 1 points for Communication
8.	Ventilation	
	wall mounted Air circulators	Where ever required
	Exhaust fans	Where ever required
9.	Type of Cabling / Wiring	Armoured/Flexible copper cables are routed through suitable SS cable trays.
10.	EARTHING (Power / Instrumentation)	Independent earthing scheme for Instrumentation / static/ Tack <1 ohm and power <5 ohm and lightning protection <10 Interconnection of Earth pit connections. Copper interconnecting strips for static and instrumentation. And GI for all other interconnections.
11.	Lightning Protection	Standard lightning protection as per IEC/BIS shall be provided. Transient earth clamps / potential equalizing clamps shall be provided between lightning earth pits and other pits.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (K	MD (KW)	C-Load (K	MD (KW)	C-Load (K	MD (KW)	C-Load (K	MD (KW)	C-Load (K	MD (KW)	C-Load (K	MD (KW)
1	SAFETY booster pump180kW1+1	180	171	180	171								
3	Illumination	4	2.85	3	2.85								
4	Switch cum Socke	5	4.75	5	4.75								
5	RPOP-LSSF					2	1	2	1				
6	FDA					2	0.5	2	0.5				
7	Breathing Air purifier					2	0.5	2	0.5				
8	RO Equipment												
9	Automation					0	0	0	0				
10	***Total Connected***	189		188		6		6		0			
11	***Maximum Demand in KW***		**178.6**		**178.6**		**2**		**2**		**0**		
12	***Maximum Demand in kVA***		**223.25**		**223.25**		**2.5**		**2.5**		**0**		

Load Estimations for AC System													
Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (K	MD (KW)	C-Load (K	MD (KW)	C-Load (K	MD (KW)	C-Load (K	MD (KW)	C-Load (K	MD (KW)	C-Load (K	MD (KW)
1	Compressor for Chilling 115.2kW*2+2St	460.8	218.88										
2	Condensor Fans	15	9.5										
3	Primary Pump	11.1	7.03										
4	Secondary Pump	6.6	4.18										
6	AHU-2 3.7kW*1+1St	7.4	3.515										
7	Heater	40	19										
8	Chemical De-Humidifier	10	4.75										
9	Exhaust blower	3	2.85										
10	***Total Connected Load***	553.9		0		0		0		0			
11	***Maximum Demand in KW***		**269.705**		**0**		**0**		0		0		
13	***Maximum Demand in kVA***		**337.131**		**0**		**0**		**0**		**0**		

NOTE: All above loads are tentative and separate feeder shall be considered for Air-Condition systems and base loads.

LHFS

Sl.no.	Description	Specification
1.	MVP/LT panels	Power Distribution for entire facility. Dual redundant feeder for process equipment alone and separate feeder for Air-Conditioning System and another non critical loads).
	UPS Panels	Power Distribution for entire facility
	Distribution Boards	Secondary Power Distribution for entire facilities
	iMCCs Drives	Control of Motors for various equipment
2.	Machine/Equipment	Various equipment like EOT cranes, compressors, pumps vacuum pumps etc
3.	Air Conditioning	Plant and AHU loads
4.	Illumination	Bay : 350 lux at a distance of 1m from ground.

Sl.no.	Description	Specification
		Control room: 300 lux at a distance of 1m from ground. All other areas: 250 lux. In and around: 150 Lux
	Emergency lighting	Throughout facility including, bay, control room, panel rooms, etc. with lamps.
	Street/Garden/ Pipe yard/Track/ Area Lighting	Adequate Illumination with suitable aesthetic light fixtures (with 1. High mast, outside Lightings, 2. Street Lightings, 3. Garden Lightings 4. Warning Lighting etc.)
5.	Power Outlets	Distribution Power through power sockets and switch cum sockets
	Single phase 16A Power outlet / plug and sockets	Ten numbers of Power sockets in each room and on either side of the bay
	3 Phase,32A Power outlet / plug and sockets	Six numbers of power sockets required on either side of the bay.
	3 Phase,63A Power outlet / plug and sockets	Four number of power sockets required on either side of the bay.
	3 Phase,100A Power outlet / plug and sockets	Two number of power sockets required on either side of the bay.
	3 Phase,250A Power outlet / plug and sockets	Two number of power sockets required on either side of the bay.
	3 Phase,32A Power outlets and 1phase, Power outlets	Provision for along pipe yard (380 m) to be planned at every 10 m interval.
	Water coolers	Single phase in the portal areas.
6.	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	3 Phase & Single phase 16A Power outlets/plug sockets points: 2 points for AC automation 10 points for Process I&CS 6 points for safety 4 Automation for Electrical Systems
7.	EPS/UPS (Single Chain Configuration with Isolation Transformer)	3 Phase & Single phase 16A Power outlets/plug sockets points: 4 points distribution 2 points I&CS 2 points for Automation 6 points for CCTV 2 points for timing 2 points for intranet 4 points for intercom 2 points for FDA

Sl.no.	**Description**	**Specification**
		2 points for Communication 2 points for High Speed Camera/infra-red camera 4 points for Technical Documentation
8.	Ventilation	
	Pedestal/air circulators/ ceilingfans	where ever required
	Exhaust fans	For rest rooms and where ever required
9.	Type of Cabling / Wiring	Armoured/Flexible copper cable in suitable routed through SS cable trays. Cable /Wire conduits are to be considered.
10.	EARTHING (Static/ Power / Instrumentation)	Independent earthing scheme for static <1ohm, Instrumentation <1 ohm and power/body <5 ohm and Lightning<10ohm , storage tanks & pipe line earthing<1ohm Copper interconnecting strips for static and instrumentation. And GI for all body and lightning protection interconnections. Rail Track Earthing for EOT crane at suitable intervals throughout the length of the track as per standards.
11.	Lightning Protection	Standard lightning protection system isolated type for bays and flare structure & Vent and other types shall be followed for other area as per latest IEC/BIS shall be provided and with suitable down conductors, and earth pits. Transient earth clamps / potential equalizing clamps shall be provided between lightning earth pits and other pits.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	GH2 Compressor 55kWx2 + 1st	165	104.5	165	104.5								
2	Leak Detector 1.5kWx2 + 1st	4.5	1.425	4.5	1.425								
3	Vaccum Pumps 5.5kWx3 + 1st	22	10.45	22	10.45								
4	Illumination	20	19	20	19					4	3		
5	Switch cum Sockets	18	17.1	18	17.1								
6	RPOP-LSSF					15	8	15	8				
7	FDA					2	0.5	2	0.5				
8	Breathing Air purifier					2	0.5	2	0.5				
9	RO Equipment									4	2		
10	Automation					4	2	4	2				
11	***Total Connected Load***	229.5		229.5		23		23		8			
12	***Maximum Demand in KW***		**152.475**		**152.475**		**11**		**11**		**5**		
13	***Maximum Demand in kVA***		**190.594**		**190.594**		**13.75**		**13.75**		**6.25**		

Load Estimations for AC System													
Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	Compressor for Chilling 52.8kW*1+1St	105.6	50.16										
2	Compressor for Chilling 115.2W*1+1St	230.4	109.44										
3	Condensor Fans	15	9.5										
4	Primary Pump	11.1	7.03										
5	Secondary Pump	6.6	4.18										
6	AHU-1 5.5 kWx1+1St	11	5.225										
7	AHU-2 3.7kWx1+1St	7.4	3.515										
8	Heater	40	19										
9	Chemical De-Humidifier	10	4.75										
10													
11	***Total Connected Load***	437.1		0		0		0		0			
12	***Maximum Demand in KW***		**212.8**		**0**		**0**		**0**		**0**		
	Maximum Demand in kVA		**266**		**0**		**0**		**0**		**0**		

NOTE: All above loads are tentative and separate feeder shall be considered for Air-Condition systems and base loads.

LMFS

Sl.no.	Description	Specification
1.	MVP/LT panels	Power Distribution for entire facility. Dual redundant feeder for process equipment alone and separate feeder for Air-Conditioning System and another non critical loads).
	UPS Panels	Power Distribution for entire facility
	Distribution Boards	Secondary Power Distribution for entire facilities
	iMCCs Drives	Control of Motors for various equipment
2.	Machine/Equipment	Various equipment like EOT cranes, compressors, pumps vacuum pumps etc
3.	Air Conditioning	Plant and AHU loads
4.	Illumination	Bay : 350 lux at a distance of 1m from ground. Control room: 300 lux at a distance of 1m from ground. All other areas: 250 lux. In and around: 150 Lux
	Emergency lighting	Throughout facility including, bay, control room, panel rooms, etc. with lamps.
	Street/Garden/ Pipe yard/Track/ Area Lighting	Adequate Illumination with suitable aesthetic light fixtures (with 1. High mast, outside Lightings, 2. Street Lightings, 3. Garden Lightings 4. Warning Lighting etc.)
5.	Power Outlets	Distribution Power through power sockets and switch cum sockets
	Single phase 16A Power outlet / plug and sockets	Ten numbers of Power sockets in each room and on either side of the bay
	3 Phase,32A Power outlet / plug and sockets	Six numbers of power sockets required on either side of the bay.
	3 Phase,63A Power outlet / plug and sockets	Four number of power sockets required on either side of the bay.

Sl.no.	Description	Specification
	3 Phase,100A Power outlet / plug and sockets	Two number of power sockets required on either side of the bay. Two number of power sockets required in drive test room
	3 Phase,250A Power outlet / plug and sockets	Two number of power sockets required on either side of the bay. Two number of power sockets required in drive test room
	3 Phase,32A Power outlets and 1phase, Power outlets	Provision for along pipe yard (380 m) to be planned at every 10 m interval.
	Water coolers	Single phase in the portal areas.
6.	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	3 Phase & Single phase 16A Power outlets/plug sockets points: 2 points for AC automation 10 points for Process I&CS 6 points for safety 4 Automation for Electrical Systems
7.	EPS/UPS (Single Chain Configuration with Isolation Transformer)	3 Phase&Single phase 16A Power outlets/plug sockets points: 4 points distribution 2 points I&CS 2 points for Automation 6 points for CCTV 2 points for timing 2 points for intranet 4 points for intercom 2 points for FDA 2 points for Communication 2 points for High Speed Camera/infra-red camera 4 points for Technical Documentation
8.	Ventilation	
	Pedestal/air circulators/ ceilingfans	where ever required
	Exhaust fans	For rest rooms and where ever required
9.	Type of Cabling / Wiring	Armoured/Flexible copper cable in suitable routed through SS cable trays. Cable /Wire conduits are to be considered.
10.	EARTHING (Static/ Power / Instrumentation)	Independent earthing scheme for static <1ohm, Instrumentation <1 ohm and power/body <5 ohm and Lightning<10ohm , storage tanks & pipe line earthing<1ohm Copper interconnecting strips for static and instrumentation. And GI for all body and lightning protection interconnections.

Sl.no.	Description	Specification
		Rail Track Earthing for EOT crane at suitable intervals throughout the length of the track as per standards.
11.	Lightning Protection	Standard lightning protection system isolated type for bays and flare structure & Vent and other types shall be followed for other area as per latest IEC/BIS shall be provided and with suitable down conductors, and earth pits. Transient earth clamps / potential equalizing clamps shall be provided between lightning earth pits and other pits.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	LCH4-LM450 360kWx2+1st	1080	684	1080	684								
2	Vaccum Pumps 3kWx1w+1St	6	4.75	6	4.75								
3	Vaccum Pumps 6kWx1w+1St	12	5.7	12	5.7								
4	LCH4 pre chilled 70kWx2 + 1st	210	133	210	133								
5	Liquid Ring Vaccum Pump 132 kWx20+1St	2772	2508	2772	2508								
6	Vaccum Pumps 5kWx1 + 1st	20	14.25	20	14.25								
7	Foam Pumps 22kWx3 +1 st	88	52.8	88	52.8								
8	Remote Water pump 50kWx3 +1 st	200	120	200	120								
9	Startup gas bottles 5kWx5+1st	30	23.75	30	23.75								
10	Illumination	30	24	30	24					4	3		
11	Switch cum Sockets	30	24	30	24								
12	RPOP-LSSF					20	12	20	12				
13	FDA					2	0.5	2	0.5				
14	Breathing Air purifier					2	0.5	2	0.5				
15	RO Equipment									4	2		
16	Automation					4	2	4	2				
17	***Total Connected Load***	4478		4478		28		28		8			
18	***Maximum Demand in KW***		**3594.25**		**3594.25**		**15**		**15**		**5**		
19	***Maximum Demand in kVA***		**4492.81**		**4492.8**		**18.75**		**18.75**		**6.25**		

Load Estimations for AC System													
Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	Compressor for Chilling 105kW*1+1St	210	99.75										
2	Compressor for Chilling 115.2kW*2+1St	345.6	218.88										
3	Condensor Fans	15	9.5										
4	Primary Pump	11.1	7.03										
5	Secondary Pump	6.6	4.18										
6	AHU-1 5.5 kWx1+1St	11	5.225										
7	AHU-2 3.7kWx1+1St	7.4	3.515										
8	Heater	40	19										
9	Chemical De-Humidifier	10	4.75										
10	Exhaust blower	3	2.85										
11	***Total Connected Load***	449.7		0		0		0		0			
13	***Maximum Demand in KW***		**274.93**		**0**		**0**		**0**		**0**		
	Maximum Demand in kVA		**343.6625**		**0**		**0**		**0**		**0**		

NOTE: All above loads are tentative and separate feeder shall be considered for Air-Condition systems and base loads.

LOFS

Sl.no.	Description	Specification
1.	MVP/LT panels	Power Distribution for entire facility. Dual redundant feeder for process equipment alone and separate feeder for Air-Conditioning System and another non critical loads).
	UPS Panels	Power Distribution for entire facility
	Distribution Boards	Secondary Power Distribution for entire facilities
	iMCCs Drives	Control of Motors for various equipment
2.	Machine/Equipment	Various equipment like EOT cranes, compressors, pumps vacuum pumps etc
3.	Air Conditioning	Plant and AHU loads
4.	Illumination	Bay : 350 lux at a distance of 1m from ground. Control room: 300 lux at a distance of 1m from ground. All other areas: 250 lux. In and around: 150 Lux
	Emergency lighting	Throughout facility including, bay, control room, panel rooms, etc. with lamps.
	Street/Garden/ Pipe yard/Track/ Area Lighting	Adequate Illumination with suitable aesthetic light fixtures (with 1. High mast, outside Lightings, 2. Street Lightings, 3. Garden Lightings 4. Warning Lighting etc.)
5.	Power Outlets	Distribution Power through power sockets and switch cum sockets
	Single phase 16A Power outlet / plug and sockets	Ten numbers of Power sockets in each room and on either side of the bay
	3 Phase,32A Power outlet / plug and sockets	Six numbers of power sockets required on either side of the bay.
	3 Phase,63A Power outlet / plug and sockets	Four number of power sockets required on either side of the bay.
	3 Phase,100A Power outlet / plug and sockets	Two number of power sockets required on either side of the bay. Two number of power sockets required in drive test room
	3 Phase,250A Power outlet / plug and sockets	Two number of power sockets required on either side of the bay. Two number of power sockets required in drive test room
	3 Phase,32A Power outlets and 1phase, Power outlets	Provision for along pipe yard (380 m) to be planned at every 10 m interval.
	Water coolers	Single phase in the portal areas.

Sl.no.	Description	Specification
6.	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	3 Phase & Single phase 16A Power outlets/plug sockets points: 2 points for AC automation 10 points for Process I&CS 6 points for safety 4 Automation for Electrical Systems
7.	EPS/UPS (Single Chain Configuration with Isolation Transformer)	3 Phase & Single phase 16A Power outlets/plug sockets points: 4 points distribution 2 points I&CS 2 points for Automation 6 points for CCTV 2 points for timing 2 points for intranet 4 points for intercom 2 points for FDA 2 points for Communication 2 points for High Speed Camera/infra-red camera 4 points for Technical Documentation
8.	Ventilation	
	Pedestal/air circulators/ ceiling fans	where ever required
	Exhaust fans	For rest rooms and where ever required
9.	Type of Cabling / Wiring	Armoured/Flexible copper cable in suitable routed through SS cable trays. Cable /Wire conduits are to be considered.
10.	EARTHING (Static/ Power / Instrumentation)	Independent earthing scheme for static <1ohm, Instrumentation <1 ohm and power/body <5 ohm and Lightning<10ohm , storage tanks & pipe line earthing<1ohm Copper interconnecting strips for static and instrumentation. And GI for all body and lightning protection interconnections. Rail Track Earthing for EOT crane at suitable intervals throughout the length of the track as per standards.
11.	Lightning Protection	Standard lightning protection system isolated type for bays and flare structure & Vent and other types shall be followed for other area as per latest IEC/BIS shall be provided and with suitable down conductors, and earth pits. Transient earth clamps / potential equalizing clamps shall be provided between lightning earth pits and other pits.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	LOX-LM650+120 LM675+LM250 230kWx2+1St	690	437	690	437								
2	C32 /C70 60 kWx2+1St	180	114	180	114								
3	C32 /C70 60 kWx2+1St	180	114	180	114								
4	GOX Bottels 50 kWx2+1St	150	95	150	95								
5	Vaccum Pumps 3kWx1w+1St	6	4.75	6	4.75								
6	Vaccum Pumps 6kWx1w+1St	12	5.7	12	5.7								
7	Liquid Ring Vaccum PumpNGLV 132 kWx20+1St	2772	2508	2772	2508								
8	Startup gas bottles 3kWx5+1st	30	23.75	30	23.75								
9	Illumination	30	28.5	30	28.5					4	3		
10	Switch cum Sockets	30	28.5	30	28.5								
11	RPOP-LSSF					42	20	40	20				
12	FDA					2	1	2	1				
13	Breathing Air purifier					2	1	2	1				
14	RO Equipment									4	2		
15	Automation					4	2	4	2				
16	***Total Connected Load***	4080		4080		50		48		8			
17	***Maximum Demand in KW***		**3359.2**		**3359.2**		**24**		**24**		**5**		
18	***Maximum Demand in kVA***		**4199**		**4199**		**30**		**30**		**6.25**		

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	Compressor for Chilling 35kW*1+1St	70	33.25										
	Compressor for Chilling 140kW*2+1St	420	266										
2	Condensor Fans	15	9.5										
3	Primary Pump	11.1	7.03										
4	Secondary Pump	6.6	4.18										
5	AHU-1 7.5 kWx1+1St	15	7.125										
6	AHU-2 3.7kWx1+1St	7.4	3.515										
7	Heater	40	19										
8	Chemical De-Humidifier	10	4.75										
9	Exhaust blower	3	2.85										
10	***Total Connected Load***	595.1		0		0		0		0			
11	***Maximum Demand in KW***		**357.2**		**0**		**0**		0		0		
13	***Maximum Demand in kVA***		**446.5**		**0**		**0**		**0**		**0**		

NOTE: All above loads are tentative and separate feeder shall be considered for Air-Condition systems and base loads.

CGSS

Sl.no.	**Description**	**Specification**
1.	MVP/LT panels	Power Distribution for entire facility. Dual redundant feeder for process equipment alone and separate feeder for Air-Conditioning System and another non critical loads).
	UPS Panels	Power Distribution for entire facility
	Distribution Boards	Secondary Power Distribution for entire facilities
	iMCCs Drives	Control of Motors for various equipment
2.	Machine/Equipment	Various equipment like EOT cranes, compressors, pumps vacuum pumps etc
3.	Air Conditioning	Plant and AHU loads
4.	Illumination	Bay : 350 lux at a distance of 1m from ground. Control room: 300 lux at a distance of 1m from ground. All other areas: 250 lux. In and around: 150 Lux
	Emergency lighting	Throughout facility including, bay, control room, panel rooms, etc. with lamps.

Sl.no.	Description	Specification
	Street/Garden/ Pipe yard/Track/ Area Lighting	Adequate Illumination with suitable aesthetic light fixtures (with 1. High mast, outside Lightings, 2. Street Lightings, 3. Garden Lightings 4. Warning Lighting etc.)
5.	Power Outlets	Distribution Power through power sockets and switch cum sockets
	Single phase 5/15A Power outlet / plug and sockets	Ten numbers of Power sockets in each room and on either side of the bay
	3 Phase,32A Power outlet / plug and sockets	Six numbers of power sockets required on either side of the bay.
	3 Phase,63A Power outlet / plug and sockets	Four number of power sockets required on either side of the bay.
	3 Phase,100A Power outlet / plug and sockets	Two number of power sockets required on either side of the bay.
	3 Phase,250A Power outlet / plug and sockets	Two number of power sockets required on either side of the bay.
	3 Phase,32A Power outlets and 1phase, Power outlets	Provision for along pipe yard (380 m) to be planned at every 10 m interval.
	Water coolers	Single phase in the portal areas.
6.	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	3 Phase & Single phase 16A Power outlets/plug sockets points: 2 points for AC automation 10 points for Process I&CS 6 points for safety 4 Automation for Electrical Systems
7.	EPS/UPS (Single Chain Configuration with Isolation Transformer)	3 Phase & Single phase 16A Power outlets/plug sockets points: 4 points distribution 2 points I&CS 2 points for Automation 6 points for CCTV 2 points for timing 2 points for intranet 4 points for intercom 2 points for FDA 2 points for Communication 2 points for High Speed Camera/infra-red camera 4 points for Technical Documentation
8.	Ventilation	

Sl.no.	Description	Specification
	Pedestal/air circulators/ ceiling fans	where ever required
	Exhaust fans	For rest rooms and where ever required
9.	Type of Cabling / Wiring	Armoured/Flexible copper cable in suitable routed through SS cable trays. Cable /Wire conduits are to be considered.
10.	EARTHING (Static/ Power / Instrumentation)	Independent earthing scheme for static <1ohm, Instrumentation <1 ohm and power/body <5 ohm and Lightning<10ohm , storage tanks & pipe line earthing<1ohm Copper interconnecting strips for static and instrumentation. And GI for all body and lightning protection interconnections. Rail Track Earthing for EOT crane at suitable intervals throughout the length of the track as per standards.
11.	Lightning Protection	Standard lightning protection system isolated type for bays and flare structure & Vent and other types shall be followed for other area as per latest IEC/BIS shall be provided and with suitable down conductors, and earth pits. Transient earth clamps / potential equalizing clamps shall be provided between lightning earth pits and other pits.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW	MD (KW)	C-Load (KW)	MD (KW)
1	He Compressor 55 kWx2+1St	165	104.5										
2	Air Compressor 55kWx1+1St	110	52.25										
3	LN2 Pumps 22kWx4+1St	110	83.6										
4	Cooling Tower 5.5kWx2+1St	16.5	10.45										
5	Vacuum Pump 5 kWx2+1St	15	9.5										
6	Leak Detector 1.5kWx2+1St	4.5	2.85										
7	EOT Crane 10kW	20	19	20	19								
8	Illumination	33	31.35							4	2		
9	Switch cum Sockets	40	38										
10	RPOP-LSSF					20	10	20	10				
11	FDA					2	0.5	2	0.5				
12	Breathing Air purifier					2	0.5	2	0.5				
13	RO Equipment									4	2		
14	Automation					2	1.9	2	1.9				
15	***Total Connected Load***	514		20		26		26		8			
16	***Maximum Demand in KW***		**351.5**		**19**		**12.9**		**12.9**		**4**		
17	***Maximum Demand in kVA***		**439.38**		**23.75**		**16.13**		**16.13**		**5**		

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW	MD (KW)	C-Load (KW)	MD (KW)
1	Compressor for Chilling 52.8kW*1+1St	105.6	50.16										
	Compressor for Chilling 140kW*2+1St	420	266										
2	Condensor Fans	15	9.5										
3	Primary Pump	11.1	7.03										
4	Secondary Pump	6.6	4.18										
5	AHU-1 5.5 kWx1+1St	11	5.225										
6	AHU-2 3.7kWx1+1St	7.4	3.515										
7	AHU-2 2.2 kWx1+1St	4.4	2.09										
8	Heater	50	23.75										
9	Chemical De-Humidifier	10	4.75										
10	***Total Connected Load***	641.1		0		0		0		0			
11	***Maximum Demand in KW***		**376.2**		**0**		**0**		0		0		
12	***Maximum Demand in kVA***		**470.25**		**0**		**0**		**0**		**0**		

NOTE: All above loads are tentative and separate feeder shall be considered for Air-Condition systems and base loads.

Safety Systems: GLR

#	Description	Specification
1.	MVP/LT panels	Power Distribution for entire facility. Dual redundant feeder for process equipment alone and separate feeder for Air-Conditioning System and another non critical loads).
	UPS Panels	Power Distribution for entire facility
	Distribution Boards	Secondary Power Distribution for entire facilities
	iMCCs Drives	Control of Motors for various equipment
2.	Machine/Equipment	Various equipment like EOT cranes, compressors, pumps vacuum pumps etc
3.	Air Conditioning	Plant and AHU loads
4.	Illumination	Bay : 350 lux at a distance of 1m from ground. Control room: 300 lux at a distance of 1m from ground. All other areas: 250 lux. In and around: 150 Lux
	Emergency lighting	Throughout facility including, bay, control room, panel rooms, etc. with lamps.
	Street/Garden/ Pipe yard/Track/ Area Lighting	Adequate Illumination with suitable aesthetic light fixtures (with 1. High mast, outside Lightings, 2. Street Lightings, 3. Garden Lightings 4. Warning Lighting etc.)
5.	Power Outlets	Distribution Power through power sockets and switch cum sockets
	Single phase 5/15A Power outlet / plug and sockets	Ten numbers of Power sockets in each room and on either side of the bay
	3 Phase,32A Power outlet / plug and sockets	Six numbers of power sockets required on either side of the bay. Two number of power sockets required in Instrumentation maintenance room
	3 Phase,63A Power	Four number of power sockets required on either

#	Description	Specification
	outlet / plug and sockets	side of the bay.
	3 Phase,100A Power outlet / plug and sockets	Two number of power sockets required on either side of the bay.
	3 Phase,250A Power outlet / plug and sockets	Two number of power sockets required on either side of the bay.
	3 Phase,32A Power outlets and 1phase, Power outlets	Provision for along pipe yard (380 m) to be planned at every 10 m interval.
	Water coolers	Single phase in the portal areas.
6.	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	3 Phase&Single phase 16A Power outlets/plug sockets points: 2 points for AC automation 10 points for Process I&CS 6 points for safety 4 Automation for Electrical Systems
7.	EPS/UPS (Single Chain Configuration with Isolation Transformer)	3 Phase&Single phase 16A Power outlets/plug sockets points: 4 points distribution 2 points I&CS 2 points for Automation 6 points for CCTV 2 points for timing 2 points for intranet 4 points for intercom 2 points for FDA 2 points for Communication 2 points for High Speed Camera/infra-red camera 4 points for Technical Documentation
8.	Ventilation	
	Pedestal/air circulators/ ceilingfans	where ever required
	Exhaust fans	For rest rooms and where ever required
9.	Type of Cabling / Wiring	Armoured/Flexible copper cable in suitable routed through SS cable trays. Cable /Wire conduits are to be considered.
10.	EARTHING (Static/ Power / Instrumentation)	Independent earthing scheme for static <1ohm, Instrumentation <1 ohm and power/body <5 ohm and Lightning<10ohm, storage tanks & pipe line earthing<1ohm Copper interconnecting strips for static and instrumentation. And GI for all body and lightning protection interconnections. Rail Track Earthing for EOT crane at suitable intervals

#	Description	Specification
		throughout the length of the track as per standards.
11.	Lightning Protection	Standard lightning protection system isolated type for bays and flare structure & Vent and other types shall be followed for other area as per latest IEC/BIS shall be provided and with suitable down conductors, and earth pits. Transient earth clamps / potential equalizing clamps shall be provided between lightning earth pits and other pits.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW	MD (KW)	C-Load (K	MD (KW)	C-Load (K	MD (KW)	C-Load (K	MD (KW)
1	Electrical Pumps 450kWx6+1 st	2700	1710	2250	1710								
2	Air Compressor 360 kWx3+1St	1440	1026	1440	1026								
3	form concentrate pump 55kWx4+1st	275	209	275	209								
4	cooling water pump 20kWx2+1st	60	38	60	38								
5	Jockey Pump 55kWx2+1 St	165	104.5	165	104.5								
6	Cooling fans 2kWx4+1st	10	7.6	10	7.6								
7	10t EOT crane 5kWx1+1st	10	4.75	10	4.75								
8	Illumination	16	15.2	16	15.2					4	2		
9	Switch cum Sockets	5	4.75	5	4.75								
10	RPOP-LSSF					38	25	38	25				
11	FDA					2	0.5	2	0.5				
12	Brething Air purifier					2	0.5	2	0.5				
13	RO Equipment									4	2		
14	Automation					4	2	4	2				
15	***Total Connected Load***	4681		4231		46		46		8			
16	***Maximum Demand in kW***		**3119.8**		**3119.8**		**28**		**28**		**4**		
17	***Maximum Demand in kVA***		**3899.8**		**3899.8**		**35**		**35**		**5**		

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW	MD (KW)	C-Load (K	MD (KW)	C-Load (K	MD (KW)	C-Load (K	MD (KW)
1	Compressor for Chilling 35kW*1+1St	70	33.25										
	Compressor for Chilling 53kW*1+1St	106	50.35										
2	Condensor Fans	15	9.5										
3	Primary Pump	11.1	7.03										
4	Secondary Pump	6.6	4.18										
6	AHU-2 3.7kW*1+1St	7.4	3.515										
7	Heater	40	19										
8	Chemical De-Humidifier	10	4.75										
9	Exhaust blower	3	2.85										
10	***Total Connected Load***	269.1		0		0		0		0			
11	***Maximum Demand in KW***		**134.425**		**0**		**0**		0		0		
13	***Maximum Demand in kVA***		**168.0313**		**0**		**0**		0		0		

NOTE: All above loads are tentative and separate feeder shall be considered for Air-Condition systems and base loads.

AC Plant (Vehicle and Process facilities)

Sl.no.	Description	Specification
1.	MVP	Power Distribution for entire facility Two feeder with Auto changeover for vehicle AC plant alone
	DB's	Secondary Power Distribution for entire facilities
	MCCs	Control of AC Equipment for various

Sl.no.	Description	Specification
		equipment
2.	Machine/Equipment	Various equipment like compressors, chillers, pumps, motors, heaters etc.
3.	Air Conditioning	AHU loads
4.	Illumination	All areas: 250 lux and 150 lux in corridors.
	Emergency lighting	Throughout AC Plant
	Area Lighting	Adequate Illumination with suitable aesthetic light fixtures
5	Power Sockets	Distribution Power through power sockets
	Single phase 6/16/20A Power outlet / plug and sockets	Four numbers of Power sockets
	3 Phase,32A Power outlet / plug and sockets	Two numbers power sockets
	3 Phase,63A Power outlet / plug and sockets	Two numbers of power sockets
6	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	Single phase 6/16/20A Power outlets/plug sockets points: 10 points for Automation/DDC
7.	EPS (Single Chain Configuration with Isolation Transformer)	Single phase 16A Power outlets/plug sockets points: 16 points for Automation 2 points for CCTV 2 points for FDA 2 points for Communication 04 points for Technical Documentation
8.	Ventilation	
	wall mounted Air circulators	Sixteen numbers of air circulators
	Exhaust fans	For all panel and rest rooms
9.	Type of Cabling / Wiring	Armoured/Flexible copper cable in suitable GI perforated routed through cable trays up to 16 sqmm size. Above this size aluminium cable routed through cable trays
10.	EARTHING (Power / Instrumentation)	Independent earthing scheme for Instrumentation <1 ohm and power <5 ohm with 150 ohm/mtr soil resistivity Driven earth pipes of 50 mm NB/6-12 mtr long may be considered. Copper interconnecting strips for static and instrumentation. And GI for all other interconnections.

Sl.no.	Description	Specification
11.	Lightning Protection	Standard lightning protection as per IEC/BIS shall be provided.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	Compressor for Chilling 250kW*4+1St	1250	950	1250	950								
2	Condensor Fans	125	95	125	95								
3	Primary Pump	46.5	35.34	46.5	35.34								
4	Secondary Pump	27.5	26.125	27.5	26.125								
5	Heater	50	23.75	50	23.75								
6	Chemical De-Humidifier	1000	760	1000	760								
7	Illumination	8	8	8	8					2	1		
8	Switch Socket loads	10	4	10	4								
9	Automation					2	0.5	2	0.5				
10	RO Equipment									4	1		
11	FDA					2	0.5	2	0.5				
12	***Total Connected Load***	2517		2517		4		4		6			
13	***Maximum Demand in KW***		**1902.215**		**1902.215**		**1**		1		2		
14	***Maximum Demand in kVA***		**2377.769**		**2377.769**		**1.25**		**1.25**		**2.5**		

Sn		Normal Power		DG Power									
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)								
1	LMFS	449	274										
2	LH2	437	212										
3	LOFS	597	357										
4	CGSS	641	376										
5	GLR	269	134										
6	Substation(pakage)	45	28										
7	NSB	2433	1823										
8	VCR	1149	552										
9	VCB	552	270										
10	FCC	621	251										
11	AC plant-Sat	2517	1902	2517	1902								
12	***Total Connected Load***	9710		2517									
13	***Maximum Demand in KW***		**6179**		**1902**								
14	***Maximum Demand in kVA***		**7723.75**		**2377.5**								

NOTE: All above loads are tentative and separate feeder shall be considered for Air-Condition systems and base loads.

Overhead tank and Bore wells

Sl.no.	Description	Specification
1.	MVP	Power Distribution for entire facility
	DB's	Secondary Power Distribution for entire facilities
	MCCs	Control of AC Equipment for various equipment
2.	Machine/Equipment	Various equipment like compressors, chillers, pumps, motors, heaters etc.
3.	Air Conditioning	AHU loads
4.	Illumination	All areas: 250 lux

Sl.no.	Description	Specification
		and 150 lux in corridors.
	Emergency lighting	Throughout AC Plant
	Area Lighting	Adequate Illumination with suitable aesthetic light fixtures
5	Power Sockets	Distribution Power through power sockets
	Single phase 6/16/20A Power outlet / plug and sockets	Four numbers of Power sockets
	3 Phase,32A Power outlet / plug and sockets	Two numbers power sockets
	3 Phase,63A Power outlet / plug and sockets	Two numbers of power sockets
6	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	Single phase 6/16/20A Power outlets/plug sockets points: 10 points for Automation/DDC
7.	EPS (Single Chain Configuration with Isolation Transformer)	Single phase 16A Power outlets/plug sockets points: 16 points for Automation 2 points for CCTV 2 points for FDA 2 points for Communication 04 points for Technical Documentation
8.	Ventilation	
	wall mounted Air circulators	Sixteen numbers of air circulators
	Exhaust fans	For all panel and rest rooms
9.	Type of Cabling / Wiring	Armoured/Flexible copper cable in suitable GI perforated routed through cable trays up to 16 sqmm size. Above this size aluminium cable routed through cable trays
10.	EARTHING (Power / Instrumentation)	Independent earthing scheme for Instrumentation <1 ohm and power <5 ohm with 150 ohm/mtr soil resistivity Driven earth pipes of 50 mm NB/6-12 mtr long may be considered. Copper interconnecting strips for static and instrumentation. And GI for all other interconnections.
11.	Lightning Protection	Standard lightning protection as per IEC/BIS shall be provided.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	Maintenance Cradle	3.7	3.515	0	0								
2	Illumination +Aviation	3	2.85	0	0								
3	Switch cum Sockets	5	4.75	0									
4	FDA					1	0.5	1	0.5				
7	Automation					1	0.5	1	0.5	1	1		
8	***Total Connected Load***	11.7		0		2		2					
9	***Maximum Demand in KW***		**11.115**		0		**1**		**1**		**1**		
10	***Maximum Demand in kVA***		**13.8938**		**0**		**1.25**		**1.25**		**1.25**		

Water treatment plant

Sl.no.	Description	Specification
1.	MVP	Power Distribution for entire facility
	DB's	Secondary Power Distribution for entire facilities
	MCCs	Control of AC Equipment for various equipment
2.	Machine/Equipment	Various equipment like compressors, chillers, pumps, motors, heaters etc.
3.	Air Conditioning	AHU loads
4.	Illumination	All areas: 250 lux and 150 lux in corridors.
	Emergency lighting	Throughout AC Plant
	Area Lighting	Adequate Illumination with suitable aesthetic light fixtures
5	Power Sockets	Distribution Power through power sockets
	Single phase 6/16/20A Power outlet / plug and sockets	Four numbers of Power sockets
	3 Phase,32A Power outlet / plug and sockets	Two numbers power sockets
	3 Phase,63A Power outlet / plug and sockets	Two numbers of power sockets
6	UPS Power requirement (2 Chain Configuration with Isolation Transformer)	Single phase 6/16/20A Power outlets/plug sockets points: 10 points for Automation/DDC
7.	EPS (Single Chain Configuration with Isolation Transformer)	Single phase 16A Power outlets/plug sockets points: 16 points for Automation 2 points for CCTV 2 points for FDA 2 points for Communication 04 points for Technical Documentation
8.	Ventilation	
	wall mounted Air circulators	Sixteen numbers of air circulators
	Exhaust fans	For all panel and rest rooms

Sl.no.	Description	Specification
9.	Type of Cabling / Wiring	Armoured/Flexible copper cable in suitable GI perforated routed through cable trays up to 16 sqmm size. Above this size aluminium cable routed through cable trays
10.	EARTHING (Power / Instrumentation)	Independent earthing scheme for Instrumentation <1 ohm and power <5 ohm with 150 ohm/mtr soil resistivity Driven earth pipes of 50 mm NB/6-12 mtr long may be considered. Copper interconnecting strips for static and instrumentation. And GI for all other interconnections.
11.	Lightning Protection	Standard lightning protection as per IEC/BIS shall be provided.

Sn		Normal Power		DG Power		UPS1		UPS2		UPS3		UPS4	
	LOADS	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)	C-Load (KW)	MD (KW)
1	Process Pump	37	17.575	37	17.575								
3	Clarified water Pump	22	10.45	22	10.45								
5	Backwash Water Pump	15	7.125	15	7.125								
6	Borewell Pump	37	21.09	37	21.09								
7	Filter Air Blower	4.4	2.09	4.4	2.09								
8	Flash Mixer	0.74	0.3515	0.74	0.3515								
9	Illumination	4	3.8	4	3.8					1	0.5		
10	Switch cum Sockets	5	4.75	5	4.75								
11	Automation					2	0.5	2	0.5				
12	FDA					1	0.5	1	0.5				
13	***Total Connected Load***	120.14		120.14		3		3		1			
14	***Maximum Demand in KVA***		67.2315		67.2315	0	1		1		0.5		0
15	***Maximum Demand in kVA***		**84.039375**		**84.039375**		**1.25**		**1.25**		**0.625**		**0**

9. Instrumentation & Control System:

9.1 TUT System

A) Introduction:

The Tiltable Umbilical Tower (TUT) is a movable mechanical structure of length 100meter approximately, that carries launch vehicle from the launch vehicle integration building to the launch pad in a horizontal condition on rails using a prime mover. The overall capacity is around 400 tons, including the launch vehicle on the TUT along with secondary mobile launch pedestal. The TUT stops near an anchoring point near the launch pad for tilting. The total structure with the launch vehicle will be tilted near the launch pad with a hydraulic system. Suitable instrumentation and control systems must be selected and configured for precise tilting. The requirements for maintaining an ***overall tilt accuracy of 0.1°*** for the control system are given subsequently.The TUT is proposed to tilt using a hydraulic system of suitable capacity, driven by suitable pumps. All necessary safety precautions shall be considered for design. Necessary Remote IO panel near TUT with pluggable connection or better shall be considered for design. Also, TUT shall hold local operating panel for tilting the TUT.

B) Tentative Measurement & Control parameters for TUT

Some of the tentative measurements and controls suggested in the TUT systems are as follows. Additional parameters must also be considered for the smooth operation of the TUT.

Hydraulic system: Pressure at the pump end and near each lifting cylinder, pressure switch, differential pressure for level measurement, oil temperature, flow transmitter, flow switch, Oil level switch, Electrical parameters from power pack IMCC/ drives, Incoming feeder electrical parameters, solenoid valve status, filter clog status, hose burst, emergency off, spare feeder electrical parameters, etc.

Tiltable UT:All Lock & unlock pins position detection, proximity status of various safety limits such as fast forward, slow forward, slow reverse, fast reverse, anchoring point detection, lifting jack top/ bottom positions (Any support/ level jacks retracted/ extended condition, Jacks inlet/ outlet pressure switches), absolute single/multi-turn angular encoders for tilt measurements, inclinometers for tilt measurement for TUT in horizontal & vertical positions, Laser sensors/ equivalent sensors for aligning the TUT with MLP in X & Y direction, hard limits at PMLP / SMLP surface to detect fully tilted TUT, Support arm retraction control etc. to be considered for smooth operation as per department requirements.

Triple Hard detection limit switches shall be considered for every 10° tilt apart from analog measurements. It is also to be noted that the retraction of TUT during lift off as per details provided in earlier chapters shall be integrated with checkout system as per department requirements. Suitable control system methodology shall be provided accordingly.

General measurements: IO panel UPS & DC voltage/ current measurements, IO panel UPS SPD/ DCPS/ Ethernet switch/ MCB status, Auto/Discrete selection.

Control: Dual coil two-way solenoid valve for direction control/double acting proportional valve with suitable control card, any warning light (Red, Amber, Green) with alarm near TUT, etc. – as required for system. Control valves of TUT Retraction during launch shall be interfaced with checkout system in order to tilt back as per launch sequences.

9.2 TLP Air Conditioning Systems:

A) Introduction:

HVAC systems will maintain controlled environmental conditions to ensure optimal equipment performance. They regulate temperature, humidity, and air cleanliness and prevent damage from condensation, thermal stress, and other contamination of sensitive equipment. HVAC components include air handling units (AHUs), filters, chillers, dehumidifiers, ductwork, and control panels. Together, these elements precisely control environmental parameters, ensuring equipment longevity, testing reliability, and personnel safety.

Launch vehicle Integration, assembly and filling operations require conditioned air from the HVAC system, and also to provide human comfort within the facility during assembly operations. Instrumentation and Control Systems of HVAC plants at the Third launch pad area are divided into three major systems as follows

1. Satellite / Vehicle environment conditioning systems
2. AC plants for Equipment and Instrumentation/Control rooms

Satellite cooling A/C systems shall be designed with critical specifications for temperature and humidity as a single-throw system and realised with chilled brine and dehumidifier configuration in two chains. D-area AC plants and all respective facility AHUS shall be configured based on the requirement.

B) Facilities required with HVAC systems

For the realization of TLP, the HVAC systems are required to be designed and considered for the following facilities with independent AC systems

1. Liquid Methane facility (21°C & 30°C)
2. Liquid oxygen facility (21°C & 30°C)
3. Liquid hydrogen facility (21°C & 30°C)
4. Compressed gas storage system (21°C & 30°C)
5. Safety ground level reservoir building (21°C & 30°C)
6. Launch vehicle service building (21°C & 30°C)
7. Valve chamber room (21°C & 30°C)
8. TUT Electrical, ICS & Checkout terminal room (21°C & 30°C)
9. Filling control Centre (21°C & 30°C)
10. Satellite/ Vehicle Chilling & Dehumidifier Plant

A satellite cooling system shall be designed per previous chapters' requirements and consist of primary pump, chiller, secondary pump, and dehumidifier. The primary pump draws brine solution from the hot well, fed to a chiller, and the chilled brine is filled in the cold well. The secondary pump draws the chilled brine from the cold well and pumps it into the Dehumidifier's primary and secondary coils. A dehumidifier draws fresh air from the atmosphere, chilled in the primary coil, where humidity is removed using a chemical dehumidifier (air is hot & with low humidity), and subsequently cooled using the secondary coil.

A decentralised AC plant shall be designed for the above facilities and, as required in previous chapters, to supply cool air to the AHUS with chillers.

C) Tentative Measurement & Control parameters of HVAC System

Some of the tentative measurements and controls suggested for the HVAC systems are as follows. Additional parameters must also be considered for the smooth operation of the HVAC and for close monitoring.

<table>
<tr><th>S.No</th><th>Facility</th><th>Control and monitoring of AC plant equipment</th></tr>
<tr><td>1</td><td>Liquid Methane</td><td rowspan="10">Control & monitoring of Pumps, Chillers, Butterfly valves, Condenser Fans, AHU’s, Dampers, Butterfly valves, 3-way valves & Heaters
Monitoring of Temperature and Relative Humidityat various location
Control and monitoring of dehumidifiers at for Satellite/Vehicle Ducts as per users’ needs</td></tr>
<tr><td>2</td><td>Liquid oxygen</td></tr>
<tr><td>3</td><td>Liquid hydrogen</td></tr>
<tr><td>4</td><td>Compressed gas supply system (CGSS)</td></tr>
<tr><td>5</td><td>Safety ground level reservoir building</td></tr>
<tr><td>6</td><td>Launch vehicle service building</td></tr>
<tr><td>7</td><td>Valve chamber room</td></tr>
<tr><td>8</td><td>TUT Electrical, ICS & Checkout terminal room</td></tr>
<tr><td>9</td><td>Filling control Centre</td></tr>
<tr><td>10</td><td>Satellite Cooling System/ De humidifier plants</td></tr>
</table>

a. ***Tentative parameters:*** Command and status of chillers, chiller pumps, compressors, fans, valves, etc., status of all flow & pressure switches, chiller temperature & level, Pressure at the pump delivery, valve feedback, AHU Command/ status, Heater command/status, damper open & close command/ status, fire alarm status, Auto/manual status, emergency command/ status, Air flow status, Bay temperature & humidity values, all command & status of dehumidifier system, Inlet & outlet pressure/ temperature/humidity, Dehumidifier primary & secondary coil temperature/humidity, brine temperature/ humidity, solenoid valve status, filter clog status,Pan humidifier statuses, humidistat status, water tank with high and low water level switch, DP transmitter for water level monitoring, etc. – as required for system

b. **Electrical Parameters:** All electrical systems, such as chillers, pumps, compressors, heaters, etc., shall be incorporated with IMCC/ drives. A control system shall acquire all parameters. Incoming feeder electrical parameters of each facility. All On/Off commands shall be hardwired with Local/ remote, emergency off, spare feeder electrical parameters, etc., as required for the system.

c. ***General measurements:*** Each IO panel UPS and DC voltage/ current measurement, IO panel UPS SPD/ DCPS/ Ethernet switch/ MCB status, and Auto/Discrete selection.

9.3 TLP Acoustic Suppression System ACOSS:

A) Introduction:

During take-off, the launch vehicle generates extreme conditions, such as vibrations and acoustics that can affect the launch pad, launch vehicle and their payloads. These acoustic loads are the results of intense acoustic environment generated by the interaction of the rocket engine exhaust stream with ambient atmosphere. The launch pad size, geometry of flame deflector, and elevation of the rocket play an important role in the acoustic field characteristics. The effect of this acoustic noise is reduced by adopting the water-quenching method for suppression of acoustics. The system located in hazardous area needs to be remotely operated from FCC (located at approx.. 8 kms away from site) in a deterministic manner involving high speed control and monitoring Instrumentation and control system

B) Tentative Measurement & Control parameters for ACOSS

Dual redundant direct operated ex-proof solenoid valves for operating Electro-pneumatic valves, Quadruple proximity / limit switch for deriving triple redundant status for Electro-pneumatic valve status indication, Pressure transmitters, Differential pressure-based level measurement, flow measurement for water level monitoring, power health and status monitoring,

d. **General *measurements:*** Each IO panel UPS and DC voltage/ current measurement, IO panel UPS SPD/ DCPS/ Ethernet switch/ MCB status, and Auto/Discrete selection.

9.4 TLP Safety System

A) Introduction:

The Fire protection system is intended to protect launch complex ground facilities, launch vehicle and operational personnel from fire and toxic hazards arising due to storage, handling of cryo propellants, other chemicals, gasses and related operations. It is planned to store very large quantities of propellant and gas to meet launch vehicle servicing requirements. Hence a comprehensive

Instrumentation Control System need to be planned for Third Launch pad fire protection system with remote operation involving control and monitoring and suitable for round the clock, 24 x 7 operations

B) Tentative Measurement & Control parameters for Safety systems

Dual redundant direct operated ex-proof / intrinsic solenoid valves for operating Electro-pneumatic / deluge valves, Quadruple proximity / limit switch for deriving triple redundant status for Electro-pneumatic valve status indication, Pressure transmitters, pressure / Flow switches, Differential pressure-based level measurement, flow measurement for water level monitoring, temperature monitoring, leak detectors like Oxygen, hydrogen, Methane, flame detectors etc, remote water monitors, local emergency backup system, remote emergency backup system, power health and status monitoring, MCC panels with soft starters , iMCC panels, ICS interfaces of Fire detection and alarm system and Fire suppression system, Annunciation system

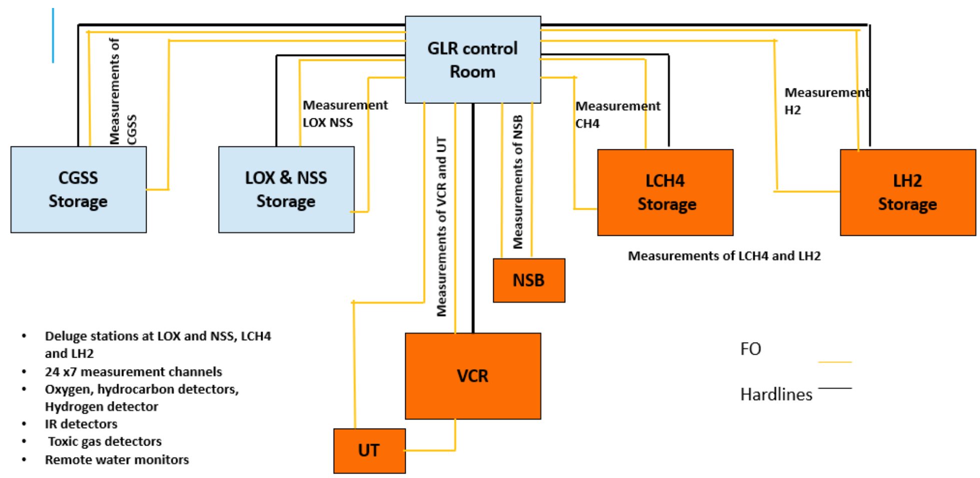
Tentative Operational Philosophy of ICS systems

S.No	Type of protection	Operational philosophy
a.	Water based deluge system	Discrete operation with EP valve and pumps - As and when required based on contingency
b.	Remote water monitor system	During propellant operations
c.	Launch pad fire protection system	During propellant operations
d.	Gas detection and alarm annunciation system	24 x 7
e.	Automatic fire detection and alarm system	24 x 7
f.	Automatic clean gas fire suppression system	24 x 7

Tentative safety systems to be realized for each facility

S. No	System /Location	Electric / Diesel Pumps	Foam based deluge system	Water based deluge system	Remote water monitor system	Gas detection and alarm annunciation system	Automatic fire detection and alarm system	Automatic clean gas fire suppression system	Annunciation system
1	LMe storage	√	√	X	√	√	√	√	√
2	LH2 storage	X	X	√	√	√	√	√	√
3	LOX storage	X	X	√	√	√	√	√	√

4	LN2 Storage	X	X	√	X	√	√	√	√
5	CGSS storage	X	X	X	X	√	√	√	√
6	NSB	√	X	X	X	√	√	√	√
7	VCR	√	√	√	X	√	√	√	√
8	TUT	X	√	√	√	√	√	√	√
9	Electrical substation	X	X	X	X	X	√	√	X
10	GLR	√	X	√	X	X	√	√	X
11	FCC-3	X	X	X	X	X	√	√	X



C) EMERGENCY BACKUP CONSOLE

1. During launch countdown, planned and contingency, operations are proposed to be performed from FCC-3 Safety console using standalone PLC system only with Digital IO shall be designed.
2. In case of any failure of main safety hot stand by PLC /IO, the safety system is proposed to be operated from Emergency Backup consoles located at FCC-3 and FPCR in discrete mode.
3. The emergency backup console at FPCR is proposed to be hardwired console.
4. The emergency backup console at FCC-3 is proposed to be ESD Safety PLC based system with single IO and PLC located at FPCR, GLR.
5. The emergency backup consoles cater to commands for main fire pumps both electric and diesel, foam concentrate pumps, EP valve and RWM and its status
6. Authorization keys for shall be considered for Console, E/P valves, RWMS and Pumps.
7. RWM steering commands shall be considered.
8. E/P valve open status and pump on status indication
9. Incoming cables to the console are entered through cable glands and terminated in connectors in hardwired console

10. System shall have independent Ored power supply for its operation
11. Separate power supply for command and status shall be considered for design
12. End to end additional wiring and interfaces to accommodate 30% spare process instruments / equipment is proposed
13. The measurement, Control and Status monitoring chains (EP valves) in standalone PLC.
14. The pump operation can be designed to operate in remote - auto and discrete mode and local discrete mode using safety console at FPCR.
15. The pump operation can bedesigned to operate on authorization and start command in
    - ✓ Remote - Auto and discrete mode
    - ✓ Local discrete mode using safety console at FPCR.
    - ✓ FCC-3 PLC based Emergency backup console
    - ✓ FPCR Hard-line based Emergency backup console

D) GAS CHECK SYSTEM

1. Gas check system (GCS) is proposed for continuous monitoring of cryo liquids leak in probable locations of LH2, LOX, LN2, LCH4 storages, VCR and TUT as per process and safety requirements.
2. Oxygen depletion in ambient due to leak of N2 gas / He gas in gas handling rooms, NSB control room is also proposed.
3. The following are the gas leaks which are proposed for monitoring

O2 detector	0-25%VOL (Electrochemical type)
H2 detector	- 0 -100%LEL (Catalytic bead type)
LCH4 detector	0 -100%LEL (NDIR)
IR Flame detector	for H2 and LCH4

4. The gas detector output is interfaced to the control network at Fire Protection Control Room and further extension to safety console at FPCR and FCC-3.
5. Synthesized alarms are proposed to be displayed at the respective propellant / gas consoles

E) ANNUNCIATION AND ALARM SYSTEM

Gas check detectors upon detecting environmental pollution / O2 abnormal levels due to leaks and vents in terms of threshold values, need to warn operating personnel by the way of audio-visual alarms locally at each facility through annunciation windows (Remote indicator unit). The audio-visual hooter shall be designed in all propellant /gas handling areas of the facility.

Tentative Annunciation Alarm Levels for Gas Check Systems

Hydrogen Levels(2)	Methane levels (2)	Oxygen Levels(3)

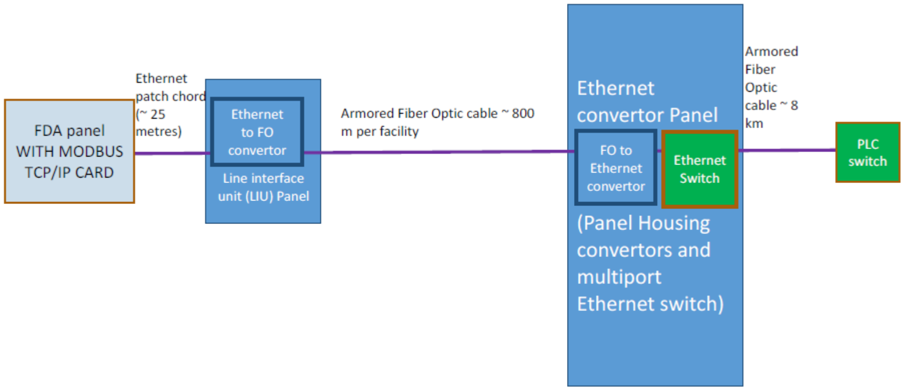
% of LEL	Annunciator Alarm Level indication	% of LEL		% In Vol.	Annunciator Alarm Level indication
< 10%	Normal H_2	< 20%	Normal CH_4	< 19 %	Low O_2
>10 %	H_2 alarm	> 20%	CH_4 alarm	19 % to 23 %	Normal O_2
				>23 %	High O_2

ANNUNCIATOR CONFIGURATION

1. Alarm annunciation system for a facility shall consist of an alarm annunciator window unit with hooters. The annunciator window unit shall be designed to house in ex-proof type for the locations at LH2, LCH4, VCR facilities and provided with flameproof hooter.
2. The annunciator window unit shall be designed to house in weatherproof type at other locations and provided with weatherproof hooter.
3. Hooters shall be designed to sound at different frequencies and visual alarms shall be displayed through different colours for each set point in window unit.
4. The annunciator window unit of suitable no of windows will be used.

F) FIRE/SMOKE DETECTION AND ALARM SYSTEM

1. Heat and smoke detectors are to be planned in selected rooms and passage ways of all facilities as per department requirement, which will be provided at the time of detailed engineering.
2. The fire detection and alarm system of all facilities proposed to be interfaced to multi-port Ethernet switch at respective facilities.
3. In addition, FACP and detector shall be designed to have suitable ethernet interface module to integrate with existing WIN CC SCADA.
4. The tentative FDA interface diagram is illustrated below:
5. The FDA shall be interfaced to respective Fire suppression system. The fire suppression system shall be capable of operating in auto / manual mode.
6. The status of FDA and FM 200 system shall be interfaced to the Centralized Safety Surveillance system



9.5 Salient Features to be incorporated for ICS

<u>Instrumentation Systems</u>

The salient features to be considered by design consultant for **Instrumentation Systems**, **but not limited to**,

1. Instruments to have minimum accuracy and response time one order above the system accuracy and system response time requirement
2. Redundant measurement sensors for analog parameter measurements.
3. Redundant control signal for valve control
4. Triple sensors for all status detection in TUT.
5. Hybrid measurement scheme shall be considered– Pressure/ Temperature/ level/flow, etc. (Hybrid means Bus based transmitters - Only PA or APL & 4-20 mA HART based transmitters). List of Bus based or HART based transmitters will be decided during detailed design for each system.
6. Zone-1 certified 4-20ma or Bus-based single axes inclinometers for TUT. (Accuracy shall be One order above the system accuracy requirement)
7. Zone-1 certified Bus-based multi-turn absolute encoder for TUT – Resolution: 0.01° with 0.05° accuracy or better. (It shall be One order above the system accuracy requirement)
8. Laser/LIDAR-based sensor for measuring the distance between PMLP & TUT with accuracy of +/- 25 mm or better
9. Apart from encoder, proximity and limit switches shall be provided at specific angle of TUT inclination, as envisaged by department.
10. Zone-1 certified sensors for propellant handling areas
11. Inductive-based proximity sensors & Hard limit switches as required.
12. Power rail-based Intrinsically safe isolators for AI & DI measurements
13. Dual redundant direct operated high availability design for solenoid valves
14. Dual coil flow control valve with control card for tilting, alignment with PMLP.

15. Diode ORed DC power supplies with Ethernet interface
16. DIN mounted Energy meters with a communication interface for incoming primary & redundant UPS chains and DC voltage/ current measurements.
17. Hermetically sealed relay with dual change-over contact for DO commands.
18. Zone-1 certified GRP junction boxes& SS Junction boxes/ Enclosures for TUT elements/ power pack elements.
19. Independent temperature & humidity measurement system
20. Digital status using proximity or limit switches for critical tilt positions
21. Linear measurement for all hydraulic jack expansion and contraction
22. Necessary safety, redundancy and protection feature to be implemented for instrumentation system and control system
23. Field triplication for critical elements
24. Triple modular redundancy for EP valves field status
25. Dual power supply for redundant power elements
26. Dual UPS fed to main and redundant power supply independently
27. Intrinsic safety to be followed in hazardous area
28. Group II B / IIC classification for instruments selected for hazardous area
29. Ingression protection of minimum IP 66 or better in outdoor environment
30. Wetted parts of process instruments shall be SS316/SS304 /SS316L/ SS304L

Control Systems

The salient features to be considered by design consultant for Control Systems, but not limited to, (Independent control systems for TUT & HVAC systems)

1. A dedicated hot stand by PLC for with Triple Modular Redundant Remote IO for **TUT** Control Systems with 20% spare channels in each IO module and with all necessary third-party interfaces.
2. Hot stand by SCADA server for **TUT** with configuration & runtime SCADA software with unlimited tags with OPC/UA licenses.
3. A dedicated Engineering workstation shall be considered in design for **TUT** PLC network interface along with stand alone unlimited SCADA license for independent operation during failure of SCADA Servers.
4. Two numbers of Zone-1 certified HMI for local control in **TUT**. Preferable on TUT on removable structure
5. Two number of compact Mobile HMI/ Handheld HMI along with necessary software’s shall be considered for **TUT** control operations.
6. Zone-1 certified HMI for local monitoring & controlling in **TUT** during movement, which an be planned to mounted in **TUT** in a safe enclosure.
7. Zone-1 certified Ethernet switch in **TUT** to transfer the signal to the PLC rack in a safe area.
8. “Digital Twin” for TUT system shall be explored.

9. A common Hot stand by PLC for all **HVAC** System with Dual Modular Redundant Remote IO at each location with 20% spare channels in each IO module and with all necessary third-party interfaces.
10. Hot stand by SCADA server for **HVAC** with configuration & runtime SCADA software with unlimited tags with OPC/UA licenses and shall consider necessary license requirements to integrate existing HVAC PLC/SCADA system.
11. A dedicated Engineering workstation shall be considered in design for **HVAC** PLC network interface along with stand alone unlimited SCADA license for independent operation during failure of SCADA Servers.
12. A dedicated hot stand by PLC for with Triple Modular Redundant Remote IO for **ACoSS** Control Systems with 20% spare channels in each IO module and with all necessary third-party interfaces.
13. Hot stand by SCADA server for **ACoSS** with configuration & runtime SCADA software with unlimited tags with OPC/UA licenses.
14. A dedicated Engineering workstation shall be considered in design for **ACoSS** PLC network interface along with standalone unlimited SCADA license for independent operation during failure of SCADA Servers.
15. A dedicated hot stand by PLC for with Triple Modular Redundant Remote IO for **Safety System** Control Systems with 20% spare channels in each IO module and with all necessary third-party interfaces.
16. Apart from safety hot stand by PLC, A standalone PLC with single chain DI/DO interface for safety emergency operation shall be considered for **safety systems**, which shall be planned to co-locate with hot stand by PLC.
17. Two numbers of stand alone SCADA system with required tags shall be considered for stand alone PLC operations proposed in **safety system**.
18. Hot stand by SCADA server for **Safety Systems** with configuration & runtime SCADA software with unlimited tags with OPC/UA licenses.
19. A dedicated Engineering workstation shall be considered in design for **Safety System** PLC network interface along with stand-alone unlimited SCADA license for independent operation during failure of SCADA Servers.
20. Minimum 2 Nos HMI runtime Client PC for TUT, HVAC, ACoSS & Safety System with unlimited tags, respectively.
21. Minimum 5 Nos of Web HMI client license shall be considered in design for remote monitoring for TUT, HVAC, ACoSS & Safety Systems.
22. IO Panels with dual UPS connectivity & with Internal panel measurements.
23. All system shall be designed in such a way that both systems can be monitored and controlled from a remote location which in 8 km way.
24. TUT PLC shall be considered with specific interface to interact with third party plc to execute commands
25. Specific TUT tilting valves are to be identified which are involved in tilt back operation during launch and shall be designed command externally from other

control system during launch operations. Data will be provided during design engineering phase.

26. Industrial grade ethernet switch with dual power supply
27. All iMCC with Ethernet connectivity
28. Fiber optic connectivity from TUT to PLC Rack -From anchoring point.
29. Plug-in type optical fiber cable & Data cable to interface the control system at launch pad after moving from integration building.
30. Wireless Zone-1 HMI on Tab option shall be explored by designer for TUT operation.
31. Digital load cells at specific loading points in TUT (Option).
32. System shall be designed with worst case PLC scan cycle time less than or equal to 100 ms for TUT, HVAC & Safety systems
33. Worst case Scan time for PLC (including Housekeeping and other internal functions) for handling 200 analog &2000 digital I/O' s shall be less than 25ms for ACOSS. It will be finalized during design engineering phase.
34. High speed logging at 50/100ms @ PLC **- ACoSS**
35. Alarm/Event logging features shall be considered
36. Auto report generation and fail/safe features shall be considered
37. Automatic test and evaluation report shall be considered in specification.
38. Datalogging feature shall be available
39. AHU controllers, Dehumidifier controller, etc shall have compatibility to interface with PLC
40. Positioning of ex. Proof of a fixed IP camera in TUT or a nearby location for monitoring tilting activity, and Integration with SCADA to monitor critical movements ot TUT (Option).
41. All PLC/SCADA shall comply IEC standards
42. Fault tolerant & Cyber secure control system is envisaged for each Process system for control and monitoring.
43. The system must be based on state-of-the-art and the latest in terms of features.
44. Local and remote I/O units and network must function in dual/triple redundancy mode for improved reliability.
45. Compliant with applicable IEC 61131 standards
46. Feature to post user defined command from IO modules (In case of failure) - ACoSS
47. All IO modules shall have three-way isolation and all IO module shall have hot swappable feature.
48. Self-diagnostics of all equipment to be monitored remotely
49. Controller & IO modules shall have conformal coating.
50. Bump less switch over of Controller & Hot swap functionality for IO modules
51. Channel and Module level diagnostics shall be available.

52. Controller shall have capability to log data at scan cycle rate and data shall be available at SCADA for trending and extraction. The duration of log in controller will be decided during detailed engineering.
53. Soft Simulator in Integrated Development Environment shall be considered
54. Interface with GPS clock/ NTP through network.
55. The Automation system must have 30% augmentation capability for future requirements
56. SCADA shall be capable of Control, Acquisition and display of Process through HMI screens.
57. SCADA shall provide features like Trending & Logging at 1 second and also shall have reporting feature with user customizable formats
58. All necessary Interface for Profibus PA/ Profibus DP/ Device Net/ Profinet/ MODBUS (Ethernet & Serial) field devices to the controller are to be considered
59. All four systems are to planned in different network.
    Additional Instrumentation & control system features are also to be considered for smooth operation.

C) Other requirements

The design consultant shall consider the following requirement for ICS

a. Finalization of design and configuration of data acquisition system
b. Necessary drag chain shall be considered near tilting location
c. Necessary drag chain certified cable/triflex cables shall be considered
d. All cables shall be of anti-rodent & fire-retardant cables
e. All cable sizing requirements

9.6 General requirements for ICS:

Design consultancy shall consider the following points to be incorporated in specification

1. Deliverables for both TUT & HVAC system shall be provided independently.
2. Site Layout & Panel placement scheme
3. Wiring Scheme for each IO
4. Interface details for all third-party devices with PLC
5. Field JB details
6. Detailed User requirement document for PLC/SCADA development
7. Detailed UPS power, Raw power and DC power distribution scheme
8. Detailed BoM and detailed specification
9. Asset management system for TUT, HVAC, ACoSS and safety systems shall be considered as a part of specification.
10. List of field elements with operating range and selection range.
11. Design of DCPS load shall be provided
12. Cable sizing details, specification and quantity with tolerances

13. All TUT & HVAC systems networking scheme.
14. Estimation for each ICS elements for each system
15. List of spares required for each system.
16. Scope such as Training, Deliverable documents as per dept requirements to be added in specification.
17. Cabling and inter connection schemes between various facilities.
18. Selection of painting scheme and application procedure
19. Ensuring the safety & compliances designs adhere to relevant codes and standards
20. Control philosophy for TUT & HVAC Control systems
21. CCTV Camera location to cover all process areas.
22. Sizing of DC power supplies
23. Single line diagrams of all process connections
24. Dual UPS power distribution scheme
25. Cable routing scheme in process facilities, LPTs, NSB, VCR and checkout rooms
26. Centralized monitoring scheme for HVAC systems
27. Scope of Non-Comprehensive AMC
28. Trench connectivity to all facilities
29. PCC incoming cable shall be selected based on process loads in each facility. Cable sizing & laying scope from substation shall be considered
30. Necessary SPD devices shall be considered for Power, Signal & Data
31. Suitable MCB/MCCB power distribution shall be planned in each facility. All power distribution shall be planned from double pole MCB not from sockets.
32. All CCTV/ FDA/ Communication/ Network panels/Campus PCs shall be considered with UPS
33. Specification shall include – “AMC procedure of all systems, FAT procedure, SAT procedure, QAP, monthly check list, Quarterly checklist, half yearly check list and Annual check list.
34. The design and installation of instruments shall be considered in accordance with ISA or similar recommended practices and applicable standards like BIS and shall be listed in the generated tender specifications.
35. The instruments and equipment used shall be suitable for a hot, humid and tropical industrial climate in which corrosive gases and chemicals may be present
36. All instruments and enclosures shall be dust-proof and weather-proof to IP-55 as per IEC-60529 and secure against ingress of fumes, dampness, insects and vermin.
37. All Panels utilized to house Control system equipment shall be secure against ingress of fumes, dampness, insects and vermin.
38. Conformal coating for electronics shall be considered wherever available

39. Intrinsic safety IEC 60079-11 to be considered wherever applicable as per department requirements.
40. Frequency response of some specified instruments shall be of the order of 1KHz, which will be decided at the time of design (TUT & ACoSS)
41. Three-way isolation to be considered between signal input from field, output to control system and power supply using active barriers wherever required
42. The Instrumentation and Control system must have 30% augmentation capability for future requirements.
43. No single point failures
44. All interfaces external to the buildings shall be designed using fiber optic links.
45. Remote Power ON and OFF Systems (RPOP)- **ACoSS**: RPOP Systems are envisaged to remotely power on/ off Instrumentation and control system
    - Necessary rack mounted enclosures.
    - Dual redundant power outlets shall be considered for design used for powering the Instrumentation and control system elements.
    - System shall be designed to Remote ON/OFF from the Filling Control Centre
    - A Separate Network (independent of the Process Automation system network) based system shall be considered.

9.7 Drawing

a. Each drawing submitted by the designer shall be clearly marked with the following details.
   - i. Name of the Owner: Satish Dhawan Space Centre, ISRO
   - ii. Project Title:
   - iii. Purchase Order No:
   - iv. The title of the drawing identifies the system, equipment, or part.
   - v. Drawing, Revision Number and Date.
   - vi. Name of the Supplier:
   - vii. Drawings duly signed in "checked" and “approved” columns.
   - viii. Scale to which the drawing is drawn.
   - ix. Cross references to all relevant drawings.
   - x. All relevant notes to the drawing
   - xi. All notes necessary for understanding and executing work shown on a drawing shall be presented on the same drawing.
   - xii. All legends to all notations& details of revisions carried out
   - xiii. Bill of materials shall be tabulated, wherever required.
   - xiv. All titles, notations, markings and writings on the drawing shall be in English

b. The supplier shall ensure that all drawing revisions are encircled with revision numbers marked on the drawing.

c. The supplier shall also ensure that general details of revisions are indicated for each revision in the drawing's revision block, along with the date and signature of the approving authority.

d. All Drawings shall be drawn either in Auto CAD electrical, E-Plan or suitable software. The Drawing Source file shall be provided after the final drawings of all panels are completed. All P&ID drawing also shall be provided with source code. One license of software shall be considered in specification for supply.

9.8 Internal & External Cable Trenches:

The internal and external cable trenches of facilities inside D-area like LHFS, LMFS, LOFS, NSS, NSB, VCR, Deluge sheds shall be interlinked and to be connected to GLR and Filling Control Center (FCC-3). The optimum configuration/design of trenches shall be made considering the location of the trench and nearness to launch pad. However, the size of the trench shall be based on the cable details from Department.

Cable Trenches connectivity (tentative)

Sl.no.	Type of Trench	External/Internal	From	To
1.	Instrumentation-data	External	NSB-ICS room	GLR
2.	Instrumentation-data	External	CGSS	GLR (via LOFS, LMFS)
3.	Instrumentation-data	External	LHFS	GLR
4.	Instrumentation-data	External	GLR	FCC-3

9.9 Checkout/RO requirements

1. SS cable trays shall be considered throughout the length of TUT – Power & Signal trays
2. Detachable Interface face plates to mount MIL connectors shall be planned at different locations in TUT, as per user requirements.
3. A suitable GRP/SS Junction box shall be planned in TUT bottom for termination of all type of cable, which shall be accessible
4. Cable tray covers shall be of 1000mm length with hinge arrangement/ lock arrangement (As TUT is moved in horizontally, tray cover lock shall be rigid to with stand weight of approximately 20 Nos of multicore flexible cable.
5. Thermal sealant shall be considered at entry points to avoid jet flame entry to cable trays
6. All necessary sensors shall be considered for smooth operations.
7. Location of RIO panel room, PLC panel room, Electrical panel room and control console location are not specified in the document.

8. All necessary cable trays shall be considered in TUT with removable cover with proper thermal coating.
9. Necessary pill boxes in lightning protection tower shall be considered for placing CCTV, Communication and other equipment’s at different levels of LPT.

10.Support Systems

Support systems like Roads, Culverts, Pedestals, Trenches, PH, external & pad lightning, Technical service building, TUT shelter, Maintenance & storage building, storage yards, SPU storage building, water treatment plant with OHT & Pump house, water pipeline distribution network, sewage disposal system, buildings pertaining to range systems etc.

The following are the scope of consultant

- Development of conceptual & preliminary design, Layout, detailed design, detailed engineering and fabrication drawings, schedules (BOQ) and cost estimates for tendering, preparation of tender document.
- Development of overall layout and minor architectural works.
- Preparation and release of MEP and construction good drawings time to time with updates.
- Preparation of composite drawings with piping, instrumentation, checkout, Electrical interfaces, Floor/Wall/Roof/ column embedment etc for respective buildings
- Incorporation of pipe trenches and cable tranches as per user requirement.

PART-C
Bidder Evaluation Formats

MAIN COVERING LETTER

(To be printed on Company letter head)

[Date]

To,

Sr.Head, Purchase & Stores
Satish Dhawan Space Centre,
Sriharikota -542124, Andhra Pradesh

Dear Sir,

Ref: Tender regarding “Design Engineering Services for Third Launch Pad”

Having examined the tender “Design Engineering Services for Third Launch Pad”, the receipt of which is hereby duly acknowledged, we, the undersigned, intend to submit a proposal in response to the RFP related to **“Design Engineering Services for Third Launch Pad”**

We attach hereto the response as required by the tender, which constitutes our proposal. Primary and Secondary contacts for our company are:

Description	**Primary Contact**	**Alternate Contact**
Name		
Designation		
Company Name		
Address		
Phone		
Mobile		
E – mail		

We confirm that the information contained in this response or any part thereof, including its exhibits, and other documents and instruments delivered or to be delivered to SDSC is true, accurate, verifiable and complete. This response includes all information necessary to ensure that the statements therein do not in whole or in part mislead SDSC in its short-listing process.

We fully understand and agree to comply that on verification, if any of the information provided here is found to be misleading the short-listing process, we are liable to be dismissed from the selection process or termination of the contract during the execution of the contract.

We agree for unconditional acceptance of all the terms and conditions set out in the RFP document.

It is hereby confirmed that I/We are entitled to act on behalf of our company/

corporation/ firm/ organization and empowered to sign this document as well as such other documents, which may be required in this connection.

(Signature)
(Name)
(In the capacity of)
(Name and Address of Company) Seal / Stamp of Bidder / Design Consultant

CERTIFICATE AS TO AUTHORIZED SIGNATORIES

I, …………………………the Company Secretary of ………………certify that …….……………Who signed the above response to RFP is authorized to do so and bind the company by authority of its board / governing body.

Date:

Signature: (Company Seal)

Annexure:

Annexure –I(a): Format for Schedule of Prices

Tender no.:

Sl.no	Item description	Qty	Basic Cost (Rs.)	GST (%)	Total Cost (Rs.)
1.	Design Engineering services for Third Launch Pad as per scope, specifications, services, terms & conditions mentioned in Part-A & B of the tender document.	1 no.	Unpriced	Unpriced	Unpriced

Note:

1. The tender is on two part bid basis. In this regard, this format shall be filled and uploaded with mentioning “QUOTED” in technical bid. **Prices shall not be disclosed in technical bid.**
2. **Prices shall be mandatorily quoted in PRICE BID only.**
3. In the price bid only, the prices shall be mentioned and uploaded.

Date:

Signature & Official seal of Bidder / Design Consultant

Annexure –I(b): Detailed Price Break-up Format

a) The tender is on two **part** bid basis. In this regard, this format shall be filled and uploaded with mentioning "QUOTED" in technical bid. **Prices shall not be disclosed in technical bid.**

b) **Prices shall be mandatorily quoted in PRICE BID only.**

c) Total Cost in Annexure – I(b) shall be same as that of Total Cost in Annexure- I(a)

Sl.no.	**System** (including civil, electrical, AC, mechanical, instrumentation & control system)	**Basic cost of system (in Rs.)**	**GST (%)**	**Total Cost of system (Rs.)**
1.	Launch Pad Systems			
2.	Process System Infra			
3.	Air Conditioning & Vehicle Cool Air system			
4.	ACOSS System			
5.	Safety systems			
6.	Support Systems			
	Total Basic cost=		**Total cost=**	

Date:

Signature & Official seal of Bidder / Design Consultant

Annexure –I(c): Providing Additional Design Engineering Services

(*To be submitted as part of Price Bid Supporting Documents*)

Sl No.	Category	Experience	Unit	**Unit Cost Amount in Rs.**	**GST (%)**	**GST in Rs.**
1	Lead Graduate Engineer	> 15 Yrs	Man day			
2	Sr. Graduate Engineer	> 10 Yrs	Man day			
3	Graduate Engineer	> 5 Yrs	Man day			
4	Draftsman	> 5 Yrs	Man day			

Note:

1. These rates are unit rates and will not be considered for evaluation of bidders.
2. The tender is on two part bid basis. In this regard, this format shall be filled and uploaded with mentioning “QUOTED” in technical bid. **Prices shall not be disclosed in technical bid.**
3. **Prices shall be mandatorily quoted in PRICE BID only.**
4. Unit rate shall remain same until completion of Contract.

Date:

Signature & Official seal of Bidder / Design Consultant

Annexure –II (a): Minimum Qualification Criteria

Bidder / Design Consultant shall fill details in the following format and submit along with credentials/documentary proof

The “Minimum Qualification criteria” mentioned below in respect of financial turnover and past experience of similar class of works completed and technical capability of Bidder / Design Consultants will first be scrutinized by Department.

The bidders qualifying the “Minimum Qualification criteria” will be evaluated further in QCBS (Quality cum Cost Based Selection) method on the basis of details furnished by bidders.

a. *Financial Soundness:*

Average of annual financial turnover of last 3 financial years shall be more than Rs.25 crores.

&

Should have a Solvency certificate from a National / Schedule Bank of value not less than Rs. 10 Crore. The Solvency certificate should not be older than six months from the last date of submission of tender.

Please provide the details as per *Annexure –IV: Financial Capacity of Bidder / Design Consultant & Annexure-V: Solvency Certificate format*

b. *Previous experience:*

During last Seven Years ending on the day prior to the bid submission deadline, the Design consultant / bidder should have successfully completed at least one of the following similar works comprising of Design Engineering Services.

Please provide the details as per Annexure –VI: Details of the Works Completed

One similar completed work not less than Rs. 25 crores

(Or)

Two similar completed works with each not less than Rs.18 crores

(Or)

Three similar completed works with each not less than Rs. 12 crores

Similar work shall mean:

Conceptual, Preliminary & Detailed Design and Engineering of Industrial plants or Process Plants infrastructure like Cryogenic / High pressure / Hydrocarbon Plants or High Raise Towers or Heavy structures. The work shall include Civil, Electrical/ Electronics, AC systems, Mechanical and Automation.

c. *Technical capability of Bidder / Design Consultants:*

S.No	Criterion	Bidder / Design Consultant Compliance	Documentary proof reference
1.	Bidder shall have <u>minimum five years</u> of experience in extending technical services in terms of Design engineering services work. *Please provide the details as per Annexure –III: Details of Company / Firm*		
2.	During last Seven Years ending on the day prior to the bid submission deadline, Bidder shall have past experience in the design of super structure (above ground level) and sub structure (below ground level). Structural construction with pile foundation methodology to withstand cyclonic wind loads / seismic loads / mechanical equipment loads (like towers and structures) / hydrostatic pressure load etc. Sub structure shall be like tunnel / duct / trench or equivalent. Depth of sub-structure (excluding foundation) shall be at-least 5m.		
3.	During last Seven Years ending on the day prior to the bid submission deadline, Bidder shall have past experience in the design of high raise industrial towers with civil foundation. Tower shall be of at-least 50m height.		
4.	Shall have exclusive captive manpower resources on payroll of bidder in different categories namely Design Engineers, draftsmen, project management professionals, diploma holders, architects sufficiently to carry out the tendered work in-house. Documentary proof along with their educational		

S.No	Criterion	Bidder / Design Consultant Compliance	Documentary proof reference
	qualification & designation duly certified by bidder's authorized personnel shall be submitted.		
5.	Shall have good infrastructure including office space, computers, software, printers / plotters and other resources for carrying the technical services in- house. *Please provide details as per Annexure –VIII: Details of Softwares & Equipment available with Bidder / Design Consultant*		
6.	a) Declaration in Affidavit on Non Judicial Stamp Paper of Rs.100/- duly countersigned by Notary that they have not been banned or debarred by any Govt./Quasi Government Department or PSUs as on tender closing date. *Please submit as per Annexure –X: Declaration Regarding Clean Track* *b*) If bidder is banned or debarred by any Govt./Quasi Government Department or PSUs as on tender closing date, copy of banned or debarred order shall be furnished for further evaluation.		
7.	Offers of those bidders taking full scope of the work as per the requirements indicated in the RFP only will be considered. Self-declaration by bidder shall be submitted.		
8.	Technical proposal of the bidder, which is not able to substantiate/satisfy the claims made by it with respect to the technical requirements laid down in this RFP, *will be summarily rejected*.		

Date:

Signature & Official seal of Bidder / Design Consultant

Annexure –II (b): Evaluation Criteria

1. The bidders qualifying the "Minimum Qualification criteria" will be evaluated further in QCBS (Quality cum Cost Based Selection) method on the basis of details furnished by bidders. The evaluation would consist of the following stages:

   Stage-1: Evaluation of Technical Bids: Technical marks of bidders will be arrived in this stage. Bidders shall achieve a minimum of 60 Technical marks for proceeding to Stage-2 (i.e evaluation of financial proposal). Technical score(S_t) of bidder will be computed.

   Stage-2: Evaluation of Financial Bids: In this stage, bidders will be evaluated based on quoted price. Each bidder shall be ranked based on their quoted price and a Financial score(S_f) will be given.

2. The Technical score (S_t) and Financial score (S_f) will be calculated for bidders as mentioned in para (4.1) and (4.2) respectively. Based on these scores, the Combined score (S_c) of the bidder will be calculated as mentioned in para (4.3) and the proposal with the highest combined core(S_c) shall be considered for issuing purchase order / work order.
3. In case of any discrepancy in the self-assessed marks by bidder and that awarded by Department on QCBS (Quality cum Cost Based Selection) method, the marks awarded by the department will be final and binding.

4. **Quality cum Cost Based Selection (QCBS) for evaluation:**

   The QCBS criteria shall be applied only to those responsive bids which qualify "Minimum Qualification criteria".

   (4.1) Stage-1: Evaluation of Technical Bids:

Sl.no	Summary	Marks	Parameters
(A)	Financial Strength of bidder	15	1
(B)	Performance on works	70	18
(C)	Personnel and Establishment	15	2
	Total=	100	21

<table>
<tr><th>Sl.no.</th><th>Parameters for QCBS Evaluation of bids</th><th>Criteria wise maximum score & its break-up</th><th>Detailed score break-up</th><th>List of Documents to be submitted by bidder</th></tr>
<tr><td>(A)</td><td>Financial Strength of bidder</td><td>15</td><td></td><td></td></tr>
<tr><td>1</td><td>Average annual turnover (in Rs.) during the last 3 years with year ending FY2024-25</td><td>15</td><td></td><td rowspan="4">Chartered Accountant (CA) certified financial data comprising of
1. Average Annual Financial Turnover
2. Audited Balance sheet
3. Profit and Loss statement
4. IT returns</td></tr>
<tr><td>a)</td><td>≥ 60 crores</td><td></td><td>15</td></tr>
<tr><td>b)</td><td>≥ 45 crores <60 crores</td><td></td><td>12</td></tr>
<tr><td>c)</td><td>≥ 25 crores <45 crores</td><td></td><td>9</td></tr>
<tr><td>(B)</td><td>Performance on works</td><td>70</td><td></td><td></td></tr>
<tr><td>1</td><td>Number of completed similar works (in no.s) of individual contract value (in Rs.) as mentioned below,

Number of Contracts executed during last 7 years ending previous day of last date of submission of the tender</td><td>9</td><td></td><td rowspan="2">List of orders along with copy of Purchase Orders / Work Orders / any other document to establish award of contract and copy of completion certificate/ performance certificate/ Final Payment certificate issued by the Client to establish completion of contract

Note: If a bidder qualifies in more than</td></tr>
<tr><td>a)</td><td><table><tr><td>Value of each work</td><td>No. of works</td></tr><tr><td>≥12 crores</td><td>≥ 18</td></tr><tr><td colspan="2">Or</td></tr><tr><td>≥18 crores</td><td>≥ 12</td></tr><tr><td colspan="2">Or</td></tr><tr><td>≥25 crores</td><td>≥ 6</td></tr></table></td><td></td><td>9</td></tr>
</table>

<table>
<tr><td>b)</td><td><table><tr><td>Value of each work</td><td>No. of works</td></tr><tr><td>≥12 crores</td><td>≥ 9 < 18</td></tr><tr><td colspan="2">Or</td></tr><tr><td>≥18 crores</td><td>≥ 6 < 12</td></tr><tr><td colspan="2">Or</td></tr><tr><td>≥25 crores</td><td>≥ 3 < 6</td></tr></table></td><td></td><td>7.5</td><td rowspan="2">one criterion (i.e., a, b, c), the highest marks among the qualified criteria will be considered.

For example, if bidder has qualified both b) and c), he will be awarded highest of 7.5 marks and 6marks, i.e 7.5 marks</td></tr>
<tr><td>c)</td><td><table><tr><td>Value of each work</td><td>No. of works</td></tr><tr><td>≥12 crores</td><td>≥ 3 < 9</td></tr><tr><td colspan="2">Or</td></tr><tr><td>≥18 crores</td><td>≥ 2 < 6</td></tr><tr><td colspan="2">Or</td></tr><tr><td>≥25 crores</td><td>≥ 1 < 3</td></tr></table></td><td></td><td>6</td></tr>
<tr><td>2</td><td>Maximum value of Single contract (in Rs.) of similar work executed by the bidder during last 7 years ending previous day of last date of submission of the tender</td><td>6</td><td></td><td rowspan="4">List of orders along with copy of Purchase Orders / Work Orders / any other document to establish award of contract and copy of completion certificate/ performance certificate/ Final Payment certificate issued by the Client to establish completion of contract which is executed in the last 7 years ending previous day of last date of submission of the tender</td></tr>
<tr><td>a)</td><td>≥ 60 crores</td><td></td><td>6</td></tr>
<tr><td>b)</td><td>≥ 45 crores <60 crores</td><td></td><td>5</td></tr>
<tr><td>c)</td><td>≥ 25 crores <45 crores</td><td></td><td>4</td></tr>
<tr><td>3</td><td>Experience of bidder / firm in extending technical services in terms of Design engineering services work.</td><td>8</td><td></td><td rowspan="4">Please provide the details as per Annexure –III: Details of Company / Firm</td></tr>
<tr><td>a)</td><td>≥ 20 years</td><td></td><td>8</td></tr>
<tr><td>b)</td><td>≥ 12 years < 20 years</td><td></td><td>6.5</td></tr>
<tr><td>c)</td><td>≥ 5 years < 12 years</td><td></td><td>5</td></tr>
</table>

4	Shall have past experience in the design of super structure (above ground level) and sub structure (below ground level). Structural construction with pile foundation methodology to withstand cyclonic wind loads / seismic loads / mechanical equipment loads (like towers and structures) / hydrostatic pressure load etc. Sub structure shall be like tunnel / duct / trench or equivalent. Depth of sub-structure (excluding foundation) shall be of	8		Any or combination of copy of WO/PO/client certificates / Reports, clearly indicating the nature of work executed in the last 7 years ending previous day of last date of submission of the tender Note: If a bidder qualifies under more than one criterion (i.e., a, b, c), the highest marks among the qualified criteria will be considered.
a)	Depth of sub-structure: ≥ 20m		8	
b)	Depth of sub-structure: ≥ 12m <20m		6.5	
c)	Depth of sub-structure: ≥ 5m < 12m		5	
5	Shall have past experience in the design of high raise industrial towers with civil foundation with a tower height of	4		Any or combination of copy of WO/PO/client certificates / Reports etc, clearly indicating the nature of work executed in the last 7 years ending previous day of last date of submission of the tender Note: If a bidder qualifies under more than one criterion (i.e., a, b, c), the highest marks among the qualified criteria will be considered.
a)	≥ 100m		4	
b)	≥ 75m < 100m		3	
c)	≥ 50m < 75m		2.5	
6	Shall have past experience in design of Heavy structures based on stiffness criterion. Weight of structure shall be of	4		Any or combination of copy of WO/PO/client certificates / Reports etc, clearly indicating the nature of work executed in the last 7 years ending previous day of last date of submission of the
a)	≥ 600t		4	
b)	≥ 400t < 600t		3	
c)	≥ 200t < 400t		2.5	

				tender Note: If a bidder qualifies under more than one criterion (i.e., a, b, c), the highest marks among the qualified criteria will be considered.
7	Shall have past experience in designing rail track systems (including civil and mechanical) with a wheel load of	2		Any or combination of copy of WO/PO/client certificates / Reports etc, clearly indicating the nature of work executed in the last 7 years ending previous day of last date of submission of the tender Note: If a bidder qualifies under more than one criterion (i.e., a, b, c), the highest marks among the qualified criteria will be considered.
a)	≥ 100t		2	
b)	≥ 70t < 100t		1.5	
c)	≥ 40t < 70t		1	
8	Shall have past experience in designing of industrial grade power distribution with multi voltage levels of 33kV/11kV/6.6kV/3.3kV/0.433kV of capacity	4		Any or combination of copy of WO/PO/client certificates / Reports etc, clearly indicating the nature of work executed in the last 7 years ending previous day of last date of submission of the tender Note: If a bidder qualifies under more than one criterion (i.e., a, b, c), the highest marks among the qualified criteria will be considered.
a)	≥ 15000kVA		4	
b)	≥ 10000kVA < 15000kVA		3	
c)	≥ 5000kVA < 10000kVA		2.5	

9	Shall have past experience in designing electrical systems configuration with Flame Proof equipment suitable for explosive environment.	1	1	Any or combination of copy of WO/PO/client certificates / Reports etc, clearly indicating the nature of work executed in the last 7 years ending previous day of last date of submission of the tender
10	Shall have past experience in designing Instrumentation system with Zone-0/Zone-1 certified sensors and other instrumentation elements for any industrial plants.	1	1	Any or combination of copy of WO/PO/client certificates / Reports etc, clearly indicating the nature of work executed in the last 7 years ending previous day of last date of submission of the tender
11	Shall have past experience in designing hot stand by PLC & SCADA/ DCS based control system with triple modular redundancy handling minimum of 20000 Tags and shall have designed interfacing 3rd party devices with PLC/SCADA.	1	1	Any or combination of copy of WO/PO/client certificates / Reports etc, clearly indicating the nature of work executed in the last 7 years ending previous day of last date of submission of the tender
12	Shall have expertise in designing Instrumentation and Control System for the operation of mechanical system / HVAC system.	1	1	Any or combination of copy of WO/PO/client certificates / Reports etc, clearly indicating the nature of work executed in the last 7 years ending previous day of last date of submission of the tender
13	Shall have past experience in design of HVAC system (including civil, electrical, AC, instrumentation & remote operation) for industrial applications with following specifications	4		Any or combination of copy of WO/PO/client certificates / Reports etc, clearly indicating the nature of work executed in the last 7 years ending previous

a)	HVAC system with multiple chillers (Screw & Scroll chillers and air side equipment) of capacity atleast 160TR for each system along with Chemical De-humidifiers with brine chilling plant and packaged AC systems of cumulative capacity of not less than 80TR		4	day of last date of submission of the tender Note: If a bidder qualifies under more than one criterion (i.e., a, b, c), the highest marks among the qualified criteria will be considered.
b)	HVAC system with multiple chillers (Screw & Scroll chillers and air side equipment) of capacity atleast 160TR for each system along with Chemical De-humidifiers with brine chilling plant		3	
c)	HVAC system with multiple chillers (Screw & Scroll chillers and air side equipment) of capacity atleast 160TR for each system		2.5	
14	Shall have past experience in development of 3D assembly of equipment or 3D layout process plant along with piping /cable trays etc or walkthrough model of plant layout	1	1	Any or combination of copy of WO/PO/client certificates / Reports etc, clearly indicating the nature of work executed in the last 7 years ending previous day of last date of submission of the tender
15	Shall have past experience in hydraulic system design with control system.	1	1	Any or combination of copy of WO/PO/client certificates / Reports etc, clearly indicating the nature of work executed in the last 7 years ending previous day of last date of submission of the tender.
16	Shall have past experience in design of fire figthing system with pumping capacity of	3		Any or combination of copy of WO/PO/client certificates / Reports etc, clearly indicating the nature of work executed in the last 7
a)	≥ 3000m3/hr		3	
b)	≥ 2000m3/hr < 3000m3/hr		2.5	

c)	≥ 1000m3/hr < 2000m3/hr		2	years ending previous day of last date of submission of the tender. Note: If a bidder qualifies under more than one criterion (i.e., a, b, c), the highest marks among the qualified criteria will be considered.
17	Shall have prior experience in design of tall RCC structures (for example overhead tanks or dams or equivalent), water distribution network and also would have carried out piping and fluid analysis. Height of RCC structure shall be	6		Any or combination of copy of WO/PO/client certificates / Reports etc, clearly indicating the nature of work executed in the last 7 years ending previous day of last date of submission of the tender. Note: If a bidder qualifies under more than one criterion (i.e., a, b, c), the highest marks among the qualified criteria will be considered.
	≥ 80m		6	
	≥ 60m < 80m		5	
	≥ 40m < 60m		4	
18	Shall have prior experience in design of infrastructure / building including civil/electrical/AC related to Liquefied Natural Gas or Cryogenic fluids or Oil & gas plants or chemical plants. Capacity of cylindrical tanks in the infrastructure shall be of	6		Any or combination of copy of WO/PO/client certificates / Reports etc, clearly indicating the nature of work executed in the last 7 years ending previous day of last date of submission of the tender. Note: If a bidder qualifies under more than one criterion (i.e., a, b, c), the highest marks among the qualified criteria will be considered.
a)	≥ 1000kL		6	
b)	≥ 750kL< 1000kL		5	
c)	≥ 500kL< 750kL		4	

(C)	Personnel and Establishment	**15**		
1	Shall have exclusive captive manpower resources on payroll of bidder in different categories namely Design Engineers, draftsmen, project management professionals, diploma holders, architects sufficiently to carry out the tendered work in-house. Details may be provided with documentary proof. No. of exclusive manpower resources on payroll shall be of,	8		List of different categories namely Design Engineers, draftsmen, project management professionals, diploma holders, architects along with their educational qualification & designation duly certified by bidder's authorized personnel shall be submitted.
a)	≥ 1000		8	
b)	≥ 500 < 1000		6.5	
c)	≥ 250 < 500		5	
2	In-house availability of Project Management / Design / Analysis Software (Note: Equivalent Software are also acceptable provided bidder demonstrates capabilities during evaluation of bids)	7		Any proof to establish in-house availability of the software such as Software license, AMC certificate etc.
a)	Project Management software tools (PLM, Primavera or MS Project or equivalent)		0.5	
b)	3D modelling software (Catia / Solidworks/ Plant 3D or equivalent)		1	
c)	Motion analysis softwares like Ansys Motion enterprise / Adams or equivalent		1	
d)	Finite Element Analysis software for structural and fluid analysis (Ansys, ABACUS or equivalent)		1	
e)	Civil Engineering Software (STAAD Pro / ETAB SAP-2000 or equivalent)		1	
f)	Drafting software (AutoCad or equivalent) for civil/electrical/mechanical systems		0.5	
g)	Hydraulic flow pressure drop calculation/ Surge/transient/water hammer analysis software like Kypipe / Kflow / Flo master/ AFT Fathom		1	

	or equivalent			
h)	Pipe stress analysis software like CEASER-II, CAE PIPE 3D plus or equivalent		0.5	
i)	Software for virtual walkthrough of plant/layout etc like Autodesk Maya or equivalent		0.5	
	Total=	**100**		

- **a)** **Bidder shall obtain a minimum of 60 technical marks (T_b) for proceeding with further evaluation.**
- **b)** All required documents/ certificates submitted by the bidder must pertain to completed projects / works with completion date within the last 7 years, ending on the day prior to the bid submission deadline, unless otherwise specified.
- **c)** If the parameter listed in QCBS evaluation of bids is not met by the bidder, no marks will be given. Bidder shall not leave any field blank.
- **d)** Bidder is required to provide manpower details as per the format specified in the tender. Random verification of the manpower data submitted by the bidder may be conducted by the department during the tender evaluation process.
- **e)** The availability of the required software at the bidder's premises may be checked during technical bid evaluation.
- **f)** Documents submitted such as specifications/client acceptance reports/approved drawings etc shall be correlating with PO/WO etc.
- **g)** For establishing completion of contract, proof shall be submitted correlating with the scope defined in contract.

Technical Score (S_t):

For bidder who is having a minimum technical marks of 60, technical score (St) will be calculates as per the formula given below

$$\textbf{Technical score } (S_t) \textbf{ of a bidder} = \left[\frac{T_b}{T_{hb}}\right] \times 100$$

T_b = Technical marks of bidder
T_{hb} = Highest of technical marks scored among the bidders.

(4.2) **Stage-2: Evaluation of Financial Bids:** After Technical evaluation, the department shall notify the date & time, for opening of Financial Proposals on tender portal to all qualified bidders. The financial bid of only qualified bidders in Stage-1 (Technical evaluation) shall be opened.

Department shall determine if the Financial proposals are complete i.e whether the bidders have quoted as per the requirements given in tender document, if not, then the financial bid shall be rejected.

For the Financial Evaluation, financial score (Sf) will be computed as per the formula given below,

$$\text{Financial score } (S_f) \text{ of a bidder} = \left[\frac{\text{Lowest quoted price among bidders}}{\text{Quoted price of bidder}} \right] \times 100$$

(4.3) **Combined score (S_c):** The weightage for technical score (S_t) is 70% and the weightage for financial score (S_f) is 30%, based on this the combined score (S_c) is calculated as per the formula given below:

$$\textbf{Combined score } (S_c) = (0.7 \times S_t) + (0.3 \times S_f)$$

(4.4) The bids will be ranked on the basis of final Combined score (S_c) and the proposal with highest Combined score (S_c) shall be considered for issuing purchase order.

(4.5) The proposals of the bidders will be ranked in the decreasing order of combined score as H1, H2 and H3 etc.

H1 will be considered for awarding of contract.

(4.6) In case of a tie in combined score (S_c) among bidders, bidder with higher technical score (S_t) shall be considered over the other bids having same combined score, for issuing purchase order.

(4.7) Even though a bidder may satisfy the above requirements, they would be liable to disqualification if they have made misleading or false representation or deliberately suppressed the information in the forms, statements and enclosures required in the prequalification document.

Signature of Authorized Person with Seal

Annexure –III: Details of Company / Firm

S.No	Details	Response
1.	Name & address of the applicant	
2.	Telephone No./Telex No./Fax No.	
3.	Legal Status of the applicant (attach copies of original document defining the legal status(s) (a) An individual (b) A proprietary firm (c) A firm in partnership (d) A limited company or corporation (e) Joint Venture(JV)	
4.	Certificate of registration of Company/Firm (attach attested photocopy). a) Year of Establishment b) Registration number c) Organization / place of Registration	
5.	Details of registration/empanelment with Central/State agencies/PSUs	
6.	Name and titles of Director & Officer with designation to be concerned with this work.	
7.	Details of the authorized person for communication with authorisation letter: • Name: • Designation: • Contact No: • Email:	
8.	Was the applicant ever required to suspend services for a period of more than six months continuously after you commenced the Engineering works/services? If so give the name of the project and reason of suspension of work.	
9.	Has the applicant or any constituent partner in case of partnership firm ever abandoned the awarded work before its completion? If so, give name of the project and reason for abandonment.	
10.	Has the applicant or any partnership firm, ever been debarred / black listed for tendering in any organization at any time? If so give details.	

S.No	Details	Response
11.	Has the applicant or any constituent partner in case of partnership firm ever been convicted by court of law? If so, give details	
12.	Any other information considered necessary but not included above.	
13.	Audited balance sheet of last three financial years	
14.	Audited certificate showing net worth of last three financial years	
15.	Income tax return of last 3 financial years.	
16.	Copy of the Bank Solvency certificate (not older than six months) *Please submit as per Annexure –V: Solvency Certificate Format*	
17.	Certificate of work experience	
18.	Performance report of the work referred	
19.	Locations of the branches of company (if any)	
20.	Litigation Details	
21.	Copy of GST registration, PAN No., WCT No, Service Tax No	
22.	PF registration certificate	
23.	Valid license under Contract Labour (R&A) Act 1970.	
24.	List of the key technical Persons with qualification & experience. *Please provide the details as per Annexure –IX: Format of Curriculum Vitae (CV) of Manpower*	
25.	Addresses of facilities/offices owned	
26.	Core capabilities (Specify brief profile, Standard products/services, etc.)	
27.	Company Website URL	

(Signed by Authorized Representative of Bidder / Design Consultant)

Annexure –IV: Financial Capacity of Bidder / Design Consultant

TURNOVER AND EXPERIENCE CERTIFICATE

(On the letter head of Statutory Auditor/ Chartered Accountant)

We have examined the records of ____
(Name of company/ firm) having CIN No./LLPIN/PAN No. ________________________).

On the basis of the records and information submitted to us, we certify the following:

1) The company/ firm has experience of ____ years in similar nature of works as per work package in India/abroad.
2) The company/ firm has completed ___ numbers of similar works in last 7 Years ending on the day prior to the bid submission deadline. The details in respect of value of similar works received is as follows:

S.No	Name of Work	Period of Contract From – To	Value of Work(s) in Rs. Cr

3) We have examined the books of accounts and other records of _______________________________ (Name of company/ firm) for the Financial Years FY2022-23, FY2023-24 and FY2024-25. On the basis of the information submitted to us, we certify the following:

Financial Year	Annual Turnover (in INR Lakhs)	Annual Turnover (in INR Crores)
2022-23		
2023-24		
2024-25		
Annualised average Financial Turnover		

This certificate has been issued to authenticate the above.

(Signature and Stamp of the Statutory Auditor/Chartered Accountant)

Date: ___________
Place: ___________

Annexure –V: Solvency Certificate Format

FORM OF BANKERS CERTIFICATE FROM A NATIONALIZED BANK

(Solvency certificate from a nationalized bank)

This is to certify that to best of my knowledge and information, M/s/Sh.____________ ________________(Having marginally noted address), a customer of our bank are/is respectable and can be treated as good for any engagements up to a limit of INR ________________(INR_________ ________________).

(Signature) For the Bank

NOTE:

1. Banker's certificates should be on letter head of the Bank, sealed in cover addressed to SDSC.
2. In case of partnership firm, certificate should include name of all the partners as recorded with the Bank.

Annexure –VI: Details of the Works Completed

Sl. No.	Name of work/ Project & Location	Owner or sponsoring Organization	Cost of works in Crores	Date of commencement as per contract	Stipulated date of completion	Actual date of completion	Litigation / arbitration pending / in progress with details	Name of address / telephone of officer to whom reference may be made	Remarks
1	2	3	4	5	6	7	8	9	10

Note: *For the works indicated against Annexure –VI, please provide each work wise details as per Annexure –VII: Performance Report of Works*

Signature of the Applicant

Annexure –VII: Performance Report of Works

1. Sr.No.
2. Name of work / Projects and Location
3. For Design Engineering works:
    i. Nature of Design Engineering
        a. Civil, Electrical & AC
        b. Equipment & Mechanical Systems
4. Agreement No.
5. Client name:
6. Amount of Work:
7. Date of Starting of project:
8. Stipulated date of completion:
9. Actual date of completion:
10. Completion cost:
11. Justification for Delay, if any:
12. Amount of compensation
    a. Levied for delayed completion, if any
    b. Amount of reduced rate items, if any
13. Litigation tendency:
14. Feedback from client:

i.	Quality of work	Very good	Good	Fair	Poor
ii.	Finance Soundness	Very good	Good	Fair	Poor
iii.	Technical Proficiency	Very good	Good	Fair	Poor
iv.	Resourcefulness	Very good	Good	Fair	Poor
v.	General behavior	Very good	Good	Fair	Poor

Third party feedback, if any:

Signature of applicant **Signature & Stamp of client**

Annexure –VIII: Details of Softwares & Equipment available with Bidder / Design Consultant

Sr. No.	Name of Software/ Equipment	Nos	Capacity of type	Age	Condition	Ownership status			Remarks
						Presently owned	Leased	To be purchased	
1	2	3	4	5	6	7	8	9	10
1.									
2.									
3.									

Date:

Signature of applicant

Annexure –IX: Format of Curriculum Vitae (CV) of Manpower

(This form to be furnished for all the Staff Deployed under this contract)			
PROFESSIONAL			
Name of the Firm			
Professional			
Date of Birth			
Years with Firm			
Nationality			
Membership in Professional Societies			
Detailed Task Assigned			
Key Qualifications			
Education:			
Title	**Board/University**	**Grade**	**Year of Passing**
Employment Record			
Name of the Firm	**Position Held**	**Detailed Task assigned**	**Years of Emp loyment**
*Architects must provide COA Regn. Number			
Certification:			
I/We, certify that to best of my knowledge and belief, the above information of officials is true and correct.			
Date:	**Signature(s) of Applicant(s) along with seal**		

Annexure –X: Declaration Regarding Clean Track

(To be submitted on letterhead of the Bidder / Design Consultant)

Date:_______

To,

Sr.Head,
Purchase & Stores,
Satish Dhawan Space Centre SHAR
Sriharikota -524 124
Andhra Pradesh

Ref: Tender of "Design Engineering Services for Third Launch Pad" at SDSC SHAR, Sriharikota for establishing Third Launch Pad (TLP)"
Tender no.:

Dear Sir,
I have carefully gone through the Terms & Conditions contained in the RFP Document regarding Design Engineering Services at SDSC SHAR, Sriharikota for establishing Third Launch Pad (TLP)"

i) I/ We have carefully read and understood all the terms and conditions of the RFP and agree to abide by the terms and conditions.
ii) I/ We further undertake that none of the Proprietor/ Partners/ Directors of the firm is or was blacklisted/ banned/ suspended in business dealing with the Government. I/ we further undertake to report to the SDSC immediately after we are informed but in any case not later than 15 days, if any firm in which Proprietor / Partners/ Directors are Proprietor or Partner or Director of such a firm which is blacklisted/ banned/ suspended in future during the currency of the contract with you. We have no objection, if enquiries are made about the work listed by us.
iii) I further certify that I am competent officer in my company to make this declaration.
iv) In accordance with the above we would like to declare that:
    a) We are not involved in any litigation that may have an impact of affecting or compromising the delivery of services as required under this assignment.
    b) We are not blacklisted by any Central/State Government/Public Sector Undertaking/Private Organizations in India and outside the India.
    c) The information provided in by us is true and no false representation has been made.

Yours faithfully,

(Signature of the Bidder / Design Consultant)
Printed Name:
Designation Seal Date:

Annexure –XI: Confidentiality & Non-Disclosure Agreement Format

(To be submitted by the service provider in their letter head to the service receiver)

Undertaking

I/We ………………………………………………………….……… (Authorized person of the service provider) …………………………… (Designation) of M/s…………………………………………………………………………… (service provider's name & address) participating in the tendering process for award of work under the contract in Satish Dhawan Space Centre, service receiver, Sriharikota do here by undertake that:

1) I/we have read and understood the general terms and conditions of the tender.

2) I/we as well as the workforce to be deployed by me/our firm/society/agency company will maintain confidentiality of the work awarded to us and will not divulge any information that had come to our knowledge during the course of the execution of the work in service receiver's establishment.

3) I/we as well as the workforce to be deployed for carrying work will not retain or remove any drawings, electronic records or any documents related to such work from the premises/establishment of the service receiver and do not take any photograph or make copies or extracts from them.

4) I/we as well as the workforce do not divulge any information or matters either during or after the term of the contract for my or our own benefit or for the benefit of others.

5) I/we have understood that in case of violation of the terms and conditions of the contract and this undertaking, the service receiver has the right to cancel the contract including forfeiture of security deposit in addition to initiation of appropriate legal action/remedies.

6) I/we have understood that strict compliance of this undertaking is a condition for award of the contract.

Dated this the……………………………………. day of……………… Year. at……………………………….

(Signature of authorized signatory of the service provider with seal)

Name in full:

Annexure –XII: Exceptions and deviations

NAME OF THE WORK : ____

____

NAME OF BIDDER : ____

EXCEPTIONS AND DEVIATIONS

In line with Proposal Document, Bidder may stipulate Exceptions and deviations to the Proposal conditions if considered unavoidable.

SL.NO	**Reference in Specification**		**Dept. Specification**	**Offered Specification**	**Deviation**
	PAGE NO	CLAUSE NO			

NOTE :

Any deviations taken by the Bidder to the stipulations of the Proposal document shall be brought out strictly as per this format and enclosed along with the bid.
Any deviations not brought out as per this Proforma and written elsewhere in the Proposal document shall not be recognized and the same is treated as null and void.
Any willful attempt by the Bidders to camouflage the deviations by giving them in the covering letter or in any other documents that are enclosed may render the Bid itself non-responsive.

(SIGNATURE OF BIDDER)